NUTRITION MANUAL
FOR HUMANITARIAN ACTION

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ICRC

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Front cover photo: Ploughing rice field during rainy season. Till Mayer/ICRC.
Back cover photo: ICRC-supported vegetable garden project to help women become more self-sufficient. Nick Danziger/ICRC.

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FOREWORD

The image of armed conflict often evokes visions of malnutrition arising from deliberate starvation policies, neglect, or the helplessness of parties to the conflict to cope with the humanitarian consequences of war.

For decades now, nutritional action has been confined to the immediate response to malnutrition. Food aid and nutritional rehabilitation have been the humanitarian reaction to major crises, based on a simple equation:

crisis = food shortage = malnutrition.

This simplistic view did not shed light on either the causes or the mechanisms of crisis.

This Manual departs from such a restrictive view. The author approaches nutrition from two different angles, from which he derives practical recommendations for humanitarian action.

The first provides an in-depth understanding of nutrition, based on a coherent range of information on the notions of nutritional need and food intake that goes beyond the usual checklists on these topics. The social dimensions of food are likewise discussed thoroughly, avoiding the pitfall of strictly quantitative analysis. This first part provides the scientific basis of the Manual.

The second angle contemplates nutrition at its broadest. It demonstrates the interrelations between nutrition and other relevant sectors, notably the economy. It places nutrition within the legal framework set by international humanitarian law (IHL); as such, it reminds humanitarian operators that the operational response to nutritional disorder is not simply technical, but also pertains to the protection of the victims' rights to have access to food in times of conflict.

From these two angles, the author analyses the impact of armed conflict at all levels: human, political, economic, ecological, social, cultural, and physiological. Vulnerability is examined at all these levels. This section provides the keystone of the Manual because it provides the link with the need for integrated approaches in recommended responses.

This overall approach guides the reader through the chapters devoted to the "classic" nutritional action types, namely general food distributions and nutritional rehabilitation. The author discusses them in terms of planning: is such action required and, if so, how should it be carried out?

Questioning the need for general food distributions encourages humanitarian operators to examine their relevance in terms of context and alternative forms of response, thus leading naturally to a multidisciplinary analysis.

The discussion on the practical implementation of general food distributions and nutritional rehabilitation programmes rests upon the scientific basis described in previous chapters, lending additional credibility to the recommended procedures.

The author shares his personal field experience with readers, and has connected scientific theory and practice – he thereby provides nutritional operations with a professional basis, which should become the standard in humanitarian action.

All humanitarian operators involved in nutrition should read, but above all study, this Manual.

Pierre Perrin

PART ONE
THE PRINCIPLES OF HUMAN NUTRITION

The first part of this Manual discusses the area of science that deals with nutrition. It may seem lengthy and of limited operational relevance. However, sound conceptual and theoretical bases are necessary in order to address nutritional disorder encountered in the field: to paraphrase Ernst Mach, “there is nothing so practical as a good theory”. Each operational gesture must make sense and comply with the logic of the specific feeding process of the populations under scrutiny. In order to do so, field workers must keep a necessary distance and, to this end, rely on some knowledge in the field of nutritional science. In line with the overall objective of this Manual, the various stakeholders in humanitarian operations must also be able to understand one another. It thus seems reasonable to provide them with a common reference on nutrition, which should promote dialogue and at the same time limit misunderstandings.

Like all biological and social sciences, nutrition is not an exact science. Moreover, knowledge remains incomplete in some of its areas, and a number of phenomena will probably never be explained conclusively, because they are too complex and do not lend themselves well to experimentation. The prediction capacity of nutrition is rather limited, especially because the mesh of events around which it revolves is itself highly unpredictable. It is therefore necessary to recognize the extent of the limitations that unavoidably befall workers involved in humanitarian nutrition. Field workers need specific tools to explain the different levels of uncertainty that they inevitably face in recommending action. Likewise, those implementing programmes must be able to refer to theory and find the necessary answers when their efforts do not yield the expected results. Finally, decision-makers must be able to rely on a reference basis in order to understand the objectives of a given operation and thus support it.

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INTRODUCTION

Nutrition is frequently ill-defined, probably because it is a developing contemporary field in search of its own identity (Rivers, 1979; Waterlow, 1981; Pacey & Payne, 1985).

Modern nutrition has evolved from very different approaches.

- ⇨ Man recognized early that growth and development are the main characteristics of childhood, and that these processes depend directly on feeding. Thus, nutrition has always been closely associated with paediatrics. As of 1550 B.C., Egyptian medical treatises recommended feeding practices for the young child in particular.
- ⇨ Plato's *The Republic* (4th Century B.C.) states that a society grows around its food production and consumption. This statement is relayed by Malinowski in his functional approach to anthropology that links biology to culture (Malinowski, 1968).
- ⇨ Driven by a scientific curiosity to clarify and understand, and so to find the underlying laws that govern phenomena, Lavoisier (1743–1794) demonstrated that breathing is no less than an organic combustion made possible by the inspiration of oxygen and involving hydrogen and carbon. He opened the way for biological chemistry and the study of metabolism and digestion.
- ⇨ Military organization, the industrial revolution and its management, the emergence of the welfare State, as well as the crises of recent decades and the importance of excess pathologies, have given rise to thoughts on minimum requirements in nutritional elements. This notion is still highly controversial.
- ⇨ The problem of feeding a rapidly growing world population has prompted interest in nutrition among development and agronomy specialists.

Today, nutrition remains dispersed among different fields related to specialized disciplines, and these may seem difficult to reconcile.

- ⇨ Socio-economics, whose fundamental importance is increasingly recognized. Sen, among others, has contributed decisively to the understanding of the famine process, as being essentially economic and social (Sen, 1981).
- ⇨ The field of excess, imbalance and deficiency pathology, studied by many in a bid to confront the gigantic public health problems resulting from nutritional deficiency, overeating and imbalance disorders.
- ⇨ Ecology, because human food production methods are devastating. This is particularly true of developed countries, owing to the use of fossil energy, the exhaustion of soils and pollution, caused by the accumulation of both inputs and agricultural by-products. But ecological concerns are just as strong in developing countries, because of the frequently desperate over-exploitation of natural resources.
- ⇨ Agronomy: this area is recovering with difficulty from the massive controversy caused by the agricultural development policy referred to as the "green revolution". Nonetheless, it is recognized as a key factor in approaching the increasingly grave food crises that threaten the planet.

⇨ So-called emergency situations: this area has expanded the scope of malnutrition from dispensaries and hospitals by promoting it to the rank of epidemic. Concepts related to this area remain tentative. The most common approach is still too often restricted to assessing the nutritional status of children from a tedious epidemiological angle and through controversial techniques.

All of these fields are in fact compatible, because they basically focus on the same issue: the exchange of matter and energy between the human organism and its environment. This exchange is dictated by the need to feed oneself (i.e. the nutritional need), a vital biological need, and is satisfied by the feeding process, that is the process by which man tries to meet his nutritional needs. Need is a phenomenon that arises from biological determinism. It concerns the organism and the physiology of its exchanges. The process, on the other hand, involves a sequence of activities deployed by the human being to satisfy a need. This sequence begins with the securing of food early in the process, and ends with the excretion of material and energy waste. The efficiency of the process is shown by the nutritional and health status of the individual. The exchange of matter and energy between the human organism and its environment (as discussed above) originally results from biological determinism; however, the process leading to the exchange is not only determined on a biological level by the organism, but also on a cultural level by the group in which the organism lives. It must thus satisfy a number of necessary and sufficient conditions in order for the organism and the group to survive in their relationship to the natural environment.

Seen from this perspective, nutrition becomes the science whose objects of scrutiny, Rivers believes, range from the ribosome to harvesting machines (Rivers, 1979), and whose responsibility according to Waterlow is to combine and join biological and social sciences, and to reduce their fragmentation (Waterlow, 1981).

This is the very broad angle from which this Manual discusses human nutrition, considered as a science in itself. Its identification is as follows.

DEFINITION OF NUTRITION

The subject

Nutrition is the science of the exchange of matter and energy between the organism and its environment.

The object

Nutrition considers the nutritional need, which provides the basis for the exchange, the conditions determined by the need, and the feeding process through which the exchange occurs. Its perspective is not confined to the biology of the human organism, but includes the cultural characteristics of the group, because individuals are usually immersed in the cultural framework of a given group.

The method

The method used in nutrition consists in taking a multidisciplinary approach which allows the exchange to be understood as a whole: the phenomena dictating the exchange, the completion of the exchange, and the performance of the exchange.

The scope of investigation

The scope of investigation covers human behaviour, both biological and social, from the search for nutrients that constitute feeding, to their digestion, absorption and utilization, in addition to the excretion of their by-products and what amounts to inevitable losses.

The prediction capacity

The observation of the completion of the exchange within its environment should therefore facilitate the prediction of the survival probability of the organism and the group it belongs to.

Ethics

Nutrition arises from the desire to understand – and, if possible, resolve – the problems that may appear at the different stages of the exchange. Nutrition thus intends to identify threats to health in its broadest sense, and to offer relevant interventions accordingly. This approach rests on a moral value: it is universally recognized that poverty is accidental, that the malnutrition that can result from it causes suffering, and that it is necessary to protect and care for its victims.

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INTRODUCTION

Feeding is a need shared by all living beings. The nature of this need is the same for all, and obeys the same mechanisms. Moreover, life has developed in such a way that nutritional interdependencies appear between and within the three kingdoms (vegetable, bacterial and animal). To understand the position of man in the living world according to his nutritional need, and before specifically considering human nutrition, that which is common to the entire biosphere must be considered.

1. THE ORIGIN OF NUTRITIONAL NEEDS

1.1 INTERACTIONS OF THE ORIGINS

The nutritional need originates in the chemical reactions that obey the principles of thermodynamics,[1] and arose during the billion years following the formation of the earth. The different energy sources that existed at the time enabled chemical compounds such as water and water vapour (H_2O), methane (CH_4) and ammonia (NH_3) to interact and combine, thus generating the basic components of living matter. Laboratory simulations of the chemical and energy conditions assumed to have prevailed at the beginning of the earth have permitted the recreation of practically all these basic components from these three simple gases. The interaction then continued through the condensation of the basic components in long chains that generated the molecules (polymers) typical of the living world, and later the assembly of polymers in organelles – these in turn formed living cells. It took a billion years for the first single-celled forms of life (or unicellulars) that compose the bacterial kingdom to come into being. It took a further three billion years for unicellulars to develop, and later assemble in, multi-cellular organisms, with the differentiation of organs, and so give rise to the vegetable and animal kingdoms. Finally, the three kingdoms continued to develop during the next 800 million years or so, by fashioning the earth and its atmosphere to bring them approximately to their contemporary form. *Homo sapiens* (or, rather, *Homo economicus*, an expression that better reflects his exploitation of the environment) appeared only one hundred thousand years ago.

During this evolution, the principles of thermodynamics remained a denominator common to the original energy reactions and the nutritional need.

[1] The universal principles that govern the exchanges of energy.

1.2 THERMODYNAMIC DETERMINISM

The evolution from the original simple gases to superior animals occurred in successive stages of association between compatible elements. Each level of association brought a new structure, but also new forms of organization, because interaction takes different forms that are specific to each level: atoms do not interact like particles do, nor molecules like atoms, nor polymers like basic molecules, any more than societies interact like their components do. However, the same forces always govern these different forms of interaction that occur when the conditions for exchange of energy are met. In other words, where a receptor can capture a source of energy in compliance with the principle of stability, the result is an energy flow. Conditions of interaction obey the principle referred to as thermodynamic determinism that governs everything that can be observed in the universe.

Thermodynamic determinism represents what is common to the original energy interactions and the nutritional need that is under scrutiny here. This nutritional need appeared at the same time as the living cell, the first form of terrestrial life.

1.3 THE APPEARANCE OF THE LIVING CELL

One crucial stage of association was the combination of constitutive elements to form a structure which became a specific entity: the living cell. Indeed, the living cell incorporates and specifically organizes energy interactions complying with thermodynamic determinism within a material structure limited by a semi-permeable membrane.

This entails several consequences, three of which are of particular interest here.

1. Thermodynamic reactions imply the presence of both a source and a receptor of energy. An organism is alive only through the thermodynamic reactions that characterize its existence; it must therefore have access to a source that can satisfy the need for energy of its material receptors. This source is initially internal, but runs out because the structure of the organism is finite in space. Therefore, the source must imperatively be renewed – and permanently so to avoid death – from the environment.
2. Between the original simple entities whose energy exchanges were chaotic, and animals whose energy exchanges occur within the organism, the energy flow was captured in increasingly complex material structures. The latter must reproduce and ensure their continued existence from materials found in the environment.
3. As complex structures developed and living matter diversified into different organisms and evolved towards superior animals, they lost their capacity to create everything from simple entities (a capacity the first cells had, and some unicellulars still have). Some species thus developed a dependency towards the living beings that retained that capacity, of which they must henceforth absorb all or part to extract the nutrients that they cannot create themselves.

This provides the three components of the nutritional need.

1. The renewal of the source of energy that governs reactions.
2. The provision of this source of energy with material support, and an envelope to manage its dissipation.
3. The obtaining of all or part of these material elements from other living species, if the capacity to create them is inadequate or lost.

The vital dependency towards these three components is the essence of the nutritional need. The nutritional need is one of the consequences of the appearance of the cell and the living organism, and it must be viewed in its conceptual framework.

1.4 THE PHENOMENON OF ORGANIZED ASSOCIATION

The nutritional need is the effective and direct consequence of the confinement of molecular interactions to a specific spatial structure – that is, the cell or living organism. More generally, from a conceptual perspective, it results from the phenomenon of organized association.

Its principles are as follows.

1. The association occurs within a defined structure in which the elements of the association perform activities.
2. This structure makes sense only because activities are organized within it; for this, they must meet four conditions:
   - → anchorage on a material support that provides them with a hold;
   - → compliance with a norm;
   - → subjection to a system of control that ensures the maintenance of, and respect for, the norm;
   - → ability to be replicated, through the transmission to successors of the elements of the group of everything required to perform the activities according to the norms specific to the organization.

   These four conditions represent the basis of organized behaviour.
3. Organized association and behaviour imply specific demands that arise from the four conditions discussed above. These demands are as follows:
   - → provision of the material support required to implement the activities;
   - → provision of a norm;
   - → provision of a control system;
   - → capability to replicate the association.
4. Organized association thus entails obligations that manifest themselves on two separate levels:
   - → on the algorithmic level of any organized behaviour, activities must meet the four conditions stated under point 2 above, which constitute the determinism of the activities;
   - → on the level specific to the association under consideration, the demands stated under point 3 above must be satisfied – these demands define its needs, which in turn represent the determinism of the association.
5. The conditions of organized behaviour, together with the needs that result from it, constitute the determinism imposed upon any organized group when it implements its activities. It is also worth noting that the determinism specific to the association includes the needs of the elements that compose it, and each new level of needs is related to the previous level. Generally, the global determinism (i.e. algorithmic and specific) of an association is defined according to the level of organization under consideration: thermodynamic in the case of particles, atoms or molecules, biological in the case of living organisms, cultural in the case of humans in a group. The effect of the biological and cultural determinisms on the completion of the feeding process that addresses the nutritional need is discussed in Chapter VI.

The nutritional need is a direct result of determinism insofar as the cell or living organism constitutes organized associations.

Indeed, if the living organism is an entity whose behaviour is organized, then it follows that the activities that occur within it rest on a specific basis, that they obey the laws of thermodynamics, and that they are subjected to the balance between substrate and product or by a neuro-endocrine system. It also follows that the organism produces replacements for its elements by using a genetic code that permits the duplication of all the elements in such a way as to function like their predecessors. For the living organism, the same demands exist, related to the following:

⇨ the material support of the structure – the three components of nutritional need;
⇨ the application of the norm – the laws of metabolism;

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⇨ the control of the application – among others, the necessary neuro-endocrine system among animals;
⇨ the specific replication of the constituents – the genetic code, present in any living cell.

The final behaviour (i.e. thermodynamic interactions and compliance with the conditions for existence) will result from the biological determinism of the organism under consideration.

To sum up, the assembly of simple elements into more complex structures that generate living things provides the transition between thermodynamic and biological determinisms. Biological determinism is characterized by the appearance of needs, among which the nutritional need according to its three components is discussed below.

2. THE COMPONENTS OF NUTRITIONAL NEED

2.1 *DEPENDENCY ON ENERGY*

The first level of nutritional dependency concerns the provision of energy, because life developed from the interaction of energies available at the beginning of earth. Without entering into excessive detail in the fields of physics and biology, it is important to improve understanding of the energy conversions of living things by recalling some basic principles.

2.1.1 General principles relating to energy

1. Matter and energy make up the universe, and they are inter-related.[2]
2. Energy can take many forms: mechanical, electrical, thermal, and radiant (such as solar energy radiated to the earth). Energy can be converted from one form to the next while conserving the total amount of energy involved, as expressed by the first principle of thermodynamics:

the total energy of the universe remains constant.

3. Conversion from one form of energy into another always results in an increase of thermal energy through friction. Thermal energy is thus the ultimate or degraded form (for our purposes) of energy. For example, an engine powered electrically to perform mechanical work necessarily overheats; its energy input cannot be entirely converted into kinetic energy, as part of it is lost in thermal form. Likewise, chemical energy used in muscular contraction converts not only into mechanical energy, but also into thermal energy. This is why physical exercise heats the organism, and shivering (i.e. rapid muscle contractions) is a mechanism that tends to maintain body temperature in a cold environment. Therefore, if conversion into thermal energy is excluded, energy conversions result in a less than 100% yield, as expressed by the second principle of thermodynamics:

universal entropy increases.

[2] Einstein's $E = mc^2$.

Entropy is the ultimate, degraded and – for our purposes – unusable form of energy. Entropy is also said to represent the degree of universal disorder or chaos. Chaos or disorder is understood here as meaning energy dissipated at random. Indeed, thermal energy dissipates spontaneously in a chaotic manner. For example, a hot body spontaneously transfers its heat to its cooler environment until thermal balance is achieved, thus defining the principle of stability. On the other hand, a body will never become cooler than its environment. To achieve the latter, as in the case of a refrigerator, it is necessary to provide an input of energy superior to that algebraically required to attain a given difference in temperature, because part of the energy used to cool the refrigerator is inevitably lost in the form of thermal energy. The example of the hot body spontaneously conveying its heat to its cooler environment shows that, in the universe, energy flows in a specific direction.

4. Energy conversion from one form into another requires a material support.
5. Energy events (such as chemical reactions, mechanical work, and exchanges of heat) fall into two categories:
   - → those that require the input of energy, as is the case for the refrigerator or the formation of glucose and oxygen gas, from carbonic acid gas and water;
   - → those that occur spontaneously in compliance with the law of entropy, such as the transfer of heat from a hot body to its cooler environment, or the reaction between hydrogen gas and oxygen gas that produces water with the release of heat; for a spontaneous reaction to occur between two bodies, the energy content of one of the bodies must be higher than the other's, and both must interact to permit the transfer of energy from the body with the higher content to that with the lower, until energy balance is achieved.
6. Energy is a measurable entity. Scientists have given it different units depending on its type (e.g. electrical, mechanical, radiant or thermal), and each unit follows its own logic. For example, in chemistry and biochemistry (where the exchange of heat of reactions is the main parameter), the unit in use is the calorie (cal): one calorie is the amount of heat necessary to increase the temperature of 1 g of water from 14.5°C to 15.5°C at a pressure of one standard atmosphere. This amount is small in comparison to reaction heats expressed in standard conditions; generally, therefore, the kilocalorie (kcal) is preferred, as it amounts to 1,000 calories. In mechanics, the energy unit is the joule (J), being the amount of energy required to move a mass of 1 kg over a distance of 1 m in the sense of the force applied, with an acceleration of 1 m per second per second.

The transformation of energy preserves the total amount of energy, and conversion factors therefore exist between the different units of energy measure. For simplicity's sake, one single unit – the joule – was agreed upon to express all forms of energy. Unfortunately, this unit no longer translates into something tangible, other than for the form of energy it initially applied to. The conversion factor between joules and calories is as follows:

1 calorie (cal) = 4.18 joules (J) or 1 J = 0.239 cal
as a result:
1 kilocalorie (kcal) = 4.18 kilojoules (kJ)

The advantage of using different units to express different forms of energy is clarity: what the unit refers to is known. Standardization is therefore not always an asset. This Manual uses both units, kcal and kJ, the former taking precedence, the latter indicated between brackets.

2.1.2 Energy and life

Beyond philosophical debates on the topic, it is now scientifically established that the laws of physics govern the entire universe, including biological mechanisms. Life in all its forms complies with the two types of reaction described above:

⇨ its environment provides it with the energy to create highly reactive chemical bodies, the main being adenosine triphosphate[3] (ATP);
⇨ ATP can then enter into spontaneous reaction with its chemical environment, enabling the tasks required for life to develop and preserve its characteristics, thanks to the information contained in the genetic code.

During this process, life uses two main forms of energy: radiant and chemical. It performs three different types of work: chemical, mechanical and osmotic. In its simplest expression, life thus depends on the conversion of forms of energy into others, of energy providing work, and of energy derived from work. As indicated above (Section 2.1.1, point 3), the yield of these operations is less than 100% in practice because, as is the case for all phenomena occurring in the universe, their friction increases the thermal energy (heat) of the system in which they occur. This heat represents a loss for any transformation whose purpose is not to generate heat. As a result, the energy transformations on which life depends occur in a single sense. They are irreversible unless they receive an energy input that compensates their losses. This implies that energy does not complete a cycle in the biosphere, but passes through it like a flux, not only owing to the permanent need to compensate for losses, but more importantly because after its passage through the organism in one way or another, energy is dissipated in a biologically unusable form. In the biosphere, it converts from radiation (usable energy) to heat (energy that is unusable directly and therefore amounts to an increase of entropy). This means that living organisms, that are no more than energy transformers, must continually draw from their environment the form of energy that they dissipate in work and heat. This is the essence of the nutritional need for energy.

2.1.3 The energy flux in the biosphere

It is important to examine the flow of energy in the biosphere more closely to gain a comprehensive understanding of the nutritional need. The notion of energy flux implies a beginning (i.e. an initial state) one or several intermediate stages, and an ending (final state).

The primary source of energy is solar radiation, and it undergoes two intermediate stages in the biosphere:

⇨ in the first stage, the radiant energy is converted into chemical energy by means of an energy-bearing molecule;
⇨ in the second stage, the chemical energy of the bearer molecule enables reactions that perform biological work (and also generate heat).

Heat is the final form of energy as it leaves the biosphere.

Only organisms that are capable of photosynthesis can carry out the first stage. The obvious example that springs to mind is green plants that do so by means of their characteristic pigment, chlorophyll. However, phytoplankton in the oceans accounts for more than half of the earth's entire photosynthesis. Photosynthesis transfers radiant energy to adenosine as follows:

water (H_2O) + $NADP^{+}$[4] + inorganic phosphate (Pi) + adenosine diphosphate (ADP) + energy → triphosphate adenosine (ATP) + oxygen (O_2) + NADPH + H^+

[3] To simplify, this Manual will only refer to ATP.
[4] NADP is a hydrogen exchanging molecule, just like ATP is an energy exchanging molecule.

The chemical energy carried by ATP then enables the second stage, for example glucose synthesis:

$$\textbf{carbonic acid gas } (CO_2) + NADPH + H^+ + ATP \rightarrow \textbf{glucose} + NADP^+ + ADP + Pi$$

This second reaction enables the production of a reduced compound (rich in available chemical energy),[5] thanks to the chemical energy of the ATP acting on oxidized molecules (i.e. poor in available chemical energy).

It is now possible to consider the entire equation for photosynthesis, as usually provided:

$$6\,CO_2 + 6\,H_2O \rightarrow C_6H_{12}O_6 \text{ (glucose)} + 6\,O_2$$

The glucose then provides the intermediary to produce the other organic compounds of plants (glucides, lipids and proteins) during reactions that also require energy provided by ATP. For proteins, nitrogenous molecules are also required, they are taken from the soil but come from the atmosphere through nitrogen fixing bacteria.

The animal kingdom is not capable of photosynthesis. It nevertheless needs ATP to perform its biological work. Animals obtain it by consuming reduced organic compounds that all derive directly or indirectly from photosynthesis. These components are oxidized during fermentation and breathing, and the energy released by oxidation is retrieved in the form of ATP. For example, the complete oxidation of glucose will produce 38 ATP molecules.

Finally, the three kingdoms function in their environment by means of ATP that enables the completion of these biological reactions. The latter can be broken down into the three following main forms:

- ⇨ chemical, essentially related to synthesis in producing the constituents of the organism itself;
- ⇨ osmotic, related to the transfer and concentration of substances within the organism by means of osmosis;
- ⇨ mechanical, in the form of traction forces relayed by contractile fibres: the most spectacular example, but by far not the only one, is the muscular contraction of superior animals.

In short, two stages can be distinguished in the energy flux in the biosphere: the stage where radiant energy is converted into chemical energy in organic compounds, and the stage where the chemical energy contained in organic compounds is converted into work and heat. The ATP molecule plays a central role in this flux. Initially, it is regenerated during photosynthesis and provides the link between the two stages by controlling the formation of the precursors of all organic compounds used later in the biosphere. Then, regenerated by fermentation and breathing, it controls the reactions that perform biological work. ATP is thus not consumed but recycled, in a shuttle between the conversions for which it provides the intermediary. Biological work, together with the dissipation of heat that inevitably accompanies it, is the final stage reached by the energy flux in the biological world. The different types of organism require more or less sustained biological work in order to survive in their medium; biological work therefore defines the rhythm of the adenosine cycle and, thus, the needs for energy input.

[5] This is the chemical mechanism of oxidation and reduction. The oxidation of elements that attract electrons only weakly (e.g. carbon) consists in sharing one or several electrons with an element that attracts them more strongly (e.g. oxygen); carbon oxidizes to the benefit of oxygen, and this reaction releases energy. The opposite reaction consists in allowing the carbon to retrieve its electrons (i.e. carbon reduction) – this reaction consumes energy and occurs during photosynthesis thanks to solar radiant energy.

2.2 DEPENDENCY ON MATTER

The flow of energy through the living organism implies energy conversions, and these require a material intermediary. Furthermore, they must occur in the material structure of the organism.

The energy flow and the existence of the organism generate a twofold material requirement.

1. The requirement related to the energy flow implies adenosine recycling through the oxidation of a material intermediary, during fermentation and breathing;
2. The requirement related to the development and renewal of the material, architectural and functional structure that accommodates the energy flow. That is, the cell, organism, or multi-cellular living being.

It is useless here to dwell on the first element: it is excessively variable according to species, and will be discussed specifically in relation to the human being in the following chapter. On the other hand, the second element (that deals with the material structure of living organisms) deserves specific attention because it is common to almost all organisms and explains their interdependency. The architectural and functional structure of living beings does not evolve from just any matter. Moreover, the universality of the energy mechanisms of the biosphere suggests that all living beings share identical material supports according to their specific role. Indeed, in spite of the great diversity of living species, a group of elements, essentially in molecular form, are common to the material composition of all organisms. The molecular logic of living organisms is extremely simple, and uses only very few different molecules to constitute a terrestrial biomass that is nevertheless of respectable dimensions. Despite this simplicity, the chemical characteristics of these molecules are such as to play very different roles and to combine in multiple ways. They are to be found in all living cells, and include: water, amino acids, purine and pyrimidine bases, sugars, lipids, vitamins and coenzymes, and some minerals.

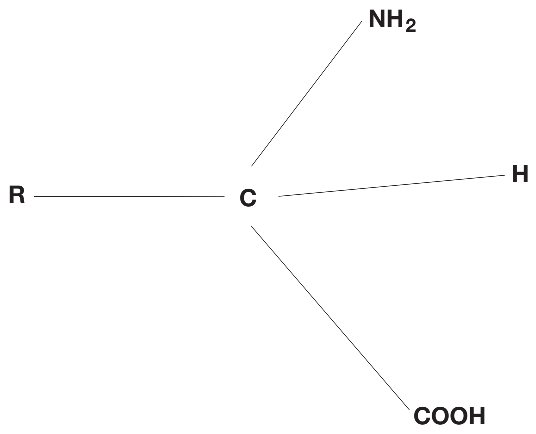
2.2.1 Water (H_2O)

Water is the support and the liquid medium of life. It is also the most abundant component of any living organism, accounting for 70 to 90% of its mass. The molecule is highly reactive, and its ionization products (H_3O^+ and OH^-) largely determine the structural characteristics and biological properties of most cellular components. Water ionization promotes the exchange of protons (H^+), and its role is thus fundamental in the biological acid-base reactions. Owing to its polarization, the molecule is also an excellent solvent. Finally, water provides the oxygen generated during photosynthesis, and this oxygen is vital to all forms of life whose energy flow results from breathing.

2.2.2 Amino acids

There are 20 basic amino acids. All have an acid group (COOH) and a nitrogen atom (N) on the first carbon atom (i.e. alpha carbon) in their carbon chain. The name “amino acids” thus comes from the combination of the acid group with “amine” (the name of the nitrogen group in the organic compounds). They differ in the rest of the chain (R). Their general formula is provided in Figure 2.1 below.

Figure 2.1 General formula for amino acids



One of the main characteristics of amino acids is their capability of linking the acid group of one with the amine group of the other (peptide bonds), and thus to form chains of 2 up to 2,000 amino acids. These chains are proteins. The combinations of the 20 basic amino acids in the form of different proteins reach one hundred billion; this provides an explanation for the presence on earth of more than one and a half million different organisms. Amino acids are first and foremost the construction units of proteins, but also of hormones and other molecules that play an important biological role. Proteins are the most abundant molecules in living cells, and account for approximately 50% of their dry mass. Their amino-acid sequence is genetically coded; the different sequences and their combination with molecules other than amino acids and with metals such as iron, copper and zinc determine their different functions. This plays a fundamental role in the cell: structure, hormone regulation, defence toxins, protection against infection and bleeding, mechanical work, transport, food reserves, enzyme catalysis.

2.2.3 The bases

The purine (2 molecules) and pyrimidine (3 molecules) bases are the five basic components of nucleotides, of which there are eight. Four provide the infrastructure of desoxyribonucleic acid (DNA), which is the support of the genetic code. The other four provide the infrastructure for ribonucleic acid (RNA), which translates the genetic code into amino-acid sequences for protein synthesis. DNA and RNA are therefore nucleotide chains, just as proteins are chains of amino acids. Moreover, as amino acids do, these bases lead to the production of other biologically important molecules, such as some vitamins and the above-mentioned adenosine.

2.2.4 Glucides

Glucides, erroneously also referred to as carbohydrates because of their general formula $(CH_2O)_n$, practically all originate from glucose ($C_6H_{12}O_6$). Glucose is the main fuel of most organisms, and the infrastructure for starch and the cellulose of plants. Starch is the prime form of energy storage, whereas cellulose is the rigid external component of the cell wall, and is fibrous, ligneous tissue. Glucides are also associated with, or precursors of, very important molecules in terms of biology. The analogy with amino acids and nucleotides reappears here: simple construction units and multiple functions.

2.2.5 Lipids

Lipids are defined as molecules that are insoluble in water. There are several lipid groups, but all share the characteristic that a significant part of the molecule is in reality a hydrocarbon. Lipids too perform various functions: they contribute to the structure of the cell membrane, they are elements of energy storage and transport, they provide a protective layer, and determine the identity and biological activity marker as hormones or vitamins.

2.2.6 Vitamins

Vitamins and coenzymes are small organic substances (carbon structures) that are indispensable to the functioning of living cells, owing to their vital contribution to many physiological processes, in particular enzyme catalysis, an indispensable process for practically all the chemical reactions of the cell. Their importance has been recognized because many species cannot synthesize them all independently and must, therefore, obtain them from their environment. Vitamins and coenzymes are only necessary in very small quantities and only constitute a very limited part of cellular composition, unlike proteins, nucleic acids, carbohydrates and lipids that, apart from water, account for most of its mass.

2.2.7 Minerals

Minerals are likewise indispensable to the functioning of the organism, and their functions vary considerably depending on their specific chemical properties. As they cannot be created, they must be found either directly or indirectly in the mineral environment shaped by the nature of the soil and the effects of groundwater.

To exist, living beings must obtain all these molecules. This is the essence of material nutritional need. Apart from water and minerals, they all originate in simple precursors that are found in the soil, water and the atmosphere. However, many species have become partly or wholly incapable of such operations, and survive to the direct or indirect detriment of those that maintain this capability, by consuming all or part of organisms or their decomposition and excretion products. This constitutes the third level of nutritional dependency.

2.3 *DEPENDENCY ON LIVING SPECIES*

The third level of nutritional dependency developed in parallel with the evolution of species. Specialization, differentiation and adaptation to the environment entailed nutritional specificities that implied unilateral dependencies and, more importantly, symbiotic interdependencies with major consequences for the survival of the living world in general. The interdependency of species can take many different forms that fall into two main categories: dependency on a source of energy or fuel, and dependency on structural or functional matter.

2.3.1 Dependency on energy flow

The first stage of energy flow in the biological world belongs to the realm of photosynthesis that uses solar radiation to create organic compounds, and the latter are the primary source of energy of organisms that are incapable of photosynthesis. The realm of photosynthesis is thus at the basis of all the energy used by the rest of the biosphere. In a way, there exists a form of “energy parasitism” in stages: the world of photosynthesis is a parasite (or predator) of sunlight, and the world of fermentation and breathing is a parasite of photosynthesis. This energy dependency can be illustrated by the chain linking carnivores to herbivores, herbivores to green plants, and green plants to sunlight. In this specific case, later links (carnivores) depend on earlier ones (ultimately, sunlight). Species are thus connected by the nature of their nutritional energy need in a sequence of levels or stages (referred to as trophic levels). Plants represent the first trophic level, herbivores the second, and so on. Each level is a consumer of the previous, and a producer for the following level.

2.3.2 Dependency on matter

As discussed above, energy flows in an organism cause fluxes of matter. The latter flows from one type of organism to another, not necessarily through trophic dependency (downstream-upstream), but according to a cyclical rhythm – in other words, an interdependency. In these cycles, organisms exchange the nutrients required for their survival. Without entering into detail as to the sometimes highly complex nutritional interdependencies that govern the biosphere, this discussion will focus on the three cycles involving practically the entire biosphere: carbon, oxygen and nitrogen. These three elements are found in the atmosphere in the form of simple gases; they can be dissolved in water or combined with solids. Their movement throughout the biosphere is thus not accidental. Furthermore, their physical and chemical features lead to the production of highly diverse molecules, on the one hand, and huge combinations of such molecules, on the other.

The carbon and oxygen cycle

Organisms capable of photosynthesis combine carbonic acid gas with water to generate organic compounds, giving off oxygen in the process. On the other hand, organisms that are incapable of photosynthesis consume organic compounds and oxygen, and give off carbonic acid gas and water in the process of breathing and fermentation. This introduces a carbon and oxygen cycle into the biosphere.

The nitrogen cycle

Nitrogen contributes to the formation of the genetic code, proteins, and other molecules essential to life. It accounts for 80% of the composition of the atmosphere, in the form of molecular nitrogen gas (N_2). In this form, it can only be absorbed by a few specific organisms, while others must obtain it in a combined form, such as ammonia, nitrites and nitrates, or from complex compounds such as amino acids or urea. Its cyclical exchanges are more complex than those of carbon and oxygen.

The cycle of matter is just as important as the energy flow: both show the interdependency of living organisms on a planetary scale. All these elements and material compounds interact in many ways in exchanges between the different organisms; what is to be remembered here is the concept of their interdependency. Evolving together, all species are necessary to one another, and any imbalance, global or local, must be avoided. If one of the three kingdoms disappears, the other two cannot survive. Likewise, on less elementary dependency levels, if one species disappears, an entire biotope and an entire ecosystem can be changed or destroyed. This is the essence of interdependency.

Seen from this perspective, the object of nutrition is indeed the exchange of matter between a given organism and its environment, in addition to its related balance or imbalance. In this sense, nutrition is a branch of ecology, and the expression "feeding" (alimentation) covers more than the simple provision of food. This is particularly true of human nutrition whose process today implies massive disruptions to the environment, owing to the number of humans on the one hand, and the agricultural and industrial economy on the other.

In short, the nutritional need is based on four phenomena.

1. Molecules interact with and change one another, depending on their respective energy characteristics and the available energy sources.
2. These changes occur in a specific sense, dictated by the principles of thermodynamics; this implies matter and energy flows.

3. Living organisms provide an organized answer to the principles of thermodynamics – this answer includes the intermediary metabolism governing the interaction between matter and energy on the one hand, and the living cell, being the material structure accommodating the metabolism, on the other. This material structure (be it single-celled or multi-cellular) is an entity that is finite in space. A clear boundary exists between it and the external medium; in other words, it contains a finite amount of matter and energy that evolve from an initial to a final stage in the course of transformations imposed by the principles of thermodynamics and controlled by metabolism. As a result, the organism must interact with its environment by obtaining matter and energy in it in the initial required state, according to the depletion rate of internal reserves due to metabolism.
4. The organism is a material structure based on specific elements found in its biological and mineral environment.

The need for a living organism to draw regularly on its environment – according to its precise characteristics – for matter and energy in a specific state, and the fact that its existence itself depends on this process is the essence of nutritional need. Obtaining matter and energy from the environment, transforming them and returning them in the form of waste therefore does represent an exchange between the organism and its environment. This is the very subject of nutrition.

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THE NUTRITIONAL NEED OF HUMANS

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THE NUTRITIONAL NEED OF HUMANS

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INTRODUCTION

The human organism is an open biological system that interacts with its environment. The notion of system implies a group of interacting phenomena. Practically all components of the living organism are interdependent: a change in one will affect all others. The analysis of the nutritional need thus inevitably leads to a systemic approach because the use of energy governs all the activities of the organism, with respect both to its internal chemistry and to its behaviour toward the exterior. This use is extended to the search for energy itself. Fully comprehending the nutritional need, its overall manifestation and its far-reaching ramifications, is a challenge verging on philosophy; on the other hand, understanding human behaviour demands specific, pragmatic knowledge. Hence, phenomena and their inter-relations cannot be envisaged as an integrated whole, but rather factorially, that is, broken down into separate entities, even though such treatment produces fixed images that are useful only for teaching purposes.

The human nutrition need is discussed here according to the approach used in the previous chapter: need arises from a threefold dependency on energy, on matter, and on other species.

1. DEPENDENCY ON ENERGY

Like all living things, man needs energy to recycle ATP [1] in order to perform the biological work that is necessary for his survival. Two methods are used to assess energy needs as follows:

⇨ the balance method, i.e. the observation of what an individual must eat to maintain a constant weight;
⇨ the factorial method, i.e. the assessment of energy use specific to the organism's energy phenomena (that is, according to each use factor): the corresponding overall requirement can be deduced from the sum of energy uses considered individually.

The balance method does not clarify the manner in which energy is used, nor does it explain the amount required for different activities, or what is required at rest. The factorial method on the other hand analyses energy use factors separately, and may therefore be preferable in some circumstances. Factors of use are classified as follows:

⇨ basal use;
⇨ the thermal effect of food consumption, or specific dynamic action;
⇨ use associated with muscular effort;
⇨ use associated with the generation of heat (thermo-genesis);
⇨ use associated with growth, recovery and production.

[1] See Chapter II, Section 2.1.2.

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The first four factors are assessed by measuring overall energy use, observed per unit of time, in the relevant experimental conditions. Specific cost can then be derived, and is generally expressed as a multiple of the basal metabolism. Growth, recovery and production can be appraised through a combination of the balance and factorial methods, or by calculating the energy content of synthesized tissue, subject to a synthesis yield factor to deduce the synthesis cost.

The energy need and its different factors are expressed in energy units, that is, kcal (kJ).

1.1 FACTORIAL ANALYSIS OF THE ENERGY NEED

1.1.1 Basal energy expenditure

Warm-blooded animals (i.e. mammals and birds) in particular tend to maintain a constant temperature; the idling (i.e. the minimum functioning) rate of their biological machine is therefore rather stable. It is referred to as basal metabolic rate or, more simply, basal metabolism.[2] The basal metabolism thus implies a consumption of energy, to be likened to the fuel consumption of a stationary car whose engine is idling. The basal metabolism represents the energy and chemical transformations required for the survival of the organism in a state of rest and thermal comfort. It includes the following:

⇨ osmotic work to maintain chemical gradients and the electro-chemical work of the nervous system;
⇨ mechanical work performed in rest conditions by the heart, the lungs, the digestive tube, and muscular tension;
⇨ chemical work performed by the liver and the kidneys, and for the permanent breakdown and synthesis of the cell and tissue compounds.

The standard average basal metabolism of adult mammals and birds measured over 24 hours and expressed in kcal amounts to:

seventy times their body weight elevated to the power of three-quarters
or
daily basal metabolism (kcal) = 70 × body weight$^{3/4}$ (kg)

Weight to the power of three-quarters is also expressed as weight to the power 0.75 (i.e. weight$^{0.75}$).

This general rule expresses the direct proportional relation between the energy flow in the organism of warm-blooded animal and their mass. Mass is understood here as active – in other words excluding the obese with a significant inert adipose mass. Indeed, the basal metabolism relates to the active cells in the organism that produce work (lean mass), and not adipocytes, that are energy storage cells (fatty tissue), and whose energy use is negligible. The five most active organs in the organism (i.e. the brain, the liver, the kidneys, the heart and striated muscle) account for more than 90% of the basal energy expenditure.

Human basal metabolism is measured in the following standard conventional conditions: the subject is at rest, in a reclining position, awake, emotionally calm, has not ingested food for the previous

[2] The notion of metabolism is discussed in greater detail under Section 2 in this Chapter.

twelve to fourteen hours, and is lightly clad in an ambient temperature of 18 to 20°C. This provides a convenient measure of the inevitable energy use of the organism. However, the basal metabolism measured conventionally is not in fact the minimum metabolism. It would be better described as standard metabolism, because the individual real basal metabolism depends significantly on climate, eating habits, vital physical activity, the intake of stimulants (such as tobacco or coffee), and the cultural and emotional level of the social group under consideration.

Within the species in general, basal metabolism depends mainly on the mass of the organism, but also on age and sex.

Age

The basal metabolism per kilogram of body weight increases during the first year, then slowly decreases until sexual maturity. The fast basal metabolism of the young child is partly explained by its faster cell renewal rate. Among adults, it remains constant until approximately 40 to 50 years, then slowly diminishes; among the elderly (over 60 years), it is 15 to 20% lower by unit of body weight than among young adults.

Sex

Per unit of body weight, the adult male basal metabolism is 15 to 20% higher than the female rate. This is partly due to the fact that the proportion of fatty tissue is greater in women than in men.

In fact, the more individuals are included, the more relevant the standard measure of the basal metabolism; it is then a statistical measure to extrapolate (with a 10% uncertainty margin) the basal metabolism of the average individual, representative of his age group and sex. Basal metabolism has been measured quantitatively on numerous occasions. Table 3.1 below presents the results published by the World Health Organization (WHO, 1985).

Table 3.1 Equations for the calculation of basal metabolism, according to weight (W), age and sex

Age range (years)	kcal/day	MJ[a]/day
Male		
0 – 3	60.9 W – 54	0.255 W – 0.226
4 – 10	22.7 W + 495	0.0949 W + 2.07
11 – 18	17.5 W + 651	0.0732 W + 2.72
19 – 30	15.3 W + 679	0.0640 W + 2.84
31 – 60	11.6 W + 879	0.0485 W + 3.67
>60	13.5 W + 487	0.0565 W + 2.04
Female		
0 – 3	61 W – 51	0.255 W – 0.214
4 – 10	22.5 W + 499	0.0941 W + 2.09

[a] MJ = megajoule; 1 MJ = 239 kcal.

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Age range (years)	kcal/day	MJ[a]/day
Female		
11 – 18	12.2 W + 746	0.0510 W + 3.12
19 – 30	14.7 W + 496	0.0615 W + 2.08
31 – 60	8.7 W + 829	0.0364 W + 3.47
>60	10.5 W + 596	0.0439 W + 2.49

[a] MJ = megajoule; 1 MJ = 239 kcal.

For example, the metabolism of a 28-year-old woman weighing 55 kg is calculated as follows:

$$\textbf{basal metabolism} = (\mathbf{14.7} \times \mathbf{55}) + \mathbf{496} = \mathbf{1{,}304.5\ kcal}$$

or

$$\textbf{basal metabolism} = (\mathbf{0.0615} \times \mathbf{55}) + \mathbf{2.08} = \mathbf{5.4625\ MJ}$$

In contrast, the metabolism of a 3-year-old girl weighing 14 kg is 814 kcal (3.4 MJ). From this viewpoint, one can say that the girl's basal metabolism is 60% of the woman's – but this says little about their respective energy needs. The comparison is more relevant if the energy use is expressed in kcal (kJ) per kg of body mass, that is, 58.1 kcal (243 kJ)/kg for the little girl, and 23.7 kcal (99 kJ)/kg for the woman. This shows that the latter's needs are only 40% of the little girl's.

1.1.2 Energy use due to food consumption

The consumption of food involves the use of energy related both to the functioning of the digestive system, and to the nature of the foods and their storage. The increase of the energy use related to the nature of the food is also referred to as "specific dynamic action" (SDA). Statistically, the SDA is 30% for proteins, 6% for glucides, and 4% for lipids. In other words, the consumption of proteins providing 100 kcal, for example, increases the metabolic rate by 30 kcal. However, the nature of SDA remains unclear, and significant variations persist depending on intake and nutritional status. As a general indication, the act of eating increases basal energy use by 20 to 30% (Trémolière, 1977).

1.1.3 Energy use due to muscular work

Mechanical muscular work, also called physical activity, can account for much of an individual's daily energy use. The use related to physical activity depends on the type of effort, but also on the manner in which it is made (movement efficiency, emotional tension), the food intake and adaptation to the environment (e.g. ambient oxygen pressure, that diminishes with increasing altitude). Therefore, major variations exist between individuals and societies, and so a statistical approach is necessary to assess muscular energy use. Furthermore, measurement methods do not distinguish between the specific components of energy use during work, but focus instead on the final overall total. Principally for these reasons, the assessment of muscular use involves the drafting of statistical tables reflecting the cost of specific activities (expressed as multiples of the standard basal metabolism[3]), based upon the overall energy use registered during effort. These tables show that activities involving the greatest energy use amount to approximately eight times the basal metabolism.

[3] See Annex 1.

1.1.4 Energy expenditure due to thermo-genesis

The heat produced through entropic[4] loss in the course of biological work is not directly usable from a physiological perspective. It nevertheless plays a vital role among mammals and birds because their biological system must maintain a temperature of 35 to 42°C to operate normally. Temperature maintenance requires a very reliable supply of energy – this is indeed a dependency, but allows the organism to adapt to extreme climatic conditions. On earth, some mammals and birds survive in temperatures ranging from –50 to +50°C. To survive in these conditions, they have physiological heating and cooling mechanisms, and protective insulation methods such as are provided by fur and feathers, subcutaneous fat and the use of shelter.

Man attempts to maintain his temperature around 37°C. He can find himself in colder or warmer environments, just like any mammal or bird and, as discussed above, will transfer his heat spontaneously to his colder environment. Moreover, the organism can “overheat” during effort or owing to infection, thus requiring cooling. The exchange of heat occurs through the skin, by radiation (infrared radiation), conduction (transmission through contact), convection (exchange related to the movement of air) and vaporization (water evaporation through perspiration). A thermo-neutral zone exists between excessive heat and excessive cold where the entropic losses of the basal metabolism suffice to maintain body temperature, and where perspiration is thus unnecessary.

When the organism overheats or exists in a warmer environment, its cooling does not imply energy costs, but losses in water and mineral salts. On the other hand, the cooling of the organism in a colder environment requires a thermo-genetic energy use to maintain body temperature. Thermo-genesis, implemented by muscular exercise, shivering or the consumption of brown adipose tissue (BAT),[5] begins when the environment reaches a “lower critical temperature”. This threshold varies significantly according to the availability of protection against the cold (clothing and shelter) and food. For a healthy, naked adult man with an empty stomach, the lower critical temperature is approximately 28°C. Following a rich meal, it falls to 22°C and, with light clothing, will further fall to 18°C. The body surface of newborn babies is proportionately much greater than that of adults. Therefore, they lose heat faster, and their lower critical temperature is 33°C. Very young children are also less mobile than adults, and cannot shiver before 18 to 24 months; cold thus represents a great danger for them.

From a quantitative perspective, the energy cost of thermo-genesis can be enormous, up to three or four times the basal metabolism. For example, a lightly-clad, immobile man weighing 65 kg in a 15°C environment free of draughts must spend approximately 750 kcal (3,135 kJ) per day to maintain his temperature – this amounts to a 45% increase of his basal metabolism (Rivers, 1988). The cost of thermo-genesis increases exponentially when ambient temperature drops linearly. Moreover, the cost is proportional to conduction: for instance sleeping on the bare ground or in contact with water (e.g. wet clothing, shipwreck). Generally speaking, Rivers considers that, between 28 and 20°C, the basal metabolism increases by 30 kcal (125 kJ) per day, for each ambient temperature drop of 1°C below the lower critical temperature. Between 20 and 13°C, this increase multiplies by three to five per 1°C drop in ambient temperature (Rivers, 1988).

When the organism cannot warm itself, its cooling causes hypothermia that is generally deadly when body temperature falls below 25°C – this is equivalent to a one-hour immersion in icy water. This provides an idea of how fast a malnourished, poorly clad individual exposed to the elements becomes chilled, a common scenario in disasters. In famines, where malnutrition becomes general and extreme, mortality peaks among the homeless at night and in rainy weather.

[4] See Chapter II, Section 2.1.1.

[5] The adipose tissue located mainly between the shoulders and involved in the thermal and energy regulation of the organism.

It is impossible to anticipate thermo-genetic energy demand, simply because man dresses, finds shelter and eats according to his environment when he can do so. Nevertheless, cold causes significant energy loss from common climatic conditions, even in the tropics; people lacking food and shelter are particularly vulnerable to this.

1.1.5 Energy need due to synthesis

Biological synthesis is a permanent phenomenon, mainly related to the renewal of cell and tissue components (i.e. maintenance synthesis). From this angle, its energy cost is taken into consideration in the basal use. But the synthesis of new tissue related to individual growth, pregnancy, breastfeeding and the recovery of lost tissue must also be considered.

Growth

Growth is the development of living beings to reach their adult physical stature. The assessment of the energy need specific to growth poses three main problems:

⇨ measurement,
⇨ distinction between the energy expenditure for normal functioning and the energy used for the accumulation of tissue,
⇨ composition of the average deposited tissue – which varies according to age and sex.

In fact, the attempt to calibrate growth accurately encounters the validity limitations of the factorial approach to needs, which becomes overly simplistic. The two reference values generally used are discussed here; they correspond to the average statistical values of existing data, and apply mainly to young children. Waterlow uses 4 kcal (17 kJ) as a reasonable estimate of the overall cost required for the elaboration of 1 g of balanced tissue (Waterlow, 1992). An FAO/WHO/UNU [6] team of experts quotes 5 kcal/g (21 kJ/g) as a widely accepted energy cost for growth (WHO, 1985). The difference is not important: on the one hand, the two values are quite close (being statistical averages whose standard deviation is greater than 1), on the other, following the first months of life during which growth is relatively fast and can account for 15 to 20% of the overall energy requirements, human growth is slow and only costs approximately 5% of energy needs on average.

Pregnancy

Pregnancy includes the growth of the foetus and the placenta, as well as the growth and change of maternal tissues, which obviously requires energy. Normal pregnancy is generally accepted to involve a weight gain of the order of 10 ± 2 kg, and an approximately 20% increase in the basal metabolism during the last quarter (Trémolière, 1977). Classic estimations set the overall cost of pregnancy at 80,000 kcal (335,000 kJ), of which 36,000 kcal (151,000 kJ) represent the deposit of approximately 4 kg of fat. It could follow that a pregnant woman must increase her daily food intake by 300 kcal (1,250 kJ); these figures however warrant caution. A study conducted in five countries shows that reality could be quite different: the average increase of the energy supply is less than 100 kcal (420 kJ) per day among well-fed Europeans. Data indicates a lower cost than classical estimates among women in three differently developed countries (Durnin, 1987). The difference between new and former estimates does not appear to result from a reduction of physical exercise during pregnancy.

[6] FAO: United Nations Food and Agriculture Organization; WHO: World Health Organization; UNU: United Nations University.

The study group led by Durnin found that caution is necessary when discussing the energy cost of pregnancy, and showed the vastness of areas requiring further research. Major differences are probable owing to the multiplicity of factors involved. As a result, it is most likely impossible to define an overall cost from which to issue universal intake recommendations for all women.

Breastfeeding

The production of maternal milk varies considerably from one woman to another; commonly quoted values range from 750 to 850 ml/day. The energy value of maternal milk varies significantly according to the origin of the women under consideration; it also varies according to the duration of breastfeeding (Waterlow, 1992). Food composition tables provide values ranging from 67 kcal (280 kJ) to 75 kcal (313 kJ) per 100 ml. The cost of synthesis is calculated based on an 80% minimum synthesis efficiency factor (WHO, 1985). For example, if a woman produces 800 ml of milk per day, the milk's energy value will represent at least 80% of the cost of synthesis, i.e. between 536 kcal (2,240 kJ) and 600 kcal (2,508 kJ); the maximum synthesis cost will be between 670 kcal (2,800 kJ) and 750 kcal (3,135 kJ). Beyond calculated assessment, it is common knowledge that the production of maternal milk will cost at least the energy value contained in the milk itself. This value is high, and breastfeeding thus amounts to considerably more energy stress for the mother than her pregnancy; it is equivalent to approximately half her basal metabolism prior to pregnancy.

Recovery

Recovery follows the loss by an individual of part of his body mass owing to illness, accident, or a food supply that is insufficient to maintain normal body weight. "Nutritional recovery" and "catch-up growth" are common terms for the recovery process that follows malnutrition. The cost of catch-up growth varies according to the composition of the synthesized tissue and the yield of the synthesis. Tissue composition varies greatly, the yield of protein synthesis is unclear, and rapid weight gain increases specific dynamic action (Waterlow, 1992). However, research (WHO, 1985; Ashworth and Millward, 1986) suggests that, on average, the energy cost of catch-up growth is in the vicinity of 5 kcal/g (21 kJ/g) of synthesized tissue. This cost is high, and significantly increases daily energy requirements for nutritional recovery to be successful. Daily catch-up growth rates can exceed 20 g/kg of body mass, amounting to a cost of at least 100 kcal (418 kJ)/kg/day. The maintenance requirement[7] for a 3-year-old malnourished girl weighing 11 kg is 100 kcal (418 kJ)/kg; this maintenance supply will need to be doubled for her to reach a recovery rate of 20 g/kg/day. The proportional cost is higher still for a malnourished adult: the maintenance supply must be trebled to reach this recovery rate.

1.1.6 Maintenance requirements

The energy cost of maintenance is a useful notion in nutrition; it includes basal use, specific dynamic action, and the use resulting from minimal physical activity (e.g. eating, personal hygiene, clothing, etc.). Maintenance requirements amount to the minimal need to remain alive when doing nothing special; the idle time spent between sleep and professional activities, leisure or house cleaning. Initially, the expression "maintenance requirements" was used only in relation to animal feeding, that is, to express the minimum conditions required for a breeding animal to maintain

[7] See Section 1.1.6 in this Chapter.

a stable weight (Kleiber, 1975). Indeed, a stabled ruminant has no other activity but to remain standing, arise, lie down, move slightly, eat and excrete. Maintenance requirements are first and foremost related to basal metabolism. Rivers sets them at 1.5 × basal metabolism (Rivers, 1986). An FAO/WHO/UNU team of experts refers to "baseline energy needs" – consistent with the idea of maintenance requirements – and sets them at 1.4 × basal metabolism (WHO, 1985).

1.2 CALCULATING DAILY ENERGY REQUIREMENTS

Energy requirements over 24 hours are determined by assessing daily energy use based on the following stages.

1. Calculation of the daily basal metabolism according to body mass, age and sex, based upon the equations provided in Section 1.1.1 above.
2. Calculation of the hourly basal metabolism, that is, the daily basal metabolism divided by 24.
3. Assessment of the number of hours spent daily on the following occupations: sleep, maintenance, professional or domestic activity, and leisure.
4. Calculation of the daily energy use related to each occupation by multiplying the hourly basal metabolism by the factor specific to the occupation under consideration and by the number of hours spent daily on this occupation, based on the following conventional multiplication factors (WHO, 1985; Rivers, 1986):
   - → sleep: 1 × basal metabolism (both sexes);
   - → maintenance, or residual energy requirement: 1.4 to 1.5 × basal metabolism (both sexes);
   - → professional physical activity – readers can use the following conventional factors or refer to Annex 1:
     - → light professional physical activity: 1.7 × basal metabolism (both sexes);
     - → moderate professional physical activity:
       - – women: 2.2 × basal metabolism
       - – men: 2.7 × basal metabolism
     - → heavy professional physical activity:
       - – women: 2.8 × basal metabolism
       - – men: 3.8 × basal metabolism
   - → leisure: the appropriate factor can be found in Annex 1;
   - → house cleaning: the appropriate factor can be found in Annex 1.
5. Calculation of the overall daily energy use by adding the requirement related to each activity (calculated under point 4 above) and possible use related to specific physiological states – such as growth, pregnancy, breastfeeding, and catch-up growth – or climate. The total use defines the daily energy requirement.

It is convenient to express energy use on a daily basis. In reality, it varies in time and according to activity cycles. As a result, if the energy requirement of an individual or a group is to be defined with a view to recommending food rations, the assessment must reflect average needs over an extended period.

1.3 LIMITATIONS OF THE FACTORIAL APPROACH

The factorial approach consists in the breaking down of energy use into factors related to understandable physical entities: temperature, work, growth. It states that the overall energy requirement can be extrapolated, provided each factor of the daily energy use is defined accurately.

This approach nevertheless has two weaknesses.

1. The arithmetic or algebraic sum of expenses is artificial, and ignores the following fundamentals:
   → the different factors of energy use are integrated into the overall functioning of the organism, which is regulated by the neuro-endocrine system – this system governs the energy metabolism according to criteria that differ from those providing the basis of the factorial approach;
   → energy use factors relate to and depend upon one another in frequently complex ways that escape factorial analysis – for instance, muscular activity reduces the need for thermo-genesis, whereas pregnancy increases needs but reduces physical activity and can result in overall metabolic adaptation;
   → emotional state, nutritional intake and adaptation are common variations in real situations – they change energy use significantly, without it being possible to analyse and quantify them for prediction purposes: for example, when preparing his field, a farmer's nervous and muscular tension changes according to whether conditions are normal or precarious.

   A better approach would involve the integration of all three real components of energy use as behaviours:
   → the behaviour of cells and organs;
   → the behaviour determined by the nervous system (emotional state, feeding behaviour);
   → the behaviour related to physical activity.

   These three behaviours determine the overall energy use. They regulate the metabolic level of different organs and, thus, the overall energy metabolism of the organism, via the neuro-endocrine system.
2. The factorial method relies on measurement methods. These do not permit sufficient analysis of energy use, owing to the uncertainty resulting from the measurement of each factor, and to the difficulties of reflecting integrations, inter-relations and behaviours that govern energy use globally. Measurement methods therefore condition both knowledge and the approach to energy requirements.

As a result, available data provides average statistical magnitudes of energy requirements as assessed in standard circumstances. They apply to a so-called reference subject, reflective of a given society at a specific moment in time. Variability related to physiological, nervous and mechanical behaviour induces an uncertainty that is impossible to appraise globally. The uncertainty grows further when the focus is not a laboratory subject, but a social group confronted with its environment. Observation of the energy situation resulting from a defined calorie intake among individuals or groups shows that, in most cases, reality does not agree with theory… It is then necessary to adapt to reality through the thorough study of energy situations and by using these data for what they are, invaluable working guides in the approach to the nutritional need, but certainly not intangible laws.[8]

[8] This difficulty is also discussed in Chapter IV in relation to recommended intakes.

III

SUMMARY OF ENERGY REQUIREMENTS

Factorial analysis must be applied to need in order to understand man's energy requirements properly. This analysis consists in identifying and quantifying the factors of energy use, notably:

- ⇨ basal metabolism, amounting to the energy use of the organism at rest;
- ⇨ specific dynamic action related to food consumption;
- ⇨ physical activity;
- ⇨ thermo-genesis;
- ⇨ growth, production (pregnancy and breastfeeding) and recovery.

The measure of the basal metabolism aims to explain the energy use of the organism at rest in its functional entirety. For the sake of comparison, it is performed in standard conditions that are not universally realistic. Except for the tissue synthesis related to growth, production and recovery, the energy use of the organism is expressed in multiples of the basal metabolism.

Factorial analysis is a tool that only clarifies the magnitudes of the different types of biological work. Expressed in multiples of the basal metabolism, they improve the accuracy of purely factorial sums. It is therefore necessary to bear in mind that this is a method for the analysis of need, and that any calculation inevitably implies a degree of uncertainty related to the following:

- ⇨ the permanent interactions between all components of need;
- ⇨ the changes that any single component imposes on all the others;
- ⇨ the different forms of balance;
- ⇨ the biological variability proper to any species;
- ⇨ the impact of behaviour on consumption and energy use.

2. DEPENDENCY ON MATTER

Energy flowing through the living organism implies energy conversions, and these require a material intermediary. Furthermore, they must occur in the material structure of the organism.

Energy flow and the existence of the organism generate a twofold material requirement.

1. The requirement related to the energy flow including the recycling of adenosine.
2. The requirement related to the development and renewal of the material, architectural and functional structure that accommodates the energy flow. That is, the development and renewal of cells, organs and tissue – that in this case constitute the human being.

The management of matter in the organism occurs through what is known as the intermediary metabolism; this is the "institution" formed by the sum of chemical reactions in the organism, as a result of thermodynamic determinism in the living being.

This management of matter fulfills four functions.

1. The obtaining of chemical energy from fuel molecules.
2. The conversion of nutrients into construction units or precursors of the macromolecules constituting the cell.
3. The assembly of these precursors into proteins, nucleic acids, lipids and other cell components.
4. The production and breakdown of molecules that perform a specialized function in the cell.

All reactions are catalysed by enzymes and are governed by a regulation system, resulting in a highly organized activity. The entirety of these reactions is quite complex; their analysis, however, shows that the intermediary metabolism operates in a simple manner through metabolic pathways. The latter govern two main effects on molecules:

⇨ synthesis, through anabolic channels;
⇨ breakdown, through catabolic channels.

2.1 NEED ARISING FROM ENERGY FLOWS

2.1.1 The nature of fuel

Adenosine recycling defines the needs of the organism for fuel or oxidizable matter and, obviously, oxidizing matter, that accept electrons.

The different forms of fuel carried in the blood for use by the organs are as follows.

Main source

⇨ Glucose, which is found in food, glycogen reserves or is synthesized in the liver from specific amino acids and glycerol.
⇨ Fatty acids, that make up complex lipids and, specifically the triglycerides present in oils and fats found in food or which are synthesized from glucose, some amino acids and the produce of the breakdown of other fatty acids.
⇨ Amino acids that are present in food in the entirety of circulating amino acids or that are synthesized from other amino acids reacting with glycolysis and the citric acid cycle substrates.

Secondary source

⇨ Ketone bodies formed from the oxidation products of fatty acids and some amino acids, when the available glucose is insufficient (for example in fasting).

Minor source

⇨ Lactic acid, formed from the anaerobic oxidation of glucose.
⇨ Glycerol, from the triglycerides splitting into fatty acids and glycerol.

Additional source

⇨ Ethyl alcohol, found in food.
⇨ Fructose and galactose, both glucides found in food.

The main electron acceptor is oxygen.

Fuel molecules transfer their energy through the oxidation of their carbon and hydrogen atoms during fermentation (i.e. anaerobic glycolysis) and breathing (the citric acid cycle combined with the respiratory chain). As suggested by its name, anaerobic glycolysis does not require oxygen, but its ATP recycling yield is low and breathing accounts for most of the work. The organism recycles a huge amount of ATP every day. An adult man weighing 65 kg and exercising moderate activity would recycle an estimated 70 kg of ATP every day. On the other hand, the overall amount of ATP present in his body at any time would probably not exceed 100 g, an energy reserve equivalent to approximately two minutes (a few seconds for the brain). This is because the utilization and recycling of ATP is extremely rapid, and explains the speed at which an individual deprived of oxygen loses consciousness and the irreversible damage to his brain after only two minutes of deprivation.

2.1.2 Energy produced by combustion

The energy use of the organism can only be measured in energy units, and not in ATP molecules converted into ADP. Energy produced by combustion is therefore expressed in kcal or kJ. To this end, it is necessary to find conversion factors between fuel grams and produced energy expressed in kcal (or kJ). In line with the principles of thermodynamics, the complete combustion of a nutrient[9] always produces the same amount of energy, whatever its course (direct combustion in a calorimetric bomb or staggered combustion through catabolic pathways). As a result, it is possible to burn different types of nutritional fuel in a calorimetric bomb to deduce their calorie value.

Reality is however complicated by different factors, some of which are discussed below:

- ⇨ man does not usually eat specific nutrients but foodstuffs whose composition is more varied, and that he digests and absorbs only partially;
- ⇨ proteins are not entirely oxidized when they serve as fuel;
- ⇨ the energy yield of nutrients varies according to their storage and their metabolic path;
- ⇨ biological variability affects both food itself, and its digestion, absorption, and utilization process in humans;
- ⇨ the method faces the same limitations as the factorial measure of energy use: it measures a heat production capacity, as opposed to the energy transformation process itself, in the complexity of homeostasis and the interchangeability of fuels.

It then follows that the energy value of nutrients measured in a calorimetric bomb is a ceiling value; it thus requires a statistical correction factor that allows for the physiology and nature of the food under scrutiny. Scientists have long studied this subject, and it is still not resolved satisfactorily. Opinions differ on the conversion factors to be applied, as illustrated by different food composition tables.

This Manual provides the factors most commonly used, being those calculated by Atwater in the early 20th century. No difference is made between energy produced by construction units and their polymers (e.g. glucose or starch), and the approach is limited to the nutritive principles of foodstuffs, to the exclusion of intermediate metabolites such as glycerol, lactic acid or ketone bodies that are all included in the overall balance of ingests.

Along these lines, the combustion of glucides and amino acids or proteins produces 4 kcal (17 kJ)/g, that of fatty acids 9 kcal (37 kJ)/g, and that of alcohol 7 kcal (29 kJ)/g.

Expressing the energy yield of fuels in kcal or kJ in this way facilitates the linking of the energy need (as discussed in the previous point) and the amount of fuel that the organism needs to absorb (and, therefore, ultimately replace). This practical approach however does not adequately reflect reality. It introduces the uncertainty related to conversion factors that combines with the appraisal of energy use.

[9] Nutrients are food substances that can be absorbed entirely and directly.

2.1.3 Calculating fuel requirements

An individual whose maintenance requirement is 2,000 kcal (8,360 kJ) can meet it by burning 500 g of amino acids or glucides (2,000 kcal/(4 kcal/g) = 500 g) or 222.2 g of fatty acids (2,000 kcal/(9 kcal/g) = 222.2 g).

In fact, this individual burns a blend of glucides, amino acids and fatty acids for an overall consumption of between 222 and 500 g of nutrients. Man does not eat nutrients, strictly speaking, but food; therefore, fuel requirements are extrapolated from food composition tables, according to the specific foods consumed, in order to determine which proportion of each in combination yields 2,000 kcal (8,360 kJ) overall.

The calculation of the food quantities necessary to meet energy requirements is simple. However, it reflects reality only insofar as the needs assessment does; this brings us back to the limitations of factorial analysis discussed above. In calculating the maintenance requirements of an obese individual according to the method described in Section 1.2 above, one would already introduce the enormous aberration of the weight of his inert fatty mass that hardly consumes energy at all. The introduction of a correction that allows for his real lean mass (for example, by referring to the weight of an individual of same height), one would still be underestimating the following in particular:

- ⇨ the preferential utilization of high-yield metabolic pathways;
- ⇨ the physical activity economy specific to obese individuals;
- ⇨ the reduced lower critical temperature that signals the starting of thermo-genesis.

These elements constitute three factors of energy use reduction that, incidentally, do not simply add up but reinforce one another.

Finally, the estimation of the fuel requirement faces three uncertainties related to the following:

- ⇨ the assessment of the need;
- ⇨ metabolic efficiency in processing nutrients;
- ⇨ the conversion factors of food into energy production capacity.

To address this, one can only use available data and compare it with reality.

2.1.4 Fuel reserves in the organism

Storage systems

Following a meal, the food absorbed by the organism is processed in part to address the immediate need, while the excess is stored for later utilization.

Excess glucose can be either assembled in **glycogen** chains, to be stored in the liver and muscle tissue, or converted into fatty acids to be stored in the fatty tissue in the form of triglycerides (three fatty acids bound to glycerol). The quantitative importance of the latter is proportional to the input because the glycogen reserves in the organism are limited, unlike fatty tissue reserves that are extensible to the extreme (obesity).

Fatty acids are conveyed in the form of triglycerides to the fatty tissue to be stored.

Amino acids are mainly used to produce proteins; these do not serve primarily as energy reserves, strictly speaking. However, proteins are permanently renewed, in combination with the continuous renewal of body tissues. The renewal of proteins implies that they be broken down and synthesized (i.e. turnover) at a frequency that varies according to the type of tissue and protein. From a functional perspective, protein turnover ensures the permanent availability of amino acids to respond to uneven enzyme synthesis rhythms for the renewal of degraded tissue proteins, and possibly as a source of energy. Protein turnover is quantitatively significant: in a normal situation of balance, daily synthesis and degradation involve four to five times more amino acids than the amount provided by food. This indicates a high turnover of the pool of circulating amino acids that are immediately available either as direct sources of energy, or as precursors of glucose, when the latter is scarce.

During fasting, the hormone management of protein turnover permits the slowing down of synthesis, and the increase of breakdown or degradation. In such a case, the skeletal muscle provides the main energy reserve since it is the most significant one. When the diet provides more protein and energy than required, the unused amino acids cannot be stored as such; they then lose their nitrogen, become energy metabolism substrates and are eventually converted into fatty acids to be stored in the fatty tissue.

Available reserves

As discussed above, the energy reserves of the organism are glycogen, proteins and fatty tissue. The latter is the ultimate storage of excess food energy, since glucides and amino acids are eventually stored as fat. It is only through this storage that the organism can manage food excesses. As a result, fatty tissue has a real capacity to expand or shrink according to energy excess and deficiency.

Cahill's study of fasting (Cahill, 1970) has shown that the potential energy reserves of an adult 70-kg man consist of approximately 15 kg of triglycerides (135,000 kcal/564,300 kJ), 6 kg of proteins[10] (24,000 kcal/100,320 kJ), 0.225 kg of glycogen (900 kcal/3,760 kJ) and 0.023 kg of circulating fuel (100 kcal/418 kJ). The same individual is then placed in a situation of complete fasting (with the exception of water and minerals) and of basic energy use. The glycogen and the circulating fuels are insufficient to meet his energy needs for one day, whereas the fats alone would allow him to survive for approximately 90 days, and the proteins would support him for another 15. In fact, compulsory glucose consumers (the main one being the brain) cause an increased protein degradation to allow for glucose synthesis. Thus, proteins are highly solicited from the onset; this solicitation then diminishes but does not disappear once the brain adapts partly to the utilization of ketone bodies, derived from lipids, as a source of fuel. Moreover, the protein losses resulting from normal operation persist. Therefore, the initial protein quantity determines survival time during complete fast. Unlike fatty tissue, this amount is only slightly extensible (through physical exercise). A 140-kg obese individual will have about 2 kg muscular proteins more than a 70-kg man, simply to carry his fat. His survival will be longer, owing to these 2 kg of protein, not his approximately 65 kg of excess triglycerides. The example of total hunger strike (except for water) among males shows that survival – in conditions of almost basal energy use – is of the order of two months plus or minus one week.

[10] We refer here to kilos of protein dry weight, and not kilos of muscle whose energy density is much lower.

2.1.5 Fuel utilization in the organism

The utilization of fuel in the organism depends on the organ under consideration, the anticipated work and diet.

Utilization by the organs

- The liver is the first organ to receive nutrients after their absorption by the intestine. It is the organism's chemical plant *par excellence* and, as a result, adapts with ease to any available fuels (except ketone bodies that it produces itself). The energy consumption by the liver of an individual at rest amounts to approximately 25% of the basal expenditure.
- The activity of the skeletal muscle at rest accounts for approximately 30% of the basal expenditure. Some 85% of the energy derives from the oxidation of fatty acids, the remainder from glucose oxidation.
- The energy consumption of the brain remains constant, regardless of intellectual effort; its activity accounts for 20 to 25% of basal expenditure. Normally, the brain utilizes only glucose as fuel.
- The heart at rest mainly burns fatty acids that provide approximately 70% of the utilized fuel. Its activity at rest accounts for 7 to 10% of basal expenditure.
- The metabolism of the kidney is extremely flexible; it can operate by burning amino acids or glucose, ketone bodies or fatty acids. It functions in a fairly constant way, and accounts for approximately 7% of basal expenditure.

Utilization of fuel according to work done

Mechanical work changes the energy consumption of both heart and muscle. The heart adapts easily to effort: its predominant consumption of fatty acids at rest is simply replaced by a predominant consumption of glucose within mere seconds after the beginning of a major effort; a few minutes later, its energy again derives mainly from fatty acids. The skeletal muscle adapts to effort in the same way.

Utilization of fuel according to diet

Since this aspect is discussed in Chapter VIII, the present section only deals with utilization principles. The food input from different meals is uneven and can even be suspended for several days without serious consequences for the organism. Breathing, on the other hand, if suspended for more than three minutes entails death. The organism therefore accommodates mechanisms for the mobilization and redistribution of nutrients to ensure continuous and constant supply, particularly to the brain, once the food ration has been disseminated by the liver to the different organs. The mobilization of fuel is subjected to endocrinal control, and occurs according to the concentration of the different substrates involved in the energy metabolism, nervous stimuli, and physical effort. This mobilization capacity is moreover related to permanent protein turnover.

2.2 *NEED RELATED TO THE DEVELOPMENT AND RENEWAL OF THE MATERIAL STRUCTURE*

Energy flows in the biosphere occur in the material structure of living organisms. The mere existence of this structure implies the use of materials.

As is the case for energy expenditure, and with the same limitations, one can analyse the utilization of the materials required to develop man in a factorial way.

- ⇨ Materials are required to develop the structure during growth, pregnancy and breastfeeding.
- ⇨ Materials are also necessary to compensate for the inevitable losses of the organism in the course of its functioning. These losses are related on the one hand to the permanent renewal of cells and tissue, which involves an inevitable leakage; and on the other hand to the completion of biological work, which involves the utilization without recycling of specific molecules, bringing about their destruction and excretion.
- ⇨ Finally, materials are sometimes required to rebuild or repair tissues lost by accident or infection, or consumed mainly as sources of energy owing to inadequate food intake.

To determine what is required for the development of the human body, its composition must first be understood. The organism and its different components can be analysed individually, and according to different criteria: atomic, molecular, cellular, or relative to tissue.

- ⇨ **Atomic composition**: the adult human being comprises 60% oxygen, 23% carbon, 10% hydrogen, 2.6% nitrogen, 1.6% calcium, 0.7% phosphorus, 0.2% potassium and sulphur, 0.14% sodium and chlorine, 0.03% magnesium and silicon, plus some 0.3% of fifteen or so other elements.
- ⇨ **Molecular composition:** Davidson *et al.* provide the following composition, relating to an adult man weighing between 65 and 70 kg: 17% protein, 13.8% fats, 1.5% glucides, 6.1% minerals and 61.6% water (Davidson, 1979). In fact, significant variations can occur without serious functional repercussions.
- ⇨ **Cellular composition**: healthy body consists of lean cells that account for most energy expenditure (55% of overall weight), fatty cells that form the fatty tissue (15% of overall weight), and extra-cellular support tissue (30% of overall weight), itself divided into extra-cellular liquid and support fibres and minerals (Davidson, 1979).
- ⇨ **Tissue composition**: the organism consists of fatty (i.e. adipose) tissue, the skeletal muscle, bone tissue and internal organs (viscera).

In terms of nutritional needs, the logic of what must be absorbed by the organism to build its structure must be understood. Man feeds on animal and plant tissue; he cannot absorb them as such, and he must therefore first degrade them into molecular components that constitute the food units that he can absorb. Anabolic synthesis pathways operate from construction units,[11] as discussed earlier in Chapter III. The following also serves as a reminder[12] of the nature of fuel:

- ⇨ glucides are the precursors of amino acids, fatty acids and other glucides;
- ⇨ amino acids are the precursors of glucides, fatty acids and other amino acids;
- ⇨ fatty acids are the precursors of amino acids and other fatty acids, but not of glucides.

The construction units are therefore highly adaptable among themselves through metabolic pathways, and man can utilize some of these construction units to synthesize others. For instance, he need not absorb nucleic acids because he can synthesize them from simpler molecules derived from his diet or its recycled components. Theoretically, he should therefore only absorb synthesis precursor molecules and those that he cannot synthesize.

[11] See Chapter II.

[12] See Section 2.1.1 in this Chapter.

Dependency on construction units thus occurs in two forms.

1. **Quantitative**: a minimum number of construction units derived from diet are required to build the infrastructure, replace losses and possibly repair the structure, whatever the adaptability of the molecules involved. Construction units also serve as fuel, as seen in the previous section (2.1.1), to cover energy use. It is important to understand that covering energy use takes precedence over all the other components of the nutritional need except, to a certain extent, for pregnancy and breastfeeding. As a result, growth, compensation for inevitable losses and repairs imply that the diet provides construction units in addition to those that have been burned to meet energy requirements.
2. **Qualitative***:* man must absorb enough of the molecules that he cannot synthesize, i.e. water, some amino acids, some fatty acids, vitamins and mineral salts. These molecules are qualified as "essential" in nutrition, because they constitute a limiting factor in the functioning of the metabolism.

This somewhat debatable distinction between the quantitative and qualitative form, aims to underscore a fundamental aspect of the material need: whether the diet contains glucides is unimportant, as long as it includes enough amino acids to meet the need for them and for them to serve as precursors for glucides. On the other hand, if an otherwise balanced diet lacks an essential construction unit such as zinc, the organism will waste and die. This clarifies how diet can contribute more or less proteins, glucides and fatty acids that are highly adaptable between themselves, but must provide quite accurate minimum amounts of essential molecules.

Quantifying the need for construction materials is discussed and defined in practical terms in the following chapter in relation to recommended intakes, because:

⇨ the quantitative nutritional need is defined more easily in its entirety;
⇨ the attempt to express the phenomenon factorially is futile, because the components of the nutritional need all interact in an almost inextricable way – factorial analysis cannot reflect these interactions quantitatively, but only highlight the factors that modify the need;
⇨ the adaptability of construction units does not permit the expression of the need for glucides, amino acids and fatty acids for a specific utilization factor – quite different intakes can lead to the same conclusion, whereas set intakes will result in different outcomes according to the individual.

This discussion therefore focuses on the qualitative aspect of the nutritional need related to the material structure of the organism.

2.2.1 Water and oxygen

Water is just as essential to the body structure as oxygen is to the energy metabolism – to the point that it is often not mentioned. Oxygen is not yet rationed, and does not demand specific discussion in this study. The need for water, on the other hand, is vital particularly in view of the limitations imposed on the planet by human expansion. Nowadays, water is free in only a few privileged places. Everywhere else, its acquisition process is becoming just as costly economically and politically as the procurement of food. It is urgent to consider access to safe drinking (i.e. potable) water as an important aspect also of food economy, in a resource management perspective.

2.2.2 Glucides

There are no essential glucides in human nutrition. They can all be produced from glucose that can itself be synthesized from some amino acids.

2.2.3 Amino acids

Of all the components of the nutritional need, the requirement for amino acids is the one whose analysis and understanding are the most complex, to the point where we still lack a comprehensive model. The protein metabolism is one of the most complicated elements of the physiology of nutrition. In spite of his extensive research, Professor Waterlow chooses not to provide estimates of the required daily protein intake in grams among children, because of the uncertainties related to the components of factorial calculation. He even goes so far as to depart from the line of the WHO expert team to which he belonged, and which issued recommendations on energy and protein needs (WHO, 1985). He prefers, from a practical perspective, to scrutinize the quality of food required to maintain a child in good health, rather than investigate the child's needs. Mothers, health officials and foodstuff producers face the same dilemma (Waterlow, 1992). Literature on the assessment of protein need is considerable and continues to grow based on new data, but reference texts concur in recognizing the difficulty of defining this need accurately (WHO, 1985; Shils *et al.*, 1994; Waterlow, 1992; Millward and Rivers, 1988; Millward *et al.*, 1989; Trémolière, 1977).

The idea here is to provide thinking tools for field work to facilitate responsible decision-making, rather than to offer "reassuring" figures which are anyway subject to variation and caution.

Proteins are formed from the 20 following amino acids: glycine, alanine, valine,*[13] leucine,* isoleucine,* serine, threonine,* cysteine, methionine,* proline, phenylalanine,* tyrosine, tryptophan,* histidine,* lysine,* arginine, aspartic acid, asparagine, glutamic acid, and glutamine.

Non-essential amino acids can be synthesized, provided the amine group is available from the degradation of other amino acids. The need for amino acids therefore rests on the availability of two main components:

⇨ enough amine groups;
⇨ enough essential amino acids.

The amine group includes a nitrogen atom; this is why one often refers to the "nitrogen need" rather than the need for proteins or amino acids. Man does not eat isolated amino acids but chains of them, that is, proteins. The nutritional value of proteins depends on two factors: their capacity to supply the organism with nitrogen (this determines their digestibility), and their capacity to supply the amino acids required by the organism (defined by their composition).

Protein digestibility

The most convenient way of quantifying the digestibility of proteins is to measure their nitrogen content. All proteins contain roughly the same amount, and it is thus possible to deduce protein quantity as follows:

$$\textbf{proteins} = \textbf{nitrogen} \times \textbf{6.25}$$

The digestibility of proteins can be calculated by measuring the nitrogen contained in food, and then the amount of nitrogen contained in the faeces after digestion (allowing for faecal nitrogen loss that exists even without eating protein). Without entering into detail as to the calculation of digestibility, one can say that animal protein (milk, eggs, meat and fish) have a 95% digestibility

[13] Essential amino acids.

rate, meaning that 5% is lost in the faeces. The digestibility of refined cereal flour proteins is likewise approximately 95%, that of unmilled cereals and legumes approximately 85%.

The digestibility of proteins is not only determined by the nature of the protein, but also by the agents present in the food ration (fibres, tannin, phytates and digestive enzyme inhibitors), cooking and industrial treatment processes.

The concept of protein digestibility is only important in situations where a protein deficiency is suspected, requiring specific measures. We will see that such situations are in fact rare.

Protein value according to amino-acid composition

The amino acids that are constantly circulated in the course of protein turnover can provide the organism with fuel. This is incidentally probably one of the reasons for protein turnover, otherwise quite costly in energy. The primary function of amino acids nevertheless remains related to synthesis (firstly the synthesis of renewed proteins, then pregnancy, breastfeeding, recovery and growth).

Human proteins combine different amino acids in specific proportions. This proportionality also applies to essential amino acids. Moreover, man cannot choose to consume separate amino acids. He eats proteins. It is therefore preferable for him to consume proteins whose proportional essential amino-acid composition is as close as possible to that of the proteins he wishes to produce. From this perspective, it could be said that human proteins are probably the most appropriate for human consumption, in terms of essential amino-acid supply.

The average dietary protein supply must of course provide all essential amino acids in the proportions required for synthesis. Clearly, the consumption of proteins leads to optimal synthesis only if their essential amino-acid composition is identical to that of the proteins to be synthesized. If, on the other hand, the proportions of essential amino acids in the food differ from those of the proteins to be synthesized, then synthesis will only occur to the point where the least available essential amino acid has all been consumed (this amino acid is the limiting factor of synthesis); the remaining essential amino acids in the food are then recycled in the energy metabolic pathways, losing their amine group in the process. For example, if the limiting essential amino acid is only 70% of what is needed, then synthesis only occurs to 70% of the ideal. Thus, in this example, at least 30% of essential and non-essential amino acids are unusable for synthesis.

This is only a problem if the diet with respect to minimum nitrogen requirements lacks essential amino acids over long periods. This type of situation is found in experimental laboratory conditions or in very specific famine circumstances.

In everyday life, man consumes foods containing different proteins that supply a pool of amino acids. A diet must contain more proteins than those required to meet the nitrogen need, combined with a limiting amino acid of, after absorption, at least 100% of needs, in order to enable normal protein synthesis.

As discussed above, the construction units provided by the diet are first used to satisfy energy needs. Natural foods are generally tissue provided by living organisms, and they supply proteins, glucides and lipids in different proportions. They therefore serve first as fuel, and then as construction units, if any remain after the energy need has been met. The most balanced diets are those supplying – in addition to energy – no more than the amount of quality proteins required to avoid protein and energy waste. Such diets administered intravenously are laboratory products. Although useful to the physiologist and the patient, they are not the foods normally consumed by man in his social and economic environment. What is, then, the protein quality of habitual diets?

III

Adults

Trémolière has compiled balance studies that show how the nitrogen requirements of adults can be met by proteins from different diets. The results are presented in Table 3.2 below, in order of decreasing yield (Trémolière, 1977).

Table 3.2 Amount of nitrogen from different protein sources needed to ensure the nitrogen balance in adults

Protein source	mg of nitrogen to be ingested per kg of bodyweight
Milk	66
Soy flour	68
Eggs	71
70% cereals 28% milk and meat	71
50% rice 45% milk 5% other	75
Casein	78
42% cereals 33% meat 25% assorted vegetals	78
64% white flour 36% soy	79
Wheat, corn, oats	80 – 90
42% cereals 33% wheat sprouts 25% other plants	83
Rice	87
80% vegetal 20% milk	87
62% cereals 38% other vegetals	95
75% cereals 25% other vegetals	96
42% cereals 33% soy 25% other plants	104
Yeast	105
White flour	110

The table above shows that the nature of ingested proteins influences the efficiency of retention, according to the combination of digestibility and composition in essential amino acids; but it also shows that, in all cases, nitrogen balance can be achieved. This means that these diets provide enough nitrogen and essential amino acids. Assuming that 95% of the intake of milk proteins – which have the highest yield and the best digestibility coefficient – are used as protein, the organism must retain 63 mg of nitrogen per kilogram to achieve nitrogen balance, i.e. 0.4 g of protein per kg. Assuming also that the experiment conditions were comparable for the different diets described in Table 3.2, it follows that all achieve nitrogen balance with roughly the same amount of protein used for synthesis, i.e. 0.4 g/kg of milk protein.

If all these elements are integrated into the global need to achieve nitrogen balance and meet energy requirements, then simple calculations demonstrate that, when they are consumed in sufficient quantity to meet energy requirements, almost all the foods or food groups indicated in Table 3.2 supply much more amino acids than are required to meet protein needs.

Trémolière and the WHO report therefore both conclude that most diets cover the adult need for essential amino acids, provided that energy requirements are met (Trémolière, 1977; WHO, 1985).

In the same logic, it is possible to demonstrate that the proteins required to cover protein needs account for 5 ± 3% of the amount of food required to meet energy needs for maintenance.

There are of course exceptions, as shown by the following examples.

⇨ In some food scarcity and famine situations, it is possible for the supply to be of a single food type, whose protein content and/or quality are inadequate. Corn and sorghum are deficient in tryptophan; this results primarily in pellagra,[14] and is often associated with kwashiorkor[15] as seen among populations displaced by war and prisoners. However, this is even more dramatic in cassava, which is generally poor in nitrogen, and can thus cause actual kwashiorkor epidemics especially when eaten by displaced and starving populations, or people who are unfamiliar with its preparation.

⇨ Abnormal feeding behaviour, resulting from psychological anorexia, alcoholism, and drug consumption can all cause protein deficiencies. This, however, is more an overall nitrogen deficit than a shortage of essential amino acids.

Children

The needs for essential amino acids decrease from birth to adulthood. However, in the overall perspective of protein and energy needs, adults require more proteins per energy unit dissipated than children do. If the child's consumption of the foods and food groups described in Table 3.2 above is sufficient to cover its energy needs, then its requirements in nitrogen and essential amino acids are necessarily also met.

Excluding the severe shortage situations discussed above for adults, risks exist nevertheless arising from local food production, eating habits, poverty and ignorance.

⇨ In all regions where cassava and banana constitute staple foods, the prevalence of kwashiorkor is higher than elsewhere and is directly caused by protein deficiency. Episodes occur particularly at the end of the hunger gap, when intake is marginal (or most deficient) before the following harvest, a period which frequently coincides with the onset of the rains that promote infection.

[14] See Chapter VIII, Section 2.5.
[15] See Chapter VIII, Section 2.4.

- ⇨ Weaning practices can be brutal, combining the introduction of porridges made from a single flour, diluted and contaminated, with the simultaneous cessation of breastfeeding. Marginal protein intake, infection and psychological stress often cause severe malnutrition, and can be fatal. Moreover, a diet based on food groups detailed in Table 3.2 does not necessarily mean that all household members enjoy the same access to these foods, owing to hierarchies, beliefs and taboos. During weaning and until the age of about 6 years, discriminatory practices can have morbid, or even fatal, consequences. However, their initial justification may well have been good, and have only become dangerous because of changed living conditions. Furthermore, the perception of infantile nutritional illness varies considerably according to context; it rarely coincides with its definition as provided by external observers, who are trained in Cartesian thinking and are unfamiliar with cultural and social factors.
- ⇨ Poverty often results in diets that are insufficiently varied to supply adequate protein quality. Poverty and ignorance are frequently quoted together; they should however be distinguished carefully. The poor usually lack the means to apply the principles of healthcare and healthy diet; as for ignorance, it cannot be addressed through education as long as poverty has not been alleviated since the poor can hardly afford to absorb the education that is so frequently imposed upon them, even if it pursues a realistic objective and is culturally understandable – this is rarely the case.
- ⇨ Ignorance itself can be devastating in all strata of any society. Aside from ignorance, changing living conditions also cause poor practice, explaining harmful reactions in some situations. In any case, the problem reaches far beyond the lack of nutritional education: it results from an inadequate access to education in general.

Infants

It is commonly accepted that the infant's essential amino-acid needs are met by breastfeeding, provided the latter covers energy needs.

2.2.4 Lipids

Most lipids in the organism can be synthesized from glucose or fatty acids. Two lipids are essential – linoleic acid and α-linoleic acid – and must be absorbed to avoid various disorders. Linoleic acid is a precursor of arachidonic acid, and together they account for a significant proportion of the fatty acids of the cell membrane and the white matter of the central nervous system. Linoleic acid is also a precursor of the prostaglandins, hormones whose spectrum is extremely vast. α-linoleic acid appears to play a role in vision and the regulation of some immune mechanisms. Gaps remain in the knowledge of essential fatty acids; deficiency in these acids is however rare, owing to their prevalence in edible plants and hence the oils extracted from them.

2.2.5 Vitamins [16]

Definition

Vitamins are molecules that man cannot synthesize himself. The word is derived from "vital amine". The clarification of the structure of some agents indispensable to life has shown that they contain an amine group. It later became apparent that all vitamins do not contain an amine group. The expression "vitamin"

[16] This Section provides general information about each type of vitamin, but recommended intakes are provided in Chapter IV. Annex 2 lists the foods that contain the four most important vitamins. Deficiencies that can result in public health problems are discussed in Chapter VIII, whereas losses resulting from food storage and preparation are detailed in Chapter V. Most quoted information is derived from: Machlin, 1984; Shils *et al.*, 1994; Davidson *et al.*, 1979.

applies to essential compounds that have a carbon skeleton, whose daily requirements are lower than 1/500,000th of the daily total ingests. These compounds cannot be synthesized by the organism (at least not in sufficient quantity), and do not serve as fuel. This last point in fact sets them apart from amino acids and essential fatty acids. Vitamins do not enter metabolic pathways, but constitute tools to enable the chemical reactions of the organism. Vitamins share no chemical link and all differ in their physiological action.

History

The discovery of vitamins is due to contemporary science. In the early 20th century, essential factors were noted to provide growth accessories in addition to conventional nutrients (glucides, lipids and proteins). Some fifty were consigned between 1915 and 1945. They were progressively identified with a letter, sometimes combined with a number to distinguish them, and later a specific name as soon as one of these factors was isolated and its chemical structure clarified. When it became obvious that many identified factors were known substances that the organism could synthesize itself, they were removed from the list. This explains the different denominations and the gaps in the numbering and lettering that identifies vitamins. Since the last discovery, that of vitamin B_{12} in 1948, 13 of these growth accessory factors have proved to be essential and constitute vitamins as we know them today. Research, facilitated by increasingly sophisticated techniques, continues into the role of vitamins. The many functions of vitamins have been demonstrated, beyond those whose deficiency results in obvious clinical evidence and potentially deadly disease. It is becoming apparent that these functions, albeit hidden, are nevertheless very important from a biochemical perspective and certainly play an essential role in the general health status of organisms, in their resistance to infection and stress, in their recovery and detoxification capacity, and in their longevity.

Classification and nomenclature

Vitamins are usually distinguished according to whether they are water-soluble or fat-soluble (i.e. liposoluble). This distinction is interesting from a nutritional perspective: the organism can store fat-soluble vitamins, but not (or only little) water-soluble vitamins. Water-soluble vitamins can be further broken down into vitamins of the B group and vitamin C. The B group comprises vitamins with several molecules whose common characteristics are that they are coenzymes,[17] that they contain nitrogen atoms, and that they are related to intermediary metabolism. In terms of nomenclature, the contemporary official designation relates to the chemical name of the substance – but the alphabetical designation persists.

Unit of measurement

The main recognized unit of measurement is the weight of the active substance. For some vitamins, former international units are still in wide use and appear in this Manual with their equivalent in weight.

Water-soluble vitamins

Vitamin C or ascorbic acid

Source: vitamin C is synthesized by almost all living organisms, apart from primates, guinea pigs, one type of bats and some birds. As a result, it is found in most animal and vegetable tissue. Berries, citrus fruits and capsicum are the richest sources, followed by greens and vegetables in the cabbage family.

[17] Non-protein organic substance, indispensable for the activity of some enzymes.

Absorption: the intestinal absorption of vitamin C is saturable, which means that it is useless to ingest more than 150 mg at a time. The excessive amounts that are sometimes ingested by vitamin C enthusiasts are mostly excreted and can result in diarrhoea and intestinal discomfort.

Metabolism, storage and excretion: the average half-life of ascorbic acid in the human body is 16 to 20 days. This time is inversely proportional to the intake and, thus, the catabolic rate is proportional to it. But the catabolism does not stop at the intake. Inevitable daily losses of several milligrams because of the irreversible degradation of ascorbic acid are observed. Hence the need to compensate for these losses to avoid fatal deficiencies. There is no storage system specific to vitamin C. However, given an adequate intake of vitamin C, the cells of the organism contain enough of it to cope with a sudden drop in intake, and for clinical signs of deficiency to appear only two or three months later.

Function: the function of vitamin C is mainly related to its reversible role as chemical reducer. It enables the reduction of metallic ions necessary to certain reactions, and plays a major role in anti-oxidizing, and in the elimination of free radicals. It contributes to the formation of collagen (conjunctive support tissue), in addition to the synthesis of carnitine (transport for fatty acids) and neuro-transmitters. It also contributes to the metabolism of hormones, medicines and drugs, and the degradation of cholesterol. The vitamin promotes the absorption of iron, and mitigates the effects of chelating agents such as the phytates and tannins that form complexes that are insoluble with iron, thus preventing its absorption. The reduction properties of ascorbic acid could improve the stability of folic acid and vitamin E.

Deficiency: vitamin C deficiency results in a series of symptoms characteristic of scurvy.[18] Scurvy is deadly if it is not treated rapidly with vitamin C.

Clinical, prophylactic and therapeutic considerations: apart from its anti-scurvy activity, vitamin C is thought to play an important role in the immune system, defence against oxidation, protection against cancer and the prevention of cardio-vascular disease.

Requirements:[19] for adults, a daily dose of 10 mg of ascorbic acid treats scurvy, without allowing the subject to build vitamin reserves. The cost of pregnancy is estimated at 3 to 4 mg/day, whereas breastfeeding costs 15 to 45 mg/day on the basis of an average daily milk production of 750 ml. The needs of an infant fed on artificial milk are met with 7 mg of ascorbic acid per day. As of the age of 6 months, needs gradually approach the adult's. Quantities quoted here are adequate to treat scurvy; it is however unclear whether they suffice in relation to the many functions of vitamin C which, when reduced, do not result in immediate clinical evidence.

Pharmacological intake: 100 to 200 mg doses are recommended to address iron deficiency in exceptional need situations such as pregnancy, breastfeeding or antibiotic treatment. In case of injury, burns or surgical operation, vitamin C requirements could be in the vicinity of 1,000 to 2,000 mg to accelerate reparation and recovery.

Toxicity: when ingested in reasonable quantities (i.e. no more than 1 g/day), vitamin C has no toxic effect. The absorption of greater doses could/may entail negative effects, but available data remains unclear.

Thiamine or Vitamin B_1

Source: thiamine is found in all animal and vegetable tissues – in other words, in all natural foods. However, thiamine is not distributed equally in the tissues, and some refinement processes can

[18] See Chapter VIII.
[19] See Chapter IV.

significantly reduce its concentration in some foods. The most abundant sources of thiamine are cereal sprouts, oilseeds and legumes, in addition to beer and pork. Fresh foods (greens, fruits, tubers, meat, milk and milk products except butter) contain enough thiamine to preclude deficiency if eaten regularly in sufficient quantity.

Absorption: thiamine is absorbed actively when its concentration is inferior to 2 micromoles (µmol) per litre, and passively when it is greater than 2 µmol/l.

Metabolism, storage and excretion: the average half-life of thiamine in the organism is 9 to 18 days. If its concentration in the organism is excessive, it is not catabolized, but simply excreted as such. The approximate total quantity for the reference adult is 30 mg; this shows that thiamine is poorly stored in the organism, and that regular intake is indispensable.

Function: thiamine is a coenzyme that is indispensable to the energy metabolism, particularly for the junction between fermentation and breathing during the oxidation of glucides, and to the metabolism of amino acids whose carbon skeleton contains a branch. It also plays a role in nerve transmission, in terms of sodium and potassium transport.

Deficiency: thiamine deficiency causes a number of symptoms typical of beriberi.[20] Beriberi is fatal if it is not treated rapidly with thiamine.

Requirements: thiamine requirements are mainly related to energy metabolism, i.e. energy use. They are therefore expressed in mg/1,000 kcal (4,180 kJ). The minimum required intake is of the order of 0.25 mg/1,000 kcal (4,180 kJ).

Pharmacological intake: thiamine-dependent patients only respond to pharmacological thiamine doses. This concerns only a few rare cases that respond to high thiamine intake, such as some forms of megaloblastic anaemia, lactic acidosis and branched chain ketoaciduria (or maple syrup urine disease, MSUD).

Toxicity: the organism is extremely efficient in excreting thiamine excesses through urine; as a result, there is no evidence of thiamine toxicity provided it is administered orally.

Riboflavin or Vitamin B_2

Source: riboflavin is found in most foods. Beer yeast, liver, eggs, milk, cheese and meat are its best sources, followed by green vegetables, and then fruits, legumes and, finally, cereals.

Absorption: riboflavin is absorbed through an active saturable system. Absorption is facilitated by bile salts. The oral administration of riboflavin as a medicine must coincide with meals, because food maintains it longer on absorption sites.

Metabolism, storage and excretion: in the tissues, riboflavin is mostly found in the form of flavine adenine dinucleotide (FAD), and most of it is free, and the rest is related to enzymes as a coenzyme. The liver is its main storage organ, and accommodates approximately one-third of the overall riboflavin in the organism. As a coenzyme, FAD is quite stable, and its renewal is directly connected to the renewal of the proteins to which it is bound. When proteins are saturated, the free form is degraded into free riboflavin, which is excreted mainly in the urine. Excretion is of the order of 200 µg per 24 hours in reference adults, and falls by approximately 75% in case of deficiency.

[20] See Chapter VIII.

III

Function: riboflavin is a coenzyme that contributes to the oxidation-reduction of many metabolic pathways, particularly in energy production (ATP) in the respiratory chain.

Deficiency: riboflavin is found in all major food categories, but in insufficient quantity in the essentially vegetarian diets of the poor in vast regions in the world, nor in traditional humanitarian relief food rations. As a result, moderate riboflavin deficiency is common, combined with other more or less serious deficiencies typical of nutritionally poor diets. The usual clinical signs include the oro-oculo-genital syndrome, together with angular stomatitis (sores at the corners of the mouth), glossitis (tongue inflammation), cheilitis (swelling and cracking of the lips), a magenta[21] colouring of the tongue, photophobia, and seborrhoeic dermatitis, particularly of the scrotum and the vulva. Of all these signs, only the magenta colouring of the tongue is an absolute indication of riboflavin deficiency. Spotting it however requires a sufficiently expert eye to distinguish it from other, close, colourings that indicate other deficiencies. All the other clinical signs of riboflavin deficiency can also result from other group B vitamin deficiencies. Strangely enough, riboflavin deficiency is not deadly, in spite of its fundamental role in the energy metabolism. This is probably because riboflavin, once it is related to oxidation-reduction enzymes, is extremely stable, that it is found in all major food categories, and that a minimum amount is always present; in extreme food shortage situations, other deficiencies are deadly sooner. The prescribed dose to deal with deficiency is 5 mg oral three times daily.

Requirements: as is the case for thiamine, the minimum riboflavin intake is expressed in mg/1,000 kcal (4,180 kJ). Unlike thiamine, however, needs do not increase significantly with energy use. The resulting minimum requirements are 0.5 mg/1,000 kcal (4,180 kJ)/day for infants. Additional needs related to pregnancy are 0.3 mg/day, and 0.5 mg/day for breastfeeding.[22]

Pharmacological intake: because riboflavin deficiency usually does not arise alone, it should be administered together with thiamine and, if possible, with all the other vitamins in therapeutic doses. A riboflavin dose of 5 mg/day is sufficient, as research has shown no additional benefits in higher doses.

Toxicity: riboflavin is non-toxic, and excessive intake is rapidly excreted in the urine.

Nicotinic acid and Nicotine-Amide (Nicotinamide) or Niacin or Vitamin B_3 or PP

The vitamin activities of nicotinic acid and its amide, nicotine-amide, are identical; they share the generic name of niacin.

Source: niacin is found in practically all foods, if only in limited amounts. The highest concentrations are provided by meat (especially offal), fish, beer yeast, some legumes and some cereals. In the latter, niacin is blocked and becomes available only through alkaline treatment, such as the treatment of maize with lime water as practised by American Indians. Niacin has a precursor, or provitamin, from which it can be synthesized; this precursor is the essential amino acid tryptophan. Niacin synthesis from tryptophan requires riboflavin and vitamin B_6. Tryptophan can contribute significantly to niacin intake, provided it exceeds both the protein requirements and the homeostasis of amino acids: 60 mg of tryptophan in the food are generally considered to supply 1 mg of niacin. This figure nevertheless calls for caution: the conversion of tryptophan into niacin probably depends just as much on the content of one as of the other in the diet. Either way, food composition tables often refer to niacin equivalent, plus one-sixtieth of the tryptophan content of the food under consideration. This is a good reflection of reality for foods that are poor in niacin but rich in tryptophan, such as milk and eggs that are indeed effective in addressing deficiencies. Niacin in

[21] Magenta: a light mauvish crimson.

[22] Recommended intakes are provided in Chapter IV.

its free form is rare in nature, where it is essentially found as nicotinamide-adenine-dinucleotide (NAD) and nicotinamide-adenine-dinucleotide-phosphate (NADP). NAD and NADP are the two complete coenzymes whose active chemical group is nicotinamide.

Absorption: NAD and NADP are hydrolysed by enzymes of the intestinal mucous membrane, resulting in the release of the coenzyme nicotinamide. The intestinal flora partially converts nicotinamide into nicotinic acid, and both are then absorbed without it being known exactly how. The absorption is very efficient, even in large quantities (approximately 3 g), with or without concomitant food intake. The tissues then rapidly extract niacin from the plasma.

Metabolism, storage and excretion: after the nicotinamide and nicotinic acid have been absorbed into the cells, NAD and NADP coenzymes form. Strictly speaking, there is no niacin storage in the organism. Excessive intake is rapidly excreted through the urine, where niacin is secreted as such.

Function: nicotinamide acts as an oxidant or a reducer by the exchange of a hydrogen atom with its substrate. More than 200 enzymes use either NAD or NADP as coenzyme. NAD is more frequently involved in catabolic reactions, using fuel molecules for the production of energy, whereas NADP is used rather in synthesis processes, such as the synthesis of steroids and fatty acids. The conversion from NAD into NADP (and inversely) is easy, and the two molecules can exchange their oxidation states. Under hormonal control, this allows a balance to be maintained between synthetic reactions that consume energy and catabolic reactions that produce it. Generally, niacin's oxidation-reduction function involves it in the metabolism (synthesis and degradation) of fatty acids, glucides, and amino acids.

Deficiency: niacin deficiency results in a number of symptoms typical of pellagra,[23] which is deadly if it is not treated rapidly.

Clinical, prophylactic and therapeutic considerations: nicotinic acid prevents cardio-vascular disease by reducing plasma cholesterol levels, by also reducing low-density lipoproteins, and by increasing high-density lipoproteins. Niacin also plays an important role in the treatment of dementia, depression and schizophrenia, three illnesses that modify the niacin or tryptophan metabolism, resulting in increased requirements for this vitamin. Niacin is of course indispensable in the treatment of pellagra.

Requirements: see recommended intakes in Chapter IV.

Pharmacological intake: a pharmacological niacin intake (3 g/day) is prescribed in the treatment of schizophrenia and of high plasma cholesterol levels.

Toxicity: niacin is not really toxic insofar as very high doses (3–6 g/day) only cause passing side effects. These can, however, be quite unpleasant: vasodilatation and hot flushes, nausea, vomiting, headache, and skin irritation.

Pantothenic acid or Vitamin B_5

Source: pantothenic acid is found in all natural foods. It is particularly abundant in beer yeast, egg yolk, offal (especially liver) and is found in more moderate quantities in cereals and legumes. It is one of the constituents of coenzyme A, into which it is usually integrated. In food, it is found in both its free and integrated forms.

[23] Pellagra is discussed in Chapter VIII.

Absorption: the absorption of pantothenic acid appears to be passive, mainly in the small intestine, but possibly already in the stomach. The integrated form of coenzyme A must first be released by enzyme action. The absorption of the vitamin is approximately 70%, the rest is excreted in the faeces.

Metabolism, storage and excretion: coenzyme A is synthesized in the cell from pantothenic acid. Following hydrolysis reactions, the latter is then released in free form and excreted as such in the urine; this means that pantothenic acid does not undergo any transformation in the organism. Pantothenic acid is not stored, excess intake is immediately excreted in the urine.

Function: coenzyme A is an indispensable vehicle of two-carbon units, both in the degradation of some amino acids, sugars, and fatty acids, and in synthesis. It is probably the most central and versatile of all coenzymes in the intermediary metabolism, while remaining just as indispensable to many more specific reactions, such as the synthesis of acetyl choline and porphyrines. Coenzyme A is also essential in the modification of cellular proteins in terms of structure, activity, and location.

Deficiency: human pantothenic acid deficiency is rare, although moderate forms can evolve in the case of diets made up essentially of transformed foods from the food industry. Atypical symptoms include weariness, headache, and indisposition. The burning feet syndrome only develops in experimental deficiency conditions, or in grave forms of marasmus;[24] its symptoms include the feeling of burning skin on the feet and ankles, that can extend up to the knee. The pain is sudden, spreads rapidly, and can be acute. Crises often occur at night and exhaust the patient by preventing him from sleeping. Cold water brings some relief. The burning feet syndrome is frequently found among malnourished prisoners whose diet is extremely monotonous and constantly unbalanced. It should be noted that the syndrome almost always appears in combination with the signs of other group B vitamin deficiencies.

Requirements: see recommended intakes in Chapter IV.

Pharmacological intake: there appears to be no indication for high doses of pantothenic acid. The burning feet syndrome is treated with an intramuscular dose of 10 mg/day. Administered orally, the vitamin also produces fast and excellent results, as an experience with severely malnourished prisoners has shown (fortuitously, a dose of 100 mg/day in a multivitamin preparation intended to treat beriberi was administered).

Toxicity: pantothenic acid is not toxic for humans.

Pyridoxine or Vitamin B_6

Source: pyridoxine is found in most natural animal and vegetable foods. As is the case for most group B vitamins, it is abundant in baking yeast, liver and cereal sprouts. Avocado, banana, potato and some nuts and legumes also contain significant concentrations.

Absorption: the absorption of pyridoxine is passive and non-saturable, and occurs in the small intestine.

Metabolism, storage and excretion: the liver provides the other tissues with active forms of pyridoxine (pyridoxal-5-phosphate), of which the major concentration is found in the striated muscle (80–90% of the overall pyridoxine contained in the organism). The vitamin is not

[24] See Chapter VIII.

specifically stored, and its turnover requires approximately 30 days. The pyridoxal-5-phosphate molecule is highly reactive, and excessive intake is irreversibly transformed into 4-pyridoxal acid, and eliminated in the urine.

Function: pyridoxine is primarily associated with practically all metabolic reactions of amino acids. It also contributes to gluconeogenesis, in the formation of niacin from tryptophan, in the synthesis of neuro-transmitters, in the regulation of steroid hormones, and in the compatibility between oxygen and haemoglobin. Its role in the lipid metabolism remains unclear and, generally, the function of pyridoxine is far from being comprehensively elucidated. In view of the vitamin's versatility, it is probably crucial for intake to be sufficient and regular to ensure these multiple roles (both known and unknown), while avoiding that one function take precedence over another.

Deficiency: human pyridoxine deficiency is rare, because the vitamin is found in sufficient amounts in all the major food categories. It is, however, associated with severe malnutrition[25] or resulting from the administration of medicines that are incompatible with the vitamin, such as isoniazid, penicillamine, and oestrogen. Several illnesses related to an innate metabolic error cause a greater dependency on the vitamin. Clinical signs among infants include convulsive crises, and anomalies in the electro-encephalogram; these are reversible through the administration of pyridoxine. Clinical signs among adults are those also associated with riboflavin deficiency: stomatitis, cheilitis, glossitis (less typical tongue colouring), in addition to irritability, depression and confusion. The treatment consists of a 10 mg/day dose, administered orally.

Requirements: in view of the versatility of pyridoxine, its needs are difficult to define in terms of a dose that would eliminate clinical deficiency signs. These signs can indicate deficiency with respect to specific functions, whereas others will prove insufficient at sub-clinical level. In this respect, specific data is lacking, and it is therefore necessary to limit action to recommended intakes.[26]

Pharmacological intake: pharmacological pyridoxine doses could be effective against nausea and vomiting during pregnancy (50 mg/day), the withdrawal symptoms in the chronic alcoholic (100 mg/day), and the treatment of illnesses resulting from radiation (25–200 mg/day). Supplements are administered simultaneously to the treatment of tuberculosis by isoniazid, and Wilson's Disease by penicillamine (10 mg/day, orally).

Toxicity: pyridoxine is considered to be hardly toxic for man, in which no side effects are noted with pharmacological doses. The "low" toxicity aspect comes from the fact that disorders have been noted following massive intake. Once again, the consumer is responsible for his excesses.

Biotin or Vitamin B_8 or H or H_1

Source: biotin is synthesized by various micro-organisms, seaweed and plants that serve as food for species that cannot produce it. The richest food sources are beer yeast, liver, soy, and egg yolk. It should be noted that the human intestinal flora produces biotin, but it remains unclear to what extent this production is adequate to cover human needs and avert dependency on food sources.

Absorption: the absorption of biotin probably requires a specific transfer system.

Metabolism, storage and excretion: the biotin metabolism among humans is not well known, but its levels in plasma and in red blood cells tends to remain constant.

[25] See Chapter VIII.
[26] See Chapter IV.

Function: biotin is crucial in the intermediary energy metabolism, involved both in the fuel synthesis (glucides/lipids) and its utilization to produce ATP.

Deficiency: human biotin deficiency is rare. Where it arises, it is usually related to an innate metabolic problem, massive raw egg white consumption, or the scientific experimentation of deficiency. Deficiency in these cases manifests itself mainly through seborrhoeic dermatitis. It is nevertheless possible that it may be involved in sudden infant death syndrome (SIDS, or cot death) in relation to artificially-fed infants. In any case, biotin deficiency is never a public health concern.

Requirements: the exact human biotin requirement is unknown. The recommended intake [27] must therefore be deduced from the different known intakes preventing signs of deficiency or pathology in specific conditions.

Pharmacological intake: doses ranging from 10 to 100 μg/day have been administered to treat specific biotin deficiencies.

Toxicity: only experimental laboratory conditions achieve toxic biotin levels for animals; the pharmacological doses usual in parenteral (i.e. intravenous) human nutrition are well tolerated.

Folic acid (pteroylglutamic acid) or Vitamin B_9

Source: folic acid is found in most natural foods; concentrated meat extracts and concentrated baking yeast are excellent sources, while offal, spinach, broccoli, asparagus, beetroot, cabbage, peanuts and avocado provide good sources. Wholemeal bread, eggs, rice, bananas and oranges provide moderate concentrations, and meat in general, grapes, apples, potatoes, and milk yield low concentrations. Losses due to cooking can be enormous, and the indications above therefore apply to the raw produce only.

Absorption: in most cases, the vitamin's natural form is tetrahydrofolic acid, which can be associated with up to six glutamate molecules. Absorption occurs mainly in the duodenum and the jejunum, following hydrolysis into monoglutamate. Absorption is active, stimulated by glucose, and saturable. However, high concentrations tend to result in passive absorption, thereby suggesting the existence of another transport system.

Metabolism, storage and excretion: the vitamin is found throughout the organism, with an overall amount of 5–10 mg, half of which is located in the liver. The folic acid metabolism is controlled by enzymes that regulate the balance between the monoglutamate (the usual form of transport) and polyglutamate forms (the active form of intra-cell storage); these proteins appear to manage a form of vitamin saving. In fact, the daily turnover rate of folic acid in the organism is less than 1%. High intakes of folic acid result in most of it remaining intact in the urine, together with 5-methyl-folic acid and 10-formyl-folic acid. However, experiments with radioactively marked vitamins show that, following major elimination of the intact form through the urine, the rest is recovered much more slowly in broken-down form. This suggests that excess folic acid is excreted rapidly, while the functional portion is finally broken down. Besides, some 100 μg of active folic acid are excreted daily in the gall, most of which is absorbed again in the bowel, and the remainder is excreted in the faeces.

Function: folic acid is the acquiring and donor coenzyme of one carbon unit in the metabolism of amino acids and nucleotides, within a group of interdependent reactions where the vitamin's metabolism is cyclical, dependent on vitamin B_{12}.

[27] See Chapter IV.

Deficiency: megaloblastic anaemia[28] is the best known manifestation of folate deficiency, and is common among the poor in tropical climates, particularly pregnant women, whose folic acid requirements are much higher. Deficiency can result from cooking habits that are deleterious to the vitamin, or from a reduced absorption due to gastro-intestinal disease or to alcohol consumption. However, it can also be associated with vitamin C, niacin and vitamin B_{12} deficiencies. As always, real deficiency comes before – in this case, several months before – the clinical signs of anaemia, without obvious actual scope. It is nevertheless known that irritability, memory loss, hostility, and paranoid behaviour are also signs of folic acid deficiency.

Requirements: the folic acid provided by food is only available at approximately 50%: it is therefore necessary to specify whether the needs are expressed in folic acid from food, or synthetic folic acid. This Manual discusses folic acid from food. Adults require approximately 100 µg per day to maintain a normal level of folic acid; pregnant women require approximately 675 µg/day, and breastfeeding women between 200 and 300 µg. Infants require approximately 10 µg/kg/day.[29]

Toxicity: folic acid is non-toxic for humans.

Cobalamin or Vitamin B_{12}

Source: vitamin B_{12} is found in food as different forms of cobalamin. The long-held view that cobalamin is absent from vegetables is questioned today: some legumes may contain small amounts, although it is believed that these plants host micro-organisms that can synthesize them. The greatest concentrations of vitamin are found in offal (kidneys, liver and brain), less in egg yolk, oysters, crab and salmon. Other animal tissues and fish contain slighter concentrations. It should also be noted that the animal intestinal flora produces the vitamin, as this is the only means by which herbivores can obtain it. Human intestinal cobalamin production is insufficient, and diet must therefore supplement it.

Absorption: cobalamin is absorbed in the ileum, at first actively through the connection of cobalamin to the intrinsic factor, which is a glycoprotein molecule synthesized by the parietal cells of the gastric mucous membrane. This process is indispensable to the absorption of the vitamin at the levels usually found in food. There also exists a dissemination process that does not involve the intrinsic factor, whereby the vitamin is administered orally, as a medicine, in doses that are higher than those found in food.

Metabolism, storage and excretion: the organism does not break down cobalamin, which is found intact in the faeces and urine. Excess intake is stored in the liver, which contains more than 50% of the 2 to 5 mg of vitamin usually found in the organism. This amounts to quite a high storage in comparison to other vitamins, because its excretion is low: slightly more than 1 µg/day through urine, whereas approximately 70% of the vitamin reaching the digestive tube through gall is absorbed again. The resulting daily excretion is estimated at between 2 and 5 µg: this is equivalent to an autonomy of almost three years, not to mention the synthesis through the intestinal flora.

Function: vitamin B_{12} is essential in the regeneration of 5-methyl-folic acid into folic acid, combined with the formation of methionine amino acid. Without this regeneration, the metabolic journey of 5-methyl-folic acid inevitably ends in excretion through urine. This causes a deficiency in another intermediary of the metabolic cycle of folic acid; this intermediary contributes to the synthesis reaction of a nucleic acid itself indispensable for the synthesis of desoxyribonucleic acid (DNA). This metabolic trap of folic acid, in the case of vitamin B_{12} deficiency, explains why anaemia related to this deficiency is impossible to distinguish from anaemia related to folate deficiency. Vitamin B_{12}

[28] See Chapter VIII.
[29] Recommended intakes are discussed in Chapter IV.

furthermore contributes to the transport and storage of folic acid in the cells. It plays a significant, albeit still unclear, role in myelin[30] synthesis; it also contributes to the metabolism of glucides, lipids and proteins as a reducing agent.

Deficiency: cobalamin deficiency is caused either by insufficient absorption due most frequently to the incapacity to produce the intrinsic factor (but also, sometimes, to other ailments of the digestive tube), or by insufficient vitamin intake.

Incapacity to produce the intrinsic factor causes pernicious anaemia, which is deadly if it is not treated; it also presents impairments typical of nutritional anaemia,[31] in addition to neuropathy (most frequently, first in the peripheral nerves, followed by the spinal cord and the brain). The clinical signs of nervous impairment include tingling and a feeling of cold and numbness in the extremities, followed by muscular weakness and lack of movement coordination as the spinal cord is affected. Mental symptoms can also appear: intellectual slowness, memory lapses, confusion, depression and paranoid psychoses. The diagnosis of nutritional anaemia should include the verification that it is a cobalamin and/or folate deficiency: on the one hand, the two vitamins are not interchangeable in the treatment of nutritional anaemia and, on the other, the administration of folic acid can improve pernicious anaemia momentarily, while the neurological damage increases, sometimes irreversibly. The treatment of pernicious anaemia leads to total remission, provided there is no irreversible neurological damage yet; it consists of a monthly subcutaneous or intramuscular injection of 100 μg of vitamin B_{12}, for life.

Insufficient vitamin B_{12} intake is rare and only concerns those too poor to secure animal products, or those confined to a strict vegetarian diet by their religion or their personal principles. Deficiency develops slowly, since the intestinal flora produces the vitamin, but in amounts that are insufficient to satisfy the need. When the dietary insufficiency results from poverty, anaemia and neuropathy develop equally, because the diet is poor in cobalamin and folic acid alike. When the insufficiency is caused by cultural restrictions, anaemia is slight, even absent, while neuropathy can be severe, because a deliberately vegetarian diet is usually rich in folic acid, and this compensates the metabolic trap effect affecting 5-methyl-folic acid. This phenomenon also appears in pernicious anaemia in richer wealth groups that develop neuropathy primarily, and in poorer strata that develop both neuropathy and anaemia: the diet of the former tends to be richer in folic acid than the latter's. The treatment of deficiency caused by insufficient intake consists of the introduction of animal produces in the diet, or the administration of vitamin preparations that supply orally 1 μg of vitamin B_{12} per day. Another solution is the treatment of pernicious anaemia.

Requirements: a daily 1 μg dose has been observed to contain anaemia and neuropathy entirely among adult patients suffering from anaemia due to dietary vitamin B_{12} deficiency. The need is proportionately greater among growing children, particularly among infants.[32]

Toxicity: vitamin B_{12} is non-toxic for humans.

[30] Myelin is a lipo-protein molecule constituting the sheath around some nerve fibres.
[31] See Chapter VIII.
[32] Recommended intakes are discussed in Chapter IV.

Fat-soluble vitamins

Retinol, axerophtol or Vitamin A

Source: vitamin A is found in food, mainly bound to fatty acids, the most common of which is palmitic acid. In order of decreasing concentration, it is found in sea fish and sea mammal liver oils (in large quantity), in the liver of animals for slaughter and poultry, butter, cheese, wheat germ, eggs and oily fish, finally in offal other than liver, milk, lean fish, red and white meat. Retinol (vitamin A alcohol) has some precursors or provitamins, mainly β-carotene, which is the main representative of the large carotenoid family. β-carotene is a retinol dimer that releases two retinol molecules per central splitting of the β-carotene molecule. It appears that β-carotene can also break down into retinaldehyde through eccentric splitting, without in this case producing two retinol molecules, but one only. Retinaldehyde is easily reduced into retinol in the presence of NADH.

β-carotene is found in vegetables and coloured fruits, among others: spinach, parsley, the leaves of cassava, amaranth and lettuce, carrots, turnips, cabbage, tomatoes, mandarins/tangerines, melons, oranges, dates, papayas, mangoes; in butter, palm oil (the richest source), wheat sprouts and flour, yellow maize, lentils and yellow sweet potatoes. According to the ingested amounts, the biological activity of the different provitamins is inferior to that observed for retinol, because food carotenoids are less well digested and absorbed than vitamin A; furthermore, carotenoids are not entirely transformed into retinol. They are then expressed as retinol equivalents (RE): 1 RE = 1 μg of retinol, or 6 μg of β-carotene, or 12 μg of other carotenoids acting as provitamins. The 1 to 6 and 6 to 12 relationships are estimated, and are used for want of a better reference. Formerly (but old habits die hard), vitamin A was also expressed in international units (IU): 1 IU amounts to the activity of 0.3 μg of retinol, or to 0.55 μg of retinol palmitate. Attention should nevertheless be paid to the fact that there are also IU of provitamin A, where 1 IU = 0.6 μg of β-carotene. To clarify, retinol IU are labelled IU_a and β-carotene IU are labelled IU_c. The retinol to β-carotene ratio is 1 μg to 6 μg in terms of RE, and 1 μg to 2 μg in terms of IU. This is due to the fact that experiments that led to the definition of β-carotene IU were conducted in optimal conditions, neglecting many a factor that determines what ultimately remains in the form of usable retinol in the organism from a given quantity of ingested β-carotene.

In short,

$$\begin{aligned}\textbf{1 RE} &= \textbf{1 μg or 3.33 IU of retinol or 3.33 IU}_a \\ &= \textbf{6 μg or 10 IU of β-carotene or 10 IU}_c \\ &= \textbf{12 μg of other carotenoids}\end{aligned}$$

In view of the above, units should be clearly defined when consulting recommended intakes and food composition tables.

Absorption: in the stomach, vitamin A and its provitamins combine with the other lipids to produce globules that pass into the small intestine. There, globules combine with bile salts to produce emulsions that permit the splitting of complex lipids into simple lipids owing to the action of digestive enzymes; these emulsions then form micelles of mixed lipids that enter into contact with the brush-shaped border of the epithelial cells of the intestinal mucous membrane. Vitamin A is transported through the intestinal wall through a specific system when it is in low concentrations, and by passive dissemination when its concentration is high, whereas provitamins disseminate passively. The absorption of vitamin A and its precursors is facilitated by the presence of proteins and lipids in the diet. The state of the intestinal mucous membrane is of critical importance. Bile salts are indispensable to the absorption of carotenoids, whereas vitamin A does not depend upon it (provided that it is properly soluble). Approximately 80% of the retinol contained in the diet is absorbed (this efficiency only diminishes with very high doses of retinol), whereas only 50% of the provitamins is absorbed, and this efficiency drops quickly with high doses.

III

Metabolism, storage and excretion: after its absorption, retinol is transported by chylomicrons [33] to the liver in the form of retinol palmitate. Carotenoids are mostly broken down into two retinaldehyde molecules by central splitting, in the intestinal mucous membrane, and then transported to the liver via chylomicrons. However, a significant amount of carotenoids can be incorporated as it is into chylomicrons, and then be transported and stored in other tissues than the liver (mainly adipose tissue). Retinol is either stored in the liver as retinol palmitate, or transported to other tissues by means of the retinol binding protein (RBP). Within the tissues, retinol is also bound to cellular retinol binding proteins (CRBP). Generally speaking, ingested vitamin A takes the following course: some 20% are directly excreted in the faeces in the following two days, 20% to 50% of the absorbed 80% are excreted in the faeces and urine during the week following ingestion, and the remainder is stored. Vitamin A reserves are considerable in adults: with a normal initial stock, they can live for one to three years without additional intake. Infants and children, on the other hand, only have minimal retinol reserves. Stored vitamin A is only metabolized very slowly, in two ways: by RBP-retinol degradation in the kidneys and peripheral epithelial tissues (the skin and the mucous membranes lining the internal body surfaces), or by retinol transformation in the liver and peripheral tissue, in combined or oxidized forms that are later excreted in the faeces or urine.

Function: vitamin A contributes to vision, cell differentiation, morphogenesis, in addition to complex physiological processes such as growth, reproduction, and the immune response.

Generally speaking, most tissues probably rely more or less on vitamin A, which explains the increasing recognition of its major significance.

⇨ **Vision**: vitamin A is one of the indispensable molecules for the transmission of information registered by the eye to the optical nerve.
⇨ **Cell differentiation**: vitamin A deficiency is observed to cause cells that produce mucus to be replaced by cells that produce keratin. The introduction of vitamin A into culture cells rapidly causes various types of cell lines to differentiate. The effect of vitamin A, or rather its deficiency, is particularly obvious on the cells of the cornea, which keratinises and finally ulcerates.
⇨ **Morphogenesis**: both the excess and the deficiency of vitamin A impair embryogenesis, but the mechanism is unknown.
⇨ **Growth**: vitamin A is a growth factor, through its derivative, retinoic acid. Here again, the mechanism is unknown. One of the first signs of deficiency is appetite loss, but it is not the real cause of growth problems related to vitamin A deficiency.
⇨ **Reproduction**: sperm formation (spermatogenesis) and foetal growth are affected by retinol deficiency, probably owing to the role of vitamin A in cell differentiation.
⇨ **Immune response**: vitamin A is also referred to as “anti-infection vitamin”. Specific and non-specific defence mechanisms both depend on it. Its deficiency, combined with protein-energy malnutrition has major consequences on the organism’s resistance to infection.

Deficiency: [34] among others, vitamin A deficiency leads to blindness and high mortality risks from infections such as measles. It should be noted, however, that any imbalance generally has a negative effect on the functions of vitamin A. Protein deficiency reduces the β-carotene cleavage and RBP synthesis; on the other hand, protein-energy deficiency restricts growth, and thus postpones the appearance of vision disorders caused by vitamin A deficiency. To be absorbed, vitamin A and retinoids must be ingested together with lipids. Iron levels depend on vitamin A, whereas the utilization of retinol is related to zinc levels. The vitamin A metabolism depends to a certain extent on vitamin E. Moreover, vitamin A interacts with vitamins C, K, and D, calcium, copper, and iodine.

[33] Chylomicrons: microscopic lipid particles common in the blood during fat digestion and assimilation, consisting of 98% lipids and 2% proteins.
[34] This deficiency is discussed in detail in Chapter VIII.

Requirements: experimentation has defined minimum male adult vitamin A requirements to be approximately 400 μg/day.[35]

Pharmacological intake: retinoic acid and, to a lesser extent, carotenoids, are used at high dose in the treatment and prevention of a number of illnesses such as acne, skin cancer (but not melanoma), acute myeloid leukaemia (AML), and breast cancer. β-carotene intake is directly associated with low lung cancer incidence.

Toxicity: taken in high doses, vitamin A is toxic to the point of being lethal. Three different types of toxicity should be distinguished, as follows.

⇨ **Acute toxicity** follows the ingestion of a single or several high doses. The threshold dose for risk of acute toxicity begins at 200 mg of retinol for adults, 100 mg for children above 5, 60 mg for small children, and 30 to 40 mg for infants. Its signs appear in the hours following absorption: nausea, vomiting, headache, dizziness, double vision, lack of coordination and muscular weakness. Fontanel swelling is possible in infants. Very high doses frequently cause vomiting, itching around the eyes, and flaky skin, particularly around the mouth. These signs usually subside within a few days, once the ingestion of massive doses has been discontinued. By extrapolation, studies with apes (which seem to provide excellent models for vitamin A toxicity in humans) show that lethal doses would be in the vicinity of 500 mg for infants, and 11.8 g for adults (Shils, 1994).

⇨ **Chronic toxicity** is quite common, because of the sometimes exaggerated popularity of vitamins, which are often imposed upon children with the best intentions. Daily intakes that can cause chronic toxicity are of the order of 10 times the recommended intake, that is, 3.75 mg for the infant, and 10 mg for adults. The most common signs of chronic intoxication include the following: skin dryness and colouring, headaches, anorexia and weight loss, alopecia (hair loss), articular stiffness and pain, and fatigue. It takes weeks, even months, for these signs to subside once normal vitamin intake has been resumed.

⇨ **Teratogenesis**:[36] vitamin A is highly teratogenic. In early pregnancy, a single dose superior to 200 mg or daily doses exceeding 30 to 90 mg for 1 week, or long-term daily intakes in the order of 7.5 mg of retinol can cause miscarriage or severe malformations of the foetus (Shils, 1994). Vitamin A supplements are therefore not recommended during pregnancy (particularly during the first quarter) for healthy women whose regular diet includes fruits and greens.

Either way, intake should not exceed 3 mg of retinol per day. Carotenoids, on the other hand, are not toxic even in very high doses because their absorption is lower than retinol's, and is quickly saturated.

Cholecalciferol or Vitamin D_3

Source: vitamin D_3 is not really a vitamin, because it is synthesized by man through solar ultraviolet radiation on his skin. Ultraviolet irradiation transforms provitamin D_3 (7-dehydrocholesterol) into an intermediary, which spontaneously converts into vitamin D_3 within one or two days simply because of the organism's heat. In adults, synthesis occurs mainly in the outer layer of the skin (epidermis), whereas in infants it also occurs in the deep inner layer of the skin (dermis), because their epidermis transfers more ultraviolet radiation to the dermis. Prolonged exposure to the sun does not cause hypervitaminosis, because both the provitamin and the vitamin are rapidly broken down into inactive biological compounds. The main source of vitamin D_3 comes from endogenous synthesis. However, the vitamin is found in high concentrations in cod liver oil, and is also found

[35] Data for other population categories is not available; readers are thus referred to recommended intakes as discussed in Chapter IV.

[36] Teratogenesis: a prenatal toxicity characterized by structural or functional defects in the developing embryo or foetus.

in sea fish, egg yolk and dairy products. Following the rickets epidemics (vitamin D_3 deficiency, see below) that affected the industrial cities of the northern United States and Europe mainly, vitamin D_3 or D_2[37] enrichment is common in milk, margarine and cereals (fortified foods vary according to country). Vitamins D_3 and D_2 are analogous, and will hereafter simply be referred to as vitamin D. Vitamin D has two types of unit: micrograms (µg) and international units (IU), 1 IU amounting to 0.025 µg, and 1 µg amounting to 40 IU.

Absorption: approximately 80% of the vitamin D supplied by the diet is absorbed, but absorption is highly sensitive to the state of the intestinal mucous membrane, and to its capacity to absorb fats. It is transported by chylomicrons to the liver. The endogenous vitamin travels to the dermal capillary network through a specific transport protein, and is then transported to the liver.

Metabolism, storage and excretion: the liver modifies vitamin D into hydroxycholecalciferol, which is converted in turn by the kidney into dihydroxycholecalciferol, the physiologically active form of the vitamin. Vitamin D, or cholecalciferol, is stored in adipose tissue, and hydroxycholecalciferol is stored in the muscle. Blood holds the highest concentration of vitamin D and, unlike vitamin A, the liver does not store it. Little is known about the turnover and excretion process of vitamin D.

Function: vitamin D appears to function like a steroid hormone. Its most striking role is to maintain the calcium concentration within and around the cell by modulating the calcium and phosphorus metabolism in the intestine and the bones. Vitamin D does not contribute directly to ossification, but promotes it by maintaining oversaturated calcium and phosphorus concentrations around the cell (i.e. extra-cellular). Apart from its action on minerals, vitamin D also contributes to cell multiplication and differentiation. It is effective in the treatment of psoriasis, a chronic, recurrent skin disorder.

Deficiency: vitamin D deficiency arises from poverty, poor housing, pollution, inadequate clothing, and an over-protection against solar radiation (for fear of skin cancer). It manifests itself in children through rickets, and in adults through the softening of bony tissue (osteomalacia). In the late 19th century, up to 75% of poor children in industrial cities were rachitic (Davidson, 1979). Narrow streets, high corbelled buildings, and domestic and industrial fumes all combined to reduce ultraviolet solar radiation significantly. Moreover, the poor lacked the means to purchase foods rich in vitamin D foods such as dairy products and eggs and, in the cities, had little access to fresh air.

These causes for rickets have subsided, but have by no means disappeared today; sub-clinical forms of rickets still (or again) constitute a public health problem in Western countries. Rickets is also related to protection and dressing customs for children, and the confinement of women and small children to backyards. In parts of Ethiopia, for instance, it is customary for infants be covered from head to foot when leaving the house, up to the age of approximately 6 months, so as to be protected from negative external influence that could make them sick. Rickets is therefore common among very small children, but recedes rapidly as soon as the child is left to move outside uncovered.

Vitamin D deficiency results in insufficient intestinal absorption, and insufficient re-absorption of calcium and phosphorus in the kidney. The serum protein levels of both minerals drops, resulting in the case of calcium in hyperparathyroidism (the excessive secretion of parathyroid hormone by one or several parathyroid glands). The parathyroid hormone and the remaining vitamin D then cause the demineralization and weakening of the bones. This leads to the malformations typical of rickets: bowlegs, knock-knees, a deviation of the spine, a beady appearance of the ribs (rachitic

[37] Vitamin D_2 or ergocalciferol is a synthesis product analogous to cholecalciferol.

rosary), and narrowed chest and pelvis. These malformations are purely mechanical, because the bones lack the resilience to sustain normal strain. Furthermore, rachitic children are agitated, worried and irritable, are pale, perspire abnormally from the head, their muscles are soft and lack tonus, leading to a distension of the abdomen, and frequently have diarrhoea.

Hypocalcaemic tetany (spasms of the extremities caused by calcium deficiency in the blood) can also occur. Rickets itself is not deadly, but increases the risk of mortality owing to an increased liability to respiratory infection. Its prognosis is nevertheless fairly good, because bone deformations tend to correct themselves spontaneously during growth.

Osteomalacia is the manifestation of vitamin D deficiency in the adult. It affects mainly women of childbearing age whose calcium levels have been weakened by repeated pregnancies. Problems are aggravated if they have suffered from rickets in their childhood, if social customs require them to remain indoors, or if they come from poor backgrounds whose access to food is inadequate. The elderly are also vulnerable to this deficiency because of their often neglected diet, their physical and psychological limitations in going out, and their reduced intestinal absorption of calcium; osteomalacia is in this case frequently combined with osteoporosis. Osteomalacia causes muscular weakness, bone pains and pelvic deformations that result in serious obstetric complications in women of childbearing age. Deformations resulting from osteomalacia are practically irreversible, or only through orthopaedic surgery.

The treatment of rickets and osteomalacia consists of daily doses of 25 to 125 μg of vitamin D for 1 month, in addition to 1 to 2 g of calcium lactate per day, in order to re-mineralize the bones and avert hypocalcaemic tetany. Measures must then be taken to promote exposure to the sun and improve the diet; this is usually extremely difficult, as it implies addressing strong cultural values and poverty. In Western countries, the decline in school and domestic education, and the alarming increase of poverty may well cause a fresh upsurge of rickets.

Requirements: the minimum daily requirement to prevent rickets and osteomalacia is 100 IU (2.5 μg). This does not mean much, as the proportion of endogenous synthesis is unknown. Exposure to the sun and diet vary considerably, and a daily intake in the food is therefore recommended today. It should be 400 IU (10 μg) for children, and 100 IU (2.5 μg) for adults.

Toxicity: vitamin D quickly becomes toxic, that is, as of doses 5 times the recommended intake. The result is hypercalcaemia in children and nephrocalcinosis in adults. In children signs of intoxication include appetite loss, often combined with nausea and vomiting. The child loses weight, is irritable and becomes depressed. Intoxication can be fatal.

Tocopherols or Vitamin E

Introduction: vitamin E is the generic reference to 8 related molecules (isomers) whose biological activities differ; the four most common are α-tocopherol, β-tocopherol, γ-tocopherol and δ-tocopherol. Little is still known about vitamin E. Various signs of deficiency have been documented for animals, but human deficiency appeared to be non-existent – vitamin E has only recently proven to be a real vitamin, and thus essential, for man.

Source: α-tocopherol and γ-tocopherol are the forms most commonly found in nature, mainly in wheat germ, sunflower, safflower, rapeseed, groundnut, corn and olive oils. Other animal and vegetable foods on average only contain approximately 5% of the vegetable oil content. Some oils, such as soy oil, contain considerably more γ-tocopherol than α-tocopherol. α-tocopherol is the isomer that contributes most to vitamin activity. β-tocopherol, γ-tocopherol and δ-tocopherol respectively contain only 40 to 50%, 10 to 30% and approximately 1% of the activity of α-tocopherol. This once again leads to the use of international units, with the following values:

α-tocopherol:	**1.49 IU/mg**	**1 IU = 0.67 mg**
β-tocopherol:	**0.60 IU/mg**	**1 IU = 1.67 mg**
γ-tocopherol :	**0.15 – 0.45 IU/mg1**	**IU = 6.67 – 2.22 mg**
δ-tocopherol:	**0.015 IU/mg**	**1 IU = 66.7 mg**

It is difficult not only to establish food composition tables but also to utilize them for any given diet because of the variable activity of the different isomers, their instability to heat, oxygen and some food preparations, and the seasonal variations of their concentration in food. The real or effective vitamin E diet content generally has little to do with values contained in tables.

Absorption: the absorption of vitamin E occurs mainly in the middle area of the small intestine. Normal dietary intake leads to the absorption of approximately 50% of vitamin E; this proportion is inversely proportional to the ingested amount. The presence of lipids in the diet promotes absorption, which also depends on bile salts and pancreatic enzymes. At this stage, no further reliable knowledge exists as to vitamin E absorption.

Metabolism, storage and excretion: what is known about the vitamin E metabolism largely comes from animal research, in particular rats. The vitamin concentration in tissue rises with intake; on the other hand, different tissues and organs accommodate very different vitamin E concentrations, without it being clear why. The vitamin accumulates especially in membrane-rich cell fractions. The organs that contain most vitamin E are adipose tissue, the liver and muscle, and these are considered to be storage organs. Little is known about the vitamin E metabolism: it appears to be very slow, and the excess vitamin is excreted as such in the faeces.

Function: current knowledge suggests that vitamin E functions as an antioxidant in cell membranes. In particular, it is thought to protect polyunsaturated fatty acids from free radicals, to which the former are highly vulnerable. Some signs of vitamin E deficiency in animals have disappeared completely following the administration of antioxidants.

Deficiency: the only certainty regarding human vitamin E deficiency is the increasing sensitivity of red blood cells to *in vitro* haemolysis, and their reduced *in vivo* lifespan when plasma vitamin E levels fall below 0.5 ml/dl. For want of a better threshold, plasma vitamin E levels lower than 0.5 ml/dl are considered to indicate deficiency. Preterm (or premature) infants and most patients suffering from intestinal malabsorption (for whatever reason) fall in this category. Vitamin E deficiency was formerly suspected of causing specific pathologies among preterm infants, such as retinopathy of prematurity (ROP) and haemolytic anaemia. However, recent research appears to contradict these hypotheses. In patients suffering from malabsorption, the relation between low plasma vitamin E levels and specific disorders, such as Duchenne's myopathy, could not be demonstrated either. On the other hand, the lifespan of erythrocytes is reduced in these patients, and this can be corrected by the daily administration of 100 to 200 IU of vitamin E. This confirms the physiological role of vitamin E, and its inclusion among essential nutrients. Recommended daily therapeutic doses in case of malabsorption are 25 to 50 IU for infants, 50 to 100 IU for children from 1 to 10 years, 100 IU for children and teenagers from 10 to 18 years, and 200 IU for teenagers and adults above 18.

Requirements: the daily minimum adult requirement to maintain plasma tocopherol levels above 0.5 ml/dl has been shown to be 2 mg of α-tocopherol ($\approx$ 3 IU).[38]

Pharmacological intake: there is currently no concrete evidence that pharmacological doses of vitamin E provide any benefit whatsoever.

[38] Recommended intakes are discussed in Chapter IV.

Toxicity: no toxicity has been observed in cases of excessive daily vitamin E intake, such as 100 to 800 mg; this may simply be due to the fact that at such levels, most of the vitamin is probably not absorbed. Vitamin E is however assumed to be toxic and, because tocopherol accumulates in tissues according to intake, caution is called for especially in case of intravenous vitamin administration.

Phylloquinone or Vitamin K

Source: vitamin K (the generic name of a range of compounds whose vitamin activity is the same as phylloquinone or vitamin K_1) is common in the vegetable, animal and bacterial kingdoms. However, only plants and bacteria can synthesize the essential part of the molecule. This is found in high concentration in green vegetables (spinach, cabbage, cauliflower, broccoli, and lettuce), dairy and meat products, fruits and cereals. Major differences exist between foods belonging to the same category. Either way, vitamin K requirements are low, and most foods provide enough of it to prevent deficiency; it appears that vitamin K is also produced in the intestine, which thereby also seems to contribute to a regular supply.

Absorption: vitamin K absorption requires bile salts and pancreatic juices. The vitamin is incorporated into the chylomicrons; it is absorbed in the small intestine and reappears in the lymph. Absorption efficiency varies between 40 and 80%.

Metabolism, storage and excretion: the turnover of vitamin K is extremely fast (of the order of one day), with an overall estimated amount of approximately 100 μg; it is therefore the vitamin whose stocks in the organism are smallest, and whose metabolism is fastest. It is however worth noting that the vitamin's metabolic cycle allows it to be stored in the liver, and without this cycle its metabolism would be faster still. Research into the radioactive vitamin has shown that, after its utilization as an enzyme cofactor, vitamin K is rapidly degraded into a range of products that are to date incorrectly identified, and that these products are found in the faeces and urine.

Function: as a coenzyme, vitamin K contributes to the formation of seven proteins involved in the chain reaction that leads to blood clotting (or coagulation).

Deficiency: vitamin K deficiency manifests itself in bleeding and haemorrhaging. It is virtually non-existent among adults, owing to the presence of sufficient amounts in almost all food types, but also because of the vitamin's preservation cycle and its synthesis by the intestinal flora. On the other hand, newborn (particularly preterm) babies are liable to develop haemorrhagic disease because their blood clotting capacity is initially very weak, their diet is low in vitamin K and their intestinal tract is sterile. The coagulation capacity usually improves spontaneously within a few days. It is nevertheless recommended to administer an intra-muscular 1 mg dose of phylloquinone to newborns. The elderly can develop vitamin K deficiency, particularly when their diet is poor, because the need for vitamin K increases with age, without it being known exactly why (possible explanations include less efficient absorption, diminished hepatic function, faster turnover, and/or effectively increased requirements). Primary vitamin K deficiency is rare, but secondary deficiency can arise for several reasons: ineffective lipid absorption (obstruction of the bile ducts and malabsorption), intake of antibiotics deleterious to the intestinal flora, excessive anticoagulant doses, or the excessive intake of vitamins A and E. Secondary deficiency appears readily, because the overall amount of vitamin K is so small and its turnover so fast that any problem has immediate repercussions – this is never so fast in the case of other vitamins.

Requirements: because normal diets contain enough vitamin K and the intestine also produces it, it is difficult to assess minimum vitamin K requirements. Research has nevertheless shown daily requirements to be of the order of 0.5 to 1.0 μg of vitamin K per kilogram of body weight.[39]

[39] Recommended intakes are discussed in Chapter IV.

Toxicity: phylloquinone or vitamin K_1 is not toxic, even at high doses; on the other hand, menadione (or vitamin K_3) is, and should therefore not be used in the treatment of secondary deficiency.

2.2.6 Minerals

Minerals are elementary chemical compounds whose atomic characteristics make them indispensable to the organism. Minerals include trace elements and are essential because they cannot be produced by the organism and therefore must be found, through food and drinking water in the mineral environment; this depends on the nature of the soil and the surface water. Minerals include major elements such as calcium and phosphorus, and trace elements of which the organism contains less than a few grams (sometimes as little as a few milligrams).

Although some minerals are present in the organism in only minute amounts, this does not mean that their deficiency is harmless. Mineral biochemistry is a developing science, and it is far from mastered. As a result, detailed information is not available for all essential minerals. The main minerals are the electrolytes (sodium, potassium, and chlorine), the minerals found mainly in the skeleton (calcium, phosphorus, and magnesium), and iron, zinc, iodine, copper, selenium, manganese, molybdenum, and chromium. Cobalt could also be mentioned, but it seems that it only acts as a constituent of vitamin B_{12} (see above). Trace metals exist, such as tin, bromine, lead and probably others that may well be essential to man, but research has yet to confirm this. Specific deficiencies have not been identified either. In terms of nutritional needs, electrolytes do not pose a major problem, other than in cases of dehydration.[40] Phosphorus is so abundant in the vegetable kingdom that dietary deficiency is virtually impossible. It is also likely that calcium deficiency due to dietary inadequacy is rare, and problems of osteomalacia and rickets are due to vitamin D deficiency, and osteoporosis to demineralization, whose possible connection to an inadequate dietary calcium intake remains unknown. Sulphur is supplied by proteins: its deficiency is therefore likely to be concealed by protein deficiency, or its effects to be confused with the latter's. Copper, manganese, magnesium, chromium, molybdenum and selenium deficiencies do not pose public health problems, because the diet should in principle provide adequate supplies. However, in the case of severe malnutrition causing the complete loss of tissue components, or of seriously restricted access to food (as is the case in some imprisonment situations), deficiency in these minerals and others should be taken very seriously. They must then be administered in therapeutic doses when treating severe malnutrition, and at levels equivalent to reference intakes in the case of imprisonment or any other situation where the diet is known to be deficient. Ultimately, the minerals whose clinical deficiency is most frequently confirmed are iron and iodine. It is however possible that sub-clinical zinc deficiency is more common, and plays a greater role than thought until recently in retarded growth and loss of appetite, which would corroborate zinc belonging to Type II nutrients.[41]

The recommended or reference intakes known for minerals are discussed in Chapter IV.

Electrolytes

The three main electrolytes are sodium, potassium and chlorine. They account for the osmotic pressure of fluids in the organism,[42] and their repartition in the body determines their volume within (intra-cellular) and outside (extra-cellular) cells.

[40] Recommended intakes are discussed in Chapter IV.
[41] See Chapter VIII.
[42] Sometimes referred to as osmolality.

⇨ **Sodium** is specifically an extra-cellular cation (or positively-charged ion), whose role is to maintain the volume of extra-cellular fluids, the osmotic pressure of these fluids, and the acid-base balance. It also contributes to the transmission of impulses in and between nerves and muscle, and to the transport phenomena of metabolites within cells.
⇨ Unlike sodium, **potassium** is a specifically intra-cellular cation, together with magnesium, organic phosphates and protein anions, where its role is complementary to that played by sodium, for functions that are essentially the same as those of sodium.
⇨ **Chlorine** is the electrochemical counterpart of sodium and potassium.

The chemistry of electrolytes is quite complex, as is that of hydrous and acid-base balances. These aspects do not relate to humanitarian action because when disorders arise, they require medical expertise and laboratory facilities. In crisis settings, on the other hand, victims (malnourished or not) often require rehydration salts whose composition differs according to whether there is severe malnutrition or not.

Dehydration can have two causes.

1. Water shortage that manifests itself in increased plasma chlorine and sodium levels; this occurs in case of insufficient ingestion of water, either because its availability is insufficient, or because one does not receive enough. This is typical when one depends on third parties to obtain drinking water, as is the case for small children but also, frequently, prisoners. The treatment simply consists of drinking water or, as a last resort only, the intravenous administration of a 2.5–5% dextrose solution (pure water would cause haemolysis).
2. The combined deficiency of chlorine, sodium and water, the most frequent form of dehydration by far and whose most common – and thus best-known – causes are diarrhoea, vomiting and excessive perspiration. The preferred treatment of diarrhoea is the oral administration of rehydration salts dissolved in water; these salts are found in sachets and are based on two standard formulae:

either	or
3.5 g of sodium chloride	3.5 g of sodium chloride
2.5 g of sodium bicarbonate	2.9 g of trisodium citrate dihydrate
1.5 g of potassium chloride	1.5 g of potassium chloride
20 g of glucose	20 g of glucose

Both formulae are to be dissolved in 1 litre of drinking water. The dosage is 1 litre per 24 hours for infants, 1 litre per 8 to 24 hours (according to age) for children, and at will for adults. The primary purpose is rehydration, and then the compensation of losses as they occur.

Other specific deficiencies, such as chlorine or potassium deficiency, result mainly from medical problems (thus warranting medical expertise), and rarely arise in humanitarian action.

Electrolyte surges are essentially caused by the overly high intake of salt or by physiological disorders. It has long been thought that excessive sodium intake *via* salt affected high blood pressure significantly. This view was later seriously challenged, but nowadays it does appear that salt intake greater than 8 g/day does indeed result in an increase in blood pressure. It is therefore recommended not to exceed this intake, which must allow for the diet's salt content. Moreover, excessive salt intake displaces calcium from the bones and could thus contribute to osteoporosis.

Bone minerals

The three minerals predominant in the bones are calcium, bound in the bones to phosphorus (in a crystal form called hydroxyapatite), and magnesium.

Calcium

Source: calcium is found (in decreasing order of concentration) in hard cheese (750 mg/100 g), oilseeds and in particular almonds, walnuts and hazelnuts (175 mg/100 g), soft cheese and milk (130 mg/100 g), and finally dried fruit (100 mg/100 g) (Randoin, 1982).

Absorption: calcium is absorbed in two ways. One is active, and is regulated by vitamin D, mainly in the duodenum; the other is passive and occurs throughout the intestine, but mainly in the ileum. Calcium absorption also depends largely on the other nutrients contained in the diet, hormonal levels, and physiological conditions such as pregnancy and breastfeeding. The absorption rate of calcium is only 25 to 50% of the ingested amount, and the remainder is excreted in the faeces. However, in case of need, the organism can retain much more calcium – as a result, deficiency resulting from an inadequate diet is rare.

Metabolism, storage and excretion: bones are living tissue, undergoing changes permanently. The calcium contained in the organism therefore perpetually circulates between the bones (that contain 99% of the organism's overall calcium) and the bloodstream that contains the remaining 1%. The concentration of calcium in the bloodstream is strictly regulated because of the vital role played by calcium in many physiological processes. This regulation occurs through absorption, excretion and calcium circulation between the bloodstream and the bones, which store it. The parathyroid hormone, calcitonin (secretions of the parathyroid and thyroid gland respectively) and vitamin D all regulate the homeostasis of calcium. In the bones, the calcium metabolism is determined by age, hormonal secretion, and physical exercise. The skeleton demineralizes in postmenopausal women and men above 65; in women, the impact is far greater because of the hormonal changes associated with menopause. Physical exercise maintains the bony mass, which atrophies in case of immobility just like any unused organ. Calcium is excreted in practically equal parts in the urine and the faeces.

Function: calcium plays a fundamental structural role in bones and teeth, and is their chief mineral constituent. Calcium also performs a fundamental trigger function in a number of physiological processes such as enzyme activation, muscle contraction, vesicular secretion, the transmission of nerve impulses, the clotting of blood and cell division.

Deficiency: calcium deficiency caused by dietary inadequacy is rare, and is limited to specific circumstances (e.g. the overall deficient diet in some prison settings). In the case of osteoporosis (the thinning of bones observed in old age), the administration of calcium supplements does not appear to impede decalcification significantly. As an illustration, in developing countries where calcium intake is minimal but physical exercise considerable, osteoporosis is less common in postmenopausal women than in industrialized countries, where calcium intake is greater, but physical exercise is limited. The preferred treatment of osteoporosis is the administration of oestrogen. In most cases, intake is adequate in view of the adaptability of absorption in case of low intake. Breastfeeding women secrete constant amounts of calcium in maternal milk, whatever their intake. This indicates that an intake that is inadequate in terms of breastfeeding is compensated by the calcium stored in the bones, implying a demineralization of the bones. Nevertheless, this demineralization is reversible after the cessation of breastfeeding.

Requirements: calcium requirements are determined by excretion and absorption efficiency, but the latter itself is influenced by a number of factors such as diet. As a result, it is difficult to formulate recommendations. On the other hand, additional needs related to breastfeeding are known and should be incorporated into the diet to avert the risk of bone demineralization in the mother.[43]

Pharmacological intake: pharmacological intakes of calcium appear to be useless, and recommended intakes are therefore sufficient.

Toxicity: overly high calcium intake is not toxic, and does not increase the risk of kidney stone development. It does however impede iron absorption, and it is therefore preferable to adhere to recommended intakes.

Phosphorus

Source: phosphorus is abundant in animal products, oilseeds, legumes and cereals. It is therefore improbable for its deficiency to be caused by an inadequate diet.

Absorption: man absorbs between 60 and 70% of ingested phosphorus, and the absorption of animal phosphorus is more efficient than that of vegetable origin. Like calcium, the smaller the amount of phosphorus supplied by the diet, the more efficient its absorption is. To date, phosphorus absorption remains ill-known; however, both an active, saturable, transport mechanism and a non-saturable mechanism (depending on the phosphorus concentration) exist. Vitamin D, which facilitates the absorption of calcium, contributes to the absorption of phosphorus likewise.

Metabolism, storage and excretion: the phosphorus homeostasis occurs in the intestine, the kidneys, bone and lean mass. Plasma phosphorus levels are mainly regulated by the kidneys that reabsorb or excrete phosphorus according to intake. The intestine, however, also plays a significant role by improving its absorption efficiency in case of low intake. Like calcium, phosphorus is mainly stored in the bones and teeth (that together contain 85% of the overall phosphorus in the organism), while 14% is found in muscle. Phosphorus excretion occurs firstly in the kidney, and its re-absorption is regulated by the parathyroid hormone, according to intake.

Function: phosphorus performs a number of essential functions in the organism. It combines with calcium in bone formation, it serves as a construction unit in the great molecular formations of living beings, it is indispensable to the storage and release of chemical energy, it is essential to membrane structure and permeability, and it regulates many enzyme activities.

Deficiency: phosphorus deficiency caused by dietary inadequacy is rare. However, in the elderly, phosphorus absorption falls, whereas its excretion in the urine increases; this can cause a deficiency that manifests itself by anorexia, muscle weakness, debility and bone pains.

Requirements: the phosphorus needs are not well known, and they are therefore assimilated on a molar basis to calcium needs.[44]

Toxicity: infants fed on unbalanced formula supplying excessive phosphorus with respect to calcium (i.e. more than 2 parts of phosphorus for 1 part of calcium) can suffer hypocalcaemia and tetany. Recommended intakes should therefore be adhered to strictly, and the phosphorus-calcium ratio should be inferior to 2 (>2:1).

[43] Recommended intakes are discussed in Chapter IV.
[44] Recommended intakes are discussed in Chapter IV.

III

Magnesium

Source: all unprocessed foods contain magnesium, but concentrations vary greatly. Milk, wholemeal cereals, legumes, vegetables and potatoes contain particularly high concentrations of magnesium. Vegetables are generally rich in magnesium (its role to chlorophyll is analogous to that of iron to haemoglobin).

Absorption: the absorption of magnesium, as is the case for other minerals, occurs through an active mechanism for moderate intakes, and this mechanism saturates as intakes increase. Magnesium is then absorbed passively. Absorption rates vary between 20 and 70% of the intake.

Metabolism, storage and excretion: approximately two-thirds of magnesium are found in the bones and teeth, one-quarter in muscle, and practically all the rest in other cells, while less than 1% is found in extra-cellular fluids. Magnesium's homeostasis is similar to calcium's and occurs between the reserves stored in the bones, intestinal absorption and urinary excretion. Little is yet known regarding its hormonal regulation mechanism. Its excretion through urine is as adaptable as its intestinal absorption.

Function: magnesium is a vital element and performs many, similarly important, functions. More than 300 reactions in the organism are currently attributed to magnesium. It is of particular importance to the building and development of the bone structure, the synthesis of lipids and proteins, phosphorylation and de-phosphorylation mechanisms, metabolic energy production channels and the maintenance of normal nerve signalling and muscle contraction.

Deficiency: magnesium deficiency caused by dietary inadequacy is improbable because all unprocessed foods, including staple foods, generally provide a good source of magnesium, and the average daily intake is usually appropriate (150 to 500 mg). However, deficiency can result from malabsorption and during recovery from severe malnutrition. It is therefore fundamental to ensure an adequate magnesium intake during nutritional catch-up, because it is a Type II nutrient.[45]

Requirements: because dietary inadequacy can hardly account for magnesium deficiency, it is difficult to determine magnesium requirements accurately – reference to a suitable intake range (150 to 500 mg/day) is therefore preferable. On the other hand, magnesium requirements during recovery from severe malnutrition are quite precise.[46]

Toxicity: overly high oral intake is not toxic because of the adaptability of magnesium excretion by the kidney. Excessive intake can nevertheless cause passing diarrhoea. On the other hand, excessive intravenous administration can cause a fatal depression of the central nervous system and muscular paralysis.

Other minerals

Iron

Source: the following, listed in order of importance, are sources of iron (Randoin, 1982):

⇨ parsley (> 10 mg/100 g): although excellent, it is uncommon to eat parsley as a vegetable, and iron intake through parsley is therefore usually limited;

[45] See Chapter VIII.
[46] See Chapter XIII.

- ⇨ liver, legumes and egg yolk all contain between 5 and 10 mg/100 g; egg yolk unfortunately inhibits iron absorption (that is, its own iron content, and that supplied by other foods);
- ⇨ meat, oilseeds, wholemeal flour, watercress and spinach all contain between 2 and 4 mg/100 g;
- ⇨ most fresh fruits and vegetables, cheese and white flour all contain between 1 and 0.5 mg/100 g; they are thus poor in iron, like fermented beverages, milk and fruits such as apples, pears and cherries that are poorer still, containing less than 0.4 mg/100 g;
- ⇨ the iron contained in drinking water and in cooking utensils can represent a significant source, but it is difficult to take them into account owing to their considerable variability.

Absorption: iron absorption is a phenomenon of particular importance, because it is at this level that the organism attempts to maintain a balance so as to avoid deficiency and excess, without resorting to loss modulation. Iron absorption occurs in two ways, according to whether it is bound to the haemoglobin or myoglobin haeme group. Isolated non-haeme iron is dissolved by gastric juices, reduced into Type II iron (i.e. ferrous iron), and bound to other molecules. Where such molecules are small – such as ascorbic acid, sugars, and amino acids – they promote the absorption of iron. Some elements nevertheless impede its absorption; these are tannins, phytates, phosphates (found in wholemeal cereals and oilseeds), egg yolk, tea, and coffee. Milk and soy proteins also inhibit iron absorption. The phytates and tannins contained in tea and coffee can reduce iron absorption by approximately half. Absorption proper occurs in the small intestine, particularly in the duodenum. Organic acids, bile salts, and the peptide by-products of protein digestion all facilitate passage through the mucous membrane.

Iron binds with a specific protein to penetrate epithelial cells. Upon entering plasma, iron is oxidized into Type III iron (ferric iron), most is then bound to transferrin, and the rest to ferritin. Haeme iron obtained from meat/fish and blood is absorbed in a different way. The haeme group is absorbed directly by the cells of the intestinal mucous membrane; the iron is then separated from the haeme group and delivered into the plasma in the form of Type III iron. The absorption of haeme iron is considerably higher (approximately 25%) than that of non-haeme iron (approximately 10 to 15%); it is not affected by absorption inhibiting or promoting factors that affect non-haeme iron. Even in small amounts, haeme iron contained in the diet considerably increases the absorption of non-haeme iron. Generally speaking, this comment applies to the different promoters and inhibitors of iron absorption whose effects are cumulative. As an example, the ingestion of a small portion of fish or meat together with cereals greatly increases the absorption of the iron contained in the latter; this effect will be strengthened by the consumption of fruit, or weakened by the consumption of tea. Calcium, for its part, inhibits iron absorption (both haeme and non-haeme); a glass of milk containing approximately 160 mg of calcium inhibits iron absorption by more than 50%.

Iron absorption increases with food intake, but in decreasing proportions. The mechanisms regulating iron absorption boost it in case of iron deficiency, and restrict it in case of excess – the reasons for this remain unclear. Healthy individuals absorb approximately 5 to 10% of the iron contained in their food, whereas deficient individuals absorb between 10 and 20%. From a quantitative perspective, the maximum iron absorption among healthy adults is of the order of 1 to 2 mg/day, while it is in the vicinity of 3 to 6 mg for deficient individuals (Shils, 1994).

Metabolism, storage and excretion: after its absorption, iron is transported to the bone marrow to be integrated into the haemoglobin during the synthesis of the red blood cells. From there, it remains in the blood together with the red cells for approximately 4 months. Following the destruction of the red blood cells by phagocytes (the lifespan of red blood cell is approximately 4 months), most of the iron returns to the plasma and extra-cellular fluids, and a small amount is stored with ferritin and haemosiderin, which return their iron to plasma after their destruction, according to their turnover cycle. Most of the iron then resumes its cycle by returning to the bone marrow for the synthesis of red blood cells. The iron transport protein in the plasma is transferrin; it transports the iron to the bone marrow, but also to any other cell that requires it. Approximately two-thirds of the overall iron contained in the organism is located in the haemoglobin, approximately one-quarter is stored, a small proportion is found in a muscle protein (myoglobin), and the rest is found in extracellular fluids and cells. Less than 0.1% of the iron is in circulation with transferrin. The organism is remarkably efficient in saving iron through almost complete recycling, whatever its level within its cycle between plasma and red blood cells. Deficiency is therefore mainly caused by abnormal losses and limited absorption. The excretion of iron is largely passive and related to inevitable losses or "leaks" of the organism: through the intestine, urine, bile, exfoliation (shedding of the skin) – together accounting for approximately 1 mg/day – and menstrual bleeding in women of childbearing age (in the vicinity of 25 mg per cycle). Pregnancy and breastfeeding also demand high iron levels in comparison to the absorption capacity: beyond normal losses that persist throughout pregnancy, 200 to 370 mg are transferred to the foetus, some 90 mg are utilized for the placenta and the umbilical cord, and an average 250 mg are lost in the bleeding associated with delivery; breastfeeding provides the infant with 0.5 to 1 mg of iron per day.

Function: the primary function of iron is obviously to transport oxygen and carbon dioxide in the organism, *via* red blood cells. Iron is vital for the production of anaerobic energy, being present in the active groups of most of the enzymes that contribute to this production. It also contributes to the transport of electrons by cytochromes in the respiratory chain.

Deficiency: iron deficiency is no doubt the most common deficiency, and mainly affects women of childbearing age. It is discussed below.[47]

Requirements: a distinction must be made between absorbed and ingested iron, because the amount absorbed is considerably lower than that contained in the diet.[48]

Pharmacological intake: there is no justification for pharmacological iron intakes, particularly in view of its toxicity. However, supplements are often necessary to correct deficiency.

Toxicity: the excessive intake of iron is toxic. A normal diet, however, does not lead to iron excesses, because its absorption is regulated efficiently. Excess pathologies – haemachromatosis (where excess iron deposited in organs causes them damage) or haemosiderosis (iron overload without obvious tissue damage) – can arise only if regulation is inadequate (hereditary metabolic aberrations), in case of excessive intake resulting from specific circumstances, or in the case of particular ailments, such as hepatic cirrhosis, and pancreatic insufficiency. The circumstances leading to excessive iron intake include protracted consumption of supplements by individuals who are not anaemic, and the consumption of traditional beverages fermented in iron containers that oxidize and release large amounts of iron into the fermentation medium.

Iodine

Source: the iodine content of food is mainly determined by the iodine concentration in the soil and groundwater, and this concentration is related to geology. During the formation of the earth, iodine was quite widespread, but was subsequently leached by rain, erosion, glaciations and floods. As a result, most terrestrial iodine is now found in the seas and in deep terrestrial layers, in the chemical form of iodide. Solar radiation transforms marine iodine into elementary iodine, which is volatile and enters the atmosphere before returning to earth through precipitations; it finally returns to the sea according to rainfall and drainage. This iodine cycle nevertheless does not compensate for losses over time, as iodine returning to earth is instantly evacuated by soil drainage. This is why rugged mountains, well-irrigated and well-drained highlands, and flood-prone plains are most vulnerable to disorders related

[47] See Chapter VIII, with reference to nutritional anaemia.
[48] Recommended intakes are discussed in Chapter IV.

to iodine deficiency.[49] It is not useful for tables to indicate the iodine content of different food types, because of its high variability. On the other hand sea fish, seafood and seaweed are iodine-rich, as are coastal plants and the animals that eat them. Nowadays the most reliable source of iodine in many countries is salt, enriched in potassium iodate at between 30 to 50 mg of iodine/kg of salt (PAHO, 1986) – this is referred to as iodized salt. The iodine must be in the form of potassium iodate and not potassium iodide, which is too vulnerable to humidity and heat. One gram of potassium iodate contains 0.6 g of iodine. Thus, enrichment will consist of 50 to 83 mg of potassium iodate/kg of salt.

Function: iodine is an essential element used by the thyroid gland to produce thyroid hormones; the latter act as regulators of the metabolism, and ensure normal growth and development (both physical and mental) in children.

Deficiency: iodine deficiency is a serious threat to approximately one-quarter of humanity and, in some regions, constitutes a major public health problem. It is described in Chapter VIII.

Requirements: recommended intakes are provided in Chapter IV.

Zinc

Source: zinc is found in most foods, but its concentration varies greatly. Its major sources include animal products (3–5 mg/100 g), cereals and legumes (2–3 mg/100 g). In countries where the consumption of animal products is high, the diet contains an adequate amount of zinc. In contrast, where animal products are not a major component of the diet, cereals and legumes provide most of the required zinc; this can prove inadequate if the cereals are overly processed or refined, because zinc is located mainly in the peripheral layers of the grain, and these are shed proportionately to the degree of processing. For example, wholemeal wheat flour contains approximately 5.5 mg of zinc/100 g, whereas white flour only contains 1.7 mg/100 g i.e. a 70% loss.

Absorption: zinc absorption is similar to that of iron insofar as it increases with its intake, but in decreasing proportions. Zinc is absorbed in the small intestine. The level of its absorption depends on the presence of promoting or inhibiting molecules; the latter are phytates, tannins and oxalates. On the other hand, zinc inhibits the absorption of copper.

Metabolism, storage and excretion: the zinc content in the organism depends on the efficiency of its absorption, which rises in case of shortage or deficiency, and falls in case of excess. However, as mentioned above, absorption continues to increase according to intake, even if in a smaller proportion; excesses must therefore be disposed of, because zinc can be toxic. This is done through faecal excretion, which increases in case of excessive intake. Zinc absorption increases in the final stages of pregnancy; it decreases with age, but so do losses, and this facilitates the maintenance of a balance. Zinc is not stored, strictly speaking, and insufficient intakes rapidly lead to indications of deficiency.

Function: zinc performs many essential functions in the organism, and is included in Type II nutrients[50] accordingly. It is necessary to no less than 200 enzymes, it is a constituent of the cell membrane, and contributes to the stabilization of ribonucleic and desoxyribonucleic acids (RNA and DNA respectively) and ribosomes. The considerable contemporary research surrounding zinc may well lead to the discovery of further functions.

Deficiency: acute zinc deficiency is caused by a genetic disease – known as *acrodermatitis enteropathica* and characterized by an impaired zinc uptake from the intestine, zinc-deficient parenteral nutrition

[49] The general story of iodine is described by Hetzel (Hetzel, 1989).
[50] See Chapter VIII.

(i.e. intravenous), different types of malabsorption, alcoholism, and kidney and metabolic disorders. In the Near East, zinc deficiency is blamed for dwarfism among young teenagers and delayed sexual maturity. Moderate zinc deficiency could be more common than assumed until recently, and results in growth retardation. Zinc deficiency develops with the severity of acute malnutrition, and addressing this condition requires the administration of zinc in therapeutic doses, because zinc determines nutritional recovery as much as other Type II nutrients do.

Requirements: recommended intakes are provided in Chapter IV.

Toxicity: excessive zinc intake can cause chronic or acute disorders. Acute intoxication causes gastric pain, nausea, vomiting, and diarrhoea. Intoxication can result from the ingestion of beverages contaminated by the release of zinc in galvanized containers. Doses above 200 mg always cause vomiting. Beyond this threshold, they can be fatal. Chronic intoxication begins with zinc supplementation doses no higher than 25 mg/day, which result in a secondary copper deficiency by competition between the two elements in their intestinal absorption. Zinc supplements of the order of 150 mg/day result in low plasma levels of high-density lipoproteins (the risk of cardio-vascular disease is inversely proportional to these levels), and gastric erosion, and weaken the immune system (Shils, 1994).

Copper

Source: most foods contain copper, the richest sources (0.3–2 mg/100 g) being shellfish, oilseeds (including cocoa powder), legumes, and wholemeal cereals.

Absorption: like other metals, the absorption of copper increases with intake, but in decreasing proportions. Zinc inhibits the absorption of copper.

Metabolism, storage and excretion: following its absorption, copper is transported to the liver where it binds with a protein called ceruloplasmin, which transports it to the tissues. It is possible that copper could be stored in the liver, but in limited amounts. Little is known about the copper excretion mechanism, other than in the intestine by bile salts. The greater the copper intake or deficiency, the smaller its excretion is. Copper homeostasis depends on its intake and excretion.

Function: copper contributes to a number of oxidation-reduction reactions, as an enzyme constituent. These enzymes are essential in the respiratory chain, the synthesis of collagen proteins, the synthesis and maintenance of myelin, the synthesis of neuro-transmitters, the iron metabolism, and the protection against oxidation risks. Like zinc, copper is assumed to perform many more functions and these are currently under investigation.

Deficiency: copper deficiency can affect preterm babies, infants fed on non-modified cow milk, and children recovering from severe malnutrition. Copper deficiency manifests itself by leucopaenia,[51] neutropaenia,[52] skeletal anomalies, and higher liability to infection. It is possible that inadequate intakes cause cardio-vascular disease in adults.

Requirements: recommended intakes are provided in Chapter IV.

Toxicity: copper is toxic and intoxication is accidental. It is caused by the ingestion of acid beverages stored in copper containers or by winegrowers who use copper sulphate. Symptoms of copper intoxication include gastric pain, nausea, vomiting, and diarrhoea. Acute intoxication leads to coma, hepatic necrosis, vascular collapse and, ultimately, death.

[51] Low white blood cell levels in the blood.

[52] Low levels of white blood cells known as neutrophils in the blood.

Selenium

Source: selenium is found mainly in sea products, offal, meat, cereals, and legumes.

Absorption: selenium is usually ingested together with methionine and cysteine, and is well absorbed. Selenium homeostasis does not depend on its absorption.

Metabolism, storage and excretion: little is known about the selenium metabolism, but its excretion is mainly urinary, and its regulation determines selenium homeostasis.

Function: the main function of selenium is to act as an antioxidant agent. It probably performs other functions, such as the protection of cell immunity, and these are currently under investigation.

Deficiency: selenium deficiency causes Keshan disease, a fatal form of cardiomyopathy (heart muscle disease); however, the involvement of other factors appears to be required for the disease to develop. It is possible that selenium deficiency plays a role in the aetiology (i.e. cause) of kwashiorkor.[53]

Requirements: recommended intakes are provided in Chapter IV.

Toxicity: selenium overdose can originate in the diet in areas where the soil is selenium-rich, or by the ingestion of tablets. High doses of selenium are toxic, and cause nausea, diarrhoea, irritability, fatigue, peripheral neuropathy, balding, and brittle nails (Shils, 1994).

Chrome

Chrome is today recognized to be an essential nutrient that promotes the action of insulin and thus influences the mechanisms of glucides, lipids and proteins (Shils, 1994). Human deficiency has not been demonstrated to date.

Other trace metals

Other trace metals appear to be essential and their deficiency poses no particular problem because their intake is usually adequate. These include boron, which influences the mineral metabolism, manganese, an enzyme activator and a constituent of some enzymes, molybdenum, also a constituent of some enzymes, and silicon, which contributes to the synthesis of bones and cartilage. Vanadium, bromine, fluorine, lead and tin could also be essential trace metals, but this remains to be proven. On the other hand, pharmacological doses of fluorine provide protection against dental cavities, and possibly against fractures associated with osteoporosis.

3. DEPENDENCY ON OTHER SPECIES

Chapter V discusses the living species that man depends on to meet his nutritional need. This section only recalls a number of important points related to this dependency.

Beyond philosophical and religious considerations, man belongs to the biosphere like all other species. He accounts for approximately 4% of the animal biomass on earth. As such, he consumes

[53] See Chapter VIII.

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and excretes within a vast cycle of matter exchange between the different living species, in an energy flow throughout the biosphere. His nutritional dependency on other living beings is total. Man's is thus a predatory position at the end of the food chain. He depends on the sun, green plants, the bacterial kingdom and, to a certain extent, the animal kingdom to meet his nutritional needs. On the other hand, other than a few parasites that are exclusively his, no living species needs man to survive. Man's main originality has been to modify his environment so as to draw as many immediate resources from it as possible. He can thus afford a high population density where an overly prolific and invasive organism would otherwise rapidly be restricted by the exhaustion of the resources necessary for its survival.

His overarching priority, consumption, has driven man from the need to preserve a sustainable balance with the species who determine his survival, to the point of threatening some of the biosphere's major equilibriums. A human nutrition manual must mention the key parameter that man depends on nature to survive, that he has the means to upset the biocoenose[54] and the biotope and, as a result, the ecosystem. Man therefore has an enormous responsibility towards nature, if only to ensure his long-term survival, all the more so if pursing the noble goal of guaranteeing health for all. Man is rapidly exhausting the support capacity of the environment, and is playing dangerously with natural resources and their ecological balance. It is crucial for man to recognize his double dependency on nature and on interrelated species, this in relation to vital species and ecosystems of which he is not necessarily aware.

Humanitarian action is particularly concerned, because emergencies often obscure the need for protecting the environment; yet it is nevertheless one of the major stakes of the long-term survival of societies requiring assistance. Humanitarian assistance is often delivered to the detriment of the environment. As an illustration, food distributions to displaced people in an environment that is subjected to desertification can have disastrous effects on the vegetation cover, if it is not combined with the distribution of fuel for cooking. Here again, greater responsibility and foresight are called for.

[54] The balanced association of animals and plants in a biotope, a natural assemblage; strictly the animal and plant associations excluding the physical aspects of the environment.

CHAPTER IV
REFERENCE INTAKES OR RECOMMENDED INTAKES

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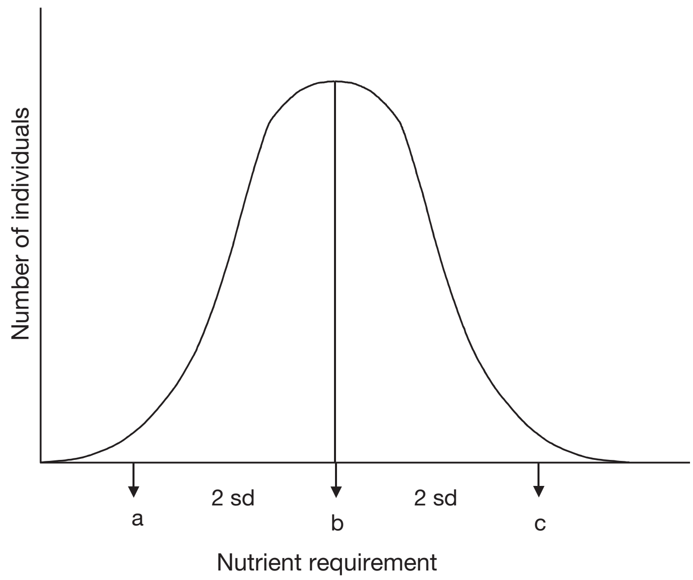
CHAPTER IV
REFERENCE INTAKES OR RECOMMENDED INTAKES

INTRODUCTION

The previous chapter discusses the human nutritional need mainly from a qualitative perspective. This need must also be quantified to reflect practical daily intake recommendations in order to determine food rations and assess their appropriateness. One difficulty arises from the fact that the nutrient requirements of seemingly similar individuals (same age group, sex, weight, height and physical activity) differ. A specific theoretical model is used in choosing values; although far from perfect,[1] it nevertheless provides an idea of this biological variability. It states that the variability of the nutritional need among a group of reasonably identical individuals (i.e. a homogenous class of individuals) follows more or less a normal distribution (Figure 4.1 below).

Figure 4.1 The frequency distribution of individual requirements for a given nutrient within a homogenous class of individuals



sd: standard deviation.

[1] The distribution of iron requirements among women of childbearing age is not symmetrical and, for many nutrients, there is no certainty that the requirement distribution follows the normal Gauss-Laplace law as described in Figure 4.1.

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This distribution illustrates the following thresholds:

⇨ minimum intake (point a) of two standard deviations below the average value; this intake is only sufficient for a small percentage of observed individuals;
⇨ an average intake (point b) which is adequate for half the observed individuals;
⇨ a safety intake (point c) of two standard deviations above average, which is adequate for almost all the observed individuals.

Evidently, the more the intake approaches point c, the greater the proportion of individuals consuming more than their requirements.

The term "adequate" with reference to point b indicates that the intake allows an initially healthy individual to maintain his good health. This intake usually exceeds that required for the clinical signs of deficiency to disappear. Research continues into the role of many nutrients whose intake, considered today as adequate, could in fact not be so and therefore result in sub-clinical deficiencies. For lack of more accuracy, experts base their recommendations on available data. Recommendations regarding nutrient requirements make sense only for homogenous classes of individuals. In other words, they refer to groups that are homogenous from a nutritional perspective, that is, according to the specific needs arising from growth, pregnancy and breastfeeding, and according to sex and age group.

This study follows the European Commission's approach: within the limits of contemporary knowledge, it provides three values per nutrient and per class of individuals. These values indicate the dispersion of needs (European Commission, 1993).

The Commission moreover proposes the following nomenclature.

⇨ PRI: <u>P</u>opulation <u>R</u>eference[2] <u>I</u>ntake (illustrated by point c in Figure 4.1 above). This intake is sufficient for most healthy members of a given homogeneous group, and can be considered as the safety intake. Generally, the PRI provides the basis for ration calculation and assessment, as it is certain to provide a security margin.
⇨ AR: <u>A</u>verage <u>R</u>equirement (point b). This point should determine the PRI wherever excessive intake may be harmful, that is, when the nutrient under consideration accumulates in the organism (rather than metabolizing) because its intake exceeds requirements. This is typically the case for energy intake in wealthy Western countries.
⇨ LTI: <u>L</u>owest <u>T</u>hreshold <u>I</u>ntake (point a). Below this intake level, most members of the group under consideration risk developing metabolic dysfunctions due to deficiency.

A given population can reflect several PRIs, depending on sex, age, pregnancy and breastfeeding. It is noteworthy that PRIs are not related to individuals, but to groups of individuals. If not otherwise specified, this study refers to PRIs drawn from the European Commission – other reports define slightly different PRIs, but these differences usually have no operational consequences in the field.

The PRIs mentioned in this Chapter assume that the diet covers requirements in other nutrients.

[2] The expression "reference" is equivalent to what other reports state as "recommended" or "advised". It is drawn from the European Commission report, which confines itself to recommendations rather than advice.

1. ENERGY

Daily energy needs are expressed in Average Requirements as opposed to Population Reference Intakes. Indeed, using PRIs as the basis for the calculation of intake leads to an obesity risk for approximately 90% of the population under consideration. Obesity is a major public health problem in industrialized societies, and it is therefore preferable to base recommendations on average requirements. On the other hand, converting average requirements into actual intake removes the corresponding safety margins in humanitarian assistance, in contexts where obesity is usually not a public health problem at all. Adult requirements are provided in relation to light, moderate and heavy daily physical activity,[3] or occupation. Data is adapted from the FAO/WHO/UNU report (WHO, 1985). The basal metabolism (BM) is provided per kilogram for different body mass and age groups, and according to sex, to facilitate calculations if intake recommendations should apply to other multiples of the basal metabolism. Values are rounded to the closest multiple of ten, and upwards if they end with 5 or more (for instance, 2,345 is rounded up to 2,350).

IV

1.1 AVERAGE REQUIREMENTS FOR MEN AGED 19–30 YEARS

Weight	BM/kg		Light occupation 1.55 BM		Moderate occupation 1.78 BM		Heavy occupation 2.10 BM	
(kg)	(kcal)	(kJ)	(kcal)	(kJ)	(kcal)	(kJ)	(kcal)	(kJ)
50	29	121.2	2,250	9,390	2,580	10,790	3,050	12,730
55	27.5	115	2,350	9,800	2,690	11,260	3,180	13,280
60	26.5	111	2,460	10,320	2,830	11,850	3,340	13,990
65	26	108.7	2,620	10,950	3,010	12,580	3,550	14,840
70	25	104.5	2,710	11,340	3,120	13,020	3,680	15,360
75	24.5	102.4	2,850	11,900	3,270	13,670	3,860	16,130
80	24	100.3	2,980	12,440	3,420	14,280	4,030	16,850

1.2 AVERAGE REQUIREMENTS FOR MEN AGED 31–60 YEARS

Weight	BM/kg		Light occupation 1.55 BM		Moderate occupation 1.78 BM		Heavy occupation 2.10 BM	
(kg)	(kcal)	(kJ)	(kcal)	(kJ)	(kcal)	(kJ)	(kcal)	(kJ)
50	29	121.2	2,250	9,390	2,580	10,790	3,050	12,730
55	27.5	114.9	2,340	9,800	2,690	11,250	3,180	13,270
60	26	108.7	2,420	10,110	2,780	11,610	3,280	13,670
65	25	104.5	2,520	10,530	2,890	12,090	3,410	14,260
70	24	100.3	2,600	10,880	2,990	12,500	3,530	14,740
75	23.5	98.2	2,730	11,420	3,140	13,110	3,700	15,470
80	22.5	94.1	2,790	11,670	3,200	13,400	3,780	15,810

[3] Annex 1 provides examples for each type of physical activity.

1.3 AVERAGE REQUIREMENTS FOR MEN AGED OVER 60 YEARS

Weight	BM/kg		Light occupation 1.55 BM		Moderate occupation 1.78 BM		Heavy occupation 2.10 BM	
(kg)	(kcal)	(kJ)	(kcal)	(kJ)	(kcal)	(kJ)	(kcal)	(kJ)
50	23	96.1	1,780	7,450	2,050	8,550	2,420	10,090
55	22.5	94	1,920	8,010	2,200	9,200	2,600	10,860
60	21.5	89.9	2,000	8,360	2,300	9,600	2,710	11,330
65	21	87.8	2,120	8,850	2,430	10,160	2,870	11,980
70	20.5	85.7	2,220	9,300	2,550	10,680	3,010	12,600
75	20	83.6	2,330	9,720	2,670	11,160	3,150	13,170
80	19.5	81.5	2,420	10,110	2,780	11,610	3,280	13,690

1.4 AVERAGE REQUIREMENTS FOR WOMEN AGED 19–30 YEARS

Weight	BM/kg		Light occupation 1.56 BM		Moderate occupation 1.64 BM		Heavy occupation 1.82 BM	
(kg)	(kcal)	(kJ)	(kcal)	(kJ)	(kcal)	(kJ)	(kcal)	(kJ)
40	27	112.8	1,680	7,040	1,770	7,400	1,970	8,220
45	25.5	106.6	1,790	7,480	1,880	7,870	2,090	8,730
50	24.5	102.4	1,910	7,990	2,010	8,400	2,230	9,320
55	23.5	98.2	2,020	8,430	2,120	8,860	2,350	9,830
60	23	96.1	2,150	9,000	2,260	9,460	2,510	10,500
65	22.5	94	2,280	9,540	2,400	10,030	2,660	11,130
70	22	92	2,400	10,040	2,530	10,560	2,800	11,720
75	21.5	89.9	2,520	10,510	2,640	11,050	2,930	12,270

1.5 AVERAGE REQUIREMENTS FOR WOMEN AGED 31–60 YEARS

Weight	BM/kg		Light occupation 1.56 BM		Moderate occupation 1.64 BM		Heavy occupation 1.82 BM	
(kg)	(kcal)	(kJ)	(kcal)	(kJ)	(kcal)	(kJ)	(kcal)	(kJ)
40	29.5	123.3	1,840	7,690	1,940	8,090	2,150	8,980
45	27.5	114.9	1,930	8,070	2,030	8,480	2,250	9,410
50	25.5	106.6	1,990	8,310	2,090	8,740	2,320	9,700
55	24	100.3	2,060	8,610	2,160	9,050	2,400	10,040
60	22.5	94	2,110	8,800	2,210	9,250	2,460	10,270
65	21.5	89.9	2,180	9,110	2,290	9,580	2,540	10,630
70	20.5	85.7	2,240	9,360	2,350	9,840	2,610	10,920
75	20	83.6	2,340	9,780	2,460	10,280	2,730	11,410

1.6 AVERAGE REQUIREMENTS FOR WOMEN AGED OVER 60 YEARS

Weight	BM/kg		Light occupation 1.56 BM		Moderate occupation 1.64 BM		Heavy occupation 1.82 BM	
(kg)	(kcal)	(kJ)	(kcal)	(kJ)	(kcal)	(kJ)	(kcal)	(kJ)
40	25.5	106.6	1,590	6,650	1,670	6,990	1,860	7,760
45	23.5	98.2	1,650	6,900	1,730	7,250	1,920	8,050
50	22.5	94	1,760	7,340	1,850	7,710	2,050	8,560
55	21.5	89.9	1,840	7,710	1,940	8,110	2,150	9,000
60	20.5	85.7	1,920	8,020	2,020	8,430	2,240	9,360
65	19.5	81.5	1,980	8,270	2,080	8,690	2,310	9,640
70	19	79.4	2,070	8,670	2,180	9,120	2,420	10,120
75	18.5	77.3	2,160	9,050	2,280	9,510	2,530	10,560

1.7 AVERAGE ENERGY REQUIREMENTS FOR ADOLESCENTS AGED 11–18 YEARS

Energy requirements are determined by the physical activity – or occupation – that is deemed desirable by the authors of the FAO/WHO/UNU report (WHO, 1985). They allow for the significant energy use of adolescents, and also for their growth. In calculating the requirements for a given population, it is preferable to do so on the basis of weight rather than age group, as adolescent growth surges occur at different ages.

Age	Median weight	Median height	BM/kg		BM multiple	Average daily requirements	
(years)	(kg)	(cm)	(kcal)	(kJ)	(kJ/day)	(kcal)	(kJ)
Boys							
11 – 12	34.5	144	36.5	152.7	1.75	2,200	9,210
13 – 14	44	157	32.5	135.8	1.68	2,400	10,040
15 – 16	55.5	168	29.5	123.3	1.64	2,690	11,220
17 – 18	64	176	27.5	115	1.6	2,820	11,770
Girls							
11 – 12	36	145	33	137.9	1.64	1,950	8,140
13 – 14	46.5	157	28.5	119.1	1.59	2,110	8,810
15 – 16	52	161	26.5	110.8	1.55	2,140	8,930
17 – 18	54	163	25.5	106.6	1.53	2,110	8,810

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1.8 AVERAGE ENERGY REQUIREMENTS FOR INFANTS AND CHILDREN AGED 3 MONTHS TO 10 YEARS

Age	Median weight	Average energy requirements			
	(kg)	(kcal/kg)	(kJ/kg)	(kcal/day)	(kJ/day)
Months					
3 – 6	7	100	418	700	2,930
7 – 9	8.5	95	397	810	3,380
10 – 12	9.5	100	418	950	3,970
Years					
2nd year	11	105	439	1,160	4,830
3rd year	13.5	100	418	1,350	5,640
4 – 5	16.5	95	397	1,570	6,550
Boys					
6 – 7	20.5	90	376	1,850	7,710
8 – 10	27	78	326	2,110	8,800
Girls					
6 – 7	20.5	85	355	1,740	7,280
8 – 10	27	67	280	1,810	7,560

2. PROTEIN

Protein requirements discussed here are drawn from the FAO/WHO/UNU report (WHO, 1985); they refer to safety intakes, in accordance with the above Population Reference Intake (PRI) as defined by the European Commission. Requirements are expressed in protein of equivalent quality and digestibility with reference to egg or milk protein.

Adult men:
0.75 g/kg of body mass/day.

Adult women:
0.75 g/kg of body mass/day.

- ⇨ **additional requirements related to pregnancy:** 10 g/day.
- ⇨ **additional requirements related to breastfeeding:**
  - → first 6 months: 16 g/day;
  - → following 6 months: 12 g/day.

Children between 4 months and 10 years:

4–6 months:	1.86 g/kg of body mass/day
7–9 months:	1.65 g/kg of body mass/day
10–12 months:	1.48 g/kg of body mass/day
13–18 months:	1.26 g/kg of body mass/day
19–24 months:	1.17 g/kg of body mass/day
3rd year:	1.13 g/kg of body mass/day
4th year:	1.09 g/kg of body mass/day
5th year:	1.06 g/kg of body mass/day
6th year:	1.02 g/kg of body mass/day

7th year:	1.01 g/kg of body mass/day
8th year:	1.01 g/kg of body mass/day
9th year:	1.01 g/kg of body mass/day
10th year:	0.99 g/kg of body mass/day

Adolescents between 11 and 18 years:

Boys	Median weight (kg)	Median height (cm)	Protein requirements (g/kg/day)
11 – 12 years	34.5	144	1
13 – 14 years	44	157	1
15 – 16 years	55.5	168	0.95
17 – 18 years	64	176	0.9

Girls	Median weight (kg)	Median height (cm)	Protein requirements (g/kg/day)
11 – 12 years	36	145	1
13 – 14 years	46.5	157	0.95
15 – 16 years	52	161	0.9
17 – 18 years	54	163	0.8

3. VITAMINS

3.1 ASCORBIC ACID (C)

Adults	mg/day
Average Requirement (AR)	30
Population Reference Intake (PRI)	45
Lowest Threshold Intake (LTI)	12
PRI for pregnancy	55
PRI for breastfeeding	70

Children and adolescents	PRI (mg/day)
6 – 11 months	20
1 – 3 years	25
4 – 6 years	25
7 – 10 years	30
11 – 14 years	35
15 – 17 years	40

3.2 THIAMINE (B_1)

Thiamine requirements are determined mainly by the energy metabolism, that is, energy spending; they are therefore expressed in mg/1,000 kcal (4,180 kJ). The energy requirement of the individual – or of the group – thus provides the basis for calculating thiamine requirements. An individual whose daily energy requirement is 2,500 kcal (10,450 kJ) needs a thiamine PRI of 2.5 x 0.4 = 1 mg of thiamine per day.

⇨ Average Requirement (AR): 0.3 mg/1,000 kcal;
⇨ Population Reference Intake (PRI): 0.4 mg/1,000 kcal;
⇨ Lowest Threshold Intake (LTI): 0.2 mg/1,000 kcal.

3.3 RIBOFLAVIN (B_2)

Like thiamine, riboflavin is largely associated with the energy metabolism, but not only; this may explain why needs do not increase significantly with energy requirements beyond maintenance thresholds. The two values are 0.5 mg/1,000 kcal for adults, and 0.6 mg/1,000 kcal for children. Additional requirements associated with pregnancy are 0.3 mg/day, and those associated with breastfeeding are 0.5 mg/day. The European Commission defines the following daily requirements in mg.

Adults	Men	Women
Average Requirement (AR)	1.3	1.1
Population Reference Intake (PRI)	1.6	1.3
Lowest Threshold Intake (LTI)	0.6	0.6
PRI for pregnancy		1.6
PRI for breastfeeding		1.7

Children and adolescents		PRI (mg/day)
	6 – 11 months	0.4
	1 – 3 years	0.8
	4 – 6 years	1
	7 – 10 years	1.2
Boys	11 – 14 years	1.4
	15 – 17 years	1.6
Girls	11 – 14 years	1.2
	15 – 17 years	1.3

3.4 NICOTINIC ACID (NIACIN, B_3, PP)

Niacin is associated with the energy metabolism and, like thiamine, its needs are expressed according to energy requirements, that is, in mg/1,000 kcal (4,180 kJ). Moreover, requirements are expressed in niacin equivalent to allow for the fact that tryptophan, an essential amino acid, is a precursor of niacin. In other words, the diet must be adequate in terms of both niacin and tryptophan. For example, a PRI of 6.7 niacin equivalent/1,000 kcal indicates that the diet supplies these 6.7 mg in the form of niacin and 1/60 of the tryptophan contained in the 1,000 kcal.

- ⇨ Average Requirement (AR): 5.4 mg/1,000 kcal.
- ⇨ Population Reference Intake (PRI): 6.7 mg/1,000 kcal.
- ⇨ Lowest Threshold Intake (LTI): 4.2 mg/1,000 kcal.

Pregnancy does not raise niacin requirements, but breastfeeding does, by 2 mg/day, which is the amount of vitamin secreted in the milk.

3.5 PANTOTHENIC ACID (B_5)

Pantothenic acid deficiency is virtually non-existent in a normal diet, and it therefore does not warrant specific recommendations. A daily intake of 5 to 7 mg is considered to be adequate for all groups (Basu, 1996).

3.6 PYRIDOXINE (B_6)

Pyridoxine is associated with most chemical reactions in the amino-acid metabolism. But pyridoxine is also highly versatile (in ways that are still not fully understood), thus complicating the definition of requirements. For lack of more accuracy, pyridoxine requirements are expressed according to the protein supplied by the diet, as follows:

- ⇨ Average Requirement (AR): 13 µg/g of ingested protein;
- ⇨ Population Reference Intake (PRI): 15 µg/g of ingested protein.

3.7 BIOTIN (B_8, H, H_1)

Biotin intake in industrialized countries varies between 50 and 300 µg per day, and is sufficient; a daily intake of 30 to 100 µg is considered to be adequate. In Canada, a daily intake of 1.5 µg per kg of body mass is suggested for all groups (Basu, 1996).

3.8 FOLIC ACID

Values allow for the fact that the bio-availability of dietary folic acid is limited to approximately 50%.

Adults	µg/day
Average Requirement (AR)	140
Population Reference Intake (PRI)	200
Lowest Threshold Intake (LTI)	85
PRI for pregnancy	400[a]
PRI for breastfeeding	350

[a] In the form of tablet supplements, because the diet alone cannot provide an adequate intake of folic acid in the late stages of pregnancy.

Children and adolescents	PRI (µg/day)
6 – 11 months	50
1 – 3 years	100
4 – 6 years	130
7 – 10 years	150
11 – 14 years	180
15 – 17 years	200

3.9 COBALAMIN (B_{12})

Adults	µg/day
Average Requirement (AR)	1
Population Reference Intake (PRI)	1.4
Lowest Threshold Intake (LTI)	0.6
PRI for pregnancy	1.6
PRI for breastfeeding	1.9

Children and adolescents	PRI (µg / day)
6 – 11 months	0.5
1 – 3 years	0.7
4 – 6 years	0.9
7 – 10 years	1
11 – 14 years	1.3
15 – 17 years	1.4

3.10 RETINOL (A)

Requirements are expressed in RE (µg of retinol equivalent per day) and the IU value is indicated between parentheses.

Adults	Men	Women
Average Requirement (AR)	500 (1,660)	400 (1,330)
Population Reference Intake (PRI)	700 (2,330)	600 (2,000)
Lowest Threshold Intake (LTI)	300 (1,000)	250 (830)
PRI for pregnancy		700 (2,330)
PRI for breastfeeding		950 (3,160)

Children and adolescents		PRI
	6 – 11 months	350 (1,160)
	1 – 3 years	400 (1,330)
	4 – 6 years	400 (1,330)
	7 – 10 years	500 (1,660)
Boys	11 – 14 years	600 (2,000)
	15 – 17 years	700 (2,330)
Girls	11 – 14 years	600 (2,000)
	15 – 17 years	600 (2,000)

NOTE – In view of the risks associated with excessive retinol intake,[4] the above PRI values should not be exceeded.

3.11 CHOLECALCIFEROL (D_3)

Man synthesizes vitamin D according to his skin's exposure to sunlight; the latter varies, but recommendations are issued nevertheless. Single values (e.g.10) indicate that it is prudent to administer a supplement to the entire group, while values ranging between 0 and an upper value (e.g. 10–15) mean that the group should in principle be able to synthesize the required vitamin (hence the value 0); the x value on the other hand indicates the reference intake for individuals whose vitamin D synthesis is minimal.

Category	PRI (μg/day)
6 – 11 months	10 – 25
1 – 3 years	10
4 – 6 years	0 – 10
7 – 10 years	0 – 10
11 – 14 years	0 – 15
15 – 17 years	0 – 15
18 – 64 years	0 – 10
65 years and above	10
Pregnancy	10
Breastfeeding	10

NOTE – Vitamin D rapidly becomes toxic; it is therefore strongly recommended not to exceed the above PRI values.

3.12 TOCOPHEROLS (E)

Vitamin E requirements are associated with the dietary supply of polyunsaturated fatty acids. Generally speaking, the higher the ingestion of unsaturated fatty acids, the greater the associated intake of vitamin E. It could be left at that, and recommendations discarded as superfluous. However, based upon the relation between the dietary supply of polyunsaturated fatty acids and vitamin A supply, a daily intake of 4 mg of α-tocopherol equivalent is recommended for men, and 3 mg for women.

[4] Chapter III discusses retinol toxicity.

3.13 PHYLLOQUINONE (K)

Human vitamin K deficiency is rare, and thus complicates the calculation of requirements. A daily intake of 1 µg/kg of body mass is considered adequate, and is in principle ensured by a normal diet.

4. MINERALS

4.1 SODIUM

There are no significant PRI or AR for sodium, but instead a range of acceptable intakes[5] (0.6 to 3.5 g/day; 25 to 150 mmol/day), and these only apply to adults. Sodium deficiency cannot arise from the diet, but from a pathological state; recommendations are therefore not useful, other than to warn against an intake above 3.5 mg for adults, owing to the risks of high blood pressure beyond this threshold. In common salt, the equivalent of the acceptable intake range is 1.5 to 8.8 g/day. Sodium is however also found in normal food, in addition to ingested salt.

4.2 POTASSIUM

Potassium deficiency caused by diet is unlikely. However, potassium plays an important part in the regulation of sodium excretion, and in mitigating the risks of arterial tension; its intake should therefore remain above the LTI.

Adults	mg/day	mmol/day
Population Reference Intake (PRI)	3,100	80
Lowest Threshold Intake (LTI)	1,600	40
PRI for pregnancy	3,100	80
PRI for breastfeeding	3,100	80

Children and adolescents		mg/day	mmol/day
	6 – 11 months	800	20
	1 – 3 years	800	20
	4 – 6 years	1,100	28
	7 – 10 years	2,000	50
Boys	11 – 14 years	3,100	80
	15 – 17 years	3,100	80
Girls	11 – 14 years	3,100	80
	15 – 17 years	3,100	80

[5] This range is known to satisfy the nutritional need, avoiding both excess and deficiency.

4.3 CHLORINE

Chlorine is closely associated with sodium (common salt is sodium chloride), both in the diet and in the metabolism, and recommendations for the two are therefore identical: daily intakes range between 25 and 150 mmol, that is, between 0.9 and 5.3 g of chlorine, or between 1.5 and 8.8 g of salt.

4.4 CALCIUM

Adults	mg/day
Average Requirement (AR)	550
Population Reference Intake (PRI)	700
Lowest Threshold Intake (LTI)	400
PRI for pregnancy	700
PRI for breastfeeding	1,200

Children and adolescents		PRI (mg/day)
	6 – 11 months	400
	1 – 3 years	400
	4 – 6 years	450
	7 – 10 years	550
Boys	11 – 14 years	1,000
	15 – 17 years	1,000
Girls	11 – 14 years	800
	15 – 17 years	800

4.5 MAGNESIUM

Magnesium is abundant in a normal diet, and deficiency is unlikely. A daily intake of between 150 and 500 mg is acceptable for adults, and these values allow for pregnancy and breastfeeding.

4.6 PHOSPHORUS

Little is known about the organism's phosphorus requirements; however, phosphorus is mostly associated with calcium in the skeleton, and the same recommendations apply as for calcium, according to a molar equivalence.

Adults	mg/day
Average Requirement (AR)	400
Population Reference Intake (PRI)	550
Lowest Threshold Intake (LTI)	300
PRI for pregnancy	550
PRI for breastfeeding	950

Children and adolescents		PRI (mg/day)
	6 – 11 months	300
	1 – 3 years	300
	4 – 6 years	350
	7 – 10 years	450
Boys	11 – 14 years	775
	15 – 17 years	775
Girls	11 – 14 years	625
	15 – 17 years	625

4.7 IRON

The table below applies to all groups, except to women of childbearing age (see below). It indicates the intakes necessary to cover the requirements of 95% of the individuals in each group. Intake levels are provided in terms both of absorbed quantities and of ingested amounts, based upon a 15% bio-availability of dietary iron.

Category	Requirements absorbed (mg/day)	Equivalent requirements ingested (mg/day)
0.5 – 1 year	0.93	6.2
1 – 3 years	0.58	3.9
4 – 6 years	0.63	4.2
7 – 10 years	0.89	5.9
Boys 11 – 14 years	1.46	9.7
15 – 17 years	1.88	12.5
18 years and above	1.37	9.1
Girls 11 – 14[a] years	1.4	9.3
Breastfeeding women	1.5	10
Post-menopausal women	1.13	7.5

[a] Pre-menstrual.

Iron requirements among women of childbearing age vary considerably. An adequate daily intake for 50% of the women in this category is 1.46 mg of absorbed iron among adult women (i.e. 9.7 mg in the diet), and 1.62 mg for teenagers between 15 and 17 years (10.8 mg in the diet). An adequate daily intake for 95% of the women in this category is 2.94 mg of absorbed iron among adult women (19.6 mg in the diet), and 3.1 mg for teenagers between 15 and 17 years (20.7 mg in the diet). Recommended daily intakes during pregnancy are 45 mg of dietary iron during the second half of the pregnancy. However, ingesting such quantities would still not permit an adequate absorption; the diet therefore needs to contain iron-rich foods that promote its absorption, avoiding foods that inhibit it as discussed in Chapter III. In addition and where possible, iron supplements should be administered during the second half of the pregnancy and the first three months following delivery. The posology is 300 mg of iron sulphate and 0.5 mg of folic acid per day.

4.8 IODINE

Adults	**μg/day**
Average Requirement (AR)	100
Population Reference Intake (PRI)	130
Lowest Threshold Intake (LTI)	70
PRI for pregnancy	130
PRI for breastfeeding	160

Children and adolescents	**PRI (μg/day)**
6 – 11 months	50
1 – 3 years	70
4 – 6 years	90
7 – 10 years	100
11 – 14 years	120
15 – 17 years	130

4.9 ZINC

Values are expressed in mg/day.

Adults	**Men**	**Women**
Average Requirement (AR)	7.5	5.5
Population Reference Intake (PRI)	9.5	7
Lowest Threshold Intake (LTI)	5	4
PRI for pregnancy		7
PRI for breastfeeding		12

Children and adolescents		**PRI (mg/day)**
	6 – 11 months	4
	1 – 3 years	4
	4 – 6 years	6
	7 – 10 years	7
Boys	11 – 14 years	9
	15 – 17 years	9
Girls	11 – 14 years	9
	15 – 17 years	7

4.10 COPPER

Adults	mg/day
Average Requirement (AR)	0.8
Population Reference Intake (PRI)	1.1
Lowest Threshold Intake (LTI)	0.6
PRI for pregnancy	1.1
PRI for breastfeeding	1.4

Children and adolescents	PRI (mg/day)
6 – 11 months	0.3
1 – 3 years	0.4
4 – 6 years	0.6
7 – 10 years	0.7
11 – 14 years	0.8
15 – 17 years	1

4.11 SELENIUM

Adults	μg/day
Average Requirement (AR)	40
Population Reference Intake (PRI)	55
Lowest Threshold Intake (LTI)	20
PRI for pregnancy	55
PRI for breastfeeding	70

Children and adolescents	PRI (μg/day)
6 – 11 months	8
1 – 3 years	10
4 – 6 years	15
7 – 10 years	25
11 – 14 years	35
15 – 17 years	45

4.12 MANGANESE

Manganese deficiency in humans is unlikely. Acceptable daily intakes range between 1 and 10 mg/day.

4.13 MOLYBDENUM

Molybdenum requirements remain unknown. Intakes appear to be adequate, and recommendations are therefore not called for.

4.14 CHROME

Available data is insufficient to deduce an accurate range of chrome requirements. A daily intake of 50 µg of chrome is probably adequate for the vast majority of individuals to remain in good health (Shils, 1994).

4.15 FLUORINE

It is as yet unclear whether fluorine is an essential element for man. On the other hand, its effectiveness in tooth cavity prevention is well known. Acceptable intakes range between 1.5 and 4.0 mg/day for adults (Shils, 1994).

4.16 SULPHUR

Sulphur is undoubtedly essential to man; its deficiency has however never been demonstrated, because it is always supplied in adequate amounts by the sulphurous amino acids of the proteins. Recommendations specific to sulphur are therefore not called for.

5. ESSENTIAL LIPIDS

Essential lipid requirements are expressed as a percentage of the energy supplied daily by the diet. For example, the daily consumption of 2,250 kcal (9,400 kJ) combined with a 2.5% PRI implies that 56.25 kcal (235 kJ – i.e. 6.25 g) must be in the form of essential lipids.

Adults	n-6 polyunsaturated lipids*	n-3 polyunsaturated lipids[a]
Average Requirement (AR)	1	0.2
Population Reference Intake (PRI)	2	0.5
Lowest Threshold Intake (LTI)	0.5	0.1
PRI for pregnancy	2	0.5
PRI for breastfeeding	2	0.5

[a] Also known as Omega 6 and Omega 3 polyunsaturated lipids.

Children and adolescents	PRI n-6 polyunsaturated lipids	PRI n-3 polyunsaturated lipids
6 – 11 months	4.5	0.5
1 – 3 years	3	0.5
4 – 6 years	2	0.5
7 – 10 years	2	0.5
11 – 14 years	2	0.5
15 – 17 years	2	0.5

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FOOD

INTRODUCTION

This Chapter discusses the different forms of food consumed by man;[1] it also discusses some related notions such as food value, the effects of processing methods on their nutrient content, toxicity, and the quantitative measuring of food. In the framework of humanitarian action, nutrient supplies must be assessed within given population groups, and supplements or alternatives suggested. This Manual could confine itself to the description of the commonest staple foods – basically those used in relief operations – such as cereals; but field work attempts to gain an understanding of crisis victims' actual access to food. Thorough assessment often reveals the wide range of food types resorted to by man, and the less obvious resources (such as hunting and gathering) that allow him to survive in spite of appearances. A comprehensive review of all food groups reflects the diversity of available resources, even – and especially – in crises.

In terms of food, humanitarian action revolves around the following points.

1. Knowing what crisis victims eat from gathering, production, purchases, sharing, and according to their culture.
2. Defining normal consumption (eating preferences), the last resort in crisis, and then drawing comparisons with the current situation.
3. Discovering the traditional diet of vulnerable groups, to determine possible deficiencies (entailing risks of malnutrition).
4. Determining food values to assess the dietary nutritional supply, allowing for the limitations of food composition tables in doing so.
5. Securing the data required for action: diet inadequacy, eating customs to be respected, major food and cooking components, state of the foods to be distributed, international import regulations, and quality specifications.

Man satisfies his nutrition need thanks to the nutrients provided by edible living species. Different cultures and individuals have diverging views as to which species (or part of it) is edible or not. Moreover, the nutrient content of foods varies. Several foods therefore must be combined to ensure a balanced and adequate intake. The foods that compose the typical meals of a given population define its diet. Diets themselves vary greatly, and result from both experience and need. Generally speaking, they are determined by the following:

- ⇨ the natural environment's production capacity;
- ⇨ culture, according to:
  - → economic development;
  - → eating habits, which determine broad preferences, dislikes, beliefs and taboos;
- ⇨ households, according to:
  - → food access possibilities/capacity;
  - → personal preferences.

[1] This Chapter only discusses specific diets briefly; they are given more attention in Chapter XV.

It goes without saying that food has accompanied the human race since its beginning, and has evolved with it; but this has been eventful. Adopting a combined historical, geographical, medical, economic, agronomic, political, cultural, artistic and philosophic approach to food is a fascinating endeavour. These aspects can unfortunately not be discussed here – but the underlying statement is that the role of food is extremely important in human life, a role which goes well beyond the simple supply of nutrients.

1. FOOD CATEGORIES

Human food is highly varied. Many processes change the rough ingredients found in nature into actual meals; these processes include extraction, transformation, combination, preparation and cooking, and they all contribute to the diversity of food. Vast cultural diversity has resulted in a multitude of products that can be difficult to distinguish. A classification of rough foods is therefore required. In terms of satisfying the nutritional need, what counts above all else is the nutrient content. This leads to a relatively simple classification, related mainly to raw foods. Foods can be listed either in decreasing order of nutrient content, or in food categories determined by general characteristics – related to their biological origin, their appearance or their utilization. The nutrient content of specific foods is rarely obvious at first sight. On the other hand, foods are easily grouped in categories; this is therefore by far the most commonly used classification, and provides both the basis for the description of food types and the structure of food composition tables. Classification based on nutrient content is especially useful to locate specific foods according to their vitamin and mineral content.

In nutrition, foods are usually allotted to the twelve following categories or groups.

1. Cereals
2. Starchy plants
3. Legumes
4. Oilseeds
5. Vegetables
6. Fruits
7. Mushrooms
8. Fats
9. Animal products
   (meat and offal, fish, larvae and insects, eggs, dairy products)
10. Sugars and syrups
11. Beverages
12. Herbs and spices

The first two categories (cereals and starchy plants) alone provide the staples of most of mankind – staple foods being understood as those that cover most of the energy needs; the other categories such as legumes, vegetables, fruits and animal products provide very useful complementary foods. Exceptions exist, of course; for example, the staple foods of the middle (and upper) wealth classes of the industrialized West are increasingly difficult to distinguish, owing to the great variety of foods they consume. On the other hand, some traditional stock-breeders still base their diet on animal products, whereas the last remaining hunter-gatherers have a highly varied diet, based on vegetables in their broadest definition, fruits and animal products. These exceptions reflect the versatility of many foods and diets.

1.1 CEREALS

Cereals are the staple food of most of mankind. As such, they contribute to covering most energy, protein and B group vitamin requirements.

Cereals belong to the grass family (*Gramineae*) whose grains are edible. These grains have certainly contributed to the diet of mankind since its origin, but they have been used massively – and later cultivated – only for the last fifteen to twenty thousand years. Nowadays, cereals account for most of the world's staple crop production, three times that of starchy plants, and ten times that of legumes (FAO, 1993). In other words, they represent the staple food of most of the world's inhabitants, and the main income source of most. As for volume of production, cultivated cereals are listed in the following decreasing order: wheat, rice, maize, barley, sorghum, oats, rye and millet. Nowadays, oats, rye and barley only play a minor role in the staple diet, whereas the others remain crucial.

The various species of cereal grains, although very different in certain respects, can be compared in terms both of food value and structure.

1.1.1 The food value of cereals

The nutritional characteristics of 100 g of dried, edible (i.e. husked), unprocessed cereal grain are provided in Table 5.1 below.

Table 5.1 The food value of rough cereals / 100g[2]

Cereal	Energy kcal (kJ)	Protein g	Calcium mg	Iron mg	Thiamine mg	Riboflavin mg	Niacin mg
Barley	339 (1,417)	12	35	4	0.5	0.2	7
Maize	363 (1,517)	10	12	2.5	0.35	0.13	2
Millet	355 (1,484)	10	20	5	0.6	0.1	1
Oats	388 (1,622)	12	60	5	0.5	0.15	1
Rice, brown	360 (1,505)	7.5	40	2	0.32	0.06	4.6
Rye[a]	350 (1,463)	8	25	3.5	0.27	0.1	1.2
Sorghum	355 (1,484)	10.4	32	4.5	0.5	0.12	3.5
Wheat	344 (1,438)	11.5	30	3.5	0.4	0.1	5

[a] 85–90% extraction rate.

⇨ Generally speaking, the average energy value of wholemeal cereals (dried, edible and unprocessed) is 350 kcal (1,460 kJ), most of which (90–95%) is provided by glucides and protein. They belong to the category of high-energy foods. They contain 70–80 g of glucides, 8 to 12 g of protein, 0.5–4.5 g of fats. They also contain B group vitamins, calcium and iron, in adequate proportions with respect to their protein and energy content. Cereals however lack vitamins A and C.

[2] From Platt and FAO (Platt, 1962; FAO, 1989a).

⇨ In terms of human protein requirements, the main limiting amino acid of cereal protein is lysine – in addition to tryptophan in the case of maize. However, cereals eaten together with legumes up to the energy needs, provide excellent quality protein. Practically all farming civilizations have combined cereals and legumes in their diet.[3]
⇨ The phytic acid contained in the aleurone inhibits the absorption of iron and calcium. With comparable doses of ingested iron, cereal iron is approximately three times less absorbed than that contained in animal products. The great affinity of phytates for calcium can reduce its absorption to the point of inducing a negative calcium balance, even with doses exceeding recommended daily intake.
⇨ Wholemeal cereals contain fibre, that is, indigestible carbohydrates. Food fibres have a beneficial effect on the regulation of the intestinal function, lowering plasma cholesterol levels, and moderating the glycaemic response and the emission of insulin.

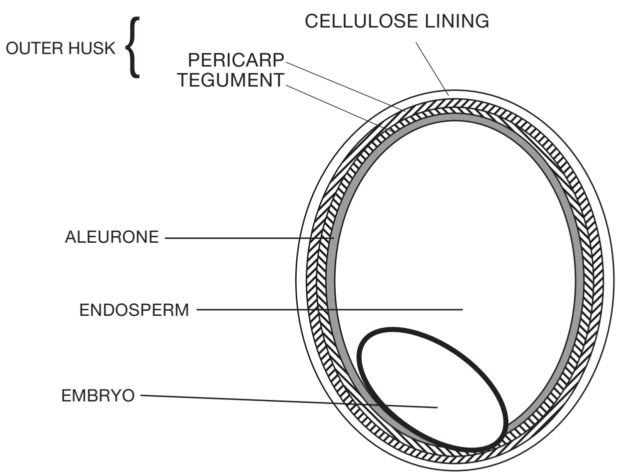
1.1.2 The structure of cereal grains

The structural description of cereal grains is important, because nutrients are not equally distributed within the grain. The processing of cereals affects grain components that are rich in some of its essential nutrients as well as fibre, and thus destroys most of them. Serious deficiencies may result; some are fatal, many are of epidemic proportions. Such deficiencies usually strike the poor, as theirs is a less diversified diet and is essentially based on one cereal alone.

The cereal grain structure illustrated in Figure 5.1 below is the following:

⇨ the outer husk consisting of three layers: the cellulose lining, the pericarp and the tegument, which are fibrous layers containing hardly any nutrients;
⇨ the aleurone, rich in protein, vitamins and minerals;
⇨ the endosperm, containing high concentrations of starch, and the main component of the grain;
⇨ the embryo, containing high concentrations of nutrients.

Figure 5.1 Cereal grain section



[3] The combination of cereals and legumes is discussed below (in the section pertaining to legumes).

Following the removal of the chaff by threshing, the first treatment of cereals is the removal of all or part of their external membranes (mainly the cellulose lining and the pericarp), which produces bran, to obtain a more or less refined grain. Refining is intended to make cereals more digestible and appetizing. The traditional manual method of pounding, followed by winnowing, generally produces a grain that is still relatively rich in protein, vitamins and minerals; mechanized methods (either artisanal or industrial) on the other hand can result in highly sieved or polished products, where practically all three peripheral layers and the embryo are lost. With them, a major proportion of vitamin B, and part of the minerals and protein are also lost. This is the case when producing white maize and wheat flour, or highly refined and polished rice, as illustrated by Table 5.2 below.

Table 5.2 Comparative food value of wholemeal and refined cereals / 100 g[4]

Cereal	Protein (g) [% loss]	Calcium (mg) [% loss]	Iron (mg) [% loss]	Thiamine (mg) [% loss]	Riboflavin (mg) [% loss]	Niacin (mg) [% loss]
Barley, wholemeal	12	35	4	0.5	0.2	7
Barley, pearl	9 [25%]	20 [42.8%]	0.7 [82.5%]	0.15 [70%]	0.08 [60%]	3 [57.1%]
Maize, wholemeal	10	12	2.5	0.35	0.13	2
Maize, flour 60% extraction[a]	8 [20%]	9 [25%]	2 [20%]	0.05 [85.7%]	0.03 [76.9%]	0.6 [70.0%]
Rice, brown	7.5	40	2	0.32	0.06	4.6
Rice, polished	7.1 [5.3%]	10 [75%]	1 [50%]	0.05 [84%]	0.02 [66.6%]	1.7 [63%]
Wheat, wholemeal	11.5	30	3.5	0.4	0.1	5
Wheat, flour 70% extraction	10 [13%]	16 [46.6%]	1.5 [57.1%]	0.08 [80%]	0.05 [50%]	0.8 [84%]

[a] See explanation in text below.

Table 5.2 above clearly shows the disastrous impact of intensive refining on the cereal vitamin B content. The flour extraction rate expressed as a percentage indicates the proportion of whole grain used to produce flour. Thus, a 95% extraction flour is a brown flour containing 95% of the whole grain weight; a 70% extraction flour on the other hand is white and only retains 70% of the whole grain weight. As a result, high extraction flours retain most nutrients, whereas low extraction flours have lost the most.

The nutritional importance of cereal sieving and refining should be considered from the angle of the dietary balance, according to the latter's diversity. The greater the diet's reliance on a staple cereal, the greater the deleterious consequences of sieving and refining on the nutritional status will be.

[4] From Platt and FAO (Platt, 1962; FAO 1989a).

1.1.3 Wheat

Wheat is the most widely cultivated cereal, and is produced mainly for human consumption. Two types of wheat are distinguished: soft wheat (*Triticum aestivum* or *vulgare*), and hard or durum wheat (*Triticum durum*). Wheat is an excellent staple food thanks to its food value. A diet in which 75% of the energy is provided by wheat flour (whatever its extraction), 20% from vegetables and 5% from animal products is balanced and adequate for child growth – assuming that the energy supply is sufficient (Davidson, 1979).

Wheat is consumed in a number of ways:

- ⇨ wholemeal grain is usually prepared as bulgur: it is boiled in water until soft, then dried and crushed. It is then eaten boiled or braised, together with meat and vegetables;
- ⇨ milled grain ranges from coarse semolina (for example *couscous*) to pure flour (as used in pastry);
- ⇨ semolina is usually made from durum wheat; fine semolina is used in gruels, whereas coarse semolina is soaked in water, and then enriched with fats and braised or steamed (e.g. *couscous*);
- ⇨ flour is used to produce leavened or unleavened bread, pasta (durum wheat), fritters and pancakes (fermented or not), biscuits and pastries (soft wheat) – bread is an almost mythical food; its symbolic value has always been extremely strong, but it is waning today owing to fashion-induced cultural levelling, and constraints related to the global economy and the erosion of regional cultural values.
- ⇨ wheat is also used in the production of spirits such as vodka and whisky.

1.1.4 Rice

Two main rice species are known to be cultivated: *Oryza sativa* (or Asian rice), predominant by far owing to the extent of its cultivation, and *Oryza glaberrima*, produced in West Africa. Originally rice was a tropical plant, but it has spread worldwide and adapted to a wide variety of climates. Rice is cultivated in four main modes: in irrigated paddies, rain-fed lowland cultivation, dry cultivation in non-flooded paddies (where moisture is provided by rain or flood recession residue), and so-called "floating rice", in water as deep as several metres.

Wheat is the most widespread cereal, but rice follows close behind and its role may be more important still. Firstly, it is produced almost exclusively (95%) in developing countries, unlike wheat (42% only). Moreover, most Asian countries where rice constitutes the staple food *par excellence* rely on the energy and protein it supplies far more than is the case for other staple foods elsewhere (FAO, 1993). In other words, rice is generally the predominant food in their diet, which contains only a few other nutritious foods. This situation entails a high vulnerability to any impact on the rice monoculture, and to nutritional deficiencies related to an insufficiently diversified diet and the consumption of overly refined rice.

One particularity of rice is that winnowing only removes its straw, not its husk. Winnowing produces rough or paddy rice – the expression referring to the grain still in its husk. The husk is removed manually or mechanically to produce brown or cargo rice. The bran is then polished away to produce more or less polished white rice – some mechanical equipment removes the husks and polishes the grain in one operation. To prepare artisanal rice, it must first be washed, then cooked, and possibly rinsed. Enormous nutrient losses (especially B group vitamins) can occur between the husk removal to rinsing. B group vitamins are lost in the course of husk removal and polishing, but also in the washing, cooking (if the cooking water is discarded) and rinsing, owing to their great water-solubility. Table 5.2 shows that polished rice has already lost 84% of its initial thiamine content – it will lose at least 50% of the remainder during washing, cooking and rinsing. Unsurprisingly, therefore, populations who rely heavily on polished white rice can suffer actual beriberi[5] epidemics, not to mention more vulnerable groups such as refugees, displaced persons and prisoners.

Some treatment techniques nevertheless produce a reasonably polished rice without excessive nutrient loss in the process. They are based on the parboiling or steaming and drying of the paddy rice prior to removing its husk and polishing, and are practised both at home and industrially. The parboiling process consists in soaking the rice, then boiling or steaming it, and then drying it. Parboiling or steaming splits the husk (which can then easily be removed), and hardens the grain making it more resistant to polishing, thus reducing nutrient loss. For example, steamed and highly polished rice only loses 28% of its thiamine compared to brown rice; the same rice, non-steamed but similarly polished loses 85% (FAO, 1989a). Parboiling and steaming nevertheless involve a risk: mould frequently develops during the drying phase, inducing a risk of contamination through *Aspergillus flavus*, which produces very dangerous aflatoxins[6] (FAO, 1989a).

The food value of rice is excellent if it has been parboiled before processing. Rice provides the most digestible and best composition protein of all cereals. Rice contains approximately 30% less protein than other cereals. However, the organism retains rice protein better than that of other cereals, resulting in a roughly equivalent outcome. Its energy, protein, B group vitamin, iron and calcium content makes it a predominant staple food that can cover most of the supply of these nutrients. It however leads to dependencies and vulnerability, as discussed above.

Rice is mainly eaten in the form of whole grains, cooked in water, and can then be prepared in different ways. Rice is also milled to produce semolina and flour. Rice semolina is used to prepare gruels, porridges and puddings, biscuits and cakes. Rice flour is used for biscuits and pastries, pasta (with or without added wheat flour), fermented pancake dough, patties, fritters and turnovers. The grain or grain fragments are also used to produce beer and rice wine – the latter can later be distilled to produce rice spirits. Glutinous rice, or sticky rice, is also used in many dishes specific to different regions or countries.

1.1.5 Maize

Maize (*Zea mays*) originated in Central America and is the third most cultivated cereal worldwide. Only one-third of this production is for human consumption, the rest is used as animal feed and in industrial starch production (FAO, 1989a). Maize is a staple food in Central America, some South American countries, and in Southern and East Africa. In Africa, it has often replaced more traditional cereals, such as sorghum and millet, because of its higher yield and the fact that its cob is better protected against predators, particularly birds. Maize is quite resistant to heat and drought (more so than wheat or rice), as long as the latter does not occur during flowering. Owing to this, maize is less resistant than sorghum and millet, and therefore more vulnerable to drought episodes – whose frequency appears to be accelerating. Another problem associated with maize cultivation is the fungal invasion of the grains following harvest, particularly by *Aspergillus flavus*, which produces aflatoxins. Careful handling after harvesting, during drying and storage reduces this problem.

The food value of maize is lower than that of wheat and rice, mainly because its protein is of poorer quality (its lysine and tryptophan concentrations are low), and owing to its low niacin content, which is mainly in a form that is unusable biologically. As a result, where the staple food is maize only, a

[5] See Chapter VIII.
[6] See Section 1.3.2 in this Chapter.

serious risk of pellagra[7] exists; this remains true in crisis situations and in prisons today, as it was in the past when maize replaced secondary cereals and became the predominant food. This risk does not exist in Central America, its place of origin, where maize is traditionally soaked in an alkaline lime solution before use and processing. This considerably increases the biological availability of niacin, improves the amino-acid balance, and reduces aflatoxin rates. However, this practice has alas not accompanied maize to other regions (nor was it perpetuated by settlers invading the South of the United States), resulting in devastating pellagra epidemics. Refining and processing maize increase the risk of pellagra, and even of beriberi if they result in finely milled white flour. The practice of refining is spreading to the detriment of processes such as crushing and light milling that waste less B group vitamins in the maize. Unlike other cereals, yellow maize contains carotenoids, some of which are precursors of vitamin A.

Maize, like other cereals, is eaten in many forms including the following:

- ⇨ the cob itself can be eaten unripe – its taste is sweet – or ripe, boiled or grilled and then chewed;
- ⇨ particularly in Latin America, the grain is roasted, grilled or boiled and eaten with beans, spices and meat (i.e. *chili con carne*). It is also heated to bursting to produce popcorn;
- ⇨ gruel is used in preparing thick (even compact in the case of the Ugandan *ugali*) porridge, patties and biscuits, weaning porridges, and beer;
- ⇨ semolina is boiled (e.g. *polenta*) or used in brewing according to its coarseness;
- ⇨ flour (more or less white) is used for pancakes (*tortillas*), unleavened bread, and gruel;
- ⇨ maize germ (embryo) provides an excellent quality cooking oil;
- ⇨ both beer and bourbon (American whiskey) are produced from maize.

Maize eaten in combination with legumes (accounting for at least 20% of the overall energy supply) does not entail risks of pellagra, beriberi and severe malnutrition.

1.1.6 Sorghum

Sorghum (*Sorghum spp.*) originated in Africa, where it is most commonly eaten as a staple food, particularly in Sahelian countries, owing to its tolerance to heat and semi-arid conditions. Its food value is similar to that of maize in terms of protein: exclusive sorghum consumption – but insufficient to cover energy needs – can cause pellagra epidemics as has been seen in Angola, for instance. However, pellagra appears rather to arise from an amino-acid unbalance: excessive leucine seems to interfere with the utilization of tryptophan and niacin (FAO, 1995). In developing countries, particularly the poorer regions of India and Africa, sorghum is cultivated for human consumption; its yield is low, less than one tonne per hectare. In industrialized countries, sorghum is produced mainly for livestock feed, and its yield is 3 to 5 tonnes per hectare (FAO, 1997).

Different varieties exist. Light-grained varieties usually provide a staple food; dark-grained varieties contain tannins and bitter polyphenols, and are used in beer production. Sorghum is used for gruel, porridges (weaning foods), semolina (*couscous*), flat breads, and pancakes. The grains are also eaten whole or broken after boiling, steaming or bursting (like popcorn). Malted sorghum is also largely eaten in Africa; however, the shoots and radicels of germinated sorghum contain large amounts of a precursor of hydrogen cyanide (HCN), a violent poison to which small children are particularly sensitive. Shoots and radicels (or rootlets) must therefore always be removed carefully from germinated sorghum before eating the grain (FAO, 1995). As mentioned above, sorghum

[7] See Chapter VIII.

plays a major role in the human diet in some regions; it also plays a culturally predominant role in the production of beer, a ritual beverage whose consumption accompanies both daily life and celebrations of all kinds.

1.1.7 Millet

Millet includes several, sometimes botanically distinct, plants that all produce minute seeds. Like sorghum, millet originated in Africa, and they are very similar cereals. Millet is mainly produced in low income, hot and semi-arid countries – it is the most resistant cereal to heat and erratic rainfall. It is however vulnerable to birds, which cause tremendous damage because millet cobs fan out and offer the birds an irresistible source of food. Moreover, as they ripen, the grains tend to fall out of the cob onto the ground below. The cultivation of millet is suited to marginal areas, but nevertheless poses problems of its own. Its yield is low – 250 to 500 kg per hectare. A reasonable assumption in millet-production areas is the probable absence of alternatives for survival: if irrigation were available to improve millet yields, then the local farmers would no doubt already have resorted to more profitable crops (FAO, 1997).

Little is known about the food value of millet compared to that of other staple cereals. It is assumed that its characteristics are similar to those of sorghum, but its protein quality is higher. Furthermore, millet is mainly a staple food of the poor – its processing is essentially artisanal and therefore preserves most of the grain's nutrients (Davidson, 1979). The preparation of millet for consumption is similar to that of sorghum.

Different types of millet exist, but two warrant particular attention: *teff*, typical of the Ethiopian highlands, and *fonio*, common in the Sahel. The cultural importance of *teff* (*Eragrostis teff*) in Ethiopia is identical to that of bread in Western Europe until the mid-20th century. It is used in the preparation of *injera*, which is the staple food and provides the "plate" for all Ethiopian dishes: *injera* is a pancake made from fermented *teff* dough, upon which a variety of savoury foods are arranged, and is then eaten with the fingers. The fermentation of *injera* enriches it in B group vitamins. *Teff* adapts to diverse climates and soils but does require abundant rainfall during its sowing and the early stages of its growth; it is therefore vulnerable to drought as was tragically seen in the 1970s and 1980s.

Fonio (*Digitaria exilis*) is cultivated in the Sahel but it is also a highly popular wild cereal. It owes its popularity to the fact that it grows freely in arid and semi-arid areas and is easy to harvest – one month's labour can suffice for a family to cover its yearly cereal requirements. However, during droughts the competition for *fonio* can be serious and lead to conflict. As a result, free collection areas for this wild grain tend to be strictly regulated by customary law. Enquiries into food access in Sahelian areas must assess this aspect carefully, in addition to the fact that *fonio* acts as a buffer by compensating for production shortages in millet or sorghum; surveys often overlook such gathering activities.

1.1.8 Barley

Barley (*Hordeum vulgare*) was a predominant staple food from the early days of agriculture. In Europe, its consumption began to decline in the Middle Ages, giving way first to wheat (bread), and later to new foods such as maize and potato, whose high yields protected against scarcity and famine. The increased production of such new foods did not improve the quality of the diet, however, because their high yield caused the diet to revolve almost exclusively around them, to the detriment of diversity and nutrient richness. The introduction of maize in Italy was followed by devastating pellagra epidemics that continued until the early 20th century (Flandrin & Montanari, 1996).

Barley is unfortunately no longer a human staple food, but nevertheless remains essential in the production of beer and the best whiskies. It is also widely used in animal feeding, which is why it is the fourth most produced cereal worldwide.

1.1.9 Oats and rye

Oats and rye (*Avena sativa* and *Secale cereale*) were staple foods in Europe, being cheap and good-yield alternatives to wheat. They are nutritious, climate resistant and were formerly a pauper's food. However, their importance has declined since the Second World War because of increased food availability and diversity, and improved purchasing power. Nowadays, they are growing more popular again, as tasty diet foods (e.g. porridge, bread).

1.2 STARCHY PLANTS

Starches can constitute staple foods, cereal complements or reserves when the cereal production is insufficient. Starchy plants above all provide a source of energy, but also of protein and vitamins according to species.

Starchy plants are not necessarily related botanically, but all have edible parts such as the tuber,[8] the fruit or the stem that all mainly contain glucides in the form of starch. By decreasing order of worldwide production, starchy plants are the following: the common potato (*Solanum tuberosum*), cassava, sweet potato (*Ipomoea batatas*), yam, plantain, taro and sago. Each species includes many varieties. Man probably identified edible roots everywhere from the origins to the development of agriculture; but the main roots with starchy tubers (i.e. common potato, cassava and sweet potato) were introduced from the Americas to the rest of the world only as of the 16th century. Their easy production and their high yield allowed their use to develop rapidly. In many regions including Europe, the introduction of the cultivation of starchy plants greatly contributed to reducing the risk of famines due to the unpredictabilities of cereal production. As previously discussed nevertheless, excessive reliance on one food type alone (and its resulting near-monoculture) can lead to dependency and thus be disastrous. This was the case in Ireland in the mid-19th century, where potato had become virtually the only energy and protein source for most of the rural population; mildew attacked the crops and destroyed three successive harvests between 1845 and 1847, and the Irish endured one of the worst famines in European history.[9]

The importance of starchy plants in human nutrition arises from the following advantages (Dunbar, 1969):

- ⇨ they grow in diverse soils;
- ⇨ their production is cheap and requires little labour and maintenance;
- ⇨ their surface yield is enormous;
- ⇨ their preparation/cooking is easy;
- ⇨ they can frequently be harvested throughout the year;
- ⇨ they can frequently be left in the ground after ripening to be collected later, and this entails secondary benefits:
  - → a cheap and convenient form of storage;
  - → a good option for reserves in anticipation of hunger gaps, and to mitigate the risks of famine;

[8] Tuber: subterranean excrescence of the stem or root.

[9] See Chapter VI, Section 3.4.4 and 3.4.5.

⇨ they are less prone to disease, and less vulnerable to parasites and predators than cereals;
⇨ their reproduction can be vegetative (i.e. asexual).

Starchy plants nevertheless have some drawbacks, but these remain minor in the light of their considerable advantages. They include the following:

⇨ when fresh, their energy density is low (approximately one-third of that of cereals and legumes) – they must therefore be eaten in larger amounts to meet energy needs, and this can result in a significant risk of malnutrition if they are the main weaning food;
⇨ owing to their high water and starch content, most tubers are difficult to handle, store and transport once collected (cassava, sweet potato and yam can spoil within a day) – their commercial use is therefore more uncertain than that of cereals or legumes;
⇨ with the notable exception of the common potato, most starchy plants supply foods that are unbalanced from a nutritional perspective with respect to human needs – these foods must therefore always be complemented by others that are richer in protein, vitamins, minerals, and higher in energy, particularly for small children, or risk serious deficiencies;
⇨ vegetative reproduction demands large volumes of stems or tubers to replant, and these are difficult to store.

1.2.1 The food value of starchy plants

Table 5.3 below provides the food value of 100 g of the main edible fresh starchy plants (Platt, 1962).

Table 5.3 The food value of starchy plants / 100g

Plant	Energy (kcal) (kJ)	Protein (g)	Calcium (mg)	Iron (mg)	Thiamine (mg)	Riboflavin (mg)	Niacin (mg)	Vitamin C
Cassava	153 (640)	0.7	25	1	0.07	0.03	0.7	30
Common potato	75 (313)	2	10	0.7	0.1	0.03	1.5	15
Plantain	128 (535)	1	7	0.5	0.05	0.05	0.7	20
Sweet potato	114 (476)	1.5	25	1	0.1	0.04	0.7	30
Taro	113 (472)	2	25	1	0.1	0.03	1	20
Yam	104 (435)	2	10	1.2	0.1	0.03	0.4	10

Generally speaking, foods derived from fresh starchy plants supply mainly energy in low concentrations, where glucides account for more than 90%. They only contain traces of lipids, and are poor in protein whose limiting factors for humans are sulphurous amino acids. They only contain small amounts of minerals and vitamins – except vitamin C that they contain in fair amounts, but considerable proportions of this vitamin can be lost according to storage and preparation methods. They contain little phytates, enabling an almost complete assimilation of the minerals they contain. Among vegetal foods, starchy plants thus provide a good source of iron, more so still because of their vitamin C content that promotes iron absorption. The yellow and orange varieties of sweet potato and coloured yam varieties contain high concentrations of β-carotene, a precursor of vitamin A.

Because of their low energy and protein density, large quantities of starchy plants must be consumed to cover the nutritional need, when they are the staple food. For example, to cover his daily energy and protein requirements, a weaned one-year-old infant must eat 1.2 kg of yam, 2 kg of cassava, 1.2 kg of sweet potato, 1.5 kg of plantain, 1.5 kg of common potato, or 1 kg of taro. These amounts are huge for such a small stomach. Hence, diets based on starchy plants (especially in the case of cassava) should always be completed with foods that are richer in protein and energy (legumes, animal products, fats, oilseeds) and vitamin and mineral complements (fresh fruit and vegetables). The low energy density of fresh products derived from starchy plants can be remedied by drying them completely – this process raises their density to the level of cereals and legumes; protein nevertheless remain a limiting factor in the case of cassava and plantain.

In terms of protein and energy, common potato and cassava occupy a special position among starchy plants: potato contains the lowest concentration of energy (10.6% P/E[10]) – cassava on the other hand is the richest in energy, but its protein (limiting factor) to energy ratio is the lowest (1.8% P/E). Moreover, common potato protein is high quality for human nutrition, whereas those of cassava contain the lowest concentrations of essential amino acids. Common potato has the best food value of all starchy plants; it is also the only cheap food that permits survival over long periods if consumed alone.

Starchy foods provide energy, mainly, and must therefore be complemented with other foods. Part of the latter can be derived from the starchy plant itself, for example the foliage in the case of cassava, sweet potato and taro. These leaves are excellent sources of β-carotene (a vitamin A precursor), vitamin C and quality protein, particularly so in the case of cassava leaves.

1.2.2 The utilization of starchy plants

Foods derived from starchy plants are not eaten raw; they must be prepared and cooked to make them more digestible and appetizing, extend their preservation and, in the case of cassava, reduce their toxicity. Preparation methods differ, and transformation involves several stages such as peeling prior to or following cooking, washing, soaking, drying, milling, crushing, grating, and fermentation. Cooking can involve roasting, grilling, boiling, steaming, and frying. Transformation and cooking stages can be combined: for example, the peeled tuber is washed, then boiled, reduced to pulp, dried, and finally milled to flour. Starchy foods are eaten whole, diced or in the form of paste, mash, patties, and their flour is used for many dishes and mixtures with cereal and legume flours. Starchy foods are rather tasteless, and they are therefore frequently associated with spicier foods (e.g. gravy, meat, fish or vegetables).

1.2.3 Common potato

The most extensively cultivated starchy plant is the common potato (*Solanum tuberosum*). It thrives in temperate climates where nights are cool. Its nutritional qualities have been discussed above. It can be boiled, fried, roasted, baked or braised; it is eaten whole, in chunks of all shapes and sizes, mashed, and even dried. Recipes and accompaniments for potatoes are innumerable; its flour and starch also provide the basis for many dishes. The importance of potato is both culinary and essential to the survival of hundreds of millions of people. It also provides the main ingredient for spirits such as vodka.

[10] P/E% refers to the protein-energy ratio; this relation is discussed in Chapter XII, in connection with the qualitative aspects of food rations.

1.2.4 Cassava

Cassava (*Manihot esculenta* and *M. dulcis*) tolerates drought but not freezing; it is therefore found in the tropics where it is both a staple food and a food security product. Cassava is mainly a source of energy, and must therefore be eaten in combination with foods that are rich in protein, vitamins and minerals. Alas, this is rarely feasible in times of drought or armed conflict when it is often the only remaining source of food, resulting in deficiency diseases such as dietary kwashiorkor.[11] Even where food sources are varied, the excessive use of cassava as a staple and weaning food leads to serious nutritional disorders.

Cassava contains linamarin, a compound that transforms into hydrogen cyanide (HCN) under the action of a specific enzyme that is also present in cassava. HCN is a most toxic and violent poison. The HCN concentration in cassava can be quite high, but fluctuates greatly according to variety. Table 5.4 below provides the HCN content of cassava plants studied in Mozambique (Ministry of Health, Mozambique, 1984).

Table 5.4 Cassava hydrogen cyanide content

Plant part	Bitter variety HCN (mg/kg)	Sweet variety HCN (mg/kg)
Fresh leaves	377	347
Fresh roots	327	138
Dried roots	95	45

An approximately 50 mg dose of HCN is lethal for the adult human; Table 5.4 above shows that a diet that is almost exclusively based on cassava that is little or not detoxified can cause death or chronic intoxication leading to spastic paraparesia[12] (called *mantakassa* in Mozambique) which is almost irreversible. Cassava eaters usually know perfectly well how to detoxify it. In any case, a varied diet and a normal nutritional status allow the organism to detoxify HCN at the rate of 20 mg/day.

However in conditions of drought, confinement, involuntary displacement or forced change in eating habits, cassava is sometimes the only available food and can be prepared inadequately, leading to real epidemics of spastic paraparesia. Its symptoms appear suddenly, often after the meal or during the night, and include fever, leg pains, headache, sensitivity disorders (tingling), vomiting and dizziness. Paralysis can follow immediately or take several days – even weeks – to develop, depending probably on the HCN dose ingested. An efficient treatment, if administered early, is the intravenous injection of thiosulphate, which converts HCN into harmless thiocyanate. The lower the protein content of the diet, the more likely this poisoning becomes. The sulphurous amino acids interact with vitamin B_{12} to detoxify HCN in the organism by transforming it into thiocyanate. A protein-poor diet reduces the number of amino acids in the blood, thus impeding detoxification. A protein-poor diet also increases the likelihood of dietary kwashiorkor, which is why the epidemics of spastic paraparesia associated with cassava consumption are often combined with kwashiorkor epidemics; in these conditions, mortality is often high. The appropriate response is to vary the diet of the affected populations, teach them and provide them with the means to detoxify cassava, and to supply them with thiosulfate for injections.

[11] See Chapter VIII.

[12] Spastic paraparesia: partial paralysis mainly affecting the lower limbs and accompanied by muscular contractions.

Cassava transformation and preparation methods are generally adequate to transform linamarin into HCN and then remove the HCN through dissolution and evaporation (above 28°C). Pre-soaking the roots for five days reduces the HCN to approximately 3% of its initial concentration (FAO, 1991). The safest cassava detoxification methods consist in peeling, soaking and fermenting (during several days), and then crushing it into a pulp that is then pressed, cooked and dried. Drying or cooking alone are inadequate methods. On the other hand, cooking the leaves in initially cold water reduces the HCN content to below its toxicity threshold.

Generally, cassava is transformed through peeling, soaking, fermenting or reducing it to pulp, paste, gruel or chips. It can also be turned into flour after detoxification through soaking and fermenting, followed by drying and pounding. Young roots contain little linamarin and can be eaten fresh and whole, after boiling. Cassava products can be boiled, steamed, braised, roasted or fried.

1.2.5 Sweet potato

Sweet potato (*Ipomoea batatas*) is akin to the common potato, and its cultivation spread at the same time as cassava and the common potato, with the return of the navigators of the 16th century. In Europe, its popularity was surpassed by that of the common potato, but it rapidly gained ground in Asia; its progress in Africa was slower. In Papua New Guinea, the huge yield of sweet potato per hectare eventually made it the number one energy source among cultivators. This particular monoculture showed its limits and dangers during the 1997 famine, which was caused by an unprecedented drought. Like cassava, sweet potato can be kept in the ground and is also fairly drought-tolerant. On the other hand, it spoils quickly after its harvest, and is fragile to transport.

Sweet potato does not require specific preparation; it is eaten boiled, roasted, fried, baked or heated on leaves spread on hot stones.

1.2.6 Yam

Yam (*Discoroae species*) requires considerable rainfall, and is thus found in the humid tropics and equatorial regions. It is considered to be the tastiest tuber, and is highly popular (FAO, 1989b). Common yam forms large tubers that can weigh up to 20 kg. Some varieties produce bitter and toxic molecules (they are called bitter yam), and are usually cultivated in anticipation of scarcity or to deter thieves. They are detoxified by washing, fermenting and roasting. Yam is usually eaten fresh, peeled, boiled and compressed into a paste. More rarely, yam is cut up and cooked, then sun-dried and pounded or milled to produce flour.

1.2.7 Plantains

Plantains are bananas picked unripe and eaten like other starchy plants: boiled, braised or baked, made into paste, roasted, fried or made into flour. All bananas grow sweet if allowed to ripen. The plantain variety called *Musa paradisiaca* is very similar to the sweet banana *Musa sapientum* that is most commonly eaten raw; it is simply mealier than the latter, and is preferred green (i.e. unripe). In Central and East Africa, plantains are also widely cultivated to produce local beer; this production is particularly important in Rwanda, Burundi and Uganda.

1.2.8 Taro

Taro (*Colocasia esculenta*) is the staple food in the Pacific islands and some regions of Asia and Africa; it is used in the same way as yam.

1.2.9 Sago

The sago tree is a South-East Asian palm tree (*Metroxylon sagu*); sago is the pulp extracted from the felled tree trunk. The pulp is washed and pressed to produce a paste that contains practically only starch. The paste can be fermented or not, and is then steamed, baked, roasted, fried or dried to produce flour whose energy content is approximately 350 kcal (1,463 kJ) per 100 g. Fermenting improves the flavour of the paste, and simultaneously increases its nutritional quality.

1.3 LEGUMES

In terms of ingested amounts, legumes (or pulses) only seldom provide a staple food; their role in human nutrition is nevertheless central, as an indispensable complement of staple foods so as to balance the diet. This point is particularly important during weaning.

Legumes are plants that bear edible seeds in pods or shells; however some legumes such as beans can be eaten whole. Strictly speaking we eat legume grains, and not – usually – legumes, just as it would be more accurate to say that we eat cereal grains (and not cereals). The legume family is considerable (including some 18,000 species), and ranges from tiny plants to large trees. Legumes are found and cultivated throughout the world. Like cereals, legumes have always been part of the human diet, just as they have been cultivated ever since the early days of agriculture. The worldwide cultivation of legumes is one-tenth that of cereals, but the diversity of legumes is far greater, with more than one hundred cultivated species contributing to the human diet, that is not to mention wild legumes. Moreover, these species often include several botanically distinct varieties, and countless cultivars.[13] The main edible legume families are peas, lentils and beans. The use of the word “legumes” usually refers to the dried grain, the form in which they are most commonly found. They can however be eaten fresh, straight after harvest, as is the case for green peas, green beans, snow peas (*Pisum sativum macrocarpon*, eaten with their pod) and broad beans (*Vicia faba*). The nutritional density of fresh legumes is approximately one-third that of their dried grains. A healthy way of eating legumes is to sprout them – this makes them more digestible, and causes vitamin C synthesis in significant amounts (13 mg/100 g of sprouted soy bean).

1.3.1 The food value of legumes

The food value of legumes is excellent; thus, even if their importance is secondary in terms of ingested amounts, their role is essential in balancing cereal-based diets or enriching starch-based diets. The many edible legume varieties all share a similar chemical composition, lending them similar food characteristics. Table 5.5 below indicates typical nutrient values of legumes (peas, beans and lentils) generally.

[13] Cultivar: a variety of a plant developed from a natural species and maintained under cultivation.

Table 5.5 Food value of dry legumes / 100 g

Nutrient	Range of values	Standard reference value	Comments
Energy (kcal) ((kJ))	320 – 370 (1,340 – 1,550)	340 (1,420)	Groundnut/peanut: 580 (2,425)
Protein (g)	20 – 26	23	Soy: 35
Lipids (g)	1 – 5	3	Groundnut/peanut: 45 Soy: 18
Glucides (g)	50 – 60	55	
Calcium (mg)	60 – 180	120	
Iron (mg)	4 – 8	6	
Thiamine (mg)	0.2 – 0.7	0.5	
Riboflavin (mg)	0.1 – 0.3	0.2	
Niacin (mg)	1.5 – 2.5	2	Groundnut/peanut: 17

Dried legumes are rich in protein (twice as much as cereals, and 10 to 20 times more than starchy plants), energy (of which more than 90% is supplied by the protein and glucides) and B group vitamins. They contain no vitamin A, and little or no vitamin C. Legumes also contain greater concentrations of iron and calcium than cereals do but, as in the case of the latter, the absorption of these two elements is strongly diminished by the presence of phytates. Legumes furthermore provide a good source of fibres that protect against bowel cancer, and their consumption helps to limit blood cholesterol levels.

In many regions, the diet of the poor is monotonous and unvaried. Legumes are then a crucial complement, particularly of cereals whose lack of protein, B group vitamin and vitamin C (after sprouting in some circumstances) are thereby compensated. In fact mankind has always and everywhere combined cereals and legumes: rice and soy in the Far East, wheat cakes and chick peas in the Middle East, wheat cakes and lentils or beans in India, maize and beans in the Americas, sorghum or millet and beans in Africa, bread and broad beans or lentils in Europe. Legumes also provide good complements for starchy plants.

Combining legumes and cereals

Protein complement

In terms of egg protein, whose human retention efficiency is one of the best, legume protein is richer in lysine, but poorer in sulphurous amino acids (methionine/cysteine); cereal protein on the other hand is poorer in lysine and sulphurous amino acids (less so, however, than legume protein). As a result, combining cereals and legumes significantly enhances the quality of the overall protein intake (but not as much as egg protein, because sulphurous amino acids remain a limiting factor). Table 5.6 below illustrates the diet improvement resulting from a 3/4 cereal – 1/4 legume combination. It compares the amount of ingested cereals (underlined) required for different age groups to meet the need for lysine and sulphurous amino acids, and the amount of the cereal-legume complement or combination (underlined) necessary to achieve the same result.

Table 5.6 Improvement of the protein value of cereals, when combined with legumes

Age	Energy requirements[a] (kcal/day) ((kJ/day))	Protein requirements[b] (g/day)	Requirements in limiting essential amino acids in cereals and legumes[c]		Cereals required to meet protein needs according to limiting amino acids (g/day)			Protein and energy provided by the underlined amount of cereal		3/4 cereal – 1/4 legume combination to meet protein needs according to the limiting amino acids (g/day)			Protein and energy provided by the underlined combination amount	
			Lysine (mg/day)	SAA[d] (mg/day)	Cereal	According to Lysine	According to SAA	Protein (g)	Energy (kcal) ((kJ))	Cereal - Legume	According to Lysine	According to SAA	Protein (g)	Energy (kcal) ((kJ))
6 – 9 months	810 (3,390)	14	924	588	Wheat	356	126	37.7	1,181 (4,940)	Wheat-B[e]	161	127	21.4	522 (2,180)
					Maize	433	249	35.9	1,589 (6,640)	Maize-B	174	223	25.9	782 (3,270)
					Rice	343	226	24	1,193 (4,990)	Rice-B	164	215	22.8	724 (3,030)
3 – 5 years	1,550 (6,480)	17.5	1,015	437.5	Wheat	391	94	41.5	1,298 (5,430)	Wheat-B	187	113	24.9	605 (2,530)
					Maize	475	185	39.4	1,743 (7,285)	Maize-B	191	166	22.2	670 (2,800)
					Rice	377	168	26.4	1,311 (5,480)	Rice-B	180	160	19.1	605 (2,530)
7 – 10 years	1,950 (8,150)	27	1,188	594	Wheat	457	127	48.4	1,517 (6,340)	Wheat-B	219	153	29.1	709 (2,960)
					Maize	556	251	46.2	2,040 (8,530)	Maize-B	224	225	26.1	790 (3,300)
					Rice	441	228	30.9	1,534 (6,410)	Rice-B	211	218	23.1	731 (3,055)
18 – 30 years	2,450 (10,240)	52.5	840	892	Wheat	323	191	34.2	1,072 (4,480)	Wheat-B	155	230	30.6	746 (3,120)
					Maize	393	377	32.6	1,442 (6,030)	Maize-B	158	339	39.3	1,187 (4,960)
					Rice	312	343	24	1,194 (4,990)	Rice-B	149	327	34.7	1,098 (4,590)

[a] WHO, 1985; Tables 42 and 49.
[b] *Ibidem*; needs are quantified in terms of the consumption of protein with the same quality and digestibility as milk or eggs (WHO, 1985; Table 38).
[c] WHO, 1985; Table 38.
[d] SAA: sulphurous amino acids considered as a whole (methionine & cysteine).
[e] Wheat-B indicates that wheat is combined with dried beans, beans being the legume referred to in this example. The same comment applies to subsequent uses of the letter B following a type of cereal.

Table 5.6 allows for the digestibility of cereal and legume protein, according to the data contained in Table 36, "Energy and Protein Requirements" (WHO, 1985). The amino-acid values providing the basis for the above calculations are drawn from Souci (Souci *et al.*, 2008).

Table 5.6 clearly shows that, referring to cereals consumed alone, only half the cereal-legume combination is enough to meet the essential amino-acid needs of children. For adults, on the other hand, sulphurous amino acids remain largely limiting, and between 70 and 95% are thus required, according to the cereal under consideration. This is unimportant for adults, because (with the complement or the cereal alone) they meet 100% of their essential amino-acid need, but less than half of their energy requirements, allowing them to complete the shortfall with other foods. However, the use of a combination is essential for children, particularly infants under 1 year: for cereals alone to meet their essential amino-acid needs, babies would need to consume more than the food required to meet their energy needs, leaving no room for other foods that are rich in vitamins and minerals.

Moreover, the amount of complement/combination necessary to meet essential amino-acid requirements varies according to age and the constituents of the mix. Furthermore, these amounts also vary according to the relationship between the constituents themselves. Generally and qualitatively speaking:

⇨ the optimal ratio allowing an adequate coverage of essential amino-acid requirements with the smallest amount of complement is not fixed; it varies according to age group (which defines the nutritional need) and the constituents of the complement (which determine respective intakes of limiting amino acids);
⇨ the smallest amount of complement required to meet the essential amino-acid need is not fixed either, because it is determined by the age group, complement components and their relation.

The data provided in Table 5.6 leads to the following quantitative recommendations: a 60 g legume complement combined with a 180 g cereal complement (1/4 and 3/4 respectively) providing 830 kcal (3,470 kJ) and 32 g of protein represents a safety intake of essential amino acids for all age groups. On the other hand, it is sufficient to meet overall protein requirements only up to the age of ten. Furthermore, one must allow for the need to absorb, in addition to the complement, what is required to meet the energy need, or risk the protein being utilized as a source of energy and not as protein. As a result, teenagers and adults not only require a complementary energy intake, but the latter must also consist of a protein complement so as to meet the overall nitrogen need.

The 60 g legume/180 g cereal complement only covers approximately one-third of the energy needs of teenagers and adults; the balance must be met with available cereals (and all this only makes sense if the diet is based mainly on cereal, without protein complements other than legumes).

Completing the cereal-legume complement with a cereal supplement up to the energy need also contributes to the overall nitrogen need; this can be easily illustrated as follows.

⇨ A 16-year-old girl whose maintenance energy need is 2,150 kcal (8,990 kJ)/day, and whose safety protein need is 44 g/day must ingest 1,320 kcal (5,520 kJ) of energy supplement – approximately 380 g of cereals, that simultaneously provide 38 g of protein. Allowing for digestibility, the protein intake that is biologically available is 56 g of protein, which is amply sufficient. The overall cereal/legume ratio thus rises to 560 g of cereal to 60 g of legumes (i.e. approximately 11% of legumes in the ration).
⇨ A 25-year-old man whose maintenance energy need is 2,450 kcal (10,240 kJ)/day, and whose safety protein need is 52.5 g day must ingest 1,620 kcal (6,770 kJ) of energy supplement – approximately 460 g of cereals, that simultaneously provide 46 g of protein. Allowing for digestibility, the protein intake that is biologically available is 62 g of protein, which is likewise amply sufficient. The overall cereal/ legume ratio thus rises to 640 g of cereal to 60 g of legumes (i.e. approximately 9% of legumes in the ration).

In short, a group that has access to cereals mainly can balance its protein intake by a minimal daily consumption of 60 g of legumes for all its members, completing this with cereals up to the energy requirement. This measure is crucial for infants under 1 who are highly vulnerable with respect to the coverage of their protein needs, especially if their weaning is abrupt, and if their diet is not varied and devoid of animal products.

B group vitamin supplements

Legume seeds contain slightly more thiamine and riboflavin than cereal seeds; however, they complement the latter mainly because they usually suffer no losses during grinding, and much lower losses during preparation (especially in comparison to rice). Legumes therefore provide a good protection against pellagra and beriberi when they complete diets based primarily on maize or rice, especially if the latter is not steamed prior to husking and polishing. To mitigate the risk of beriberi in a diet mainly based on rice that has not been steamed, but polished twice, at least 20 to 25% of the energy requirement must be absorbed in the form of legumes.

Data regarding the average amount of niacin actually biologically available in maize is inconclusive. As a result, it is impossible to make firm recommendations regarding the amount of legumes to be added to a maize-based diet in order to mitigate the risk of pellagra. Experience with groups whose diet depends entirely on humanitarian relief nevertheless shows that a ration of 25% of legumes and 75% of maize always provides an effective protection against pellagra.

Vitamin C supplements

As mentioned above, the germination of legumes causes significant vitamin C synthesis. A simple technique used in drought and famine settings, for example in India and Ethiopia, consists in soaking approximately 40 g of unshelled legumes per person for 12 to 24 hours. The grains are then removed from the water, spread in a thin layer between two wet blankets that are then kept wet by regular water sprinkling. The legumes sprout and produce ascorbic acid, and its maximum content is reached after some 30 hours of germination: 40 g of germinated legumes contain 12 to 20 mg of vitamin C – a sufficient individual daily amount to forestall scurvy (Davidson, 1979).

The three roles of legumes as cereal complements described above are of particular relevance to food relief. The commodities that should be distributed to meet the overall nutritional need are well understood; however, many factors complicate this, and rations are therefore very often incomplete. Resorting to legumes resolves this problem to a certain extent.

A relief ration representing most of the food supply and consisting mainly of cereals and legumes (80% of the calorie intake) should contain 3 parts of cereal to 1 part of legumes – the legumes, thus account for some 20% of the overall energy intake. This meets the protein and B group vitamin requirements. Moreover, the risk of scurvy disappears if the diet includes approximately 40 g/day/person of sprouted legumes.

Such a ration however usually contains a greater proportion of legumes than are normally consumed. As a result, if the vitamin and mineral ration can be balanced by other means than legumes, the latter can be reduced down to a minimum threshold of 60 g per person per day; this ensures an adequate protein intake without involving the preparation and consumption of excessive amounts of legumes.

Combining legumes and starchy plants

In starch-based diets, legume complements offer the double advantage of varying the meals and improving their flavour. They also increase the protein content of such diets, without however significantly enhancing the quality of the ingested protein in terms of amino-acid content. Like legumes, starchy plants are poor in sulphurous amino acids in terms of human requirements. Unlike cereals therefore, the combination of legumes and starchy plants does not result in a protein compensation.

Foods based on the common potato, yam and, to a lesser extent, sweet potato provide a satisfactory protein supply per energy unit, and the protein is of high quality. On the other hand, the energy and protein density is weak with respect to consumed amounts and thus poses a problem, especially during weaning when infants do not have the stomach capacity to absorb the amount required to meet both the energy and protein need. As a result, legume complements are useful in providing children with an adequately concentrated diet. This role is even more important in diets based on cassava, plantain and sago, whose amino-acid composition is poor, whose protein density is weak in terms both of volume unit and energy unit, and whose energy density is likewise fairly low.

However, legume complements in poor diets based on starchy plants cannot resolve nutritional security on their own. The variety of the diet must be enhanced by all possible means, affording access to fresh fruits and vegetable, in addition to animal products and oilseeds. This also holds true for poor diets based on cereals, but special attention must be devoted to those involving starchy plants, as the latter eventually turn into the main source of food when nutritional crises become chronic.

1.3.2 The utilization of legumes

Legume varieties

There is a vast variety of legumes, and it is impossible to discuss them comprehensively here. Rather, field investigation should determine locally used varieties in each specific context, together with acceptable alternatives. This Manual only discusses the most common, those whose international trade has spread widely. However, more marginal, lesser-known varieties exist; they are local specialities whose yield is often lower or that are more complicated to utilize, but they are generally well adapted to the local ecology and often suffer from the competition of imported varieties. The commonest legumes and their main regions of consumption are briefly summarized in Table 5.7.

Table 5.7 Common legumes and consumption regions

Legume	Main consumption regions
Groundnut (peanut) *Arachis hypogaea*	West Africa, North America, Indonesia
Hyacinth bean (Lablab bean) *Dolichos lablab*	West Africa, India
Broad bean *Vicia faba*	Europe, Mediterranean, Middle East
Grass pea *Lathyrus sativus*	India
Common bean *Phaseolus vulgaris*	Latin America, Caribbean, North America, Central and Southern Africa, Europe
Lima bean (butter bean) *Phaseolus lunatus*	All humid tropical and subtropical regions
Yam bean *Pachyrrhizus erosus*	Humid tropical Africa
Gram (mung bean) *Vigna radiata*	India, spreading in Africa
Lentils *Lens culinaris*	Europe, Mediterranean, Middle East

Green pea *Pisum sativum*	Europe, Mediterranean
Bambara groundnut *Voandzeia subterranea*	West Africa
Pigeon pea *Cajanus cajan*	Humid tropical Africa, India, Caribbean
Chickpea *Cicer arietinum*	Mediterranean, Middle East
Soybean *Glycine max* or *Glycine soja*	Far East and South-East Asia

Two legumes play a major role in human nutrition: groundnut and soybean. Groundnut (or peanut) is rich in lipids (45 g/100 g, i.e. 15 times the average general legume concentration). It also contains a high concentration of niacin (17 mg/100 g or 30 mg/1,000 kcal (4,180 kJ)) – recommended intakes can therefore be met with 40 g of groundnut for 1,000 kcal (4,180 kJ) absorbed. Finally, the consumption of groundnuts does not cause flatulence, unlike other legumes. These characteristics have made it a major complement in starch-based diets, and an excellent weaning food. Soybean is rich in protein (1.5 times the average legume concentration) and lipids (6 times the average legume concentration). Soybean is therefore another excellent staple diet complement, for example in the Far East where the poor eat almost only rice. The oil and pastes extracted from groundnut and soybean are also very useful in human and animal nutrition.

Problems arising from the utilization of legumes

In spite of their excellent food value, legumes are less used than would seem logical; they usually only serve as complements for staple diets, but not as staple foods themselves. Several reasons – taken in combination or in isolation – explain this.

Yield

In the subsistence economy of poor countries, the surface yield of legumes is half or one-third that of cereals, and one-tenth (or less) that of starchy plants. Where the cultivated surface matters, farmers need to optimize the overall return on their labour and make choices. Staple foods obviously take precedence. On the other hand, intercropping can result in interesting improvements for cereals, starchy plants and legumes; the former protect the legumes from heat and cold, the latter enrich the soil in nitrogen.

Flatulence

The consumption of legumes other than groundnuts causes flatulence, which can entail considerable discomfort particularly for infants during weaning. This is one of the main reasons for legumes not being consumed in larger amounts. There is no solution to this problem, other than – to a certain extent – protracted cooking.

Preparation

Dried legumes require much time and work before they can be eaten. They also harden during drying and storage, and therefore demand lengthy cooking. This involves expenses in time and other resources to secure the required fuel, and the cooking time itself discourages a more intensive use of legumes.

Husking and preliminary soaking with or without baking soda are two methods aimed at reducing cooking times significantly (by 50 to 90%). Only adding salt at the very end of the cooking process also shortens it (adding it at the beginning slows down the cooking).

Losses resulting from storage

Storage can expose legumes to rodents and insects. In the case of domestic storage, losses often reach 20%, and can exceed 50%.

Where possible, the use of insecticides during plant growth significantly reduces the risk of infestation during storage. Moreover, the quality of the drying process is very important, as are fumigation and storage temperature. In subsistence agriculture, small-scale farmers can reduce storage losses by firmly packing clean and dry grains in airtight containers, and storing the latter away from heat.

Digestion

The protein and starch contained in legumes are more difficult to digest than those of cereals and starchy plants, and sometimes cause bloating and discomfort.

Protracted cooking reduces these effects, as do preliminary treatments such as husking, sprouting, malting, crushing, fermenting and roasting.

Adverse factors concerning the food itself

Inhibitors of the protein digestion enzymes
These substances inhibit digestion by blocking the digestive enzymes. Boiling eliminates the inhibitors of digestive enzymes, provided it is long enough (up to several hours). Sprouting helps to some extent.

Phytohaemagglutinin (PHA)
Also called lectin, PHA agglutinates mammalian red blood cells (erythrocytes) and destroys them, causing food poisoning; it also impairs the quality of ingested protein (Aykroyd, 1982). Soaking before cooking, followed by covered boiling for several hours alters PHA and, therefore, reduces its negative effects. Sprouting also alters PHA to some extent.

Phytates
Phytates significantly reduce the absorption of calcium, iron and zinc, and impair protein digestibility. Normal cooking destroys phytates, whereas sprouting only partly alters them.

Cyanogens
Legumes, particularly Lima beans, contain linamarin that produces hydrogen cyanide under the action of an enzyme. In addition to its toxic effect itself, hydrogen cyanide is transformed in the organism into thiocyanate, a substance inducing goitre. Hydrogen cyanide is a water-soluble toxin; as a result, soaking followed by rinsing and boiling eliminates the toxin almost entirely. Lima beans contain high levels of hydrogen cyanide, but also of its precursor, linamarin, which is resistant to soaking, rinsing and cooking. This bean is the most toxic in terms of hydrogen cyanide and should therefore be crushed and soaked for 24 hours at room temperature (Aykroyd, 1982).

Miscellaneous
Other factors worth mentioning include the allergenic potential of legumes (particularly soy milk for infants), their content in anti-vitamin and anti-mineral substances, and the presence of protein digestion inhibiting tannins. In most cases, husking, soaking and boiling mitigate most of these anti-nutritional factors, allowing the organism to eliminate the remainder harmlessly.

Lathyrism

Lathyrism is an irreversible paralysis of the nervous system resulting from the excessive consumption of grass pea (*Lathyrus sativus*), which is particularly drought-tolerant. In the arid areas of India, it is planted at the same time as cereals to serve as a reserve in case of a poor cereal harvest. Normally, grass pea is consumed in far smaller amounts than the staple food, and thus presents no danger. When grass pea accounts for more than 30% of the diet, however, lathyrism develops within 3 to 6 months (Aykroyd, 1982). Lathyrism affects the lower limbs mainly. The toxin responsible for lathyrism (B-oxalyl aspartic acid) is water soluble like hydrogen cyanide. Husking, followed by soaking for 12 hours, thorough rinsing and boiling for approximately 1 hour reduce toxins to levels that are harmless for the organism. Despite the simplicity of this detoxification method, lathyrism remains a serious public health problem in India, Bangladesh, and Ethiopia, because grass pea is usually crushed dry, and the resulting meal is then mixed with wheat flour to produce patties. The toxin is therefore not eliminated. On the other hand, rinsing the peas, boiling them and leaving them in the water to cool for 2 hours, then decanting the water and allowing the grains to dry in the sun provides well detoxified peas that are safe to use to produce patty flour (Dwivedi, 1975).

Favism

Favism is associated with the excessive consumption of broad beans (*Vicia faba*) and the inhalation of the plant's pollen. The condition only affects individuals suffering from a genetic deficiency in the enzyme glucose-6-phosphate dehydrogenase (G6PD), which influences the stability of the red blood cell membrane. The reaction manifests itself in haemolytic anaemia and high fever within minutes following pollen inhalation, or within the hours following the ingestion of the bean. It can be fatal within 1 or 2 days, quite frequently so in young children. If the patient survives the acute phase, he recovers within 4 weeks approximately (Aykroyd, 1982). Deficiency is more common among men than women, and is widespread in the Mediterranean. The only protection against favism is to refrain from eating broad beans if one appears to react to them.

Aflatoxins

Aflatoxins are produced by a fungus (*Aspergillus flavus*) and are the most potent known causes of cancer. The fungus develops on almost all grains stored in humid and hot conditions and handled without due consideration for hygiene. The quality of the grain drying is also essential in arresting the development of the fungus. Aflatoxins contaminate cereals and legumes alike, but particularly maize and groundnuts. Moreover, they can then pass into the food chain, for example through the milk of animals fed on contaminated cereals. The recommended aflatoxin ceiling level is 0.5 μg per litre for milk, and 20 μg per kilogram for other foods. These levels remain high if one considers that animals exposed long-term to diets containing 15 μg of aflatoxins per kilogram of food all developed tumours. The toxicity of aflatoxins is greater among young people than the elderly, and among males than females.

Aflatoxin contamination can be avoided by ensuring that grains are thoroughly dry prior to storage. They must then be stored carefully in a dry, clean, cool place, if possible in airtight containers.

The above may suggest that the preparation and consumption of legumes is both tedious and risky. This is true only in crises, when options and means are scarce and assistance is external. It is worth stressing the fact that normally – lathyrism, favism and aflatoxins notwithstanding – people usually know how to utilize legumes, based on thousands of years' experience. Changes in lifestyle and eating habits, prompted by external interference in crises, can inhibit this knowledge. The delivery of food relief must always involve the ascertaining that recipients know how to prepare the legumes they receive; likewise, the variety that is locally known should be distributed, because preferences are usually strong in view of the always pronounced flavour of these foods.

Legume preparation

Problems arising from the utilization of legumes require the development of indispensable preparation methods. Traditional age-old methods have resulted in the production of nutritious and tasty dishes to complement staple foods.

Soaking

The process of soaking prior to cooking is widespread. In Rwanda, nevertheless, groups met by the author refrained from soaking as they believed that the beans would thereby lose their flavour. Soaking contributes to eliminating the envelope, reduces toxin levels, and shortens the cooking time by saturating and softening the grain. Soaking times change according to variety, and must be proportional to the storage time. A common practice is to soak the legumes overnight at room temperature; they can also be soaked in hot water, reducing the soaking time.

Husking

Husking is the removal of the sometimes hard envelope of legumes, in order to improve flavour and digestion, but mainly to shorten their cooking. Husking consists of detaching the envelope through roasting, the application of oil and drying, or soaking and drying. The envelope is then removed by abrasion with different techniques ranging from the domestic mortar to industrial machines. In India, husked legumes are called *"dhal"*, a word that has spread and is now commonly used in reference to any husked legume. Husking is however not universal: in India, where the process is most widespread, only 75% of the legume production is transformed into dhal. In some places, husking is not systematic, or occurs automatically during soaking and cooking.

Cooking

Cooking is the most important stage to enable the consumption of legumes, because it destroys most of the toxins and enhances both flavour and digestibility. The two main methods are wet cooking (boiling or braising) and dry cooking (roasting or frying). Wet cooking allows legumes to retain approximately 70% of their water-soluble vitamins and 80% of their minerals other than sodium (Aykroyd, 1982).

Sprouting and malting

Sprouting is common in Asia, especially in the Far East. To sprout, the non-husked grain must be soaked, then patted dry and placed on a humid surface. The process takes a few days during which the grains are frequently rinsed. Sprouting splits the envelope, which is then easy to remove, and causes biochemical reactions that improve the food value and the flavour of the grain, while resulting in a partial degradation of the phytates, lectins and enzyme inhibitors. As mentioned above, sprouting causes significant vitamin C synthesis. Sprouting can be combined with malting, which consists in stopping the process by roasting the sprouted grain. Malting enhances both digestibility and flavour.

Fermenting

Fermenting is an age-old process involving legumes as the basis for highly digestible and tasty foods and spices; the best known is probably soy sauce. Fermentation techniques vary greatly and can be quite sophisticated; they usually concern legumes that are still not really edible after soaking, husking and cooking. This is particularly true for soybeans, which are mainly eaten fermented in some way or other, or sprouted.

Finally, legumes as food plants are useful because of their grains, but also their pods, flowers, leaves and tubers. This contributes greatly to meeting the need for vitamins, minerals and protein, and considerably enhances diet variety and flavour.

The preparation of legumes takes many forms that cannot all be discussed here. Globally, they can be eaten whole, reduced to pulp, as patties, pastes or crushed, each form having inspired a host of recipes to make the dish appealing. In most developing countries, it is the legumes and their accompanying sauce that enhances the blandness of staple foods. In industrialized countries, legumes are often treated before sale, resulting in short-cooking dry or canned legumes, ready to heat.

1.4 OILSEEDS

The listing of oilseeds follows no set rule; this manual simply describes a number of energy-rich foods whose common denominators are their high lipid content and the fact that the lipids are extracted from them. Their protein concentration is also quite high. Soybean and groundnut are sometimes associated with them because they are oil-producing legumes. This Manual adopts the botanical approach, and the latter two plants are therefore discussed in the previous section on legumes. Oilseeds can be subdivided into those that are eaten whole and whose oil is also extracted, and those that produce butters or oils only. Noteworthy is the fact that, in addition to common cultivated oilseeds, there are many semi-wild, semi-cultivated or specially protected (e.g. grasses, trees, creepers) local plants; they play a major complementary role in the diet, as well as providing a source of lipids, both during normal times and during hunger gaps or periods of scarcity. Outsiders can easily overlook such resources, disregarding the importance of picked or gathered products in the normal diet and in the mechanisms of food and economic security.[14]

1.4.1 Oilseeds for consumption and oil extraction

This category includes nuts and what is commonly referred to as seeds. Nuts include walnuts, hazelnuts, almonds, pistachios, cashew nuts, Brazil nuts, macadamia nuts in addition to other, less familiar exotic varieties such as the Mongongo nut common in southern Africa. An edible portion of 100 g of dried nuts provides on average 650 kcal (2,717 kJ), for 14 g of protein, 60 g of lipids, and 14 g of glucides. Nuts are good sources of thiamine and riboflavin, but contain little niacin and no vitamin A and C. They contain iron and good amounts of calcium.

The most familiar seeds are sunflower, sesame and linseed, in addition to those from the many pumpkin and melon varieties. Without their envelope, the average energy value of 100 g of these seeds is 550 kcal (2,300 kJ), for 23 g of protein, 46 g of lipids, and 11 g of glucides. Their vitamin and mineral content is similar to that of nuts.

Nuts and seeds keep well. They can either be eaten as they are or prepared, or used for oil extraction, the energy content of the latter reaching 900 kcal (3,760 kJ) per 100 g. The residual meal remaining after oil extraction is protein rich and often serves as animal feed. The utilization of nuts and seeds serves different purposes: snacks, enhancing the flavour and/or the food value of dishes, economic resource, food complement, particularly during hunger gaps or lean seasons.

[14] The industrial utilization of oilseeds is not discussed in this Manual, which refers mainly to their domestic use.

1.4.2 Oilseeds as sources of lipids

Cocoa beans, Illipe nut (*Shorea spp.*) and shea nut (*Butyrospermum parkii*) are used to extract fatty matter called "butter" (cocoa, Illipe, shea butter). They are rather congealed – although their viscosity depends largely on room temperature, preparation mode and their degree of refining. The fruit of the oil palm provides the β-carotene rich palm oil, the fruit of the olive tree provides the healthy[15] mono-unsaturated oleic acid, and the fruit of the coconut tree produces the (unhealthy) saturated fatty-acid rich coconut oil.

Cottonseed, rapeseed, safflower, grape seed, colza seed and mustard seed all produce edible oils. The energy value of all these fats is approximately 900 kcal (3,760 kJ)/100g.

V

1.5 VEGETABLES

Intuitively, everyone knows what vegetables are; it is however difficult to define them from a nutritional perspective, and they escape all botanical classification. They are edible plants – entirely or in part – that do not keep well, implying that they must be eaten fresh or dried or preserved, and that cannot serve as staple foods owing to their low energy density. Nevertheless, garden vegetables that are extremely cheap to produce can play a major role in the rural daily diet. Vegetables also improve the variety and flavour of the diet, and play a decorative role. The edible parts of vegetables include the leaves (e.g. spinach, lettuce, cabbage, amaranth, sweet potato), the stem (celery, cardoon, rhubarb, asparagus), the roots (turnip, radish, onion, carrot), the fruit (tomato, marrow, squash, zucchini, eggplant), and the flower (cauliflower, broccoli, artichoke). People eat vegetables for their taste and because they can produce them, rather than out of nutritional concern. Nowadays, vegetable consumption is actively promoted by health professionals, but it remains difficult to determine consumption trends. In the industrialized West, the proliferation of fast-food chains and the dispersion of families at mealtimes rather run counter to an increase in vegetable consumption. In developing countries, the rural exodus towards urban centres and the urban market price of vegetables are also adverse factors.

1.5.1 The food value of vegetables

The average food value of vegetables is approximately 35 kcal (146 kJ)/100 g of edible parts, for 1.8 g of protein. These values vary greatly, however, according to samples, origin, freshness, season, soil, and the same applies to all the nutrients of vegetables. The nutritional importance of vegetables relates to their high concentrations of β-carotene (the β-carotene content is roughly proportional to the vegetable colour intensity), ascorbic acid (of which a large proportion is however lost during cooking), and folic acid. In terms of these vitamins, vegetables are essential in balancing diets, especially those based on cereals. Vegetables also provide reasonable amounts of riboflavin and minerals such as calcium and iron, but they are absorbed only marginally. Vegetables are also rich in fibre. Recent epidemiological research has confirmed the direct or indirect importance of high vegetable consumption in mitigating the risks of cancer, hypertension, and high cholesterol (role of fibre).

1.5.2 The utilization of vegetables

Vegetables can be prepared in many different ways. Usually, their preparation involves rinsing and peeling to remove the fibrous or bitter parts. They can then be eaten raw with some form of

[15] Notions of "healthy" and "unhealthy" are relevant mainly for environments characterized by excessive calorie intake and lack of energy expenditure through exercise.

dressing, or be cooked and spiced. Preparation types include boiling, braising or steaming, mixed with sauces/gravies, very brief high-temperature cooking in a little fat (scalding – the best way to preserve their vitamins). They can also be preserved by fermentation and canning.

Fresh vegetables play a crucial role in human nutrition in providing the essential vitamins and minerals required for man to lead a normal life and avoid deficiency disorders such as anaemia and xerophthalmia (dryness of the eye that can result in blindness). This aspect does not get the attention it deserves, however, because many populations are intent only on securing an adequate calorie intake. Relief workers in nutritional crises must pay specific attention to the presence or absence of vegetables in the victims' diet, and take the necessary measures to ensure a balanced food intake.

1.6 FRUITS

In botany, a fruit is the ripened ovary – together with seeds – of a flowering plant; in cuisine, the term usually refers to plant products that are sweet and fleshy (such as mangoes, bananas, and apples). Even more so than vegetables, people eat fruit because they like its flavour, smell, its refreshing and thirst-quenching quality and, to a lesser extent, texture. The nutritional importance of fruit arises from its high vitamin C content; most fruit are also rich in β-carotene (all except pears, quinces, lychees, citrus fruit and some berries). The energy content of fruit is low: an average 60 kcal (250 kJ)/100 g of fresh fruit, for which sugar accounts for more than 90%. Fruit also contains limited concentrations of B group vitamins. Normally, fruits contribute to a balanced diet, thanks to their β-carotene and ascorbic acid. In the harvest season, however, their importance can grow substantially, particularly among children who can literally gorge themselves on fruit. The advantage is an evident massive vitamin intake, but the downside is a protein deficiency that can lead to dietary kwashiorkor (as witnessed in epidemic proportions in Angola during the mango season), and the risk of gastro-intestinal infection, promoted by unhygienic handling and high sugar content that can lead to fermentation. Like vegetables, fruits are rich in fibre, thus mitigating the risk of bowel cancer and reducing blood cholesterol levels.

Two types of fruit stand out: banana and avocado. The banana energy content is approximately 100 kcal (418 kJ)/100 g, and it is easily digested when ripe. It is therefore a recommended fruit for infants as from the age of three months, and a significant complement to the staple diet. The avocado energy content ranges between 160 and 200 kcal (670 and 840 kJ)/100 g, mainly of lipid origin. It contains significant amounts of niacin and other B complex vitamins, β-carotene, and vitamin C. As such, it can constitute a major complement.

1.7 MUSHROOMS

Mushrooms are used mainly to vary and spice dishes, conferring on them a well-deserved distinction. But fresh mushrooms only provide 10 to 15 kcal (42 to 63 kJ) and between 1 and 3 g of protein/100 g. They cannot, therefore, contribute significantly to meeting nutritional needs, even if some varieties contain B group vitamins, ascorbic acid and vitamins D and E.

1.8 FATS

Fats are lipid substances used in cooking that are not found in the natural state – they are extracted from animal and vegetable products. Fats include butter and lard (that are congealed at room temperature because of their high saturated fatty acid content), and oils (groundnut oil, cod liver oil), that are liquid at room temperature because they contain polyunsaturated fatty acids. The average energy content of purified fats – especially oils – is 900 kcal (3,760 kJ)/100 g. Fats derive their importance in nutrition from two main factors: they are a concentrated source of energy, and they contribute greatly to the taste and flavour of foods. Furthermore, they can hold high concentrations of fat-soluble vitamins. Because fats are so rich in energy, only a small quantity suffices to improve the energy input substantially; they are however expensive. For those who can afford to eat enough (or more) to satisfy their hunger and choose their foods, fatty matter rich in saturated fatty acids (butter and mammal fat) promote cardiovascular disease through the formation of atheromata.[16] On the other hand, the use of vegetable oils rich in mono- and polyunsaturated fats, combined with a reduced intake of red meat and an increased consumption of fish, has a protecting effect against atherosclerosis provided, nonetheless, that the energy intake is not excessive and that lipids constitute no more than 30 to 35% of that intake.

1.9 ANIMAL PRODUCTS

Animal products first and foremost constitute an excellent source of protein for humans; they are also a significant source of vitamins and minerals. However, like fats, animal products are often very expensive, and the poor are usually unable to consume them regularly in reasonable amounts. It is therefore useful to remember that animal products are not indispensable to man, who can balance his diet with vegetal products – for example by combining cereals and legumes. In addition to the animals usually eaten, many others serve as food or source of income for many populations, be it mammals, birds, fish, molluscs, shellfish, amphibians, reptiles, insects, larvae or worms. Their nutritional value is often significant, especially during nutritional crises, but like gathered foods, these hunting and fishing products often go unnoticed.

Animal products are quite popular; they improve flavour and the nutritional properties of the diet, and thus enhance its variety. Wherever they are eaten, their social status is high, and theirs is usually a clear place in the food accompanying rites and celebrations: Christmas turkey, Easter or Eid-el-Kabir lamb, sacrificing a cow for funerals (the slaughtering itself often constitutes a ritual). On the other hand, their cost usually prevents them from being a staple food, other than in hunting or fishing communities.

1.9.1 Meat and offal

Meat and offal constitute the edible flesh of warm-blooded animals – although the flesh of reptiles, where they are eaten, can also be referred to as meat. The expression meat refers to skeletal muscle, and is subdivided into red (beef, mutton, horse), white (poultry, veal, pork, rabbit), and black (game such as boar, hare, deer, dikdik, woodcock, agouti, bush rat, possum, and monkey meat). Offal refers to everything edible in an animal other than skeletal muscle, that is the internal organs (heart, liver, kidney, brain, tripe, thymus[17]) and the rest: feet, snout, tongue, tail, ears, and marrow. As mentioned above, many warm-blooded animals other than the conventional butchery and hunting animals exist that are hunted or reared by man, and can contribute significantly to the diet. Meat is an average source of energy, provided by the protein and lipids. However, the energy value of meat varies according to its lipid content, its protein remaining rather constant. Lipid variations are determined by species, the cut, the animal's lifestyle and its diet. Generally speaking, domesticated animals are fatter than wild animals, and domesticated animals subjected to industrial rearing are fatter still than those that must feed themselves. For example, at the end of the dry season, the lipid content of a nomadic (roaming) Sahelian cow is closer to that of the deer and antelope than that of industrial Angus beef. Therefore,

[16] Atheroma (pl. atheromata): A fatty deposit in the inner lining of an artery, resulting from atherosclerosis.
[17] The thymus produces what is referred to in cooking as sweetbread.

significant variations can appear in food composition tables between the reference energy value and the real value of the cut under consideration. Meat contains iron (which is very well absorbed), zinc, in addition to fair amounts of niacin and riboflavin. Table 5.8 below indicates the values of the main nutrients contained in 100 g of meat of the main butchery and hunting species.

Table 5.8 Meat food value / 100g[18]

Food	Energy (kcal) (kJ)	Protein (g)	Iron (mg)	Thiamine (mg)	Riboflavin (mg)	Niacin (mg)
Beef (sirloin)	266 (1,112)	17	2.5	0.07	0.15	4.2
Mutton (leg)	225 (940)	18	2.7	0.2	0.25	5
Veal (sirloin)	175 (731)	19	2.9	0.18	0.27	6.5
Pork (fillet)	290 (1,212)	16	2.5	1	0.2	4.5
Poultry, rabbits, etc.	220 (920)	20	1.75	0.1	0.2	8
Game	120 (502)	22	8.50[a]	0.05	0.1	6

[a] Adapted from Paul and Southgate (Paul & Southgate, 1978).

As discussed above, calorie values can vary significantly according to the lipid content of different meat types; on the other hand, all meat types contain roughly the same amount of other nutrients, except pork (rich in thiamine) and game (rich in iron).

Different types of offal also contain comparable amounts of nutrients, and can thus be described generally as follows:

energy:	130 ± 10 kcal (543 ± 42 kJ)
protein:	16.4 ± 0.3 g
iron:	5.8 ± 2.1 mg
vitamin C:	22 ± 9 mg
thiamine:	0.27 ± 0.03 mg
riboflavin:	1.7 ± 0.9 mg
niacin:	7.3 ± 0.8 mg

The high vitamin C content of offal is worth noting; vitamin C concentration in meat is minute. Liver is the type of offal that usually contains the greatest nutrient concentration, particularly iron (> 10 mg/100 g).

The nutritional characteristics of other warm-blooded animals (e.g. rodents and small birds) are similar to those listed above, except their calorie value, which can vary substantially.

[18] Adapted from Randoin *et al.* (Randoin, 1982).

Meat preparation methods are diverse, but basic methods include simmering, roasting, grilling and frying. Fresh meat spoils quickly, and traditional preservation methods have been developed accordingly – they include drying, salting and smoking, often combined and involve the use of spices and seasoning to enhance the flavour of the meat. Where electrical power and technology allow it, deep-freezing and canning are also excellent preservation methods.

1.9.2 Fish and other cold-blooded animals

The quality of the protein provided by fish and other cold-blooded species is just as good for man as that supplied by meat and offal. Sea fish and freshwater fish contain the same amount of protein: 17.8 ± 1.7 g/100 g of edible flesh. On the other hand, the calorie values vary according to the lipid content, ranging from fish virtually devoid of lipids such as pike, tench, codfish, bream and sole – whose approximate energy value is 80 kcal (334 kJ)/100 g – through fatty fish such as lamprey, anchovy and sardine – 170 kcal (710 kJ)/100 g – to extremely fatty fish such as tuna (230 kcal (961 kJ)/100 g). Furthermore, the reference energy values indicated in food composition tables vary substantially, because the lipid content of fish is not constant, explaining sample fluctuations. Generally speaking, the energy value of most fish is far lower – between 80 and 110 kcal (334 and 460 kJ)/100 g – than that of the meat of domesticated animals. Fish contains moderate amounts of iron (approximately 1 ± 0.2 mg/100 g), and sea fish is the richest food in iodine and also supplies a lot of fluoride. Fritter fish, when eaten whole with their bones, constitute a useful source of calcium. Fish contains approximately the same amount of thiamine and riboflavin as meat, but less niacin. Fresh fish also provides small amounts of vitamins A and C. Fish oil and liver is very rich in vitamins A and D, to the point of toxicity.

Crustaceans share approximately the same general nutritional characteristics as lean fish, while molluscs and shellfish contain slightly less protein and energy, but remain good sources of protein, fluoride, zinc and iron.

Frogs share approximately the same general nutritional characteristics as lean fish (Randoin, 1982; FAO, 1989c); so do reptiles.

The utilization and preservation of fish is similar to that of meat, but fish spoils even faster than meat, and must therefore be prepared even sooner.

1.9.3 Insects and larvae

Many insect species are edible: the best-known include termites, locusts, grasshoppers, crickets and caterpillars, besides many other species that constitute local delicacies. Insects and their larvae are very good sources of protein (10 to 50 g/100 g), lipids (approximately 10 g/100 g), B group vitamins and iron. They are usually gathered at specific times in the year, coinciding with a specific stage in their development or in the overall food availability. Dried, salted, smoked or crushed, they keep well. They are very tasty, especially grilled, and often serve to enhance the flavour of other dishes. Their consumption can go unnoticed, but may account for most of the protein intake.

1.9.4 Blood

Blood is an important food in many pastoral societies, and is used to produce sauces and sausages; it contains high levels of iron (50 mg/100 g), as much protein as meat (18 g/100 g), and its calorie value is 80 kcal (334 kJ)/100 g.

1.9.5 Eggs

All bird eggs share the same approximate food value, except for energy that varies according to their lipid content. Eggs contain all the nutrients required for the development of the embryo up to hatching. For man, its greatest appeal lies in the fact that it provides best quality protein in relation to his need (13 g/100 g). Eggs also provide lipids (12 g/100 g for chicken eggs). They contain no glucides, but fair amounts of thiamine, riboflavin, vitamins A and D and iron (but the latter is only poorly absorbed by the human organism). Eggs are digestible, easy to prepare and to obtain through home production; they are an excellent food for children as from the age of 6 months, and for the elderly.

1.9.6 Milk and dairy products

Milk

Milk alone can feed mammal young from birth up to an age that varies according to species. Milk composition varies according to species and its specific growth requirements – all differences resulting from a functional aspect proper to the species under consideration. Milk composition further varies during suckling and the nursing. Different milk types can be substituted for one another, but none will provide the same quality as that species' own. There is no better milk for a calf than its mother's – and the same reasoning applies to humans. The latter can be fed exclusively on maternal milk until the age of 4 or 6 months, after which they require supplements to meet protein, energy, iron and thiamine needs – this is the beginning of the weaning process.[19] For young mammals to survive and develop normally, the composition of secreted milk must remain fairly constant, in spite of the sometimes major hazards faced by their mothers in securing their own food. Milk secretion mechanisms mobilize the mother's tissues so as to preserve the quality of the milk. If the mother's diet is systematically inadequate, the amount of secreted milk will diminish first, followed by its nutrient content. For a significant alteration of the milk composition, the mother must herself be in a serious state of malnutrition. The quality of secreted human milk begins to drop when the mother's daily intake no longer exceeds approximately 1,200 kcal (5,000 kJ), assuming that she was not obese to begin with. Thiamine is the exception: the organism only contains slight reserves of thiamine, and immediately eliminates any ingested excess. As a result, if a mother develops beriberi, her infant will do so also quite rapidly.

The use of milk from other species in the infant diet and during weaning varies according to culture, its economy and outside influence. This influence can have serious consequences. For example, the promotion in developing countries of the Western practice of cow milk utilization, fresh or powdered, and maternal milk substitutes has had severe repercussions both on the economies of these developing countries, and on health. As a result, the World Health Organization in 1981 promulgated an international code of marketing of breast-milk substitutes. This code is one of the means devised to avoid substituting maternal milk and local weaning products with commercial alternatives.[20] However, where their utilization is common, milk and dairy products are excellent foods, especially because of their protein quality and their high levels of calcium, riboflavin, vitamin A and vitamin C. The only glucide to be found in milk is lactose, whose flavour is less sweet than commercial sugar. Table 5.9 below provides the composition of 100 g of the different milk types consumed by man.

[19] Weaning is discussed in more detail in Chapter VI, in relation to food consumption, and in Chapter XV.

[20] Annex 3 discusses this issue which is to be taken very seriously, particularly in crises.

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Table 5.9 The food value of milk types/100g[21]

Milk	Energy (kcal) (kJ)	Protein (g)	Lipids (g)	Lactose (g)	Calcium (mg)	Iron (mg)	Vitamin C (mg)	Thiamine (mg)	Ribo-flavin (mg)	Niacin (mg)
Buffalo	118 (493)	5.3	9	4	200	0.2	1	0.05	0.12	0.1
Camel	65 (272)	3.2	4.3	3.4	143	0.1	3.5	0.05	0.11	0.3
Cow	68 (284)	3.5	3.9	4.6	125	0.1	0.5 to 5	0.04	0.15	0.2
Cow full, powdered	500 (2,090)	25	26	37	950	0.7	4 to 10	0.3	1.3	0.7
Cow skimmed, powdered	373 (1,560)	38	1	53	1,300	1	traces	0.35	1.8	1
Donkey	43 (180)	1.7	1.1	6.6	–	–	–	–	–	–
Ewe	96 (400)	5.3	6.5	4.3	230	0.05	1 to 5	0.06	0.1 to 0.2	0.3
Goat	72 (300)	3.9	4.5	4.6	146	0.1	1 to 4	0.04	0.12	0.3
Mare	49 (205)	2.3	2	5.6	100	–	10	0.03	0.02	0.05
Reindeer	238 (995)	10.3	19.7	4.8	–	–	–	–	–	–
Human	76 (318)	1.2	5	6.5	30	0.2	2 to 6	0.02	0.04	0.2

Table 5.9 above provides average values because, as indicated above, the food value of milk varies during nursing. The milk composition of milking animals also varies according to season and feed (grasses or industrial feed).

Lactose intolerance

Lactose intolerance is frequently mentioned – it manifests itself through abdominal pain, flatulence and osmotic diarrhoea. It results from an activity deficiency of lactase, the enzyme enabling the digestion of lactose. Three reasons explain lactase deficiency. The first and rarest is congenital (i.e. genetic), owing to a complete absence of lactase at birth. It is usually fatal which is why it is so rare.

The second is due to the fact that mammals usually lose their capacity to synthesize lactase some time between their childhood and adulthood, and this loss is irreversible. The problem affects Africa and Asia, mainly; human populations that grew accustomed to consuming animal milk from the

[21] From Randoin *et al.* (Randoin, 1982).

early days of domestication, thousands of years ago, have been able to preserve their lactase through natural selection. They are the populations in the Mediterranean, the Middle East, India, some regions of Africa and Europe, the latter including their descendants who have migrated to America, Australia, New Zealand and elsewhere. Clearly, therefore, the indigenous populations of the Pacific Rim, however, face the same problem as Africans and Asians.

The associated problems are moreover quite minor: children lose the capacity to digest milk rather slowly after weaning, usually implying a fair reversibility through which, after a few days of a dairy-based diet, lactase is reactivated and permits the harmless resumption of milk consumption. Adults who have lost lactase show moderate – if any – intolerance symptoms, unless they absorb large quantities of milk at once (< 1/2 litre).

The third type of lactase deficiency results from disorders affecting the intestinal mucous membrane, and are not further discussed here.

Dairy products

Milk is a highly perishable commodity because it is a liquid medium that can be rapidly infested by micro-organisms and because it contains lactose, free amino acids and vitamins making it an ideal culture medium for the rapid multiplication of micro-organisms. Man has thus developed milk conservation methods, the commonest being pasteurization or uperization (thermal treatments to destroy micro-organisms and allow a longer conservation in a sterile and closed container), fermentation, and the production of cheese, fats and condensed or powdered milk.

Fermented milk

Among the many types of fermented milk, the most widespread are yoghurt (resulting from fermentation mainly producing lactic acid from lactose) and kefir (resulting from a fermentation that inter alia produces alcohol). The principle of milk fermentation involves the seeding of the milk with an adequate amount of a selected bacteria strain, for it to develop faster than the other germs contaminating the milk. By so doing, less and less lactose is available for these germs, whereas the developing lactic acid eventually inhibits bacterial growth and curdles the milk. The food value of fermented milk is similar to milk, except that approximately 1/3 of the lactose is consumed during fermentation. Industrial transformation uses highly purified strains to seed the milk, but artisan and home production involves the use of the previous day's curdled milk to seed the latest fresh batch.

Cheese

Cheese varieties are innumerable. Cheese production involves three stages: clotting, draining and maturing – the latter is not done in the case of fresh cheese. Fabrication produces curds (the cheese itself), and lactoserum, or whey, which is either discarded or used as animal feed or commonly in industrial food production. Whey contains most of the lactose lost in the process, up to 90% of the water-soluble vitamins, the uncurdled water-soluble protein, and small amounts of lipids and minerals. However, draining and maturing reconcentrate nutrients, and cheese can be a very rich source of protein, lipids and minerals (especially calcium), and a fair source of water-soluble vitamins that are synthesized during the maturing stage.

Fats

The fats drawn from milk are cream, butter and ghee (butter oil). The cream is separated from the milk either by spontaneous concentration or by centrifugation. The result is skimmed milk, and cream – the latter is no more than milk with a fat content ten times higher. A 100 g portion of

30% fat cream contains 300 kcal (1,254 kJ), approximately 3 g of protein and 4 g of glucides. Butter is extracted from cream by churning, or beating, which results in separating the lipids (the butter) from the cream's watery phase, called dasher. Butter consists of more than 80% lipids, approximately 15% water, less than 1% protein, and less than 1% glucides. Its calorie value is approximately 750 kcal (3,135 kJ) for 100 g. Butter also contains fair amounts of carotenoids precursors of vitamin A, and vitamins A and D. Removing the remaining water, protein and glucides results in ghee, by decantation or centrifugation after heating. The calorie value of ghee is close to 900 kcal (3,760 kJ)/100 g. The advantage of ghee over butter is its tolerance to high cooking temperatures, since it has lost the protein and glucides that carbonize when butter is overheated.

Condensed and powdered milk

The crucial importance of water quality and hygiene in reconstituting milk is discussed below. Powdered skimmed milk keeps better and is considerably cheaper than full milk. For use in humanitarian action the former, nevertheless, must be enriched as discussed below. It is also worth noting that the use of powdered milk in humanitarian action is restricted.[22]

The concentration of milk by evaporation produces condensed milk (sweetened or unsweetened) or powdered milk (skimmed or full). Condensed and powdered milk preclude micro-organism development, and are therefore long-conservation commodities.

Powdered skimmed milk no longer contains fat-soluble vitamins (especially vitamins A and D); it must therefore be enriched at least in vitamin A, and preferably in vitamin D also,[23] as per the following enrichment rates:

⇨ vitamin A: 1,500–3,000 μg (5,000–10,000 IU)/100 g of powdered skimmed milk.
⇨ vitamin D: the rate must be 10 times lower than vitamin A, based on international units. This amounts to 12.5–25 mg (500–1,000 IU)/100 g of powdered skimmed milk. (European Commission, 1991).

Powdered milk must be reconstituted in a way that produces a liquid with an energy density identical to liquid full or skimmed milk. Such reconstitution demands impeccable hygiene conditions and the strict application of the manufacturer's instructions (usually expressed proportionately: "*x level measures of powder to y identical measures of drinking water*").

In the absence of such instructions, the following can be applied.

⇨ Measure 130 g of powdered full milk using scales, place powder in a volume-graded container, top it up to 1 l with clean water (boiled for 10 minutes if the water quality is not guaranteed), and stir. This produces 1 l of milk containing approximately 650 kcal (2,720 kJ). To reconstitute 1 l of milk weighing approximately 1 kg, therefore, 130 g of powder are completed by 870 g of water (i.e. 870 ml of water, since the density of water is 1 kg per litre in standard conditions). This implies that milk containing approximately 65 kcal (272 kJ)/100 ml is produced by mixing a given mass (x g or kg) and 6.7 times this mass of drinking water. Indeed, 130 g of water mixed with 6.7 times 130 g of water, (i.e. 871 g of water) produces the same result as completing 130 g of powder up to 1 l with water. The translation into mass can prove useful in the absence of a graded container indicating volume.

[22] See Annex 3.

[23] If intended for humanitarian relief, powdered skimmed milk must imperatively be enriched at least in vitamin A.

⇨ In the absence of both scales and volume-graded containers, full milk can be reconstituted by mixing one measure (e.g. a cup) of milk powder and four measures of water – this produces a slightly lower (by a few percent) energy density milk than that produced with the above method of topping 130 g of milk powder up to 1 l with water. Tests have shown that 130 g of milk translate into a volume of 220 ml; consequently, adding 4 times 220 ml of water to 220 ml of powdered milk, the powder is mixed with 880 ml of water (instead of the 870 ml used in the illustration above). The difference is negligible.

In the absence of instructions provided by the manufacturer, powdered skimmed milk should nevertheless result in an energy density of approximately 340 kcal (1,420 kJ)/l of reconstituted milk, equivalent to entirely skimmed fresh milk[24] – 94 g of powder should be topped up to 1 l with drinking water. In other words, 1 mass unit of powder to 9 mass units of water, or 1 volume measure of powder to at least 4 and at most 5 volume measures of drinking water. The lack of accuracy between 4 and 5 measures arises from the variations in the density of powdered skimmed milk, ranging between 400 and 550 g/l of powder.

V

1.10 SUGARS

Sugar, syrup, honey and treacle are popular because of their sweetness, their preservation qualities, their digestibility and their high energy value. However, they provide nothing besides calories in the form of glucides and their excessive intake is deleterious for health (risk of diabetes, cardio-vascular disease, obesity and dental decay).

Commercial sugar comes from the sugarcane and the sugar beet; both contain approximately 16% sugar (saccharose). Industrial extraction methods result in chemically almost pure products, whose calorie value is 400 kcal (1,672 kJ)/100 g. Honey is produced by bees from the sweet nectar found in flowers, and its calorie value is approximately 300 kcal (1,250 kJ)/100 g, provided by fructose and glucose. Maple syrup also contains 75 to 80% sugar, with similar calorie values to honey. Hydromel is an alcoholic beverage produced by fermented honey mixed with water. Hydromel can be distilled to produce a strong spirit. Treacle is a syrupy residue of sugarcane or sugar beet production with a calorie value of approximately 250 kcal (1,045 kJ)/100 g. Honey and treacle are believed to be particularly healthy and to have medical virtues, but this is not supported scientifically. Preserves and jams are a convenient way of keeping fruit, by mixing them with an equivalent amount of sugar, and heating and stirring them until the mixture thickens to the desired texture. The calorie value of jams is of the order of 250 kcal (1,045 kJ)/100 g; their vitamin C content varies greatly according to the treatment of the fruit prior to preparation and preparation time.

1.11 BEVERAGES

Man needs only still water for his hydration. He nevertheless prefers other beverages, be they natural or chemical, for their flavour and because many have pharmacological effects. This explains the popularity of sodas, alcohols, sweet or chocolate drinks, tea, coffee and fruit juice, and the huge diversity of artisan and industrial beverages. This popularity often translates into habits and social or religious rituals, which are sometimes deep-rooted and can have major economic and political repercussions. The consumption of some beverages, especially alcoholic, causes psychosomatic

[24] Powdered skimmed milk should not be reconstituted in a way that raises the final energy levels to those of liquid full milk: this results in excessively high concentrations of minerals and protein, and this can be dangerous according to the final use of the reconstituted milk.

dependencies and health disorders that often reach public health proportions. In addition, it sometimes entails an economic cost that can be exorbitant at household level and within the society itself. The production and sale of these beverages is of course a major source of income for the private sector and for the State through tax channels.

Alcohol consumption is a source of individual enjoyment, and can play a social binding role. But these two aspects sometimes have significant repercussions on humanitarian action:

⇨ the absorption of alcohol can generate violent behaviour, and the need for alcohol provokes it – this causes major security problems;
⇨ the economy of victims of armed conflict or natural disaster obeys its own rules: humanitarian aid can be diverted to produce alcoholic beverages intended for sale, or to purchase tea or coffee and sugar, which, in some settings represent the key to any economic negotiation – this behaviour is often frowned upon by relief agencies who react tactlessly as a result; it is however easy to explain by the survival conditions of households confronted with a hostile environment – rather than drawing hasty conclusions, the reasons underlying such behaviour must be understood before reacting.

In addition to hydration, and excluding maternal milk, the nutritional role of beverages is secondary, even if some provide substantial amounts of energy and vitamins. Sweet drinks such as sodas, syrups and beverages containing cola nut extracts consist mainly of sugar and aromas. Their energy value varies between 40 and 50 kcal (170 and 210 kJ)/100 g. Their excessive intake is one of the main causes of obesity among children. Fresh fruit juice contains the same nutrients as fruit, and provides a good source of vitamin C, but the nutritional quality of industrial fruit juice varies greatly. Coffee and tea are popular for their aroma and their stimulating effect. In alcoholic beverages, a distinction should be drawn between beers, wines and spirits. Beer is produced from cereals (barley, sorghum) or bananas. Its calorie content varies according to its alcohol and sugar concentration. The energy value of common pale and dark ales with an average alcohol content is approximately 45 kcal (190 kJ)/100 g. The same value applies to commercial ciders and hydromel. Levels vary greatly however in the case of artisan products or specialities. Wine is produced from grapes and its energy value likewise varies according to its sugar and alcohol levels. Common white and red wines contain approximately 70 kcal (290 kJ)/100 g; this value can double in the case of sweet or dessert wines. Wine is also produced from palm juice and fruit other than grapes. Spirits are strong alcoholic beverages produced from fruit, cereals or potato. The alcohol produced by the fermentation of glucides is concentrated through distillation. Commercial 40% alcohol/volume spirits contain some 250 kcal (1,045 kJ)/100 g and thus constitute a significant source of energy – but this is usually not the purpose of their consumption.

1.12 HERBS, SPICES AND SEASONINGS

Herbs (e.g. thyme, rosemary, laurel, oregano and tarragon) are leaves, whereas **spices** (nutmeg, pepper, cumin, chilli, cinnamon, ginger, saffron and vanilla) are seeds, fruits, pistils, bark or roots. **Seasonings** are preparations such as mustard, chutney or stock in cubes, but salt is a seasoning too. These three categories of condiments serve primarily to enhance and flavour dishes. They play virtually no nutritional role other than to make food appetizing – and this in no way diminishes their culinary importance, explaining why even the poor use them widely. This aspect is too often neglected in emergency food relief for already malnourished groups receiving tasteless food rations. But it is precisely those groups that most need the means to enhance their food to render it appetizing when malnutrition-related anorexia is already rampant. Furthermore, the author has observed everywhere that groups requiring significant food assistance sacrifice part of their ration to secure these means; this behaviour must therefore be anticipated and the use of herbs, spices and seasonings (especially salt) encouraged, by providing it in some way. In this context, salt is not indispensable to cover chloride and sodium needs (except in cases of extreme perspiration); food in fact provides enough of these minerals. The average individual daily intake of salt varies greatly according to population groups and individuals, but 10 g is an average.

2. ADDITIONAL INFORMATION REGARDING FOOD

2.1 FOOD COMPOSITION DATA

Understanding food composition in terms of its nutritive value is useful in several respects. First, it enables the extrapolation of nutrient intake from food consumption data and it then facilitates the definition of diets and food rations to provide the specified nutrients. Food composition is found in tables or in computerized databases. Data is expressed in weight (g, mg, µg) for 100 g of edible portion of the commodity under consideration. Data is "representative" of the nutrient content of a given foodstuff. The values are by no means absolute or unchanging; likewise they are not overly specific to the method applied or the sample under scrutiny, in order to remain representative. The development of databases encounters two main difficulties: biological variability that is characteristic of life, and the nutritional content of specific foodstuffs, which varies considerably according to soil, cultivation and rearing methods, age of the plant or animal, freshness and hydration. As a result, the analysis of different samples in different locations produces different results. Bearing these limitations in mind, tables nevertheless provide invaluable working tools, providing the user is prepared to apply the required flexibility to ranges and average values rather than absolute values. For example, the deviation between the real calorie value of a given foodstuff and the reference value indicated in the table can reach 10% – far more in the case of meat, whose fat content varies considerably. Protein deviation is in the order of 5%, and the deviation can be significant in the case of vitamins and minerals. Values provided by tables should, therefore, enable observers to determine what diet is most likely to supply this or that element beyond deficiency thresholds, rather than accurately calibrating the intake in this element.[25]

2.2 FOOD PROCESSING AND COOKING

Food processing is defined here as including cooking; processing is intended to improve digestibility and appeal, preservation and transport, and enrich the foodstuffs thus treated. Processing methods are innumerable and highly interesting – this Manual restricts itself to discussing the effects of the commonest methods on food. Losses are largely proportional to the duration and intensity of exposure, but they are difficult to quantify.

The nutritional value of processed foods can be affected as follows.

1. Cereal refining can be disastrous for their B group vitamin content.
2. Soaking and washing can remove water soluble vitamins and minerals.
3. Cooking in water (e.g. boiling or simmering) can dissolve water-soluble vitamins and minerals and thus waste them, unless the cooking water is consumed. Furthermore, boiling usually reduces the energy density of basic foods (see below).

[25] Annex 20 provides a composition table for the commonest foodstuffs.

4. Cooking can waste 30 to 60% of the vitamins – in the case of vitamin C, the loss can be complete.
5. The ambient acidity affects vitamin stability. Vitamin C and thiamine are unstable in neutral or alkaline mediums, but stable in acid mediums. Retinol is unstable in acid mediums, vitamin D is stable only in neutral mediums, and riboflavin is unstable in alkaline mediums. Vitamin E, niacin, and vitamins B_6 and B_{12} are unaffected by the ambient acidity.
6. Only riboflavin, niacin and vitamin B_6 are stable in the open air (that is, they are not oxidized by atmospheric oxygen).
7. Only thiamine and niacin are stable to light.
8. Only niacin and vitamin B_{12} are stable to heat.
9. Unsaturated fatty acids are unstable at high temperatures and oxidize resulting in potentially toxic products. This is a problem only if the fat under consideration is overheated and smokes, and is used repeatedly (e.g. frying oil, which oxidizes slowly). In the case of butter, it is not the fat that blackens during cooking, but the protein and lactose residue contained in the minute whey content in butter. Clarified butter does not present this problem (see above, regarding fats).
10. If foods are cooked normally (i.e. not burnt), the food value of glucides, protein and lipids is not or only slightly affected by cooking.
11. Cereals and legumes are substantially enriched in vitamin C when sprouted (30 to 50 mg/100 g of dry matter).
12. Fermentation through non-toxic germs raises acidity, and thus prolongs the preservation of foodstuffs by inhibiting the growth of other micro-organisms that can be dangerous. It also enhances flavour and digestibility, enriches the foods thus processed – and is part of alcohol production.

2.3 FOOD TOXICITY

Food can cause poisoning or infection for a number of reasons.

1. The plants or animals that they are derived from naturally produce toxins:
   → cassava contains cyanide;[26]
   → *Lathyrus sativus* (grass pea) contains a neurotoxin that causes lathyrism (see above);[27]
   → other legumes contain haemagglutinins that attack red blood cells and intestinal cells;
   → some sea fish contains potentially lethal neurotoxins;
   → some fish, such as tuna, must be rapidly processed after its catch, or its protein deteriorates and produces histamine causing headache, palpitations and diarrhoea;
   → vegetables in the cabbage family potentially cause goitre;
   → some mushrooms produce toxins (sometimes lethal, such as Death Cap, *Amanita phalloides*), or hallucinogenic substances (e.g. Fly Agaric, *Amanita muscaria*).
2. Some foods are contaminated by toxin-producing organisms, such as mussels that feed on a type of plankton producing the potentially deadly saxitoxin, which causes tingling (or paraesthesia), muscular weakness and vomiting; or oil produced from mustard seeds collected together with other seeds containing sanguinarin, an alkaloid that causes serious heart muscle inflammation (cardiomyopathy) identical to that associated with wet (or cardiac) beriberi.[28]
3. Food can be contaminated by bacteria or parasites:
   → bacterial infection:
      → the commonest are caused by salmonella (*Salmonella typhimurium*), *Clostridium perfringens* and yellow staphylococcus (*Staphylococcus aureus*), causing acute gastro-enteritis;

[26] See Chapter III, Section 1.2.4.
[27] See Chapter V, Section 1.3.2.
[28] See Chapter VIII.

- → *Eschericia coli* also causes acute gastro-enteritis among children and traveller's diarrhoea;
- → *Clostridium botulinum* produces one of the most potent toxins (1 μg/kg is a lethal dose); it thrives in cans and ham, and its growth is forestalled by adding nitrite – a bloated can, or a can that releases gas upon opening should be disposed of with its contents; its contents should **never** be eaten – contamination is not absolutely certain, but prudence should take precedence in view of the risks;
- → brucellosis causes fever, with peaks and remission; it is caused by bacteria infecting cows and goats, found in their milk and derived dairy products, unless the milk has been pasteurized – the infection is common among people who drink the milk fresh or eat dairy products made from fresh milk;
- → bovine tuberculosis is easily transmitted through fresh milk – it causes lesions in the lymph glands, joints and bone;

→ parasite infection:

- → the commonest arise from the consumption of beef infested by bovine tapeworm (*Taenia solum*), pork infested by porcine tapeworm (*Taenia saginata* and *Trichinella spiralis*), freshwater fish infested by broadfish tapeworm (*Diphyllobothrium latum*), saltwater fish and crustaceans infested by Oriental liver fluke (*Clonorchis sinensis)* and Oriental lung fluke (*Paragonimus westermanii*) – infection results from insufficient cooking or raw consumption of these animals;
- → raw vegetables, such as lettuce and watercress, can be contaminated by trematodes (flukes), and by intestinal roundworm (*Ascaris lumbricoides*), whipworm (*Trichuris trichura*), and giardiasis (*Giardia lamblia*).

4. Food can be contaminated by mould that produces toxins such as aflatoxins (mentioned above in relation to maize and legumes),[29] or the toxic alkaloids produced by rye ergot (*Claviceps purpurea*), a parasite fungus.
5. Food contains substances that cause reactions in some individuals (gluten and lactose intolerance, favism, specific food allergies).
6. Food is contaminated by substances used in agriculture and stock rearing (fungicides, insecticides, hormones and antibiotics), or by environmental pollution (dioxin, mercury, cadmium, radioactive substances).
7. Food contains deliberately added chemicals that can prove dangerous, such as some preservatives used to excess in the delicatessen industry.
8. Food produced from sick plants or animals.

The major health problems associated with food toxicity are those caused by bacterial and parasite contamination, and those related to the toxins contained in some foods. Contamination commonly occurs through direct contact (hands, food, soiled objects, flies and other insects, rodents and domesticated animals); faecal-oral[30] contamination is frequent. Food is also an excellent culture medium for pathogenes (especially milk, both natural and reconstituted from powder). Infection resulting from food contamination can be serious and accounts for most cases of infant morbidity and mortality. Poisoning from toxins contained in basic foods or regularly consumed foods can take on serious proportions, as it usually affects the entire population.

Strict hygiene measures are required to forestall these problems, throughout the food chain from producer to consumer, and to ensure water cleanliness and the appropriate processing of waste and vectors. Moreover, consumers must be informed regarding potentially toxic foods, and the methods of preparing them safely and healthily.

[29] See Chapter III, Sections 1.1.5 and 1.3.2.

[30] Faecal-oral contamination follows direct or indirect contact between the hands and faecal matter, or excreta. It is then followed by direct contact between the hands and the mouth, or indirect contact, via food for instance.

National and international regulations govern food quality by specifying quality criteria. The best known are those provided by the FAO's *Codex Alimentarius*, and the European Commission (European Commission, 1991), in addition to specific domestic regulations. Humanitarian action has a major responsibility in adhering to these regulations, given that some producers consider humanitarian assistance as a convenient channel to dispose of products considered to be sub-standard in the country of origin.

2.4 FOOD MEASUREMENT UNITS AND THE EFFECTS OF COOKING

The mass (effective weight) of solids and the volume of liquids must be measured in order to calibrate food consumption. Food composition tables then provide the tool to determine nutrient intake. Possible food processing – and its impact on food value – is integrated into this analysis. Humanitarian action sometimes lacks the measuring tools and conversion factors required to measure food and appraise the effects of specific processing. Some benchmarks are provided below; they are not all absolute, but nevertheless provide useful approximations.

2.4.1 Food measurement units

Abbreviations

microgram	μg	milligram	mg	gram	g
kilogram	kg	millilitre	ml	centilitre	cl
decilitre	dl	litre	l		
fluid ounce	fl oz	pound	lb	ounce	oz
quart	qt	gallon	ga	pint	pt l

Weight and volume conversion

1 kg = 1,000 g	1 g = 1,000 mg	1 mg = 1,000 μg
1 l = 10 dl	1 dl = 10 cl	1 cl = 10 ml
1 gal = 4 qt	1 qt = 2 pt	
1 pt (UK) = 20 fl oz	1 pt (US) = 16 fl oz	
1 gal (UK) = 4.8 l	1 gal (US) = 3.8 l	
1 oz = approx. 30 g		
1 fl oz = approx. 30 ml		
1 lb = approx. 450 g		

2.4.2 The effects of cooking

Boiled foods tend to absorb some of the cooking water, and thereby dilute their energy content. A conversion factor can thus be applied to the weight of cooked foods *versus* raw foods. For example, the conversion factor of white flour into bread is roughly 1.4 (i.e. bread prepared with 100 g of flour weighs approximately 140 g). Conversion factors, obviously, are not absolute values – they vary according to the quality of the ingredients and cooking methods. But they do give an idea of the impact of cooking on the weight of raw food. Where required and feasible, it is better to calculate values on the spot through practical experimentation. Table 5.10 below provides conversion factors for staple foods and the energy density of the raw and cooked food.

Table 5.10 Weight and energy density conversion factors between raw and cooked foods

Food	Conversion factor	Energy density (kcal (kJ)/100 g)	
		Raw[a]	Cooked[a]
Rice > boiled rice	3	360 (1,500)	120 (500)
Wheat flour > white bread	1.4	340 (1,420)	240 (1,000)
Wheat flour > *chappati*	1.7	340 (1,420)	200 (840)
Pasta	3.1 – 3.4	370 (1,550)	120 – 110 (500 – 460)
Maize flour > maize meal[b]	3.4	370 (1,550)	110 (460)
Beans	3.1	300 (1,250)	96 (400)
Lentils	3.6	325 (1,360)	90 (376)
Split peas	2.8	340 (1,420)	120 (500)

[a] In this table, raw values are divided in order to translate into cooked values.
[b] According to custom and wheat extraction levels, the factors varies from 3.4 to 9. However, the factor for flour prepared for normal meals is closer to 3.4. Factor 9 applies to low extraction rate flours (i.e. highly refined) and prepared as gruel – the Angolan *fuba* for instance.

Conversion factors can be useful in translating weight into volume, and raw volume into cooked volume. Table 5.11 below provides these factors that are likewise relative according to food quality and cooking methods. Here also, therefore, on-the-spot practical experimentation is recommended.

Table 5.11 Conversion of 1 kg of raw food to raw volume and cooked volume

Food	Weight raw/volume raw	Volume raw (litre)	Weight raw/volume cooked	Volume cooked (litre)
Rice	1.2	1.2	3.6	3.6
White wheat flour	1.6	1.6		
Maize flour	1.2	1.2	3.4 – 10	3.4 – 10
Beans	1.2	1.2	3	3
Lentils	1.1	1.1	2.75 – 4	2.75 – 4
Oil	1.1	1.1		
Sugar	1.1	1.1		
Powdered milk, full	1.6 – 1.8	1.6 – 1.8		
Powdered milk, skimmed	1.8 – 2.4	1.8 – 2.4		

The effect of boiling on energy density is important in the diet of small children because they can only eat limited amounts of food. As a result, the effects of cooking on the porridges they receive must be compensated for by adding high-energy, high-protein foods.[31]

[31] See Chapter XV.

CHAPTER VI
THE FEEDING PROCESS

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CHAPTER VI
THE FEEDING PROCESS

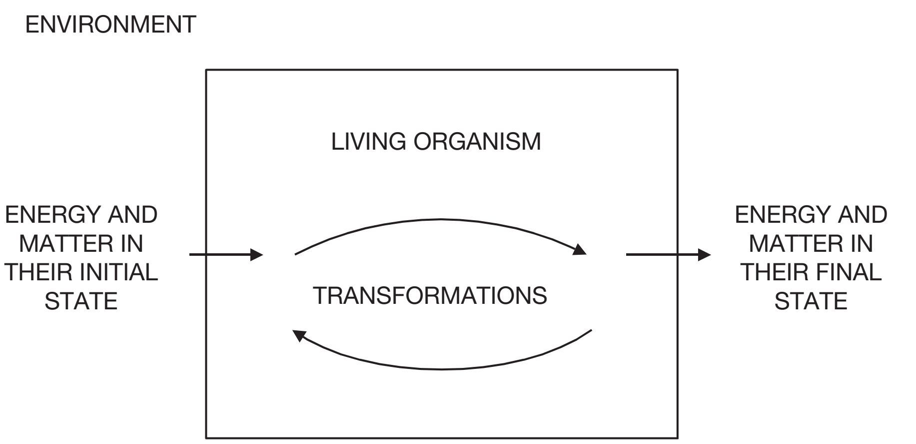
INTRODUCTION

Nutrition is the exchange of matter and energy between the organism and its environment. This exchange results from a need,[1] and occurs in the course of the feeding process, the subject of this Chapter.

Living organisms must, according to their specific characteristics, continually find matter and energy in certain states in their environment, and their survival depends on it – this is the essence of the nutritional need. But living organisms are finite entities and must therefore excrete matter and energy that they cannot recycle, or risk bursting – excretion must occur in proportion to the absorption and transformation of matter and energy (including the renewal of specific structural elements). From this standpoint, excretion is the second vital need arising from biological determinism.[2] Thus, the nutritional need is met by matter and energy found in the environment in the course of a process called the nutritional flow (Figure 6.1 below).

VI

Figure 6.1 The nutritional flow



The nutritional flow covers a need, and its human manifestation is called the feeding process.

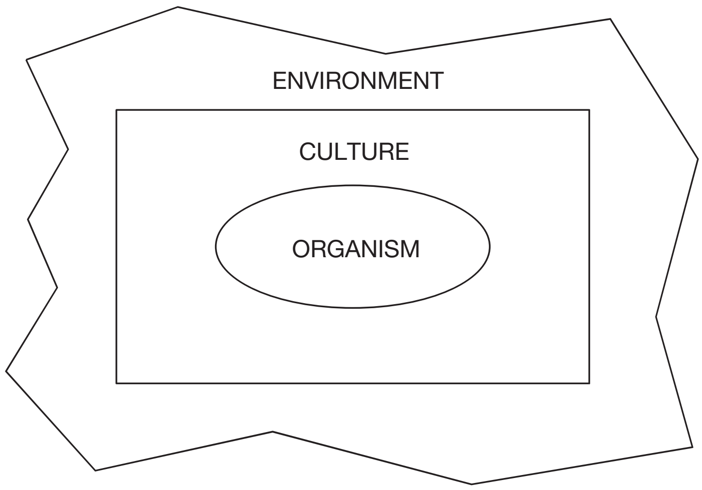
[1] See Chapters II and III.
[2] See Chapter II.

VI

1. THE THREE PARAMETERS OF THE FEEDING PROCESS

The feeding process initially involves the organism interacting with its environment to obtain food, and this interaction is conditioned by the culture of the organism itself. This is represented in Figure 6.2 below.

Figure 6.2 Parameters of the feeding process



The importance of these three parameters arises from their influence on the feeding process, and the different types of determinism that they impose upon it.

1.1 DETERMINISM SET BY ORGANISM AND CULTURE

The feeding process is determined by the phenomenon of organized association. This determinism is related to the preconditions for a specific behaviour, and to the requirements of association.[3] The first level of association, that of the living organism, obeys biological determinism; the second is that of society as defined by its culture, and obeys cultural determinism as an extension of biological determinism. These two determinisms manage human life, which means that the latter must satisfy specific needs.

1.1.1 Biological determinism

Biological determinism is specific to life and expresses itself firstly in vital needs. In higher animals it subjects individuals to largely involuntary functions such as breathing, rest, nutrition, excretion and reproduction. Man has however gradually departed from his initial lifestyle, in which he was a "naked ape", and his biological determinism thus translates into the concept of basic needs. Malinowski defines this concept as "*the system of conditions in the human organism, in the cultural setting, and in the relation of both to the natural environment, which are sufficient and necessary for the survival of group and organism*" (Malinowski, 1994).

[3] See Chapter II.

These conditions are the following:

1. Metabolism
2. Reproduction
3. Bodily comforts
4. Safety
5. Movement
6. Growth
7. Health

As mentioned above, meeting these conditions gives rise to largely involuntary phenomena. But it also prompts deliberate phenomena, such as the search for and the consumption of food, reproduction, and the quest for bodily comforts and safety. These phenomena influence one another insofar as each requires time and minimal resources for them to be carried out – and, thus, for allowing the survival of the individual and the group. As a result, voluntary (or deliberate) phenomena associated with the feeding process belong to the overall satisfaction of vital needs, and discussing them individually is pointless.

1.1.2 Cultural determinism

Cultural determinism appears as soon as individuals resort to social organization to increase their chances of survival and, if possible, to improve their living standards through an enhanced coverage of their basic needs.

In principle, society is an organized association, implying that the behaviour of the individuals that make it up is itself organized and regulated in all its forms of activity. This behaviour is nothing more than the culture that defines the society under consideration, since culture is the sum of the behaviours acquired within that society. Basic needs can therefore be matched by cultural responses (Malinowski, 1994), as follows.

Basic needs		Corresponding cultural responses
1. Metabolism	→	Commissariat[4]
2. Reproduction	→	Kinship
3. Bodily comforts	→	Shelter
4. Safety	→	Protection
5. Movement	→	Activities
6. Growth	→	Training
7. Health	→	Hygiene

Organized and regulated organization (i.e. culture) implies that the conduct of activities satisfy the four conditions discussed in Chapter II,[5] that is:

- ⇨ anchorage on a material support enabling the coverage of basic needs;
- ⇨ compliance with standards of behaviour that satisfy these needs;

[4] "Commissariat" in Malinowski's parlance is the cultural response to metabolism, i.e. how food is grown, prepared and consumed; where food is consumed and in what social units; the economic and social organization of the distribution of food; the legal and customary rules related to food distribution and the authority that enforces those rules.

[5] See Chapter II, Section 1.4.

⇨ presence of an educational system to ensure that the young can take over from the retiring elderly – in its absence, the risk is cultural erosion;
⇨ subjection to an authority that enforces standards of behaviour.

These conditions provide the foundation for any culture, and give rise to new needs called instrumental imperatives, or cultural needs (Malinowski, 1994), as follows.

1. The cultural apparatus of implements and consumer goods must be produced, used, maintained, and replaced by new production.
2. Human behaviour, as regards its technical, customary, legal, or moral prescription must be codified, and regulated in action and sanction.
3. The human material by which every institution is maintained must be renewed, formed, drilled, and provided with full knowledge of tribal tradition.
4. In society, authority must be defined and endowed with the powers and means to enforce its orders.

These cultural needs are just as demanding as the basic needs arising from biological determinism, being bound to them by an instrumental relationship. For example, man may not necessarily have to use a tractor-drawn plough or a combine-harvester to obtain his bread; but if such practices arise from his cultural development, the implements involved become indispensable and vital to the society's supply. In other words, it becomes necessary to produce, maintain and replace them, to train mechanics and engineers, to extract petroleum, which are essential subsistence conditions. Farmers also need to own land or have the possibility of cultivating it, to buy and use the necessary implements, spare parts and fuel without which they cannot perform the actions required to live in society. Likewise, members of society must have housing that complies with specific standards, and they must resort to sometimes costly transport systems to commute between their home and their workplace. This is the nature of cultural needs arising from the conditions governing the organized behaviour common to all cultures. The instruments providing the foundation of a culture and the resulting cultural needs represent the cultural determinism of a given society.

Just as basic needs find a cultural response, cultural responses also exist for cultural needs (Malinowski, 1994), as illustrated in Table 6.1 below.

Table 6.1 Cultural needs and responses

Needs	Responses
1. The cultural apparatus of implements and consumer goods must be produced, used, maintained, and replaced by new production.	Economics
2. Human behaviour, as regards its technical, customary, legal, or moral prescription must be codified, regulated in action and sanction.	Social control
3. The human material by which every institution is maintained must be renewed, formed, drilled, and provided with full knowledge of tribal tradition.	Education
4. Authority within each institution must be defined, equipped with powers, and endowed with means of forceful execution of its orders.	Political organization

Cultural identity is shaped by the specific cultural response.

Cultural identity therefore arises from biological determinism (i.e. the cultural response to a biological demand). It takes over from biological determinism when a culture develops and enables man to create a new environment for himself – his cultural environment.

Cultural determinism answers the need for combining basic and cultural needs. In terms of the feeding process, this means that social standards dictate feeding on the basis of the material means developed by society, and that the sum of all available resources (time and other assets) is shared between all basic needs, among which feeding is not necessarily a priority.

1.2 DETERMINISM SET BY THE ENVIRONMENT

The determinism imposed by the environment is different from both biological and cultural determinisms insofar as it arises from confrontation rather than organization. Society attempts to free itself from environmental constraints by responding to its own needs and familiar environmental limitations as efficiently as possible. This shapes the culture itself: lifestyle, architecture, technology, neighbourhood relations, social structure and hierarchy, spirituality, etc. In terms of the feeding process, culture develops ways of producing and securing food, and – in order to avoid crisis – other means of adapting to known constraints. For example, the organism adapts its cardiac rhythm and its metabolism in order to strengthen its immune system. The natural and human environment shapes the behaviour of society and organisms, because they must take specific measures to survive.

In short, the feeding process is man’s response to his nutritional need: biological response of the organism (interior) and cultural response of the society (exterior). Man is subjected to the determinisms thus created, and takes his chances with his environment, and must survive and reproduce within it.

2. FEEDING PROCESS ACTIVITIES

The feeding process is the practical expression of the nutritional flow. Theoretically, the nutritional flow is continuous within the organism: if it ceases, the organism dies. In reality, however, stops and starts occur well back from where the elementary thermodynamic reactions take place. For example, the liver works continuously, as does the brain, but man only drinks and eats a couple of times per day – and he only cultivates his land twice or three times yearly. This discontinuity results from the feeding process being made up by separate activities organized in a specific sequence. Activities of the feeding process begin in the cultural and environmental framework of the individual, and end in the biological framework of the organism. Arising from an organized behaviour, they are thereby determined. They must moreover perform sufficiently well to respond to the demands of the nutritional need and its coverage.

2.1 ACTIVITY SEQUENCE

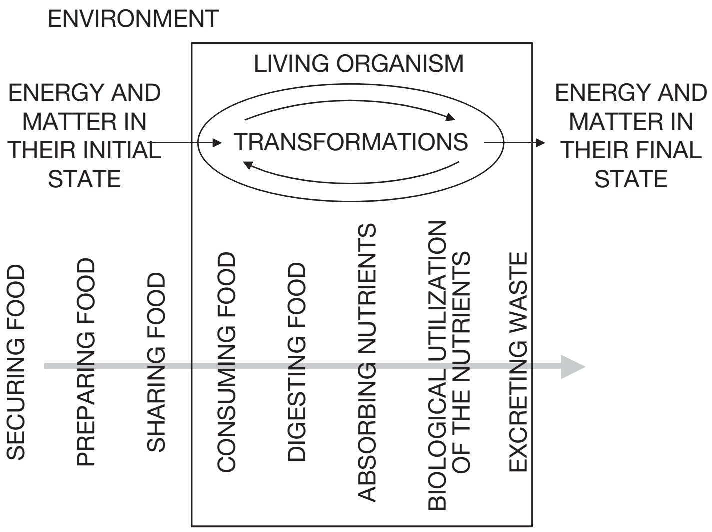
The activities of the feeding process follow a specific sequence, from the individual confrontation with the natural and human environment to secure food, to the excretion of stool and urine, and the release of carbon gas and thermal energy.

These activities all share causal relations in the following sequence.

1. Securing food
2. Preparing food
3. Sharing food
4. Consuming food
5. Digesting food
6. Absorbing nutrients
7. Biologically utilizing the nutrients
8. Excreting waste

Figure 6.3 is adapted from the nutritional flow, adding its concrete manifestations, made up of the activities of the feeding process.

Figure 6.3 Feeding process activities



The activities of the feeding process thus ensure the management of the nutritional flow, from the securing of matter and energy in the medium to the elimination of waste.

2.2 THE ORGANIZATION AND DETERMINISM OF ACTIVITIES

The activities of the feeding process are organized and determined, because they occur within the framework of the organism and culture. They therefore rest on a specific material base, comply with execution standards, and submit to some form of control; these are all conditions that express the determinism of activities. Table 6.2 briefly summarizes this analysis and illustrates the logic that connects all activities and ensures the consistency of the feeding process.

Table 6.2 Organization and determinism of the feeding process activities

Organization				Determinism		
Structure	Group	Activity	Function	Standard	Control	Material
Professional institutions of the society	Active members of society	Securing food	Supplying the family	Ownership of the means to secure food	Recognized or imposed authority	Agricultural inputs, cash/credit, natural environment
Family	Family members who take on this task	Preparing food	Making the food edible	Eating habits	Recognized family authority	Cooking inputs, food
Family	Family members who take on this task	Sharing food	Ensuring the feeding of all family members	Social sharing standards	Recognized family authority	Food
Family	All family members	Consuming food	Appeasing hunger by supplying the organism	Table manners	Appetite/ satiety	Food
Human body	Digestive organs (digestive tube, pancreas, gall bladder)	Digesting food	Transforming food into nutrients that can be absorbed	Mechanical, enzyme and chemical sequence	Neuro-endocrine system and chemical feedback[a]	Food
Intestine	Intestinal cells (enterocytes)	Absorbing nutrients	Transferring nutrients into the interior medium	Active or passive transport system according to gradient	Neuro-endocrine system, chemical feedback and gradient status	Nutrients
Human body	Organic cells, liver	Utilizing nutrients	Allowing the metabolism to function	Thermodynamic principles	Neuro-endocrine system and chemical feedback	Nutrients
Human body	Filtering concentration and excretion cells (skin, lungs, liver, kidneys, colon, bladder)	Excreting waste	Freeing the organism of matter and energy that cannot be utilized	Gradient law, bacterial digestion, perspiration, expiration	Neuro-endocrine system and chemical feedback, abdominal and bladder retention	Waste, non-recyclable metabolites, heat, water, components of the inevitable losses

[a] Influence on the sequence of chemical reactions according to what they produce.

2.3 ACTIVITY PERFORMANCE

Each activity of the feeding process must be performed efficiently enough to enable the organism to live. Performance is thus associated with specific conditions, which are difficult to meet because the organism (interior) does not control them, no more than the individual (exterior). As a result, efficiency is not automatic, and the organism, the individual and society must develop adaptation mechanisms to face risks of poor performance (or counter-performance itself). It goes without saying that activity inefficiency can have serious consequences for other activities, especially if it occurs at an early stage of the feeding process. Unfortunately, success is difficult to ensure early in the process, precisely where adaptation mechanisms must be especially effective.

2.4 STAGES OF THE FEEDING PROCESS

Some activities of the feeding process are shared by all humans. They include the digestion and absorption of food, and urinating, and they result mainly from biological determinism. Others tend towards a common objective, for instance the securing of food, but can differ significantly in nature or manifestation: these relate mainly to cultural determinism. This Manual proposes a model for the feeding process within any society, in spite of differences. This provides a tool to facilitate, among other things, the analysis of nutritional crises within the cause and effect relations and, consequently, to suggest relevant action.

To this end, the activities of the feeding process are divided into three main stages, and discussed accordingly; these stages are defined by the structure that accommodates them.

1. **The securing of food** is always determined by the cultural and natural environments of the individual concerned. It is sometimes determined by the "outside" human environment when this interferes with the human environment specific to the individual concerned. The securing of food is the stage during which man faces outwards to confront his environment (society and natural environment). Man is forever competing for available resources; for this, he resorts to his own resources, and makes an effort that costs energy and can be unpleasant. This also implies that he is healthy and adequately fed, in other words, that his previous efforts have proven effective in every way.
2. **The consumption of food** (i.e. preparing, sharing, actual consumption) is determined by the successful completion of the previous stage, culture and health. This second stage is one of intimate social interaction, that is, within the family – the smallest sustainable social cell. If the family has secured enough food during the first stage, it prepares it, shares it among its members, and eats it. This provides the enjoyment both of social interaction, and of satisfied hunger.
3. **The biological utilization of food** (digesting, absorbing, biological utilization and excreting) depends on the two previous stages, but also on the health status of the subject. This stage is one of satisfaction associated with satiety. With the exception of its last phase (excretion), it takes place inside: man stores energy, and outside activities are replaced by internal chemical and mechanical processes.

Within the feeding process, this Manual pays specific attention, to the securing of food (i.e. stage 1); securing food is the crucial stage within the feeding process, because life depends on its efficiency or inefficiency. Inefficiency can result from individual elements that tend to be dismissed as social cases and are of interest to humanitarian agencies whose mandate includes this aspect. But such inefficiency can also affect entire communities or trade categories owing to perturbations preventing them from securing food – sooner or later resulting in disaster. In terms of nutrition, humanitarian agencies are confronted mainly with generalized cases of inefficiency or failure to secure food; this failure in turn entails an inefficient consumption and biological utilization of food. Generalized failure in later stages (i.e. in the consumption or utilization stage) where people do not actually lack food suggests that the problem is mainly medical and sanitary. An adequate response must then involve health services and those concerned with the quality of water and habitat. In-depth understanding of the securing of food is especially important today because humanitarian agencies are changing their approach to nutrition problems. In the past, this approach was alas frequently confined to malnutrition and food distributions once the disaster was widespread. Nowadays, the trend is to develop a broader understanding of nutrition (integrating economic, political and social factors), thus enabling a more timely and preventive approach. This implies a better understanding of the lead-up to crisis, and closer interaction with its possible victims. In terms of humanitarian operations, therefore, more attention must be paid to the first stage – that involving the securing of food – than the two others.

Each stage of the feeding process is made up of organized, determined activities that are linked to performance, and each stage is thus discussed according to these elements.

3. THE SECURING OF FOOD

3.1 INTRODUCTION

The securing of food involves activities aiming at obtaining food from the environment. The performance – or success – of such activities is crucial, because the rest of the feeding process depends on it. It is therefore a key stage in terms of the nutritional functioning of a given society; it has also, in man's recent history, undergone changes with fundamental consequences on the functioning of society and the relation between man and his environment.

The search for food has evolved with the development of different cultures and their instrumental imperatives such as economics, social control, education and political organization; many lifestyles exist side by side today. The food securing activities of the Amazonian hunter-gatherer, the Senegalese farmer, the Russian miner, the Afghan businessman and the CEO of a French car manufacturing plant differ greatly. But they all respond to the same physiological demands and consist in finding matter and energy in the environment, at a specific frequency, with the means that are adapted to the individual culture. The matter, energy and means involved pertain to the "*cultural apparatus of implements and consumer goods must be produced, used, maintained, and replaced by new production*" (Malinowski, 1994) – economics provide this response in any culture. As a result, the securing of food is associated mainly with the economy of a given society according to its culture; an economic approach is required to understand this mechanism in any society, and also provides a basis for comparison.

A brief discussion of the evolution of food securing activities also sheds light on the development of economics and its consequences.

3.2 THE EVOLUTION OF FOOD SECURING ACTIVITIES TOWARDS MORE ECONOMIC ACTIVITIES

For hundreds of thousands of years, man was a hunter-gatherer who found his food by collecting, hunting and fishing whatever the environment produced spontaneously. In terms of the securing of food resources, the human diet was quite similar, to that of many other higher animals.

The Neolithic revolution allowed man to manage his environment in order to secure his food through production activities such as agriculture and stock-breeding; this shift was caused by a sometimes variable combination of opportunity, comfort, ingenuity, and sometimes insecurity caused by the shrinking of natural resources. For the first time, man was faced with food surpluses that he could exchange for non-food commodities produced by non-farmers. In some conditions, agriculture is a guarantee for survival, but it also imposes greater cultural determinism on its derived activities: implements must be made, maintained and replaced, infrastructure must be built, and a security system must be created and maintained to produce, preserve and store food. This shift is associated with the sedentary settling that appeared at the time in densely populated areas. Such village or town groups promoted the assembly of specialized production activities other than agriculture (e.g. commercial, administrative, political and military), which indirectly promoted the securing of food. The discovery and the utilization of metal defined a new evolution of tools, trade and armament, and further promoted this trend. Agriculture nevertheless long remained the predominant activity to ensure subsistence, because productivity was still too low for surpluses to accumulate and enable significant population segments to conduct other activities.

The agricultural revolution of the 17th and 18th centuries eventually overcame this hurdle in Europe (this had been achieved centuries before in Asia, but on a lesser scale owing to the absence of an industrial revolution); it resulted in the production of significant agricultural surpluses to respond both to the nutritional demands of the major part of society that was not involved in agriculture, and to set aside the stocks required to face the normal variations of any agricultural production. Production increases were determined by implements, and thus resulted in major demands on metalworking for the production and maintenance of such implements. The production of metal required the smelting of ore, which in turn implied the use of coal, itself extracted from mines, and operating the mines involved steam engines. This development introduced the industrial revolution, followed by the intensive use of cotton in the textile industry – promoting the rapid development of this major segment of the urban economy. Cotton is considerably better suited than wool to the constraints of mechanization, and so responded to the high textile demands in Europe (Bairoch, 1983). Man's access to and mastery of fossil energy (coal and, later, petroleum) provided the basis for the industrial revolution. Combined with agricultural production, the use of fossil energy generated societies where production activities are varied and often highly specialized, resulting from an intensive (and not always judicious) exploitation of the natural environment. This is not food production in itself, but enables the securing of food through appropriate exchanges; such a change entails major lifestyle upheavals. Table 6.3 below summarizes the main differences between the lifestyles of industrialized societies and those of traditional hunter-gatherers.

Table 6.3 Compared lifestyles of hunter-gatherers and industrialized societies

Hunter-gatherers	**Industrialized societies**
Food is secured through gathering, hunting and fishing activities to collect the spontaneous and accidental natural production.	Non-agricultural production activities aim at securing food through a recognized exchange system, which relies on an industrial-scale agricultural production.
Individuals and family cells directly carry out the activities required to cover their essential needs: protection, the production of implements, clothing, shelter and weapons, education of the offspring, and contribution to the definition of group behaviour.	Active individuals and their relatives have lost the ability to cover all their essential needs directly: they rely for this on specific professions and the public and private sector against compensation.
The resources required to meet the essential needs are found directly in the environment – the means used to exploit them are mainly labour and competence within the private company represented by the family.	The resources required to meet the essential needs are no longer found in the environment, but must instead be secured through the use of own production assets in a specific production activity.
The knowledge of plants and the skills of hunting, fishing, shelter building, and the production of implements, weapons and clothes is shared by all.	The skills required for the maintenance of the economy and culture are distributed among all segments of activity – no individual masters them all.
Activities are diversified to cover all essential needs; they are not fully specialized. Hunter-gatherer families each require much space to survive; as a result, family cells are small. There is no room or need for group survival to rest upon the interdependency of specialized activities.	The production activities performed by active individuals are undiversified, frequently highly specialized because of the diversity of the *"cultural apparatus of implements and consumer goods"*; this is permitted by population density and agricultural productivity.
Sustainability is contingent upon preserving the capital of environmental renewable resources (plants and animals), or allowing it to renew through migration cycles. Sustainability only depends on the fertility of productive species, the space that can be exploited, and population density. There is no environmental exploitation, strictly speaking.	Sustainability is directly contingent upon the exploitation of all available environmental resources, including non-renewable resources such as minerals and fossil energy (coal, gas and petroleum). Short-term sustainability therefore depends on the capacity to maintain or increase yields, usually to the detriment of the environment. Long-term sustainability depends on controlling population density, preserving the ecological balance and a shift to the massive and predominant use of renewable forms of energy – this has not yet been achieved.
Human interference in the production of useful and edible resources is negligible or non-existent. It has no impact on mineral and fossil resources, and does not harm the ecological balance.	Human interference in the production of edible and useful resources is massive. Its impact on mineral and fossil resources is disastrous, and destroys the ecological balance.
The economy is contained in the family entirely. Exchanges (barter) between groups or families rarely entail total dependency.	The economy is a highly complex, all-inclusive interdependency system.
The energy yield of the securing of food is approximately 3 to 7 calories obtained for 1 spent, per day. Time devoted to securing food averages 3 hours per day.	The yield of production activities intended to secure food can no longer be calculated easily. It varies according to food prices and the proportion of the budget that is devoted to it. The working class spend 8 hours or more per day working, and the yield is slightly higher than 1 calorie obtained for 1 spent.
Food has the same value for all; in addition to its role in the diet, it is even more important as the symbol and object of social exchanges within the group, clan or tribe.	Food is no longer freely available for all, it has become a commodity that must be obtained like any other. It has lost its symbolic value and has become an essentially economic token.

Table 6.3 clearly shows that, over time, the procuring of food evolved from simple gathering towards food production, and later towards the production of non-food items to exchange for food. All these new developments became part of the sum of economic activities. In parallel the cultural apparatus of implements and consumer goods developed and diversified, because this increasingly complicated apparatus had to be produced, used, maintained, and replaced by new production.

As indicated above, economics provide the cultural response to the increasing complexity of food procurement; in other words, as the network of material interdependencies develops, man sacrifices some of his material self-sufficiency and subjects his diet to economics. This evolution consists of the following sequence:

⇨ the appearance of production – through production activities,[6] man secures goods that nature does not provide spontaneously (i.e. without his intervention);
⇨ the diversification of the cultural apparatus of implements and consumer goods;
⇨ the specialization of production activities, and their association with the three familiar sectors of the modern economy – primary (i.e. agriculture, forestry, and hunting and fishing), secondary (transformation), and tertiary (the provision of services such as trade, banking, administration, transport, health, education, and insurances).

The diversification of implements and consumer goods and the specialization of production activities have two major consequences for the securing of food: the increase of cultural demands and the need for transactions.

3.2.1 The increase in cultural demands

The diversification of the cultural apparatus of implements and consumer goods increases dependency on these implements and goods, and cultural demands therefore grow proportionately. This influences the coverage of all basic needs that depend on the economy (i.e. basic economic needs) including food, according to the income available[7] to cover all associated expenses. The following example drawn from the Swiss Federal Statistics Office illustrates the average budget proportion devoted by Swiss households to their main basic economic needs in 1993:

⇨ food	17.9%
⇨ housing	15.7%
⇨ hygiene	13.1%
⇨ transport and communications	11.2%
⇨ education and leisure	9.6%
⇨ beverages and tobacco	6.8%
⇨ clothing	4.2%

The Swiss example is an extreme in terms of the proportional attribution of expenses between basic economic needs that are unrelated to food and those related to food. The above data is based on the average available household income in Switzerland – the same calculation based on average gross household revenue shows that the proportion allotted to food is in fact well below 17.9%. Clearly, the budget percentage allocated to food varies according to available revenue; wealthier Swiss households devote proportionately less of their budget to food than the poor. This phenomenon is

[6] This Manual departs from the classical definition of production activities as being compensated for by a salary (as is the case in classical economics), but adopts the broader sense of work that produces material resources.

[7] "Available income" is defined as the balance once taxes and obligatory insurance have been paid.

expressed by Engel's law: with given tastes or preferences, the proportion of income spent on food increases as income diminishes. This confirms what seems self-evident: basic economic needs that must be met with an available budget follow priorities – food ranks high, but only up to a given point: Engel's law shows that it is impossible to allocate 100% of the budget to food. Direct observation in many countries has led Lipton to note that food practically never accounts for more than 80% of the total expenses (Lipton, 1982). This appears to be a critical threshold beyond which people behave as if there were no further alternative: they can no longer save on non-food commodities, and yet cannot survive on less food. If their available revenue falls, then they reduce their food and non-food expenses in the same proportion (Pacey and Payne, 1985). This means that, even in cases of malnutrition, people do not devote their entire resources to food, and every incipient famine bears out this fact. In diversified economies, the threshold of 80% of resources being allotted to food can be considered as the threshold of absolute poverty.

3.2.2 The need for market transactions

The specialization of production activities causes a loss in self-sufficiency to varying degrees. Social partners thus accept mutual dependencies in order to meet their basic economic needs: those who produce food need implements, those who produce implements need food, and both need the clothing they purchase from suppliers; the latter in turn must secure food and implements, and so on. These interdependencies call for transactions during which commodities produced are exchanged for commodities required. Social partners therefore account for both supply and demand. As the specialities entailing interdependencies multiply, it becomes impossible to resort to the direct exchange of commodities in the form of barter. This problem is addressed by the following parameters:

- ⇨ money as a means of exchange;
- ⇨ the market, where supply and demand meet within transactions;
- ⇨ the trade-offs that set transaction prices or terms.

Money

Money appears in all societies based on economic specialization; it deprives specialized partners of their independence in terms of meeting their basic needs, making them dependent on services. Money nevertheless provides a standard, and also a form of payment. It is a purchasing power reserve, because one of its main functions is to separate individual exchange operations. Expressed in prices, it also indicates the value attached by consumers and producers to a given commodity. Initially, therefore, money is a technical instrument; it however rapidly became an instrument of power (by generating new power relations in which the shrewder dominates the physically stronger) and hence the object of envy. Indeed, it confers power by providing the means of buying practically anything at a favourable moment, and permits the exploitation of weakness.

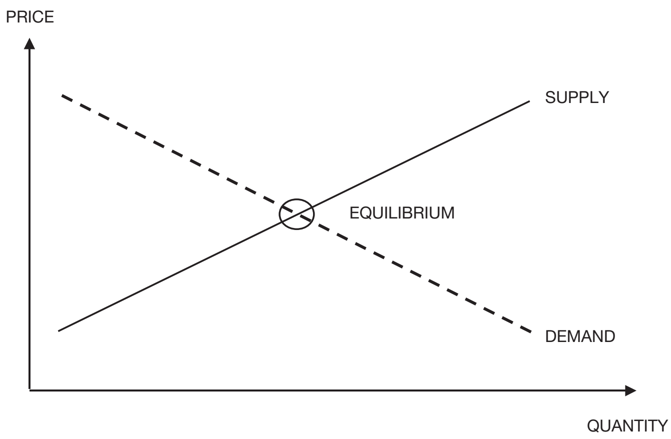
The market

The market is an arrangement allowing supply and demand to meet in transactions. It finds a compromise between the conflicting interests of producers who attempt to fetch the highest price, and of consumers aiming at the lowest price. Such arrangements can be made in the market-place. Understood as an arrangement, however, the market does not necessarily suggest a specific location, and there are as many markets as there are transaction types: the goods and services market, the labour market, the exchange market, and so on.

The terms of trade

Terms of trade[8] set prices for transaction levels – they are the laws of supply and demand. They represent the reactions of all producers (supply) and all consumers (demand), and not of specific individuals. Generally speaking, the laws of supply and demand are expressed as follows: supply increases if prices rise, and demand increases if prices drop, as illustrated in Figure 6.4 below.

Figure 6.4 Supply and demand (1)



Supply and demand reflect the behaviour of sellers and buyers. The point at which the curves intersect is defined as equilibrium, meaning that at that specific price, supply and demand agree.

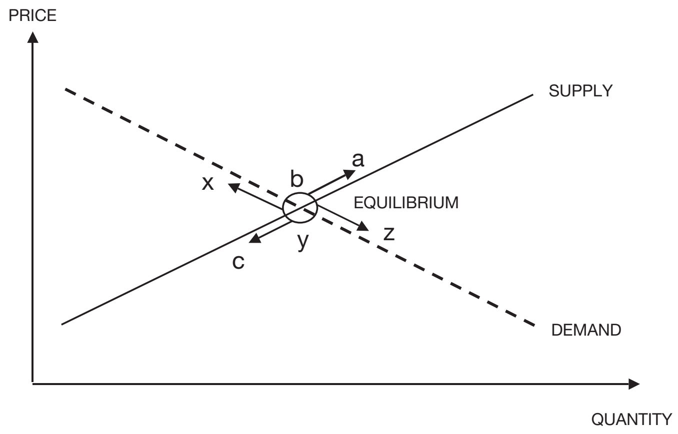
The behaviour of supply and demand is summarized briefly below, and illustrated by Figure 6.5.

⇨ Supply:
- → shortage increases supply and prices (a) – higher prices encourage producers to increase supply;
- → equilibrium maintains supply and prices (b);
- → surplus diminishes prices, and may hence diminish supply (c) – suppliers will prefer to keep their stocks for sale at a more auspicious moment if possible;

⇨ Demand:
- → rises in price diminish demand (x);
- → balanced prices maintain demand (y);
- → drops in price increase demand (z).

[8] Strictly speaking, the expression “terms of trade” refers to the relation between import and export commodities only, in which relative currency values complicate the calculation. However, the expression is used here in reference to domestic markets also.

Figure 6.5 Supply and demand (2)

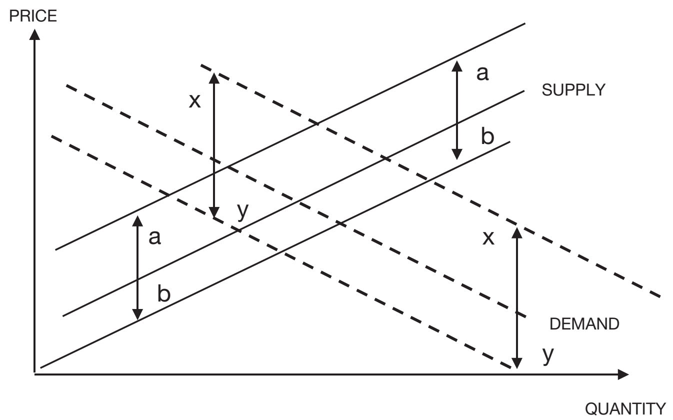


This example applies to producers and consumers searching for a point of equilibrium along the supply and demand curves. The supply or demand curves themselves do not move up or down owing to a change in price (movements prompted by price fluctuations occur **along** the curves); the curves themselves shift only under external influences, some of which are discussed below and as are illustrated in Figure 6.6.

⇨ Supply:
- → the supply curve is displaced upwards if production costs rise, for example through a tax increase (a); it is displaced downwards if production costs fall, for example through the provision of subsidies (b);

⇨ Demand:
- → the demand curve is displaced upwards if income increases, or a new fashion appears, or the price of substitutes (or alternatives) rises, or the price of complements drops (x); it is displaced downwards if income falls, or the commodity loses appeal (fashion), or the price of substitutes falls, or the price of complements rises, or if the savings rate increases (y).

Figure 6.6 Supply and demand (3)



The mechanisms of terms of trade briefly described above apply strictly only to a free market environment, where supply and demand can meet without hindrance – that is, where producers and consumers are sufficiently numerous for competition to be free, and where prices can fluctuate freely without governmental (or other) interference. Such free interaction of competition and price fluctuations in fact is extremely rare; reality usually lies somewhere between the two extremes of strict free market on the one hand, and absolute monopoly over supply and demand, on the other. Monopoly confers the means to dictate the behaviour of suppliers or buyers; it is associated with man's predatory nature, and with the power related to the possession of money. Both these factors entail temptations to dominate and manipulate the market: examples include cartels,[9] takeovers, and corruption. The role of the State is fundamental in this setting, because it can intervene by setting prices and profit margins, and regulating competition – it should be noted that this is contrary to the concept of free market, albeit sometimes necessary. Moreover, individuals are not equal in the marketplace: their economic means differ, and the wealthier may not need to submit to the terms and conditions of producers or consumers. Finally, the value of the goods and services available on the market varies according to the need to secure them.

This introduces another major concept in market relations that influences supply and demand: the price elasticity of demand. This elasticity is the degree of sensitivity of demand for a given commodity to changes in its price. Expressed briefly, elasticity is located between two extremes: total inelasticity, where demand is absolutely invariable whatever the fluctuations in price, and infinite elasticity, where demand shifts very rapidly from nil to a maximum following only a slight change in price. Clearly, the more vital a commodity is (e.g. staple food), the more inelastic its demand is; this factor can only be compensated for by the range of alternatives when the price rises.

Central economies could be discussed here, where demand and offer are substituted by production and distribution plans. However, not only has this type of economy collapsed, but its weaknesses has previously always given rise to a parallel black market regulated by supply and demand.

In terms of securing food, some important aspects of transactions in the market economy are worth noting.

1. If the market is accessible, the possession of money (i.e. purchasing power) enables the purchase of all necessary commodities, including food.
2. The money required to purchase food can be secured through anything that can be sold on the market, according to the laws of supply and demand.
3. The market price of food also obeys the laws of supply and demand.
4. The need for food is vital; as a result, the demand for food is quite inelastic, thus generating latent power relationships on the market. Consumers tend to avoid weak bargaining positions, whereas producers try to take advantage of observed consumer weaknesses. This is particularly true where:
   → the market food availability diminishes, offering opportunities for profiting from shortage (the demand emanating from the poorest drops, but the wealthier maintain their demand in order to purchase whatever is available even at high price);
   → market competition wanes or vanishes, leading to the creation of a monopoly or a cartel, enabling the domination of the market including price and quantity control;
   → food availability fluctuates, encouraging speculation.[10]

[9] Cartels are arrangements among suppliers (or purchasers) setting amounts and prices, in order to control the competition and the market.
[10] Speculation is the process of buying and selling with a view to buying and selling at a profit later when prices have changed.

5. The return on production activities and their social value vary greatly according to the type of activity under consideration. This means that food does not have the same value for all, and that economic and social classes appear, with different abilities to adapt to the power relations that govern society. Typically, unskilled workmen have the lowest income in spite of harsh working conditions, and must unite to voice their concerns; on the other hand, some professionals derive considerable income from less trying occupations whose image represents a very real economic and political power.
6. Food, as mentioned above, is a consumer good that is bought and sold like any other. In spite of preserving a strong symbolic value, it is therefore marginalized in terms of being an instrument of social interaction and turns into a chiefly economic commodity.
7. The securing of food is of concern primarily to the individual who plays an active part in managing his resources by means of market transactions. This micro-economic approach must however not detract from a broader, macro-economic understanding (inflation, unemployment, and financial crisis) of the overall economy surrounding the individual, and of world markets.
8. The securing of food can no longer be viewed as an isolated production activity: this is due to the exchanges that enable the transformation of food into cash and cash into food (and other goods and services), the need to cover all or part of essential economic needs through such exchanges, and the sometimes large proportion of household resources allocated to essential economic needs that are unrelated to food. The securing of food is thus an activity that is integrated into the overall economic behaviour, reinforcing the above considerations as to the impact of determinisms on the feeding process, as discussed in Sections 1.1 and 1.2 above.

Summing up, the development of the securing of food into an economic activity is associated with culture, and manifests itself in cultural determinism. This phenomenon is recent, and has probably had little if any impact so far on the nutritional need as generated by the biological determinism of mankind, owing to adaptation and biological variability. It however has a massive impact on lifestyle, the environment, the utilization of natural resources and the future of life on earth.

3.3 ECONOMIC ACTIVITIES

3.3.1 The activities

Economic activities are those required for survival, i.e. to meet all basic economic needs, including food. Typical activities enabling survival today – alone or in combination – are the following five.

Tapping the natural environment

This consists in collecting the food resources produced directly and without significant human intervention. Such activities include hunting, gathering, and fishing. Hunter-gatherers depend on this, and their survival depends directly on the renewal of natural food resources, and on the extent of the territory available. Some groups still rely exclusively on hunting and gathering; they are however disappearing because they lack the means of defending both their culture and the vast expanses required for their livelihood against technically more advanced competitors. Collecting nevertheless persists in most cultures, and its dietary importance ranges from essential (e.g. the Sahelian farmer) to recreational (the French weekend mushroom collector).

Non-industrial animal and plant production

Subsistence agriculture and pastoralism are livelihoods in which the direct product of agricultural and pastoral activities provides the basis for the diet. These livelihoods are vanishing in highly industrialized countries; elsewhere, subsistence agriculture and, more still, pastoralism, are increasingly eroded owing to the deterioration of the environment by man and modern forms of globalization.

Activities generating a purchasing power

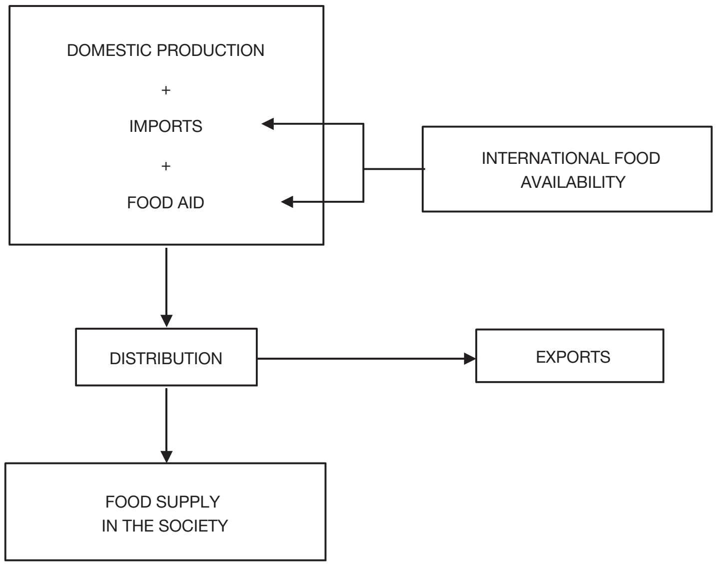
These activities enable people to acquire the goods and services produced by others, in cash or kind. Purchasing power in kind results in barter based on agreed trade-offs. Purchasing power in cash results in purchases; this facilitates access to various goods and services, but the trade-off is accordingly more complex than for barter. Production activities that generate purchasing power are highly varied and include the following:

- ⇨ the production of raw materials through agriculture, forestry, horticulture, fishing, etc. – profit is derived from the supply of raw materials;
- ⇨ transformation: artisanal or industrial production from raw materials: extraction, refining, assembly, finishing – profit is derived from the value added to the product at each transformation stage (mineral becomes metal, metal becomes specific parts, parts are assembled into implements; animals are slaughtered and the meat thus produced is butchered, the hides are tailored into clothes, shoes, etc.);
- ⇨ services: transport, trade, distribution, banks, insurances, health professions, administration, education – profit is derived from services that facilitate, preserve or improve the life of consumers (letter or person delivered to their destination, ownership confirmed by legally recognized documentation, individuals in better health or professionally trained, etc.).

Such activities are conducted by private or public companies. From an economic perspective, those owning the company must be distinguished from its employees. Specialization can be quite high, both for the company and for its employees: the greater the degree of specialization is, the more complicated it becomes to streamline its network of interactions.

These activities appear at the same time as production activities differentiate, work is divided and market trends become the main influence on production. They are typical of market-oriented and nationalized societies that rely heavily on the input of paid labour for production, distribution and the provision of services. This means that the food supply of the segments of society that are not involved in its production must be ensured by industrial food production, by the return on other activities allowing the import of foreign food commodities, or external food aid. Therefore, households whose main economic activities lie outside the food production sector rely on their society's feeding system for their supplies. The feeding system engulfs production, imports, and food assistance, in addition to the distribution of both export and domestic commodities. Where imports and/or foreign food aid account for a significant proportion of the available food, the country depends on food availability on an international scale. The feeding system of a given society or country is illustrated in Figure 6.7 below (see also Section 3.8 below regarding the synoptic approach to the securing of food).

Figure 6.7 The domestic feeding system



Behavioural activities and/or the absence of production activities

These prompt individuals (or the society) to refund, donate or lend food, or the means to secure it. Such behaviour is dictated by kinship, reciprocity, pity, interest, bad conscience or charity, or by a mutual assistance contract. Examples include the protest of infants, the deliberate subservience of a beggar, the flattery of a customer intending to take advantage, the threats issued by a crowd to guarantee the price of bread, the flight from famine of a starving migrant, the waiting for assistance of a refugee in a camp. These are all more or less successful attempts at invoking social obligations. To donors and lenders, the strength of such obligations is directly proportional to their psychological, social, economic, cultural and political proximity to the social cell under consideration (e.g. family, corporation, clan/tribe/ethnic group, or State), and their motivation to act. Inactive members of the family have probably contributed already, or will eventually do so. But for most of society, production activities (or their absence) that involve the activation of social obligations are sustainable only in the presence of an effective social welfare system – based on the prerequisite that all members of society contribute towards it, and thus benefit from the system when they become inactive.

Tapping the human environment

This consists in stealing food or the means to secure it. Within a given society, petty larceny (such as stealing fruit or eggs) may be forgiven; but systematic theft is usually not tolerated because it entails no viable reciprocity. However, it can be imposed out of fear of the thief or his background, for example. Theft can thus be more or less accepted, but it always implies some form of reciprocity, and certainly never provides the basis for subsistence. History has in fact demonstrated that no society can develop if its own culture is exclusively based on looting.

Described as an activity, theft amounts to gathering, except that the field of activity is not the natural environment, but the product of the activity of other individuals, even humans in the case of slavery in many ancient societies – and even today in some countries, or cannibalism – e.g. in pre-Colombian America (Harris, 1978).

In short

To sum up, modern man resorts to these five types of economic activity to secure his food and other essential goods and services; he attempts to combine them as best he can so as to reduce the dependency caused by excessive reliance on one type alone as discussed in Section 3.7 below.

3.3.2 The necessary means for the activities

Economic activities imply the use of means to produce economic resources in a regular manner. These means are the household production assets, and are referred to here as "means of production".

Means of production are those enabling the continuation of production activities, in a way consistent with the rate of consumption of goods and services. In other words, they provide access to food and all essential goods and services in a renewable way. They consist of a basic resource and the inputs required for its utilization. Inputs are usually associated with a basic resource in some way; in some cases however the required input can fulfil different functions, such as a car, used both to commute to work and for leisure. These means of production are:

⇨ labour is the first and most important, and is common to all forms of economic activity; it is determined by the general health condition, and its inputs are food and hygiene;
⇨ land and water that are useful in terms of food collection and animal and plant production, and mining; its necessary inputs include implements, machines, draught animals, spare parts, fertilizers, pesticides, seeds, power, labour, and time;
⇨ professional training and the inputs required to produce saleable commodities or goods (e.g. a shoemaker's training, combined with the required material and tools, or a doctor's education and his practice);
⇨ capital to establish or develop transactions; required inputs relate to the securing of customers (for example, an oil merchant seeks to purchase oil in the countryside for sale in the city – this requires cash to actually buy the oil and rent a stand at the city market, in addition to transport and possibly storage);
⇨ the professional training and corresponding inputs that enable a specialized salaried activity (e.g. an engineer's training and the budget to cover the cost of transport and professional clothing, or a tradesman's training and the necessary implements and clothing); today, employees are less expected to provide the tools of their trade in developed economies, and employers allow a specific budget for this;
⇨ capital that generates interest (e.g. cash investments, breeding stock, leased land) and the inputs required to attract customers, maintain the herd, and maximize the land's market appeal;
⇨ status that facilitates the activation of social obligations – the main input is either a legal status for the unemployed, the retired, the disabled among others, or an image that inspires pity, bad conscience, fear or compassion.

People are not all equal in their economic activities between and within societies, depending on the quality, the quantity and the appropriateness of their means of production and their ability to use them.[11]

[11] See Section 3.6.3 in this Chapter, regarding return on production activities.

3.4 THE ORGANIZATION AND DETERMINISM OF ECONOMIC ACTIVITIES

Economic activities carried out through the use of means of production must take place within a culture. They can thus be analysed by following their organization and determinism schemes.

3.4.1 The function of economic activities

Man resorts to economic activities in order to meet his essential economic needs (including food) directly or indirectly. However, the relation between this activity and the covering of needs is not automatic; the observation of individual economic behaviour must therefore always involve an understanding of its underlying reasons, and resulting expectations.

3.4.2 Community

The community involved in economic activities depends mainly on the use of its resources and its culture. However, all economic producers share two characteristics: they must participate in activities, and each family unit must include at least one producer. Families are understood here as households, the smallest sustainable social unit: individuals living alone or groups living together voluntarily. The household unit is central to this Manual, being the smallest common denominator for a range of activities that are logically and closely connected:

- ⇨ it determines food-securing activities, which in turn shape the subsequent stages in the feeding process for all members of society;
- ⇨ it is central to the preparation, sharing and consumption of food, because it accommodates dependants such as infants and the elderly in addition to its productive members;
- ⇨ it influences other elementary needs (such as reproduction, and the search for shelter and safety) – as discussed below, these needs determine activities and the food securing performance; the link between reproduction of the species and survival of its culture, on the one hand, and nutrition on the other, is close because of imperative reciprocal obligations.

Individuals do not always form a family with children; this is unimportant here, because they must nevertheless obey the same rules in order to secure economic resources.

The concept of household tends to suggest a solid nucleus, in which interests and resources are both shared. However this may be misleading, because the active members of a household can have strongly diverging interests and obligations; even so, the household is the strongest social unit, considerably more so than the individual, the group or the nation.

3.4.3 Structure

The structure is the basic organization unit required to fulfil a function. The structure that supports the active economic contributors is determined mainly by the means of production available to households to meet their basic needs (in turn shaped by the economic development and the social structure of the society). In practical terms, hunter-gatherer families each represent a structural unit, because each is self-sufficient in satisfying its own basic needs. The same comment still applies to some pastoralists and subsistence farmers; in this case, however, the relation is not as clear because pastoralists and farmers may not actually own the herd or the land they look after, but are paid to do so. Therefore, not owning the produce of their labour, they must resort to the market to cover their economic needs, like any artisan or wage earner.

In short, the greater the self-sufficiency at household level, the more its close society (i.e. the family, clan or tribe) provides the basic structure determining its economic activity. The lower the household's self-sufficiency, the more the "Tribe-State"[12] takes over the different economic segments that ultimately enable everyone to meet their needs through exchanges. In this case, the integrating structure is too remote from daily concerns for households to identify with it; they therefore gather and organize themselves to defend their interests against other economic groups. In fact, wherever the organized behaviour of a society is highly divided in this way, social classes appear in direct or indirect association with the economy; the degree of association is determined by their activities and real power within the economy. This explains the existence of associative professional structures such as artisan corporations, trade unions, associations, and castes: they all provide a real structure for economic activities and, thus, for the means of securing food. Such associations all design charters or standards that are superimposed with the political norm, in order to regulate the group's specific activities in both content and form. They also generate their own teaching systems accordingly. The strength of its structure determines the group's capacity to voice its concerns towards the central authority, and to secure its status and employment – this capacity determines its survival. Indeed, the social status of all such structures or units is a reflection of their economic power, be it direct (i.e. activities that are indispensable to the economy) or indirect (activities that are recognized as vital for the culture, or associated with the exercise of power). They are also bound to one another by dependencies or interdependencies that are often complicated by the fact that modern States result from the blending of several cultures that must be reconciled by means of a political authority, with all the problems of interest and power that this suggests. Nowadays, particular attention must be paid to the meaning of such structures in view of globalization; the power of some of them reaches well beyond that of national political leaders, and they regulate human life with the sole objective of profit, with no further thought to the social contract that the economy needs in the long term, or the other instrumental imperatives that are indispensable to the existence of any culture.

VI

3.4.4 Norm

The concept of norm defines what can be done, and how.

Acceptable activities

The relationship between man and the cultural apparatus of implements and consumer goods is based first and foremost on ownership; the ultimate objective is to appropriate existing economic resources. In every society, anything can only be appropriated in relation to one's own available means, which must be recognized by the rest of the community as one's own, thus conferring upon them a varnish of legitimacy. The means of production described above must comply with this norm – they must either belong to the individual and his family, or be communal goods whose relevant access is clearly regulated. In short, the legitimate ownership of means of production entails the right to secure resources through recognized activities. It is in this sense that looting and theft are usually not recognized appropriation activities – this being said, in the complexity of modern economic relations some types of appropriation are accepted when they are in fact akin to theft or looting.

The normative dimension in securing economic resources is crucial, particularly in crises:[13] households or entire segments of society can starve alongside resources that they cannot appropriate because of the social contract that binds them to the rest of society. Breaking the rule would prompt

[12] The Tribe-State comprises only one cultural group, as opposed to the Nation-State that can consist of many.
[13] See Chapter VII.

reprisals, in which the offender would have even more to lose. Normally, people commit illegal actions only because they feel utterly desperate, or because they do not belong to the society – or no longer feel that they do. Either way, this situation means that the society under consideration has lost its primary function, that is, of increasing the chances of survival through the organization of individuals into a group; thus offenders no longer have much to lose. This can result from the fact that their life itself is at stake, or that society lacks the means and the will to react. The great Irish famine of the 19th century illustrates this to a large extent (Gray, 1995).

Rules of conduct and implementation techniques

Every type of effective activity has to be organized in one way and one way only, through which it becomes culturally stabilized, that is, incorporated into the cultural heritage of a group (Malinowski, 1994). This implies the presence of an educational apparatus, which is just as differentiated as production activities are. In any culture worthy of the name, this apparatus is not confined to teaching techniques only; it also aims at conveying a set of ethics, rules of conduct and moral values, without which technology tilts culture towards technocracy. "*Science without conscience is but the ruin of the soul*" said Rabelais, in 16th century France. The main component of the educational apparatus is therefore the family, in which codes of general conduct and the cultural taboos of the society are taught – these provide the indispensable basis for the implementation of specific activities according to the accepted cultural norm. Specific activities can be taught as such. Each culture has its own coherence and deep roots that provide the foundation for the form and substance of activities. Respect for this form and substance are just as indispensable to the survival of the culture as culture is indispensable to the survival of the individuals that make it up.

3.4.5 Enforcement

All societies give themselves strong means (authorities and representatives) to ensure that the securing of resources obeys the ownership norms that it (or the power in place) has recognized; it can deal with non-compliance if necessary. The great Irish famine resulted from this phenomenon: the State rejected the survival mechanisms that threatened to violate existing rules, and instead allowed millions to starve or be forced into exile. This shows that in crises (certainly at their onset), survival mechanisms are limited to what is permitted, according to what personal possessions are left. This is an important concept in attempting to understand the conduct of victims of incipient crisis.

Norms, but above all the authority that enforces them, are rather stable elements whatever the circumstances because they ensure the survival either of society (when it is culturally homogenous), or of the segment of society that holds power (when society is culturally heterogeneous). In the latter case, it is both politicized and heterogeneous, therefore uneven from an economic perspective.

3.5 INTRODUCTION TO ACTIVITY PERFORMANCE

For a household to eat adequately, its economic activities must return an average 0.6 kg of varied food per day, per person, in compliance with its eating habits. Achieving this restrictive objective is determined by the performance of its activities.

Generally speaking, performance is defined by the ratio between the actual and the expected output. The performance of economic activities can be expressed as the ratio between the food resources actually produced, and the food resources required to meet the nutritional need; this must in addition take place within a given timeframe set by the cycle of economic activities.

$$\textbf{Performance} = \frac{\textbf{Food resources produced}}{\textbf{Food resources required}} \textbf{ / Time}$$

However, this approach is rather simplistic, and does not entirely reflect reality, as illustrated by the example below.

On the basis of the above "food produced/food required" ratio as influenced by time limitations, a daily worker must secure every day a salary that he can then use to buy food in an adequate quantity and of adequate quality to feed himself and his dependants. Likewise, a farmer must obtain from one or two yearly harvests a yield that is adequate to cover his, and his family's, yearly consumption.

However, in line with the above discussion on basic economic needs, the worker and the farmer must produce an income and a harvest that are greater than their food requirements (see Section 3.2.1 above): they must also cover basic needs that are unrelated to food. If the performance of economic activities is sufficient only to cover the nutritional needs of the household, then the farmer and the worker do not have enough available income to meet their basic needs. They will probably restrict their food intake in order to be able to cover their other basic needs with the resources thus saved, but to the detriment of their health.

The stage corresponding to the securing of food cannot therefore be considered in isolation. It is always included in the securing of the overall economic resources enabling the coverage of all basic economic needs.

It follows that the performance of economic activities cannot be assessed only in the light of food production. Assessment must include the need to meet – qualitatively and quantitatively and as often as necessary – the basic economic needs; the securing of food being integrated into the household's overall economic strategy. Seen from this angle, household activities must achieve a performance that enables the coverage of all basic economic needs, including food, by allocating its resources proportionately to each of these needs according to their magnitude.

The concept of performance can thus be related to that of overall economic performance, allowing for all the resources required for the sustainability of the household. The performance equation can be adapted as follows.

$$\textbf{Overall economic performance} = \frac{\Sigma^{a} \textbf{ Economic resources produced}}{\Sigma \textbf{ Economic resources required}} \textbf{ / Time}$$

[a] Σ is the mathematical symbol for "sum".

In the above formula, the "sum of economic resources produced", the "sum of economic resources required", and "time" are the terms of performance. Timeframes apply both to produced and required resources, and could in principle be removed from the equation accordingly. This removal might however conceal the fact that timeframes are common to both types of resources; it expresses the production rate of goods and services, their rate of consumption, but above all enables the comparison of these rates to determine the economic balance of revenue and expenses.

In this broader approach, a performance equal to or greater than 1 enables the coverage of the nutritional need in addition to other economic needs; a performance lower than 1 entails impoverishment in some way. In other words, if performance is equal to or greater than 1, the household is economically self-sufficient; if performance is lower than 1, it is not, and this precarious situation can deteriorate rapidly. Performance usually revolves around 1, depending on circumstances: what is of importance here are the overall trends, calculated over sometimes long periods of time. Seen in this light, performance appears as a realistic and intellectually satisfying approach to the household economy. In reality, however, performance calculation remains a difficult exercise, because resources (produced or needed) cannot always be translated into monetary equivalents. Securing goods and services is partly ensured by home production, partly by acquisition. The "economic resources required" therefore refer to goods and services as expressed in their actual form – be it in kind if produced by the household, or in cash if they must be secured on the market. Likewise, the "economic resources produced" must be both in cash and kind – thus generating purchasing power – to acquire goods and services. Expressing overall economic performance is therefore more complicated than a simple fraction, especially because situations change and imply changes in the form of exchange and of the choices that can have a significant impact on the terms of performance themselves.

The above general conceptual formulation nevertheless provides the key to any thinking on economic performance: to be in a position to secure through one's activities at least as much as one consumes, and this at a rate that is in line with the cycle of activities.

3.6 FACTORS DETERMINING ACTIVITY PERFORMANCE

The economic resources required and the timeframe can be viewed as the two major constraints forcing households to produce a given minimum quantity of resources, at a rate that is consistent with their possibilities.

3.6.1 Factors determining the economic resources required (denominator)

Economic goods and services required for the coverage of basic needs can be quantified to a certain extent. This should enable the appraisal of the economic resources required for this coverage to be adequate, that is, to set an objective to be met with the production of resources in cash and kind. Special attention must nevertheless be paid to the fact that needs vary between and within cultures (and according to the environment), and such variations fall into five broad categories: cultural variability, the magnitude of needs, economic status, behaviour and the conjuncture.

Cultural variability

The cultural apparatus of goods and services, like the set of values specific to each culture, entails expenses that vary from one culture to another. Marriage can involve a cost here, and a profit there; housing and schooling do not involve the same constraints everywhere; political, economic, and social status may – or may not – entail obligations involving an economic cost; furthermore, cultural value can make some commodities indispensable when, at first sight, they are not. Similarly, it may be vital to take part in traditional or religious rituals involving considerable expense.

The magnitude of needs

The need for clothing, shelter, heating and food depends on climate. Transport costs depend on the distance between the home and the workplace. Finally, household needs will also vary according to the evolution of the family.

Economic status

As illustrated by Engel's law (see Section 3.2.1 above), the proportion of the budget allocated to different needs varies according to the resources that are available to the household, that is, according to the economic status within the culture and the range of choices that result from it.

Behaviour

The economic behaviour of individuals in the same economic bracket varies according to their spending habits (i.e. wasteful or sparing). Lifestyle does not have the same meaning for everyone, translating into different preferences or priorities (i.e. utility) and, thus, different costs. Households do not all seek the same forms of wellbeing and safety. This behavioural aspect is particularly relevant to the nutritional need. Chapter III has discussed the fact that the nutritional need cannot be quantified entirely; as will be discussed later, the nutritional status resulting from food intake experiences significant variations, within which the individual functional capacity hardly changes. The full spectrum of nutritional needs can be covered with different foods whose costs vary greatly.[14] Consequently, the direct observation of individual normal food behaviour is indispensable to define accurately the food resources required within a given timeframe. A household can meet its nutritional need adequately from very diverse foods, provided it has the choice. Within set limits, households can consume varying amounts of the same products without health or functional problems, but with a different nutritional status.

Economic circumstances

Economic situations vary according to season, the markets of goods, employment, capital, dividends and exchange rates, and according to politics. Such variations lead to different types of budget utilization and needs coverage behaviour; a given expense may be considered exaggerated and unnecessary today, and normal tomorrow.

This highlights the differences in the economic needs of households, social groups and cultures, but also how these vary over time. The concept of basic needs may appear to be straightforward, but its reality is far more complex; only its economic aspects are discussed here. One major difficulty arises in attempting to appraise individual basic needs: there is no general rule, and each must be considered separately.[15] A common pitfall is the ranking of basic needs, and the setting of minimum thresholds in order to quantify the economic resources required to achieve minimum sustainable living standards. This is subjective, and can become judgmental and elitist:

⇨ ranking his needs reduces man to his involuntary needs, ignoring his psychological, social and cultural identity – this mistake is common both in development programmes and in so-called humanitarian operations.

⇨ in addition, the question arises as to setting poverty thresholds rather than wellbeing, or even wealth thresholds – this mistake may be common in development programmes, but is almost standard in humanitarian operations.

In short, individuals and groups set their own priorities and define their own concept of needs, and both are related to their culture. Economic needs can always be quantified, but only with the direct participation of those who are under scrutiny. The overall economic performance of households can therefore not be fitted with a universal quantitative and qualitative denominator.

[14] See Chapters III and V.

[15] These assessment aspects are discussed in Chapter X.

3.6.2 Factors determining timeframe

The timeframe in which performance is appraised is determined by the time unit specific to the production rate, related to the renewal of economic activities: hunting, fishing, gathering, and agricultural seasons, paydays, the time required for the production of a given good or the provision of a service, or the recovery of capital interest. Households sometimes conduct several economic production activities simultaneously: performance is in this case determined by the production cycle of the activity that accounts for most of the revenue. However households can also set timeframes for themselves, according to the evolution of both the family and its needs. This entails a division of time into intervals that are not necessarily regular.

3.6.3 Factors determining the economic resources produced (numerator)

To produce resources regularly, economic activities must allow for means of production. Production is determined by:

⇨ the return on, or productivity of, activities (return, or yield, is defined as the output per input unit of a specific means of production);
⇨ the number of production units activated.

Thus, resources produced within a given timeframe correspond to the resources produced per input unit, multiplied by the number of input units – in other words, the output multiplied by the number of input units.

Such an approach to economic resources produced may appear cumbersome, but it involves the scrutiny of the underlying analogous mechanism of the production of any type of resource: a standard must be applied to both exchanges and production.

Input and output are illustrated in Table 6.4 below.

Table 6.4 Inputs for the production of economic resources

Means of production	Input	Output (examples)
Wage labour	Man-hours,[a] or unit of goods or services produced	Hourly wage, or unit wage
Cultivable land	Surface unit cultivated, or weight unit for sale	Harvest per surface unit, or profit per weight unit sold
Herd	Female of reproducing age	Number of offspring and/or litres of milk per female, and/or profit per head or litre of milk sold
Capital	Monetary investment or lending unit	Interest rate on investment or lending
Provision of services	Typical service unit (e.g. medical or other professional consultation, specific action, distributed item), or man-hours	Profit per typical service unit, or per man-hour
Production of goods	Produced unit	Profit per unit produced

[a] When the production unit is expressed in man-hours, the production of goods and services per time unit is implicit and is regulated by tacit or formal agreement.

For example, in a household where economic resources result from wage labour whose yield is twenty francs per hour, the economic resources produced are equal to twenty francs multiplied by the number of hours worked within the budgetary timeframe under consideration. In the case of food production, the yield amounts to the kilograms produced per cultivated surface unit, and the economic resources produced amount to the yield multiplied by the number of cultivated surface units, within the timeframe as set by cropping seasons. In the first case, the input is labour, in the second it is cultivated surface.

The yield of production activities

The basic definition of productivity, or yield, is simple: it is the ratio of output to a selected input. In the case of household economy, yield is not so obvious because households can usually secure their economic resources through various activities, involving different means of production, to produce different types of resources according to their degree of self-sufficiency. As seen above, most households must produce economic resources in both cash and kind. In the first case, productivity is a direct result of man-hours or any other relevant measurement unit, such as cultivated surface. In the second, the production of cash resources usually involves the production yield of goods or services per relevant unit, and a cash conversion yield of this production. For example, a cereal farmer calculates his yield in terms of weight per surface unit (this calculation is particularly relevant in terms of the farmer's domestic cereal consumption). He also calculates the yield (from which he derives his profit) of the surplus sale, expressed in monetary unit per weight unit. An abundant harvest thus translates into a high production yield, but market prices can be low owing to the resulting available cereal excess; the sale yield is then accordingly reduced. In such a case, the farmer may find it difficult to balance his budget, in view of his unavoidable expenses in order to survive. On the other hand, a mediocre harvest in shortage situations can prove quite profitable in terms of sale, if demand is strong enough to raise prices. For wage-labourers, the form of compensation plays a central role in terms of yield, depending on whether the salary is related to time or to output. Here again, the law of supply and demand is crucial, both on the labour market and on the goods and services market, to determine the yield of production activities. Moreover, it is usually possible to choose different ways of utilizing resources in order to obtain the greatest yield or productivity, depending on the household's own appraisal of its circumstances, sometimes involving gambles as to economic trends. Returning to the above example of the cereal farmer, if his harvest is excellent but market prices are low, he may choose to borrow money to cover those needs that require economic resources, and store his harvest for sale in the following season at a better price. His knowledge of climate and market trends enables him to anticipate developments with good prospects of success; however, such a gamble may also be a last, desperate resort, heralding destitution if it fails.

The examples above show that the best concrete approach to yield or productivity calls for the scrutiny of the general and specific parameters of the five types of activity that define economic activities and the securing of food.[16]

[16] See Section 3.3.1 in this Chapter.

General parameters

Four parameters can influence the yield of household production activities, but they may not all peak together.

1. The value of activities on the labour market and the goods and services market.
2. Productivity inputs.
3. Individual factors.
4. Contextual and structural factors.

Activity value

Clearly, resources produced within the same timeframe but by different professions vary considerably.

The capacity of a given profession to produce economic resources is determined by what is referred to here as its qualitative value in the economy of the culture under consideration. This value determines the trade-offs between what is sold and what is bought in exchange for this production.

It is defined by three main types of power.

1. **The economic power associated with the activity** is linked to demand for the production specific to this activity on the goods and services market – that is, that value is set by the rarity of the profession, its production, and the inelasticity of demand for this production.
2. **The political power held by the community resorting to a specific activity** is linked to the means of pressure it can exert to defend its interests (such as compensation rate and form, work-time, etc.), and its position in economic, political and social power relations. For example, in the early days of the industrial revolution in the 19th century, mining was essential to industrial and trade developments, and demand was thus strong. The economic power of miners was weak, however, because their social status was among the lowest, and their political weight insignificant. This status is reflected in the way they were exploited (imposed working hours, compensation). Upheavals, strike and union assemblies proved the only way to exert pressure effectively and afforded them the political power to improve their salaries and social status.
3. **The cultural power arising from the carrying out of a specific activity, conferring social status upon whoever exercises it**. This type of power reflects the cultural values of the society and is usually elitist, that is, bound to a feature that is not commonly shared within society, but acquired by the individual or inherited, and enjoys the esteem of society in general (the arts, medical or religious activity, superior erudition or professional expertise, high-level responsibilities, political stature).

Often, one of the above types of power alone confers recognition upon the activity, but they can also accumulate: producing something rare and necessary, within a powerful and socially prestigious guild, is a reliable formula for a comfortable income.

Productivity inputs

Productivity inputs influence the yield of production activities per production unit. They permit the increase of production per time or surface unit. The household, or economic unit in charge of the activity, must secure them and cover the costs associated with their utilization. Table 6.5 below provides some examples of productivity inputs.

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Table 6.5 Examples of productivity inputs for selected production activities

Production activity	Productivity input
Physical and/or intellectual work performed by the individual	Healthy diet, adequate living conditions, access to healthcare
Agriculture	Fertilizer, pesticides, irrigation, quality seeds, protection against climatic hazards
Stock-breeding	Veterinary services, water and animal feed availability, protection against climatic hazards
Hunting, gathering, fishing	Reasonable predation on the species according to mating seasons and to the ecological balance
Trade	Advertising, supply, quality products, customer care, securing of privileges or monopolies
Artisanal or industrial production	Training, organization, employee motivation, tooling
Investments and speculation	Market knowledge, risk mitigation
Requesting social obligations	Tenacity, seeking patronage

Generally speaking in terms of productivity inputs, production activities all require physical and/or intellectual work. As a result, productivity inputs associated with such work determine health and functional capacity, and are involved in all production activities. Such inputs nevertheless involve an economic cost that the poorer households usually cannot afford. As a particular example, Western-type intensive agriculture practices demand an input increase in order simply to maintain a yield that nevertheless often continues to decline (Pimentel, 1979; Georgescu-Roegen, 1979).

Individual factors

In spite of identical activities, means of production and health condition, major productivity differences can appear, because individuals are not equal in terms of their own capabilities (will, manual and intellectual capacity), nor are they in terms of their professional training. Moreover, the compensation for equal work can nevertheless reflect discriminatory inequalities according to the social status attached to individual factors such as racial or ethnic segregation, and gender discrimination; women are usually paid less than men.

Contextual and structural factors

Contextual and structural factors are independent of the will of the individual, of their activities and their productivity inputs. They include, in particular, geo-climatic parameters, and the conditions of supply and demand that set the market forces and the terms of trade at both micro- and macro-economic level.

Parameters specific to activities

The yield of gathering activities is determined by climate and the availability of game and plants; the input unit refers to the surface covered.

The yield of food production is determined by the cultivated species, climate, natural soil fertility, and agricultural techniques. The input unit refers to the cultivated surface.

The yield of activities that generate purchasing power is determined by what can be obtained in terms of sale price, salary, fees, interest rate, savings or loans. Input units refer to the units sold: respectively, time or production units (depending on the form of compensation) in the case of salaries, service units in the case of fees, monetary units in the case of savings or investments, and monetary or in-kind units depending on the nature of loans.

The yield of social obligations is determined by, on the one hand, the strength of social status to "impose" an obligation upon the benefactor, and the performance of the benefactor's production activity in terms of satisfying his own needs, and contributing to the coverage of those of one or several beneficiaries, on the other hand. The input unit refers to the benefactor.

The yield of activities preying on the human environment (such as theft) is determined by power relations; the input unit refers to the producer of stolen commodities.

The yield of economic activities poses increasingly acute problems to more and more societies whose economy, ecology, and demographic growth are close to saturation and breaking point.

Number of input units activated

The input units of the means of production are essential in defining yield, or productivity. The number of units activated determines the overall mass of economic resources that a given household can produce. This number is directly defined by the importance of the means of production engaged in terms of basic resource and production inputs;[17] this is called the household productive or active assets (Table 6.6 below). This number of assets is also determined, to a certain extent, by individual factors (e.g. will, capability, functional work capacity), and the same contextual and structural factors that influence productivity.

Table 6.6 Active assets at the disposal of households – examples

Basic resources	Production inputs
Labour (physical or intellectual)	Man-hours
Cultivable surface	Seeds, tools, manpower
Capital (cash)	
Herd (females of reproduction age)	
Raw materials for industry and transformation handicrafts	Implements, manpower
Capital (cash and fees) to conduct commercial transactions	Distribution logistics, manpower

[17] Production inputs must be clearly distinguished from productivity inputs. Production inputs enable the growth of the overall mass produced; productivity inputs, on the other hand, increase the yield (or productivity) of each production unit.

The productivity inputs of physical and/or intellectual labour (e.g. food, living conditions, and access to healthcare) contribute to increasing the yield of most production activities; likewise, the production input of labour (i.e. man-hours) influences the utilization of most basic resources. This notion of time devoted by households to work is important, because time is finite, and a specific time period must be devoted to work. In other words, work takes time – regardless of the importance of the means of production – and is frequently a limiting factor. This is mainly the case when the hourly production yield of necessary resources is low, or when circumstances set specific timeframes for the implementation of given tasks (for example, in agriculture, the preparation of land before the rains and weeding). Even the most robust cannot work longer than a certain number of hours per day without adverse consequences; likewise, wage-labourers are limited by the conditions imposed by their employment contract. Besides, a robust man may own 15 hectares of land – if he must prepare the land within two to three weeks, without machinery, before the onset of the rains, he will be unable to till more than one or two hectares, depending on the nature of the soil. Moreover, when time is the limiting factor, basic activities compete. There are only so many hours in a day, a week or a season, to accomplish all the tasks necessary to the life of a household. Meeting basic needs thus costs time, first and foremost.

The activities required to meet basic needs differ greatly, but all are necessary:

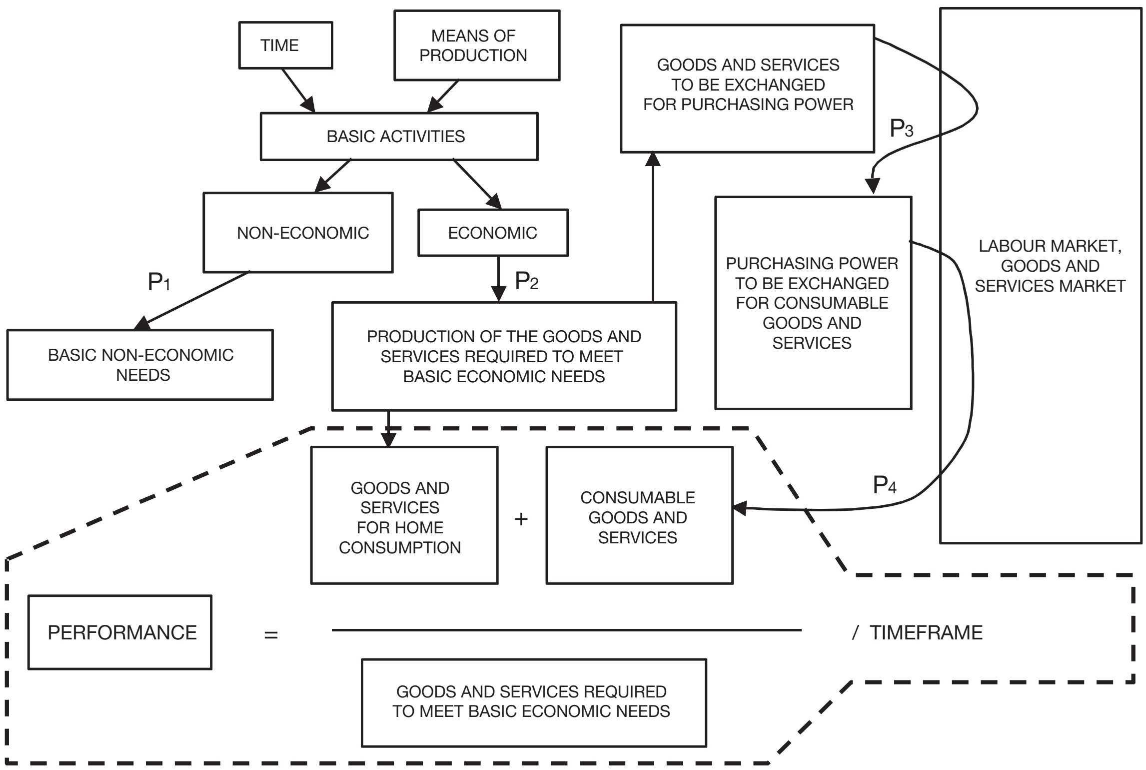
- ⇨ production generating economic resources
- ⇨ household
- ⇨ family
- ⇨ other human relations
- ⇨ cultural
- ⇨ recreational
- ⇨ rest

The above basic activities may compete in terms of the time they require. The typical example is that of a single mother ensuring the survival of her household on her own. Her normal day can total up to fifteen working hours or more, devoted to household tasks, child care, and activities generating economic resources (usually low-yield) – and this is sometimes still insufficient to meet the minimum required to cover a single basic need. In such conditions, and by constraint, the activities sought as a priority are economic activities that preserve the most independence. Food is then probably a priority among others, and suffers accordingly, both in terms of quality and in terms of food consumption proper. Thus, economic resources produced are highly dependent on the time that can physically be devoted to them. Seen from this angle, time is also an economic resource. As the saying goes: “time is money”.

In short

The overall household economic performance is determined by its capacity to transform its productive assets into the resources required to meet its basic economic needs: consumable goods and services, goods and services to be converted into purchasing power, and purchasing power to be converted into consumable goods and services that the household does not produce itself. This capability is determined on one hand by the active assets and the productivity of their transformation into necessary resources, through the exchanges enabled by production activities (e.g. work, sales, and production), and on the other hand by the importance of the economic resources required to meet the economic needs, bearing in mind that time can become a limiting factor. These concepts are illustrated in Figure 6.8 below.

Figure 6.8 Overall economic performance of the household



Performance is located within the area surrounded by the dotted line. Factors P_1 to P_4 are the crucial productivity factors:

P_1 is the hourly yield of non-economic basic activities, and together with P_2 it defines the time allocated to each basic activity;
P_2 is the yield of work (hourly/production) for the production of goods and services;
P_3 is the yield of the conversion of goods and services produced into purchasing power;
P_4 is the yield of the conversion of purchasing power into the goods and services required to meet basic economic needs.

P_3 and P_4 correspond to the terms of trade faced by the household in acquiring goods and services in the market. It is worth noting the attribution of time between the different basic activities – this aspect is all too often ignored by household economy analysts, who usually study the time factor only in terms of defining hourly productivity and budgetary timeframes (i.e. timeframe). Expressed mathematically, long-run performance must be greater than or equal to 1 for the household to be economically self-sufficient.

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3.7 PERFORMANCE SECURITY

3.7.1 Introduction

The overall household economic performance is determined by the variables $V_1 \ldots V_n$, bound by the different productivity levels ($P_1 \ldots P_n$), as illustrated in Figure 6.9 below.

Figure 6.9 Productivity variables and factors affecting performance

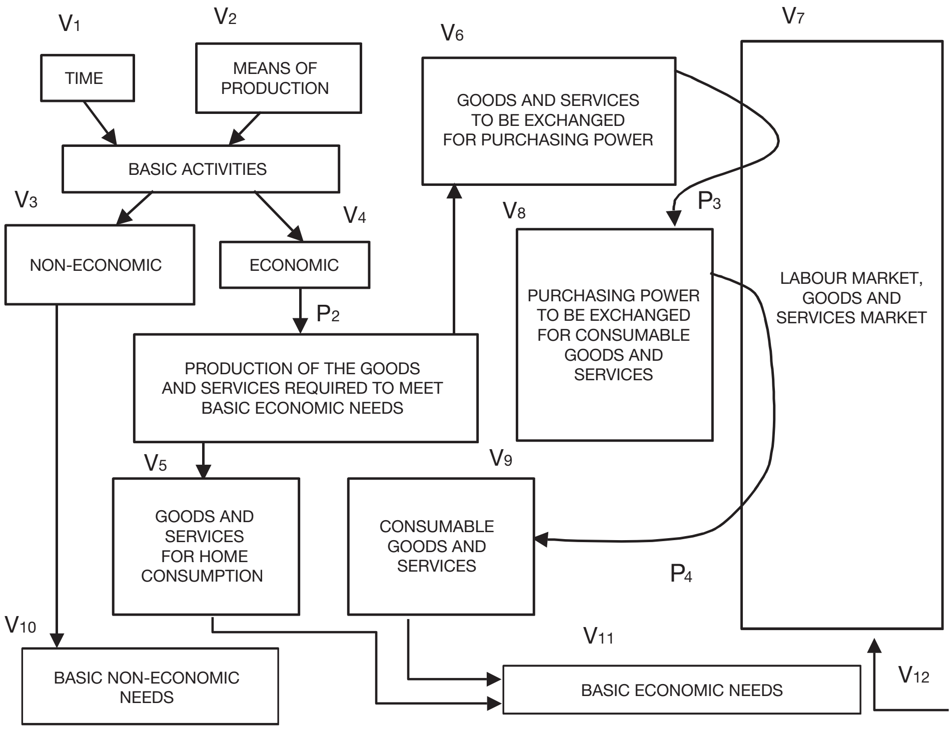
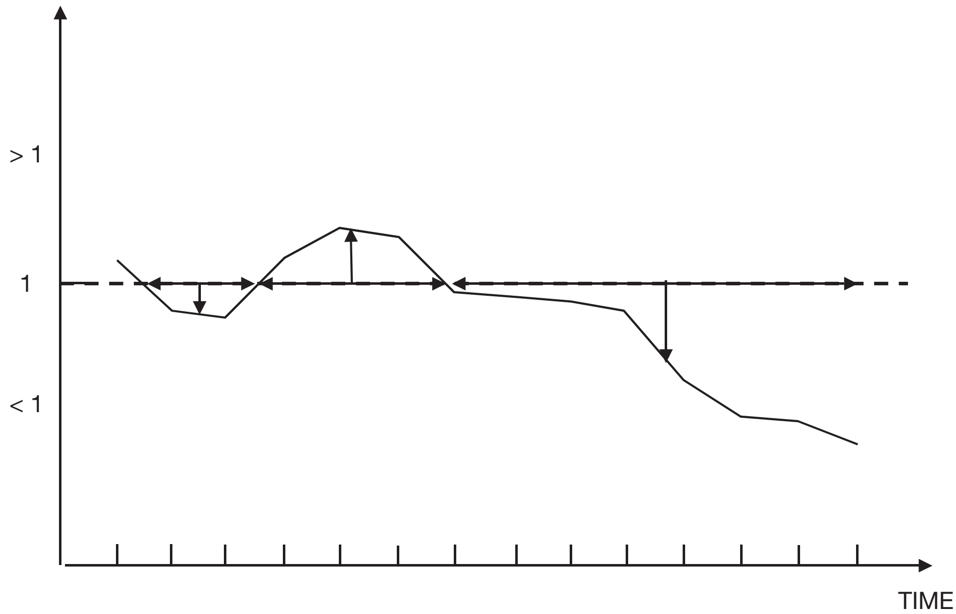


Figure 6.9 above illustrates the immediate surroundings of the household and its micro-economy; they are related to the macro-economy through the entry point labelled V_{12}. When variables and productivity remain constant, the overall household economic performance also remains constant. However, developments associated with the natural environment and human beings are subject to change and accidents. As a result, any economic activity that is related to the utilization of a given means of production can generate varying amounts of consumable goods and services, because production varies, but so do the terms of trade. This has repercussions on the household's economic performance. Therefore, a given performance is not automatically sufficient for a given economic activity: it can be influenced by variations in both quantity and time. As illustrated in Figure 6.10, shortage or profit periods can be more or less protracted.

Figure 6.10 Possible performance variations in stable consumable goods supply conditions



Insufficient performance entails a risk of nutritional crisis[18] that can have disastrous consequences at household level. To mitigate this risk, society develops security mechanisms at different levels of social, economic and political groups. Such mechanisms are intended to preserve reliably an adequate access to the goods and services required to meet basic economic needs.

3.7.2 The concept of security

Economic security is achieved when a household has the sustainable means to obtain all the goods and services that it requires to meet its basic economic needs, according to its cultural and physiological standards.[19] The economic security of a given household is therefore determined by its access to consumable goods and services, and the conditions for security demand that this access be adequate and stable.

Adequate access

As discussed above with respect to the denominator of performance in Section 3.6, the notion of adequacy is very difficult to outline in terms of basic needs, including the nutritional need.

This being said, and assuming the household is well aware of this difficulty, adequate access is determined by four main parameters.

[18] See Chapter VII.

[19] Cultural standards are defined by values transmitted by tradition and translate the coverage of physiological needs into the specific practice of a given society within its environment. The speed of modern change complicates the identification of such standards, and practices can be lost or be created within one generation. Some livelihoods are so precarious that standards in fact no longer allow for even the most basic physiological needs. Physiological needs are discussed in Chapter III and IV – they too are difficult to quantify with accuracy.

1. the means of production (or productive assets), in terms of quality and quantity to achieve the required economic performance;
2. the market availability of the consumable goods that the household cannot itself produce – this availability is influenced by:
   → the capacity of the society or country to produce goods, services and currency to fund imports;
   → the aid received from other countries or organizations;
   → the distribution system;
3. the physical proximity of labour markets and the goods and services markets that the household depends upon;
4. the economic reserves and social obligations that protect against possible economic counter-performances.

Stable access

Access stability is determined mainly by the sustainability of the household's means of production – in other words, on the condition that the means of production permit the renewal of access to resources: the land, thanks to sun and rain, provides one or several harvests per year; labour regenerated by rest and food, is able to conduct paid activities every day; invested capital produces regular interest; herd reproduces. But the stability of access is also influenced by the stability of availability or supply, which in turn reflects the vitality of the regional or national economy that softens production and import fluctuations.

Thus, the economic security of a given household is determined by the sustainability and adequacy of its means of production and reserves, but also by the economic security of its partners in the market, in turn influenced to some degree by the national economy.

Specialized literature all too often discusses economic security from the restrictive angle of food security, as if households only consumed food. This Manual deliberately chooses the broader approach of studying the overall economic performance that is required to meet all the basic needs that involve economic resources (goods or services). Indeed, the allocation of resources to the coverage of basic needs is determined by the inelasticity of demand for the goods and services required to this end. The more limited the resources are, the more the priority of their allocation goes to goods whose demand is most inelastic and renews most rapidly; in this case, when the limit of survival has been reached, it is found to be food (and very possibly water in future). This radical perception of needs leads economists, nutritionists and politicians to discuss food security before addressing economic security. Their approach is pragmatic regarding poverty and disaster, considering that at least access to food resources (Sen's "food entitlement" – Sen, 1981) and food availability must be sufficient. However, when the nutritional need has become acute to the point of eclipsing all other economic concerns, then an advanced stage of famine has already been reached, and the victims of such situations have only their lives to lose.[20] The terminology of food security implies that food is the minimum commodity to which people must have access; it quickly turns into a priority objective, for households, societies, nations and the politicians and economists that govern them. Such an approach is overly restrictive as discussed above (Lipton, 1982; Pacey & Payne, 1985; Gillespie & Mason, 1991; Maxwell & Frankenberger, 1992).

"Sufficient access" and "acquisition" are both determined directly by the means of production by which households produce the resources for exchange or consumption. This in fact means that the key to food security lies in the means of production, in their productivity and their sustainability: these provide durable access to food and the other consumable goods and services.

[20] See Chapter VIII.

The concept of "economic security" is thus preferable to that of "food security", because it allows for human wellbeing according to culture, and is not limited to the digestive tract.

3.7.3 Security mechanisms

Economic security concerns all households, without exception. However, households are usually bound to others by family, economic, cultural or political ties; while at the same time, public or private enterprises have the mandate to ensure the security of specific groups. In other words, different groups set up different security systems – they are grouped as follows: individuals, households, communities and professional groups, non-governmental organizations, States and their services, international institutions and donors. When security mechanisms are ranked, it appears that households (defined as the smallest social common denominator) and the individuals they include cannot always ensure their self-sufficiency alone – and the same comment applies to some extent to the economic and social sub-structures surrounding them. They therefore require relays at higher or external levels of organization. Households can therefore resort both to their own security mechanisms, and external ones; these are discussed below, but some important general aspects require clarification first.

Origins of security mechanisms

Security mechanisms are not improvised, they reflect an accurate knowledge of the hazards that usually threaten economic performance. They arise within a culture in response to events registered in its collective memory. They usually correspond to an organized behaviour specific to each culture, where they form part of tradition and are specifically carried over from one generation to the next. The purpose of such mechanisms is to reduce or remove vulnerability to possible events that could harm the collective economy. They are generally related to the variations whose amplitude is considered normal by different economic groups. When the magnitude of unfavourable phenomena exceeds the norm, then difficulties arise. For example, in central Mozambique, the oldest farmers claimed that drought never occurred in two successive years, resulting in their habit of constituting reserves for two years at most. In 1992, however, drought struck exceptionally for three years in succession, causing scarcity. Village elders thereafter adapted their position to allow for three-year reserves. Another example is provided by the Western European unemployment security system. Resulting from the Great Depression of the 1930s, it was mainly put in place after World War II, in a time of great economic growth. This system was perfectly adequate to respond to the minimal contextual unemployment that existed until the 1970s. However, this system is inadequate in addressing massive structural unemployment arising from neo-liberalism, because the issue is no longer to assist a few individuals in times of prosperity, but rather to redefine the terms of the social contract, for which "growth generations" are ill-prepared. In cultures rooted in strong traditions, it is easy to analyse and understand the intrinsic security mechanisms. But the sometimes rapid changes in lifestyle can render such mechanisms obsolete or irrelevant exposing the population to unforeseen problems.

The corporatism of mechanisms

Security as defined above constitutes an ideal that is only rarely attained. Households strive for it, but its prerequisites are numerous, complicated and often impossible to satisfy. This holds true within cultural groups whose cohesion appears to be strong, but in which the specialization of roles and activities leads to corporatism, diverging opinions and consequently the appearance of social classes competing for political power. These factors are nothing but manifestations of the security construction performed by every economic corporation, sometimes to the detriment of others. The labour market and the goods and services market provide the meeting point of societies, where power relations express themselves between the different economic partners of a given culture.

Partners know exactly what to expect from one another, and each firmly intends to profit. The exploitation of weakness expresses itself here discreetly or openly, depending on whether such weaknesses are temporary or structural. Tourists enjoy the exoticism of local markets; they are not always aware that, for many partners in poorer countries, the market constitutes a combat arena.

Households' quest for economic security today is no longer confined to national boundaries, and this complicates the analysis further. Every village arena can be influenced to some extent by developments on global stages such as the New York, London, Paris or Tokyo stock exchanges. The latter are dominated by a handful of private companies whose power is greater than that of nation States. These companies are clusters of many smaller enterprises and likewise result from the construction of economic security at individual and private level. This construction ensures the security of those who belong to the company, in addition to its shareholders, but at the same time it is detrimental to that of countless households, as reflected by the growth of unemployment statistics resulting from restructuring.

3.7.4 Household security mechanisms

Foundations of household security mechanisms

Between World War II and the 1980s, the industrialized West provided a unique example of economic stability and social security, in which most of the active population only performed one economic activity (in the form of wage labour) during most of its working life. Relatively low unemployment rates, the reasonable price of basic consumer goods, and insurance against unemployment, accidents and sickness ensured stable living standards. The State played a major role in price stabilization policies and in the egalitarian management of social security systems. As a result of all this, households ceased to ensure their own security, because it was guaranteed by the State, which made it compulsory and automatically deducted the required premiums and taxes. However, most of the world's population live in conditions that neither the State nor anyone else cares about. The flow of consumer goods is unstable, prices are not controlled, there is no social security system or employment guarantees. This means that performance varies greatly, that economic accidents are frequent and that households are left to their own devices to face these factors, accidents, and sickness that strike them directly. Incidentally, wishes for good health that are common in many cultures are not simple courtesy, but reflect a real concern. An individual suffering long-term illness or disability cannot cover his needs and can face destitution together with his family. It is therefore crucial for households exposed to common hazards in their environment to secure their own response mechanisms.

Household security mechanisms in terms of the security concept

The security mechanisms that households can resort to are limited to the parameters that they can influence:

⇨ in terms of the parameters determining the adequate access to the consumable goods and services described above, households can influence only the management of their means of production and the constitution of reserves – they cannot, individually, influence the availability of employment opportunities, nor that of goods and services on the market;
⇨ in terms of access stability, households determine the sustainability of their means of production, but not the stability of the availability of employment opportunities, nor that of goods and services on the market – as a result, they cannot influence demand and supply trends that set prices that, in turn, define employment opportunities and compensation rates.

This means that security mechanisms can be limited when it is a case of facing economic stress. Nevertheless, they are indispensable to reduce dependency on external mechanisms that are often non-existent or slow in reacting.

The purpose of security mechanisms

Security mechanisms clearly serve to ensure the stability of an adequate access to consumable goods and services. The underlying concern, however, reaches well beyond the immediate coverage of basic needs: it is a matter of preserving the active and passive household assets as the only real guarantee for survival. The plough, the land, the tool, the herd and the store are more important than food or clothing, because the former are required to obtain the latter. In difficult circumstances however, the plough, the store or the land may have to be disposed of in order to obtain food. This abnormal economic behaviour occurs in all famine situations; it allows the individual to secure food for a time but deprives the household of its means of production, and thus results in destitution and dependency. Security mechanisms are intended to avoid this. From this standpoint, and as described above, it is not so much food security that is sought as the preservation of the means of production, which is a precondition for household economic security.

The functioning of security mechanisms

Security mechanisms protect active and passive household assets according to a strategy revolving around the three following axes.

1. Managing the means of production to ensure a sufficient and stable economic performance.
2. Constituting reserves in order to face possible counter-performance periods with minimal damage.
3. Establishing and using social obligation networks, for the same purpose.

Managing the means of production

Ensuring a sufficient and stable performance is the overall priority in the survival of a household; economic performance, as discussed above, is primarily determined by the means of production enabling basic economic activities. Means of production can suffer a loss in productivity, or may even become unusable. This happens when droughts reduce the yield of agricultural production, or when competition grows intolerable on the labour market or the goods and services market. To face this hazard, productive assets must be reinforced in favourable times, and the means of production must be diversified. This enhances the choices of the most appropriate means of production in times of stress, and also facilitates the compensation of productivity loss of given means of production through the use of other means. Diversification rests upon two major preconditions: alternatives must exist, and households must be both flexible and adaptable enough to resort to them. The concept that is central to diversification applies to economic activities, but also to the manner in which they are conducted.

A common example in rural settings is the organized use of the following means of production: subsistence agriculture, stock-breeding on different scales, artisanal production of usual consumer goods and charcoal, wage labour of one family member (on site or in the nearest city, seasonal or permanent), gathering of natural resources (especially food-related, but also fuel for domestic use). The resources thus produced are intended both for domestic consumption and for sale. Agriculture provides examples of diversification in the form of inter-cropping, the use of varieties with different maturing cycles, taking advantage of microclimates, and the successive use of different plots of land to save water. In this framework, large families initially face a problem, insofar as they include many "idle" mouths to feed, but these may soon become productive and develop into a significant labour force that will strengthen the diversification of economic activities. The diversification and accumulation of jobs are likewise common in towns, often entailing significant involvement in the informal economy,[21] be it legal or illegal. Diversification thus offers options for subsistence. Their utilization complies with the organization of the workforce in order to obtain the best possible yield at the right moment. The tactic of utilization of the various options aims firstly at avoiding the utilization of household reserves (see below). It usually follows a "normal" pattern to face variations, likewise considered as "normal", of the production of economic resources and the basic economic needs. Thus, in normal circumstances, a certain proportionality of work distribution applies. Any change in this proportionality is tantamount to perturbation, be it positive or negative.

Managing the means of production in order to ensure sufficient and stable performance in fact consists in putting in place mechanisms of adaptation to the normal fluctuations of the yield of production activities, and to the normal fluctuations of the needs to be covered. The implementation of these mechanisms is likewise considered as normal and is in no way pathological, because it consists in avoiding a rise in the economic vulnerability level of the household. On the other hand, three comments apply to the diversity of choices and to security:

⇨ diversity of choice is not to be confused with the need to utilize all possible options to their maximum – the former is synonymous of security, while the latter indicates crisis or poverty, hence vulnerability;
⇨ crisis victims are often forced into production activities that would be considered unacceptable in normal circumstances – here again, this behaviour can easily be misinterpreted as the utilization of a diversity of alternatives, when it in fact reflects a crisis behaviour;
⇨ in a precarious natural and human environment, it is possible to accept excessively low salary conditions and to restrict the scope of alternatives, as a counterpart for the contractual guarantee provided by even a limited employment security.

These three comments illustrate the importance, when assessing economic security, of identifying why people conduct a specific activity, and its qualitative cultural value. The three types of behaviour listed above do not constitute the development of a security system nor its utilization by a coping mechanism, they are survival mechanisms. The difference between coping and survival mechanisms is that the former maintains performance without loss, whereas the latter entails a cultural, economic or physiological penalty.

Finally, two facts complicate external observation somewhat:

⇨ households do not all have the same capacity or will to modify the utilization of means of subsistence to ensure their economic security;
⇨ the transition from adaptation to coping mechanisms is rarely clear-cut – rather, it occurs within a grey area where adaptation and coping overlap according to individual opportunities and reactions.

[21] The informal economy consists of all the odd jobs performed on a daily basis (e.g. shoe polishing, cigarette selling, water carrying), in addition to black-market work (this can imply long-term employment based on tacit agreement), but also the pure and simple exploitation of those who have no alternative, and illegal mafia-type forms of trade where the use of force is common. The informal economy is in fact informal only for the beholder, because it is usually highly structured: actors know precisely what they can do within it, and how to go about it. The informal economy accounts for 40-50% of production activities in the cities of the developing world (Bairoch, 1983).

The constitution of reserves

The constitution of reserves is essential to the protection of the household's means of production and assets. Reserves (or passive assets, or fixed household capital) include anything that can be consumed, exchanged, or sold to meet basic needs, when the means of subsistence[22] do not permit a sufficient economic performance. The constitution of reserves is possible when the production of goods and services is equal to or higher than what is required. As long as production is sufficient, it is less risky to reduce consumption deliberately and constitute reserves with the resulting balance. The constitution of reserves follows various channels:

⇨ limiting consumption in order to generate surplus;
⇨ increasing food consumption in order to constitute fatty reserves;
⇨ increasing production in order to generate surplus;
⇨ saving surplus or exchanging it for goods with a high market value or a high exchange value (e.g. savings accounts or life insurance policies);
⇨ purchasing, keeping or investing only with respect to what has a market value – for example, it is preferable to purchase corrugated iron rather than tiles to cover a roof, because the iron sheets can more easily be removed and sold if necessary.

The constitution of reserves is a long-term process, often spanning generations. In this view, family jewels are not simple ornaments, they represent an economic security (they can be pawned or sold in times of economic difficulty). Fixed capital represents an economic buffer for use when the means of production and resorting to diversification no longer ensure minimal living conditions. When production is insufficient, reserves protect the means of production, because the latter do not then need to be sold for survival. Clearly, after a poor harvest it is preferable to sell off some jewellery rather than the plough or draught animals.

The constitution of reserves in fact amounts to securing coping mechanisms to compensate counter-performance: thus the use of reserves to compensate counter-performance entails impoverishment.

Establishing and using social obligation networks

In terms of security mechanisms, social obligations form part of mechanisms that are external to the household, since they exist for it and are directed towards it from outside. Households nevertheless play an active role in this framework, as follows:

⇨ firstly, on an individual level, by invoking these obligations and being able to demonstrate that they amount to a right;
⇨ secondly, by using and creating them on a participatory basis: the household associates with others in a more or less organized structure – association and organization are two potential strengths relative to those who are solicited; trade unionism, demonstrations, membership of professional societies with the power to demand are all activities that allow social obligations to be established and exploited – the common form of participation in industrialized countries is the (usually compulsory) contributory membership of the social security system (see below);
⇨ finally, by contributing to these structures as a donor, on the basis of reciprocity that provides the basis of the development of social obligations within a culture.

[22] As a reminder, subsistence means are defined in this Manual as those enabling the production of economic resources on a continuous basis. Therefore, they do not include reserves, because they dwindle as they are used.

Social obligations provide access to refunds, gifts, loans, credit, and exchanges. They are an important security mechanism because they offer additional alternatives when performance is poor, and when the diversification of economic activities – or the use of reserves – cannot improve it. However, in response to poor economic performance, households can adopt different tactics: for example, they may prefer social obligations to reserves or to the diversification of economic activities. As a result, one should not draw hasty conclusions regarding a given economic situation from the choice of a specific security mechanism: only thorough behavioural analysis will clarify the situation. Usually, the social obligations that households can invoke belong to the culture of their society. They relate to responses that are clearly named and are associated with clearly defined problems (e.g. loss of herd or harvest, unemployment, accident, sickness, widowhood, or loss of one or both parents).

Social obligations can also contribute to increasing assets, and thus reinforce security. Those based on custom or law are compulsory – within the limits of the conferring entity's possibilities – and therefore well deserve the name of obligations. Their associated reciprocity is worth noting, be it based on written contract (e.g. private and public insurance) or verbal tradition, known, respected and enforced by all the members of the community on pain of expulsion. Reciprocity guarantees that all community members can enjoy similar measures in case of need; without it, it is likely that social obligations would be much more limited. Reciprocity and enforcement are two concepts central to social obligations: they guarantee both sustainability and survival.

When social obligations are based on moral values rather than on a norm, reciprocity can lead to blackmail or abuse. The beneficiary may be relieved for the moment, but at a considerable price that increases his dependency.

The constitution of reserves and the establishment and use of social obligation networks both in fact extend the diversification of possible options at the level of the means of production. They are nevertheless quite different in nature, because their sustainability is considerably more limited, particularly in facing a crisis that affects the entire population. The separation of the establishment of social obligation networks from diversification may be challenged; indeed, many poor families often include at least one member whose production activity is begging. Likewise, many families draw part of their income from remittances in cash or kind from relatives who are wealthier or whose position obliges them to do so. The diversification of subsistence means and the remittance system traditionally form part of the means of production in some cultures. The establishment of social obligation networks on the other hand entails a dependency towards the donor, and is only available in case of demonstrated need, with very different social, cultural and economic implications.

The many famines of the past thirty years amply demonstrate that household security mechanisms are often insufficient to protect individual households against crises that extend to the community as a whole. Larger entities must provide a relay, or accept responsibility for household security; security mechanisms thus become external to the latter.

3.7.5 External security mechanisms

External mechanisms have been mentioned above; they result from the same concerns and follow the same purpose as household mechanisms. Household mechanisms are overall quite similar, to the point of providing scope for a set formula; external mechanisms on the other hand vary considerably depending on the country, the region, and the economic group under consideration. They must therefore always be appraised individually. Variations result mainly from the political, economic, ideological and social parameters that characterize individual States; they also result from the interest of the international community in those States and their population, in compliance with international regulations, or because of its own economic, political, and social agenda. The expression “international community” refers here to private and public organizations such as the World Bank (WB) and the International Monetary Fund (IMF), the United Nations Food and Agriculture Organization (FAO), the United Nations Development Programme (UNDP), the World Trade Organization (WTO), the International Labour Organization (ILO), the World Food Programme (WFP), official bilateral cooperation agencies, non-governmental development agencies, and human rights and environmental protection agencies. The means and the methods resorted to in order to ensure or improve economic security vary greatly, as do their results. Consequently, the subject is very broad, and can only be mentioned here in passing. Globalization has boosted the importance of external mechanisms because of the (not always reciprocal) dependencies that it implies. These mechanisms are described below.

Ensuring adequate economic performance

At local and regional level, workforces, resources and negotiating groups (e.g. trades unions) are associated in order to increase the productivity of economic activities, and to ensure an equitable allocation of produced resources.

At national level, the role of the State is crucial. Stabilizing prices, implementing a participative growth policy, exerting economic power over weaker States, authorizing unions and negotiating with them, promoting employment, providing and maintaining distribution, health and education services, guaranteeing freedom of the press (which operates both as a detector and as a means of pressure), setting up early warning systems, etc. These are all examples of the means at the disposal of the State to improve or ensure the economic security of its citizens.

At international level, macro-economic policies associated with structural adjustment, trade liberalization and the exploitation of comparative advantage are currently viewed by those who devised and imposed them as indispensable means to ensure the economic security of all countries. This has raised serious doubts. The United Nations have attempted repeatedly to promote food security and adequate nutrition for all (First International Conference on Nutrition (FAO/WHO, Rome, 1992) and World Food Summit (FAO, Rome, 1996). In spite of the media attention attracted by such events, their short-term positive effects are difficult to see, whilst in the long term their effect may be positive in sensitizing the public and the media. The discouraging aspects of these summits are manifold, in particular because of the contrast between the stated intentions aimed at defending rights, and the weakness of their recommendations and the means available for their implementation. Besides, a host of development agencies have attempted, more or less successfully, to raise the economic security of social groups ranging from villages to States themselves.

The constitution of reserves

At local and regional level, the reserve constitution mechanisms lie in the hands of small highly traditional communities who have been able to preserve communal granary systems or stocks to be shared in times of crisis. Such mechanisms however tend to disappear, because of the growing influence of national economies on such private systems. This tends to promote individual interest to the detriment of collective interest, and leads to reluctance in pooling resources that could otherwise be invested individually.

The constitution by the State of monetary, energy and food reserves provides a relative security in case of crisis. However, if the crisis becomes nationwide, its associated needs are such that regular supplies depend entirely on market and production dynamics (in other words the stability or growth of economic production). On such a scale, in addition, the constitution of significant reserves (both public and private) is less and less encouraged by the facility of exchanges, taxes on existing stocks, international trade agreements, and consumption rates. There is a rough divide between industrialized countries, where consumption is high and food self-sufficiency is almost total, and non-industrialized countries, which are usually too poor to constitute reserves (with some notable exceptions). However, in the long run, industrialized countries are probably more liable to serious crisis than poor countries. This is due to the major challenges such as the exhaustion of fossil energy, world economic competition, the automation and specialization of production, the frailty of distribution systems, and the confinement of agriculture to a minute proportion of the population. In industrialized countries, the State only has limited reserves, and households keep virtually no stocks, and have practically no alternative means of production to face durable crisis. In poor countries, on the other hand, households must fend for themselves entirely, and therefore set aside reserves and resort to diversification – this often enables them to overcome a crisis in a remarkable way. Non-development is in fact possibly a security for the future, while over-development is stretched to the limit.

At international level, the constitution of reserves is in decline. International trade agreements on agriculture, the reduced importance of the public sector in favour of the private sector, and the concentration of most of the world's industrial food production in a handful of multinationals have all reduced the world availability of food stocks. At the same time, the demand for them has risen considerably. This is a kind of dead-end, because the food deficit of many developing countries is worsening, while food production subsidies in surplus-generating countries has dropped considerably – this does not augur well for the worldwide improvement of food security.

Establishing and using social obligation networks

At local and regional level, solidarity is expressed through social obligations relative to family, corporation or tribe (or clan).

At State level, social obligations correspond to what is called social security. This security can be determined by the public or the private sector, frequently in combination, and may be compulsory. The principle is one of mutual insurance to which all active members contribute, in order to obtain a financial cover in case of accident, sickness or unemployment. Moreover, the State may also set up security systems in anticipation of crisis, such as the creation of jobs, subsidizing the price of staples, the distribution of food ration cards and food-for-work type projects.

At international level, the United Nations system (in particular the WFP), together with non-governmental organizations (NGO) and the international donor community have set up early warning systems and constitute contingency food stocks, in order to respond to economic counter-performances affecting regions or countries in crisis.

In short, security mechanisms define the resilience of a given society, community or household to the risk of crisis and crisis itself. Security mechanisms – permanent cultural behaviour phenomena – are not to be confused with coping mechanisms, which take advantage of the alternatives offered by security mechanisms momentarily when economic performance is insufficient. Security mechanisms are set up in favourable circumstances; coping mechanisms appear in incipient crisis.

3.8 A SYNOPTIC APPROACH TO THE SECURING OF FOOD

All the above elements illustrate the complexity of the first stage of the feeding process (i.e. the securing of food); this first stage must be considered within the modern context of diversified economies. It is nevertheless possible to apply a relatively simple model to all households. In order to achieve its purpose (i.e. to provide a set formula for the securing of food), the model is quite general and suggests a number of concepts that are valid in all circumstances, containing all the key elements that must be taken into account. Clearly, no two situations are identical; but each can nevertheless be described with accuracy. For example, the population of central New York, Paris or London secures its food according mainly to its purchasing power; on the other hand, in the great marshlands of the White Nile, in southern Sudan, the securing of food is determined by fishing. In many situations, however, the securing of food is highly diversified, and changes according to seasonal and economic circumstances. The model is thus general because it offers the full range of possibilities to be investigated in considering a given population. The same comment applies to the variables influencing performance. All do not apply everywhere, but they must all be mentioned in order to investigate a problem anywhere.

First concept

The securing of food is an essentially economic phenomenon.

When man distances himself from nature by evolving from the status of hunter-gatherer to that of producer, he develops the cultural apparatus of implements and consumer goods – that is, his economy. He also generates cultural needs in the wake of his elementary needs; he diversifies his production activities, specializes and so loses autonomy in terms of meeting his elementary and cultural needs (shortened here to his basic needs). In other words, he creates societies of individuals that are interdependent in terms of meeting their basic needs.[23] From an economic perspective, interdependency revolves around the labour market, the goods and services market, currency as standard of exchange value, and around demand and supply. As activities specialize, these factors soon turn food into just another economic good – with the difference that food is an absolutely essential good. This means that demand for this commodity is constant whatever the circumstances (i.e. inelastic demand), and that priority must be given not to food itself, but rather to the means that permit it to be secured regularly. Such means also allow the securing of other necessary goods and services through exchange. As a result, households (understood here as the smallest social common denominator) must include the securing of food in their overall economic strategy. The latter enables it to acquire all the goods and services required to meet its basic needs, and preserves this capability in the long run, according to the forces of the economic environment.

Second concept

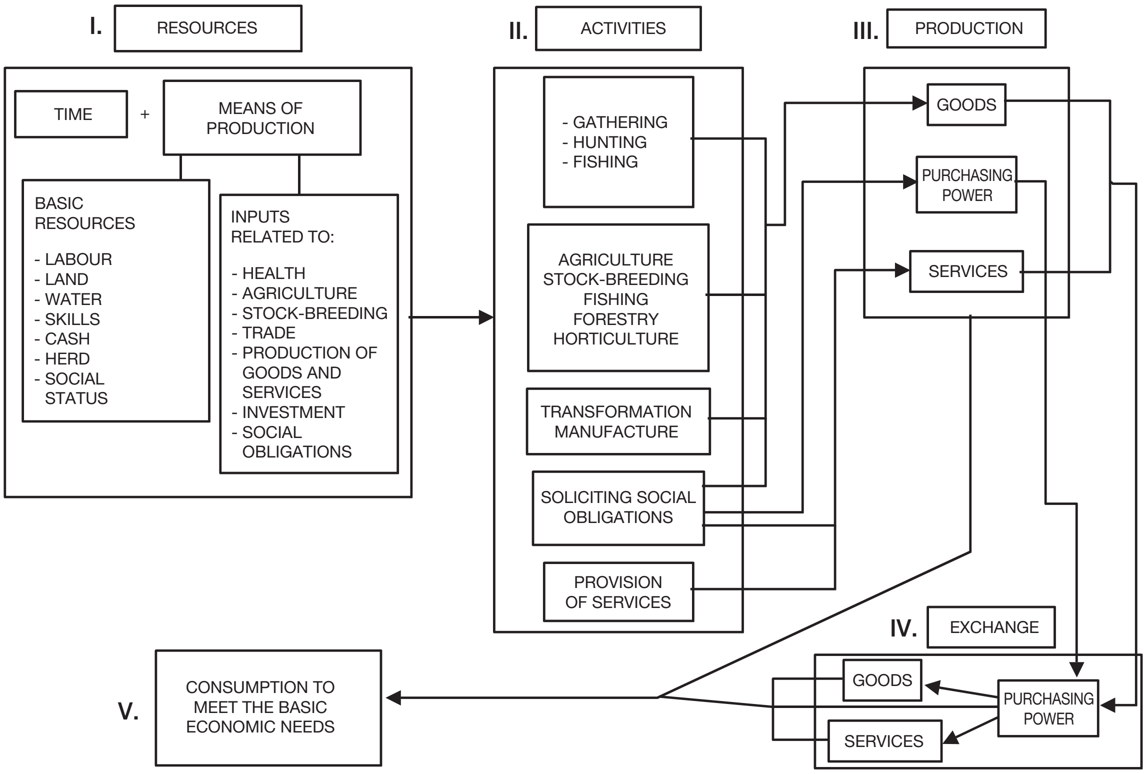
The securing of food rests on the resources that enable economic production activities.

Economic production activities that permit the securing of the goods and services required to meet basic economic needs must be sustainable; to this end, both time and production means (or active assets) are necessary, and the latter are made up of basic resources and inputs. “Sustainable” is understood here as responding regularly to the renewal rate of needs in the long run. Goods and services are acquired through direct production for domestic consumption (i.e. consumption by the producing household) and/or through exchange. In the case of exchange, the idea is indeed to acquire first a form of purchasing power in exchange for the goods and services produced, and then the goods and services required in exchange for this purchasing power. Production means represent the basic condition for the durable economic sustainability of households. Figure 6.11 below illustrates this second aspect of the model.

[23] Referred to as basic economic needs when they are determined by the cultural apparatus of implements and consumer goods.

VI

Figure 6.11 Resources and activities giving rise to the production of goods, services and purchasing power, in order to meet basic economic needs



The general sustainability conditions of the main types of activity represent the crux of household economy assessments.

1. Hunting, gathering and fishing must not deplete the production capital (plant and animal), and must allow it to regenerate by tapping resources elsewhere. Sustainability is determined here by the fertility of the productive species and the available area.
2. Agriculture, stock-breeding, horticulture, forestry and fish farming must regularly provide an amount sufficient for domestic consumption[24] and sale (in order to cover the other basic economic needs through exchange). Sustainability is determined by the productivity of utilized surfaces and volumes (and its ecological preservation), the terms of trade to convert the production into purchasing power, and finally the ratio between that purchasing power and the desired goods and services.
3. The acquisition of purchasing power (manufacture, transformation and the provision of goods and services) must provide regularly a means of exchange whose value is at least equal to the cost of all basic economic needs. Sustainability is determined by hourly productivity, the cash yield of what is produced, the exchange between purchasing power and the desired goods and services, and the labour supply for the production under scrutiny.
4. To invoke social obligations, the social status must be strong enough to impel the donor to provide the necessary contributions, and the donor's own performance must be sufficient to cover his own needs, in addition to those of his beneficiaries.

[24] In the case of industrial production and forestry, domestic consumption is unusual.

The following general points are equally important.

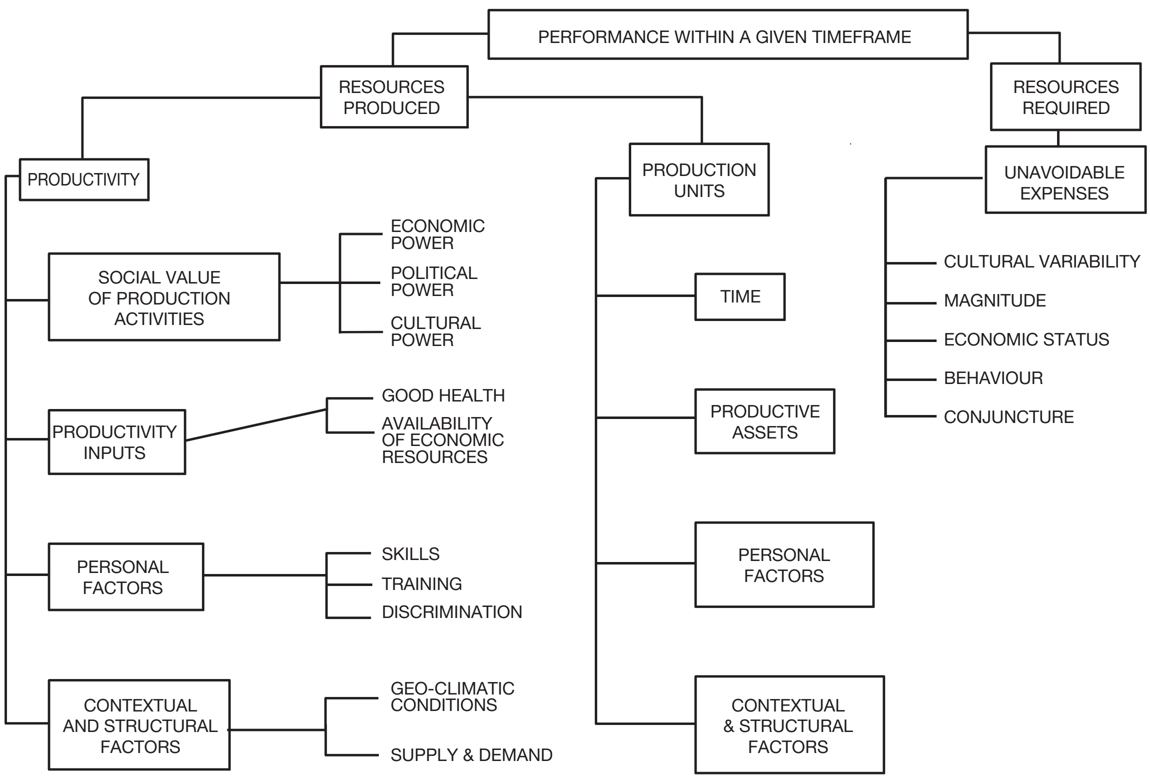
1. The means of production of households are recognized as legitimate. The same comment applies to their production activities, and the goods, services and purchasing powers that these activities allow to acquire. This amounts to the concept of "entitlement" as discussed by Sen: an individual's ability to secure commodities is determined by the legal relations that govern the ownership and utilization of resources in his community (Sen, 1981).
2. Production activities are subjected to an organizational scheme and determinism specific to the culture of any type of society, and of any group that is economically active within it. This means that such activities always have a specific function, that the smallest social common denominator that conducts them is the household. The household exists within an economic structure, as defined by the cultural norms in force, and under the supervision of a specific authority.

Third concept

Meeting basic economic needs implies the use of goods, services and purchasing power. These must be secured through production activities. Households must conduct these activities in a way that enables them to be economically self-sufficient.

In order to cover basic needs regularly and adequately, the economic performance of households must be sufficient, that is, their production activities must allow them to acquire at least as much as they must consume (self-sufficiency condition). What households must consume corresponds to unavoidable expenses. Performance is influenced by many variables, as illustrated in Figure 6.12 below.

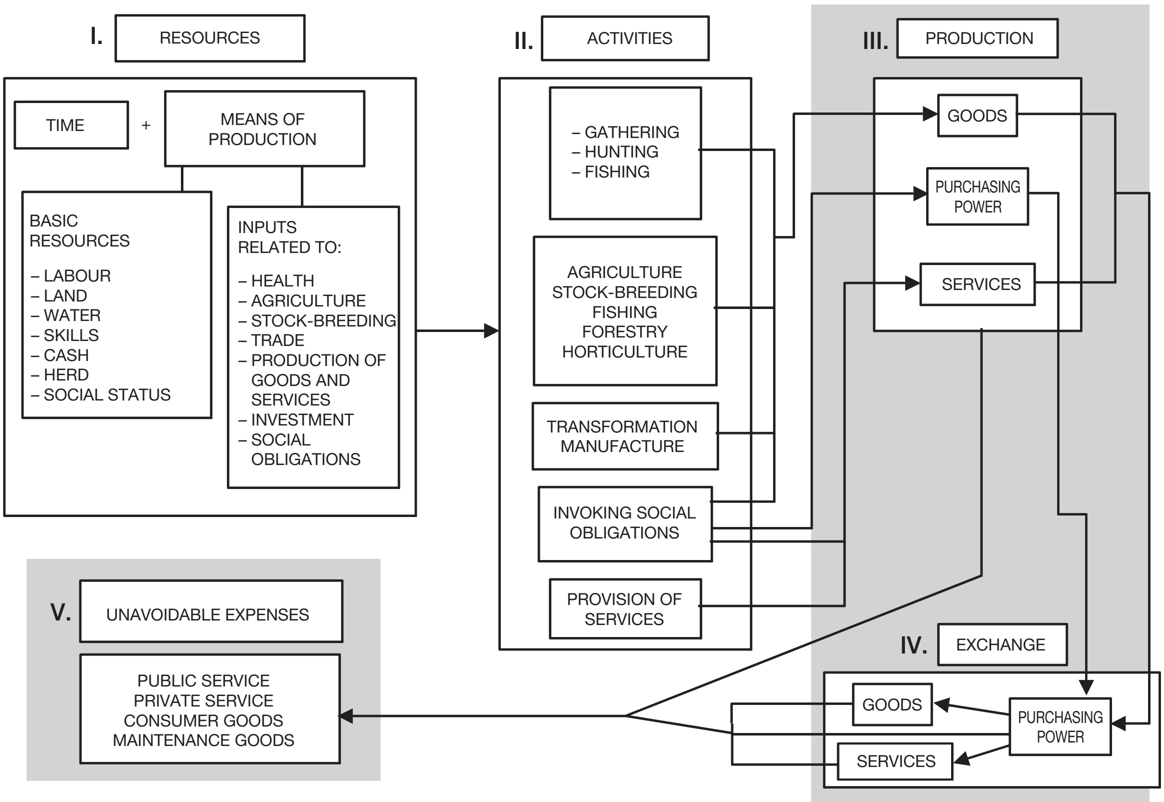
Figure 6.12 Variables influencing the economic performance of households



The two most important variables in the production of economic resources are the productive assets and the value of activities. The latter is determined, among others, by the labour market and the demand for the goods thus produced.

Self-sufficiency can be illustrated simply, as in Figure 6.13 based upon Figure 6.11, where "consumption to meet the basic economic needs" (point V) has been replaced by "unavoidable expenses". The condition for self-sufficiency is that the sum of resources produced directly and by exchange (points III and IV) must be equal to or greater than the sum of unavoidable expenses (point V).

Figure 6.13 The terms determining the economic self-sufficiency of households



Fourth concept

In order to cope with the unexpected, households must set up security systems enabling them to compensate the possible shortcomings of their means of production. The latter, together with security systems and unavoidable expenses, make up the household economic system.

The economic performance of households varies, because conditions associated with the natural or human environment vary. As a result, the economic units of society (e.g. households, professional corporations, companies and the State) must set up economic security mechanisms to limit these variations and compensate for them if they impair performance. Households must therefore diversify production activities and introduce buffers if diversification alone is not enough. Such buffers can consist of reserves established during favourable times and, if needed, social obligations (other than those that contribute normally to subsistence). The inclusion of security mechanisms completes the household's overall economic resources, leading to the illustration of the overall household economic system as provided in Figure 6.14 below, according to the type of resources utilized.

Figure 6.14 The household economic system

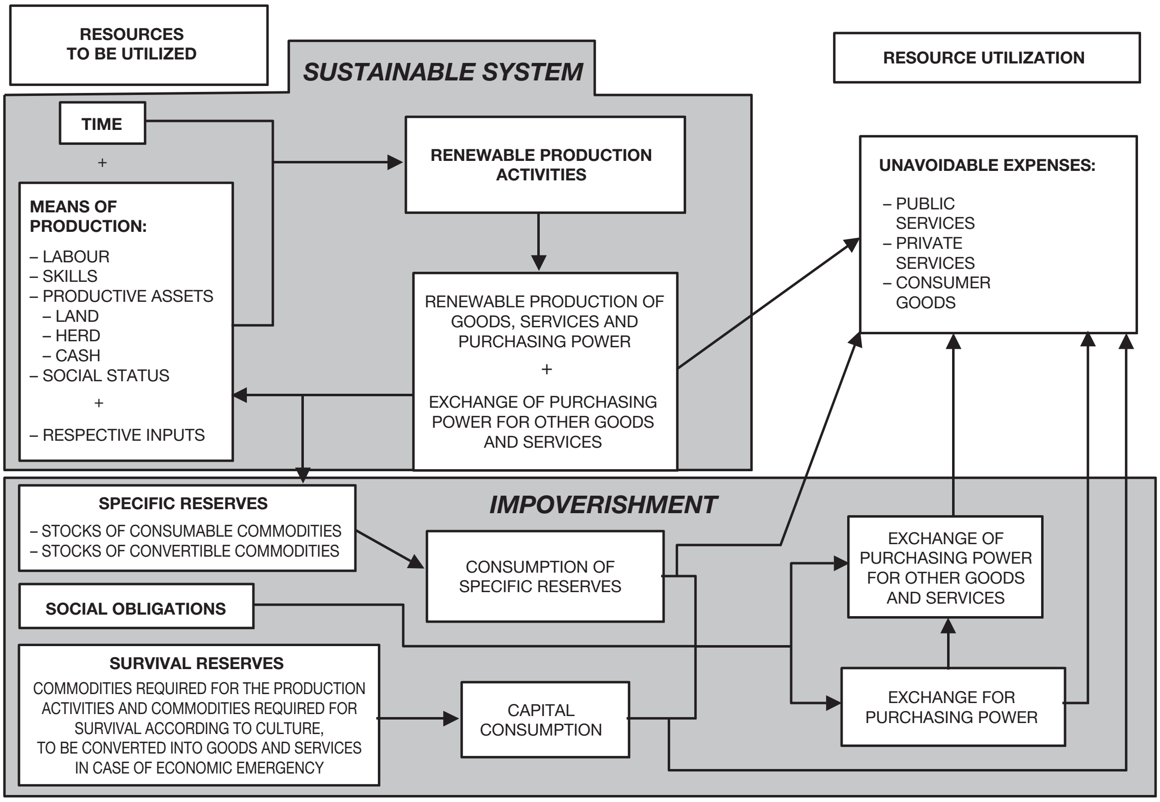


Figure 6.14 reflects a fundamental distinction: that between the economic resources necessary for household self-sufficiency (i.e. the means of production enabling the renewal of a sufficient economic performance) on one hand, and the economic reserves (specific and survival) and social obligations that enable households to cover their unavoidable expenses temporarily, on the other.

Survival reserves involve goods that may have two different uses.

1. Their intended use, that is, economic production (means to achieve a sufficient performance) for production factors such as land, machinery, herds, invested funds, and transport; or their utility in the household's daily life for commodities such as clothes, bedding, furniture, kitchen utensils and housing.
2. Their use as survival reserves:[25] such commodities are exchanged or sold in order to cover unavoidable expenses that the means of production, specific reserves and social obligations can no longer meet. However, this second role is deleterious: the sale of commodities required for renewable production activities is an economically contradictory behaviour that harms (or may even destroy) the household economic system. After the exchange, some resources may indeed have been found, but at the cost of independent production. If it involves the household's infrastructural assets, this behaviour leads to a precarious existence and, ultimately, vagrancy. In both cases, these actions usually reveal a state of emergency to cover elementary needs; it is a last economic resort to prolong life by a few weeks or months, and at an exorbitant cost. Impoverishment and destitution resulting from the consumption of capital assets are typical of the famine process.[26]

[25] This aspect is discussed in greater detail in the second part of this Manual, dealing with nutritional crises.
[26] The famine process is discussed in Chapter VIII, where Figure 6.14 is again used and completed.

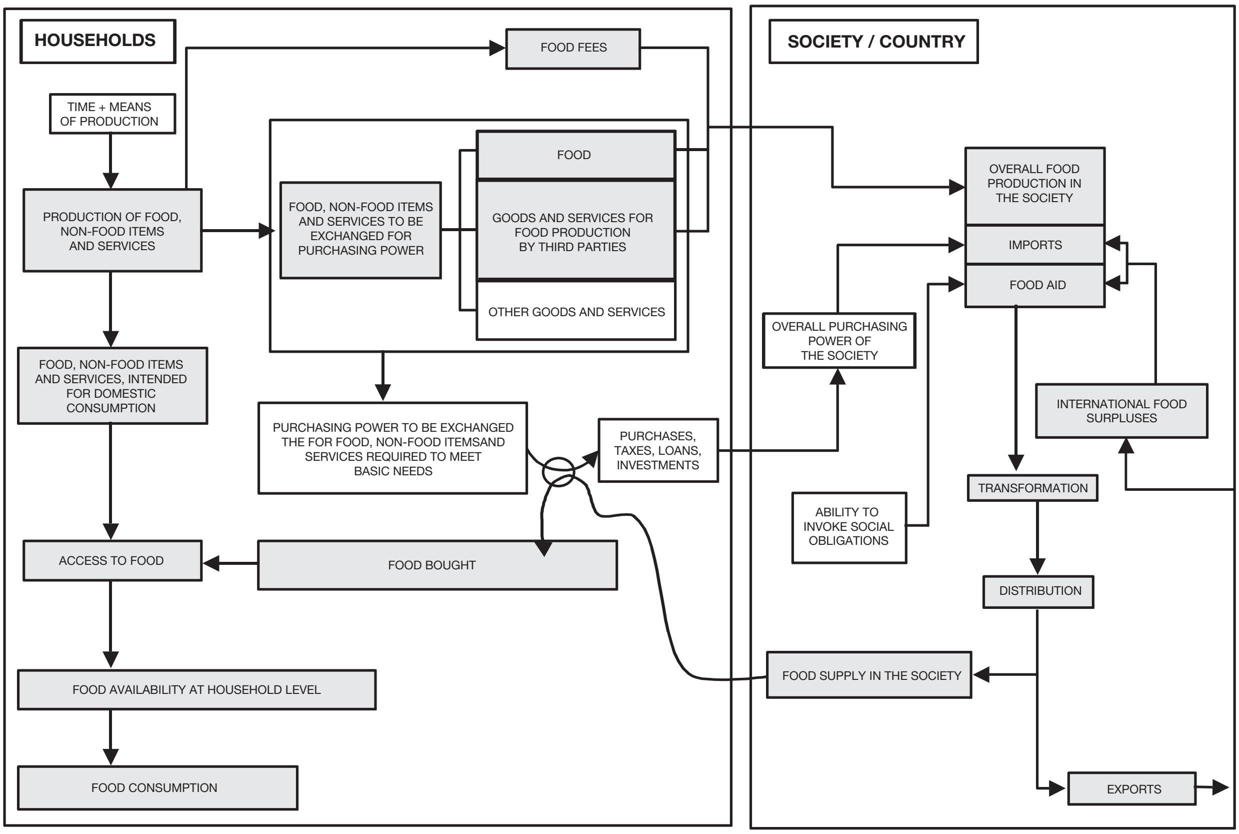
Fifth concept

With respect to food, the household economic system becomes the feeding system.

Having set the economic household framework, it is possible, without becoming overly simplistic, to direct the approach specifically on the securing of food. This is done by resorting to a model of feeding system that illustrates the key points of household feeding (Figure 6.15 below).

This model, extended to the overall economic operations of households, is a crucial tool in attempting to understand how the latter meet their food requirements, in addition to their other basic economic needs, and with which performance. It describes the relations that determine the availability of food, which in turn determines the households' food consumption. The shaded boxes in Figure 6.15 enclose the food chain in a given society, from production to consumption. As discussed below, the individual feeding system must also be included in Figure 6.15 in order to reflect the overall feeding system and the food chain.

Figure 6.15 The household feeding system



The household feeding process must respond to the individual demand in this field through the production of goods, services and purchasing power that provide access to food. This is achieved through the direct production of foodstuffs and/or through exchange. Households must therefore establish relations with the feeding system of their society or country. As a result, it is important to analyse and understand this system inasmuch as households resort to it, because it determines the availability of food within the society. Likewise, it is important to assess the international feeding system, insofar as the country relies on it for its imports and for the possible food aid it receives.

From access to food (which defines food availability at household level), the system leads to the other two major stages of the process: the food consumption of households and individuals, and the biological utilization of food by individuals.[27]

4. THE CONSUMPTION OF FOOD [28]

The securing of food is the most crucial stage in the feeding process, because inadequate performance at this level results in insufficient consumption. Moreover, to secure food, man must come to terms with his environment, which can be more or less hostile to him. Individual and household behaviour is by no means the determining factor at this stage, it is rather the availability of resources. On the other hand the activities associated with the consumption of food are mainly influenced by behaviour or factors that affect the individual directly (such as sickness). Humanitarian operations often address problems related to resources – this is their main purpose after all – and thus avoid potentially dangerous survival economy behaviours; they however have little influence on behaviours resulting from cultural practices or culture shock. Humanitarian operations can at best mitigate the effects by protecting and restoring health. Exerting direct impact on the consumption of food by changing behaviour is difficult;[29] it is however possible to influence consumption by intervening earlier in the process, at the level of resources, and later in the process, at the level of healthcare services, in addition to acting upon water and habitat.

4.1 THE ACTIVITIES ASSOCIATED WITH FOOD CONSUMPTION

The consumption of food consists of a series of activities that range from the choice of food to its ingestion.

4.1.1 The choice of food

The choice of food is influenced by the following parameters:

⇨ the performance of the securing of food, which is mainly determined by purchasing power, and food production and gathering;[30]
⇨ culture-specific eating habits;
⇨ foods available locally;
⇨ personal attitude, as determined by the interest in food, preferences, priorities in the allocation of resources, level of education, dietary knowledge, and trends and fashions in feeding.

Most of the world's population is limited in its choice of food by its economic performance and, thus, its ability to secure the food. People eat what they can produce, buy or gather in the framework of their eating habits; they often limit the budget they devote to food to the strict minimum. Their dietary knowledge is sketchy or non-existent – it is anyway unimportant in the absence of the means

[27] These two stages are discussed briefly in the following two sections of this Chapter, which concludes with an analysis of the nutritional status.

[28] Chapter XV discusses the aspects of food consumption that can be related to nutritional information. These aspects are associated with food hygiene, infant and child feeding, and diets. In the following points, subjects that are discussed in greater detail in Chapter XV are indicated accordingly.

[29] See Chapter XV, the limits of nutritional information.

[30] Social obligations and humanitarian aid only operate minimally (if at all) in normal circumstances, but play a crucial role in crises.

to apply it. In the Western world, the luxury of choice promotes a diversified diet and removes deficiency; but it also results in disorders due to excess (those that are the most serious in terms of both morbidity and mortality) and in clinical or sub-clinical deficiencies, when choice results in the systematic selection of the same type of food. The Western diet is in fact tending to become uniform and lose its social connotations (eating is performed like any other somatic function), and this contributes all the more to the development of disorders due to excess.

4.1.2 The processing of food

The processing of food is limited here to household practices, and includes the following:

⇨ treatment and storage after harvest or purchase;
⇨ cooking or other culinary preparation;
⇨ serving;
⇨ storage of prepared food and leftovers.

Food processing methods are important on several accounts (especially in terms of culinary preparation), but their major aspect in terms of humanitarian operations is their influence on food hygiene,[31] food conservation, and the preservation of nutrients.[32]

4.1.3 The sharing of food

The sharing of prepared food is a fundamental activity in the feeding of dependants. It reflects the social structure and hierarchy, and the cultural norms in force – bearing in mind that standards may change in case of crisis.[33]

4.1.4 Feeding infants, children and other dependants

Dependants are defined here as individuals who are incapable of feeding themselves independently. Such individuals therefore require someone to take charge and do so properly; possibilities include the following:

⇨ **households** themselves in the case of infants, small children, the sick and elderly living under the same roof;
⇨ **institutions** such as hospitals, homes, orphanages and prisons.

Households

Clearly, this is where the feeding of infants and small children is crucial, with breastfeeding or its substitute, terminated by the weaning process.

[31] See Chapter XV.
[32] See Chapter V, cereal milling and cooking.
[33] See Chapter VII.

Breastfeeding

Breastfeeding[34] is an activity that pertains to biological determinism and, to a certain extent, to cultural determinism. Indeed, although mothers are naturally inclined to breastfeed their infant, some societies have developed artificial feeding methods, by resorting to wet-nurses or to substitutes for maternal milk, usually administered in a feeding bottle. Breastfeeding provides the first food: maternal milk. The latter alone covers all nutrient requirements in a balanced manner and simultaneously protects the infant against infection. Maternal breastfeeding is the most appropriate manner of feeding children up until the age of 4 to 6 months; from then on, maternal milk no longer suffices to cover infant energy, protein, iron and thiamine requirements. At this stage, therefore, the diet must begin to diversify and weaning sets in.

Weaning[35]

Weaning follows breastfeeding, and replaces it (or bottle feeding) with foods that are increasingly those of adults. But weaning is not only a change in diet; it is also a fundamental transformation in the child's lifestyle and its relation to its mother. This shift can be traumatic, especially if it coincides with the arrival of a sibling. In developing countries, weaning is the most crucial period in the survival of infants for the following reasons:

⇨ their exposure to infectious disease increases, through a growing contact with their social and natural environments, and through their change in diet – weaning foods are easily contaminated, while the protection against infection previously provided by maternal milk wanes;
⇨ their diet is changed, and this shock itself must be overcome;
⇨ the quality of this diet is not always adequate, especially if breastfeeding ceases abruptly;
⇨ the affective bond with the mother is seriously frayed.

Feeding other dependants

This category includes the elderly, the sick and the helpless wounded. The determining factors in the diet of the elderly are appetite, the specific care they may require, and the portion of food allocated to them. The same factors apply to the sick and wounded, in addition to the dietary requirements of their condition.

Institutions

Institutions call for a service that ensures food of adequate quality and quantity. In the case of specialized facilities such as hospitals, they must also provide an appropriate response to the dietary needs of their patients.

The factors determining institutional food consumption include the budget available, possible domestic food production, kitchen equipment, and the quality and availability of their staff. This is important here, because humanitarian operations sometimes involve the taking over of the food supply of institutions such as hospitals and psychiatric facilities, orphanages, homes for the elderly and prisons. This need usually arises from lack of funding and/or equipment, but it can also result from corruption (fund or food diversion) and the ostracism against some inmates. The problem in

[34] Chapter XV discusses breastfeeding in greater detail.
[35] Weaning is a crucial transition, and Chapter XV discusses it in greater detail accordingly.

prisons is particularly serious in developing countries: in some cases, prisoner feeding is entirely in the hands of their relatives, if not of humanitarian aid.

4.1.5 The ingestion of food

The ingestion of available food is determined by appetite, which in turn depends on physical and emotional health, the appeal of the diet and the quality of its processing and, finally, the social environment. The ingestion of food is the culmination of all the earlier activities (both deliberate and involuntary) in the feeding process.

4.2 THE PRECONDITIONS FOR CONSUMPTION

These include firstly the means of storage and preservation that enable the keeping of food after harvest, slaughter, catch or purchase. The storage quality of staples is essential. Hazards such as rodents, birds, insects, mould and bacteria must all be protected against. Foodstuffs must also be protected from excessive moisture, light, and heat; they must be stored in a closed but ventilated place, sheltered from humidity, weather, and infestation. Time must also be given to the supervision of stocks and the elimination of parasites and of foods that have become improper for consumption. It is not easy to fulfil all the requirements for the quality storage of staples such as cereals and legumes (especially in the form of flour) while limiting losses; as a result, most losses in subsistence agriculture after harvest usually occur during storage.

Food preparation must involve equipment and the water and fuel necessary to cook meals. In stable situations, equipment does not damage easily, and is thus not a limiting factor. On the other hand, access to water poses increasingly serious qualitative and quantitative problems; population growth and concentration, erosion, deforestation, desertification and pollution all aggravate these problems. The search for fuel for cooking often results in ecological disaster. Crisis exacerbates water and fuel problems. Another difficulty is related to kitchen equipment, particularly in case of population displacements, when heavy material such as pestles and mortars or modern stoves must be left behind. The quality of prepared food always suffers, and hazards associated with pathogenic contamination or insufficient detoxification result. Insufficient quality also has the most serious repercussions during weaning, when infants are less shielded or lose the protection of maternal antibodies and are exposed more or less abruptly to pathogens.

4.3 THE ORGANIZATION AND DETERMINISM OF ACTIVITIES

Like the securing of food, the conduct of activities associated with consumption is always set by a given culture and its acquired behaviours; they can therefore be analysed by following their pattern of organization and determinism.

4.3.1 The function of food consumption activities

Activities associated with food consumption complete those related to the securing of this food, in order for man to satisfy his nutritional need. This function involves, firstly, the selection of foods among existing resources, then their preparation to make them more comestible, then their sharing among the members of the community and, finally, their ingestion. But meals usually have a social and sometimes political additional role.

4.3.2 Community

As seen above in relation with the securing of food, the community involved at the consumption stage is confined to the household, or to several related households. But an institution can also be regarded as a community in this way.

4.3.3 Structure

Structure is the elementary organization unit required to perform a function; as such, it is often merges into the community.

4.3.4 Norm

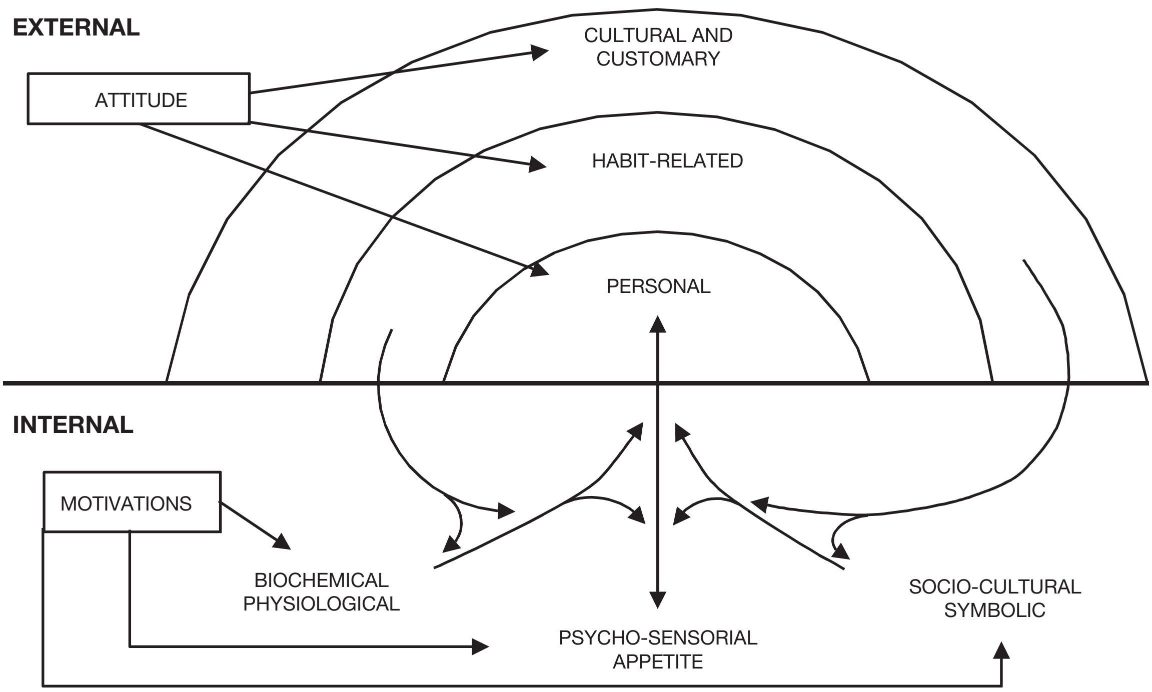
The food consumption norm is defined mainly by eating habits, which also set the following:

⇨ the choice of food (where possible);
⇨ the different ways of preparing food;
⇨ the sharing of food;
⇨ the ingestion of food;
⇨ the nutritional care provided to dependants, particularly breastfeeding, infant feeding and weaning methods.

Eating habits also include dietary taboos that can affect the choice of food and its attribution to different family members, in addition to the weaning and feeding of small children. The understanding of taboos is important for two reasons: avoiding mistakes in nutritional intervention, and detecting possible vulnerabilities.

Behaviour towards food is an attitude associated with the personal daily relation to food, and with the various behaviours observed by the individual in his vicinity, which result from habits and culture. These are external factors. But behaviour towards food is also related to physiological, psycho-sensorial and symbolic motivations, and these are internal factors. These behavioural factors combine in complex ways to set the behaviour towards food, as illustrated in Figure 6.16, adapted from Trémolière (Trémolière, 1977).

Figure 6.16 Factors influencing behaviour towards food



"Influencing factors" is understood here as meaning that they are not isolated within the framework of the behaviour towards food; the latter results from the whole. An individual can feel hungry (i.e. positive physiological motivation), yet be unable to eat a given food because it disgusts him or is unfamiliar to him (negative psycho-sensorial motivation), or because its symbolic value is not in line with the situation at that specific moment (negative socio-cultural motivation).

The integration of factors influencing the behaviour towards food implies, *inter alia*, a process of memorizing tastes, odours, circumstances and sensations perceived consciously or unconsciously around meals, and which later determine the affinity for a given food, according to its preparation and the circumstances surrounding its consumption. For example, food poisoning involving agreeable foods can lead to repulsion (sometimes definitive) from such foods, because the disagreeable feeling of indigestion takes precedence over the initial liking. Thus, behaviour towards food is also influenced by psycho-sensorial motivations some of which arise from the subconscious, giving eating habits a normative character much stronger than may be thought.

This aspect is also very important for humanitarian operations. In cases of anorexia caused by physiological disorder, patients only accept specific familiar foods, and then only in minimal amounts. They have no appetite for new foodstuffs and reject them. This is particularly spectacular in severely malnourished children also suffering from related disorders. They become anorexic, and they must above all not encounter unfamiliar foods at that stage.

Another interesting aspect of eating habits relates to consumption modes. Man does not view his food in terms of its nutrient content, but in terms of ingredients. He has succeeded empirically in combining the different ingredients required for his dietary balance, and has also developed appetizing preparations. He has conferred a symbolism upon his foods, and this symbolism is a determining factor in human relations. He has succeeded in feeding himself while developing his taste for food. These considerations are also important in humanitarian operations, as they must allow for a human outreach that goes well beyond the simple delivery of balanced rations.

4.3.5 Enforcement

In Western countries, the control of food consumption is primarily a private domestic matter, and only to a certain extent is it individual. But in more traditional societies, this control can also be enforced by religious and lay authorities. Furthermore all countries have food quality control mechanisms and associated regulations at national level; these regulations must be respected strictly when importing foodstuffs to assist populations in crisis.

4.4 ACTIVITY PERFORMANCE

The performance of food consumption is expressed in the following equation:

$$\frac{\textbf{nutrients consumed}}{\textbf{nutrients required to satisfy the nutritional need}} \ \textbf{/ timeframe}$$

This equation is influenced firstly by the analysis of activities related to the securing of food, in order to determine whether the food thus obtained is sufficient for a given family or community. A positive answer does however not necessarily suggest that each individual receives a portion that is adequate to cover his nutritional need. Performance must therefore also be verified in relation to the various members of the community, particularly the most vulnerable. It must be done, all the more, if performance is insufficient, in order to detect possible discrimination – bearing in mind, however, that humanitarian action has only little influence on cultural behaviour patterns.

4.4.1 Nutrients required to meet the nutritional need

The sum of nutrients required to meet the nutritional need in fact represents the nutritional need itself. Nutrients must therefore be expressed as available amounts of food, once prepared and directly ready for consumption (in other words, when they have already lost some of their initial nutrient content through storage, refining and cooking[36]). The calculation is not complicated but requires the use of food composition tables, a limited number of basic dietary rules[37] and the application of appropriate correction factors according to the probable losses incurred during the food processing stages, particularly cooking. It is also worth noting that a balanced food ration, sufficiently rich in energy, usually also contains enough protein, vitamins and minerals. Iodine and zinc provide two exceptions, because their concentrations in foods vary according to soil and water composition.

4.4.2 Timeframes

Man usually consumes food on a daily basis, and timeframes are thus usually set for 24 hours. This does not mean that a nutritionally healthy individual must absolutely eat every day although, if he does not, he must then compensate for the resulting reserve loss. This is rather easy for adults, whatever the available foods; but it can be impossible for small children fed on low energy-density foods such as cassava, during weaning. When people eat less frequently than once a day, it is due to famine, sickness or personal decision.

[36] Chapter V discusses the effects of food processing and cooking in greater detail.

[37] See Chapter XV.

4.4.3 Nutrients consumed

The nutrients that are actually consumed are determined by the following factors.

1. The overall economic performance in the securing of basic economic goods, which in turn influence:
   → the quantity, quality and diversity of the regularly available food, in turn affecting appetite;
   → the material means necessary to prepare food;
   → in part, the time required to prepare and distribute food to the family members;
   → the mental disposition to prepare attractive food and share it within the family.
2. Appetite defines the amount of food that individuals can ingest; it is determined firstly by the individual's physical and mental health, and then by his preferences and the quality of the food.
3. Eating habits, which in turn influence:
   → the amount of food allocated to each family member;
   → food taboos;
   → discrimination;
   → sharing priorities which do not necessarily reflect discrimination;
   → the atmosphere surrounding meals and their role in the cohesion of the family system;
   → food quality;
   → food given to infants and small children (breastfeeding and weaning).
4. The care provided to vulnerable groups or dependants; these partly influence their physical and mental health, and thus their appetite. This care is defined by the provider's (usually the mother) education and skills, attitude, motivation, and available time and resources – both of which are frequently the most important limiting factors.
5. The quality of the food preparation; this influences the micro-nutrient content and appetite, is determined by culinary practices and means, and the skills, motivation and health of the cook, and finally the time available to do so.

4.5 *PERFORMANCE SECURITY*

It is accepted that to varying degrees all peoples who have survived had eating habits and cultural behaviours that ensured an adequate, sufficient, balanced and comprehensive diet. The notion of varying degrees introduces that of vulnerability for those on the brink of sustainability in terms of means and customs. There is no direct security mechanism that ensures food consumption. The latter can, however, be ensured indirectly by the mechanisms that govern the securing of food, by the quality of the care given to dependants (e.g. education, economic growth, the fight against discrimination, etc.), and by the means of preservation of health (access to healthcare, water, habitat and safety). The mechanisms that govern the securing of food are described above, the care that must be given to dependants is discussed in Chapter XV, and the main conditions allowing health to be preserved are briefly listed below.

4.5.1 Conditions for physical health

Good physical health is determined by the following factors:

⇨ a good nutritional status;
⇨ a healthy diet, that is, supplying all the required nutrients in sufficient quantity but without excess and in a balanced manner – foods that provide them must not be harmful, they must be prepared in a way that preserves nutrient quality and prevents toxicity; finally, their processing and handling must be hygienic;

- ⇨ the integrity of the organism in order to consume, digest, absorb and utilize the foods, and finally to excrete their waste;
- ⇨ the absence of illnesses that may interfere with nutrition or mental health;
- ⇨ adequate care of dependants;
- ⇨ sufficient access to preventive and curative healthcare;
- ⇨ sufficient education to make the most of healthcare services, particularly in terms of prevention;
- ⇨ good water and habitat hygiene conditions, themselves set by:
  - → sufficient access to drinking water, implying that sources are sufficient in number and that catchments and distribution networks are in good condition and protected from contamination;
  - → environmental sanitation in order to control the risk of contagion that may be associated with it, as follows:
    - → the adequate evacuation and treatment of human, domestic and water waste;
    - → the control of vectors of contagion (i.e. flies, mosquitoes, parasites, and rodents), by direct eradication and reducing the chances of human contact – this is already partly achieved by waste disposal;
  - → adequate shelter from cold and weather.

4.5.2 Conditions for mental health

Mental health is firstly determined by physical health, and then by living conditions. Children need affection and a reassuring environment; adults need security – political, economic and social – in order to be able to cope with the long-term difficulties they face.

5. THE BIOLOGICAL UTILIZATION OF FOOD

Man's biological utilization of food is involuntary, because it is subjected to biological and thermodynamic determinism. Humanitarian action can influence it indirectly by addressing the conditions that define it; these include, mainly, health, domestic food availability, and care of dependants. The influence of humanitarian action can also be direct, in the form of therapeutic nutrition measures.[38]

5.1 ACTIVITIES ASSOCIATED WITH THE BIOLOGICAL UTILIZATION OF FOOD

The activities associated with biological utilization can be classified in four major stages: digestion, absorption, functional utilization and excretion. These activities are not particularly relevant to humanitarian operations, and are only discussed briefly here.

5.1.1 Digestion

Digestion is defined as the sum of the chemical and mechanical transformations undergone by food in the digestive tract. Digestion transforms food into its basal molecular units, thus allowing it to be absorbed.

[38] See Chapter XIII.

The digestive tract includes the mouth, the oesophagus, the stomach, the small intestine and the colon or large intestine.

- ⇨ **In the mouth**, chewing allows a first rough crushing of the foods. Dental condition is important in this respect. Saliva moistens and lubricates the food and thus facilitates its swallowing into the oesophagus. Saliva also contains ptyalin, an enzyme that begins the degradation process of starch.
- ⇨ **In the stomach**, food is mixed and reduced to a pulp called chyme. It is at the same time exposed to the action of hydrochloric acid, which dissolves it and promotes the action of digestive enzymes, particularly pepsin (which acts upon proteins), and lipase (which acts upon lipids).
- ⇨ **In the small intestine**, chyme is subjected to the action of:
  - → gall, originating in the liver through the gall bladder, which emulsifies the fatty elements contained in the food into fine droplets;
  - → pancreatic juices which contain the major digestion enzymes that act upon proteins, starches and fats;
  - → enzymes secreted by the intestinal mucous membrane, which terminate the fragmenting of macro-nutrients into their essential components: simple sugars, fatty acids, glycerol and amino acids, which can then be absorbed.
- ⇨ **In the colon**, digestion is practically complete. Only food residue (fibre, partly digested nutrients), cell residue, bacteria (that form the intestinal flora) and water (largely reabsorbed) remain.

5.1.2 Absorption

Absorption is the transfer of the nutrients contained in the intestine into the organism through the intestinal mucous membrane. Most nutrients are transported actively through their own mechanisms – regulated mostly by their level of intake and their concentration in the organism. In addition, passive absorption can set in beyond a certain intestinal concentration. Nutrient absorption is complex and is not yet fully understood.

5.1.3 Functional utilization

After their absorption, nutrients are stored and/or transported to the organs to be utilized according to their respective functions. Some, such as sugars, are consumed in metabolism and must therefore be replaced as fast as they are consumed. Others, such as iron, are recycled regularly and efficiently; they are however lost sooner or later, be it specifically through metabolic pathways, or through the unavoidable losses that result from "organic leakage" and tissue renewal. They must therefore be replaced according to the average time they spend in the organism.

5.1.4 Excretion

Having fulfilled their function in the organism, or when they are present in excessive concentrations, nutrients or the produce of their degradation are excreted through urine, stool, perspiration and the gases produced by breathing. Furthermore, the "leakage" of some metabolic pathways, intestinal and skin desquamation, and hair and nail growth are also forms of nutrient (or their metabolites) excretion; as such, they also constitute unavoidable losses. Urine contains most soluble metabolites (e.g. salts, nitrogen group amino acids in the form of urea, excess vitamins, and other degradation products). Stool contains gall salts, trace metals and other products excreted by the organism into the intestine, in addition to the undigested food residue mentioned above. Breathing expels carbon dioxide and water, mainly. Carbon dioxide is produced by the combustion of carbon molecules utilized as a source of energy (sugars, the carbon framework of amino acids, lipids). Perspiration expels water, in order for it to be vaporized and thus refresh the body (the transformation from liquid to gas consumes heat). Perspiration also expels salts, particularly sodium chloride.

5.2 THE ORGANIZATION AND DETERMINISM OF ACTIVITIES

The organization and determinism of activities in the biological utilization of food have been discussed above, in Table 6.2. There is no need to dwell on the points that are not particularly relevant to humanitarian action.

5.3 ACTIVITY PERFORMANCE

The performance of the biological utilization of food can be expressed as the ratio of the use by the organism of consumed nutrients, on the one hand, and what it should be in order to achieve an adequate nutritional and health state, over a given period, on the other. At this stage in the activities in the organism, such an approach to performance makes little sense, because it cannot be used in practice, except in laboratory conditions. However, attention must be paid to the factors that affect this phase in order to maximize its efficiency.

The biological utilization of food is determined by the following:

⇨ the amount of food consumed;
⇨ the quality of food consumed, in terms of balance between nutrients, be they Type I or Type II nutrients;[39]
⇨ the quality of food consumed, in terms of hygiene;
⇨ the reserves of the organism and its nutritional status;
⇨ health in terms of any possible influences on the activities of biological utilization, mainly:
  → the condition of the digestive tube in terms of digestion and absorption;
  → the liver function in terms of storage and metabolism;
  → the metabolic function throughout the organism;
  → the kidney function in terms of metabolism and excretion.

Intestinal parasites and bacterial and viral infection have a major impact on digestion and nutrient absorption. They profit from chyme nutrients (thus contributing to deficiency), and cause sometimes serious malabsorption and nutrient loss through diarrhoea and lesions to the intestinal membrane. Parasite and infectious diseases are common, and thrive in crisis situations. Nutritional interventions in such settings must always include control measures for these diseases.[40]

Furthermore, food hygiene is directly related to the spread of infectious disease. The ingestion of contaminated food is widespread, particularly in crisis situations. A particularly dangerous food commodity in this respect is reconstituted powdered milk, used as a substitute for maternal milk and bottle-fed: the quality of the water (or the cleanliness of utensils used in the process) used to reconstitute the milk is often doubtful or poor.[41]

[39] See Chapter VIII.
[40] See Chapter IX, Section 3.
[41] See Chapter XV, Section 6.2.1, on the utilization of maternal milk substitutes, and Chapter V on dairy products.

The biological utilization is thus determined early in the feeding process, and by health; as a result, intervention that aims at promoting the biological utilization of food must focus on these two aspects.

5.4 PERFORMANCE SECURITY

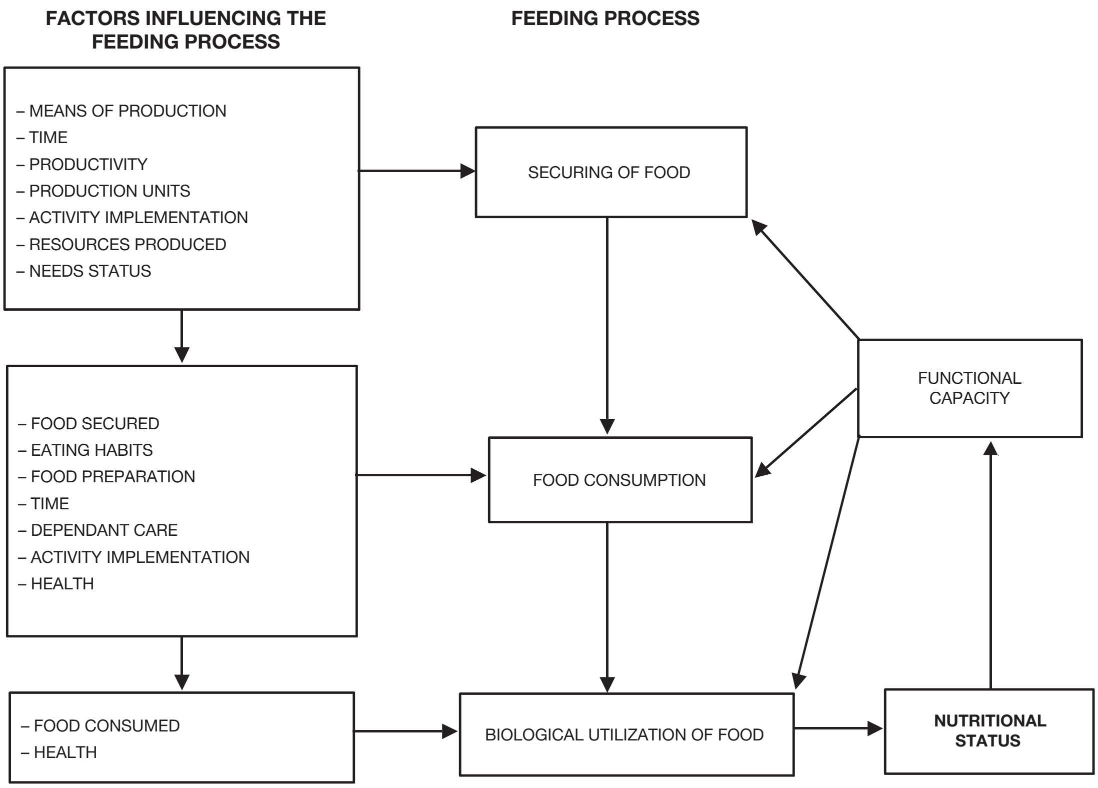
Like food consumption, there is no direct security mechanism for the biological utilization of food. The only way of achieving this security is to ensure an adequate nutritional status and mental and physical health at individual level. The conditions for this are themselves related to the performance achieved during the two previous stages of the feeding process (the securing of food and its consumption), the integrity and security of the family and social structure, sufficient access to preventive and curative healthcare, and satisfactory access to water and habitat.

VI

6. NUTRITIONAL STATUS

The living organism must meet its nutritional needs through a feeding process. The degree to which these needs are met defines the nutritional status of a given organism. The nutritional status, in other words, is set by the performance of the feeding process, and the factors that influence it. Together with health, the nutritional status however also defines the functional capacity of the organism, which in turn influences the biological utilization, the consumption, and the securing of food; this is illustrated in Figure 6.17 below.

Figure 6.17 Interdependencies between the feeding process and the nutritional status



The nutritional status is thus both the result of and the input to the feeding process. Preserving an adequate nutritional status is therefore essential in order to maintain a sufficient functional capacity to carry out the activities of the feeding process efficiently. Two questions thus remain: what is the nutritional status, and how is it measured? What is an adequate nutritional status?

6.1 NUTRITIONAL STATUS AND ITS MEASUREMENT

The picture that springs to mind in relation to the nutritional status is one opposing "thin" and "fat" persons, neither of whom is considered "normal". This image refers to the status of the lean mass (i.e. muscle and organs) and the fatty (or adipose) tissue. But this approach remains restrictive, because the nutritional status relates to the condition of all the parts of the organism. The "thin/fat" image in particular ignores the vitamin and mineral status – it is not necessarily related to lean mass and adipose tissue. Fat individuals may lack vitamins and minerals, while thin ones may be amply provided. How, then, can all the parts of the organism be measured? No single method provides the answer, and several must be combined to do so, bearing in mind that some parts cannot be measured with accuracy. Assessment methods are briefly discussed below.[42]

6.1.1 Investigation of clinical signs

Clinical signs include those that are visible at the level of the skin, eyes, hair, the mouth lining, of palpable organs such as the liver and the thyroid, and of the reaction (or absence thereof) to stimulation. These signs provide sometimes useful deficiency indicators and permit the quantification (to a certain extent) of deficiency, because they usually appear when deficiency is advanced. The absence of such signs suggests the absence of obvious deficiency, but does not rule out deficiency itself: deficiency may still be at a sub-clinical stage, and suddenly become visible. More than fifty clinical signs have a nutritional meaning. Some are unambiguous, easy to observe and interpret, such as goitre or pellagra dermatosis; others are difficult to isolate and interpret, such as diffuse facial or hair discolouring. The appraisal of clinical signs must be left in the hands of skilled staff.

6.1.2 Nutritional anthropometry

This method consists in measuring the physical dimensions of the organism and, often, in combining them in order to determine the adequacy of growth or nutritional status with respect to the lean mass and adipose tissue, on the basis of reference data. Anthropometry however only provides an estimate of the lean mass and adipose tissue and, like clinical signs, does not enable absolute quantification of the fat and protein reserves available to the organism. Resorting to nutritional anthropometry and investigating clinical signs are the two approaches preferred by humanitarian agencies.

6.1.3 Biochemical tests

Biochemical tests applied to blood and urine samples in particular can, directly or indirectly, provide a fairly accurate idea of the status of many constituents. Humanitarian agencies do not use them widely, however, because they are not suited to most encountered field conditions; their use must be left to well-equipped laboratory facilities.

[42] Some are discussed in greater detail in the Chapters devoted to nutritional disorders (VIII) and assessments (X).

6.1.4 Biophysical methods

Biophysical methods, like the extrapolation of lean mass from the potassium isotope 40 content, are even more accurate than biochemical tests, but they cannot be applied in humanitarian operations.

It is thus worth noting that the nutritional status of individuals cannot be assessed comprehensively; for assessments to be as accurate as possible, a full battery of methods must be applied, most of which are impractical in the field. Clinical deficiency signs and anthropometric measurements (related to reference values) are ultimately the only realistic tools, and as such do not provide absolute answers.

6.2 ADEQUATE NUTRITIONAL STATUS

An adequate nutritional status may be described as one that is not improved by administering essential nutrient supplements. This definition implies a satisfactory functional capacity of the organism, because it is determined by the nutritional and health states. Functional capacity is determined by the presence of all the components of the organism, in sufficient amounts, and according to specific proportions. Furthermore, functional capacity must be defined according to performance criteria in terms of growth, pregnancy and breastfeeding, physical work, emotional stability, resistance to sickness or recovery following sickness. Resistance to infection is not necessarily determined by the same parameters as resistance to cancer and cardio-vascular disease.

An adequate nutritional status can also be described as the quantity and proportion of the components of the organism associated with the smallest mortality risk (or the greatest chances of longevity) in good mental and physical health conditions. Mortality risks cannot be quantified accurately in terms of the relative component proportion (except in case of deficiency or lethal excess of specific constituents); on the other hand, life-insurance statistics indicate that, below minimum lean mass and above maximum adipose tissue thresholds, mortality risks increase owing to deficiency and excess disorders respectively. In adult males, for example, the mortality risk increases exponentially as soon as the body mass index (BMI)[43] falls below 16 or rises above 30. Between these two extremes lies a mortality risk area that is equivalent for BMI between 20 and 25, amounting to an approximately 15 kg variation for a height of 1.75 m. This shows that differences in nutritional status can be associated with an identical longevity, thanks to the organism's ability to regulate its homeostasis (i.e. the stabilization of various physiological constants). It is also likely that within this low-risk area, functional capacity is satisfactory.

It may seem that functional capacity and mortality risk go hand in hand, but they can in fact be opposed. Muscular mass and height can be useful for heavy physical work, but shorter, less robust individuals may face lower risks of mortality and of degenerative illness related to age, and be more vigorous (Pacey & Payne, 1985).

Moreover, the association between mortality risks and nutritional status varies according to situation, because mortality is not only determined by nutritional status, but also by the synergic interaction of this with other factors such as infection. Mortality risks related to nutritional status can therefore not be extrapolated from one situation to another. During the great Ethiopian famine (1983–1986), considerable variations were observed in the mortality risks for a given nutritional status between the Tigre highlands in the rainy season and the desert fringe in the dry season. Highland children

[43] The body mass index expresses the ratio between weight (kilograms) and height (metres) squared (weight/height^2).

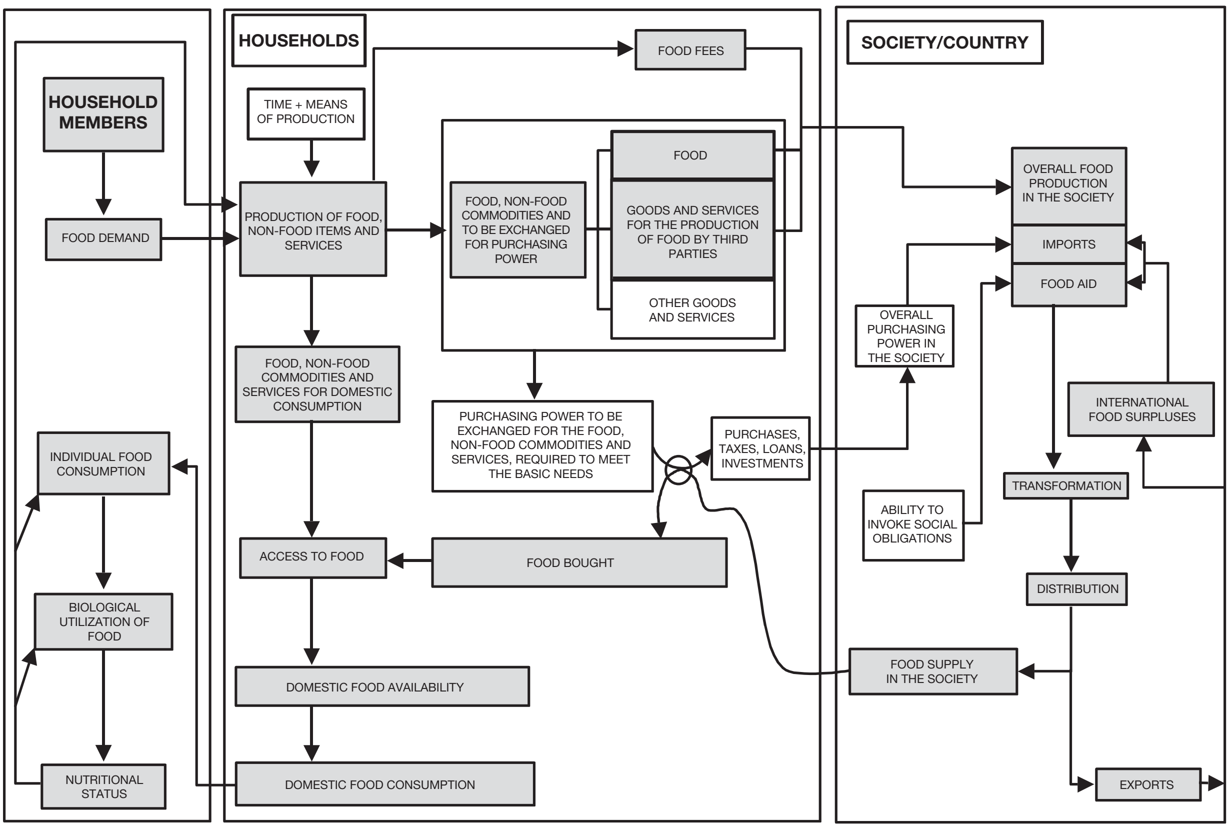
whose weight-for-height index lay below 60% of the median had practically no hope of survival in therapeutic feeding centres, whereas desert children practically all survived because they were not much exposed to infectious disease. However, the mortality risk variation was smaller in the case of mid-upper arm circumference (MUAC) for height measurement: different anthropometric indicators do not have the same meaning.

The above comments show how difficult it is to define an adequate nutritional status: it cannot be measured accurately, and it is not a set entity.

It can, at best, be defined as the absence of clinical deficiency signs, the absence of manifest illness, and a given status of lean mass, adipose tissue and growth – this can be approached through anthropometry. But the latter only provides an estimate of one aspect of the nutritional status (reserves of adipose, muscular and visceral tissue), itself only an estimate of the actual nutritional status. However, the status of the adipose tissue and, to a large extent, that of the lean mass, reflect the organism's energy reserves, and the energy need is the most demanding. In nutritional crises, inadequate coverage of the energy need (through insufficient intake or anorexia) most rapidly and usually causes complications; as a result, the combination of anthropometric measurements and clinical examinations provide a fair estimate of the nutritional status, and shed light on whether it is good or degraded.

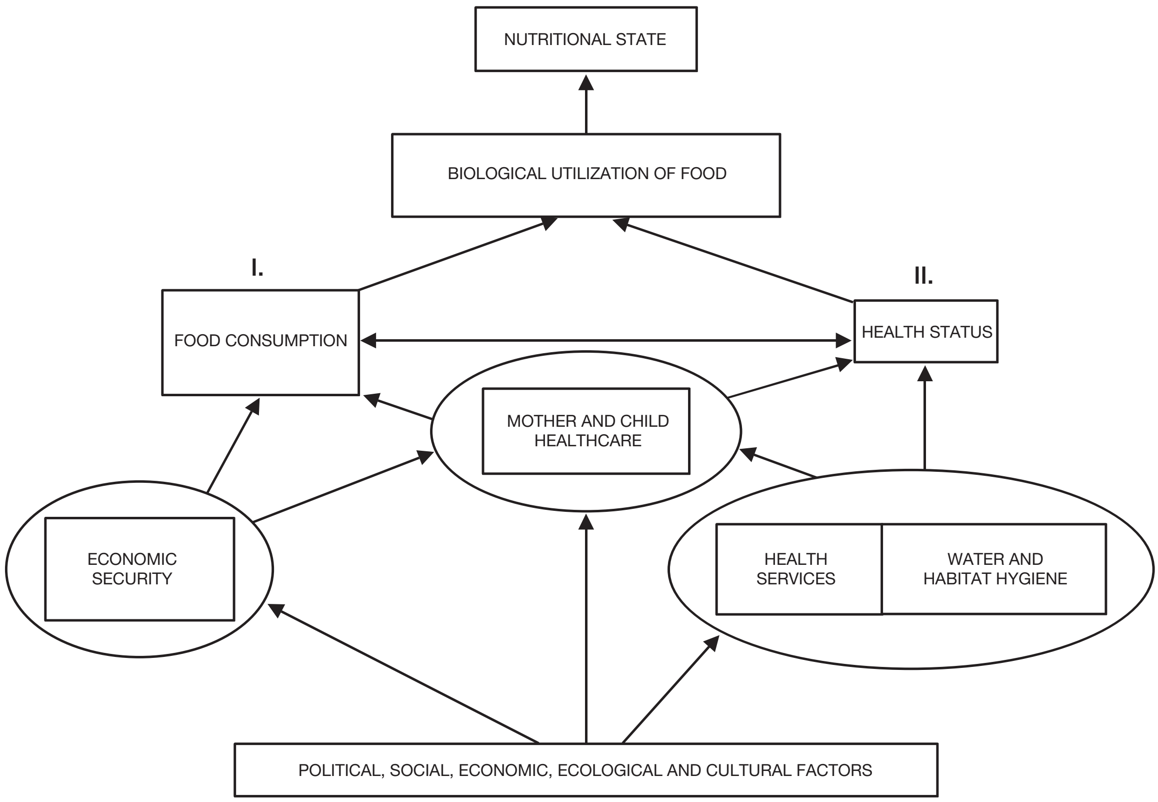
In short, the nutritional status must first be located within the feeding system, in order to qualify its importance in comparison to all the involved factors. This is illustrated in Figure 6.18 below.

Figure 6.18 Nutritional status within the feeding system



Next, it should be understood that the nutritional status sheds unique light on the functioning of the feeding process. This is illustrated in Figure 6.19 below, which is as useful in terms of analysis as it is in operational planning.

Figure 6.19 Factors affecting the nutritional status



Figures 6.19 and 6.20 show that measurement of the nutritional status is a valuable indicator of the functioning of the feeding process. They also show that measuring the nutritional status only permits a belated, reactive, approach to crisis situations. All the more so if it is used as the main detector of the need for aid, itself proportional to the deterioration of the nutritional status. The validity of this measurement is in this way misunderstood, and its use can prove detrimental to the objectives of humanitarian action, that is, preventing and alleviating suffering. It is pointless to wait for 30% of the population to have lost 20% of its weight before action is envisaged – help will arrive too late for many of the malnourished, and the delay will meanwhile have exposed many healthier people to malnutrition. The measurement of the nutritional status must therefore not provide the criterion for humanitarian action. It can only serve to verify a hypothesis, monitor the evolution of a given situation, measure the impact of a specific operation or the gravity of a given situation, and to select individuals for inclusion, for example, in a therapeutic feeding programme.

PART TWO
NUTRITIONAL CRISIS

The meaning of the word “crisis” seems obvious: it indicates that something is wrong. The Oxford English Dictionary (2002) however provides two different definitions: *“a time of intense difficulty or danger”*, or *“the turning point of a disease, when it becomes clear whether the patient will recover or not”*. The expression clearly refers to several notions simultaneously: that of a given moment in time, of difficulty or pathological disorder, of attack, situation or state, and also change and evolution. For example reference to a rheumatism crisis implies a specific event in time, the condition of an individual, the inflammatory attack, and the problem that manifests itself in the form of rheumatism. “Crisis” may also suggest a certain magnitude: if a country is said to be in crisis, for example, this usually implies that a substantial part of its population is affected.

The generic expression “crisis” thus applies to many different phenomena that vary according to their nature, their causes (and their evolution), their environment, the response to them (on the part of their victims or perpetrators), and the action that aims at averting them. Crisis can be simple or complex, structural or caused by circumstances, chronic or acute; it may affect entire populations, or single individuals. In spite of the variety of circumstances that the word refers to, it is the only expression that includes them all, providing them with a common denominator. The principle must therefore be understood and set within a conceptual framework: this is done by agreeing on a definition, outlining a number of general features, and finally explaining the mechanisms that produce them. This process sets the foundation for the subsequent discussion of the specificity and pathology of nutritional crises.

CHAPTER VII
A CONCEPTUAL APPROACH TO CRISES

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CHAPTER VII
A CONCEPTUAL APPROACH TO CRISES

1. A CONCEPTUAL FRAMEWORK FOR CRISES

1.1 DEFINITION

A definition of the word "crisis" must first be agreed on. Among its different meanings, that of a "grave phase" in the evolution of events appears to be most fitting to the intuitive notion of a crisis in terms of humanitarian intervention.

1.2 GENERAL CHARACTERISTICS OF CRISES

A crisis does not arise from nothing, nor is it due to chance. It develops more or less rapidly according to a cause and effect process, referred to as the crisis process, which is characterized by specific conditions.

1.2.1 The crisis process

A crisis process develops in the course of events which, in turn, makes history and blends into it.

The limits of the process must therefore be identified, and to do this, three phases are defined.

1. **The preliminary phase**, in which the crisis emerges and develops. During this phase, to a certain extent, adaptation occurs and, if necessary, is followed by the utilization of reserves and defence mechanisms.
2. **The acute phase**, which amounts to the crisis as such. Reserves and defence mechanisms are exhausted first, and a growing functional degradation then gradually leads to the failure – and, ultimately, death – of the system under consideration. The system can be the economy, an organism, or a society.
3. **The recovery phase**, in which the crisis is resolved for such elements as have survived it; this includes resuscitation, followed by recovery or rehabilitation and, ultimately, consolidation or strengthening.

The preliminary phase

This phase is frequently unobtrusive, and it might even go unnoticed when the primary causes for the crisis are such that they result directly in crisis, or when they occur without obvious warning signals – this is sometimes the case in earthquakes, tidal waves, or volcanic eruptions. The duration of this phase can vary. It is contingent upon circumstances and/or events integrated into the crisis process, and which herald and prepare the acute phase. From a prevention perspective, the preliminary phase thus warrants the attention of humanitarian organizations, although the line between the preliminary and acute phases is sometimes difficult to draw in the causality chain.

The preliminary phase is nevertheless always crucial, because events preceding the crisis are less serious than those occurring in acute crisis. This is, in fact, one of the major challenges facing humanitarian intervention in terms of prevention, as crisis processes often subside by themselves. For instance, it is rare for an isolated drought episode in an arid setting to threaten the population seriously; indeed, the latter can usually resort to adaptation mechanisms in reaction to a phenomenon which is both familiar and sufficiently recurrent to be anticipated. However, if several drought episodes occur in such rapid succession as to deplete adaptation mechanisms, this population will be under threat. The first episode is thus the trigger factor for the crisis process. It equates to the preliminary phase but, at this early stage, the event of crisis itself remains uncertain. The distinction is made both by the population experiencing drought, and the humanitarian agencies, officials, the media, donors, and the general public. Illustrations include the repeated failure of early warning systems intended to arrest the crisis process. During the preliminary phase, most gamble on a spontaneous reversal of fortune towards normality – especially as damage is still invisible, and this frequently discourages many prevention efforts. However, it is during this phase that resistance to crisis factors develops, and sometimes collapses.

The acute phase

This is the crisis itself, the phase of real threat for those experiencing it. Its duration is variable, and the crisis develops according to the nature and progress of its causes, according to the appearance (or not) of new crisis factors, and to available reserves and defence mechanisms. This development can take several forms as follows:

⇨ a rapid shift to recovery, thanks to appropriate assistance measures;
⇨ stabilization through coping mechanisms,[1] but this entails increased vulnerability owing to their exhaustion;
⇨ deterioration, possibly leading to disaster.

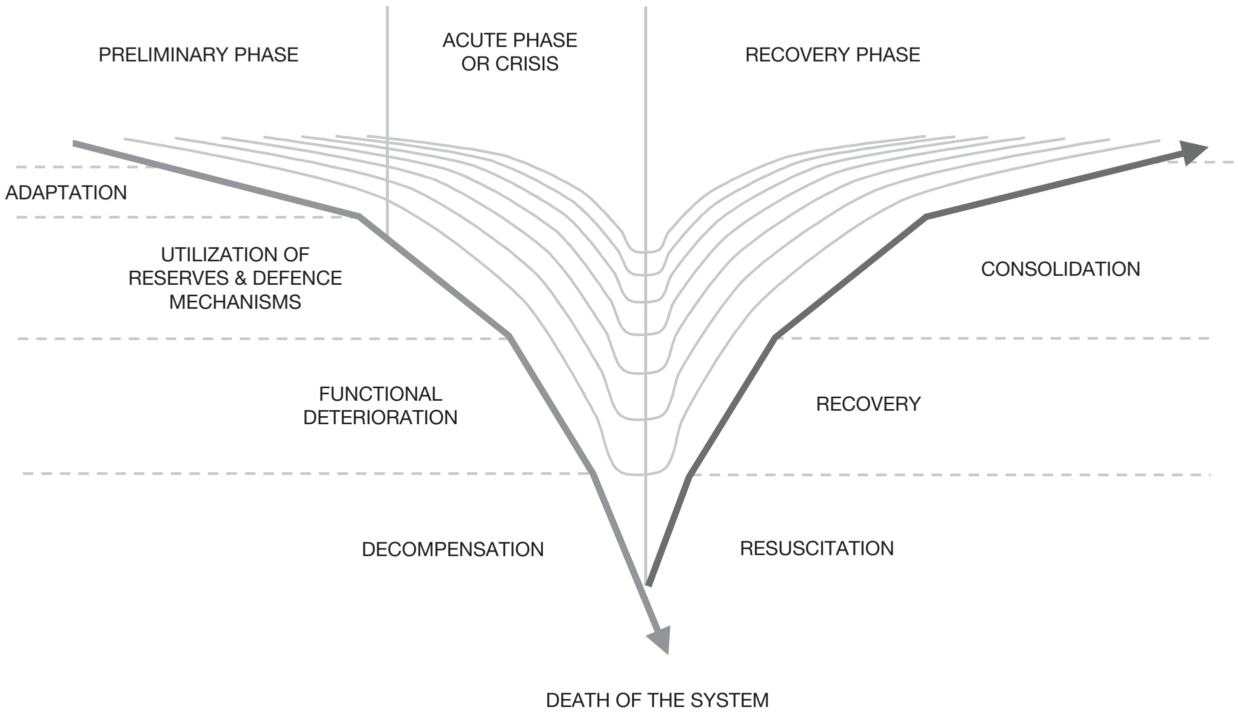
The recovery phase

This phase can take many forms, but can only begin when the causes of the crisis have vanished or diminished substantially. The recovery phase is contingent upon what remains of the victims' coping mechanisms and potential outside assistance. Possible scenarios include rapid and sustainable improvement, a restored status (roughly equivalent to that preceding the crisis), or a resumption of precarious but sufficient living conditions, with an aggravated weakness (increasing the chances of a resumption of acute crisis as soon as its causes reappear).

Distinguishing three phases, albeit somewhat artificial, enables us to model crisis processes, to approach them in an analytical manner, and to define needs for humanitarian assistance. Thresholds between the three vary from one situation to the next, but are always linked to the appearance of a more or less immediate threat between the first and second phase, and are bound to the more or less gradual disappearance of the causes for the crisis between phases two and three. The crisis process can be compared to the evolution of an illness, comprising different possible stages, as illustrated in Figure 7.1 below.

[1] See Chapter VIII.

Figure 7.1 The crisis process



In Figure 7.1 above, the parallel lines located above the limit indicate that, within a heterogeneous population, different social strata suffer differently from the effects of the crisis owing to the fact that, given the same causes, vulnerability levels may vary, as discussed in the next Section.

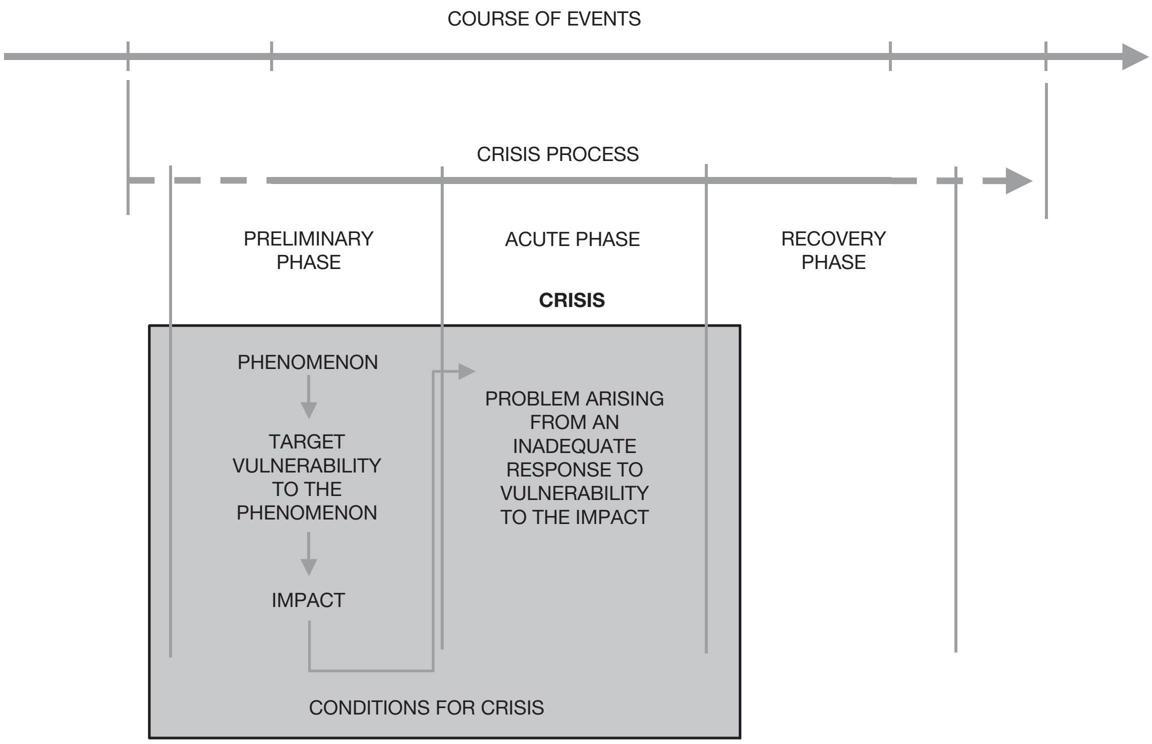
1.2.2 Conditions leading to crisis

1. In the cause and effect chain characterizing the crisis process, one or several causes must stand out at some stage as crisis factors. To use the terminology developed by Dr Pierre Perrin, we shall refer to such causes as "phenomena" (Perrin, 1996) or, to borrow from physics, "perturbations".
2. For a phenomenon to result in a crisis, it must first strike a target.
3. The target must be vulnerable to the phenomenon. The action of the phenomenon on the target then amounts to aggression.
4. The effect of aggression must manifest itself through damage.
5. For damage to precipitate a crisis, it must constitute a problem whose seriousness characterizes a crisis situation. In other words, those confronted with it lack the means to respond to it adequately (either by direct action or by evasion), thus exposing themselves to a critical situation, or critically increasing their vulnerability.
6. Inability to respond adequately results from the abnormal magnitude of the problem and/or vulnerability.

This chain of conditions indicates that the emergence of a crisis is related to two levels of vulnerability: the first is providing the initial phenomenon with a foothold, the second is the inability to respond adequately to the impact of the phenomenon. For example, if the influenza virus (phenomenon) propagates and meets a vulnerable individual (target), the individual will suffer an influenzal infection (impact, amounting to the damage for the system and creating the problem). In this case, the problem is usually surmountable because the immune system is activated and eventually rejects the virus. Thus here there is no crisis, strictly speaking. If, on the other hand, the individual is abnormally vulnerable to the impact, if he or she is unable to fight the virus once the infection appears, the individual faces an insurmountable (or difficult to surmount) problem which endangers his or her life. He or she is thus clearly in a crisis situation, and probably requires medical assistance.

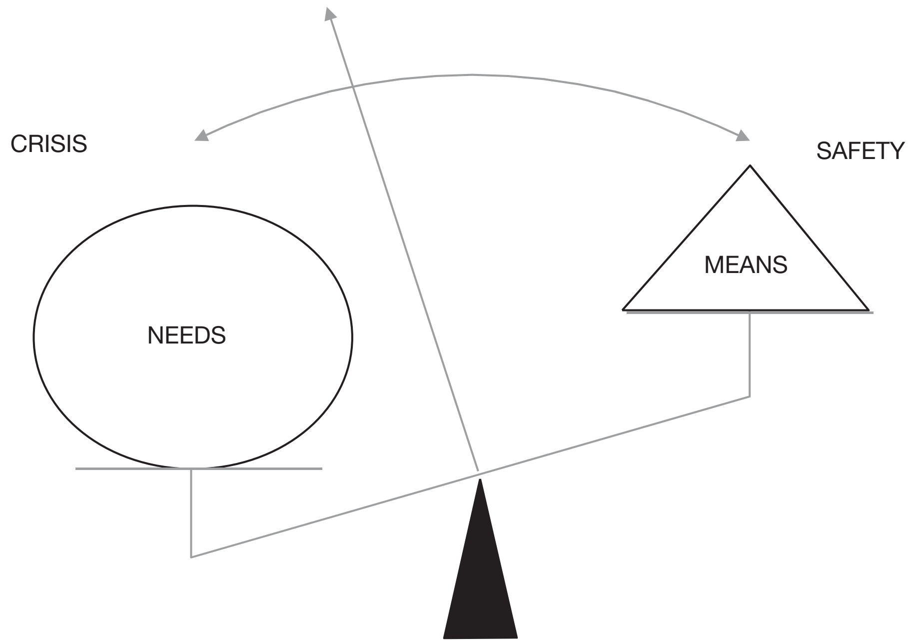
Furthermore, in a cause and effect relationship, the impact clearly also represents a phenomenon which can meet with incapability to confront it (second vulnerability level). The resulting invasion is all the more significant, and the patient's weakness increases. This increased weakness then amounts to a new impact (and, at the same time, a new phenomenon) which can encounter, for instance, pulmonary vulnerability, while another phenomenon may appear (for example, the presence of bacteria causing pneumonia). Figure 7.2 below illustrates the crisis concept.

Figure 7.2 Crisis concept



If crises result from inadequate response to an aggression, then the available means are inadequate to cover the needs whatever they may be. There is thus a discrepancy between the needs and the means, and the greater it is, the more serious the crisis. This approach to the notion of crisis through the existence of a discrepancy, or disequilibrium, can be illustrated by a scale in which the needs weigh heavier than the means (adapted from Perrin, 1996), as in Figure 7.3 below.

Figure 7.3 The scale model



The unbalance between the needs and the means justifies and calls for humanitarian intervention, insofar as local or national systems which should normally assist in restoring equilibrium are incapable (or unwilling) to do so.

1.3 FORMULATION OF CRISES

From a conceptual perspective, the occurrence of crises obeys the following principles.

1. The crisis process develops following the combination of a phenomenon and vulnerability, generating an (adverse) impact:

   phenomenon × vulnerability = impact

   This formula (Perrin, 1996) demonstrates that impact is directly proportional to the magnitude of both the phenomenon and vulnerability. It also means that one or several phenomena can act on different types of vulnerability, and that this can result in several impacts.
2. The impact constitutes damage which, in itself, poses a problem.
3. The victims of the damage attempt to respond to the problem, according to two different scenarios:
   → their response is adequate, and crisis is thus averted;
   → their response is inadequate because they are vulnerable to the impact, and crisis results.
   In case of crisis, the inadequate response can be due to either short-sightedness, or incapability of reacting. However, the resulting situation is critical in both cases:

   a problem addressed inadequately results in crisis.

4. Damage without adequate response increases vulnerability, or leads to new types of vulnerability.

5. In the cause and effect logic, impacts – insofar as it is impossible to respond to the problems they generate – turn into new phenomena acting upon other types of vulnerability, or on the increase of a vulnerability they have already generated:

$$\textbf{phenomenon} \times \textbf{vulnerability} = \textbf{impact}_1$$
$$\textbf{impact}_1 \times \textbf{vulnerability} = \textbf{impact}_2$$
$$\textbf{impact}_2 \times \textbf{vulnerability} = \textbf{impact}_3$$
etc.

In this chain reaction, each impact – which can convert into a new phenomenon – will:

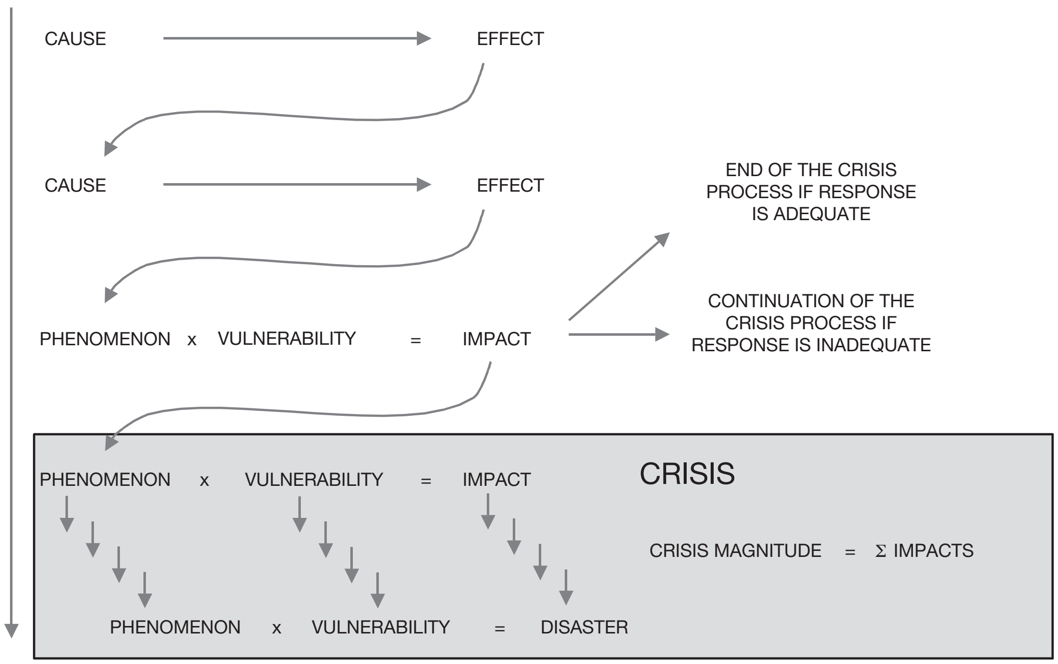
⇨ exploit existing vulnerability;
⇨ increase vulnerability;
⇨ provide existing phenomena with new opportunities for aggression, thus creating ramifications towards new and different problems.

Owing to the multiplicity of cause and effect reactions, crisis is characterized by increasing problems, combining to aggravate the deterioration of the situation; this can result in disaster.

This means that the crisis phase itself can present different stages of gravity by involving more and more people. Similarly, pauses can occur between the appearance of new phenomena and that of new types of vulnerability, or between the appearance of a new phenomenon and its impact.

The development of a crisis situation can be illustrated as follows (Figure 7.4).[2]

Figure 7.4 Development of a crisis situation



This general conceptual model being set, it is now possible to discuss nutritional crises more specifically.

[2] Adapted from Pierre Perrin's description (Perrin, 1996).

2. NUTRITIONAL CRISES

2.1 DEFINITION OF NUTRITIONAL CRISES

The human being's nutritional need is met by the feeding process. Nutritional crises can thus only develop if the feeding process is unable to cover this need (unbalance between needs and means as illustrated in the scale model above). Nutritional crises can therefore be explained as follows.

A nutritional crisis is a serious situation that results from the inadequacy of the feeding process performance, to the point of creating problems which those confronted with them cannot independently resolve in a satisfactory manner.

From this, it becomes obvious that nutritional crises can vary in nature and affect isolated individuals as well as entire populations, according to phenomena, vulnerability, and the feeding process level where performance is inadequate. Moreover, owing to cause and effect reactions, an insufficient performance (or one that cannot be compensated for) at a given level will result in inadequate performance at other levels of the process. This shows both that crisis is dynamic, and that it can be contingent upon (or result from) a specific problem or an accumulation of problems. Such a definition is not easily grasped from the onset, but has the advantage of avoiding the classic pitfall restricting nutritional crises to the realm of catastrophes such as famine or severe malnutrition. This restrictive approach likewise results in limiting humanitarian intervention to curative measures applied to the latest problems in the process, in contradiction with the general principle that humanitarian intervention aims at least as much at prevention of suffering as its alleviation.

In a crisis situation, the feeding process performance is inadequate, owing to the combination of phenomena and vulnerability – producing impacts. These three factors of crisis are discussed below.

2.2 THE PHENOMENA

A phenomenon is anything amounting to the aggression of factors determining the performance of the different steps of the feeding process. Phenomena inducing nutritional crises affect the following:

- ⇨ the resources that are necessary to carry out the activities;
- ⇨ the implementation of these activities;
- ⇨ the resources produced by these activities.

Phenomena can come from two sources: the human community and the natural environment. Those originating in the human community relate to war, economic, social and cultural crises, and disturbances to the environment resulting from human activity (given forms of erosion and desertification, the resulting drought, global warming[3] and pollution). Those originating in the environment relate to natural climatic phenomena (drought, floods, hurricanes, or erosion), non-human predators and geophysical phenomena (earthquakes, volcanic eruptions, tidal waves).

[3] Provided that the currently observed trend in warming is indeed mainly due to human activity.

In the framework of nutritional crises, phenomena related to the obtaining of food are those which can possibly influence economic production activities and their produce. Indeed, any significant reduction in production or return will, most frequently, have major consequences on the performance of securing food. Any phenomenon influencing the securing of food will likewise affect its consumption and biological utilization, since these two steps are contingent upon the first.

Phenomena regarding, primarily, food consumption will also have an impact on its biological utilization. But they may also alter the securing of food, by impairing the functional capacity due to the more or less rapid degradation of the subject's nutritional status.

Phenomena regarding primarily the biological utilization of food, other than those affecting its consumption, result in illness that impairs principally the system (illnesses of the vital functions and organs, metabolic congenital malformations, some cancers). Such phenomena are likely to affect the obtaining and consumption of food as well, since they impair functional capacity.

2.2.1 Human phenomena

Political phenomena

Among political phenomena, war is the main trigger of nutritional crises. Looting, destruction, danger, restrictions of access and movement, population displacements, confinement, occupation, terror and harassment, compulsory levies, embargo and conscription... all these elements may undermine the household economy and, thus, the securing of food. Indeed, they directly influence the means of production, production activities and the resources thus generated. War also indirectly affects activities aimed at obtaining food owing to its impact on the domestic economy, on the environment and on the different forms of authority. Furthermore, the insecurity often resulting from war can cause farmers to cultivate only the absolute minimum, to avoid unnecessary expenses in the probable event of flight (this has been observed in Rwanda, for instance), or if they fear that their harvest may be looted. It must be noted, nevertheless, that when the danger related to war is not flight, but rather the levying of contributions, farmers take this factor into consideration when planning their production to avoid resource shortages or possible violence (similarly, businessmen subjected to fees levied by the mafia increase the commodity price to cover this tax).

Acts of war may also modify the consumption and biological utilization of food, particularly by the wounded, but also by communities themselves. Indeed, they may influence feeding and food preparation customs and generate post-traumatic stress disorders (PTSD) which in turn affect both the individual's appetite and the family cell, and the behaviour of those responsible for dependants (particularly mothers). In displaced persons' camps on the Cambodian border, it was observed that malnutrition increased in parallel with food availability; this in itself seemed absurd, all the more so considering that the incidence and prevalence of infectious diseases remained stable. On the other hand, the population under scrutiny had been displaced several times and had been subjected to severe abuse, bringing the mothers to a psychological breaking point manifested in the neglect of their children. Humanitarian agencies responded to the ensuing malnutrition by increasing food rations which, of course, resolved nothing.

The side effects of war, such as the displacement of populations, may foster the development of epidemics with direct consequences on the consumption and utilization of food, either among specific groups (e.g. measles), or within the entire population (e.g. cholera, tuberculosis or other viral or bacterial infections). The latter will then also reduce the production potential of existing economic resources.

Governance and government authority can also influence the securing of food. Drèze and Sen have demonstrated that measures to control famine are taken by democratic governments in countries accommodating an opposition and where freedom of the press prevails (Drèze & Sen, 1989). Furthermore, lifestyles chosen on an ideological basis and imposed by force can lead to catastrophic famine, as in the USSR in the 1930s, and in Cambodia under the Khmer Rouge.

The weakness of institutions, especially professional, may also constitute a risk factor for some groups whose vulnerability increases owing to their incapability to react to economic or political orientations, or simply competition.

Similarly, some development choices can foster nutritional crisis and a general weakening of the economy, amounting to the preliminary phase of the crisis: the exploitation of the Aral Sea basin in the former USSR is an example of this.

Some aid policies can also have negative effects potentially leading to crisis. In spite of their political origin, they are discussed below in relation to economic phenomena.

Economic phenomena

Economic phenomena are major factors of nutritional crises, either by causing famine directly, or by inducing poverty and restricting choice. Several types of phenomena exist among which the most important relate to (or result from) the market and speculation, competition or economic subjection, economic policies imposed by the State or international economic bodies, adverse economic development, competition over scarce resources, and international aid, in particular food aid. All these phenomena influence the household economy directly and, consequently, food availability and consumption – but they also impair living standards. This generates other phenomena affecting the consumption and biological utilization of food directly.

The impact of phenomena related to the market and speculation can be deleterious by raising the price of essential commodities such as food. Such phenomena result from the combination of shortages and power struggles. They can trigger famine when the terms of trade are reversed for major segments of the population who, to survive, would need to spend more than the income they can actually secure. The phenomenon can be even more devastating insofar as demand is determined not only by the victims of the reversal of the terms of trade. Consider for instance farmers who, in a given region, sell a good harvest massively to private traders whose clients reside outside the region under consideration, or even abroad. If the farmers have sold too much (thus undermining the necessary reserves), or if the following year's harvest is poor, they will need to purchase food, thereby generating an abnormal demand. If this food can be subjected to speculation, or simply if it is exported for a higher price than what the farmers can afford, they will risk famine. Another serious degradation factor is currency devaluation for those whose income is fixed and not adjusted, such as pensioners. It has been observed that, following a devaluation of the currency and a price inflation in Abkhazia, the price of bread had increased approximately ten thousand times, putting pensioners in a dire situation. They continued to receive the same, unchanged pension, they were no longer productive, and it was therefore impossible for them to adjust their income.

Phenomena related to economic subjection aim at rendering domestic economies dependent upon crucial inputs. The most typical example is that of hybrid or genetically modified seeds: on the one hand, their use requires repeated, yearly purchases as their properties are not maintained following reproduction. On the other hand, they also demand considerable yield inputs such as fertilizers, pesticides and controlled irrigation. In Angola in 1999, the living conditions of a specific community deteriorated following its abrupt isolation due to the war. Depending on this type of seeds and its related necessary inputs that it could no longer secure, this population would rapidly have faced catastrophe in the absence of humanitarian aid.

Harmful phenomena related to the policies currently imposed by international economic bodies, particularly structural adjustment, liberalization and globalization based on the theory of comparative advantage, are increasingly well understood. This is particularly the case for structural adjustment, whose impact is more strongly felt by the poor than the wealthy (Azoulay & Dillon, 1993; Salih, 1994). Furthermore, privatization excludes major segments of the population from services indispensable to their wellbeing. Cost-recovery policies have the same effect when applied indiscriminately.

Adverse economic development can lead to environmental deterioration (erosion, desertification, soil salinity, deforestation, resource depletion and pollution). The impact of such phenomena spins into a vicious circle between available resources and the environment's support capacity (reduced by excessive exploitation); it thus contributes to rural exodus towards urban centres, and to the impoverishment of both migrants and residents who prefer to remain in their areas of origin in spite of the difficulties they face. The overall degradation of living standards and public hygiene also affects food consumption, not only owing to an inadequate performance in obtaining food, but also *via* the effects of infectious diseases on appetite, and by the deteriorating quality of the attention devoted to those who require it. Moreover, the excessive exploitation of the environment gives rise to risks of flooding and landslides whose consequences can be catastrophic.

An increasing number of people depending on the informal sector also imply increasing poverty, in terms both of the resource base and of the affected population. Poverty is understood here as a combination of precarious living conditions and a greater vulnerability both to adverse economic phenomena of any type, and to phenomena potentially influencing food consumption.

Food aid can itself cause more damage than good if delivered indiscriminately and without relation to a need assessed with a view to preserving or supporting the local economy. This applies to so-called "emergency" food aid, delivered in crises, as well as to "project-related" food aid, delivered to "vulnerable" groups, and to "programme" food aid. The latter is intended to be sold in order to secure resources (counterpart funds) for the government to finance development projects, among others. It is now recognized that aid can compete with and discourage local production; it can discourage local initiatives aiming to improve economic security by inducing a dependency syndrome. In such cases, food aid usually does not provoke famine directly, but contributes to increasing the vulnerability of the local economy by weakening it, and increasing the danger that it will be seriously affected by the next aggressive phenomenon.

Social phenomena

Population (or demographic) growth is beyond doubt the most worrying phenomenon. Already in the 19th century, Malthus had predicted that if the planet's population adjustment did not occur in a managed way (birth control), it would occur through famine and war, because population grows geometrically,[4] while the production of resources grows arithmetically. In industrialized countries, Malthus's theory has not yet been verified, because industrial and agricultural development has kept up with, even overtaken, population growth – which itself has tended to stabilize – at the cost of the massive use of fossil energy. In countries where this development has not taken place, the Malthusian dilemma remains strongly valid. It often results in competition for scarce resources; this translates into a high conflict risk and contributes to adverse development, and thus to the deterioration of the environment and its support capacity, to pollution, to rural exodus and an increasing precariousness of living conditions.

[4] **Geometric progression:** progression in which each term is a **fixed multiple** of the preceding one (e.g. 1–4–16–64).
Arithmetic progression: progression in which **a constant** is added to each term in order to obtain the next term (e.g. 2–4–6–8).

A manual dealing with nutrition and humanitarian assistance cannot ignore the negative side-effects of food aid.[5] Although intended to be social in nature, food aid nevertheless can cause the economic repercussions discussed above.

The deterioration of the social fabric, linked to the evolution of specific lifestyles, is another phenomenon inducing anomalies in food behaviour, in water and habitat hygiene, and in care given to dependants. Its impact is therefore also felt on the consumption and biological utilization of food.

Cultural phenomena

Distinguishing between social and cultural phenomena is not easy. Social phenomena can be observed in any society, while cultural phenomena relate to specific acquired types of behaviour. For example, the Somali individualistic and clanic behaviour resulted in a conflict which caused one of the last century's most devastating famines. This behaviour is acquired, and thus eminently cultural. Some cultural weaning and infant care practices also have serious consequences on the consumption and biological utilization of food. For instance, the Baganda children in Uganda are weaned by abruptly changing from maternal milk to mostly starchy food, low in protein and other nutrients, and poor in energy. They suddenly lose the immune protection of breastfeeding, the weaning food exposes them to new forms of bacterial contamination, and their appetite is satiated without their nutritional needs being covered, resulting in many cases of severe malnutrition.

Accidents and illness

Accidents resulting in massive pollution (Minamata in Japan, Bhopal in India, and Chernobyl in the former USSR) can make entire regions improper for human settlement, or contaminate resources and result in serious problems in terms both of the economy and health. However, the most common accidents affect individuals: workplace and traffic accidents, mainly. Such accidents can influence all three steps of the feeding process, and endanger the survival of the household when the victim is a parent, particularly in the absence of social security. The same applies to non-infectious and infectious diseases (the latter are discussed briefly below as phenomena, and in further detail in the section devoted to malnutrition and infection[6]).

2.2.2 Climatic environmental phenomena

Climatic environmental phenomena generally have the greatest consequences on the primary sector of the economy. Therefore, they affect primarily those who depend upon it for a living, and then those who depend on it through exchange. Some climatic phenomena owe their importance – even their existence in specific regions – to the deterioration and pollution resulting from the growth of human activity. It is therefore no longer easy to differentiate with certainty between climatic phenomena that are in fact natural accidents, and those whose origin is also human.

[5] See also Chapter XII, Section 1.7.

[6] See Chapter VIII.

Drought

Among natural climatic phenomena, drought causes the greatest number of nutritional crises. Combined with war – and, occasionally, non-human predators – it can be absolutely devastating, as seen in Ethiopia, Angola, Mozambique, Somalia and Sudan. Drought is first and foremost a climatic occurrence. These occurrences show three types of variation:

⇨ yearly variations, involving short time scales;
⇨ pendulum systems, where periods of relatively humid years alternate with other, relatively dry spells;
⇨ climatic change, which either develops over centuries or results from accidents (meteorites, solar spots or human activity as a whole), and can thus occur more rapidly.

An increase in the frequency of drought spells in sub-Saharan Africa has been observed since the late 1960s, but it is difficult to attribute this to a pendulum system or climatic change owing to persisting uncertainty as to the nature of global warming. It is however possible that we are witnessing climatic change aggravated by a pendulum movement. In northern Mali, some areas are completely dry yet contain shell residue; these areas accommodated permanent ponds until 1972, and have not contained water since. Terrestrial warming may have played a major part in this development. It must nevertheless be borne in mind that pendulum variations are considerable in the Sahel (10 to 18 years), while they are shorter in southern Africa, where dry spells do not exceed five years (Glantz, 1987). In Angola, since the early 1980s, the altitudes at which endemic malaria begins have been observed to be rising, thus indicating warming. Since the late 1980s, dry spells have also become more frequent, while they were previously unknown in the country. In Mozambique, an old traditional leader stated in 1992 that for the first time in his life he had experienced three consecutive dry years, and that he intended to modify his safety mechanisms accordingly. Drought can also result from human environmental over-exploitation, particularly deforestation.

Most frequently, populations are prepared for climatic variability, and have introduced cultural safety mechanisms to respond to it. However, at the negative extreme of a pendulum phenomenon, or when the frequency and intensity of variations abruptly exceed the norm, cultural mechanisms can prove insufficient. A famine is likely to develop in the absence of timely governmental and humanitarian intervention. When war combines with this type of situation, famine obviously becomes difficult to avert, as local authorities frequently lack the means or the will to intervene, while humanitarian agencies often face major acceptance and security challenges.

In semi-arid areas, drought is a relatively frequent feature, for which people are usually prepared because the rainfall variability is up to 30% around the annual mean. Therefore, the frequency and/or intensity of the phenomenon must be excessive to give rise to crisis. Usually, climatic or agronomic data cannot offer this threshold – it is indicated rather by the economic and social behaviour of the victims, as well as the terms of trade prevailing on the market. As a result, in most cases one cannot predict a nutritional crisis from an isolated drought episode, or from the episode considered at the moment of the enquiry. It must be placed in the context of past episodes, in the prevailing economic context, and be observed and analysed through the eyes of those experiencing it. In some cases, years of reasonably serious drought are required to precipitate famine; in others a single episode will suffice, as was the case in Irian Jaya in 1997, following El Niño.

Moreover, while exceptional droughts, sometimes combined with war or other deleterious phenomena, can be the predominant cause for nutritional crises, the social, cultural demographic, economic, political and ecological context also plays a major part. The resulting vector can differ substantially from what the drought episode, considered in isolation, may have suggested. It is therefore possible for a seemingly minor drought episode to launch a crisis, while several consecutive droughts may not.

Floods

Floods result from abnormally abundant rainfall saturating the soil's absorption capacity, or from spates provoked by rainfall or erosion upstream, sometimes very far from the flooded area. Generally, flood is less of a crisis factor than drought, although this depends on duration, the time of year, the speed of the waters and the available means to confront it and mitigate its effects. In Somalia, floods in the Shabelle and Juba River basins usually have serious consequences because they occur during the main planting season in a geographic (and sometimes political) environment that is unfavourable to efficient intervention. Paradoxically, flood often follows drought: firstly because the latter can be followed by abnormally abundant rainfall, secondly because drought hardens the ground and thus fosters surface flow. Floods, like drought, can also result from human activity, such as deforestation upstream, which causes erosion and significant runoff, in turn provoking unusually fast and large spates.

Hurricanes

Hurricanes are less frequent than drought and floods, and their consequences are usually more short-lived. More frequently, the danger arises from the risk of injury. Nevertheless, hurricane Mitch, combined with torrential rains, has demonstrated the high damage potential of such phenomena; they can push large areas into precariousness, thus increasing the danger of disaster related to any aggravating phenomenon.

2.2.3 Phenomena linked to non-human predators

Predators of production activities

Man is increasingly his own worst predator; however today some societies and regions still fall prey, for lack of control capacity, to predators that can massively threaten agricultural production, be it in the form of crops or harvest. The well-documented devastating damage of locusts can result in famine. Similarly, some insects and caterpillars can destroy agricultural production, as observed in southern Sudan in 1989 and 1994. Birds are likewise feared, particularly in areas where millet and sorghum are staple crops, because the ripened grain is literally proffered to the birds. Great flights of birds, similar to cricket swarms, can in fact be observed. Insects and rodents also attack the harvest once it is stored, and can cause significant losses that seriously weaken the economy. Predators of animals can also endanger the pastoral economy: nowadays, those are mainly epizootics caused by parasites and infectious diseases affecting livestock.

Predators of man

In the food relations of ecology, man is indeed a formidable predator and destroyer, but he also accommodates predators who threaten to kill him through viral, bacterial or parasitic infection. Illness therefore also plays a major part in triggering nutritional crises. Those of specific concern to humanitarian intervention include infectious diseases, owing to their potentially devastating consequences on entire communities. Diarrhoea and infant diseases can cause individual nutritional crises: infection, anorexia, malnutrition, etc.[7] But they also influence maternal health, as the natural

[7] See Chapter VIII, Section 2.4.6 dealing with malnutrition and infection.

reaction to high infant mortality is an increase in birth rate, for which women pay the highest price. Illnesses first modify the consumption and biological utilization of food. However, they lead to an alteration of the functional capacity of the organism, which can impair performance in securing food. Malaria, river blindness (onchocercosis), sleeping sickness (trypanosomiasis), tropical sores (leishmaniasis or *kala-azar*), cholera, not to mention HIV/AIDS are illnesses that not only seriously undermine the household economy, but also, when they reach epidemic proportions, threaten to hinder the overall economy. Epidemics thrive in concentrated populations and deteriorated living conditions.

2.2.4 Geophysical environmental phenomena

Geophysical environmental phenomena – such as earthquakes, volcanic eruptions and tidal waves – are brutal occurrences that can cause many casualties both human and infrastructural in mere seconds. Governmental and humanitarian response, in terms of nutrition, is usually required and significant for only a very brief period immediately following the catastrophe and until its survivors have recovered from the initial shock. Thereafter, recovery programmes – or resettlement and integration elsewhere, if the area is so badly affected that it precludes permanent human dwelling – become more important. Such phenomena do not themselves lead to famine, but may impoverish populations that must resettle or have lost their assets to the point of dependency and poverty.

The review of the various phenomena directly causing nutritional crisis indicates that many raise the propensity to crisis by creating or increasing vulnerability, and by paving the way for other phenomena. Furthermore, these phenomena can combine in many ways to exploit both existing vulnerability, and the vulnerability they cause. All these phenomena do not necessarily amount to an aggression but may turn into one as defences fail, prevention proves ineffective, non-existent or impossible, and when alternatives and reserves diminish. The evolution of the crisis process therefore depends on the time required for this failure, ineffectiveness and diminution to be evident.

Generally speaking, phenomena triggering nutritional crises can:

- ⇨ vary in nature;
- ⇨ combine together and exploit existing vulnerability;
- ⇨ attack diverse entities;
- ⇨ affect several activities within the feeding process;
- ⇨ have a trickle-down effect by opening the way for new phenomena, by themselves growing, or by generating new types of vulnerability;
- ⇨ have multiple and different impacts according to the type of vulnerability they encounter;
- ⇨ take advantage of several types of vulnerability.

2.3 *VULNERABILITY*

Vulnerability expresses the susceptibility or weakness of a given entity confronted with aggression, and indicates a deficiency rather than something tangible. Indeed, for a phenomenon not to constitute an aggression, a system must preclude it from occurring by preventing or destroying it; or it must be evaded while relying either on the means to wait for it to end, or on activities which do not provide it with a hold. As a result, vulnerability that provides a hold for the phenomenon arises from the absence of preventive measures, and the inadequacy or lack of defence mechanisms, reserves, and/or alternatives. Vulnerability is relevant only with respect to the presence of risks, that is, the probability of an aggressive phenomenon manifesting itself and undermining the affected entity. Vulnerability is therefore proportional to these two probabilities. Similarly, it makes sense only with respect to the nature of its relation to events. Thus, vulnerability must be qualified. Economic vulnerability is only meaningful in relation to phenomena which can generate an aggression on the economy. Furthermore, if one can qualify vulnerability, and demonstrate the existence of a threshold beyond which the phenomenon will produce an impact, then it follows that below this threshold the system is not vulnerable. The concept of vulnerability is thus relative to the magnitude or scope of the aggressive phenomenon, and fluctuates with it.

In short, the vulnerability of a given system is directly proportional to the probability of a phenomenon arising that affects it, and to the magnitude of the aggression. It is inversely proportional to the system's resilience to the aggressive phenomenon. This can be expressed as follows:

$$\textbf{vulnerability (\%)} = \textbf{phenomenon probability (\%)} \times \frac{\textbf{aggression} - \textbf{resilience}}{\textbf{aggression}}$$

A 100 % vulnerability indicates that the phenomenon will occur, that resilience is negligible, and that the aggression will thus have maximum impact. If resilience is greater than the aggression, vulnerability becomes negative and thus indicates safety with respect to the phenomenon. A 0 % vulnerability indicates either that the phenomenon is unlikely to occur, or that resilience is equal to the aggression. Such an equation is difficult to quantify accurately, as is the crisis equation. Nevertheless, it facilitates the analysis of the main aspects of vulnerability and their relative importance.

Taking the same approach as for phenomena in the previous section, we shall now discuss the different types of vulnerability by relating them to the three stages of the feeding process.

2.3.1 Nutritional vulnerability

In human nutrition, "vulnerable groups" is a common concept. It encompasses small children, pregnant and lactating women, sick people and the elderly, in the context of nutritional vulnerability. Indeed, within the population, these categories or groups are the most vulnerable to malnutrition, but their vulnerability is universal because its nature is above all physiological.[8] However, restricting nutritional vulnerability to physiological vulnerability indicates a narrowness of mind which, combined with other controversial issues, can have serious consequences on humanitarian intervention (Mourey, 1995; Mourey, 2002).

Physiologically vulnerable groups are the same everywhere; however, the members composing such groups do not necessarily all suffer from their vulnerability, far from it. It turns out that those who suffer from it have an individual vulnerability by far superior to the norm and/or they belong to areas, communities, groups or households experiencing ecological, economic, social, cultural or political types of vulnerability before physiological vulnerability. Specifically, one can differentiate societies by the following distinctive features regarding the prospect of malnourishment for the physiologically vulnerable (sometimes the entire population):

- ⇨ the capacity of the productive means to satisfy essential economic needs and, thus, secure food;
- ⇨ hygiene, water and habitat conditions;
- ⇨ access to health services;
- ⇨ the level of care devoted to dependants, specifically the attention given to small children.

[8] See Section 2.3.7 in this Chapter.

In other words, economic capacity, the natural environment, the level of development, culture and the political environment are all determining factors in distinguishing between societies with respect to their nutritional vulnerability. This shows that vulnerability types vary significantly in human nutrition. In crisis, it is not uncommon to encounter several of these vulnerability types, which can combine and lead to tragic outcomes. As a result, the observer concerned by the nutrition of communities must set himself apart from what is traditionally referred to in nutrition as vulnerable groups, if he wishes to understand the concept of nutritional vulnerability as a whole. He must first seek possible vulnerability types related to the distinctive nutritional (and, more generally, lifestyle) features of the society under scrutiny before investigating physiological vulnerability. The latter is to be found everywhere, but will manifest itself more or less strongly depending on vulnerability types located earlier in the feeding process.

To reinforce the notion of diversity and multiplicity of vulnerability types, it must be remembered that – for a phenomenon to qualify as aggressive and cause crisis – two different vulnerability levels must necessarily combine, whatever the affected activity:

⇨ the inability to prevent or evade the phenomenon;
⇨ the inability to confront or evade the impact of the phenomenon once it has occurred, for lack of resilience.

Generally speaking, regarding the three steps of the feeding process, the main vulnerability types are linked to the following dimensions.

1. In terms of **obtaining food**, vulnerability is linked to:
   - → poor health, affecting functional capacity;
   - → poverty, being the opposite of economic resilience;
   - → war, which can influence all factors determining economic performance;
   - → the level of domestic development, which determines the capacity of the economy to perform on the international market;
   - → the type of government, which chooses what assistance to extend in case of harmful phenomena affecting the overall economic performance of communities or regions;
   - → climate, influencing harvests, hunting and collecting, and fishing activities;
   - → lack of integration or social support, undermining resilience;
   - → production activities, depending on the nature of the aggressive phenomena;
   - → dependency on institutions (prisons, hospitals) for access to food;
   - → cultural practices, when they lead to passivity or deleterious reactions towards new phenomena.
2. In terms of **food consumption**, vulnerability on the one hand ties in with other types of vulnerability occurring before and related to the obtaining of food; on the other, it results from poor health (reducing appetite), but also from the neglect of dependants (in terms of care and food), particularly children and the elderly. Poor health, as well as sub-standard healthcare can stem from different types of vulnerability (see below). Furthermore, persons living alone are vulnerable because, more often than not, they deprive themselves of, or are precluded from, a favourable social environment: those particularly affected are the elderly, social cases and addicted persons (alcohol, drugs). Changes in lifestyle can also result in vulnerability in terms of food consumption: the elderly, increasingly idle and lonely, teenagers and students breaking out of the family circle, displaced persons who cannot (or do not know how to) take advantage of existing resources, impoverished populations who cannot adapt to an inferior lifestyle, and migrants. Finally, access to new, unfamiliar types of food that are not always healthy but are appetizing and can lead to real dependency phenomena, is also a source of vulnerability.

3. In terms of **the biological utilization of food**, vulnerability arises from other types of vulnerability occurring before and related to the obtaining and consumption of food, and from poor health condition (impaired functions of the organs and metabolism).

Clearly, the higher (i.e. earlier) in the feeding process the vulnerability is located, the greater the probability that it will be faced by many; whereas vulnerability related to dysfunctions of the metabolism and located further down (later) in the process rather affect specific individuals, even exceptional cases. This trend should, nevertheless, not be regarded as an absolute rule.

2.3.2 Political vulnerability

Political vulnerability is related to the risk of conflict, repression or discrimination, the lack of appropriate measures to arrest the crisis process, and disregard for the provisions of international humanitarian law and other legal instruments aiming at securing acceptable living conditions for man. It also relates to the inadequacy of services which usually depend on the political system functioning properly, such as public transport, and health and education services. Deficient transport leads to economic vulnerability; poor health services result in physiological vulnerability, and inadequate education services cause social vulnerability, *inter alia*. Political vulnerability can promote all the above phenomena, and its mere existence can influence the entire feeding process.

2.3.3 Economic vulnerability

Commonly, economic vulnerability allows phenomena to undermine economic productive activities and their yield. It can be caused by human and natural phenomena, as described above. It can influence human groups or entire regions, depending on whether the phenomenon affects geographic zones or specific productive activities. This type of vulnerability is inversely proportional to the household's means of production and resilience. It influences the securing of food and, thereby, the following stages of the feeding process directly, but it can also modify the attention given to dependants, access to health services, and hygiene, with indirect repercussions on the consumption and biological utilization of food.

2.3.4 Ecological vulnerability

Ecological vulnerability is shaped by the environment's support capacity, and to the danger of environmental hazards. The environment's support capacity is inversely proportional to the intensity of production activities exploiting it. Environmental hazards such as drought, locusts or endemics like trypanosomiasis weaken the productive capacity as well as the organism. Ecological vulnerability often accompanies economic and physiological vulnerability, and can thus affect the feeding process as a whole.

2.3.5 Social vulnerability

Social vulnerability generally refers to the weakness of individuals, households or groups, due to ignorance, isolation or behaviour, and diminishes them within a society by, for example, excluding them from solidarity mechanisms and preventing them from countering aggression adequately. However, social vulnerability also arises from dependency on external assistance for survival. This is obviously the case of small children, the sick and the injured, the elderly who have lost their financial independence, and the disabled. Furthermore, women face social discrimination in most cultures: this vulnerability is social rather than cultural, because discrimination against women is usually a feature of human society, whatever the culture. Cultural vulnerability can however be an aggravating factor, depending on the region and lifestyle.

2.3.6 Cultural vulnerability

In cultural vulnerability, inadequacy in responding to phenomena results from economic, educational, legal or political practices inherent in the culture in question, that is, the acquired behaviour specific to a society or community. It is, for example, the absence of norms regarding the exploitation of given secondary resources, which can nonetheless become vital in case of difficulty; behaviour types transmitted through education which can arrest development and creativity, or weaken the attention given to dependants (e.g. harmful weaning practices); the lack or inadequacy of community solidarity mechanisms, obscurantist traditional beliefs; institutions, practices or individuals, the respect for which can prove harmful when it is time to confront aggression; ostracism against individuals with specific defects (physical or psychological), or who have deliberately or unwittingly breached codes of conduct. But cultural vulnerability is also an expression of difference which can generate unease or envy, and can become a pretext for abuse and discrimination, even extermination.

2.3.7 Physiological vulnerability

Physiological vulnerability has been discussed above. With respect to nutrition, it concerns higher than average food needs, and susceptibility to illness, particularly infectious diseases. It is aggravated by inadequate access to healthcare, be it due to lack of resources (economic vulnerability at household level), or because the latter are inappropriate (political vulnerability at society level). The combination of malnutrition and infection increases physiological vulnerability, precipitating crisis towards disaster. It should be noted that, in every society, some individuals are particularly vulnerable from a physiological perspective; they constitute the customer base of any health structure, and are particularly prone to developing complex pathologies, combining malnutrition and infection. Such persons thus face individual nutritional crises, which must not be confused with a signal of emerging crisis potentially affecting the entire community. Moreover, physiological nutritional vulnerability among infants refers to different nutritional needs than for adults. Indeed, the energy requirements per kilogramme of body weight are higher for children than for adults. Children's protein needs are lower per consumed energy unit, while the requirements in essential amino acids are greater, owing to the greater speed of protein turnover. It is therefore necessary to specify in what way the nutritional requirement of small children is greater than that of adults and aggravates their relative vulnerability. This avoids prejudices, such as are used to justify in part selective supplementary feeding programmes.[9]

2.3.8 Psychological vulnerability

Psychological vulnerability refers to the quality of the socio-cultural environment and the amount and magnitude of stress. The socio-cultural environment largely determines a group's resilience and self-confidence. Stress also plays a major part in determining reactive capacity. At the inception of a stressful event, this capacity can be undermined by the refusal to face reality, just as much as it can be stimulated. On the other hand, if stress is too severe or protracted, post-traumatic disorders can follow, undermining or destroying the reactive capacity. This can influence the entire feeding process directly or indirectly, particularly for those who rely on psychologically affected persons, for example children in war.

[9] See Chapter XIV.

2.4 IMPACT

In view of the large variety of phenomena and types of vulnerability from which they can arise, impacts are relatively easy to understand. Indeed, they manifest themselves very materially with respect to the feeding process.

2.4.1 Difficulties in obtaining food

- ⇨ Low food availability within the society, which often results in a rise in the price of essential commodities (additional impact).
- ⇨ Insufficient economic production at household level, indicating an inadequate economic performance.
- ⇨ Losses before and after the harvest.
- ⇨ Loss of reserves through excessive sale, consumption or looting.
- ⇨ Impoverishment resulting from the use of reserves to cover essential needs (due to an inadequate economic performance).
- ⇨ A negative change in the management of time – particularly if more time is required to produce the same result.
- ⇨ Market disturbances due to shortages, infrastructural damage and transport malfunctions alike.

2.4.2 Problems in food consumption

- ⇨ Insufficient food consumption, owing to shortfalls in the obtaining of food, discussed above.
- ⇨ Disturbed eating habits, owing to changes in the availability of food products, the available time for the preparation and sharing of food, and weaning practices.
- ⇨ Lack of means and knowledge regarding the care of dependants, because changing circumstances impose unfamiliar or inapplicable measures.
- ⇨ Exposure to infectious disease and the lack of healthcare due to modified living conditions.
- ⇨ Health problems affecting food consumption.

2.4.3 Problems in the biological utilization of food

- ⇨ Inefficient biological utilization of food, owing to reduced and inadequate food consumption.
- ⇨ Disturbed biological utilization of food, owing to insufficient intake and damage to the system.

2.5 IMPORTANT ASPECTS OF NUTRITIONAL CRISES

2.5.1 Diversity and complexity

Nutritional crises can be diverse and sometimes quite complex in nature, for the following reasons:

- ⇨ the feeding process comprises three distinctive steps, themselves reflecting a combination of specific activities – inadequate performances within the process can therefore be manifold;
- ⇨ the inadequate performance of a given activity can have a trickle-down effect on activities following it in the process, as well as affecting those occurring before;
- ⇨ many different phenomena precipitate crisis, and often combine to do so;

⇨ types of vulnerability are just as numerous and varied – they interact and often aggravate one another as damage accumulates;
⇨ negative impacts, and the resulting problems and damage which define the seriousness of the situation vary according to the magnitude and nature of the phenomenon and vulnerability;
⇨ response can take many different forms, depending on resilience,[10] and is part and parcel of the crisis process;
⇨ the evolution of the crisis process is determined by resilience, the appearance of new, potentially aggressive phenomena, the degree of vulnerability with respect to these new phenomena, and external intervention to arrest the crisis process;
⇨ depending on its evolution, crisis can be extremely short-lived, or protracted.

The vertical and horizontal interaction of several phenomena and different types of vulnerability, and their dynamics justify specific analysis for each and every specific crisis. Impacts accumulate, contingent upon the number of phenomena and vulnerability types involved in the process, directly causing a deterioration of the crisis, as illustrated in Figure 7.4 above. Figure 7.5 below summarizes the diversity of possible causality effects in nutritional crises.

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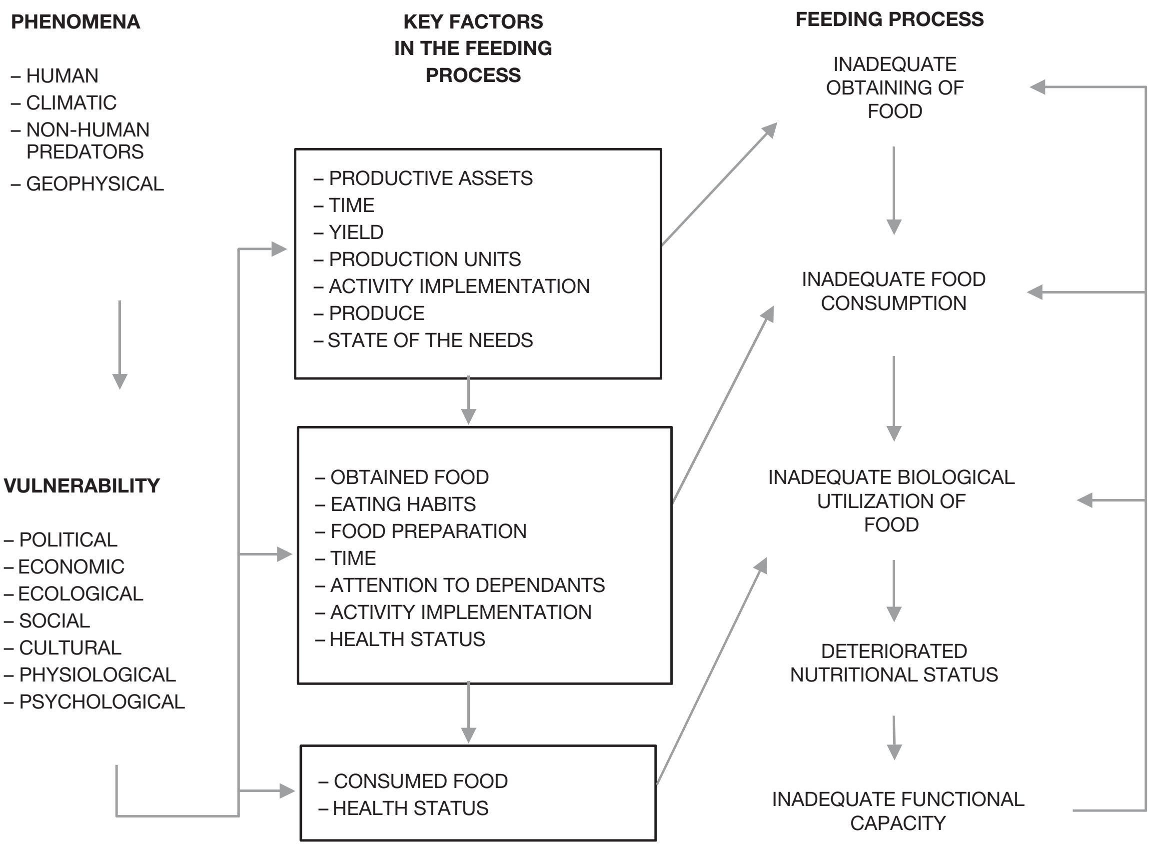
Figure 7.5 Causes and effects in nutritional crises



[10] As defined in Chapter VI, resilience is the capacity to resist an aggression or a force. In human nutrition, it amounts to the activation of safety nets to restore an adequate performance, be it at the level of the economy, social interaction or the organism. Resilience is also discussed in Chapter VIII, in relation to famine.

Because of the diversity of cause and effect phenomena, there can be no such thing as a "typical" nutritional crisis. A severely wasted individual suffering from tuberculosis, a widow supporting five children who must choose between tending her crops and working for someone else to feed her family, a population facing drought and war are three examples of nutritional crisis. They illustrate the fact that attempting to reach a definition leads to the problem of being either excessively vague (so as to include all possible crisis parameters), or overly specific.

2.5.2 Numbers

In the humanitarian world, referring to victims in numbers is significant in defining the crisis itself, because it serves to justify intervention. Indeed, when a crisis affects only a limited number of households or individuals, it is likely that the resources required to address it will be found locally. This is no longer the case where crisis strikes large segments of the population. But the use of numbers is also contingent upon the parameters of the crisis, and is subjective in nature as it depends on the intervening agency, its mandate and the political environment.

2.5.3 Nutritional crises and malnutrition

To conclude, the effect of aggression on the food process is sometimes analysed according to the nutritional status of individuals or selected groups, giving an idea of the overall performance of the process. From this angle, nutritional crisis refers to malnutrition – being the last stage before death experienced by victims of dysfunctions in the food process. This approach to nutritional crises through malnutrition ignores the fact that some event has preceded malnutrition, and that it has caused problems that might have been resolved in a more timely fashion. It also ignores the fact that intervention, if it is to justify its humanitarian label, must not only alleviate suffering, but also pre-empt it.[11] In practical terms, it is therefore unacceptable to restrict analysis to the performance of the food process *via* its result. One must, at the very least, consider the performance at each step of the process, and that of the crucial activities of each of these steps.

2.6 *NUTRITIONAL CRISIS ILLUSTRATED*

The following example illustrates the application of the formulation of the mechanism of a crisis.

For farmers relying on subsistence agriculture in an area where production alternatives are limited, where agriculture is essentially restricted to a monoculture vulnerable to water shortage, the impact of a major drought will be negative by significantly depleting production. The most probable response will be to resort to resources intended to face the situation which, however, is probably not yet abnormal. If it is followed shortly by other dry spells, reserves are depleted and the abnormal frequency of drought becomes a phenomenon. Vulnerability to the phenomenon is illustrated by the plant's poor resilience to the lack of water, and impact is a production shortage. The latter translates into damage, being a net loss of resources. This loss constitutes a problem precipitating the crisis for those who can no longer compensate, that is, those lacking:

[11] See Chapter IX on humanitarian ethics.

- ⇨ alternative types of production providing access to food resources;
- ⇨ edible or exchangeable reserves accumulated prior to the drought;
- ⇨ social obligations allowing them to subsist until the following harvest.

Such individuals face destitution. They show the second level of vulnerability (vulnerability to the impact), which is an economic vulnerability characterized by an excessive reliance on a climate-sensitive crop. They therefore face a crisis situation.

Their destitution increases their vulnerability, on the economic, social (they face isolation due to their misfortune or social status), and physiological (lack of resources restricts their access to healthcare) fronts.

Moreover, impact (production shortage) is observed to turn into a new phenomenon in combining with economic vulnerability. It then manifests itself in a new impact, being destitution. In turn, the latter acts as a phenomenon in encountering economic vulnerability, and its impact leads to a utilization of the reserves of the organism, ultimately causing malnutrition, with an increase of physiological vulnerability. This spiral can persist until the exhaustion of the reserves of the system, or until a contagious disease (new phenomenon) combines with physiological vulnerability to cause death of the system, this being the final impact of the evolution of the crisis process.

This example shows that, owing to the multitude of cause and effect phenomena, crisis is characterized by increasingly numerous and accumulating problems, resulting in an increasingly significant deterioration of the situation, which can end in disaster. Moreover, the crisis itself can go through different stages of seriousness (for example, by involving a growing number of individuals); one may also observe periods of respite depending on the time between the emergence of new phenomena, new types of vulnerability, and the resulting impacts.

It will also be noticed that the crisis develops according to the process described above. The preliminary phase begins when a second dry spell follows shortly behind the first drought, and so on, until relying on existing reserves can no longer deal with such an event. If nevertheless this then occurs, acute crisis – the crisis as such – begins; in the above example, the crisis does not develop into the recovery phase, but towards disaster. Whether acute crisis develops into recovery or disaster depends directly on external intervention. If external assistance is extended during the preliminary phase, it would prevent the exhaustion of reserves and provide safety in facing another abnormal drought episode; it would thereby limit damage. If assistance is delayed until the acute phase of the crisis, it encounters already highly impoverished individuals, possibly already facing problems related to the consumption or biological utilization of food. This is where the gamble – or the dilemma – arises with respect to intervention: is it preferable to intervene early during the preliminary phase, thus risking waste of resources if the drought is not repeated (this is however not the case for the recipients, who will be able to replenish their assets faster)? Or should the next drought episode be awaited to ensure that measures decided on are absolutely indispensable, at the cost, however, of greater damage to the victims? This issue is discussed in Chapters IX and XI.

CHAPTER VIII
THE PATHOLOGY OF NUTRITIONAL CRISIS

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CHAPTER VIII
THE PATHOLOGY OF NUTRITIONAL CRISIS

INTRODUCTION

The previous Chapter discussed the preconditions for nutritional crisis, in addition to providing a definition; it showed that crisis can affect groups or individuals in different ways, depending on the type of phenomenon affecting the nutritional need or the feeding process. This Chapter discusses the pathology resulting from nutritional crisis.

Disorders that appear within the food securing phase indicate damage to the household or group economy. Problems that arise during the food consumption phase may suggest earlier disorder – e.g. in the food securing phase – which can alter eating habits and reduce the availability of food; but it may also result from illness or family cell dysfunctions because of lack of means, time, motivation, or ignorance. Ignorance is understood here in its broadest sense: a lack of knowledge regarding dietary balance or the specific care required by vulnerable groups, or compliance with deleterious rules, taboos, or methods that lead to imbalance and deficiency. Problems associated with the biological utilization of food imply earlier disorders, either during the food securing or consumption phases, but also in the individual health status.

Crisis that emerges during the food securing phase can cause scarcity and famine. It rarely affects single households, but usually entire socio-economic groups and regions. If it occurs during this phase, it logically also affects the following two phases of the feeding process (i.e. the consumption and biological utilization of food), and may prove fatal.

Whatever its cause, crisis occurring primarily in the food consumption phase or in the biological utilization phase sooner or later causes nutritional disorder.

The review of famine and nutritional disorder reflects the full spectrum of nutritional pathologies, which can take on epidemic proportions; it is this pathology that humanitarian agencies are usually expected to address, both in prevention and cure.

1. FAMINE

1.1 INTRODUCTION

Famine is the most classical type of nutritional crisis. The definition of "famine" nevertheless remains hazy. This is no doubt because, although all famines result from a serious and protracted deficiency in the securing of food, the process resulting in this situation, as well as its severity and prognosis vary considerably. The process is determined by aggressive phenomena and vulnerabilities, resilience and the timeframe set by economic performance. Its severity is determined by the magnitude of the food access deficiency, its duration, and aggravating factors such as displacement, deficient water and habitat hygiene, inadequate access to healthcare, exposure to contagious diseases, frayed social ties, and emotional trauma (particularly affecting the mother and child bond). The severity of the problem clearly shapes the prognosis. As a result, some famines cause millions of victims, while others are closer to scarcity or chronic malnutrition. One question is the subject of much debate: does the epidemic mortality that is characteristic of some famines result mainly from malnutrition, or rather from transmissible diseases that are exacerbated by deteriorated living conditions and social disintegration? This question is important to humanitarian operations that cannot view famine only as a food shortage to be addressed through food distributions, especially where risks of epidemics exist (this is not always the case). Whatever the circumstances, relevant humanitarian intervention cannot restrict itself to addressing the most obvious symptoms; it must attempt to address all the disorders that threaten the survival of victims, and as early as possible in order to limit suffering and avoid having to remedy it at a later stage. This concept assumes the availability (allowing for possible constraints) of all the means necessary for a global approach to problems and their prevention.[1]

1.2 DEFINITIONS

As mentioned earlier, the definition of famine remains hazy. The commonest definitions are:

⇨ *"Extreme and protracted shortage of food, causing widespread and persistent hunger, emaciation of the affected population, and a substantial increase in the death rate".* (Encyclopaedia Britannica, 2006).
⇨ *"Extreme scarcity of food".* (Oxford Dictionary, 2000).
⇨ *"Extreme food scarcity: a severe shortage of food resulting in widespread hunger".* (Encarta, 2005).
⇨ *"A regional failure of production or distribution systems, leading to a sharp increase in mortality due to starvation and associated disease".* (Cox, 1981).
⇨ *"A series of increasingly desperate actions by people to obtain food".* (Seaman and Holt, 1980; Sen, 1981; quoted in D'Souza, 1988).
⇨ *"A reduction in normally available food supply such that individuals, families, and eventually whole communities are forced to take up abnormal social and economic activities in order to ensure food. If these activities are unsuccessful, then starvation will follow".* (D'Souza, 1988).
⇨ *"Alongside the obvious manifestations of hunger, a more insidious form exists, which is usually termed misery but is, in fact, a state of chronic famine affecting entire populations of the third world and various groups in the industrial world, whose members face permanent dietary shortage, both in quality and in quantity. This chronic famine is associated with repartition that is dictated by economic and financial concerns only, leaving the response to excessive distress to public charity".* (Encarta Encyclopaedia 97, 1993–1996).

These definitions invite a number of comments.

1. **Food shortage**
Food shortage is an ambiguous concept: is food lacking in the absolute sense, or rather is it inaccessible to the affected population (because it is unaffordable or for any other reason such as crops are growing in a conflict/mined area) ? In fact, both are possible, and one does not exclude the other. It is therefore preferable to refer to an insufficient access to food, without attempting a more accurate definition.

[1] See Part III of this Manual.

2. **Victims suffer from hunger** (famine comes from the Latin *fames*, hunger)
   That the victims of famine suffer from hunger seems self-evident. However, an insufficient access to food can confer different meanings on hunger, depending on the magnitude of the shortage and the prospects for improvement. In scarcity situations, people suffer from hunger without necessarily fearing for their economic and physiological security. In the course of normal seasonal variations, it may be usual to go hungry for a given period – it is even sometimes a deliberate choice intended to preserve the household economy without serious penalty. In famines, suffering from hunger takes on a different meaning. This suffering results in abnormal and desperate behaviours that go well beyond the daily struggle for survival, even in conditions of extreme poverty or scarcity. These behaviours themselves contribute to the deterioration of the famine situation if its causes persist. Moreover, this suffering reflects a degree of widespread malnutrition to be found only in such situations, when all age categories show the symptoms of serious energy deficiencies, i.e. of Type II nutrients, sometimes combined with specific deficiencies.[2]
3. **Widespread mortality**
   Widespread mortality may indeed be a major characteristic of famine, distinguishing it from scarcity. But this mortality, however frightful it may be, varies significantly according to the cause of the famine, its duration, its severity, the associated risk of infectious disease, and the resilience of the affected population.
4. **Famine affects specific geographic areas**
   Famine is a regional phenomenon. On the other hand, nutritional crisis that affects individuals or households can be explained by inadequate access to food, suffering resulting from hunger, and one or several deaths. As long as the phenomenon is restricted to single individuals or households, it is not famine, even if the affected individuals may consider it to be so. The expression famine refers strictly to the fact that a significant proportion of the population living in a given area suffers from serious hunger (whatever the size of the area under consideration) – corroborating the fact that famine is a collective phenomenon.
5. **Duration**
   The process resulting in famine is undoubtedly lengthy. The concept of duration is questionable however, because it is not a precondition for famine. When a famine is said to be protracted, reference is being made to the period during which its victims have been suffering from hunger. Famine may in fact develop rapidly, depending on the severity of the lack of food access. For example, a general strike in the transport sector of a capital city could cause famine within weeks, and result just as quickly in massive mortality if supplies do not resume. In the 1980s, population groups of the Angolan Planalto were displaced abruptly (in less than one day) and were cut off from their resource base accordingly; it was impossible to assist them, and severe malnutrition became general within six weeks.
6. **Collective dimension**
   Widespread mortality and the regional dimension both suggest that famine affects a significant proportion of the population of a given region. If these two concepts are accepted, then it follows that famine is a collective phenomenon.
7. **Cause and effect**
   Famine results from a chain of causes; but the expression famine suggests the inevitable, and thus encourages fatalism when it would in fact be possible to address its causes.
8. **Causes of mortality**
   The mortality associated with famine is much discussed: does it really result from malnutrition, or rather from disease? The mortality caused by disease is clearly worse

[2] See Sections 2.2.1. and 2.5. in this Chapter.

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than usual in famines.[3] Similarly, the chaos surrounding many famine situations promotes the spread of infectious diseases such as typhus fever, cholera, tuberculosis, and measles. Generally, the first to die are the more severely malnourished; in many famines, in fact, mortality is associated primarily with malnutrition. Mortality reaches its peak during the night or rainy spells, that is, in cold conditions. But it would be erroneous to conclude that cold is the killer in famine, and not malnutrition. Ultimately, death is caused by cardiac arrest. Whatever the immediate cause for mortality in famine, malnutrition is the underlying cause.

9. **Regional disruption of food production and distribution mechanisms**
The disruption of regional systems suggests a macro-economic approach to famine. But such systems may be of little importance, particularly in terms of distribution. The problem arises at a more individual level, through lack of the means to purchase food, for example because of speculation or inflation. This underscores the fact that famine results from an insufficient access to food.
10. **Increasingly desperate behaviour**
Famine has two fundamental characteristics in this respect: it is the culmination of a process (as suggested by "*increasingly*"), and the economic disorder is eclipsed by the biological problem, which usually aggravates the economic disorder. Desperate behaviour replaces a conduct intended to preserve economic self-sustainability with biological survival reflexes, induced by the suffering related to acute and protracted hunger, and by the absence of alternatives. If famine is indeed associated with increasingly desperate conducts, then it follows that famine is a process and not a situation.
11. **Abnormal economic and social behaviour**
The previous Chapter has shown that an unusually strong (in duration or magnitude) aggression provokes an insufficient or abnormal response. This is no doubt the crux of the famine problem. Abnormal economic and social behaviour suggests the existence of a famine process; urgent action is thus required in order to prevent the otherwise inevitable economic, social, physiological and psychological consequences. Assessment must highlight such abnormal behaviour or, better still for prevention purposes, the phenomena whose impact may lead to abnormal behaviour. Abnormal behaviour is discussed under Section 1.4 below.
12. **The chronic and usually unnoticed misery of a significant proportion of mankind**
Authors generally agree that famine is different from abject poverty and scarcity (Rivers, 1976; D'Souza, 1988); according to them, the difference lies in the social disintegration typical of famine that arises from the inability of cultural equilibrium mechanisms to cope with the situation. They claim that chronic poverty can be addressed through considerable social, psychological and physiological adaptation, enabling its victims to cope in spite of all. The use of the word famine in relation to such situations, however tragic they may be, is therefore inaccurate because their consequences are different, and humanitarian operations as such cannot address them appropriately. Scarcity on the other hand amounts to a more or less serious food shortage, but does not itself jeopardize the functioning of society; it can however lead to famine if the crisis is protracted or deepens.

[3] See Section 2.4.6 in this Chapter.

These remarks give a clear idea of famine, which must now be defined as a process or a specific situation resulting from a process. The word itself gives rise to a problem – which refers not to a process but to its result. Moreover, the word famine, like kwashiorkor, is common and – as noted by Sen – refers to an easily recognized condition, even in the absence of an accurate definition (Sen, 1981). This Manual takes the view that famine is the result of a process, and not the process itself. The following description can be derived from the aforementioned considerations.

Famine is the disaster stage of an evolving process. It affects a significant proportion of the population of one or several regions. Access to food for the affected population is grossly insufficient. As a result, the population suffers from hunger to the point of widespread mortality caused by starvation, often combined with infectious disease. Economic and social disintegration result from abnormal and desperate behaviour.

1.3 THE CAUSES OF FAMINE

Famine always results from insufficient access to food; its direct cause is therefore an insufficient performance in the securing of food. This direct cause itself has two underlying causes that may combine:

⇨ households cannot afford available commodities;
⇨ the availability of food is limited.

These underlying causes have their own causes (i.e. secondary causes):

⇨ household food production is insufficient or non-existent;
⇨ the hunting, gathering and fishing activities of households are insufficient or non-existent;
⇨ household food reserves are insufficient or exhausted;
⇨ the household purchasing power cannot secure locally available food:
  → either because prices are high owing to actual shortage or speculation, inverting the terms of trade between food and production or possessions;
  → or because the population no longer has enough resources, whatever the market price of commodities;
⇨ food is unavailable on local markets owing to isolation, structural damage or insecurity, whatever the purchasing power:
  → local food is unavailable, and the distribution network is sub-standard; the price of available food rises according to shortage, exposing the poor to famine; the problem then affects better-off households, depending on the duration and magnitude of the shortage – this is common in conflict situations, when markets cannot be supplied because transport systems are the target of attacks and the necessary infrastructure is damaged or destroyed;
⇨ food is absent from local markets because the overall purchasing power is insufficient to generate a sufficient demand to encourage distribution networks – assuming that food is available elsewhere and could be transported to the region affected by famine, and that distribution networks could perform if demand were attractive:
  → this is particularly common in rural subsistence zones, following harvest failure caused by drought, for example – production losses lead to an abnormally high dependency on local markets, while the absence of income, savings and reserves restricts demand and discourages the transfer of stocks from elsewhere;

- ⇨ local social obligation and mutual assistance networks have collapsed or are non-existent;
- ⇨ national famine prevention systems are inadequate, neglected or non-existent;
- ⇨ international solidarity has not yet translated into humanitarian action.

Secondary causes themselves result from tertiary causes directly associated with the phenomena, vulnerabilities and impacts discussed in Chapter VII.

Famine therefore results from cause and effect relations, and its possible causes are manifold. On the other hand, confirmed famine indicates that prevention efforts (if any) have proven inefficient; this cause is constant. In view of man's right to acceptable living conditions, famine nowadays is a bitter failure. It reflects the ambiguous side of human nature, which prompts man to lament such situations, while promoting them and finding excuses for inertia. However, in view of the world's current resources, there is simply no excuse for famine. It always results from deliberate action and/or lack of goodwill, and the denial of fundamental rights. Real famine is rare, and the cost of its prevention is negligible in comparison to the expenditure of wealthy economies in other sectors. As an illustration, the belated rescue operations prompted by media reports of advanced tragedy are usually more costly than the preventive means that could have arrested the process. Nevertheless it is not always possible in practice to act in time, even if the means are available.

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1.4 THE FAMINE PROCESS

Some famine processes are obvious, because their causes have rapid and clear consequences. Examples include the sudden displacement of populations who have lost all their belongings and depend entirely on outside assistance, and complete isolation such as that produced by a siege or a suspension of supplies, where food is no longer available, whatever the means to purchase it. In such extreme cases, the cause and effect relation is clear enough, and does not require further discussion. However, the commonest famine processes do deserve discussion; they pertain to a protracted economic counter-performance of production activities, which depletes both resources and alternatives. Such processes have brought about most of the major known famines of the 20th century, and can go unnoticed until resource exhaustion is considerably advanced. These processes must be identified in order to be arrested.

The famine process as defined here at once raises questions of predictability: the process is initiated whenever a phenomenon impairs the household economic performance, but it may not be irreversible because it stops as soon as improved conditions enable the affected households to recover. As a result, famine is rare in comparison to the frequency of aborted famine processes. For famine to culminate, a phenomenon must either destroy the household economy entirely and abruptly (these are extreme cases that do not warrant further discussion), or the duration and magnitude of a negative phenomenon (or of connected phenomena) combine with the existing and successive vulnerabilities of the economy resulting in an erosion of usable material resources to the point where only physiological reserves can cover the nutritional need. As mentioned above, efforts to stop the process must also have proven fruitless. Usually, when actual famine is close, the utilization of physiological reserves has already begun to compensate for the erosion of material reserves.

The famine process can be halted, provided that a spontaneous positive reversal of fortune or appropriate assistance can bridge the gap. Likewise, the process can develop in several stages, with stops, starts, and passing remission. Both reversibility and erratic development thus complicate the diagnosis and relevant action.

The famine process involves four closely connected entities:

⇨ **households, taken as physiological units** that must satisfy their nutritional needs, that is, cope with a constraint that is persistent, and cannot be reduced (or only slightly);
⇨ **the basic economic and cultural needs** that households must meet in addition to their nutritional needs – the former usually account for at least 20% of overall expenses, even in famine situations;[4]
⇨ **the economic household resources** to secure the food that is required to meet the nutritional need and other basic needs – economic resources eventually prove insufficient to meet these needs adequately;
⇨ **the food** required to meet the nutritional need and whose access is restricted owing to lack of means and/or availability.

Households can and must decide the use and allocation of their resources according to their constraints and priorities. On the other hand, they have no influence on the external forces that determine their economic performance and local food availability. The famine process thus arises from the uneven confrontation between households and such forces when they become detrimental, that is, when the basic household needs exceed the capacity of available means to satisfy these needs. Because the evolution of the famine process is usually difficult to anticipate, households must allocate their economic resources carefully. In other words, their objective is to survive as long as possible, and remain economically sustainable as long as possible in order to maximize their chances of recovery when conditions improve.

The famine process is thus typified by specific behaviour with respect to the use of economic resources when production activities can no longer cover all the basic needs. Such behaviour reflects individual priorities that may not match those of humanitarian agencies. A common example is provided by the opening of therapeutic feeding centres intended to save infants whose malnutrition contributed to the triggering of humanitarian action, in spite of possibly diverging priorities on the part of their parents (such as preparing the fields ahead of the next planting season, the guarantee for longer-term survival), making the parent's obligatory presence with the child impossible.

No two famine situations are identical, and the same comment applies to their lead-up. However, in spite of such variations, similar household behaviour patterns will be found: in their absence, thought must be devoted to whether the situation qualifies as a famine, or whether a specific element has escaped the analysis. Either way, the affected population is the soundest source of information, and can explain what may otherwise seem inconsistent to outsiders.

The famine process can be divided into four stages that may overlap: adaptation, impoverishment, capital loss, and starvation (see Figure 8.1 below).

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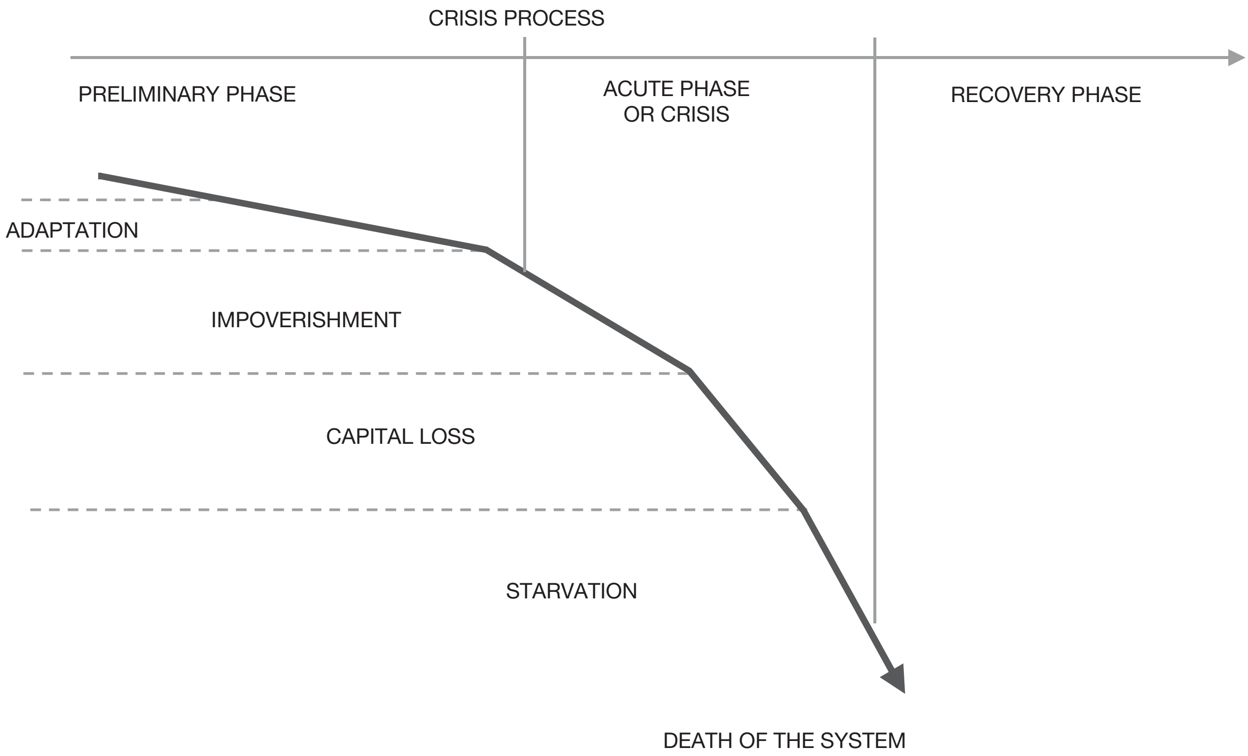
[4] See Chapter VI, Section 3.2.1.

Figure 8.1 The famine process



The famine process amounts to a crisis process, and the same type of illustration is thus applied to both; the illustration of the famine process however uses a terminology that corresponds to the use of economic and physiological resources, instead of the wording similar to the development of illness used in the crisis process.[5] The following stages have been defined.

1. **Adaptation** is the stage in which households modify the relative importances of their normal production activities, in order to maximize the overall economic yield when the normal main activities suffer a fall in yield. At this stage, reserves set aside in anticipation of production and market fluctuations are also used, and households avoid unnecessary expenses. The objective is to preserve a normal standard of living as much as possible. This stage does not warrant particular alarm, because adaptation takes place within the limits of what the culture considers to be normal variations of the factors that influence living standards. In rural areas, adaptation occurs almost every dry season, but is more acute when the previous harvest was less productive than expected.
2. **Impoverishment** begins when the factors that normally influence living standards change beyond what is culturally accepted as normal. It causes an increasing reliance on production activities that are considered to be minor or less appealing, the erosion of reserves intended to cope with usual production and market fluctuations, and the use of non-productive commodities that would otherwise be kept but must be disposed of for survival. Expenses are limited to the bare essentials. A controlled food restriction is usually normal and is often cultural, that is, it belongs to the habitual coping

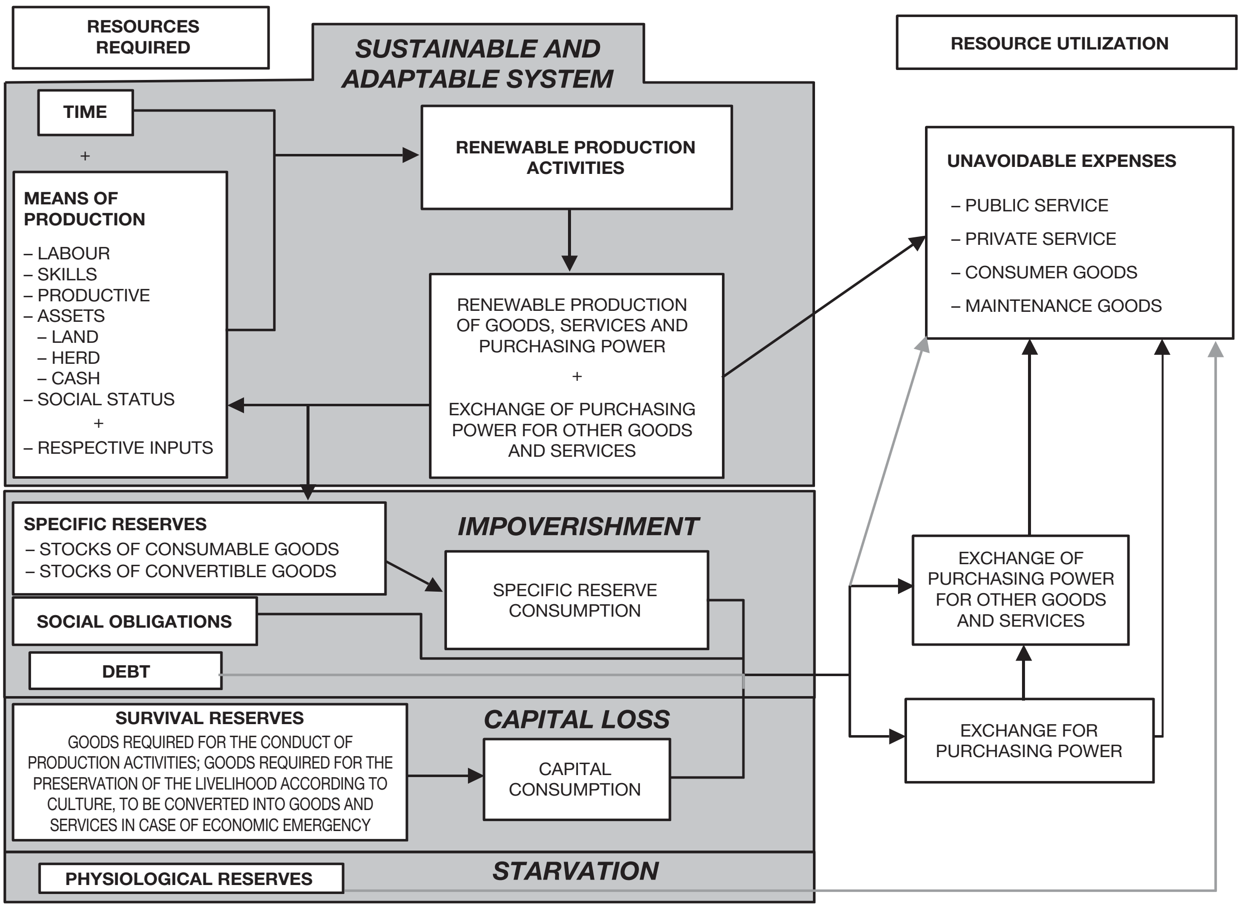
[5] See Chapter VII.

mechanisms of the society under consideration. Such a restriction may nevertheless begin to promote nutritional disorders, especially specific deficiencies. At this stage, community social obligation networks are invoked to their maximum because reciprocity is fully guaranteed. Households resort to credit in order to preserve their means of production. The utilization of resources is also subjected to the preservation of the means of production, with a view to economic recovery when circumstances improve.

3. **Capital loss** is the stage where households are forced to use all available means of production for survival, to sell or barter all remaining non-productive assets and, more importantly, the basic assets that enable them to lead a normal life and are thus converted into survival reserves. Such assets are those that contribute to economic production (means of production) in order to achieve sufficient renewable economic performance, such as land, tractors, herds, savings, and means of transport. But they also include utilitarian domestic assets such as clothing, bedding, furniture, cooking utensils, and housing. The loss of assets that are essential to survival leads to destitution. This change in the function of commodities that are required to lead a normal life is highly detrimental to the household economy. The sale of assets required for the conduct of renewable productive activities is an economically aberrant behaviour that finally dooms the normal economic household system: the exchange may produce some resources, but at the cost of independent production. The disposal of infrastructural household assets leads to precariousness, even vagrancy.
   In both cases, such behaviour reflects the urgent need to meet elementary requirements. It is the last economic resort to prolong life for a short time, but at exorbitant cost. Capital loss forcibly restricts food consumption, which becomes increasingly uncontrollable; this implies an erosion of the physiological reserves inducing nutritional disorder, and a functional inability to ensure both production activities and the defence of the organism. During this stage, social obligation networks are also severely tried and weakened, and are eclipsed by the survival of the household within its increasingly hostile environment in which reciprocity is no longer common practice. Likewise, social regulations lose meaning; social life formerly provided survival guarantees and thus encouraged compliance, but it no longer does. Social disintegration therefore follows economic collapse. Both are catalysts for famine. As from the capital loss stage, the famine process fuels itself from the desperate economic and social behaviour of those who are obliged to submit to it. Capital loss is the stage where survival is the overarching objective, at any cost.
4. **The starvation** stage amounts to famine strictly speaking. Victims exhaust their last physiological reserves, fully develop nutritional disorders and abandon their homes in search of hypothetical outside assistance. This situation leads to the all too frequent tragic images of endless lines of destitute people, the desperation and death camps in the Sahel, Cambodia, Ethiopia, Rwanda, Somalia and Sudan, to name only the most familiar. At this stage, family social obligations and the strength of family ties weaken (but not always), and the mortality associated with malnutrition and infectious disease becomes epidemic. It is unfortunately usually only at this late stage that the international community reacts, whatever the previous warning signals may have been.

The process described above amounts to an abnormal and increasingly desperate economic and social behaviour, which results in famine. Figure 8.2 below is adapted from Figure 6.14 in Chapter VI, and provides a model of household economic resources and their use during the famine process.

Figure 8.2 Stages of economic resource utilization during the famine process



The four stages of the famine process are in fact not as clearly distinguished in the use of resources. Overlaps exist, as mentioned above: food intake may be restricted in a controlled manner during impoverishment – this implies the utilization of physiological resources up until weight loss with only limited functional capacity loss (if at all). Assets such as food may also be set aside in anticipation of yet harsher times (amounting to speculation, and probably inducing a price increase). This saving howerer involves debt in order to face unavoidable expenses.

The most important aspect of this process is no doubt the fact that its victims look ahead, beyond the immediate needs of their stomachs, and what worries them more than hunger is the complete loss of their livelihoods, which is leading them to destitution and seriously affects their chances of recovery.

In short, the famine process is characterized by the shrinking of alternatives (or choices); this may be abrupt (owing to the confinement or displacement of populations) or gradual (drought extending over several successive years). This reduction in alternatives is caused by phenomena that aggravate vulnerability and whose impact in a chain reaction impairs economic production, specific reserves, survival reserves, and physiological reserves in the following sequence:

⇨ normal adaptation mechanisms fail, thus ending the adaptation phase;
⇨ resilience intended to preserve livelihoods in compliance with culture also fails, thus ending the impoverishment phase;

⇨ resilience intended to allow individual survival in compliance with physiological needs fails, thus ending the capital loss phase;

⇨ physiological reserves are the last resort, driving people to migrate in search of assistance; in the absence of such assistance, the starvation phase – frequently aggravated by infectious disease – results in death.

Poverty grows as the famine process develops. A critical threshold is crossed when people lose the means that normally ensure their self-sufficiency, precipitating them into destitution.

Furthermore, the famine process – marked by impoverishment and capital loss – creates dependency, and not only for food because their entire economy collapses. During the recovery phase, their usual basic economic needs, their assets lost in the course of the process, and their accumulated debt must all be compensated. Humanitarian operations, in order to achieve their goal, must therefore address all these parameters.

1.5 RESILIENCE TO FAMINE

Resilience to famine amounts to the ability to overcome aggressive phenomena that threaten the usual means of ensuring economic performance; more briefly expressed, it is embodied by coping mechanisms, which are activated during the first three phases of the famine process. They consist of the qualitative and quantitative adjustment of production activities, the invoking of social obligations, the utilization of reserves, resorting to credit, the restriction and modification of consumption, and the reduction of household dependants. When production proves insufficient, the application of these measures reflects the intention to optimize the coverage of unavoidable expenses while ensuring long-term survival. One of the most salient aspects of the chosen strategy is that mobilized resources can contribute differently to the survival capacity, depending on their present (and anticipated) exchange value for food. Females in a herd can be sold for grain at a given moment; but if they are not sold they can still produce milk and thus continue their significant and daily contribution to food consumption, and their offspring may contribute to the rebuilding of reserves in the following season. Choices and priority ranking always have significant consequences, and are complicated by the uncertainty of future developments. It goes without saying, therefore, that they rest on careful thinking and risk mitigation. Outsiders must exercise great care in interpreting observations, and ensure that the information provided by interlocutors as to their choices is pertinent.

1.5.1 The adjustment of production activities

When productivity drops substantially, the first reaction is an attempt to compensate the resulting loss by increasing production in minor sectors, or resorting to production activities that are normally unpopular because of their image or because they are gruelling. In other words, the full exploitation of all available production alternatives in order to maintain a sufficient economic performance; however, this is not always possible. Where feasible, it can be considered as a reversible adaptation to temporary stress.

1.5.2 Invoking social obligations

Social obligations are usually cultural mechanisms intended to assist community members who face economic difficulties to avoid destitution. Their strength varies according to society and circumstance. They flow from rich to poor through the conversion of surplus wealth held by the rich into commodities that are essential to the survival of the poor. Social obligation mechanisms are usually codified with a view to defining their reciprocity modalities. As a result, the appraisal of their contribution to survival should involve due consideration to their ultimate cost, and the extent to which they compromise the future of their recipient. In their extreme form of charity, social obligations are a free right – for example, the cash contributions of wealthy migrants who, by virtue of their affluence, must help their poorer relatives (assuming that, in case of a reversal of fortune, they may expect the same from their relatives, depending on their means). In its extreme form, the exploitation of weakness consists of usurious or disproportionate interest rates applied to loans, which lead to indebtedness.

1.5.3 The utilization of reserves

Reserves are manifold, as illustrated in Figure 8.2 above. Stocks of consumables primarily include food reserves, whose utilization is particularly sensitive in a famine process that usually involves steep price increases. It is therefore probably preferable to resort to credit when interest rates and local food prices are still reasonable; this enables food to be kept for a time when speculation is favourable, and interest rates reflect the risk-mitigation efforts of lenders. Convertible reserves include monetary savings, valuable non-productive assets such as jewellery, and surplus animals (in terms of herd sustainability and expected production rates). The utilization of such specific reserves is not itself pathological, because it does not endanger the household economy directly. It does, however, amount to an impoverishment that increases vulnerability to protracted or additional stress factors. The utilization of specific reserves is followed by the utilization of survival reserves, whose deleterious effects on the economic survival of households have been discussed earlier. The utilization of physiological reserves is controlled during the impoverishment phase, but is increasingly chaotic as the capital loss phase gives way to starvation.

The lifespan afforded by physiological reserves is difficult to appraise because it appears to be determined by protein intake. An adult whose initial nutritional status is good who undertakes a complete (excluding sufficient water intake) hunger strike dies within approximately 50 to 70 days. In this case, vital proteins (protein of the cardiac muscle, in particular) probably fail eventually, because the organism still contains energy reserves in the form of fat; if the latter could be utilized, they would no doubt extend survival by some 15 days. Famine victims however rarely face complete fasting, and what little food they can secure also supplies them with protein in balanced amounts with respect to energy, unless they only eat cassava. This intake enables them to survive considerably longer, to draw more efficiently upon their energy reserves, and to preserve their protein.

Depending on circumstances, famine victims may thus survive for months on minimal intakes. In terms of specific deficiencies arising in famine, beriberi and pellagra appear within approximately three months, and scurvy within 3 to 6 months (Rivers, 1988). This data is relevant to humanitarian operations only in terms of planning food relief, when resources are limited and the logistics chain slow. The decision to distribute food and the calculation of required rations should not normally rest on the degree of exhaustion of the victims' physiological reserves.

1.5.4 Debt

Credit is a means of extending the household capacity to cope with economic difficulties. Its cost may however be high, and refund efforts may affect several successive generations. Like social obligations, the sustainability of debt is related to compliance with reciprocal obligations. Resorting to credit is always determined by the cost of debt with respect to the utilization of alternative mechanisms, such as the sale of animals, and by the prospects for improvement or deterioration of the circumstances. The current and anticipated commodity exchange values for food are weighed in order to decide whether to dispose of them, or to keep them and seek credit.

1.5.5 Dietary restriction and adjustment

The controlled restriction of consumption is a privileged mechanism in the management of resources, because it enables the preservation of household assets, and the ability to cope with economic difficulties at a usually acceptable cost (i.e. hunger and weight loss). Intake restriction and weight loss increase physiological vulnerability and may give rise to specific deficiencies that often remain at the sub-clinical stage, but may develop into fatal clinical deficiency if the access to food deteriorates further. The adjustment of food consumption may also permit considerable economy, but at the cost of additional work and/or an impaired nutritional value and taste. For example, staples can be replaced with famine foods, which are by definition only resorted to in major food scarcity conditions. Such foods are usually the produce of gathering and are often difficult to find and/or require specific preparation owing, for instance, to their toxicity or the need to extract their nutrients. Expensive foods, such as meat, fish and oil are replaced by cheaper foods. The adjustment of food consumption during the famine process may induce specific deficiencies in addition to severe malnutrition; specific attention must therefore be paid to the food consumption of famine victims in order to prevent such deficiencies from developing into fatal epidemics.

1.5.6 Restricting the number of household dependants

An efficient way of alleviating the pressure of the nutritional need on households is to send children to stay with wealthier relatives and adolescents or young men to work afar, to marry off young girls and, sometimes, to return wives to their own families. Of course, such behaviour contributes to social disintegration and, hence, to the famine process.

1.5.7 Additional remarks regarding resilience

1. When all the members of a given group share the same coping mechanisms, some will automatically lose efficiency because of increased competition for the same resources, jobs or social obligation networks. This competition deteriorates the terms of trade and weakens the coveted resources, and this is always to the detriment of the victims of the famine process. For example, if all members of the group must sell cattle to purchase grain, and if grain producers and cattle herders are both aware of the price inelasticity of grain, then the price of cattle drops against a rise in grain prices. If all group members seek employment with those who are less affected by the crisis, wages drop. If they all intensify gathering activities, natural resources deplete rapidly.
2. The activation of coping mechanisms always involves a penalty with respect to normal living standards. During the adaptation phase, the renewable production of resources is ensured by an adjustment of production activities, and work grows more strenuous and may involve a loss in image. The utilization of reserves implies impoverishment. Resorting to credit and invoking social obligations both translate into indebtedness, involve reimbursement or reciprocation, and thus contribute to economic vulnerability. Dietary restrictions and adjustments predispose to nutritional disorders, and weaken the organism and the physiological reserves. The splitting of the family cell results in a loss of cohesion and an imbalance that promote social disintegration, the deterioration in the care of dependants, and feelings of insecurity.
3. The two previous points show that resorting to coping mechanisms is not sustainable in the long run – its penalty is a fall in living standards, an increase in vulnerability, or both. As a result, the current trend of tampering as little as possible with coping mechanisms first, and then attempting to reinforce them, should be viewed with caution. Some coping mechanisms are clearly deleterious, ultimately, in spite of allowing survival in the short run. It would therefore be preferable to recommend not the reinforcement of coping mechanisms,

but rather that of the security mechanisms that determine resilience, particularly those that generate alternatives and improve the yield of production activities.

4. Some groups experience protracted exposure to economic stress; as a result, their lifestyle may be based mainly on the utilization of renewable coping mechanisms because normal production is suspended, or its performance is chronically inadequate. Such groups can be said to have adapted to circumstances; adaptation does not hold the same meaning here as the phase of the famine process, where the adjustment is temporary and harmless in response to a problem that is most probably transient. The distinction between these two meanings is important. The former implies a major increase in vulnerability that in fact contradicts the commonly accepted positive meaning of the noun; the latter in fact indicates that the population can still react positively, providing the underlying causes recede rapidly.
5. On the other hand, it is possible to mistake normal livelihoods for coping mechanisms. For example, some groups prefer to devote three months to food gathering when it is profitable, rather than to unrewarding agricultural activities.
6. Economic vulnerability is inversely proportional to the sum of the components of resilience; this sum represents the coping potential of a given group. In principle, the probability of famine developing is directly associated with poverty.

1.6 FAMINE AND WAR

The previous Chapter presented war as a catalyst of nutritional crises. The relationship between famine and war is not absolute: famine can occur in the absence of war, and vice-versa. Nevertheless, many of the worst famines occur during armed conflict. The reason for this is simple: the climatic and economic factors conducive to famine notwithstanding, the loss of access to food resources arises primarily from deliberate action. This action usually falls into one of the following categories:

⇨ action that directly or indirectly deprives the population of its own resources and means of adaptation (such as the displacement of populations, restrictions on production activities, the severance of lines of communication, and the looting and destruction of resources);
⇨ action that prevents the implementation of operations intended to restore food access (such as action that bans the provision of food aid, the transfer of resources, and the creation of employment).

In armed conflict, liability to famine is determined by six main factors:

⇨ the extent to which acts of war inhibit food access;
⇨ the concurrence of climatic or economic phenomena that may inhibit food access;
⇨ the duration of acts of war and concurrent phenomena;
⇨ the magnitude of acts of war and concurrent phenomena;
⇨ the impact of war and concurrent phenomena on the overall economy;
⇨ the resilience of the affected population.

These factors may combine in many ways, complicating the links between famine and war, the diversity of situations, and the definition of a model to explain this relation.

Acts of war that inhibit access to food are manifold, and their impact on the feeding process varies greatly according to their extent.

1. **Attacks on food production** include the destruction of harvests or material, the laying of mines in arable areas, and confinement. They have an obvious and direct impact on food access.

2. **Looting** is a common form of hostility in wartime; it targets all basic economic assets, including food reserves and livestock. It can reduce a population to destitution in a very short time. Looting can be a deliberate act aiming at weakening a population group; but it is frequently the expression of man's predatory instincts when he can vent them, which is often the case in armed conflict. Furthermore, looting – at the expense of civilians, be they allied or enemy – is often the only source of income and food for many armed groups.
3. **Attacks on distribution networks** mainly target means of transport and communication, and markets. Dismantling distribution networks has many effects on the economy, resilience, and food production itself. The loss of market opportunities and the risk related to the transport of commodities represent a major shortfall with repercussions on economic security. Many access channels to basic economic resources are directly bound to the market, while the free movement of goods and persons is a usual and necessary feature of most economies.
4. **Attacks on the population:** in most modern conflicts, the population is the target, the hostage and the issue all at once, because the overarching objective is to control the population by all possible means. The salient features of this type of attack include forced displacement and migration, subjection through terror, and the supervision and restriction of activities and movements. It always entails the loss of access to economic resources, and this loss can be complete. This results in economic insecurity for its victims, and the displacement of populations that are thus uprooted and dependant on external assistance. Furthermore, sustained and protracted violence and threat cause psychological trauma, and thus aggravate social disintegration.
5. **Attacks on infrastructure** aim to weaken the overall economy, but they also impede access to services, and may destroy the services themselves. The absence or inadequacy of services aggravates vulnerability: for example, an insufficient access to education narrows, *inter alia*, the scope of eventual employment opportunities, while the lack of access to health services leads to human and animal disease, and thus a net production loss.

After the deed, the only resort for victims of armed conflict is humanitarian intervention – this is not automatic by far. Warring parties can divert humanitarian aid to their profit, may view the presence of outsiders and the media as undermining their grip on the local population, and are well aware that humanitarian aid may be extended to the enemy also. They may therefore not facilitate the establishment of humanitarian agencies, and usually attempt to control them in some way.

However, most acts of war that inhibit access to food are explicitly prohibited by international humanitarian law (IHL). IHL provisions and all those that generally protect civilians against the effects of armed conflict express the principle that belligerents cannot legally resort to every possible means to subject the enemy. With respect to civilians, the foundation for these rules rests on the established distinction between combatants and civilians, who must not be the direct object of military attack. This protection is stated in article 48 of Protocol I of 8 June 1977 additional to the Geneva Conventions, and extends to civilian objects (articles 48 and 52 Protocol I).

IHL nevertheless expresses a compromise between military demands and humanitarian concerns. It is therefore often difficult to apply its provisions strictly, for the following reasons:

- ⇨ in modern warfare, practically the entire enemy territory and economic infrastructure can be taken as a legitimate military objective – as a result, the border between civilian and military objects becomes highly blurred in the light of the existing legislation;
- ⇨ commodities that in peacetime are strictly civilian may become legitimate military objectives depending on their use by the warring parties (e.g. direct support to military action);
- ⇨ famine as a method of combat against the military is authorized, and this may encourage the latter to attack and remove commodities that are essential to the survival of civilians.

Consequently, the "line of defence" provided by IHL is often crossed, and relief operations then become necessary. IHL provisions regarding assistance to the needy in addition represent an important means of reinforcing the principle of protection of civilians: assistance is an active counterpart to protection. Both concepts are therefore closely connected and complementary. However, like protection against destitution, the IHL provisions regulating humanitarian assistance to civilians are weak in the face of modern warfare. Furthermore, their application always involves some degree of legal interpretation, usually in difficult circumstances.[6]

1.7 FAMINE PREVENTION, EARLY WARNING AND FAMINE INDICATORS

1.7.1 Famine prevention

"In the early 1990s, world production is theoretically sufficient to feed the 5.3 billion inhabitants of the planet, and it seems possible to meet the food requirements during the first half of the 21st century. An equitable distribution would nevertheless be required, based on an organization enabling the inhabitants of each region to meet their needs independently. This assumes that the international market organization, aid (financial, technological, infrastructural, medical, etc.) allow the countries under consideration to organise their self-sufficiency and ensure public health."

(Encyclopaedia Encarta 97, 1993–1996).

It is generally accepted that famine should no longer exist. Unfortunately the numerous famines observed in the last thirty years or so have also revealed the rift between good intentions and their application. Explanations for this range from the lack of political commitment to famine prevention to, sometimes, the political will to create famine. All pretexts have been put forward to justify inaction. A common example is provided by the mistrust of donors (usually representing major political powers) towards the malnutrition statistics produced by nutritionists, alluding to the latter's use of different methods in the same setting. This argument is particularly specious because famine prevention aims specifically at averting the risk of malnutrition "epidemics". As mentioned above, the development of famine processes is highly unpredictable, and is often reversible before they reach the starvation stage. Why waste resources before the deterioration of the situation is undisputable?

The quandary is further complicated by a number of factors:

⇨ staff rotations, particularly among humanitarian agencies and donors, which undermine institutional memory and motivation;
⇨ famines follow one another without strong resemblance, and therefore the same indicators cannot be applied to all;
⇨ the lack of reliable early warning systems;
⇨ access restrictions and the control over information that occur in war;
⇨ the specifics of humanitarian agencies in terms of mandate, objective and competencies;
⇨ bureaucracy.

[6] See Chapter IX.

Furthermore, the fact that man strains to fully grasp a threat through intelligence alone – he is, however, a living being that reacts mainly to sensorial signals. In spite of his delusions of superiority, he appears to have difficulty in anticipating the effects of a threat he cannot see, hear, smell, and whose signals he does not recognize because they are unfamiliar. Many factors therefore interfere with famine prevention, and this global appraisal of failure invites the reminder of some useful aspects in famine prevention.

1.7.2 Early warning

The suffering and the waste of human life and resources caused by famine are unacceptable in the modern world, and any system devised to avert famine is welcome. Credible early warning might provide a solution but, in spite of numerous attempts at introducing such systems, their efficiency is disappointing. Even the combination of several such systems does not enable the reliable forecast of nutritional crises.

Questions related to early warning include: how early need it be? What exactly should it predict? How do communities express stress associated with food shortages? Ultimately, the objective should be determined by the intention to act, that is, the choice between preventive and curative action. In the case of prevention, the surveillance associated with early warning must detect regular and inevitable decline towards overt crisis, defined as the shrinking of alternatives. Ideally, any point located along this decline should be anticipated. In practice, the point located just before the capital loss phase should provide the absolute threshold for intervention. If on the other hand, the intention is to predict the epidemic increase of mortality, early warning can confine itself to methods that highlight the signs of an increased risk of mortality (i.e. the spread of the occurrence and prevalence of severe malnutrition). But an increase of moderate malnutrition in the absence of a proportional rise in severe malnutrition may indicate that the affected population has resorted to controlled dietary restrictions. This usually occurs shortly before the onset of the capital loss phase.

Famine prevention first implies an understanding of the behaviours that are typical of famine processes and their different stages, based on reliable indicators. The second step involves a reasonable prognosis regarding the development of the process. Intervention criteria and modalities must also have been defined. Finally, the urgency must be made clear to the relevant agency and its donors in order to avert famine itself.

These four aspects of famine prevention may seem mundane, but each presents several complicated problems, some of which may be without resolution.

1. The understanding of behaviours heralding famine is complicated when famine remains remote: the more distant the prospect, the more indicators must be combined in order to ascertain abnormality. In the early stages, indicators at best provide trends, whereas more accurate indicators do not provide information yet. Moreover, famine phases may overlap somewhat, making it difficult to determine what phase exactly has been reached. The social, economic and political parameters that signal the inception of the process are usually difficult to identify properly; likewise, the circumstances converting causes into phenomena, or factors into causes, may be ambiguous.
2. Famine processes may develop slowly, and it should therefore be possible to detect them early. On the other hand, they remain reversible for a considerable length of time, rendering their development uncertain. As a result, information obtained at a given moment may become obsolete as the circumstances determining economic performance change. Early detection rarely leads to final predictions and, consequently, rarely results in early response.
3. Intervention criteria may be very clear, but different members of the affected population may experience different degrees of impoverishment, and may therefore not behave as one.

Criteria must therefore also be set with respect to the population segment that reflects a given behaviour, on the basis of which humanitarian agencies can act. Flexibility must also be applied in defining the necessary means for intervention in order to respond to problems appropriately and forestall famine itself.

4. In view of these difficulties, motivating decision-makers to act is sometimes an arduous task, especially as regards the timely mobilization of resources.

1.7.3 Famine indicators

The famine process threatens the household economy well before individuals seriously resort to their physiological resources. The economic analysis of optimum resource utilization provides a first detection level. Indicators relevant to prevention are therefore those that highlight the fact that a given population is reduced to its coping mechanisms in order to survive.

The common early warning indicators are as follows.

Meteorological and harvest monitoring indicators

Meteorological data provides invaluable information as to the anticipated reduction in agricultural production and food availability; but it provides no prognosis as to the possible resulting human suffering and its location. Rainfall and other climatic phenomena are erratic in time and space. As a result, rainfall monitoring must be synoptic, that is, performed through many stations widely scattered throughout the area under consideration. The monitoring of agricultural production implies the same constraints – whatever the weather conditions, harvests may be abruptly destroyed by parasites in any case. Moreover, even extensive crop destruction may not result in disaster if the population can fall back on adequate reserves (including the means to purchase the rest). Precisely for this reason, the inhabitants of famine-prone areas usually do not rely entirely on their home production for survival, but instead diversify their income as much as possible. Clearly, drought and crop failure are serious events that contribute to the impoverishment of specific sectors of the population. However, the full understanding of their implications requires a thorough knowledge of the overall household economy, and of the economy of the region under scrutiny. As a result, these indicators alone do not support accurate forecasting.

Nutritional anthropometry

Nutritional anthropometry is considered by many humanitarian agencies and donors as the absolute precondition for early warning. As mentioned above, a deteriorated nutritional status may indicate controlled dietary restriction; however, many humanitarian agencies tend to concentrate on the deterioration caused by the last resort, being the consumption of physiological reserves. Similarly, prime-time media reporting – and, therefore, the widespread alert of the general public – focuses more on this spectacular, final decline. At this stage of deterioration it is too late for prevention. Furthermore, significant nutritional deterioration may also arise from infectious disease.

Economic and social information

Economic and social data are more basic to predictions than the previous category. A significant, unseasonable, rise in staple prices is a clear indication of a problem regarding access to food, especially if it combines with other economic phenomena or behaviours, such as a drop in the market value of livestock and a rise in the volume of sales. This indicates instability, and significant progression in the famine process. However, the significance of such transactions can be exaggerated because of ignorance of their local causes, which may be explained otherwise than by serious economic pressure. Sales, and the prices of food and livestock must therefore be appraised thoroughly. The difficulty lies in determining whether the situation is sufficiently serious to justify means such as the distribution or importation of food, or its subsidy. The answer is provided by other factors such as the timing of the following harvest, and resilience. However, economic and social data is invaluable in detecting famine processes and forecasting their development, provided that it is interpreted in the light of local reality. Furthermore, behaviour grows increasingly predictable as famine becomes more imminent.

These comments argue that the use of such indicators must be flexible, and involve combining them on the basis of their interrelation and relevance in order to reveal famine processes where they exist. As indicated above, no two famine processes are identical; the overall concept is thus limited to a formula, based on the four stages listed above (see Figure 8.2). The following points must then be clarified:

⇨ the normal lifestyle of the affected community must be defined;
⇨ since one or more phenomena have upset this lifestyle; their impact on production must be defined, and so must the reaction of the affected groups:
  → adapting to normal variations of the factors that determine production performance;
  → resorting to resilience according to the six above options;
⇨ the prognosis regarding anticipated needs for assistance must be determined.

To conclude, famine prevention primarily assumes the understanding of the causes and impact of insufficient access to food. It also implies the understanding of local response mechanisms. It then involves the introduction of measures that enable households to preserve an adequate access to food, rather than free food distributions shortly before or during the starvation phase. Action during the starvation phase of the famine process is of course essential; nevertheless it may also be an indication of failure to provide the preventive measures that could have averted the outcome.

2. NUTRITIONAL DISORDER

2.1 INTRODUCTION

The general expression “malnutrition” is commonly used in reference to nutrition problems of a physiological nature. This expression covers various ailments that correspond to nutritional disorders. These conditions have many causes – this Manual restricts itself to the discussion of the deficiency disorders that are most commonly encountered in humanitarian operations, and that pose problems insofar as they may escalate into epidemics and have serious, sometimes fatal, consequences.

In the course of the famine process, some of these disorders represent the final damage to the individual prior to his death; as a result, they usually require urgent action. They however also indicate earlier aggression on the feeding process, because all types of aggression on the feeding system may affect the nutritional status. Furthermore, nutritional deficiency disorders usually have more than one cause, and they rarely result from deficiency in a single nutrient. They frequently associate with other ailments, cause them, or result from them. The detection of any form of deficiency calls for the immediate identification of all possible causes, including associated deficiency and other disorders. This enables the definition of comprehensive treatment, and the appraisal of the magnitude of the problem within the general population. This in turn enables the simultaneous adoption of appropriate preventive measures and the initiation of treatment. Prevention derives its importance from the fact that it limits the sheer numbers of patients seeking curative treatment; it thereby complies with the humanitarian mission of preventing suffering.

In terms of their causes, deficiency disorders may affect specific individuals, households, or entire communities. Individual deficiency usually results from a specific health problem. Deficiency among groups or households is associated with a predisposition (e.g. solitude, alcoholism, drug addiction, ignorance, poverty, occupation, habitat, and imprisonment). Deficiency in communities may be related to the environment, eating habits, or a modified access to food resources. Isolated cases cannot be predicted in the humanitarian framework; they are detected and treated on an *ad hoc* basis as they refer to health facilities. In terms of groups and communities, however, the factors leading to deficiency and liable groups must be known, in order to act pre-emptively or to apply timely treatment.

2.2 CLASSIFICATION

The classification of nutritional deficiency disorders follows two criteria: the type of nutrient that is deficient, and the primary cause.

2.2.1 Classification according to nutrient deficiency

Nutritional deficiency disorders are classified according to the response of the organism to deficiencies in different nutrients; it translates into a reduced tissue concentration of the nutrient under consideration (i.e. Type I deficiency), or stunting and weight loss (Type II deficiency) (Golden, 1988; Golden in Waterlow, 1992). The classification of nutrients according to observed responses in case of deficiency is provided in Table 8.1, according to Briend & Golden (1977).

Table 8.1 Nutrient classification according to the type of response to deficiency

Type I	Type II
Ascorbic acid	Essential amino acids
Cholecalciferol	Magnesium
Calcium	Nitrogen
Copper	Water
Folic acid	Phosphorus
Manganese	Potassium
Pyridoxine	Sodium
Retinol	Sulphur
Riboflavin	Zinc
Selenium	
Thiamine	
Tocopherol	
Vitamin B_{12}	

Two major elements are missing from the table above: molecular oxygen and carbon – the latter is taken as an energy source in the form of lipids, glucides and protein. Oxygen and carbon are bound by the energy metabolism. There is no need to include oxygen in either group, because its deficiency rapidly causes asphyxia and death. Carbon on the other hand is necessary to practically the entire organism, either as a source of energy, or as carbonated skeleton, and this complicates its classification. For want of a more satisfying approach, it is classified in a separate category here (Golden, 1998).

The distinction between Type I and II deficiencies is important. Type I nutrients derive their value from their contribution to the mechanisms and functions of specific metabolic pathways; this means that a specific deficiency in one of these nutrients can manifest itself individually. The reduction in the tissue concentration of the nutrient under consideration is then observable, and the appearance of specific clinical signs facilitates both diagnosis and treatment. However, Type II nutrients play a major role in the formation of tissue. They are mutually interdependent in precise proportions; if one is deficient, the entire tissue diminishes, and this involves the loss of other essential constituents. The interrelation of Type II nutrients is similar to that existing between essential amino acids, and this entails the following consequences (Briend & Golden, 1997):

- ⇨ the response to Type II nutrient deficiency (i.e. stunting and weight loss) does not permit the identification of the deficient nutrient;
- ⇨ the deficiency in one of the Type II nutrients causes the loss of the others that cannot be used;
- ⇨ the recuperation of weight loss requires a diet that contains above all adequate and balanced amounts of all Type II nutrients;
- ⇨ anorexia is typical of Type II nutrient deficiencies, probably because all nutrients consumed in excess with respect to the limiting nutrient must be eliminated before reaching toxic levels;
- ⇨ a diet that is deficient in Type II nutrients causes the organism to consume its own tissue in order to balance its metabolism – this can quickly result in severe malnutrition;
- ⇨ Type II nutrient deficiency is difficult to diagnose – combined with the lack of specificity of weight loss, it often leads to a considerable underestimation of such deficiencies and the stunting they cause.

The classification of deficiency according to nutrients provides the basis for the definition of three types of nutritional deficiency disorders:

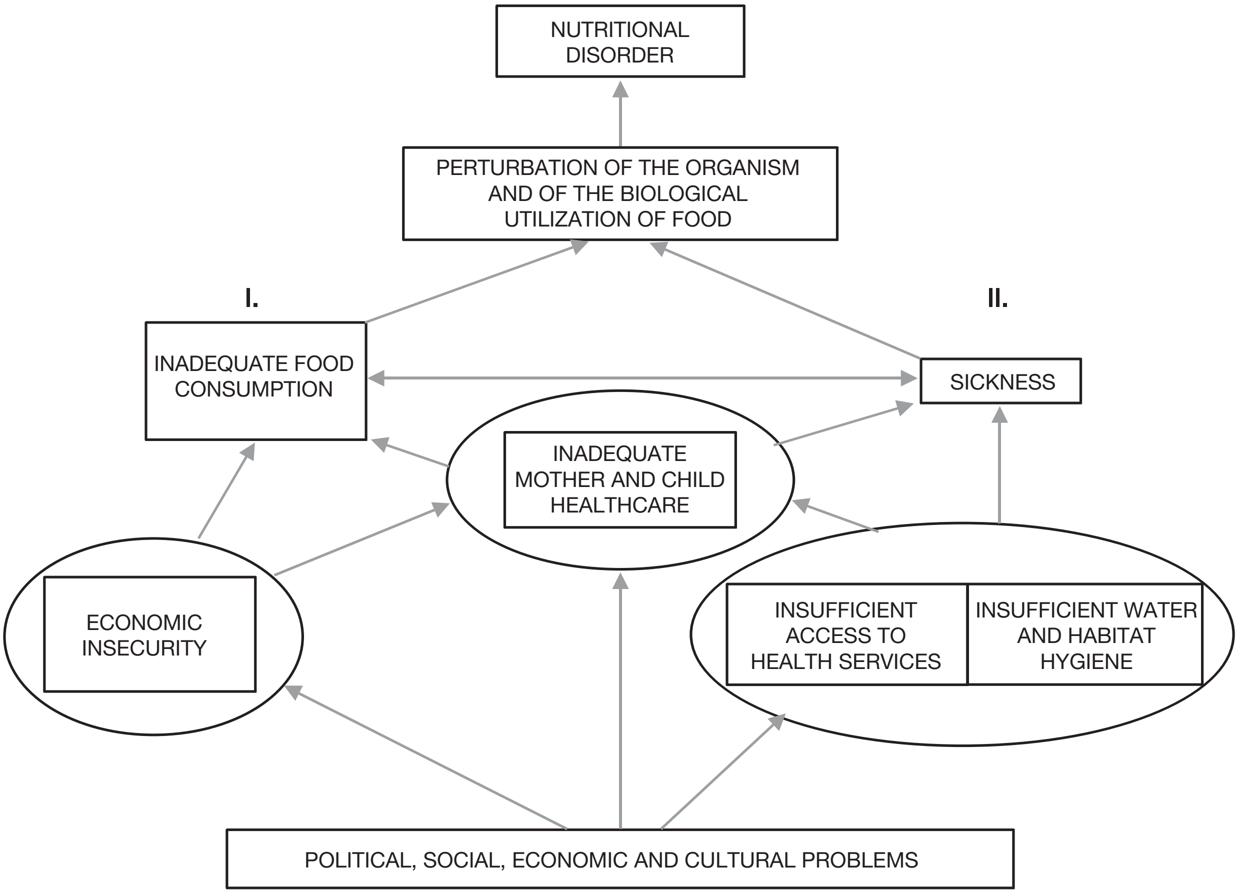
- ⇨ deficiency with specific effect (Type I deficiency);
- ⇨ deficiency with global effect (Type II deficiency);
- ⇨ carbon (as a source of energy) deficiency.

It is not uncommon for these three deficiencies to occur together.

2.2.2 Classification according to primary cause

The concatenation of the causes of nutritional disorder is illustrated in Figure 8.3 below, which lists causes according to their ranking. The primary causes are of interest here (underlying causes have been discussed in the previous Chapter).

Figure 8.3 Ranking of the causes of nutritional disorder



Nutritional disorder arises from perturbations of the organism and the biological utilization of food, and is thus directly caused by the following:

- ⇨ inadequate food consumption due to insufficient access to a balanced and diversified diet (dietary inadequacy);
- ⇨ diseases that can influence biological utilization in the organism directly, and/or cause inadequate food consumption through anorexia or the inability to absorb enough food.

These two causes frequently combine.

Primary malnutrition refers to nutritional disorder caused mainly by dietary inadequacy; secondary malnutrition results rather from illness.

Nutritional disorders encountered in crisis settings require that the fundamental distinction between primary and secondary malnutrition be made, in order to define strategies. In the case of primary malnutrition, economic and/or social problems are necessarily involved; in the case of secondary malnutrition on the other hand, problems are rather associated with hygiene, access to healthcare and services, not excluding social problems. In the absence of crisis, individual physiological and psychological weakness explains most of the malnutrition cases that are almost inevitable in the tropics, but also a sometimes significant proportion of paediatric hospital admissions for sickness worldwide.

2.3 DEFINITIONS

A distinction is usually made between specific vitamin and mineral deficiencies (i.e. Type I nutrient deficiency) and protein-energy malnutrition (PEM), which manifests itself through a broad range of signs from kwashiorkor to marasmus, and refers to protein and/or energy deficiency as the main cause of malnutrition. The expression "specific deficiency" has been in common use for some time, and is accordingly referred to in this Manual also. The expression protein-energy malnutrition is disputed today in the light of recent knowledge of Type II nutrient deficiency, and of the uncertainty of the causes of kwashiorkor; Briend and Golden have suggested an alternative wording that avoids specific reference to causes: "severe malnutrition" (Briend & Golden, 1997). This expression is also used in this Manual because it suggests an organic response, whatever the initial nutrient deficiency may be. The expression is also consistent in terms of treatment: whatever the deficient nutrient, the diet must supply an adequate energy intake, and must absolutely include all Type II nutrients (and usually Type I nutrients also).

2.4 SEVERE MALNUTRITION

2.4.1 Definitions

Severe malnutrition includes all Type II deficiencies in addition to carbon deficiency as a source of energy. Severe malnutrition thus amounts to a multiple deficiency, and the limiting nutrient may not be obvious except in situations of declared famine. This is in fact unimportant because, as deficiency develops, all Type II nutrients in excess with respect to the limiting nutrient are lost; as a result, nutritional treatment is the same because it must include all Type II nutrients in the right proportions and Type I nutrients.

Severe malnutrition refers to three major clinical disorders: marasmus, kwashiorkor, and nutritional dwarfism (Briend & Golden, 1997). The three disorders can concur, but so-called severe malnutrition epidemics refer rather to marasmus and kwashiorkor – nutritional dwarfism develops slowly, and does not itself entail immediate danger. Furthermore, the circumstances of each crisis involve a specific proportion of marasmus and kwashiorkor in addition to nutritional dwarfism, worsening the latter where it already exists. Marasmus, kwashiorkor and the combined form of marasmic kwashiorkor require immediate and specific action owing to the high mortality that they induce. They are commonly associated under the name of severe acute malnutrition (SAM),[7] in contrast to nutritional dwarfism, considered as a form of severe chronic malnutrition; this Manual chooses to refer to critical forms of severe malnutrition (which contribute to nutritional dwarfism).

Marasmus and kwashiorkor have long been thought to represent the two extremes of PEM, with kwashiorkor arising from clear protein deficiency, and marasmus from clear energy deficiency. This opinion has since been contested owing to the questioning of the nature of kwashiorkor and its causes, and because of developments in the study of nutrients that have led to their classification as Type I or II. As discussed below, the concept nevertheless retains nutritional significance. It is still unclear why some individuals – especially children – develop marasmus, while in the same conditions others develop kwashiorkor.

[7] The usual distinction between acute and chronic malnutrition confines the appraisal of statural-ponderal growth retardation primarily to dietary deficiency, either present (acute malnutrition) or repeated (chronic malnutrition). Moreover, growth retardation can be as acute as weight deficit, and the latter can also be chronic. If the expression "acute" is used to describe the seriousness of the situation, then "critical" is preferable.

Nutritional dwarfism does not require urgent action; it deserves analysis nevertheless, because it results from growth disorders and is thus relevant to malnutrition observed in the field.[8]

2.4.2 Classification[9]

Clinical manifestations of severe malnutrition result from an evolving process during which malnutrition is initially mild, becomes moderate, and then finally severe. Quantifying severe malnutrition requires the application of parameters that distinguish between these three forms and, consequently, enable a quantitative classification of observed individuals, depending on their state of malnutrition.

As mentioned in Chapter VI, one of the interpretations of nutritional status is that it amounts to the overall outcome of the two components of the growth process: ponderal growth (i.e. the weight achieved for a given height) and statural growth (the height achieved at a given age). In terms of severe malnutrition, marasmus refers to an insufficient weight with respect to height, that is, wasting; nutritional dwarfism on the other hand refers to an insufficient height at a given age, that is, significant growth retardation, or stunting.

Kwashiorkor refers to the presence of bilateral oedema of the lower limbs resulting from primary or secondary nutritional disorders.

Children

The most commonly used classification has been devised by Waterlow (Waterlow, 1973), and provides the following criteria for severe malnutrition: bilateral oedema, wasting and stunting, according to the NCHS[10] reference tables discussed below. Wasting is expressed as weight-for-height: it compares the child's weight to the standard for its height. Stunting is expressed as height-for-age: it compares the child's height to the standard for its age. Waterlow initially proposed a classification that expressed thresholds as a percentage of the median; he later recommended that thresholds be expressed in multiples of the standard deviation of the reference population (Waterlow, 1977).[11]

Table 8.2 The Waterlow classification

Classification of malnutrition according to Waterlow[a]				
	Normal nutritional status	Mild malnutrition	Moderate malnutrition	Severe malnutrition
Weight-for-height	90 – 120 %[b] +2 Z[c] to –1 Z	80 – 89 % < –1 Z to –2 Z	70 – 79 % < –2 Z to –3 Z	< 70 % < –3 Z
Height-for-age	95 – 110 % +2 Z to –1 Z	90 – 94 % < –1 Z to –2 Z	85 – 89 % < –2 Z to –3 Z	< 85 % < –3 Z

[a] This classification includes children with bilateral oedema of the lower limbs in severe malnutrition.
[b] Percentage of the reference median.
[c] Z = Z-score, amounting to one standard deviation from the reference median.

[8] Chapter XIII discusses the treatment of severe malnutrition.
[9] Chapter X discusses the methodology of the determination of nutritional status and malnutrition in greater detail (Section 4.4. Nutritional anthropometry).
[10] United States National Center for Health Statistics.
[11] These aspects are discussed in Chapter X.

Wasting may also be expressed in mid upper-arm circumference (MUAC, or brachial circumference) in relation to height, or even in MUAC alone (but the latter can only be applied to children aged between 1 and 5 years).

MUAC-for-height

⇨ Acceptable nutritional status: > 85 % of the reference median
⇨ Moderate malnutrition: 85–75 % of the reference median
⇨ Severe malnutrition: < 75 % of the reference median.

Z-scores may also be applied to MUAC-for-height, with the following thresholds: –2 Z instead of 85 %, and –3 Z instead of 75 %.[12] The application of these two thresholds to a reference population reveals roughly the same prevalence of severe malnutrition, but Z-scores provide a somewhat lower prevalence rate of moderate malnutrition.

MUAC alone

⇨ Acceptable nutritional status: > 13.5 cm
⇨ Moderate malnutrition: 13.5–12.5 cm
⇨ Severe malnutrition: < 12.5 cm

Médecins sans Frontières recommend a < 11 cm threshold in selecting severely wasted children for admission to therapeutic feeding centres (MSF, 1995). Thus different thresholds may be applied, depending on the ultimate purpose.

Adolescents

No weight-for-height reference table in relation to age has been developed for adolescents. One table does provide centiles for the Quételet body mass index (see below), and malnutrition should be diagnosed among adolescents when the Quételet index is lower than the fifth centile (WHO, 1995). This indicates wasting levels that range between approximately 87% of the weight-for-height index in a 9-year-old child, and 80% in a 20-year-old man. The fifth centile threshold is thus useful in detecting moderate wasting, but proves useless in defining a severe malnutrition threshold. However, the combination of NCHS weight-for-age and height-for-age tables provides a theoretical weight-for-height table that enables the measurement of wasting in adolescents according to the Waterlow classification.[13] This table results from the combination of two other tables – as a result, the standard deviation cannot be set, and Z-scores cannot be applied. Thresholds must consequently be expressed as a percentage of the reference value. The table included in Annex 4 also provides the basis for the calculation of body mass index (BMI) thresholds, according to the model below used in assessing adult wasting.

Adults

The Quételet index, or body mass index (BMI), enables the measurement of wasting, and the comparison of individuals of different heights. A given index therefore defines the same degree of wasting whatever the stature of the individual under consideration. Thresholds are provided in Table 8.3 below.

[12] Compliant with the table provided in Annex 4.3.
[13] See Annex 4.4.

Table 8.3 Body mass index classification (Quételet index)

Classification of the adult nutritional status according to BMI				
	Obesity	Normal nutritional status	Moderate malnutrition	Severe malnutrition
Women	> 28.6	23.8 – 18.7[a]	18.6 – 15.5	< 15.5
Men	> 30	25 – 20.1[b]	20 – 16	< 16

[a] Desirable average: 20.8 (WHO, 1985).
[b] Desirable average: 22 (WHO, 1985).

This classification is derived from the thresholds provided in a WHO report on energy and protein requirements (WHO, 1985).[14]

In adolescents and adults, bilateral oedema of the lower limbs usually (but not always) indicates severe malnutrition; adult oedema must therefore be ascertained to be the result of nutritional disorder, particularly in the elderly and sedentary, and this may be difficult to do.

The three clinical conditions associated with severe malnutrition are reviewed below. Clinical and pathophysiological data is similar for all age groups, and their treatment principles are identical; this Manual therefore makes little distinction between age groups except in specific cases, which are indicated.

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2.4.3 Marasmus

The aetiology, or cause, of marasmus that occurs in schoolchildren (i.e. above five), adolescents and adults is usually easier to define than that affecting pre-school children and infants, in whom several phenomena may interact to cause malnutrition.

Marasmus is a condition of wasting resulting from the fact that the organism is reduced to consuming its own reserves (mainly muscle and adipose tissue) in order to satisfy its nutrient requirements – this amounts to self-cannibalism. Wasting is well advanced if it lies below the anthropometric thresholds that define severe malnutrition. Marasmus is clearly a pathological condition insofar as it increases the vulnerability of the organism considerably; the wasting process on the other hand amounts to the organism's ability to feed on its own tissue in order to adapt to an erratic securing of food (this is usual for animals). This adaptation can be quite impressive: in Somalia, adults have been observed to recover in spite of a BMI slightly above 9, and were able to resume a normal life following treatment in therapeutic feeding centres.

Marasmus is the commonest form of severe malnutrition in famines. It is in this case primary marasmus, because it is caused mainly by access to food that is insufficient to cover energy requirements; the latter are the main determinant of the amount of food necessary to the organism, but the diet supplies both energy and nutrients. As a result, a diet that lacks energy is usually also deficient in protein, vitamins, and minerals, and it may also be unbalanced. Energy deficiency therefore also entails specific deficiencies (Type I nutrients) as well as Type II nutrient deficiency. Energy deficiency must nevertheless be significant to cause confirmed marasmus: it must be at least

[14] The possible adoption of new thresholds is discussed in Chapter X, Section 4.4.5.

40 to 50% lower than the levels required to preserve a good nutritional status. This corresponds to starvation, not to be confused with fasting (or voluntary starvation), which amounts to the absence of feeding, with the exception of water. In acute famine, energy intake can drop to levels that are similar to fasting, rapidly resulting in death. As a reminder, an initially healthy adult who does not eat but drinks water survives for 50 to 70 days; a child under the age of five dies within 30. In addition to famine, which can cause entire populations to develop marasmus, childhood infections and parasite-borne diseases such as measles, malaria, whooping cough, diarrhoea, and intestinal worms (parasitoses) are common causes of secondary marasmus. But other possible causes include digestive disorders, mental retardation, premature birth, tuberculosis and AIDS.

During a famine, marasmus can affect all age groups; but (unlike kwashiorkor) it otherwise manifests itself rather during the first year of childhood, and is then usually associated with weaning and bottle-feeding. Weaning consists in replacing maternal breastfeeding in the infant's diet with a semi-solid and solid diet, preferably in stages. This phase often entails psychological trauma for the infant, and it may simply refuse to eat. The commonest problem nevertheless relates to the quality of weaning foods, which may be monotonous and thus cause anorexia, and sometimes rejection; their energy density may also be weak, and combine with a deficiency in many nutrients. Weaning foods produced from staples are usually quite bland; their energy density is often insufficient, and so may be their protein density if they are made from tubers. They thus provide an inadequate dietary intake unless they are combined with other foods or, better still, maternal milk itself. Weaning foods are frequently contaminated through contact with their environment, particularly faecal bacteria and parasites, and may cause gastro-intestinal infection inducing anorexia, and precipitate marasmus and dehydration with serious consequences (see below).

Bottle-feeding replaces or complements breastfeeding, and may as such constitute one of the stages of weaning. It usually involves preparing milk from powder. As discussed later,[15] bottle-feeding even in optimal conditions has many disadvantages if the mother is in good health and is lactating properly – the best-quality powdered milk cannot compete with maternal milk. More importantly, bottle-feeding is a frequent cause of marasmus because the milk is overly diluted and the child can no longer cover its energy requirements. In addition, owing to lack of means or knowledge, the necessary strict hygiene conditions may not be satisfied in the preparation phase (aseptic water) or in washing the bottles themselves. Reconstituted milk is an excellent culture medium for many pathogenic bacteria. In inadequate hygiene conditions, therefore, infants usually develop gastro-intestinal infections that, in combination with the anorexia that always accompanies this type of infection, can precipitate marasmus and ultimately death. This phenomenon is frequently aggravated by dehydration caused by vomiting and diarrhoea; it may be worsened by the mother's reluctance to feed the child sufficiently, fearing that this may prompt further vomiting and diarrhoea. Dehydration can rapidly be fatal, and the marasmus-dehydration combination is a major cause of infant mortality. Weaning and bottle-feeding problems are of course usually closely associated.

Clinical aspects

General appearance

The classic presentation of marasmus is emaciation, giving the patient a shrunken, wasted appearance due to the loss of subcutaneous fat and muscle. The skin is flaccid, sagging (particularly on the buttocks), and wrinkled, conveying the impression of an "old man's face" (some authors refer to simian features, or "monkey face").

[15] See Chapter XV.

Appetite

Primary marasmus usually does not diminish appetite, and patients may even be voracious. Secondary marasmus on the other hand (and the clinical complications associated with primary marasmus) almost always induces anorexia to some degree. However, if the associated disorder is bacterial or a parasite infection (giardiasis or amoebiasis), appropriate treatment quickly stimulates appetite. Appetite is a major indicator of the seriousness of the problem, and the possible presence of underlying infection that may go unnoticed in severely malnourished children. Appetite – and mood swings – is also an excellent indicator of the prognosis. However, metabolic perturbation and lesions to the main organs reduce the patient's food intake capacity in both quantity and quality. Dietary reanimation must therefore follow a strict procedure, involving the simultaneous administration of appropriate medical treatment.

Mood

Apathy and lethargy are typical of severe malnutrition – and indeed of any disorder causing the exhaustion of the organism. With the exception of the final stage, when ocular disorder prevents the patient from focusing and movements are slow, marasmic patients can remain alert and focused, showing interest in their environment; they may show anxiety in spite of their often sunken eyeballs. This may also be a sign of dehydration. Marasmic children are often moody, but are usually less irritable than children suffering from kwashiorkor. These aspects related to mood are less obvious in schoolchildren, adolescents and adults because the latter can express themselves more accurately and can usually be treated and reasoned with more easily.

Hair

Hair texture and colour changes may occur; but this is not systematic, and is definitely less obvious than in kwashiorkor patients. Hair loses colour and lustre, thins, and becomes brittle.

Skin

Marasmus does not cause specific skin lesions, but sores may appear.

Abdominal distension

The stomach of children may be swollen for many, frequently combined, reasons: the abdominal muscles are no longer strong enough to contain the viscera adequately, helminthic (worm) infection produces a mass of parasites that distend the intestine and cause its inflammation, and intestinal gas may also contribute. Parasite infection can be significant enough to alter anthropometric data, particular that involving weight-for-height measurements. It is not uncommon for the worming of severely undernourished children to prompt the excretion of a kilogram or more of intestinal parasites (especially ascaris); furthermore, inflammation can double intestinal mass because of fluid retention. Such phenomena may seriously influence the assessment of the prevalence of severe malnutrition, and the selection process for admission into therapeutic feeding centres if the latter is based on anthropometric measurement (weight-for-height) alone, to the exclusion of clinical diagnosis.

Other clinical signs

Marasmus is often associated with Type I nutrient deficiencies, and the clinical signs of such deficiencies may be detected accordingly.[16]

[16] The clinical signs of specific deficiencies are described in Chapter III, Sections 2.2.5 and 2.2.6, and in this Chapter, Section 2.5.

Pathophysiological aspects

Arrested growth and weight loss provide the overall manifestation of severe malnutrition. They result in the third clinical disorder, nutritional dwarfism. A reduction in physical activity is another general manifestation owing to muscle loss, but also as an energy preservation mechanism. As discussed above, marasmus is the pathological outcome of wasting, which expresses the ability to adapt to an insufficient dietary intake. The physiology of marasmic subjects also expresses this ability. Furthermore, almost all the functions of the organism are modified in critical severe malnutrition.

Adaptation to an insufficient dietary intake

Energy mobilization and expenditure

Physical activity drops and subcutaneous fat reserves are used first; amino acids are then increasingly used as a source of energy (particularly alanine for gluconeogenesis). This causes adipose tissue and muscle loss. In parallel, the energy utilization improves, and the vital functions slow down, particularly those associated with the sodium pump and protein synthesis, in order to reduce the basal metabolism.

Protein utilization

Adaptation also enables the preservation of protein, particularly in order to maintain the essential functions that depend on it. Changes in enzyme activity promote the degradation of muscle protein, the synthesis of liver protein, and the mobilization of stored fat. Visceral protein is preserved longer than muscle protein; when the latter is depleted, the loss of visceral protein is fatal. Another indication of adaptation is provided by the fact that the protein half-life increases owing to a reduction in the degradation rate.

Hormone balance

The hormone balance changes in case of insufficient dietary intake, in order to maintain energy homeostasis and determine the mechanisms described above. Hormone mechanisms are complex, and are not further discussed here. It should be noted nevertheless that changes in the hormone balance (that defines the general sense of the metabolism towards degradation or synthesis – catabolism or anabolism) do not occur instantly in either direction. When nutritional catch-up begins, hormone mechanisms invert from metabolic degradation to feed the organism towards metabolic synthesis for the regeneration of organs and tissue. At this moment, the organism must above all continue its recovery – if the dietary intake again drops abruptly, the hormone balance cannot be modified fast enough to avert hypoglycaemia, hypothermia, and eventually death. This is why in extreme cases of critical severe malnutrition dietary reanimation is a continuous process, consisting of eight food intakes at regular intervals over a period of 24 hours.

Oxygen requirements

The loss of lean mass and the reduction in physical activity cause a drop in the tissue oxygen requirements. Red blood cells and the haemoglobin concentration diminish as a result, thus contributing to the saving of amino acids. This no doubt amounts to a form of adaptation, but nutritional catch-up increases the demand for oxygen, and the organism must be provided with iron, folic acid and vitamin B_{12} in order to avert anaemia.

Harmful physiological change

Adaptation to an insufficient dietary intake can extend over a given period of time; beyond a certain point, however, the response no longer amounts to an advantageous adjustment, but entails an increase in the patient's liability to accidents that may impair his health.

Cardio-vascular function

Reductions in the blood flow, the cardiac rhythm, and blood pressure can result in cardiac insufficiency.

Kidney function

The kidney function is impaired, and kidney failure may result, particularly in patients whose protein supply abruptly exceeds their maintenance needs. This may occur at the onset of treatment, if the staff is unskilled in the treatment of severe malnutrition. In such cases, patients develop oedemas, not to be confused with those resulting from kwashiorkor, and these may prompt some caretakers to increase protein intake further – such a diet is fatal in most cases. Furthermore, if the sodium pump activity increases faster than the recovery of the kidney function at the beginning of the treatment, excess extracellular sodium can rapidly be fatal (Briend & Golden, 1997).

Digestion

The entire digestive function (i.e. intestinal motility, secretion, and absorption) is considerably reduced. Recovery is usually complete but, at the inception of treatment, a precise dietary gradient should be observed in order to avoid surcharge, which can also be fatal.

Nervous system

Critical forms of severe malnutrition affect the nervous system, especially during growth, as growth failure corresponds to impaired brain growth. The brain is however much better protected than other organs, and its weight deficit amounts to growth retardation rather than to an actual loss of substance. However, myelin production is delayed, conduction may slow down, and the density of the nervous synapses may decrease (Waterlow, 1992). The impact of these alterations is not known at the time of the malnutrition crisis itself; what matters here is the potential for consequences on the mental development of the child.[17]

Immune system and response to infection

Critical forms of severe malnutrition induce a significant depression of the acquired (cellular, but also humoral) and innate immune function. This manifests itself notably in the T lymphocytes (in the form of thymus atrophy) and in the complement, owing to the reduced production of several of its proteins. Antibody production may also be perturbed (e.g. Immunoglobin A – IgA). As a result of these alterations, patients suffering from critical forms of severe malnutrition are highly liable to infection from bacteria negative to gram colouration. This increased predisposition to infection usually combines with serious complications in case of normally benign infection, and protracted infection. Lesions to the digestive tract also increase vulnerability to gastro-intestinal infection. More generally, any tissue lesion provides an entry for infection, or promotes it. The common absence of fever makes the infectious process unobtrusive, and accordingly increases the risk of mortality.

Water, electrolytes and minerals

Severe malnutrition may combine with dehydration or over-hydration. Patients must be able to drink, but must not be forced to do so in the absence of clinical evidence of dehydration. Furthermore, the changes in body composition associated with severe malnutrition imply an increase in sodium and a loss in potassium, while other minerals (i.e. copper, magnesium, manganese, and zinc) are lost as metabolic activity diminishes. As a result, the rehydration formula in cases of severe malnutrition is different from that used in the absence of malnutrition, and the dietary treatment of malnutrition must allow for the unavoidable loss of nutrients and minerals during the wasting phase.

[17] See Section 2.4.7 in this Chapter which discusses the consequences of malnutrition.

Thermal response

The thermal response is altered because the organism is struggling to maintain a normal body temperature. This may lead to hypothermia (if the ambient temperature drops below the lower critical temperature) or hyperthermia. When temperature drops moreover, thermo-genesis through shivering no longer works; this increases heat loss, and may delay the detection of hypothermia by health workers. The combination of hypothermia and hypoglycaemia is common, and is a major mortality factor.

2.4.4 Kwashiorkor

Kwashiorkor is doubtless the most serious form of critical severe malnutrition, entailing the greatest risk of mortality. Marasmus is caused by famine, acute infection, and improper weaning conditions and early infant feed; kwashiorkor (clearly indicated by bilateral oedema of the lower limbs) results rather from dietary imbalance, belated weaning, chronic infection, and metabolic disorder. It may develop quickly but unobtrusively. Kwashiorkor is much less common than marasmus in famines. However, its prevalence and incidence indicate significant exposure to infectious disease and/or low protein concentrations in what little food remains; this is frequently the case when cassava is the last available staple. Nevertheless, in many famine situations, the diet deficit is global rather than the result of imbalance. Energy deficiency is in these cases such that it dictates the response of the organism, which usually tends towards marasmus rather than kwashiorkor. Kwashiorkor oedema is well known and has always been associated with nutritional disorder: historical evidence includes the *Bouffissure d'Annam* (or "swelling of Vietnam") observed in the 1920s, "kwashiorkor" in the 1930s, and the famine oedema observed during the Second World War.

The expression "kwashiorkor" is used today to describe oedematous malnutrition. The word comes from the West African Ga language, and may be translated by "displaced child illness" – meaning, in fact, "illness of the child who is weaned at the birth of its junior". In 1935, Cicely Williams first employed the vernacular term in reference to the disorder, and published it as such. It has persisted since, in spite of many attempts at rationalization. Kwashiorkor has been – and still is – the subject of much debate as to what exactly it covers. The widest held theory (which does not provide comprehensive explanation, however) relates to protein deficiency; this view was held by the first observers of nutritional oedema. Another relates to the aggression by oxidizing agents resulting from the dietary deficiency in antioxidant Type I nutrients (i.e. vitamins A, E, and C, riboflavin, thiamine, and niacin, in addition to selenium). Finally, another theory invokes the role of infection or aflatoxins. These various approaches are discussed below in relation to the pathophysiological aspects.

Kwashiorkor affects adults and children alike; in children, it is most common between 1 and 3 years, but is frequent up to 5 years of age. In older children and adults, it is usually associated with a dietary imbalance and specific deficiencies. Geographically speaking, kwashiorkor is most common where cassava, yam, plantain, rice, and maize are the staple foods.

Clinical aspects

General appearance

Kwashiorkor patients provide the very image of human misery and extreme fatigue.

Oedema

Oedema is the distinctive feature of kwashiorkor; the absence of bilateral oedema of the lower limbs excludes the kwashiorkor diagnosis. Oedema (from the Greek *oidein*, to swell) is produced

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by an expansion of the extra-cellular fluid in the tissue, and this results in diffuse and painless swelling. Kwashiorkor causes the swelling to begin in the feet, and then to extend to the legs; it may spread as far as the hands and face. Oedema can be recognized by applying strong finger pressure to the arch of the foot or the ankle for approximately 3 seconds; in the case of oedema, this pressure leaves a depression or pit (pitting oedema) that can be seen and felt easily. This imprint disappears within seconds, and the exact duration indicates the severity of the oedema. Oedema must then be sought on the other leg also: only bilateral oedema has nutritional implications.

Appetite

Kwashiorkor usually occurs with anorexia, except if it is strictly dietary and when oedemas develop rapidly in the absence of precipitating or concurrent infection; this is rare. Vomiting is frequent and complicates the initial treatment.

Mood

Small children are usually apathetic or lethargic, and grow irritable when cared for and subjected to feeding. They cry easily. The same apathetic behaviour is noted in older patients, but these are less irritable and are easier to care for.

Facial features

Before the face itself is affected by oedema, it shows swelling, chubby cheeks, and enlarged lower eyelids. Dark skin grows lighter. The first impression might be that the child is in fact overfed. The miserable demeanour, compounded by the other clinical signs (particularly bilateral oedema of the lower limbs), should quickly dispel any doubts, however.

Hair

The effects of kwashiorkor on hair are usually more obvious than in marasmus. Hair discolours and may turn auburn-red, sometimes a pale muted blonde tending towards grey. It thins, loses its lustre, and becomes brittle.

Skin

Skin lesions, or kwashiorkor dermatosis, can be spectacular; they are however not systematic and their severity varies greatly, as does their extent. They usually appear first on the legs, followed by the arms and buttocks, in the form of dark, irregular-shaped spots; ultimately, they look similar to burns, and ulceration is common. The skin where the lesions occur is cracked, fine, and desquamated (dry and flaking); it peels easily, and a pinkish discolouring may occur around the darker spots. Kwashiorkor dermatosis has frequently been associated with that occurring in the case of pellagra; however, they cannot be confused because their location and appearance differ. Besides, niacin alone remedies pellagra dermatosis easily, but has no effect on kwashiorkor dermatosis. Patients may, however, suffer from both.

Hepatomegaly

Hepatomegaly (i.e. the enlargement of the liver beyond its normal size), owing to lipid retention, is common. Post-mortem analysis suggests that lipid retention is systematic in kwashiorkor, but it can be more or less significant and may therefore not result in hepatomegaly. The latter may contribute to abdominal swelling, in addition to helminthic (parasite worm) infection and intestinal gases.

Wasting

Wasting can occur to varying extent. Generally speaking, subcutaneous fat is usually preserved and muscle loss unobtrusive. The combined condition called marasmic kwashiorkor discussed below nevertheless presents serious wasting in association with oedema.

Other clinical signs

Kwashiorkor is often associated with Type I nutrient deficiencies, and the clinical signs of such deficiencies are thus common.[18] It is also usually accompanied by diarrhoea resulting from intestinal infection. Finally, pallor of the conjunctive tissue signals anaemia, which is also frequently concurrent.

Pathophysiological aspects

In kwashiorkor, arrested growth provides the global manifestation of severe malnutrition. Like marasmus, it results in the third clinical disorder, nutritional dwarfism. The reduction in physical activity that is typical of kwashiorkor results much less than in the case of marasmus from muscle loss and energy saving; it rather results from the patient's morbid state and apathy. Unlike marasmus, which results from an adaptation, kwashiorkor indicates the failure of an attempted adaptation. All the responses of the organism are pathological from the onset, which is why it is so serious.

The fact that kwashiorkor oedema is the outcome of a nutritional disorder is widely accepted. However, oedema is not a problem in itself: it signals deeper problems. Several hypotheses attempt to explain its origin, the most widespread being the following:

- ⇨ protein deficiency or imbalance, in which the energy supply via glucides is excessive with respect to the protein intake – imbalance may arise, with or without concomitant infection;
- ⇨ aggression by oxidizing agents, particularly the free radicals resulting from infection among others, and related to a dietary deficiency in reducing agents;
- ⇨ aflatoxin intoxication caused by the mould that frequently contaminates cereals and legumes stored in humid conditions and/or have not been adequately dried.

Experience has shown that kwashiorkor may well be associated with all the above aspects. Kwashiorkor oedema in fact appears to be no more than an indication of different physiological disorders – bearing in mind that they may be connected. Furthermore, bilateral oedema of the lower limbs may be unrelated to malnutrition, but arise from posture (similar to the possible consequences of long aeroplane flights), kidney insufficiency and/or cardiac insufficiency.

Protein deficiency (or a low protein/energy ratio) associated with a non-limiting energy intake causes a hormone response in the form of elevated insulin levels and low cortisol levels; this promotes the utilization of amino acids by muscle rather than the liver. The result is a reduction in the albumin and lipo-protein synthesis by the liver. The albumin synthesis reduction causes hypoalbunaemia (i.e. insufficient amounts of albumin proteins in the blood) and, thus, a diminished osmotic plasma pressure, which in turn causes oedema. The reduction in lipo-protein synthesis diminishes the

[18] The clinical signs of specific deficiencies are described in Chapter III, Sections 2.2.5 and 2.2.6, and in this Chapter, Section 2.5.

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transfer of fats from the liver to peripheral tissue and, as a result, induces the infiltration of lipids into the liver. Kwashiorkor epidemics (such as those observed in Uganda, Angola, and Mozambique) and situations documented in the specialized literature demonstrate that kwashiorkor develops when the child's diet is rich in glucides and poor in protein. Furthermore, kwashiorkor is commoner where the diet is based on protein-poor foods, or foods whose protein quality and availability is weak. This dietary imbalance is common in populations whose staple food is cassava.

In Angola, kwashiorkor epidemics develop during the mango season, because small children feast on the fruit and lose their appetite for anything else. Fruit collected off the ground is exposed to soil contamination, and rapidly causes diarrhoea. But its excessive sugar content with respect to protein – or rather its protein deficit with respect to the overall energy supplied in the form of sugar – may also play a significant role. In Uganda, a kwashiorkor epidemic affected all children (including adolescents) in a stock-breeding community who had abruptly lost its herds, and was thus reduced to a diet of cassava and fruit preserves donated by a charity. Here again, the diet was rich in sugar and poor in protein. This group showed exceptional oedemas. A milk-based diet resolved the problem in a matter of days. In Mozambique, practically the entire population of a specific village showed oedemas; it turned out to be confined to the vicinity of the village, and was due to the fact that people no longer had access to food other than cassava.

The protein deficiency theory has been seriously questioned by observers who have noted the development of both kwashiorkor and marasmus within groups of children in the same environment, and sharing the same diet. But children differ in terms of their nutritional needs: in some, energy is the limiting factor, and such children would be more prone to marasmus, whereas in others protein is the limiting factor, exposing them rather to kwashiorkor (Waterlow, 1992). It should also be noted that protein deficiency, or a diet providing a low protein-energy ratio, almost always entails deficiency in other nutrients, particularly Type I because the latter are often associated with protein in food, and thus with protein-rich foods.

On the Angolan Planalto, in the 1980s, specific kwashiorkor and marasmic kwashiorkor cases were caused directly by infection, without initial declared dietary deficiency. Such cases required appropriate antibiotic treatment. The mothers' testimony suggested specific vulnerability to infection – these are found everywhere, whatever the environment. In these specific cases, the lack of timely care promoted the spread of the infection, and a monotonous diet probably deficient in vitamins and minerals prompted anorexia – these were the determining factors. In the same context, a therapeutic feeding centre readmitted for several successive years the same children who experienced respiratory and gastro-intestinal infections at the onset of the rainy season, and who developed kwashiorkor. These cases could be tracked, and demonstrated that neither the diet, nor their families' socio-economic circumstances, nor hygiene were determining factors. Besides, several had siblings in perfect health. Most of the children survived and, beyond 5 or 6 years, no longer developed serious infection or kwashiorkor during the rainy season. Infection may of course worsen primary protein deficiency, or even precipitate it; infection generates large quantities of bacteria that thrive on the amino acids of the host. It is plausible for one of the essential amino acids to become a limiting factor, producing the same effect as an overall protein deficiency.

Golden suggests the free-radical hypothesis as a global theory of kwashiorkor. It states that practically all the characteristics of kwashiorkor can be explained by the uncontrolled production of free radicals (Golden, 1985). This theory states that the inability of the organism to defend itself adequately against free radicals is directly associated with primary and/or secondary dietary inadequacy. The theory of free radicals assumes that the liver of children who develop kwashiorkor has been exposed to oxidative stress, that is, an imbalance between the generation of free radicals and their disposal, exposing the liver to free-radical damage. The damage ascribed to free radicals has been demonstrated by laboratory tests. However, the fact that free radicals or their products (or the consequences of their activity) are indeed the cause for oedema remains to be demonstrated. The theory is nevertheless interesting and deserves further investigation because it invites the scrutiny of the biochemical mechanisms whose role is believed to be more complex than current knowledge suggests. Moreover, the theory provides an answer that, if verified, binds all the characteristics of kwashiorkor together. What remains to be demonstrated, therefore, is whether excess free radicals always induce kwashiorkor, or whether they are one cause among others, particularly protein deficiency and secondary deficiency due to infection. It is understood that all three causes may combine, resulting in the most serious clinical cases and the most pessimistic prognoses.

The aflatoxin theory states that the latter contribute, in particular, to liver disorder: the aflatoxin detoxification capacity of children suffering from kwashiorkor is lower than that of healthy children. However, it remains unclear whether this reduced ability is the cause or consequence of kwashiorkor, or whether it is rather associated with specific genetic factors (Ramjee, 1992). The role of aflatoxins is included in Golden's theory.

In terms of humanitarian operations, Golden's overall approach is not incompatible with the fact that kwashiorkor may have different, associated or independent, causes. Specific circumstances must be allowed for in assessing specific cases. Kwashiorkor, and marasmic kwashiorkor even more so, always expresses an adaptation problem of the organism whose outcome may be fatal. It must therefore be established whether kwashiorkor results primarily from infection, dietary protein deficiency, suspected aflatoxin intoxication, or a combination of causes. Infection has been proven to precipitate kwashiorkor (which is thus secondary): examples include measles outbreaks followed by kwashiorkor epidemics. In some situations, primary kwashiorkor (or, as discussed here, "*dietary kwashiorkor*") predominates: this is sometimes the case in hospitals, prisons, and in specific famine conditions. In such cases, infection plays virtually no role, and oxidant or toxic aggressions are absent also: protein deficiency combined with the probable deficiency in other nutrients is the direct cause. Finally, the aggravating effect of aflatoxins is notorious, and they may even be the trigger. Specific circumstances require specific action in terms of prevention and, to a certain extent, treatment (specific medical care) – the nature of the problem must therefore be understood.

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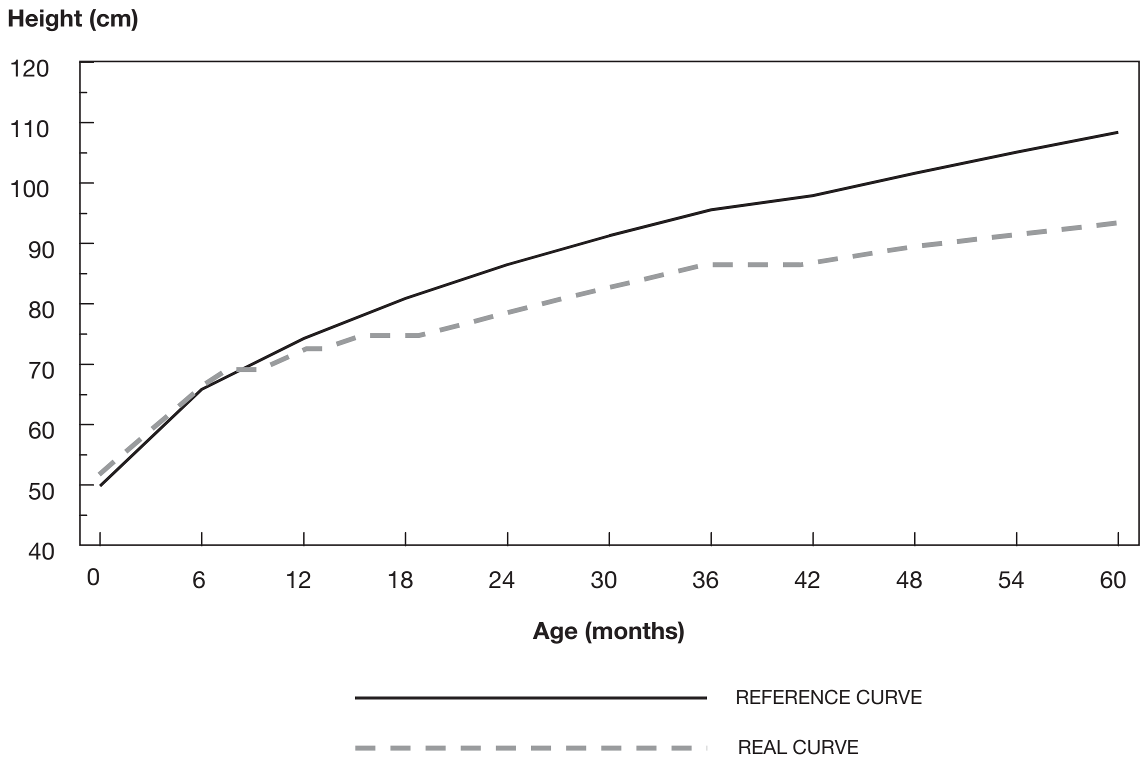
Marasmic kwashiorkor

Kwashiorkor oedemas appear at different stages of wasting; when wasting is considerable, however, the problem is called marasmic kwashiorkor. Marasmic kwashiorkor calls for the most pessimistic prognosis, particularly if it combines with septic shock. It usually results from protracted diarrhoea, which could lead to significant potassium deficiency. Another common disorder, hyponatraemia (i.e. low plasma sodium) indicates significant cell damage; it is the main cause for prognosis pessimism. Marasmic kwashiorkor can present all the characteristics of marasmus and kwashiorkor.

2.4.5 Nutritional dwarfism

Nutritional dwarfism or stunting refers to a grossly insufficient height at a given age; it can also be called growth failure. It can usually only be detected by comparing the subject's height with the reference height for his age group. Individuals who have suffered from arrested growth usually share the same characteristics as other individuals of the same height, and remain healthy. Stunting may therefore be described as the stigma of failed growth, insofar as the latter is arrested or fails if the conditions for catch-up are not met. Retardation then continues to increase, as illustrated in Figure 8.4 below.

Figure 8.4 Growth retardation causing nutritional dwarfism – evolution of height according to sickness and malnutrition episodes



In the above example, growth retardation at 60 months lies 12% below the standard – this amounts to moderate malnutrition according to the Waterlow classification provided earlier.

Growth retardation is not irreversible, provided that specific conditions are met. These include a healthy diet, the appropriate and timely treatment of ailments and, thus, an appropriate level of healthcare and attention. Growth retardation that is associated with an unfavourable social and economic environment offers little chance of recovery, at any rate during infancy. It should be noted that weight loss and gain can be rapid, whereas height catch-up is slow, if it occurs at all. Data on growth retardation catch-up demonstrates that it is secondary to weight catch-up. Statural growth only resumes once weight has recovered to a given point – approximately 85% of the standard; furthermore, height catch-up only begins after a given period after weight recovery – approximately 2 to 3 months (Waterlow, 1992).

An individual suffering from major growth retardation is not necessarily ill, and therefore does not usually require urgent action; but the underlying causes for this retardation must be ascertained in order to determine whether such an individual qualifies for humanitarian attention. In other words, the observer must be capable both of assessing growth retardation, and of understanding its causes. Finally, the relevance of intervention must be appraised in order to determine whether it falls within the realm of humanitarian action.

The validity of anthropometric reference curves

Nutritional dwarfism can only be measured by comparing the subject's height with the standard provided for the same age group by reference tables. A natural question immediately arises as to the validity of the data contained in these tables, in view of obvious ethnic and regional differences. This leads to the concept of genetic growth potential and environmental factors. The reference curves that are commonly used and recognized by the WHO today are those produced by the United States National Center for Health Statistics (NCHS), based on North American subjects; these tables are unfortunately obsolete and no longer comply with modern growth curves developed in other industrialized countries; the main reason for this is that the NCHS data is based on artificially fed children, whereas the latter refers rather to breastfed children, and thus induces slower statural and ponderal growth. The questioning of the curves based on NCHS data is therefore reasonable, particularly in view of the disorders occurring in later life that are associated with artificial feeding in infancy (e.g. obesity and cardio-vascular disease). Furthermore, many studies have highlighted significant differences between growth curves relating to different ethnic groups. Among others, Van Loon and his collaborators have advocated in favour of the use of national, or even ethnic, reference curves, particularly if their intended use is the screening of malnourished children. The logic behind this move is that local reference curves reflect an acceptable growth pattern in a given environment, according to the genetic growth potential of the group under consideration. In many tropical countries, the environment has a significant impact on growth; the use of local reference grids facilitates the selection of actual retardation with respect to the standard that is specific to the context. NCHS reference data applies to a larger number of cases, many of which, however, prove to be false positives. Evidently, the public health response to the problem will vary greatly depending on the incidence of growth retardation (Van Loon, 1986).

The relevance of global reference curves thus fuels much justified debate, but the use of local reference curves also raises many questions: the difficulty here relates to the need for reference curves for each ethnic group, and for them to be updated according to climatic variations and the evolution of such groups. The genetic growth potential probably varies from one group to another; however, environmental parameters are known to have far greater impact on growth than genetic potential has (Martorell, 1985). Furthermore, pre-school children from different ethnic groups but from wealthy backgrounds show the same growth potential as children in the United States (Habicht, 1974). These two observations tend to support the use of an international reference grid, based on reasonable wealth as the objective: if a group does not achieve this level, then its living standards must be suboptimal. This approach is adopted here because it also offers the advantage of enabling comparison between different groups, and encouraging the understanding of observed discrepancies. The above-mentioned bias must nevertheless be remembered, and anthropometric malnutrition thresholds must be adjusted according to circumstances and the overall purpose.[19]

The aetiology of nutritional dwarfism

As stated above, reference values only enable the relative detection of nutritional dwarfism, and a margin of uncertainty results between rather specific anthropometric malnutrition thresholds and a sufficiently sensitive threshold. The actual causes of growth retardation must then be clarified. Generally speaking, growth retardation can be ascribed to Type II nutrient deficiencies, hormone disorder, chronic infancy ailments, repeated or protracted infectious episodes, and insufficient psycho-social stimulation. The fundamental contribution of poverty and scarcity to the causes of nutritional dwarfism is also recognized (Waterlow, 1992).

The role of Type II nutrients

Children who suffer from growth failure during primary or secondary malnutrition episodes do so because they lack the nutrients required for their growth in terms of height and weight. In terms of Type II nutrients, growth will occur up to the most limiting nutrient, according to

[19] See also Chapter X, Section 4.4.7.

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the necessary balance between nutrients. Protein and zinc appear to play a significant role in this respect (Waterlow, 1992). Protein and zinc intakes are largely determined by eating habits, the presence of minerals in the environment from which the diet and drinking water are extracted, access to a varied and protein-rich diet, and health status. Clearly, then, growth retardation results from a major economic, social, cultural and environmental determinism. But growth retardation may equally be attributed to unfavourable living conditions whose impact restricts access to food and impairs health; it can also be ascribed to an environment that is deficient in one of the Type II nutrients, when living conditions and health may well remain satisfactory. In the first case, the necessary response is an improvement in living conditions; in the second case, a foodstuff consumed by the entire community should be fortified in the deficient nutrient(s), as is done by adding iodine to salt.

The role of anorexia

Anorexia is a loss of appetite that expresses itself in an insufficient food intake. It leads to growth retardation if it is protracted or repeated without sufficient recovery periods between episodes. Anorexia may result from illness, a monotonous diet or one that is deficient in one or several Type II nutrients, and insufficient psycho-social stimulation. Anorexic subjects do not necessarily stop eating entirely, but lose appetite and thus can no longer meet their nutritional needs. The eventual lack of Type I and II nutrients may induce both specific deficiencies and malnutrition, which can become severe. Dietary monotony is a common cause of anorexia, particularly among small children; it is also found among inmates whose diet is limited to one or two foodstuffs (such as maize and beans) that are cooked without culinary care. Anorexia related to solitude and the loss of dynamism is also a major cause of nutritional degradation in the elderly.

The role of sickness

The relation between growth retardation and chronic and metabolic illnesses, and infectious disease seems obvious. The first two types of disorder are essentially individual, and infectious disease is therefore of greater interest to humanitarian action, because it can affect large numbers and develop into epidemics. Waterlow concludes that the relation no doubt exists, but does not explain everything. Indeed, growth retardation always results from the balance of a triple interaction: the impact of infection, the duration of anorexia, and food availability. In individuals and groups alike, this balance is determined by age, sex, the time and care devoted to patients, and diet. Measles is the infectious disease that appears to have the greatest impact: its energy balance is highly deficient during fever episodes, and it can induce protracted anorexia (Waterlow, 1992). On the basis of his observations in Bangladesh, Briend concludes that diarrhoea may have a significant effect on growth retardation statistically, but the resulting retardation is slight and temporary (Briend, 1989). In other words, provided that adequate care is delivered, convalescents have a good chance of catching up their statural growth deficit. Nevertheless, the role of intestinal parasites in growth retardation must not be underestimated, although the relation is not systematic: as discussed above, infection is a known precipitating factor in kwashiorkor because of the combined effects of infection on the biological utilization of food and objective dietary deficiency, particularly in Type II nutrients. Kwashiorkor is proven to cause growth retardation.

The role of scarcity and famine

Scarcity and famine cause an overall reduction in food intake; this can lead to marasmus, kwashiorkor, or their combined form. In addition to an inadequate dietary intake of Type I and II nutrients, changes in eating habits, a poor quality or monotonous diet can cause anorexia related to food insufficiency and malnutrition. Furthermore, the loss of resistance to infectious disease can increase morbidity, which also causes anorexia and perturbs the metabolism and the biological utilization of food.

In short, the above considerations demonstrate that growth retardation always results from a dietary deficiency in Type II nutrients, for different reasons that may combine:

⇨ some Type II nutrients are usually insufficient in the diet, without resulting in crisis as defined above – growth retardation occurs slowly;
⇨ anorexia is protracted or repeated, arising from illness, neglect or a monotonous or abruptly insufficient diet – growth retardation occurs in steps;
⇨ food access is restricted abruptly and causes marasmus and/or kwashiorkor – growth retardation likewise occurs in steps.

However, growth retardation only occurs if catch-up is inadequate, that is, if the diet remains more or less deficient in Type II nutrients during growth. The reasons for this include the following, and they may combine:

⇨ ecology and living conditions, in the absence of crisis;
⇨ poverty and scarcity, in the absence of crisis;
⇨ anorexia and under-nourishment on such a scale as to impede full catch-up – this always indicates protracted or repeated crisis.

The implications of nutritional dwarfism

Growth retardation may be associated with the following disabilities, summarized according to Waterlow (Waterlow, 1992).

The work capacity of adults suffering from growth retardation is inferior, to the point that short individuals find employment with greater difficulty than taller individuals. In women, a limited height is associated with problems in childbirth and an increase in infant mortality. The immune function of children having suffered from growth retardation is inferior, and diarrhoea episodes last longer, in spite of their occurrence being no greater. But mental development is also impaired, and this is more serious. Even if growth retardation is sometimes reversible, public scrutiny of individuals with mental disabilities can jeopardize their future seriously.

It should be noted that the mental retardation mechanism results less from alterations of the central nervous system during critical malnutrition episodes than from a lack of interaction with the environment. This is due to the fact that the generally apathetic and irritable countenance of severely malnourished children tends to invite the rejection of their environment, resulting in a lack of interest, care and attention. This deprives the patient of the stimulation required for his balanced physical, mental and social coming of age (i.e. maturation).

Below a given threshold, growth retardation thus clearly becomes a problem. Above this threshold, its interpretation is controversial. Some view it as a useful adaptation: a short but healthy individual has a better chance of coping with food intake restrictions thanks to his lower nutritional need (Seckler, 1984; Pacey & Payne, 1985). Others, particularly Gopalan, consider that growth retardation must be interpreted as a sign of malnutrition as soon as it is detected (Gopalan, 1983). The adaptation hypothesis is valid as long as the threshold – separating harmless adaptation from that entailing functional damage – is marked. On the other hand, dysfunctions associated with growth retardation that increase with it in a continuous manner call the adaptation argument into question. This aspect is, however, not clearly defined. In terms of mortality, there appears to be a difference. In terms of physical effort, it diminishes regularly. In terms of mental retardation and resistance to infection, it is unknown (Waterlow, 1992).

Moreover, the distance is great between a normal growth status and growth retardation indicating severe malnutrition. Growth retardation may well be instantly interpreted as heralding malnutrition, but slight and moderate growth retardation by no means has the same implications as severe retardation; in addition, the implementation of nutrition policies anyway requires the setting of thresholds to distinguish acceptable from unacceptable statuses. Furthermore, severe retardation (i.e. < 85% of the standard height-for-age) occurring in a 2-year-old child does not hold the same implications as a severe retardation of similar magnitude in a 20-year-old (or even 6). More complex still: is the lower immune function observed in children suffering from growth retardation a result of retarded growth? Or is it its cause? Or is it an associated factor? If growth retardation results from an impaired immune function, then the problem is rather individual and difficult to resolve from a humanitarian perspective. If not, then preventing growth retardation should be a priority in public health. As long as this quandary remains unresolved, action is limited.

Operational consequences

Growth retardation results from inadequate living conditions during growth; the question thus arises as to whether it affects a significant proportion of the population, or isolated individuals. In the first case, the exposed population is significant, and timely protective and preventive measures must be taken accordingly. In the second case, serious growth retardation (< 85% or <–3 Z-scores from the height-for-age standard) probably reflect extreme vulnerability to the environment, or isolated cases that illustrate an intrinsic failure of the family cell; such cases are found universally, including in the paediatric units in wealthy societies. They do not represent a public health priority, and their relevance to humanitarian action is negligible. In crises, however, where scarcity and unfavourable living conditions prevail, a significant proportion of the population is likely to develop growth retardation and require action.

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Prevention is probably the most appropriate action, because curative care is considerably longer and more uncertain. Here again, humanitarian operations related to nutrition must involve measures to ensure adequate water and environmental hygiene, and ensure minimum access to healthcare. The family cell and parent confidence must also be strengthened, particularly with respect to mothers, in order to ensure the physical and psychological wellbeing of children.

2.4.6 Severe malnutrition and infection

The relation between malnutrition and infection is important. Infection can alter the nutritional status by causing secondary malnutrition, whereas primary malnutrition can affect the liability to infection and its invasive process. This may lead to a vicious circle in which infection and malnutrition reinforce one another, entailing high mortality rates. The mechanisms that are involved in the relation between malnutrition and infection are highly complex, and do not warrant further discussion here.[20]

The effects of malnutrition on infection

The ability of infection to spread in the host organism contributes to the severity of the infection. This capacity is shaped by the means of defence of the host, and by the integrity of its tissue (tissue contributes to the organism's defence mechanisms). In critical forms of severe malnutrition, the means of defence are seriously impaired, while damaged tissue is prone to infectious invasion. As a result, severe malnutrition increases vulnerability to infection, prolongs its duration, and aggravates

[20] The topic is discussed in greater detail in the literature quoted in reference: Shils, 1994, and Waterlow, 1992.

its effects on the organism. Indeed, malnutrition reduces the availability of basic nutrients for the host, and thus for infection also – this may impair or impede infectious development. However, the impact of malnutrition on the immune[21] and non-immune systems must also be allowed for in this approach. The more serious malnutrition is, the more defence is weakened and the more this aspect influences the invasive potential. Furthermore, the effects of severe malnutrition on infection are clear; but the effects of mild to moderate forms of malnutrition are rather more ambiguous (Waterlow, 1992). There is probably a critical threshold below which damage associated with malnutrition promotes infection.

Severe malnutrition always combines with vitamin and mineral deficiencies, some of which may play a crucial role in infection.

Vitamin A

The role of vitamin A in protection against infection is capital: it contributes significantly to the state of mucous membranes (and, hence, resistance to invasion), and to the cell immunity and lysozyme activity.[22] Even sub-clinical vitamin A deficiency increases liability to diarrhoea and respiratory disease; vitamin A supplementation can reduce mortality by approximately one-third (Tomkins, 1989). Vitamin A is especially important in mitigating damage and mortality in measles (Shils, 1994).

Iron

Iron contributes significantly to many functions of the organism, but it is also an indispensable growth factor for most infectious agents. This raises questions as to the possible benefits of iron deficiency in terms of protection against infection, while at the same time depressing immunity and increasing morbidity. Tomkins and Watson have reached the following conclusions regarding this quandary (Tomkins, 1989):

- ⇨ iron deficiency is associated with:
  - → a reduction in cell immunity and bactericide activity, while humoral immunity is relatively spared;
  - → an increase in the prevalence of respiratory disease, diarrhoea, and malaria;
- ⇨ the effects of iron supplements are:
  - → the regular oral intake of limited doses may reduce morbidity;
  - → the oral intakes of significant doses may increase morbidity, particularly among wasted subjects whose environment is contaminated;
  - → the injection of iron doses probably has no effect on the morbidity of children whose environment is healthy;
  - → the injection of iron doses probably increases morbidity and even mortality among children and pregnant women whose environment is contaminated.

Clearly, the priority should be to treat and prevent infection before instigating iron supplementation, particularly in wasted individuals. Moreover, exceptionally high iron levels are frequently observed in subjects suffering from critical forms of severe malnutrition; levels are higher in the case of kwashiorkor than marasmus, and are associated with proportional mortality levels (Waterlow, 1992). Because iron is also a growth factor for infection and promotes the formation of free radicals, care must be exercised in administering it.

[21] See also above, the effects of marasmus on the immune system and on the response to infection.

[22] Lysozyme: an enzyme that kills some bacteria by attacking their cell lining.

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Zinc

As a Type II nutrient, zinc plays an essential role in the organism, and is thought to be determining in resistance to infection. But it is precisely because it is a Type II nutrient that the definition of its exact role is difficult. Moreover, measuring the zinc status is difficult. Sub-clinical zinc deficiency most probably combines with a general and proportional deterioration of the nutritional status; an adequate nutritional therapy must include zinc in the concentrations required to correct possible vulnerability to infection due to zinc deficiency. Excess zinc inhibits immunity (Tomkins, 1989).

Other minerals and vitamins

Deficiency in other vitamins and minerals (such as riboflavin, folic acid, vitamin C, and iodine) is, probably correctly, assumed to play a role in the vulnerability to infection, and in the impact of its spread. But this assumption remains to be demonstrated with certainty. Once again, the emphasis should be on a global approach to the prevention and treatment of malnutrition, with a view to protecting health; this would most probably result in most nutritional factors promoting infection to be kept under control.

Conclusion

Infectious agents must also satisfy their nutritional needs, and therefore compete with the host organism. This means that, in the early stages of the treatment of severe malnutrition, when the defence of the organism remains weak, the infectious agent will thrive on the nutrients made available; as a result, it may delay recovery or even dominate. Infection must therefore be prevented and treated at the onset of nutritional catch-up, and the administration of iron must be withheld as long as infectious signs persist and the organism remains unable to benefit from the catch-up diet.[23]

The effects of infection on the nutritional status

The impact of infection on the nutritional status may be ascribed to various factors that can combine.

Restricted food consumption

This restriction is associated primarily with anorexia; it consists of a loss of appetite caused by a mechanism that remains not fully elucidated, but appears to involve cytokines, which are molecules that are produced and released by macrophages in response to infection. Anorexia is the main cause of secondary malnutrition. When it combines with infection, it restricts the appetite for solids more severely than that for liquids (maternal milk is particularly well tolerated). As a result, maternal breastfeeding must clearly be encouraged and preserved in case of infection (Waterlow, 1992).

Food consumption may also be impaired, and even suspended owing to vomiting, abdominal pain and discomfort, and lesions to the upper digestive tract (particularly the mouth). This form of anorexia has different causes, and plays a less significant role than that described above.

Eating habits may also influence matters, particularly in children who depend on their parents' medical or other beliefs. A common habit consists of depriving feverish patients of food; others

[23] See Chapter XIII, on therapeutic nutrition.

involve the banning of some foods during infection, particularly in the case of diarrhoea. Justifications for such practices exist, of course, but they are deleterious overall, particularly when they relate to specific taboos applied indiscriminately. The belief that food must be restricted in order to respond to infection properly is widespread; although it may be advantageous in initially well-fed patients, it can be harmful in already seriously malnourished individuals.

Malabsorption

Many infections, be they systemic or local, induce diarrhoea; gastro-intestinal infection usually manifests itself in diarrhoea also. Diarrhoea reduces the absorption of macro-nutrients (i.e. lipids, protein, and glucides) by initially nutritionally healthy individuals by 10 to 20%. Micro-nutrient absorption is likewise impaired, particularly in the case of vitamin A and iron. Malabsorption is worse still in already malnourished patients.

Metabolic losses

The organism responds to infection with fever, by improving the efficiency of the immune system, which is more active at 39°C than at 37°C. This performance entails a metabolic cost that is estimated to be an increase of the energy spending of around 10 to 15% per degree of body temperature increase. Moreover, infection and wounds induce a negative protein balance as a result of the increased degradation of muscle protein, itself arising partly from an altered utilization of energy producing substrates.

Intestinal losses

The cell turnover of the intestinal mucous membrane is rapid; discarded cells terminate in the intestine, where they are dismantled. In normal circumstances, their components are well reabsorbed – but not in case of infection. Furthermore, damage to the intestinal mucous membrane increases the disposal of mucous cells into the intestine, thus involving nutrient leakage. In addition, some parasites cause bleeding.

Some types of infection deserve particular attention here owing to their prevalence and/or severity. However, this should not suggest that infections that are not discussed here are harmless in terms of the nutritional status; any type of infection has consequences, but to varying degrees depending on the seriousness of the infection. This holds particularly true for respiratory infection.

Diarrhoea

Diarrhoea is the commonest illness in children, with a prevalence peak between the end of the first year and the second. This is due to the foreign pathogens found by the child in its diet during weaning, and in its environment. Diarrhoea is also a secondary disorder to many types of infection (e.g. malaria, measles, and otitis). Where poverty prevails, the environment is often highly contaminated, and climatic factors (hot and humid conditions) promote this contamination. Diarrhoea is diagnosed as of a frequency of three occurrences of liquid stool per day. A diarrhoea episode usually lasts between three and seven days (Waterlow, 1992); it is considered to be persistent beyond 14 days, and this is the case in 3 to 20% of all diarrhoea episodes, depending on their geographical location (WHO, 1988a). Primary persistent diarrhoea is usually caused by the *Escherichia coli* and *Shigella sp.* bacteria; it is often secondary to measles and tuberculosis, but may also arise from allergic reaction, for example to cow or soy milk protein. It may also express lactose intolerance, but this phenomenon is rare in infants. A large proportion of persistent diarrhoea affects children with a low birth weight (i.e. lower than 2.5 kg) because their immune system may be deficient. Maternal breastfeeding is a major diarrhoea prevention and control mechanism, explaining why the prevalence peak is situated towards the end of the first year. In terms of nutrition, the effects of diarrhoea include anorexia, malabsorption and intestinal losses; this may eventually lead to weight loss and marasmus or kwashiorkor, in addition to specific deficiencies in the case of persistent diarrhoea. In the long run, repeated diarrhoea episodes (persistent or not) result in growth retardation.

Measles

Measles is rightly considered to be one of the most frightening childhood illnesses in the tropics. Its seriousness results from the following:

- ⇨ the illness itself puts the organism under considerable stress;
- ⇨ it is often complicated by the infection it causes, such as diarrhoea (persistent or not), and infections of the respiratory tract;
- ⇨ it often results in full-fledged epidemics of critical severe malnutrition, particularly kwashiorkor;
- ⇨ it depresses immunity for up to several months, opening the way for further infection;
- ⇨ its impact on the vitamin A status is serious because it impedes its absorption, increases its excretion, reduces its transport capacity from the liver to peripheral tissue, and increases its consumption in order to repair epithelial surfaces that have been damaged by the virus – in the tropics, the combination of measles and vitamin A deficiency is the greatest cause for blindness in children (Waterlow, 1992).

Severe malnutrition resulting from measles is caused by associated long-term anorexia (i.e. lasting several weeks), in addition to the other disorders that complicate and follow it. Anorexia is worsened by high fever and oral lesions. Furthermore, taboos and local beliefs frequently apply to measles, entailing a reduced food intake. Measles also causes malabsorption, the increase of needs associated with fever, and intestinal losses.

Tuberculosis

Tuberculosis is again becoming a major public health problem, affecting the entire world. Cachexia[24] associated with tuberculosis is a familiar phenomenon since the disease is a cause of severe malnutrition, and impedes nutritional treatment until the chemical treatment of tuberculosis begins. Untreated adolescent tuberculosis patients in a therapeutic feeding centre on the Angolan Planalto in 1983 were observed to lose weight at the same rate as their food intake increased; only after the inception of chemical tuberculosis treatment did they begin to regain weight. In other words, if critical severe malnutrition is suspected to be associated with tuberculosis, national health services (or agencies in charge of tuberculosis control) must become involved, owing to the complexity of the problems induced by tuberculosis. Difficulties include, among others, the diagnosis itself, and the detection of possible resistance to the treatment. With respect to the diagnosis, if nutritional catch-up does not occur in spite of the treatment for malnutrition, if there is no other obvious pathology, and if tuberculosis is suspected to be the underlying problem, chemical treatment must be initiated. However, measures must be taken to ensure that patients receive adequate care for the entire duration of their treatment; these conditions may be difficult to meet, particularly in the contexts that are typical of humanitarian operations. When conditions are adequately met, then weight gain afterwards confirms the diagnosis. In terms of possible resistance, competent health professionals must be consulted with a view to defining an appropriate strategy.

[24] Cachexia is a state of extreme wasting and general fatigue related to undernourishment and the terminal phase of serious disease.

Malaria

Malaria resulting from *Plasmodium falciparum* has the most serious consequences on the nutritional status. However, the degree of immunity, or exposure, also contributes significantly. Malaria entails the same type of metabolic reactions as any other systemic infection, particularly nitrogen loss; it induces haemolytic anaemia. It depresses immunity, thus raising the prevalence and severity of infections such as diarrhoea and respiratory disease – this has additional consequences on the nutritional status (Waterlow, 1992).

Intestinal parasites

All intestinal parasites have some impact on the nutritional status; they cause growth retardation, mild to moderate wasting, anorexia, anaemia, and diarrhoea. The significance of such symptoms is determined by the spread of the infestation and its duration, and is aggravated by a poor nutritional status. The commonest infection is caused by intestinal roundworm (*Ascaris lumbricoides*): it results in the greatest accumulation of parasites, to the point of rendering weight-based anthropometric measurement irrelevant. Moreover, all communities appear to include some individuals with a greater accumulation of ascaris – hence the expression "wormy people" (Waterlow, 1992). Ascaris infection frequently causes significant anorexia. Infection caused by whipworm (*Trichuris trichura*), when it combines with weight loss, growth retardation and anaemia, can also result in oedema (Waterlow, 1992). Infection by hookworm (*Ankylostoma duodenale*) results in iron and protein deficiency, and is a major cause of nutritional oedema in adults in areas where it is endemic (Waterlow, 1992). Giardiasis (*Giardia lamblia*) is a common infection that affects virtually the entire population in areas where it is endemic. Infection usually occurs during the first year, and its effects vary according to the individual and the giardiasis strain. It may cause violent diarrhoea that can become persistent and lead to significant malabsorption, which is conducive to critical severe malnutrition. In some regions, infection affects most children suffering from critical severe malnutrition.

Acquired Immune Deficiency Syndrome (AIDS)

Like tuberculosis, AIDS is a cause of critical severe malnutrition: the latter always accompanies the terminal stage of the illness. It results from pronounced anorexia, the eating difficulties caused by oral lesions, malabsorption related to diarrhoea, and the aggravating effects of associated infections. Usually, the manifestation of recurrent infection suggests the presence of AIDS. Like tuberculosis, AIDS is difficult to detect in the situations that are typical of humanitarian operations. Moreover, the two illnesses often combine, without it being possible to confirm this. The lack of response to nutritional treatment on the part of patients suffering from critical severe malnutrition should suggest AIDS infection (or tuberculosis, as discussed above).

The interaction between malnutrition and infection

In view of the two previous points, the relation between infection and malnutrition implies reciprocal causality; this can give rise to an interaction[25] in which infection and malnutrition reinforce their mutual severity in a process that may spiral and is commonly fatal. This interaction, and the main contributing factors, is illustrated in Figure 8.5 below.

[25] The expression "malnutrition-infection complex" is commonly found in the literature. This Manual prefers to refer to "interaction": although more restrictive, the word is considered to be more self-explanatory.

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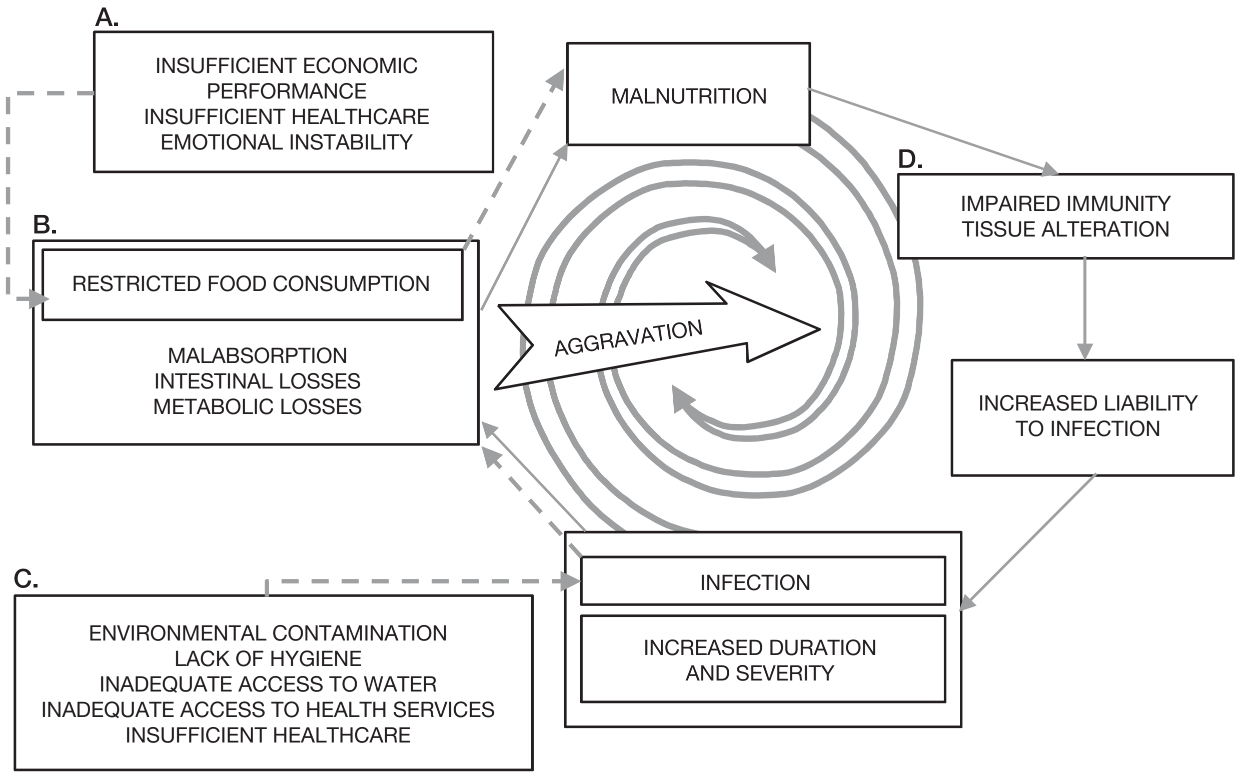
Figure 8.5 The interaction between malnutrition and infection



Box A: factors of primary malnutrition

Box B: factors of secondary malnutrition

Box C: factors of primary infection

Box D: factors of secondary infection

- - ▶ : primary cause inducing the interaction

——▶ : secondary cause initiating the interaction

Primary and secondary causes combine as of the inception of the interactive process between malnutrition and infection.

Figure 8.5 demonstrates that, although this interaction is the major cause for infant mortality in poor countries, primary malnutrition and infection launch the process itself; as a result, the latter must be addressed jointly in a prevention approach. In terms of humanitarian operations, this emphasizes the necessary integration of assistance programmes in a broad definition of health and, as a result, a combined response in preventing and treating malnutrition and infection.[26]

[26] This approach is discussed in greater detail in Chapter IX.

2.4.7 The prognosis and consequences of severe malnutrition

The prognosis of critical severe malnutrition episodes is shaped by:

- ⇨ the possibility of treatment;
- ⇨ the quality of treatment;
- ⇨ the history and causes of the episode, and the history of the period preceding it;
- ⇨ the quality of the social environment.

Critical severe malnutrition that is not treated specifically, or whose causes have not been addressed comprehensively, is usually fatal. The loss of reserves, the resulting metabolic phenomena, infection, and the weakening of vital functions all eventually cause the patient to lose control over his organism – in other words, he loses his homeostasis and dies rapidly. In crises, the possibility to treat it is determined to some extent by national health services, but mainly by the therapeutic feeding centres run by humanitarian agencies. Establishing such centres nevertheless demands that specific conditions be met.[27] Abolishing the causes on the other hand involves environmental, political, economic, and social parameters that usually lie beyond the control of humanitarian agencies. Nevertheless, action aimed at treating severe malnutrition must also seek to remedy its direct causes, both for ethical and practical reasons.

The quality of the treatment is determined by the expertise of those running therapeutic nutrition facilities (be they official health services or humanitarian agencies), and by the means at their disposal. External constraints must also be taken into consideration; they include security, and the availability and motivation of people accompanying the patients, especially in the case of small children. Whatever the circumstances, the quality of treatment must be no less than the minimum standards set forth in Chapter XIII.

The prognosis is determined primarily by the history and the causes of the episode. It is usually good in the case of primary malnutrition associated with famine, without serious medical complication and addressed in time. But the same famine circumstances affect individuals who are about to die, suffering from oedema, medical complications, and hypothermia – to counter these, the best equipment is virtually helpless. The same comment applies to children who are particularly vulnerable to the stress caused by their environment, who are repeatedly sick and undernourished; they develop a malnutrition-infection interaction that has time to deteriorate into critical severe malnutrition and into serious infectious complications.

Finally, the social environment plays a significant role, in terms both of coping with cases of severe malnutrition, and of recovery.

In addition to serious cases, recurrent cases of moderate to severe malnutrition occur, both primary and secondary, related to the environment, poverty and social misery, who survive as best they can or thanks to having been treated during the critical phase – they recover more or less well each time but sooner or later develop growth retardation.

The relation between a given degree of wasting, or oedematous disorder, and mortality varies depending on the presence of aggression and vulnerabilities that complicate the nutritional problem. For example, individuals with marasmus and a weight-for-height index below 60% have been known to nevertheless be in reasonably good condition and recover well in arid and dry settings; elsewhere, at the onset of the rains, climatic factors and exposure to disease resulted in an almost 100% mortality in children whose weight-for-height index lay below 60%.

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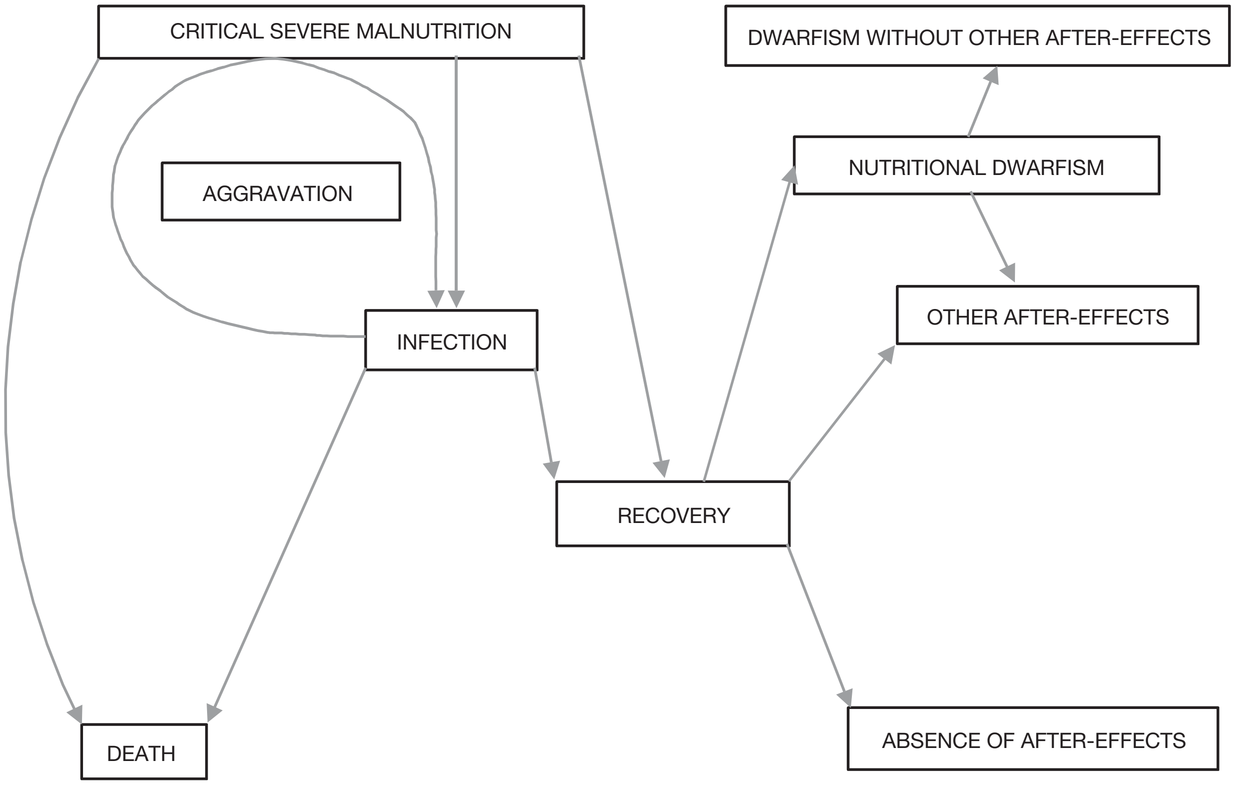
[27] See Chapter XIII.

The consequences of severe malnutrition are clearly determined by the prognosis and the parameters surrounding it. They may cause death, result in complete recovery, or cause nutritional dwarfism with or without after-effects, as illustrated in Figure 8.6 below.

Figure 8.6 Possible evolutions of severe malnutrition



The primary consequence of critical severe malnutrition may be growth retardation if the conditions for height recuperation are not met. However, as discussed in Section 2.4.5 above, nutritional dwarfism may be associated with a number of disabilities; the most worrying of these are behavioural change and mental retardation. The question thus arises as to whether repeated episodes of critical severe malnutrition eventually lead to mental retardation, independently of dwarfism; such consequences are sometimes quoted among the after-effects of famine, and are sometimes exploited by the media in a disturbing way. In fact, they are difficult to identify accurately, and do not always materialize by far; they may also result from different causes. Care must therefore be exercised in, for instance, forecasting the effects of famine on the future ability of a given population to cope with adversity, or those of episodes of critical severe malnutrition on the lifelong mental retardation of children surviving them. The danger of mental retardation is in fact greater among individuals suffering from socio-cultural deprivation in addition to critical severe malnutrition, and who remain undernourished for a lengthy period following the episode itself. Such cases can arise in famine, but are to be ascribed mostly to a pre-existing social environment where poverty and socio-cultural deprivation prevail.

Grantham-McGregor has reviewed the state of knowledge on the matter, and has shown how difficult it is to single out possible behavioural change and mental retardation in relation to malnutrition. Moreover, she finds that, overall, the available literature agrees that malnutrition does have an impact on mental development and retardation, but that the cause and effect relations are more difficult to establish and do not demonstrate a dominant role of critical severe malnutrition episodes as such (Grantham-McGregor, 1992). On the basis of another study conducted in Jamaica, the same author states: *"the mediocre development usually observed in severely malnourished children may possibly be largely explained by factors associated with growth retardation rather than with the acute episode"* (Grantham-McGregor, 1989). If – as assumed in most of the reviewed literature – growth retardation results primarily from poverty and socio-cultural deprivation, then famine probably has little repercussion on the functional and intellectual capacity of its victims, insofar as the latter's socio-cultural level is healthy in normal circumstances. In this respect, appropriate humanitarian action can contribute significantly to the prevention of mental and growth retardation, by enabling victims to regain adequate living conditions rapidly, and by providing them with the means to retrieve their economic self-sufficiency. This is an important social stimulus, and limits socio-cultural deprivation. The reviewed literature unanimously emphasizes the benefits of a stimulating environment (in addition to appropriate treatment) for the physical and mental recovery of the victims of severe malnutrition. The hope of survival and of resumed independence is probably a crucial stimulus, when it is combined with stimulating attention in terms of affection, the motor function, and the sensorial system, in addition to appropriate medical and dietetic care.

In short, there is insufficient evidence to conclude that critical severe malnutrition systematically induces mediocre mental development. On the other hand, if it occurs during the first two years amidst socio-cultural deprivation, it inhibits mental development at least during childhood. The catch-up of this retardation is nevertheless possible, if it occurs early enough and involves the administration of nutritional supplementation and psycho-social stimulation (Grantham-McGregor, 1991).

2.5 SPECIFIC DEFICIENCY[28]

Specific deficiency relates to Type I nutrients. It manifests itself through a decrease in the reserves of a specific nutrient, followed by a reduction in its tissue concentration, and the appearance of clinical signs. The presence of clinical signs indicates that the deficiency is overt and declared, and physiological damage is usually well advanced. However, sub-clinical deficiency levels already have serious consequences, and protracted marginal deficiency is suspected to sometimes have grave repercussions on the functions (not yet fully understood) of the deficient nutrient(s). Prevention should therefore encourage the adjustment of possibly deficient diets, before the appearance of clinical signs of deficiency.

This Manual deliberately concentrates on deficiency that may significantly affect the physical and mental health of its victims, even entail death, in addition to its potential for epidemic proportions. This type includes deficiency in ascorbic acid (scurvy), thiamine (beriberi), nicotinic acid (pellagra), retinol (xerophthalmia), iron and folic acid (anaemia), and iodine (goitre and cretinism). Their diagnosis can be complicated, and their existence must be confirmed by competent medical staff as of the first suspicion. Because of their seriousness, in addition to their incidence and prevalence in crises, particular attention must be paid to the early detection of specific deficiencies. Firstly, the probability of deficiency must be assessed in the population under consideration; analysis must then confirm or exclude dietary deficiency. If confirmed, clinical signs must be sought for actively. Measures must be taken, based on reasonable indications, to supplement the diet with appropriate foods or tablets. Furthermore, a population with homogenous eating habits and living standards, in which representative individuals who should normally be healthy nevertheless show signs of clinical deficiency, suggests that a general epidemic is imminent, and that a significant proportion of the population is already affected by sub-clinical deficiency. Attention to the risks of specific deficiency must be maintained because the

[28] Minor specific deficiencies that are not discussed in this Chapter are briefly presented in Chapter III, in the points relating to vitamins and minerals.

first cases are usually not identified as nutritional problems, neither by the patients themselves, nor by health staff; the latter are usually unfamiliar with the clinical signs, and are not trained to detect them. Humanitarian staff is not always aware of the risks, and this is all the more serious because of the difficulty of supplementing basic food rations with vitamins and minerals.

2.5.1 Scurvy

Scurvy is the clinical manifestation of deficiency in ascorbic acid, or vitamin C. Vitamin C deficiency is mainly associated with an insufficient intake of fresh vegetables and fruit.

Scurvy was common in Antiquity, but was poorly identified. In the Middle Ages, scurvy was endemic in northern Europe during the winter, when fruit and vegetables all but vanished from the diet. The expression "scurvy" is of Germanic origin. Because of its terrible toll on the crews of maritime expeditions as of the 16th century, scurvy is commonly associated with seafaring; in reality, scurvy has always been typical of three distinct situations:

⇨ long-distance displacement in unfamiliar and inhospitable terrain: this affected armies, the crews of ships, migrants, and explorers;
⇨ problems of access to food (seasonal availability, scarcity, or famine, such as the Great Irish Famine of the 19th century);
⇨ dietary dependency in institutions (e.g. prisons, psychiatric and hospital facilities, orphanages, and homes for the elderly).

In the 20th century, scurvy became uncommon. On the one hand, its origin had been completely elucidated – its treatment and prevention is well understood, and synthetic ascorbic acid and the contemporary diet habits can ensure balance in all circumstances. On the other, living standards have improved in many parts of the world, providing access to a better diet. But the disorder, like many others, is regaining ground owing to the deterioration of the social welfare and public health systems in countries facing political turmoil and growing economic precariousness.

Vulnerability

The groups that are particularly vulnerable to scurvy are:

⇨ the elderly, alcoholics, heavy smokers, social outcasts, and migrant workers, because their diet is usually poor owing to isolation and/or addiction;
⇨ the inmates of institutions such as prisons, orphanages, homes for the elderly, and psychiatric and hospital facilities – the food can be monotonous, insufficient and deficient, large-scale cooking promotes vitamin loss, healthcare may be insufficient, and the living conditions depressing (which affects behaviour towards food);
⇨ populations fleeing war or famine, those that are gathered or interned in camps for refugee or displaced[29] camps, poor people facing scarcity in arid regions, and those facing famine (all these groups *de facto* lack access to a balanced diet).

[29] Refugees and displaced persons are all migrants; however refugees have crossed a national border in their flight, whereas displaced persons remain within their initial national territory.

The development of deficiency and symptoms

At the stage of declared scurvy, the illness is already well advanced, and death may be imminent. There are, however, intermediate stages of deficiency that are either temporary because deficiency is developing, or stable because the diet contains some ascorbic acid, but not enough. A diet that lacks vitamin C entirely causes depletion at a daily rate of 2.6% of existing reserves. Clinical signs appear when reserves drop below 300 mg. Basu & Dickerson describe the stages of scurvy development as follows:

> *"Based upon a normal ascorbic acid reserve, the first sub-clinical deficiency signs appear after approximately 40 days; these are fatigue, weakness, shortness of breath, pain in the joints, bones, and muscle, and loss of appetite. In parallel, plasma concentrations have dropped from 0.8–1.5 m 100 ml to 0.1–0.3 mg/100 ml. The signs of sub-clinical deficiency are asymptomatic, because vitamin C has many functions that all begin to be depressed. After approximately 100 to 120 days, follicular hyperkeratosis (i.e. a hardening and roughening of the hair follicles) appears, as does perifollicular haemorrhaging on the buttocks, the abdomen and the limbs. Plasma concentrations of ascorbic acid drop to 0.01–0.02 mg / 100 ml. After 140 to 160 days, the classic clinical signs appear: petechia (small haemorrhagic spots), and spontaneous ecchymoses (bruises) anywhere on the body, internal subcutaneous bleeding due to the rupture of capillary blood vessels, first around the ankles and legs, subcutaneous bleeding and swelling of the gums, bleeding of the gums following contact, and difficult healing. After 180 to 200 days, internal haemorrhaging intensifies, old scars reopen, gums become spongy, teeth loosen, osteoporosis appears, pain is considerable, and the patient becomes immobile."* (Basu & Dickerson, 1996).

The above timeframe warrants caution. The development of scurvy is determined by two variables: reserves existing at the onset of deficiency, and the magnitude of the dietary deficiency itself. Moreover, dietary vitamin C concentrations may vary according to circumstances. What matters here is that a population whose diet contains virtually no vitamin C and who already faces sub-clinical deficiency is exposed to epidemic-scale scurvy within 2 to 3 months, and mortality will appear within 3 to 4. Furthermore, death can occur without warning at any time after the appearance of the classic clinical signs of deficiency (internal bleeding and gum damage). Declared scurvy is thus a very serious illness, and preventive and curative measures must be taken as soon as dietary vitamin C deficiency is suspected.

The clinical signs of scurvy mainly result from an inhibited collagen synthesis, which accounts for the maintenance of the cell structure of mesenchyme tissue such as bone, cartilage, dentine and connective tissue. The traditional clinical signs combine with other, behavioural, symptoms: emotional instability, apathy, and depression. Moreover, vitamin C deficiency precipitates anaemia owing to loss of blood, and an impaired performance of the vitamin C function in the absorption and utilization of iron and the folic acid metabolism.

An infantile form of scurvy is called Moeller-Barlow disease; it particularly attacks the bone tissue of the thorax and the cartilage of the bone extremities (epiphyses). Infantile scurvy affects infants fed artificially on non-vitamin C enriched formulas, which, once heated, lose what little vitamin C is contained in the powder. Forerunner signs include irritability, a pallid complexion, and loss of appetite. Sensitive and swollen areas then appear around the knees and ankles: these indicate bone damage that is visible on X-ray images. Later, haemorrhage appears along the bones (femur and shinbone). It is painful, and causes the infant to adopt the typical "frog leg" posture, probably for more comfort: legs are bent at an approximately 90° angle at the knees, and slightly flexed and turned outwards at the hips. At this stage, the infant cries almost constantly and screams when lifted. Anaemia worsens, subcutaneous bleeding can appear anywhere, and internal haemorrhage begins. Death is then imminent, owing mainly to intracranial haemorrhage, which develops very quickly.

Treatment

Scurvy is easily treated, especially because of the availability of synthetic ascorbic acid that can be administered orally at very high doses without danger of toxicity. The vitamin is highly soluble and easily assimilated by the digestive tract. Usually a 250 mg dose four times a day, administered orally for a week, brings vitamin C reserves back to the highest possible level. The risk of mortality is averted as of the first dose; recovery is usually fast and complete. Except in the case of significant vomiting, there is no need for the intravenous administration of vitamin C, especially because this form of administration results in tremendous vitamin C losses through urinary excretion, and is thus less effective than oral administration. In parallel with the actual treatment, other deficiencies must also be addressed (especially anaemia, through the administration of iron sulphate and folic acid in the form of tablets). The diet should also be balanced, and the patient needs to be motivated to eat vegetables and fruit if the causes for scurvy are rather social in nature, as may be the case for solitary and isolated people.

In the absence of adequate amounts of synthetic vitamin C (for example, in prisons in poor countries), good therapeutic results may nevertheless be obtained by distributing fresh fruit and vegetables, sprouted legumes, or infusions of the foliage of resinous plants (e.g. pine needles). In fact, if that too is impossible, any green leaves may be chewed (provided they are not toxic), because they all contain vitamin C. This arrests the development of scurvy, and gives time to decide upon an adequate solution.

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Prevention

Preventive measures consist of immediate dietary improvement; this is done through the provision of fresh fruit and vegetables and, where feasible, the promotion of local fruit and vegetable production and consumption. Horticulture should in this case be encouraged through the provision of seeds, secured access to family gardens (allotments), and the planning of orchards and vegetable cultivation areas, both in towns and in rural environments. If these foods cannot be produced or found in adequate amounts, then vitamin C tablets must be used in order to meet recommended intakes.[30]

Nutritional education may also be useful; it should emphasize the need to eat fresh foods, and provide guidance as to the reduction of vitamin losses during food preparation.

As for the solitary elderly, drug addicts, and social outcasts who neglect their diet, the only efficient way of preventing scurvy is the provision of balanced meals, fruit and vegetables, or vitamin tablets. They may be persuaded to change their eating habits, but such groups can be less cooperative, and are usually least able to implement them.

2.5.2 Beriberi

Beriberi is the clinical manifestation of thiamine or vitamin B_1 deficiency. The name comes from the Sinhalese *beri*, meaning “I cannot”, in reference to the weakness resulting from neuro-motive damage. Deficiency is usually the result of an excessive dietary dependency on overly refined cereals, particularly rice. The abrasion of the outer layers of the grain during processing causes significant loss in various nutrients, especially thiamine.[31] Beriberi was endemic for thousands of years in Asian

[30] See Chapter IX.
[31] See Chapter V, Table 5.2.

countries where polished rice is a staple; it became a regular scourge in the 19th century, owing to the replacement of family husking by mechanized artisanal or industrial processing. In the 20th century, however, the situation improved significantly in Asia, thanks to better living conditions (and, thus, a better diet), a better understanding of the aetiology, or causes, of the disorder, the growing popularity of parboiling, and the ability to provide synthetic thiamine for both prophylactic and curative use. Beriberi nevertheless remains quite endemic in many remote areas of Asia, where rice is still the staple food. It also appears to be spreading in Africa (Latham, 1979), in a way that is reminiscent of its earlier spread in Asia, that is, where the processing of maize flour is mechanized and finely ground with a low extraction rate.[32] It is also worth noting that some fermented foods eaten or chewed raw, such as fish and tea leaves, contain substances that destroy thiamine and, consequently, reduce its concentration significantly, particularly when the basis is polished, non-parboiled rice. Finally, like scurvy, beriberi is gaining ground because of the current increase in political, social and economic turmoil.

Vulnerability

The groups that are particularly vulnerable to beriberi are:

- ⇨ alcoholics, because alcohol inhibits the duodenal absorption of thiamine and thiamine phosphorylation, and induces an increase in its consumption; furthermore, heavy alcoholics have a very poor diet; sub-clinical thiamine deficiency is also common in the elderly, because of their greater thiamine requirements and their eating habits; it is also found in adolescents who feed excessively on snack foods (a habit commonly referred to as cafeteria diet);
- ⇨ the inmates of institutions such as prisons, orphanages, homes for the elderly and psychiatric and hospital facilities – the food can be monotonous, insufficient and deficient, large-scale cooking promotes vitamin loss, healthcare may be insufficient, and the living conditions depressing (which affects behaviour towards food);
- ⇨ populations fleeing war or famine, those that are gathered or interned in refugee or displaced camps, poor populations whose diet consists mainly of refined cereals, and those facing scarcity or famine (all these groups *de facto* lack access to a balanced diet);
- ⇨ groups suffering from sub-clinical deficiency abruptly expected to make an unusually heavy physical effort (thiamine requirements increase with energy spending).

The development of deficiency and symptoms

Thiamine deficiency is frequently associated with deficiencies in other B group vitamins, and severe malnutrition. As a result, early clinical signs are not always easy to interpret unambiguously as indicators of thiamine deficiency. The onset of deficiency may be identified through a reduced thiamine excretion in the urine. After approximately 10 days, the transketolase activity of the erythrocytes becomes depressed; after 3 to 4 weeks, fatigue, irritability, headaches, emotional instability and depression appear (Basu *et al.*, 1996; Shils *et al.*, 1994). If deficiency persists, beriberi as such appears. Just as for scurvy, this timeframe reflects the development of deficiency beginning from a normal situation. The clinical signs typical of beriberi can appear within 1 to 2 months. But if the affected population initially experienced marginal deficiency, then beriberi may appear within 2 to 3 weeks, even days if the subjects must make a significant physical effort. This is due to the fact that the organism stores only minimal amounts of thiamine (at best, 30 mg in the adult), whereas the energy metabolism of glucides utilizes 0.25 mg of the vitamin to produce 1,000 kcal (4 180 kJ). Sustained effort can thus precipitate deficiency, and clinical signs may appear suddenly.

[32] See Chapter V, Section 1.1.2.

As a result, the strongest members of a community experiencing dietary thiamine deficiency can be the first to develop beriberi. Furthermore, particularly in prisons where the diet can be deficient, otherwise healthy individuals have been known to develop wet or shoshin beriberi quickly. In such circumstances, one must bear in mind that beriberi is not necessarily associated with wasting, although it is common in populations facing chronic deficiency.

Thiamine deficiency manifests itself in various forms of beriberi: infantile beriberi, wet beriberi, dry beriberi, shoshin beriberi, and the Wernicke-Korsakoff syndrome. Other, less common, forms are related to dry or wet beriberi, and mainly affect alcoholics or individuals with digestive disorders (such as stomach cancer, significant and repeated vomiting during pregnancy, and an overly drastic treatment of obesity). These forms are not discussed here.

Infantile beriberi

Infantile beriberi frequently affects breastfed infants between the age of 2 and 8 months; affected infants do not necessarily suffer any other disorder, and usually receive adequate amounts of maternal milk. The problem results from a thiamine deficiency in the mother's milk, without her necessarily showing obvious signs of deficiency. In fact, mothers face mild deficiency towards the end of their pregnancy. Early signs of infantile beriberi include anorexia, vomiting, pallor, agitation, and insomnia. The disorder develops towards three forms (cardiac beriberi, aphonic beriberi, or pseudo-meningitic beriberi) or their combination (Shils *et al.*, 1994). The age bracket provided for the appearance of each form is indicative only, based on observed trends.

Cardiac form
Cardiac beriberi is an acute form that usually appears in babies between the age of 2 and 4 months in an abrupt attack. Symptoms appear with a piercing scream, followed by cyanosis, dyspnoea (respiratory disorder), vomiting, tachycardia (accelerated heart rate) and cardiomegaly (enlarged heart muscle). Death usually follows within a few hours after the attack if thiamine is not administered.

Aphonic form
Aphonic beriberi is a sub-acute form that appears between the age of 5 and 7 months, and is less brutal than the cardiac form. Infants produce hoarse and aphonic cries owing to paralysis of the laryngeal nerve. They cannot assimilate food, regurgitate or vomit it; they become anorexic and suffer from diarrhoea. They lose weight and become cachectic as the disorder advances. Oedema may develop; the appearance of convulsions announces imminent death due to cardiac arrest.

Pseudo-meningitic form
This is a chronic form that appears between 8 and 10 months, frequently in combination with the aphonic form. Patients suffer from vomiting, persistent constipation, nystagmus (i.e. involuntary twitching of the eye, especially in lateral sight), uncoordinated movements of the extremities and convulsions. The analysis of the cerebral spinal fluid (CSF) is normal. Sudden death from cardiac arrest is common.

Infantile beriberi still remains a major cause of mortality in children between 2 and 5 months (acute and sub-acute forms) in rural areas where milled rice is the staple food.

Wet beriberi and dry beriberi

These are by far the commonest and best known forms of beriberi. In their early stages, their symptoms are similar: the onset is insidious and may be precipitated by fatigue and/or fever. Initially anorexia appears, and an ill-defined discomfort and heaviness of the lower limbs discourage movement. Small oedemas may appear on the legs or face, and patients sometimes complain of palpitations. They frequently feel tingling and numbness in their legs; often, the skin of the shin is insensitive. Where beriberi is endemic, these symptoms are common, and the disorder may remain at this stage for months and even years. Patients usually continue their normal activities, in spite of their mild disability and lower productivity. However, the chronic character of the disorder can degenerate into the more severe humid or wet beriberi at any moment (Davidson *et al.*, 1979). It is still unclear why it develops into one form rather than the other. Davidson suggests that active people tend to develop wet beriberi, owing to the high concentration of pyruvate produced by the expenditure of energy; more sedentary people tend to develop nervous disorders (peripheral neuropathy and, less frequently, encephalopathy associated with the Wernicke-Korsakoff syndrome, particularly among alcoholics) (Davidson *et al.*, 1979).

Wet beriberi

Also called cardiac beriberi, wet beriberi implies progressive cardio-vascular disorder, associated with excess pyruvate and lactic acid in the bloodstream (thiamine deficiency impedes the transformation of pyruvate into acetyl coenzyme A). The accumulation of these metabolites appears to cause the dilatation of peripheral blood vessels, resulting in vasodilatation. At this stage, fluid is leaking from capillary vessels, resulting in the formation of oedemas. Vasodilatation also causes an increase of the cardiac function in order to maintain blood circulation. The cardiac muscle, already weakened by the deficiency in thiamine, must therefore produce an additional effort that causes its dilatation and failure, which accentuate oedema (this is referred to as high-output cardiac failure). Cardiac failure can occur at any moment and cause acute circulation failure, and death. Clinical signs include oedemas (usually in the legs, but sometimes on the face and chest); patients present palpitations, shortness of breath, an accelerated pulse, and neck vein swelling with visible pulsations. Diastolic arterial pressure diminishes, and systolic pressure increases proportionately. Patients may complain of leg pains following mild effort such as walking. While blood circulation still functions properly, the extremities feel hot because of vasodilatation. The urine volume diminishes, but without an increase in urinary albumin excretion (albuminuria), enabling diagnosis orientation. When cardiac failure appears, the skin turns cold and cyanosed, particularly in the face, oedemas spread and shortness of breath (dypsnoea) intensifies. Patients remain alert, however, and may even appear reasonably well, but their condition can deteriorate rapidly and result in sudden death.

Dry beriberi

Dry beriberi mainly involves peripheral neuropathy, combined with sometimes severe wasting. The problem here appears to be related to a lack of acetyl coenzyme A, a precursor of the nerve myelin lining, causing a loss of myelin and axon (the long nerve fibres leading away from the cell body or the neuron) destruction. This causes a symmetrical reduction in motor functions, reflexes and sensitivity, which affects the distal segments (i.e. those directed away from the midline) of the limbs more particularly. Anorexia is typical of all forms of beriberi; together with the lack of motivity, it causes gradual wasting and loss of muscle. Walking becomes increasingly difficult, to the point where patients become bedridden. Dry beriberi is mainly chronic and may be arrested at any stage through appropriate treatment and a rectified diet. Bedridden and cachectic patients risk death through infection such as dysentery and tuberculosis. Clinical signs include wasting, loss of skin sensitivity particularly of the shin, pain to pressure applied to the calves, tingling in the feet and arms, difficulty to straighten up from a crouch, flexed and hanging hands, and dangling feet (Latham, 1979).

Shoshin beriberi

This form is similar to wet beriberi, except that it causes fulminant cardiac failure (from a few hours to a few days), but usually no oedemas of the lower limbs. *Shoshin* is Japanese meaning acute disorder (*sho*) of the heart (*shin*). In addition to its rapid development, this form of beriberi is characterized by rapid breathing (because of acute lung oedema and metabolic lactic acidosis), agitation (due to anxiety and acidosis), cyanosis arising from intense peripheral vasoconstriction and hypoxia (the classic cyanosis of the extremities in tight gloves and socks), "straight" signs of varying intensity, depressed tension (classically, femoral pulse is ample and quivering, and peripheral pulse is strongly diminished), oligoanuria (excessive diuresis) and atypical thoracic pain (Meurin, 1996). These signs combine with extreme tachycardia, cardiomegaly and hepatomegaly, turgescent veins of the neck, and extreme thirst (Shils *et al.*, 1994). Shoshin disease in its pure form amounts to high-output cardiac insufficiency combined with arterial hypotension, depressed systemic arterial resistance, pulmonary arterial pressure, elevated capillary and right atrium (upper cavity of the heart) pressure, and a high cardiac index (Pereira *et al.*, 1984). Shoshin disease is formidable because it causes sudden death. However, the intravenous administration of thiamine always results in spectacular improvement within hours, and treatment is thus especially rewarding.

Wernicke-Korsakoff syndrome

In 1881, Wernicke described a form of neurological disorder that affected alcoholics mainly, and was characterized by ophthalmoplegia (i.e. weakness of the eye muscles), which affected patients looking upwards and sideways, in addition to mental confusion and apathy. Nystagmus and ataxia (unsteady and clumsy motion of the limbs or trunk) may also appear. In its most serious form, this disorder also called Wernicke's encephalopathy, causes coma, resulting in high mortality. The recovery of patients treated with high thiamine doses is usually spectacular.

In 1887, Korsakoff described another phenomenon affecting alcoholics; initially called "Korsakoff's psychosis", its modern name is Korsakoff's syndrome or, less commonly, "retrograde amnesia". Korsakoff's syndrome manifests itself in memory loss, especially of very recent events (anteretrograde or short-term amnesia), but which may include entire periods, and an inability to learn, whereas other intellectual processes remain reasonably unharmed.

In 1971, thanks to the research of Victor, it appeared that Wernicke's encephalopathy and Korsakoff's syndrome were in fact manifestations of the same pathological disorder, related to thiamine deficiency. Modern reference is therefore made to the Wernicke-Korsakoff syndrome, which provides a comprehensive description of the process. In fact, most patients who develop a Wernicke encephalopathy also experience memory loss, whereas patients suffering from Korsakoff's syndrome also present ataxic and ocular signs. Patients are assumed to develop Korsakoff's syndrome once they have recovered from Wernicke encephalopathy. Korsakoff's syndrome may also be occulted by Wernicke encephalopathy, and only become apparent after thiamine treatment because, unlike Wernicke encephalopathy, its response to thiamine treatment is slow, and usually incomplete.

Wernicke-Korsakoff syndrome mainly affects alcoholics, and is commonest in Europe and North America; but it may also be secondary to any disorder that seriously affects the biological utilization of food (Davidson *et al.*, 1979). It may therefore be found in prisons, and camps for refugees or the displaced where beriberi is endemic or epidemic.

In short

The diagnosis of beriberi is not always obvious, because many disorders may be analogous to its different forms. As a result, the presence of recognized but ambiguous signs must result in the examination of the diet in order to seek confirmation by this means, and the immediate administration of thiamine supplements because of the high mortality risks associated with some forms of beriberi. Moreover, response to treatment usually confirms or invalidates the initial diagnosis.

Treatment

Different treatment protocols exist, depending on the type of beriberi and the literature source. Experience has nevertheless shown that a minimum 5 mg dose of thiamine per day, administered orally during two weeks usually suffices to remedy wet, infantile and shoshin beriberi, and to arrest the neuropathy associated with dry beriberi and Wernicke-Korsakoff syndrome. In some cases, the consumption of legumes up to 120 g per day prevents and treats beriberi (Davidson *et al.*, 1979). This comment does not imply that this treatment should be applied alone in the presence of alternatives, but rather that the absence of chemical thiamine should not discourage action. Furthermore, if beriberi is suspected in a hospital or dispensary, then perfusions containing sugars (e.g. dextrose) must be combined with thiamine supplementation of at least 10 mg/day. Sweetened intravenous solutions are likely to cause an increase of the energy metabolism and, thus, raise thiamine requirements. Sweetened perfusions administered without thiamine are therefore likely to precipitate beriberi in cases of marginal deficiency, not to mention the disastrous consequences on declared but undetected cases.

Beriberi usually accompanies severe malnutrition, and even often causes it. But it also frequently combines with other specific deficiencies, particularly those in other B-group vitamins. As a result, the presence of beriberi must prompt the investigation (and, if confirmed, treatment) of other possible deficiencies; broad treatment is strongly recommended if other deficiencies are suspected.

Infantile beriberi

The cardiac form should ideally be treated by slow intravenous administration of 25 to 50 mg of thiamine (Davidson *et al.*, 1979), if possible in hospital facilities. Following improvement, treatment should be adjusted to 5 to 10 mg of thiamine administered orally twice a day. Other forms require the intramuscular administration of 10 to 20 mg of thiamine per day during three days, and then 5 to 10 mg orally twice daily. In parallel, and in order to address the cause of the problem, relapse related to the consumption of maternal milk must be prevented by treating the mother with 10 mg of thiamine (injected or oral), twice daily and improving her diet as soon as possible. But breastfeeding must not be suspended under any circumstances, in spite of the fear that milk is thiamine deficient.

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Wet beriberi

Absolute rest in bed is necessary. The intramuscular or intravenous injection of thiamine must follow the diagnosis immediately; even in ambiguous cases there should be no delay in the administration of thiamine (which is not toxic). Recommended doses vary according to sources:

⇨ injection of 10 to 20 mg/day and then, following improvement, 10 mg/day orally (Latham, 1979);
⇨ intramuscular injection of 25 mg twice daily during 3 days, and then 10 mg orally twice or three times daily until convalescence (Davidson *et al.*, 1979);
⇨ intravenous or intramuscular injection of 50 to 100 mg per day during 7 to 14 days, and then 10 mg/day orally until full recovery (Shils *et al.*, 1994).

The recovery from wet beriberi following thiamine administration is spectacular: within hours, the clinical signs subside, and patients are instantly relieved. Such results have been observed following oral intake of 30 mg of thiamine. There is no reason to administer excessive amounts of thiamine, because the organism excretes excesses rapidly and efficiently. This Manual recommends compliance with the recommendations set forth by Davidson, bearing in mind that inferior doses would probably suffice (Latham, 1979), and that the results of oral administration from the onset would be equally good. What must be remembered is that safety margins subsist, even when means are limited. Davidson's recommendation applies to children up to the age of 10 or 12 years, but the intramuscular doses must be halved approximately (twice 15 mg/day during 3 days); this is for reasons of economy, not for any reason related to toxicity (as a reminder, thiamine is not toxic, even in very high doses). The treatment for adolescents is the same as for adults, as per Davidson's protocol.

In parallel with thiamine treatment, the dietary disorder causing the deficiency must also be addressed through the provision of a balanced diet and, if appropriate, by discouraging alcohol consumption – this can be the most problematic aspect of treatment.

Thiamine by-products such as thiamine propyl disulfide (TPD) and thiamine tetrahydrofurfural disulfide (TTFD) are hardly water-soluble, are resistant to thiaminase attacks, and their intestinal transport is not limited. These compounds (administered in injection or orally) provide a faster and more efficient response than the usually used thiamine hydrochloride, particularly in alcoholics who do not respond well to the latter.

Dry beriberi

The treatment of dry and wet beriberi is the same in terms of rebuilding the reserves of the organism; but Latham only recommends a 10 mg oral dose per day in the case of dry beriberi (Latham, 1979). However, spectacular improvement should not be expected: treatment averts an aggravation of the condition, but acts slowly, and recovery takes several weeks or even months.

Shoshin beriberi

Here again, treatment protocols vary according to their source:

VIII

- ⇨ the treatment for wet beriberi is recommended as the basis for the treatment of all forms of beriberi, including shoshin beriberi (Shils *et al.*, 1994; Davidson *et al.*, 1979);
- ⇨ 100 to 200 mg administered intravenously, followed by 1 g/day in perfusion, replaced by oral administration after a few days, accompanied by the usual complementary measures common to all intensive care units, especially acidosis correction through the intravenous administration of sodium bicarbonate (Meurin, 1996);
- ⇨ twice 25 mg of TTFD intravenously, followed after improvement, by three times 50 mg of TTFD per day orally, with complementary measures (Djoenaidi *et al.*, 1992).

The spectacular success of thiamine administration in all cases of beriberi that involve cardiac symptoms may suggest that doses of at least 20 mg/day alone suffice for recovery in most cases. But this restrictive approach is, once again, recommended only in the absence of other means: wherever possible, patients should be referred to hospital facilities urgently, and receive thiamine there without delay.

Wernicke-Korsakoff syndrome

The treatment is the same as for wet beriberi, and must be administered as early as possible to avert the development of problems whose cure demands more time as the disorder progresses. Early detection is however not simple, because the disorder is uncommon and may escape scrutiny. Like dry beriberi, recovery from Wernicke-Korsakoff syndrome is slow: it may take weeks or even months in the case of Korsakoff syndrome (in which case recovery is usually incomplete) (Davidson *et al.*, 1979).

Prevention

Prevention consists mainly in immediately improving the diet. Good dietary sources of thiamine are sprouted cereals, oilseeds, legumes, beer yeast and lean pork. Fresh foods (green vegetables, fruits, tubers, meat, milk and dairy products except butter) contain enough thiamine to protect against deficiency if they are eaten regularly, and in sufficient amounts. If such foods cannot be produced or obtained on a regular basis, then the only alternative is thiamine tablets; in such cases, it is recommended to provide all required vitamins and minerals in order to comply with recommended intakes.[33] The excessive polishing of rice should then be discouraged, its parboiling encouraged, and the production of low extraction flours also discouraged. Nutritional education may prove useful as well by providing information as to the causes of the disorder, the importance of a balanced and varied diet, the benefits of parboiling and of coarsely milled flours, and of food preparation methods that preserve nutrients.

As mentioned above in relation to scurvy, the only efficient way of preventing the appearance of beriberi in the solitary elderly, drug addicts and social outcasts who neglect their diet is the provision of balanced meals or vitamin tablets. They may be persuaded to change their eating habits, but such groups can be less receptive to recommendations, and are usually least able to implement them.

2.5.3 Pellagra

Pellagra is the clinical manifestation of niacin deficiency. The word "*pellagra*" comes from the Italian *pelle* meaning skin, and *agra*, rough. Pellagra is usually associated with other deficiencies – primarily in tryptophan, an essential amino-acid, and a precursor of niacin. Tryptophan can contribute substantially to niacin intake, provided it is excessive with respect to protein requirements and the amino-acid homeostasis. Pellagra is usually related to deficiency in riboflavin and vitamin B_6 (pyridoxine), which contribute to the conversion of tryptophan into niacin. Furthermore, anaemia always concurs with pellagra. Consequently, pellagra is considered as resulting from a multiple deficiency, rather than from niacin deficiency alone.

Pellagra is associated with diets whose protein supply (and, hence, the energy supply) is accounted for by maize, mainly. It spread in Europe with the introduction of maize, which frequently superseded traditional and secondary cereals because its yield is higher and the plant is better protected against pests (particularly birds). Unfortunately, the nutritional value of maize is lower than that of other cereals, particularly because its protein is of inferior quality (poor in tryptophan), and because its niacin content is mainly in a form that is biologically unusable. As a result, serious pellagra risks arise in settings where maize provides the only staple, as is the case today in many rural areas, in crises, and in prisons. Interestingly, pellagra is uncommon in Central America, where maize was first cultivated; this may be explained by the local custom of soaking the grains in an alkaline lime solution – this increases niacin availability substantially, improves the amino-acid balance, and reduces aflatoxin rates. Unfortunately, this practice did not follow the geographic spread of maize. The developing trend of processing maize to the point of producing fine white flour – thus inducing considerable B group vitamin loss, unlike traditional processing methods – increases the risk of developing pellagra, and introduces the risk of beriberi. Latham reports that the disorder appears to be unknown in populations whose staple food is millet or sorghum (Latham, 1979). Nevertheless, in 1984, a population group displaced on the Angolan Planalto by armed conflict and whose only food was sorghum was observed to suffer from a pellagra epidemic.

Vulnerability

The following groups are at risk:

⇨ in pellagra also, where niacin deficient diets should not normally prevail, alcoholics are at significant risk;

[33] See Chapter IV.

- ⇨ the inmates of institutions such as prisons, orphanages, homes for the elderly and psychiatric and hospital facilities – the food can be monotonous, insufficient and deficient, large-scale cooking promotes vitamin loss, healthcare may be insufficient, and the living conditions depressing (which affects behaviour towards food);
- ⇨ populations fleeing war or famine, those that are gathered or interned in refugee or displaced camps, poor populations whose diet rests mainly on maize, and those facing scarcity or famine (all these groups *de facto* lack access to a balanced diet).

The development of deficiency and symptoms

Where the diet consists entirely of maize, clinical signs appear within 50 to 60 days (Machlin, 1984). This timeframe has been determined in experimentation. In humanitarian practice, it is however often difficult to determine the former diet of a population facing nutritional crisis. As a result, if niacin deficiency is suspected but not yet obvious, it should be addressed before the appearance of clinical signs – in the case of pellagra, these usually consist of the four "Ds": dermatosis, diarrhoea, dementia, and death, but this is not always borne out by reality.

Dermatosis

The first clinical sign of pellagra is dermatosis. It is photosensitive, and appears symmetrically on skin that is exposed to the sun. It is particularly visible around the collar (known as Casal collar), the shoulder blades, the forearms and wrists, the back of the hands and the shinbones. On white skin, it appears as strong sunburn; darker skin initially shows stronger pigmentation, and then dries and cracks. The affected area is rough. Dermatosis evolves towards desquamation, crevices and vesicular lesions. Lesions that are directly exposed to the sun cause a painful burning sensation (Latham, 1979). However, pellagra dermatosis does not develop without exposure to the sun.

Diarrhoea

Gastro-intestinal disorder follows, including diarrhoea (but not always). Painful mouth lesions are usual, however, including angular stomatitis, cheilitis, and a bright red colouration of the tongue. Other disorders affect other parts of the digestive tract and cause abdominal pain and a burning sensation. Gastro-intestinal disorder is not unique to pellagra; it also suggests riboflavin deficiency, and this is frequently concurrent. In doubt, a positive response to the administration of niacin confirms the diagnosis.

Dementia

Advanced niacin deficiency undermines the nervous system in various ways. The first symptoms include irritability, anxiety, headache, apathy, insomnia, and memory loss. Muscular weakness, loss of sensitivity, and trembling are systematic. The disorder develops towards manic-depressive psychosis or, less usually, dementia. It is not uncommon for the psychic disorders arising from pellagra to be interpreted as resulting from madness, and for patients to be interned in psychiatric facilities accordingly.[34] Consequently, where pellagra is suspected, all known cases of madness must be investigated for possible indications of pellagra. In doubt, a positive response to the administration of niacin confirms the diagnosis (as is the case for diarrhoea).

[34] This practice was common in Europe until the 1930s, particularly in Italy where pellagra was devastating among the poor.

Death

Untreated pellagra is fatal because of the generalized failure of the energy metabolism and the anabolism[35] it causes.

As mentioned earlier, pellagra dermatosis does not develop without exposure to the sun (e.g. during the rainy season, concealing clothes, etc.); atypical gastro-intestinal and digestive tract disorders thus appear first. But they must still be recognized as such, in a timely fashion. In other words, a significant reservoir of sub-clinical deficiency cases (or clinical deficiency that has not yet been identified as such) may already exist. At this stage, the risk of mortality is already high, particularly because of high vulnerability to opportunistic infection. This may raise mortality, without the nutritional problems having been detected, be they the prevalence of severe malnutrition or unambiguous clinical signs of niacin deficiency. Only the analysis of dietary intake and the response to the treatment of suspected cases of deficiency enable the timely detection of the disorder. In any case, when the doubt concerns the entire population, immediate steps must be taken to improve the diet.

Treatment

The most serious cases require bed rest; 50 mg niacin doses must be administered orally three times daily during fifteen days or until the disappearance of clinical signs. Recuperation is usually fast, with spectacular improvements setting in during the first day of treatment. Food rations must be corrected, and must contain good quality protein (meat, fish, eggs, dairy products, legumes) and energy in sufficient amounts to ensure rapid recovery in case of wasting; food rations must contain little fibre to avoid worsening intestinal disorder. Pellagra is frequently associated with other deficiencies in B group vitamins (and, to a certain extent, caused by riboflavin and pyridoxine deficiency); other B group vitamins must therefore be supplied also in the form of tablets in doses at least equivalent to the daily requirements but, preferably (and where feasible) therapeutic intakes.[36] Patients also suffering from mental disorder must receive tranquilizers for a few days.

Prevention

Prevention consists mainly of an immediate improvement in the diet. Niacin is found in most foods in limited amounts, however meat (especially offal), fish, beer yeast, peanuts, and wholemeal barley and wheat all contain higher concentrations. Animal products are particularly good sources of niacin because, in addition to their high niacin concentrations, they also contain significant amounts of its precursor, tryptophan. However, the synthesis of niacin from tryptophan involves riboflavin and vitamin B_6; rations intended to prevent niacin deficiency must therefore be balanced, particularly in terms of other B group vitamins. If the dietary micro-nutrient intake cannot be balanced, all vitamins and minerals should be supplied in amounts consistent with recommended daily intakes. The excessive reliance on maize should then be mitigated by promoting dietary diversification through the production and consumption of niacin-rich (e.g. cereals other than maize, and legumes, particularly peanuts) or tryptophan-rich (animal products) foods. The use of low-extraction flours should be discouraged, and milled maize should be enriched in niacin (as is done in the USA, for example). Nutritional education may also prove useful in providing information as to the causes of the disorder, the importance of a balanced and varied (including foods that protect against pellagra, in particular) diet, and the benefits of coarsely milled flours.

[35] Anabolism: the synthetic pathways of the metabolism; the two states of oxidation of the vitamin enable, under hormone control, the preservation of a balance between synthesis reactions, which consume energy, and the catabolic reactions that produce it. Generally speaking, the oxidation reduction function of niacin involves it in the metabolism (synthesis and degradation) of fatty acids, glucides, and amino acids.

[36] See Chapter III, Section 2.2.5.

Here again, the only efficient way of preventing pellagra in alcoholics who neglect their diet is the provision of balanced meals or vitamin tablets. They may be persuaded to change their eating habits, but such groups can be less receptive to recommendations, and are usually least able to implement them.

2.5.4 Vitamin A deficiency

The following is adapted from McLaren and Frigg (McLaren & Frigg, 1997).

Vitamin A deficiency is the primary cause of blindness in pre-school children, but also affects older children. It furthermore increases the risk of mortality and morbidity in relation to infectious disease. The WHO estimate that 6 to 7 million new cases of xerophthalmia (see below) appear each year, among which one-tenth suffer from corneal lesions. Among these, approximately 60% die within the following year, and 25% of survivors become completely blind, and 50% partially blind. At any given time, 3 million children under 10 years old are blind, and 20 to 40 million suffer from moderate deficiency that can seriously affect their chances of survival (WHO, 1991). Vitamin A deficiency is therefore a serious nutritional problem that is unfortunately widespread in Africa, Southern and Southeast Asia, Central America, and the Middle East; it is mainly associated with poverty, but may also result from famine. A low socio-economic level, the insufficient education of women, lack of resources, social inequalities, inadequate access to health services, and poor water and habitat conditions all increase liability to vitamin A deficiency. In any case, a monotonous diet that lacks fruit, vegetables, and animal products, combined with aggravating seasonal factors and some weaning practices, give rise to deficiency, which is often precipitated by infection. The interaction with infectious disease is synergic: deficiency strengthens the effects of infection, and the latter reinforces the deficiency. Seasonal factors may play a double role, combining a deficient diet and an increase of infectious disease.[37]

Vulnerability

Pre-school children are the most prone to vitamin A deficiency. This is due to their increased requirements associated with growth, while retinol reserves are low. Moreover, their diet is usually undiversified, weaning practices are adverse, and infectious disease common. Breastfeeding pregnant women reveal prevalence rates that are considerably higher than those of other female community members. Prevalence studies have shown that boys are more prone to the deficiency than girls are (1.2 to 10 times more). Patients, especially young children, suffering from infectious disease can show an insufficient vitamin A transport (related to systemic infection), significantly increased faecal excretion (diarrhoea), strongly diminished absorption (intestinal parasites), and an increased urinary excretion combined with a reduced absorption (respiratory infection). Other vulnerable groups include prisoners (whose diet is usually insufficient and largely or entirely lacking fresh foods), and refugees and the displaced who do not have access to complete rations.

The development of deficiency and symptoms

Thanks to the storage of vitamin A in the liver, reserves enable survival for many months. However, where the disorder is endemic, precipitating factors such as measles or kwashiorkor (their combined effects are devastating in this respect) can reveal clinical signs within days. In view of the potential

[37] Secondary causes of vitamin A deficiency that do not result from an insufficient dietary supply, but from medical disorders (that can be serious but remain rare) are not discussed here.

consequences, preventive measures must be applied without delay to all children under 10 to 12 years old (see below). Vitamin A deficiency manifests itself in three types of ailments: xerophthalmia, its effects on morbidity and mortality, and other effects.

Xerophthalmia

Xerophthalmia is a pathological dryness of the eye that deprives it of its epithelial protection. However, the expression includes all clinical signs and symptoms of ocular disorder caused by vitamin A deficiency. Xerophthalmia in principle progresses according to the following stages (except the XF stage):

Night blindness (XN stage)
Night blindness usually refers to a loss of visual acuity in the dark. It manifests itself through obvious clumsiness, and the inability to recognize familiar people.

Conjunctival xerosis (X1A stage)
Conjunctival dryness[38] is the first stage of the alteration of the epithelial protection of the eye. At this stage, the conjunctiva loses its brilliance and its shine, and becomes lacklustre. This dryness is not easy to detect, and is thus an unreliable indicator.

Bitot's spots (X1B stage)
Bitot's spots are raised triangular or oval white, foamy lesions. The disorder is bilateral, appearing first on the temporal side of the cornea, and then on the nasal side. Bitot's spots may be removed if the patient rubs his eyes strongly.

Corneal xerosis (X2 stage)
Conjunctive dryness extends to the cornea, which becomes milky. As from this stage, ulceration through the softening of the cornea occurs within a matter of days.

Corneal ulceration or keratomalacia involving less than one-third of the cornea (X3A stage)
Corneal ulceration, or keratomalacia, occurs in two stages of severity (X3A and X3B); it results from necrosis of the cornea. If ulceration is not immediately treated, then the cornea perforates and infects, causing the loss of the eye. The infection may cause patients to become seriously ill and develop high fever. At the ulceration stage, however, the eye can still be saved through the administration of vitamin A and adequate treatment (rinsing and the application of ophthalmic antibiotic ointments); the ailment nevertheless leaves a corneal scar (XS stage) and alters vision.

Corneal ulceration or keratomalacia affecting one-third or more of the cornea (X3B stage)
Ulceration is more extensive than in the previous stage (X3A) and the danger of blindness is greater.

Corneal scar (XS stage)
Corneal scars result from healed keratomalacia.

Xerophthalmia fundus (XF)
In the early stages of the deficiency, examination through an ophthalmoscope may sometimes reveal white spots around the periphery of the *fundus oculi* (that is, the back of the eye).

The following five indicators for minimum prevalence are used in order to determine whether xerophthalmia is a public health issue.

[38] The conjunctiva is the mucous membrane that lines the inner surface of the eyelids and extends over the forepart of the eyeball.

Sign	Minimum prevalence rate
Night blindness	1%
Bitot's spots	0.5%
Corneal xerosis and/or keratomalacia	0.01%
Corneal scars	0.05%
Seric retinol < 10 μg/dl	5%

If any one of the above signs reaches the minimum prevalence rate for children between 6 months to 5 years old, then xerophthalmia is to be considered a public health issue in the population under consideration, and preventive measures must be taken immediately.

Impact on mortality and morbidity

The risk of mortality has been demonstrated to be significantly higher in children who are objectively affected by xerophthalmia. The reason for this is probably a weakened response to concomitant infectious disease. Studies conducted after the distribution of vitamin A to pre-school children have confirmed this observation, with mortality drops of the order of 30%. These distributions appear to have a greater effect on mortality related to measles and diarrhoea than to respiratory infection. Studies on the reduction of mortality through the distribution of vitamin A do not associate the relative mortality risk and xerophthalmia, probably because of the weak prevalence of clinical xerophthalmia. The impact on mortality is more probably due to sub-clinical vitamin A deficiency.

Worldwide, 1 to 2.5 million deaths *per annum* are attributed to vitamin A deficiency; severe malnutrition is an associated factor in approximately 50% of cases. However, the administration of zinc reduces mortality through diarrhoeal disease concurrent with vitamin A deficiency by 25%. These observations confirm the view according to which the prevention of vitamin A deficiency is a public health priority, and that the overall nutritional status plays a major role in the prognosis of serious infectious disease in children. As a result, health and nutrition problems must be jointly addressed. These remarks also emphasize the importance of including the prevention of nutritional disorders during humanitarian operations.

Measles has a particular relation to vitamin A deficiency. The measles virus rapidly invades the eye and can cause serious damage. Even the vaccine causes minimal invasion of the cornea that only disappears after several months. Moreover, the impact of measles is considerably stronger in malnourished subjects; complications are more frequent and more severe, and mortality is considerably higher than in well-nourished individuals. Among measles patients treated within hospital facilities and who receive vitamin A supplementation there is a spectacular drop in mortality. In terms of the humanitarian response to nutritional crises, therefore, measles vaccination and vitamin A supplementation are indispensable; they belong to the measures that must be taken systematically.

The combined effects of vitamin A deficiency and infection on morbidity are difficult to clarify because the expression "morbidity" refers to both chronic and acute cases, both mild and severe. Moreover, infection and vitamin A deficiency reinforce one another. Experimentation involving animals has demonstrated that vitamin A deficiency, more than any other, is associated early with infectious developments, particularly those affecting epithelial tissue. Such infections develop before the appearance of signs of xerophthalmia. Although vitamin A supplementation does not appear to alter moderate diarrhoea, it does influence mortality associated with diarrhoeal disorder by reducing the incidence of severe diarrhoea. The effect is proportional to the daily number of stools. A major study conducted in a hospital environment showed that the prevalence of respiratory infection increased with the severity of xerophthalmia. However, vitamin A supplementation does not appear to influence acute inferior respiratory infection; it is possible that the association between inferior respiratory infection and vitamin A deficiency only appears in the case of severe deficiency. With respect to measles, the vitamin A status influences morbidity directly, that is the complications and after-effects that are considerably mitigated by vitamin A supplementation. Vitamin A deficiency promotes urinary infection and infection of the middle ear. It is associated with a greater mortality rate and severity of infections in the case of AIDS. Moreover, HIV-positive mothers suffering from vitamin A deficiency face a greater risk of infecting their children. Vitamin A supplementation for young HIV-positive children reduces morbidity significantly.

Other effects of vitamin A deficiency

The other effects of vitamin A deficiency remain hypothetical and would require confirmation; they are, however, supported by many converging indications. Vitamin A deficiency may contribute significantly to growth retardation, a depressed immune response, and insufficient haematopoiesis.

Treatment

Vitamin A deficiency must be addressed urgently in the case of xerophthalmia, because partial vision loss can deteriorate into complete blindness within a matter of days, even hours. Except for pregnant women, the treatment is always the same, whatever the advancement of xerophthalmia:

- ⇨ children aged 1 year and above: immediate oral dose of 200,000 IU (110 mg of retinol palmitate, or 66 mg of retinol acetate); another 200,000 IU dose the following day, and another 2 to 4 weeks later;
- ⇨ children under 1 year: same as above (children aged 1 year and above), but with halved doses, i.e. 100,000 IU each:
- ⇨ pregnant women (or suspected to be): same as for children aged 1 year and above in case of corneal lesions, but oral administration of 10,000 IU every day during 2 weeks in case of less advanced stages of xerophthalmia, because of the teratogenic risk[39] associated with high intakes of vitamin A.

Vitamin A is available in 10,000, 100,000, and 200,000 IU capsules that contain the vitamin in an oily solution. In case of persistent vomiting and severe diarrhoea, a single dose of 100,000 IU of vitamin A in aqueous solution must be administered by intramuscular injection.

In the case of corneal damage, antibiotic (e.g. bacitracin) ophthalmic ointment must be applied 6 times daily, and systemic antibiotic treatment must be initiated.

All associated medical disorders – such as severe malnutrition, infection, and dehydration – must also be treated. In case of severe malnutrition, measles and serious infection, patients must be treated against vitamin A deficiency systematically, according to the instructions provided above.

[39] See Chapter III, Section 2.2.5.

Prevention

If sub-clinical deficiency is suspected (i.e. when vitamin A deficiency has been defined as a public health issue) measures based on the above criteria must be taken at different levels – these may not all pertain to humanitarian agencies, but the latter can contribute to the effort:

- ⇨ general measures devolving on governments, aimed at improving living standards and including access to curative and preventive healthcare, especially with respect to extended programmes on immunization (EPI);
- ⇨ promotion of the production of vitamin A rich foods within the community;
- ⇨ vitamin A enrichment of specific, common (particularly to the poor), foodstuffs: mainly flour, sugar, and oil;
- ⇨ nutritional education in order to promote the consumption of vitamin A rich foods at family level – this education should emphasize the specific vulnerability of pre-school children;
- ⇨ breastfeeding must also be promoted, as it is capital in the prevention of deficiency in infants, provided that the mother's vitamin status is adequate; it should be prolonged as long as possible – this effort may be hampered by limited resources (time and material), and possibly cultural reservations.

Such measures only show results after several years, and demand a long-term commitment that few humanitarian agencies can deliver, if any. However, humanitarian agencies can contribute temporarily to the prevention of deficiency, through massive and systematic vitamin supplementation in the areas where they are active, by the blanket distribution of vitamin A capsules to all children under 10 years of age.[40]

Vitamin A can be stored in considerable amounts in the liver. The recommended amount is a single oral dose of 100,000 IU (55 mg of retinol palmitate or 33 mg of retinol acetate) for infants between 0 and 12 months; a single dose of 200,000 IU (110 mg of retinol palmitate or 66 mg of retinol acetate) for children between 1 and 10 years old. Prevention should be avoided during pregnancy, but a single 200,000 IU dose should be administered immediately after delivery. Women of childbearing age (pregnant or not) should ingest no more than 10,000 IU per day. The common dosages of vitamin A capsules are 10,000, 100,000, and 200,000 IU. In the absence of 100,000 IU capsules for infants under 1 year, a 200,000 IU capsule may be pierced, from which three drops can be administered to each child. The dosage described above prevents deficiency for approximately 6 months (except in the case of women of childbearing age); as a result, vitamin A capsules should be distributed at least every 4 to 6 months. General food distributions and vaccination campaigns provide a useful opportunity for this. Sound coordination with national health services and other assistance agencies is essential in order to avoid unnecessary duplication and optimize coverage. Furthermore, the distribution of vitamin A enriched foods (e.g. fortified oils and enriched flour) can provide the means to reach people who are not included in capsule distributions (especially women of childbearing age who cannot ingest high preventive doses because of the teratogenic risks).

Furthermore, all children must be vaccinated against measles if this is not yet the case.

[40] Usually, recommendations for prevention include all children up until 6 years of age for vitamin A capsule distribution, mainly because xerophthalmia affects pre-school children essentially. However, in view of the protection provided by vitamin A supplementation in terms of infection, and as confirmed by field experience, this Manual prefers to extend the recommendation so as to include older children as well.

2.5.5 Nutritional anaemia

Anaemia is certainly the most widespread nutritional disorder in the world. It is a major problem, but one that often goes unnoticed because it does not cause spectacular symptoms, and is rarely fatal. It arises mainly from an iron deficiency within the organism, but can also arise from dietary folic acid deficiency (its second most important cause), or deficiency in vitamin B_{12} and protein. Vitamin A, C, E, B_6 (pyridoxine), and copper deficiency also contribute to anaemia. In developing countries, the average prevalence of anaemia caused by iron deficiency among women of childbearing age is approximately 40%, against 12 to 18% in industrialized countries. Whatever its cause, anaemia indicates that haemoglobin levels in the blood are too low for the organism to function adequately. Haemoglobin is a protein comprising four sub-units, each containing a haeme group to which iron is fixed. The haeme group gives blood its typical deep red colour. Haemoglobin iron contributes to the transport of the oxygen required for the aerobic production of energy. Haemoglobin is contained in red blood cells; the life span of these cells is short (some four months), and their constantly renewed synthesis causes significant dependency on factors that may inhibit their synthesis or that of haemoglobin. According to these limiting factors, anaemia may be microcytic (in which red blood cells are unusually small), macrocytic or megaloblastic (unusually large red blood cells), haemolytic (many red blood cells are destroyed), or hypochromic (red blood cells contain little haemoglobin). Folic acid and vitamin B_{12} are the major limiting factors because of their contribution to synthesis in the bone marrow, whereas iron is limiting because it is a constituent of haemoglobin. Deficiency in folic acid and vitamin B_{12} induces macrocytic anaemia, whereas iron deficiency induces microcytic and hypochromic anaemia. Anaemia caused by iron deficiency in the organism and deficiency in folic acid and vitamin B_{12} is called dimorphic anaemia. It is common among poor populations. This Manual considers the two main causes of anaemia, being iron deficiency in the organism, and folic acid deficiency.[41]

Anaemia caused by folic acid deficiency usually results from a mediocre diet and food preparation methods that are deleterious for the vitamin (due to oxidation and dilution in cooking water). Moreover, the loss of red blood cells (due to malaria, for example) may precipitate anaemia through lack of folic acid to repair losses.

Anaemia caused by iron deficiency may be due to a deficient diet, insufficient absorption, and iron loss. In these circumstances, the iron reserves in the organism (in the order of only 500 mg) can erode quickly.

Dietary deficiency

In adults, the diet is rarely iron deficient in quantitative terms, but may be in qualitative terms, because the iron contained in foods is in a form that is difficult to assimilate. On the other hand, premature and/or low birth weight (< 2.5 kg) infants frequently develop anaemia through dietary deficiency because their iron status is weak, and cannot be compensated by maternal milk; in parallel, growth requirements are significant (the amount of iron in the organism must double within the first year). Furthermore, children that are breastfed beyond six months but whose weaning food is mediocre in terms of iron, are likely to develop anaemia due to a real dietary iron deficiency. Between the first and sixth year, the amount of iron in the organism must double again.

[41] Anaemia caused by vitamin B_{12} deficiency is discussed in Chapter III.

Insufficient absorption

Iron retention by the organism is remarkable, but its absorption is rather poor. Iron from animal sources is generally better absorbed than vegetable iron. Moreover, non-anaemic subjects only absorb approximately 10% of the iron contained in their food, whereas anaemic subjects tend to absorb the double, that is, 20%. Iron from animal sources increases the absorption of vegetable iron – in other words, even low dietary contents of animal origin result in a considerably better overall iron absorption than identical amounts of animal and vegetable iron, but ingested during well separated meals. Iron absorption is inhibited by the phytates and tannins that are sometimes found in large concentrations in cereals and legumes. It is also inhibited by calcium (a glass of milk drunk during the meal reduces iron absorption by half), and phosphorus. The absorption of iron from vegetable sources is promoted by ascorbic acid (vitamin C), and malic and citric acids.

Owing to the fact that absorption is limited, the diet cannot supply enough iron when requirements rise, as is the case during pregnancy (costing approximately 700 mg), breastfeeding (approximately 175 mg during the first six months), and growth. Usually, the diet cannot compensate significant and/or regular losses either.

Iron losses

Two types of iron loss should be distinguished: normal loss associated with the metabolism and the functioning of the organism, and abnormal loss related to a disorder. Normal iron losses are minimal due to the organism's exceptional ability to recycle it. Daily losses are estimated at 1 mg for men, and 0.8 mg for women; during menstruation however, women lose significant amounts of iron (usually of the order of 25 mg during the entire cycle, but significant variations exist, related to the iron status in the organism). Because of the weak iron absorption capacity of the organism, particularly among the poor whose diet is essentially vegetarian, it does not come as a surprise that anaemia prevalence levels are particularly high in women of childbearing age.

Losses arising from disorders such as ulcers and any other form of bleeding obviously cause iron loss. In the tropics, the commonest causes of significant loss are parasite infections such as ankylostomiasis (or hookworm infection) and schistosomiasis (or bilharzia). Malaria itself does not cause major iron loss because the latter is preserved and recycled in the organism. But where malaria is endemic, iron loss, albeit moderate in comparison with the destruction of red blood cells, nevertheless manifests itself: successful malaria control programmes also reduce anaemia prevalence levels significantly (Davidson, 1979).

Vulnerability

Pregnant women are most vulnerable to folate acid deficiency because of the increased cell multiplication resulting from foetal and placental growth, and during the expansion of the uterus and the overall blood volume. The risk is clearly magnified by a mediocre diet, that is, in case of poverty. But children and adolescents are only slightly less vulnerable, because their growth requires additional folic acid with respect to their maintenance needs. The elderly are also vulnerable because of their common and typical changes in diet.

In other words, women of childbearing age are clearly the most vulnerable to iron deficiency, followed by children and adolescents. As indicated above, risks are inflated by essentially vegetarian diets, and an endemic prevalence of parasite infections such as ankylostomiasis, bilharzia, and malaria. Vegetarians whose diet combines vegetal and dairy products are also at risk. Anaemia may have several causes, and some are not nutritional; as a result, vicious circles may appear between its different causes, aggravating it accordingly.

The development of deficiency and symptoms

Timescales for the development of anaemia are difficult to set, because it is influenced by the nature of requirements, losses, and diet. Anaemia manifests itself in fatigue, shortness of breath following any type of physical effort, dizziness, headache, palpitations, an unusually perceptible heartbeat, pallid mucous membranes, and oedemas in severe cases. Severe anaemia can cause cardiac arrest. Moreover, anaemia reduces the physical and emotional functional capacity. It results in an inability to learn and poor mental concentration. In women, anaemia increases the risk of mortality during and following childbirth; the risk is also greater for the baby. Iron deficiency also affects thermoregulation and immune defence.

The following are commonly used thresholds in the diagnosis of anaemia: haemoglobin levels lower than 13 g/dl for adult men, 12 g/dl for adult women, 11 g/dl for pregnant women, 11 g/dl for children between 6 months and 6 years, and 12 g/dl for children between 7 and 14 years old.

Treatment

Because of the weak absorption of dietary iron, the recommended treatment is the administration of iron tablets, usually combined with folic acid. If, however, the anaemia results from vitamin B_{12} deficiency, then this vitamin must also be administered. The treatment of anaemia resulting from iron deficiency corrects haemoglobin imbalance within 3 to 4 months, but therapy must last for 6 to 12 months to ensure that iron reserves have been reconstituted. The treatment dosage for adults is 300 mg of ferrous sulphate twice daily, between meals. For children, it is 50 mg of ferrous sulphate per day and year age, up to 600 mg per day (12 years old and above). Doses recommended for children must be observed strictly, because excessive iron becomes toxic. Iron sulphate colours the stool black – this is harmless, but parents must be forewarned. The administration of folic acid in the form of tablets should be limited to 1 mg per day; in the case of higher doses, excess amounts are excreted in the urine. It is worth noting that the consumption of a fresh fruit or vegetable per day is another quick and efficient way of correcting folate acid deficiency.

In addition to the treatment itself, corrective measures must be taken as feasible in order to remedy pathological losses and associated disorders.

Prevention

In the industrial world, the prevention of nutritional anaemia should not be a problem, provided that appropriate measures are in place to enrich common foods in iron and folic acid, and that mother and child healthcare includes supplementation during the critical phases of pregnancy, breastfeeding, and infancy. Dietary diversity is another important factor of prevention, particularly the consumption of high vitamin C fresh foods. Nutritional education may contribute, owing to changing dietary habits in the West, where diversity doe not necessarily amount to judicious choices and healthy diets.

The prevention of anaemia is a major challenge in developing countries. The diet of the poor, who constitute the majority, cannot be enriched easily; advice and nutritional education have little impact if the issue is mainly one of resources. Therefore, humanitarian agencies must see to it that their food rations contain sufficient amounts of iron and folic acid; they must distribute supplements in the form of tablets to pregnant and breastfeeding women. The recommended dosage is 300 mg of iron sulphate and 0.5 mg of folic acid per day.

2.5.6 Iodine deficiency

Iodine is an essential element because it is integrated into the thyroid hormones thyroxine (T4) and triiodothyronine (T3), which are indispensable to physical growth and mental development. Iodine deficiency has long been associated with goitre and cretinism; but it has since become clear that it also induces a number of other disorders, and reference is therefore made nowadays rather to disorders arising from iodine deficiency.

The origin of most manifestations of iodine deficiency is ecological. Hetzel has described this accurately in his study of the history of iodine deficiency (Hetzel, 1989).[42] Now that the scope of disorders related to iodine deficiency is better understood, approximately one-quarter of the world's population is estimated to be under threat from the disorder, and it is considered to be one of the four major specific deficiencies.

Vulnerability

The populations of mountainous and/or high rainfall and well-drained highlands, and of flood-prone plains are most exposed, particularly if they rely on subsistence agriculture and stock-breeding, that is, if their food has grown on an iodine-poor soil and where, as a result, drinking water likewise lacks iodine. The consumption of goitrogenous foods – such as cassava, bamboo shoots, sweet potato, Lima beans (butter beans) and, to a lesser extent, maize and millet – clearly increases the risk, as they contain agents that reduce the iodine availability. Apart from this, vulnerable groups cannot really be defined in terms of their diet, since iodine concentrations in foods are determined by the nature of the soil, and of irrigation and drinking water. Food composition tables are useless in this respect. On the other hand, the iodine levels in locally available water indicate iodine levels in the soil, which in turn determines the iodine concentrations in plants and animals in the area. Water iodine levels that are lower than 2 μg/litre indicate an iodine-deficient region. Populations living in high-risk areas, but who nowadays have access to iodized salt and varied foodstuffs (including, in particular, sea fish and seafood) from iodine-rich areas are no longer at risk.

The development of deficiency and symptoms

The most striking clinical manifestations of iodine deficiency is goitre, which is a hypertrophy (or abnormal enlargement) of the thyroid gland. This hypertrophy in fact reflects an adaptation of the organ to an insufficient iodine intake, enabling it to drain more blood and, thus, improve the capture of circulating iodine, which is necessary for the synthesis of thyroid hormones. A daily iodine intake that is lower than 50 μg is considered to be insufficient in adults. The thyroid is located at the base of the neck, just below the Adam's apple. According to the severity of deficiency, the goitre may cause a slight, unobtrusive or large (larger than 1 litre) and highly visible swelling. It may be soft or nodular; the latter indicates long-term deficiency. The goitre is detected by palpating the base of the neck: goitre is diagnosed when each of the thyroid lobes is larger than the patient's terminal thumb phalanx. Goitres are classified as follows (Shils, 1994):

[42] See Chapter III, Section 2.2.6, which briefly describes the history of iodine on earth.

- ⇨ degree 0: no goitre;
- ⇨ degree 1a: detectable goitre;
- ⇨ degree 1b: palpable goitre, but visible only when the neck is fully extended backwards;
- ⇨ degree 2: goitre visible when the neck is in its normal position; palpation is unnecessary;
- ⇨ degree 3: large, visible goitre.

The classification of goitre is an estimation, but nevertheless useful in comparing prevalence rates and the impact of goitre eradication programmes. The target population for goitre prevalence assessments are children between 6 and 12 years old; it is considered to be endemic when the prevalence rate in this group exceeds 10%. Prevalence is considered to be mild between 5 and 19.9%, moderate between 20 and 30%, and serious above 30%. However, even mild rates demand blanket intervention, because of the serious consequences of iodine deficiency. Goitre may develop in adults and children alike, but in areas where it is endemic, its development clearly begins in childhood. The greatest prevalence rates are observed in adolescents, and they are greater in girls than in boys. Goitre itself is not painful, but is disturbing because it is a deformation that can become ugly, and even uncomfortable by exerting pressure on the trachea and the oesophagus; this may impede breathing, cause coughing through irritation, alter the voice, and impair swallowing.

The second most familiar phenomenon associated with iodine deficiency is endemic cretinism, which appears when the daily iodine intake drops below 25 μg. The expression "cretinism" (or the French *"crétin des Alpes"*) is a medical term for the specific syndrome common in the European Alps until the introduction of iodized salt between the two world wars. Endemic cretinism arises from iodine deficiency in the mother, before and during pregnancy. Latham provides the following description of cretinism (Latham, 1997): the child may appear normal at birth, but its growth and its development are slow, it is mentally apathetic, and slow in learning. It quickly shows growth and mental retardation; it is not uncommon for such children to be deaf mute. The child also develops the appearance of a cretin. Its skin is thick, its features coarse, it has a pug nose, a large and visible tongue, and is cross-eyed. At the age of 2, it may still be unable to walk unassisted. Two forms of cretinism are distinguished. Its neurological form includes severe mental retardation, the typical cretinous appearance, the inability to walk and control the lower limbs, and sometimes goitre. Its hyperthyroid form, on the other hand, includes a slow pulse, thick skin, swollen features, severe growth and mental retardation, and a weak basal metabolism. In both forms, damage occurs during foetal development, and is irreversible, even if the administration of iodine may avert deterioration.

It is important to be able to detect both goitre and cretinism, because they are the two most obvious indications of iodine deficiency. These symptoms also indicate other disorders associated with iodine deficiency, and the prevalence rates of some are frequently far greater. During foetal development, iodine deficiency in the mother can also lead to disorders that may cause spontaneous abortion and congenital anomalies. Iodine deficiency also results in significant perinatal mortality and low birth weight. Children born with iodine deficiency are likely to suffer from mental retardation at some stage. In children and adolescents, deficiency manifests itself mainly by goitre, but also in weak intellectual performance and growth rates that are lower than the standard for their age group. In adults, deficiency manifests itself by goitre, but also by apathy and a reduced ability to make decisions and take initiatives – this may have serious consequences on their survival capacity and economic development.

Treatment

The treatment of goitre with 6 mg of potassium iodide per day shows good results, provided that the goitre is simple, non-nodular, and therefore still in its early stages. This treatment is particularly effective in children and adolescents. Larger and nodular goitres that do not respond satisfactorily to iodine or thyroid hormones require a thyroidectomy (i.e. the physical removal of the thyroid gland), but this implies that the patient be placed under thyroid hormone treatment for life. Other disorders arising from iodine deficiency are practically irreversible, but their progress may be arrested. Prevention is therefore crucial.

Prevention

Theoretically, the prevention of iodine deficiency is very simple: table salt only needs to be enriched with 30 to 50 mg of iodine per kilogram (PAHO, 1986). Iodine must be in the form of potassium iodate and not iodide (the latter is highly sensitive to humidity and heat). One gram of potassium iodate contains 0.6 g of iodine; enrichment thus consists of 50 to 83 mg of potassium iodate per kilogram of salt. The enrichment of table salt has become common in the industrialized West, but this is not the case where poverty, war, remoteness, and the absence of political commitment combine to eclipse the issue. Some populations have also been known to reject unfamiliar salt. Where iodized salt is unavailable or unacceptable, the entire population may be injected with iodine-enriched oil, in doses that avert deficiency for three to five years. This approach is sometimes recommended for nomadic or isolated peoples, provided that medical teams have access to them. The oral administration of iodized oil is also efficient, but its duration is shorter, between one and two years only (Latham, 1997). The oral administration of oil is clearly easier than injections, as it requires no specific skills or injection material (and therefore none of the specific precautions associated with the transmission of HIV/AIDS).

In endemic goitre areas where iodized salt is the only significant dietary source of iodine, foods must be salted after cooking. Cooking causes the evaporation of considerable amounts of iodine that can reach 60% if the salt is added to boiling water.

PART THREE
HUMANITARIAN ACTION

The previous Chapters provided an initial approach to nutrition by developing the concepts that are most useful to humanitarian operations. This third part of the Manual discusses field practice. It is worth noting that nutrition is considered here as one discipline among others in this type of action, for which an overall approach can be found in Pierre Perrin's *Handbook on War and Public Health* (Perrin, 1996). Chapter IX briefly introduces humanitarian aid by setting nutrition in context; the following Chapters discuss action itself, including assessment as the pre-condition for relevant response, and aid programmes.

CHAPTER IX
AN APPROACH TO HUMANITARIAN ACTION

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CHAPTER IX
AN APPROACH TO HUMANITARIAN ACTION

1. INTRODUCTION

1.1 DEFINITION

Humanitarian action is the assistance, usually without compensation, extended to individuals, groups, or populations who face crisis because they have become vulnerable to problems that prevent them from meeting their basic needs, thereby threatening their survival. This vulnerability translates into the requirement for external assistance, and assessment must document this properly. The key concept here is the "requirement" for assistance: all individuals and groups have basic needs, but do not necessarily require assistance to meet them. Moreover, requirements should not be confused with the victims' requests.[1] The requirement for assistance justifies humanitarian action when existing services falter or fail. Humanitarian action consists of sensitization, the introduction or strengthening of local capacities and skills, and direct assistance. It always amounts, by definition, to replacing services that, deliberately or otherwise, are no longer delivered through official channels.

1.2 OBJECTIVE

The overall objective of humanitarian assistance is twofold: preventing and alleviating human suffering. This consists in preserving or restoring the living standards of victims with a view to reducing their dependency on external assistance, and enabling them to maintain acceptable living conditions in compliance with their cultural standards. This clearly implies an additional responsibility to that of keeping people alive: providing them in some way with prospects for their future.

1.3 STRATEGY

Humanitarian operations must rest upon a strategy that combines and coordinates all available means. This strategy obeys the following principles.

[1] The latter arise from the victims' own perception of their needs: this perception is frequently correct, but may be biased by ignorance of what humanitarian agencies can and should do, and by the natural inclination to secure as many resources as possible.

1.3.1 Defining a balance between the different components of action

The need for assistance usually arises from neglect or deliberate action, and humanitarian action must therefore combine dialogue and assistance itself. Dialogue aims to put an end to neglect, abuse, and the violation of fundamental rights; it addresses relevant authorities and stakeholders in order to encourage behaviour complying with the rights and principles that provide its basis. Assistance on the other hand expresses itself in two ways: the support and reinforcement of local services or, by replacing these, the direct delivery of indispensable goods and services to victims. Dialogue (or representation) and assistance must combine to generate synergy, and are usually intimately connected in the overall perspective of the protection of victims.

In practice, humanitarian action therefore rests on the following three pillars.

1. Representation to remind authorities of their responsibilities, and sensitization aimed at ending neglect and abuse, and at applying appropriate measures to satisfy the needs caused by the situation.[2]
2. The strengthening and support of national and local service providers, in order for them to comply with their mandate fully or partly (some aspects are discussed in Section 3 below regarding ethics).
3. The direct coverage of assistance requirements, according to the available means.[3]

These three points are indivisible, and must incorporate:

⇨ the causes of the need for assistance;
⇨ the urgency of this need;
⇨ the existing national and local facilities and means to respond to the needs;
⇨ the likely evolution of the situation.

Preventing and alleviating suffering can be incompatible endeavours. Prevention rests primarily on dialogue, and the strengthening and support of national or local services; the urgency lies in the motivation and commitment of stakeholders, and the effectiveness of available services. Alleviation on the other hand rests primarily on immediate and direct attention to victims, and it is urgent to prevent the deterioration of the situation and, possibly, save lives when official and regular services fail.

In both prevention and alleviation efforts, the concept of emergency[4] signals the importance of time in defining operational strategies and striking the necessary balance between the three pillars. In fact, the respective weight of each component is determined by their short-term, mid-term, and long-term efficiency, and the ultimate objective.

The direct delivery of assistance may be easier, faster, and more efficient; however, it may discourage or even impede official action. Clearly, if the ultimate objective is sustainable change that will persist beyond the duration of the operation proper, then direct assistance may be counter-productive. Likewise, drawn-out dialogue efforts may prove detrimental to the victims themselves, by delaying the delivery of assistance to them. Consequently, the three components of action are frequently in opposition, and their respective priorities must be reappraised regularly throughout the action itself.

[2] See Chapter XI.
[3] See Chapters XII to XV.
[4] See Section 1.4 in this Chapter.

Direct assistance may be preferable in pursuing short-term objectives, and indirect assistance in building capacities and motivation.[5] The modalities of handing over programmes to development agencies are of great importance here. It is worth noting that the two forms of assistance are not, in fact, incompatible; they should on the contrary run parallel as from the onset of operations. This prepares and ultimately facilitates withdrawal, as local services regain the ability to cope with the situation. Finally, acute crisis in which tensions and needs are already obvious undermines the efficiency of dialogue alone; in combination with direct assistance, however, it reinforces the latter's impact.

1.3.2 Defining priorities for action

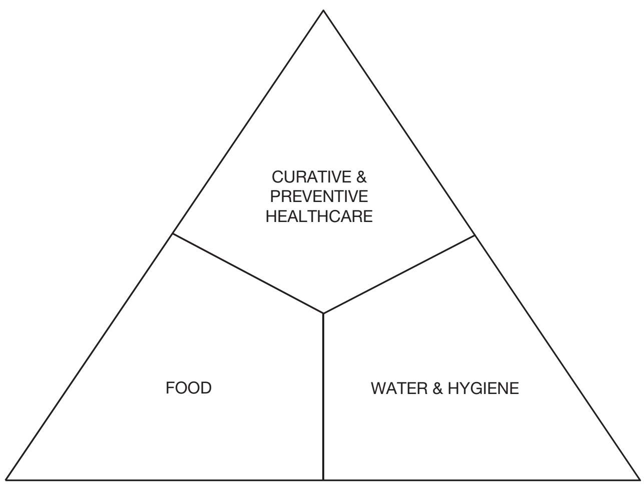
Up until the late 1970s, human lives had to be at immediate risk for humanitarian operations to be launched, and this condition itself shaped the concept of emergency. Food distributions were initiated only when severe malnutrition rates were on the rise or achieved endemic proportions; this frequently resulted in serious mistakes and real disaster.

It was later recognized on the one hand that responding to a deteriorated health status alone is a late reaction and, on the other, that hurriedly deployed curative care cannot arrest crisis and is quickly overstretched. It became clear that the main factors influencing health needed to be dealt with in order to avert or arrest malnutrition and infectious epidemics. This realization enabled the redefinition of priorities for action:

⇨ access to safe water and food;
⇨ satisfactory hygiene conditions in the immediate environment;
⇨ preventive health measures.

The above are absolute pre-conditions for curative care to be effective later on. This approach is dictated by common sense, and may be illustrated by the health pyramid (Perrin, 1996) in Figure 9.1 below.

Figure 9.1 The health pyramid



[5] The common dilemma between short- and longer-term objectives is discussed below in Section 3.2 on Ethics.

1.3.3 Preventive action

The health pyramid suggests that steps must be taken early to avoid creating demand that overwhelms health services at an already advanced stage of the crisis; it also expresses one of the principles of humanitarian ethics, that is, the need to *prevent* suffering and not confine action to its alleviation. This introduces the concept that prevention is also incumbent upon humanitarian action. Chapter VII discussed the cause and effect relations that shape crisis processes; intervention criteria must now clearly be defined within these interrelations. Intervention should not be contingent upon malnutrition reaching epidemic proportions; on the other hand, slow soil erosion that may lead to crisis several years later probably does not justify humanitarian action. At this stage in prevention, other agencies are more competent, and should be alerted accordingly. Furthermore, the implementation of preventive action is determined by the likelihood of the situation deteriorating. This parameter is difficult to determine, not least because of the difficulty of establishing the seriousness of the current situation itself: it may subsequently deteriorate, stabilize or improve. This quandary applies both to climatic and political developments. The resulting uncertainty sheds some light on the prudence of agencies and donors in taking preventive action; many famines have resulted from this reluctance to accept risk. Indeed, the media image of human suffering no doubt provides a stronger incentive to act than the analysis of possible economic downward trends towards impoverishment. As a result, the concept of prevention does not always lead to action easily.[6]

1.3.4 Ensuring multidisciplinary action

The health pyramid sets operational priorities according to a strategy that enables timely and efficient action in terms of the danger of morbidity and mortality. This rests upon a multidisciplinary approach that deploys specific skills in the fields of nutrition, water supply, water and environmental hygiene, habitat, and preventive and curative medicine. This in turn requires a strong compatibility among the members of the agency under scrutiny, but also among the different agencies operating on the ground, in order to ensure that all the needs are met in a comprehensive manner. Clearly, it is ethically unacceptable to confine action to feeding crisis victims if, for example, they are threatened by a measles or cholera outbreak, or if they are without shelter from the elements.

1.3.5 Operational tactics

Strategy rests upon general principles that apply to any type of action. Actual operations must then adapt to specific contextual parameters. This practical approach to action is referred to as operational tactics, which are subjected to the overall strategy. They aim at optimizing the use of all available means in order to respond to a specific situation. As such, humanitarian action amounts to an adapted response that applies strategic principles to achieve the objectives set by preliminary assessment.[7]

1.4 *HUMANITARIAN ACTION AND EMERGENCY*

Humanitarian aid is often simply referred to as emergency aid, for two main reasons. Firstly, humanitarian aid has long been viewed as a last resort, dictated by the "emergency" of saving lives. Secondly, the expression contrasts humanitarian aid (i.e. emergency aid) and development aid,

[6] See also Chapter VIII regarding the prevention of famine.
[7] See Chapter X.

with occasional reference to a continuum where rehabilitation support[8] provides the transition. This jargon may have since become common, but it remains questionable because it consigns humanitarian aid to the role of a fire brigade – which is not expected to address prevention or rehabilitation, and certainly not development. The discussion on emergency and development commonly opposes relief and development workers, as discussed in Pirotte and Husson's essay (Pirotte & Husson, 1997), according to the parameters defined in Table 9.1 below drawn from the same source.

Table 9.1 Emergency and development parameters

Parameters	Emergency	Development
Time	Immediate action, that applies exceptional measures to an exceptional situation. The speed of the action determines success.	The action is sustainable.
Target	Aid may benefit large groups, but is primarily tailored to ensure individual survival.	Development addresses society and its functioning.
Type of action	Emergency aid limits itself to specific fields of action, such as food aid and curative healthcare.	The approach is global and concentrates on the daily life of society, according to cultural standards.
Cost of the action	The goods and services are provided free of charge, because recipients are assumed to be completely destitute at the time of implementation.	Financial contribution is the rule, mainly for recipients to contribute to decision-making and ensure ownership (if not, they do not participate).
Interaction with officials	Initiative, even interference, is tolerated because substitution is obligatory, and because the end is thought to justify the means (rightly or wrongly).	Development operations are doomed to failure without the direct participation of local authorities and society. Their support is actively sought.
Interaction with local associations	Usually neglected, again because of the emergency, and because relief workers usually lack the skills and inclination to cooperate with local associations.	The rule, because development must be anchored in local structures for success.

Pirotte and Husson use the above observation of the dichotomy between emergency and development as the basis for their healthy questioning of the approach to emergency, as defined above, which reflects biases that are detrimental to so-called emergency relief. This Manual agrees with these authors: humanitarian action cannot and must not shy away from understanding events that precede and follow acute crisis, or the society that provides the setting for a given crisis. Table 9.1 above is commented by the author as follows.

[8] Rehabilitation is defined as the restoration of whatever has been damaged in the course of the crisis proper; it applies more specifically to livelihoods.

1.4.1 Time

Humanitarian operations must sometimes be quick and comply with exceptional measures, because the situation is exceptional, mainly because the response is belated. But it may also spread over time and allow for the type of crisis – ranging from prevention to rehabilitation – or compensate for the absence or inadequacy of local services. Humanitarian action must, therefore not be limited arbitrarily. It should instead begin at the emergence of a threat, and persist until it has been averted, meanwhile paving the way for development agencies.

1.4.2 Target

In crisis, individuals whose life is endangered are usually not a distinct group within their society or culture. They are simply the most vulnerable, and herald the fate of their companions if crisis cannot be averted. The principle of prevention being accepted and encouraged, action must focus on those whose life is already endangered, but extend to those who face the same threat ultimately. This aspect is now understood and accepted by most humanitarian agencies, even if some (owing to their mandate and competencies) target specific individuals within society.

1.4.3 Type of action

The view that humanitarian aid is confined to specific operations such as food assistance or healthcare is now obsolete. Accordingly, Perrin's essay adopts a global and multidisciplinary approach: humanitarian and development aid are both linked to social problems, and must ensure that society can live adequately in compliance with its cultural standards (Perrin, 1996).

1.4.4 Cost

Free donations are less common today; concepts such as cost recovery and compensation funds – or micro-credit – are steadily gaining ground, not to mention "food-for-work" projects that are questionable in many circumstances. In fact, when services default (and not the population's resources), free donations are probably not the most appropriate. The challenge lies in setting contribution levels that do not exclude the poorest: this may be achieved through differentiated tariffs, or the waiving of payment for the most destitute. But such solutions are not easy to implement, and may even prove unrealistic, owing to the difficulty of targeting and setting thresholds between recipient categories.

1.4.5 Interaction with local authorities

Unless humanitarian action combines with military intervention (on the basis of the right to interfere as defined by Jean-François Revel, 1979), it has little chance of imposing views on local or national authorities. However, combining efforts with the military is rarely an option in humanitarian action because of the principle of independence. Humanitarian action must therefore convince authorities of the need for their action, especially when neutrality is an issue. Persuasion is complicated by the serious risk of abuse and the diversion of aid, and dialogue must serve to achieve set goals and ensure staff security. On the other hand, abstention is preferable to doubtful compromises that only address underlying problems temporarily, and aggravate them ultimately. Unfortunately, political constraints are often quoted, as is "emergency", in order to justify anything. However, no action in which political considerations eclipsed common sense has ever met with success. Resorting to compromise must imply careful consideration of the seriousness of the problems with respect to the anticipated negative side effects of the compromise.

1.4.6 Interaction with local organizations

Humanitarian action is rather imperialistic and, frequently, unacceptably arrogant towards the societies it intends to assist. The same attitude is noted towards local organizations whose resources are limited and sometimes, like some local authorities, attempt to divert assistance for their own profit. Here again, emergency and political constraints are frequently invoked (rightly or wrongly) to avoid cooperating with such associations. Pragmatism is however called for: organizations that derive their legitimacy from general community support (and those that form spontaneously to organize relief efforts) can be invaluable operational partners. The role of such organizations in the operational context must be carefully appraised; the modalities of collaboration with those that are found to be of real added value to the victims must then be clearly defined. Development aid eventually hands over its programmes to local counterparts; humanitarian aid on the other hand frequently withdraws without having strengthened its operational partners. Worse, it usually inflates them artificially for the duration of the crisis. A responsible approach should then be taken, either by providing relays enabling them to pursue their efforts, or supporting them to become self-sufficient, even on a smaller scale.

1.4.7 The concept of emergency

The expression "emergency" as it is commonly understood should be questioned because it confuses the issue and is counter-productive. When opposing relief and development in terms of a *continuum*[9] where the starting point is emergency relief and the finishing point is development, via rehabilitation, the implicit admission is that each expression refers to a type of intervention. In fact, from a semantic perspective, the words development and rehabilitation are compatible, but the term emergency is incompatible with the other two. Development and rehabilitation express action, whereas emergency simply indicates a state of affairs. Semantic rectitude would suggest the use of "survival relief": this expression avoids confusion, and can easily be associated with rehabilitation and development. "Emergency" would then preserve its first meaning according to the circumstances of a given operation: the urgency of enforcing fundamental rights, of providing economic support to vulnerable groups to avert famine, of evacuating casualties to save lives, of restoring economic self-sufficiency, of engaging in development to mitigate structural weaknesses...

Distinguishing emergency from humanitarian action provides a more serene image of humanitarian aid, and invites more accountability towards the victims, especially if it is agreed that prevention is required whenever possible and that food aid programmes should not be stopped under the excuse that malnutrition has been brought back to its pre-crisis levels, but rather because the recipients have resumed their economic self-sufficiency. This approach eludes the perverse effects associated with emergency, by understanding that it is cheaper to prevent famine than to remedy its consequences. In other words, the key to addressing emergencies lies in prevention.

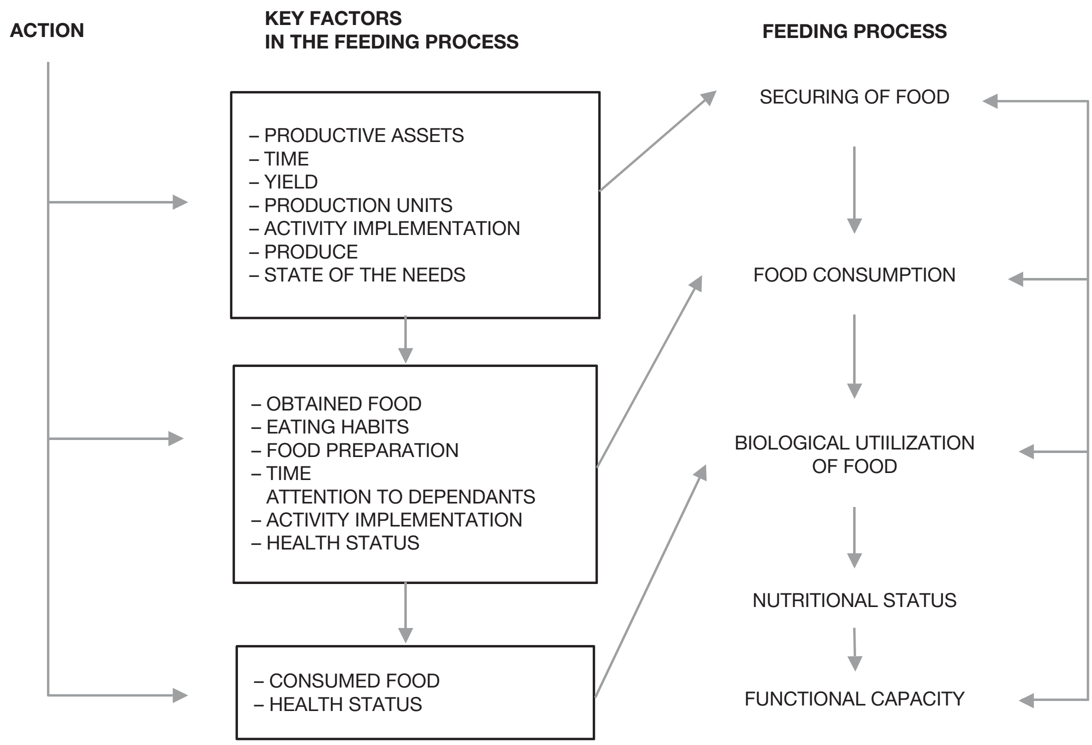
1.5 HUMANITARIAN ACTION IN THE FIELD OF NUTRITION

In nutrition, humanitarian action is justified to prevent or mitigate crisis, defined as a situation in which the performance of the feeding process is insufficient, and its victims cannot cope independently. The concept of preserving or restoring living conditions has horizontal implications

[9] A continuum is defined as a linear evolution following precise steps towards a clear outcome; in this case, the transition from emergency relief through rehabilitation to development. In order to reflect the common conduct of relief, rehabilitation, and development operations simultaneously in the same overall context, the term "*contiguum*" was coined in the mid-1990s by the United Nations Economic and Social Council. In contrast to "*continuum*", contiguum suggests a mobile, back-and-forth approach that better matches the notion of durable assistance in emergencies.

at each level of the feeding process (depending on where the disorder lies), and two-way vertical implications: addressing disorder that occurs at the food securing stage (curative horizontal dimension) averts a snowball effect towards the consumption and biological utilization of food (preventive vertical dimension). Addressing disorder at the consumption stage (curative horizontal dimension) averts negative side effects on the biological utilization of food, but also on the securing of food, by preserving the functional capacity (preventive vertical dimension). These vertical and horizontal implications (or dimensions) are illustrated in Figure 9.2 below.

Figure 9.2 Vertical and horizontal dimensions of action in the field of nutrition



The general objective of humanitarian action in the field of nutrition is the following.

The active promotion of the economic and, thus, nutritional self-sufficiency of the victims of latent or overt crisis; the active promotion of a good nutritional and health status through the implementation of appropriate programmes in the field of nutrition, supported by complementary programmes in the fields of water and habitat, healthcare, economic support and rehabilitation, the promotion of development, and the protection of rights.

The remaining point to consider is the set of objectives specific to each level of the feeding process.

1.5.1 The securing of food

This is the determining stage of the feeding process, the one that requires most effort and means, and whose influence on living conditions and social integration is the greatest. Its success is determined by the household's overall economic performance, which is in turn shaped by the means of production and their yield. In other words, households must be economically self-sufficient for their securing of food to be adequate. This leads to the following definition of the objective of action.

The preservation or restoration of economic self-sufficiency at household level, in an economic security perspective, through palliative measures that persist until self-sufficiency is guaranteed.

Action must therefore revolve around the household economy – mainly the means of production intended to meet the basic economic needs, as determined by physiology, environment, and culture. The adequacy of the means of production in meeting such needs (that is, ensuring a sufficient economic performance) must first be appraised; aid must then fill observed or anticipated gaps that could result in crisis. Action cannot be confined to feeding already famished crisis victims, and providing them with the means essential to their survival; it must include the restoration of economic self-sufficiency, being the only condition that justifies the cessation of assistance, particularly food aid. The introduction of the concept of economic security[10] takes the debate further than the simple preservation or re-establishment of self-sufficiency: it involves an idea of sustainability, in order to limit the exposure of its beneficiaries to low intensity phenomena that may revive crisis and result in the risk of famine. Economic security is an ideal, and it may not always be pursued by humanitarian agencies. However, it widens the scope of action beyond the actual crisis at hand alone, and invites the quest for means that may reduce existing vulnerabilities, in order to issue recommendations for other agencies more competent in terms of development. Seen in this light, economic self-sufficiency means that households and communities have the means to live according to their cultural standards, and are able to cope with future difficulties.

1.5.2 The consumption of food

If access to basic economic goods and services for households is ensured by survival relief and activities in the fields of protection, support, substitution or the rehabilitation of production means, then the food that corresponds to eating habits and the means required for its preparation are, in principle, ensured (vertical preventive dimension, see Figure 9.2). Consequently, action should concern itself with the parameters that determine consumption directly, as follows:

- ⇨ eating habits;
- ⇨ the time required for consumption-related activities;
- ⇨ the attention to dependants (particularly infants, and the sick and elderly);
- ⇨ the quality of consumption-related activities;
- ⇨ the health status of the individuals in the household.

The outstanding question relates to where exactly the disorder lies, and to whether humanitarian action can remedy it. Eating habits, the attention to dependants, and the quality of food consumption-related activities (i.e. food hygiene, cooking methods, culinary customs, and the attribution of food within the family) are all shaped by the cultural determinism specific to the society under consideration, and by the level of education and motivation of the individuals in charge of consumption-related activities. In other words, problems at these levels are unlikely to be relevant to humanitarian action: if the society has survived so far, then these parameters are probably normally adequate. On the other hand, the stress caused by crisis is a different matter, whether it aggravates deleterious practices, or induces new ones. Dangerous behaviour and its causes must therefore be detected, and addressed if possible. This is preferable to attempting to resolve disorders in the previous category without addressing their causes. Deleterious behaviour has three main causes that should be properly distinguished in crisis:

[10] See Chapter VI.

⇨ constraints, especially relating to means and time, that affect material living conditions;
⇨ pre-crisis practices, which are usually deeply rooted in culture and, thus, difficult to modify;
⇨ maladjustment to the conditions imposed by crisis.

Constraints can only be removed in order to remedy their effects on consumption. Practices and maladjustment, on the other hand, can only be tackled through sensitization and education. However, natural intelligence and curiosity tend to be eclipsed by the need to survive in times of crisis. Nutritional and sanitary education is therefore rather fruitless – more so even if it aims at correcting practices that are caused by material constraints rather than ignorance. Unfortunately, many humanitarians tend to confuse the real causes of inadequate behaviour: it is all too frequently ascribed to ignorance, especially in the case of women who are usually in charge of consumption-related activities and care of dependants. Ignorance may contribute to food consumption disorders, but their main cause in crisis is the lack of means and time. This issue must be addressed first, before attempting to improve food consumption itself in consultation with women.

Humanitarian action may resolve the time constraint to some extent by providing goods and services whose securing is less time-consuming. Examples include the supply of food to spare people excessive work, locating health facilities and water supply points at a reasonable distance and ensuring their sufficient capacity, and the distribution of fuel; these measures do not aim at improving household performance directly in terms of food consumption, but do so indirectly by freeing time. This being said, the time devoted to the various household activities is also set by culture and privacy, and great care should be applied to any type of humanitarian interference accordingly.

If food and the means required for its preparation are available, then the health status becomes the main determining factor in terms of food consumption. The health status is determined by the quality of attention, but also (particularly in crisis) by access to safe water, habitat hygiene, and healthcare. This implies measures that are not strictly nutritional; the exception is therapeutic feeding intended to resolve serious cases of malnutrition, but it has no preventive dimension in terms of the general health status of the population under consideration.

In short, the specific objectives of humanitarian action in terms of food consumption may be defined as follows:

⇨ to ensure an adequate diet, including the means of preparing meals;
⇨ to ensure conditions that preserve or restore health;
⇨ to sensitize the population to dietary and sanitary practices that optimize the food consumption stage.

1.5.3 The biological utilization of food

Food consumption occurs in a rather private sphere, shaped by cultural determinism. It can only be promoted through indirect operations such as the delivery of food and material assistance earlier in the process, and water and sanitation operations in order to preserve or restore health. The biological utilization of food takes place within the organism, and is shaped by biological determinism – further complicating its direct resolution. Problems that occur in the biological utilization phase can only arise from inadequate food consumption or a disorder of the organism in terms of food absorption or the metabolism. Action must therefore take place earlier in the feeding process (targeting the securing and consumption of food with the above specific objectives), and simultaneously restore the nutritional status if it has deteriorated. The objectives are the following:

⇨ to ensure adequate food consumption;
⇨ to ensure the conditions that maintain or restore health.

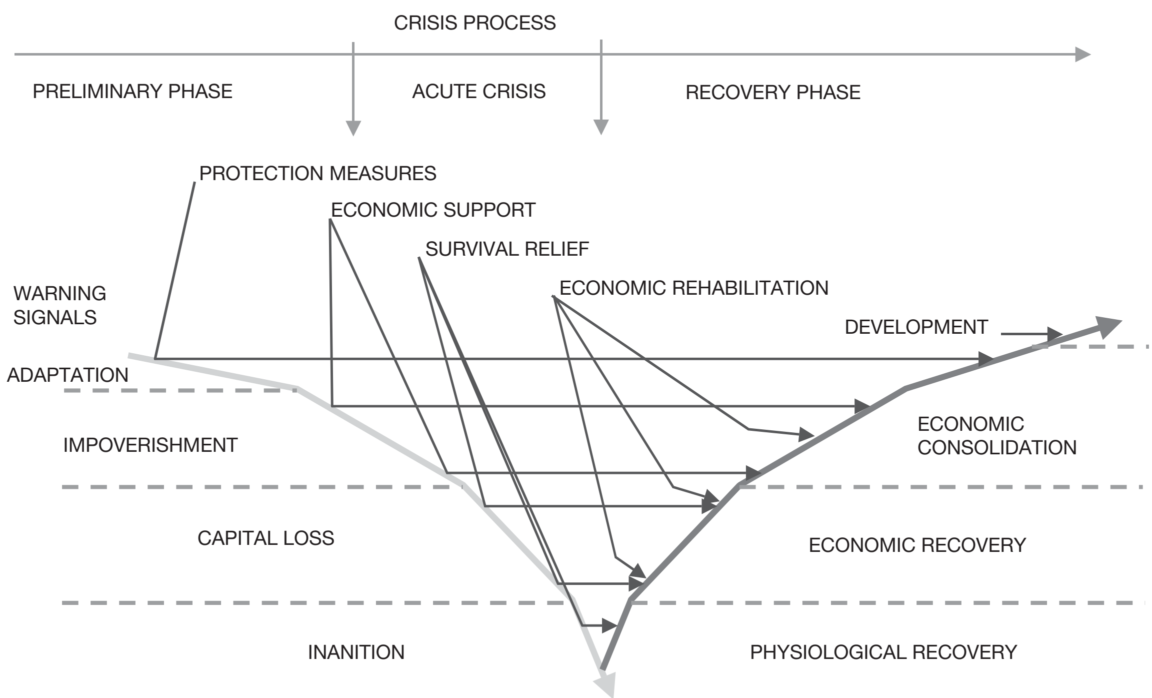
2. THE COMPONENTS OF ACTION

Humanitarian action in the field of nutrition may be divided into the following:

⇨ **action modes** that are determined by the timing of the action with respect to the crisis,
⇨ **programmes** that are determined by the operational strategy.

The model chosen to illustrate humanitarian action modes is the famine process, which also refers to the crisis process (see Figure 9.3 below).

Figure 9.3 Humanitarian action modes in the crisis process



2.1 HUMANITARIAN ACTION MODES

Figure 9.3 above shows the possible humanitarian modes of action in the field of nutrition. Their specific content is discussed below.

2.1.1 Protection measures

Such measures consist in motivating authorities to enforce respect for fundamental rights, thus protecting the conditions necessary for economic self-sufficiency against abuse or, failing that, enabling the timely adoption of appropriate assistance measures. Protection measures are clearly essential in times of armed conflict; but they are also necessary in the modern economic environment, in the face of developments such as global economy, structural adjustment programmes, and the theory of comparative advantages. They are also justified by the loss of interest on the part of governments with respect to their populations. Protection measures must be taken as soon as warning signals herald crisis, and as long as the crisis process persists and protection measures are called for. Unfortunately, addressing this concern with the authorities can be difficult, but it must be done consistently for unacceptable behaviour to be prohibited, and to promote fundamental rights.

2.1.2 Economic support

This mode of action consists in providing a given group with the means to avoid disaster, and to enable it to wait for the crisis to abate. Examples include the distribution of food in order to preserve the resource base and the production capacity, support to the diversification and intensification of production, the provision of employment opportunities, support or strengthening of the local services required for production, and the provision of such services (e.g. veterinary services and access to credit).

2.1.3 Survival relief

This mode amounts to what is usually referred to as emergency relief; it provides a given group with the goods and services that are essential to its survival when its own production can no longer ensure it independently. As mentioned earlier (see Section 1.4.), the expression “survival” is preferred here to “emergency”. Survival relief includes general food distributions (GFD), non-food distributions, therapeutic feeding, water and sanitation projects, the provision of healthcare and shelter, and access to adequate habitat conditions.

2.1.4 Economic rehabilitation

This mode consists in restoring the means of production to the point of ensuring economic self-sufficiency at household level. Economic rehabilitation clearly only makes sense if the circumstances permit durable rehabilitation, that is, usually during the recovery phase following crisis. Economic rehabilitation should nevertheless be considered earlier also, in order to ensure a timely and comprehensive approach when circumstances permit.

2.1.5 Development

Development seldom devolves on humanitarian agencies, at least in the sense of mitigating vulnerability to possible crisis. Those who analyse vulnerability must nevertheless inform relevant development agencies in order for the latter to devote the necessary attention to groups that have been affected by crisis. They must also see to it that rehabilitation programmes are followed by development initiatives that consolidate economic security.

The action modes discussed above occur at different stages of the crisis process, and their intended effects correspond to the recovery levels indicated in Figure 9.3 opposite the different stages of the famine process. The intended effects are:

- ⇨ physiological recovery – when the health of victims is impaired;
- ⇨ economic recovery – when production means have failed;
- ⇨ economic consolidation – when the economy is so fragile that the slightest stress factor may result in renewed crisis;
- ⇨ development – to mitigate the vulnerabilities that initially caused the crisis, but did not disappear with it (or may even have deteriorated).

The frequent reference made to the so-called "emergency-rehabilitation-development *continuum*" deserves further comment here. Indeed, Figure 9.3 may mislead the reader into believing that this Manual follows the "*continuum*" logic by adopting a linear approach to proposed action modes. However, Figure 9.3 only serves to illustrate the different stages of the crisis process and the possible action modes that they call for. Clearly, crisis can develop up or down the curve, or even oscillate, according to its causes and their evolution; it may be protracted to the point of never reaching the degree of recovery that would invite development efforts.

As mentioned earlier,[11] a multidisciplinary approach is recommended in the different action modes described above.

The impact of crisis on economic activities can be such as to induce gradual change, to the point of no return to previous normality. This forces its victims to adapt to new parameters that determine their lives directly. This form of adaptation is different again from the two types discussed earlier in relation to famine,[12] and humanitarian agencies that observe such a change in living conditions must then:

- ⇨ share their observations with other humanitarian and development agencies;
- ⇨ not insist on traditional coping mechanisms that have lost their justification or that can no longer ensure long-term survival;
- ⇨ assist the population in finding alternative, sustainable livelihoods;
- ⇨ involve development agencies in supporting the victims to adapt to new economic circumstances;
- ⇨ alert international opinion as to the danger faced by populations that are gradually excluded and/or forced into culturally unfamiliar living conditions.

2.2 HUMANITARIAN PROGRAMMES IN THE FIELD OF NUTRITION

Humanitarian action must be multidisciplinary, and its implementation requires specific skills: some programmes pertain to nutrition directly, and others complement them.

2.2.1 Nutrition programmes

Such programmes are traditionally the following:

- ⇨ general food distributions (Chapter XII);
- ⇨ therapeutic feeding (Chapter XIII);
- ⇨ supplementary feeding programmes (Chapter XIV);
- ⇨ nutritional and sanitary sensitization/information (Chapter XV).

However, operational implementation and monitoring require the conduct of assessments. Such assessments do not constitute operational programmes as such, but their contribution is nevertheless essential, and they are discussed in the following Chapter accordingly. The role of nutritionists in enforcing the respect of fundamental rights is indeed limited, but some rights are specific to nutrition, and are mentioned accordingly.

[11] See Section 1.3.4 in this Chapter.

[12] One is the temporary and successful adaptation to climatic and economic variations. The other is the long-term adaptation to chronic disorders by adopting – as the main method for survival – activities that were previously resorted to in crisis only.

2.2.2 Complementary programmes

"Complementary" does not imply "of less importance" or "unjustified on its own"; in fact, complementary programmes usually contribute significantly to the overall impact of operations on the feeding process and health.

Water and habitat

Water and habitat programmes aim especially at:

⇨ ensuring sufficient access to safe water;
⇨ eliminating waste and taking relevant hygiene measures (the construction and rehabilitation of latrines and wastewater treatment systems, and waste collection and disposal);
⇨ building or renovating essential structures such as hospitals, camps for the displaced or refugees, and providing material assistance for housing (building and heating material, and fuel);
⇨ protecting the environment by preserving or improving the quality of the air, soil, rivers and groundwater, vector control, protection of foodstuffs, habitat decontamination and energy saving.

Health services

Healthcare programmes aim at providing access to curative and preventive care in compliance with universal quality standards. Healthcare services divide into:

⇨ community healthcare for public and primary healthcare programmes;
⇨ hospital support, which consists in setting up hospital facilities, and assisting existing ones through the provision of the required materials and personnel;
⇨ the rehabilitation of the disabled (amputees, paralytics, and the psychologically traumatized).

Non-food relief

Non-food relief consists in distributing economic commodities (essential household items) that are indispensable to the survival of households, such as clothing, blankets, tarpaulins, mosquito netting, kitchen utensils, candles, toiletries and fuel. Such commodities contribute to survival relief and economic support, and represent a necessary complement to general food distributions, in order to avoid the sale of the latter in order to secure other essential goods. They may also translate into purchasing power, in the form of credit, cash, or vouchers.

Economic rehabilitation

Economic rehabilitation consists in restoring production means (that is, livelihoods) and their capacity to ensure the economic self-sufficiency of households. Humanitarian action must include it in some form to reduce the dependency of victims on external aid, and enable them to preserve their living standards in compliance with their culture. It provides a logical continuation to survival relief programmes. Economic rehabilitation usually involves the provision of the inputs required for agriculture, stock-breeding, fishing, artisanal work, the rehabilitation of the services necessary for the conduct of such activities (e.g. veterinary and commodity transformation services), and credit or cash to revive production. Humanitarian agencies are usually able to produce a satisfactory impact in the primary sector of the economy, but the secondary and tertiary sectors are another issue. In the primary sector, the essential inputs are provided by nature (sun, rain and land), and even limited rehabilitation programmes can be successful; examples include the provision of cattle vaccination, seeds, tools, fertilizers and pesticides. In the case of mechanized and intensive agriculture, costs rise accordingly. The secondary and tertiary sectors, for their part, are entirely determined by economic parameters such as market competition, safe investments, supply and demand, industrial infrastructure, and transport. Improving industry and public services requires huge material and human investments that far exceed the means of most humanitarian agencies. Nevertheless, the analysis of economic vulnerability in crisis, especially in case of war, tension, embargo or overall impoverishment of the society, is essential to voice the concerns of victims.

Economic support and rehabilitation are easily confused, because economic rehabilitation makes sense only if it enables its beneficiaries to regain their economic self-sufficiency, that is, free themselves of their dependency on humanitarian aid. However, assistance can be restricted to supporting a population by stimulating the overall economy, rather than providing the commodities that the economy can no longer produce. This approach has its advantages, and probably preserves the dignity of its beneficiaries but, even when realistic and cost-effective, it only stimulates the economy artificially because it depends on external funds.

Development

Development understood broadly departs from rehabilitation mainly because it seeks to generate improved and more secure living conditions by addressing vulnerability factors. Rehabilitation on the other hand is restricted to restoring economic independence, but the factors of vulnerability may remain unchanged in the process. Development that attempts to mitigate vulnerability addresses the three parameters of the crisis process, and aims to:

- ⇨ predict and prevent phenomena;
- ⇨ reduce the factors of vulnerability that are associated with predictable phenomena and have resulted in crisis previously;
- ⇨ prepare people to cope with unavoidable crisis more efficiently when the vulnerability factors cannot be corrected.

This implies a thorough understanding of the nature of the crisis, and the necessary analysis should in principle take place during the crisis itself. As a result, the sharing of information between the humanitarian agencies operating during a crisis and the development agencies that follow them is of utmost importance.

Rehabilitation and development are difficult to link because very few agencies combine the two, humanitarian and development agencies differ vastly in nature, and because of the absence of a formal system to bridge the gap. Moreover, the transition to development implies the resumption of political, economic, and social stability to an extent that enables the conduct of development programmes. Finally, the cost is huge and implies a timeframe that is usually incompatible with the scope of humanitarian deployment or attention. Much remains to be done to improve the cohesion between the two types of action.[13]

[13] The link between humanitarian and development action is discussed in great detail in Perrin's *Handbook on War and Public Health* (Perrin, 1996).

3. HUMANITARIAN ETHICS

Humanitarian ethics amount to a code of conduct for action. The philosophical bedrock of humanitarian ethics is expressed in the three first principles of the International Movement of the Red Cross and Red Crescent (Fundamental Principles, 1993):

"***Humanity*** *The Movement, born of a desire to bring assistance without discrimination to the wounded on the battlefield, endeavours – in its international and national capacity – to prevent and alleviate human suffering wherever it may be found. Its purpose is to protect life and health and to ensure respect for the human being. It promotes mutual understanding, friendship, cooperation and lasting peace amongst all peoples.*

Impartiality *It makes no discrimination as to nationality, race, religious beliefs, class or political opinions. It endeavours only to relieve suffering, giving priority to the most urgent cases of distress.*

Neutrality *In order to continue to enjoy the confidence of all, the Movement may not take sides in hostilities or engage at any time in controversies of a political, racial, religious or ideological nature.*"

These principles are today widely recognized as providing the foundation of any humanitarian operation. The remaining principles relate more specifically to the International Red Cross and Red Crescent Movement, but are mentioned nevertheless owing to their relevance to humanitarian action.

"***Independence*** *The Movement is independent. The National Societies, while auxiliaries in the humanitarian services of their governments and subject to the laws of their respective countries, must always maintain their autonomy so that they may be able at all times to act in accordance with the principles of the Movement.*

Voluntary service *The Movement is a voluntary relief organization not prompted in any manner by desire for gain.*

Unity *There can be only one Red Cross or Red Crescent Society in any one country. It must be open to all. It must carry on its humanitarian work throughout its territory.*

Universality *The Red Cross is a worldwide institution in which all Societies have equal status and share equal responsibilities and duties in helping each other.*"

The mottos of the Movement, *Inter Arma Caritas* (in war, charity) and *Per Humanitatem ad Pacem* (through humanity towards peace) express the sum of its ideals.

Practical translations of the philosophy of humanitarian action as defined by the Fundamental Principles of the International Red Cross and Red Crescent Movement may be found in the *Code of Conduct*[14] and the *Sphere Project* (1998). These documents encourage greater accountability on the part of humanitarian agencies towards the recipients of their assistance and donors, and invite better working relations. The *Code of Conduct* is limited to general principles, whereas the *Sphere Project* sets minimum standards in the main areas of humanitarian action.

[14] *The Code of Conduct for the International the Red Cross and Red Crescent Movement and for Non-Governmental Organizations in Disaster Relief Operations,* see Annex 5.

A number of other points deserve attention; they lie somewhere between practical action and the principles for action, and contribute to the definition of professional ethics.

3.1 THE ETHICS OF OPERATIONAL PRACTICE

The ethics of operational practice rest mainly on the professionalism of field staff and the respect of procedures.

3.1.1 Professionalism

The professionalism expected of humanitarian staff comprises training and experience in the first place. In addition, considerable tact and sensitivity are essential for these two aspects to be fully exploited in the field. Sensitivity is a quality that combines courtesy and respect for local customs. In humanitarian operations, the concept reaches further: it is an instrument fundamental to establishing dialogue and securing acceptance, understanding problems and, ultimately, deserving respect.

When locally available skills are inadequate, staff must be trained and coached in the field, and this provides the advantage of real-life conditions. Lack of professionalism must under no circumstances be permitted to worsen the situation.

3.1.2 Deontology

Frequent reference is made in humanitarian affairs to the concept of "good practice", which is understood broadly as compliance with a set of policies and practices that are required to ensure the promotion and protection of the rights of victims. This Manual prefers the expression "deontology", which takes the concept further to include not only proper standards of behaviour, but also the principles that provide their basis.

It should be obvious for humanitarian action to respect deontology. However, it faces many constraints and pressures: political agendas are sometimes incompatible with humanitarian concerns, good intentions still often lead to amateurism,[15] and emergency provides the pretext for hasty action. To be ethical, action must:

- ⇨ pursue prevention and efficiency, according to the strategy defined above;[16]
- ⇨ arise from adequate assessment in order to act effectively;
- ⇨ follow a clear procedure;
- ⇨ comply with recognized operational policies and professional practices;
- ⇨ involve the necessary resources in terms of funding, material, personnel, skills, and management – ethical action cannot condone miserliness or amateurism, and humanitarian aid must be strictly tailored to the needs;
- ⇨ rest upon a strong commitment for the entire duration of the operation, and not risk, for example, untimely changes in outlook owing to financial or political considerations and priorities (programmes may lose their fashionable appeal well before the needs recede);
- ⇨ avoid negative side effects, or at least restrict them to a minimum.

[15] Amateurism is understood here as thoughtless and unprofessional action covered by good intentions; as such, it can easily lead to harmful consequences.

[16] See Section 1.3 in this Chapter.

The concept of negative side effects deserves a comment here. Any type of action may have three sorts of effects:

⇨ intended effects, as defined in the operational objectives;
⇨ side effects, which frequently accompany intended effects;
⇨ negative effects, which are secondary effects whose impact is negative or counter-productive.

Using the brakes on a car may illustrate this: braking aims at stopping the car (intended effect); the inevitable side effect is a heating of the brakes due to friction and, thus, energy loss. Braking too hard may cause the car to skid by locking the wheels (negative side effect). If the driver must brake abruptly, is the negative side effect of possible locked wheels preferable to the collision he is attempting to avoid? In the case of food distributions, the intended effect is to feed people; the side effect could be a drop in the market price of food, and the negative side effect a security incident perpetrated in protest.

In view of the above, possible side effects (both positive and negative) must be considered already during assessments, in order to allow for them in defining action. Effects can never be predicted with complete confidence, and their evolution must therefore be carefully monitored during the operation proper. The best way of dealing with predictable negative effects is to engage in dialogue with local stakeholders to secure their acceptance and support – bearing in mind that most (such as victims, beneficiaries, authorities, organized criminals, and locals) know perfectly well how humanitarian agencies operate, and how to profit from their presence.

3.2 ETHICS CONCERNING VICTIMS

An ethical approach to victims consists mainly in preventing and alleviating suffering. Then local customs must be observed when defining the needs and the required assistance. Ethics also require that victims be treated as privileged working partners: participatory practices invite the direct involvement of recipients, and this is the only way of securing their active support. The ethics underlying participatory approaches are those of a real desire to understand different cultures, views, and practices.

The above does not invite a naive outlook or the undue idealization of victims: they are human beings, no better, no worse than others and, as such, predators. In a critical situation predators seek to survive by any means, and this can involve cheating and diverting assistance. In the midst of crisis, the forces that are necessary for survival may eschew selflessness and respect, and such behaviour is normal in the circumstances. Participatory approaches must allow for these parameters, and information and behaviours must be verified whenever necessary – not only to avoid being fooled, but above all to confirm that the chosen approach is indeed relevant or, if necessary, to take corrective action. Moreover, provided that field workers know what to expect and can make themselves understood, participation is the only way of assisting crisis victims efficiently, and ethically it is the only acceptable way.

It is worth noting that ethics constitute a two-way bond between humanitarian agencies and victims: from humanitarian staff towards victims and reciprocally. The enforcement of this condition is usually well accepted and encourages mutual respect. The open discussion of rules and limitations that contribute to the general interest pertains to operational ethics, and may promote social restructuring in addition to providing security guarantees for the operation itself.

Salient ethics considerations in relation to victims (in terms of the participatory approach) are discussed below, following the sequence of operations.

1. At the stage of initial assessments, crisis victims are usually in the best position to identify their problems and address them. However, their requirements may not match the agency's means or its objectives. They must therefore be informed of the type of information that is sought, and be involved in the definition of the problems, needs for assistance, and operational priorities and objectives, while being made aware of limitations and possibilities. Victims frequently equate assessment with the promise of assistance. Assessment should therefore be based upon the firm intention to act upon observed needs, to secure the means to do so, or to ensure that another agency will respond.
2. The assessment of needs is complicated by the variety of societies whose living standards, expectations, and means of voicing them all differ, and this variety may lead to different responses. This problem may be resolved to some extent by examining the difficulty of surviving, in the light of the pre-crisis living conditions that enabled the society under scrutiny to function according to its cultural standards. Economic development gives rise to needs that are shaped by cultural determinism,[17] some of which are just as constraining to the survival of society as those resulting from biological determinism. These are the needs that humanitarian action must sometimes satisfy, and explain possible differences in the response. For example, fuel distributions are probably redundant in an economy that is based mainly on non-mechanical subsistence agriculture, but indispensable where agriculture is mechanized. Another aspect in determining the need for assistance is taking the victims of crisis seriously, and above all not making decisions for them.
3. Planning must involve the consultation of the victims themselves as to the best way of assisting them. This secures their cooperation, and avoids misunderstandings and negative side effects. If they know their problems, they usually also know how assistance may be used, manipulated, and viewed.
4. Implementation must involve dialogue in order to ensure the relevance of the operation, and to appraise its impact. On the other hand, partnership with the victims is more difficult, as it can entail risks for those involved and may give rise to diversion, depending on possible power relationships and pressures. Supervision of this aspect is crucial, and its absence may give rise to sometimes irreversible negative side effects. For example, beneficiary registrations in view of food distributions should never be left entirely in the hands of the recipients or local authorities: temptation and pressure are too great. The same comment applies to the actual distribution. Beneficiaries must be made aware of the reasons for limiting their involvement. This explanation may cause resentment and disagreement, but must not be avoided: if it is well managed, it is a guarantee for the ultimate efficiency of the operation. Moreover, the quality of delivered goods and services is essential – for example, expired or damaged commodities must never be distributed.
5. In terms of follow-up and impact assessments, beneficiary involvement is clearly just as important, and the danger of deliberate or forced information manipulation exists here too. It must therefore be possible to verify all aspects of the operation whenever necessary.

Finally, ethics concerning victims consists in voicing their concerns to the relevant authorities or forces, and to international opinion. Authorities must be reminded of their responsibilities, and encouraged to abide by their duty towards the population. As discussed previously, however, representations[18] and direct assistance may contradict. If the authorities lack both the means and the intention of abiding by their responsibilities, then no assistance is delivered, and victims pay the price. Should they also be the victims of humanitarian agencies attempting to deliver moral messages at the cost of their suffering? In such circumstances, representations turn against those they intend to help, and thus undermine humanitarian ethics. Reminding authorities of their duties must not involve the use of human suffering as a means of blackmail, and representation must combine with assistance where the latter is required.

[17] See Chapter VI.
[18] See Section 1.3.1 in this Chapter.

3.3 ETHICS CONCERNING THE UNAFFECTED POPULATION, LOCAL SERVICES AND ORGANIZATIONS, AND LOCAL AND NATIONAL AUTHORITIES

The purpose of this section is to raise awareness as to the existence of these entities, to encourage respect for and recognition of them, to draw attention to the fact that they may require assistance themselves, and to invite their involvement without risking diversion.

3.3.1 Unaffected population

The unaffected population frequently accommodates displaced persons (hence the expression "host community"), and the resulting cost may be such as to cause a need for assistance. In such cases, the motivation to assist the host community should clearly be humanitarian ethics and also common sense. Humanitarian agencies that do so thus apply the principle of reciprocity, and preserve the social peace that discrimination would certainly jeopardize. Moreover, if victims are granted access to healthcare while the host community is not, this imbalance must be corrected – either by extending the access to the local population, or by ensuring that the gap is covered by another agency. However, the pitfall of refusing healthcare to victims on the pretext that the host community lacks it should also be avoided.

3.3.2 Local services and organizations

In times of humanitarian crisis, local institutions lack the means to satisfy the needs for assistance adequately. This leads to the question as to how other actors should stand in for them, to what extent, and what role they should be given. There is no simple answer to this question. Some local services and organizations are effective and provide reliable partners, while others are closer to petty crime and do not shy away from physical threats to achieve their ends. Here again, open dialogue is required to understand the nature of the relationship, and for humanitarian agencies to demonstrate that they intend to abide by their guiding principles. Parting on friendly terms may in fact be a convenient outcome for all involved, and is usually preferable to a showdown. Substituting local services and organizations is a major problem in humanitarian action, because international agencies are increasingly accused of exploiting them and leaving little (if anything) behind when the operation is over.

Humanitarian imperialism is still all too common. However, if outside support is required it is because local means have failed. As discussed earlier, humanitarian action by definition amounts to substitution. That being said, the extent of this substitution must be determined, as must the role and responsibilities of humanitarian actors with respect to local services and organizations. The competencies of the latter should provide the answer: the more competent they are, the more useful it is to rely on them. The less competent they are, the more capacity-building is justified, and this is not always compatible with humanitarian action and is certainly not its primary role. The overarching priority, after all, is the impact of humanitarian operations on the circumstances of the victims, who should not have to pay the price for incompetence, corruption, and the failings of local means. As mentioned earlier, the ethical attitude consists in recognizing their role and, if possible, involving them directly. Implementation is then determined by local reality and may range from complete substitution to complete support, the latter meaning that the humanitarian agency does not operate directly but provides local counterparts with the means for action. Clearly, the more local counterparts are supported, the greater the responsibility for providing them with the means to pursue this effort beyond the duration of the operation at hand. This responsibility may be likened to that discussed earlier, between economic rehabilitation and development, and should be accepted as such.

3.3.3 Authorities

Transparency is a must in dealing with host authorities, as is the observance of local and national rules and standards. The latter include regulations that apply to road traffic, importation practices, and the treatment of contagious disease. Clearly, local traffic regulations do not warrant further discussion here; but humanitarians may be confronted with health standards that are inappropriate in view of the circumstances of a given crisis. The issue is not to follow regulations blindly, but to devote careful thought to them, and always weigh the interest of the victims against the preservation or strengthening of national services.

In armed conflict, needs are frequently greater on one side. Because assistance must be adapted to observed needs, the parties must be persuaded that it cannot just be arbitrarily divided between them, and agencies must resist the pressure to do so allegedly to preserve a balance that is, in fact, strictly political. Aid may be diverted by politicians, and armed groups may tax or despoil the recipients of assistance. The danger of diversion is averted by maintaining control over the aid until its final delivery to its destination: this avoids temptation, abuse and pressures. Authorities are frequently offended by what they view as a lack of confidence; humanitarian agencies are well placed, however, to know that confidence has its limits. The associated risk is twofold: with respect to the victims (who may not receive the assistance they need), and with respect to the opposition, which could resent what may be seen as an unacceptable surrender of principles. The latter would react rapidly in ways that may include attacks on humanitarian actors. Here again, the principles of neutrality and impartiality are fundamental, and must be explained, understood and accepted, first and foremost in the field.

The situation is worse still in the case of armed groups that exist at the expense of both the population and humanitarian aid. Here again, transparency and dialogue are crucial. The issue must be addressed directly with such armed groups, and resolved jointly if possible; however, consensus, compromise and dialogue are frequently impossible in such circumstances. This must also be acknowledged, and more radical solutions may then be necessary. However, the efficiency of humanitarian agencies is often determined by their ability to persuade, and radical measures can involve withdrawal and abandoning the victims. The risks deserve thorough thought in order to reach the best possible compromise, which is acceptable for all. Clearly, agencies should refrain from doing too much in order to remain in the picture: in extreme circumstances withdrawal pure and simple is the only ethical option. Humanitarian agencies are not in principle to blame for a crisis situation, and their staff should not automatically feel guilty for their inability to act. Agencies whose staff is murdered usually withdraw for a long time, and risks should never be taken unnecessarily. This is an ethical issue concerning both humanitarian staff (local and expatriate) and victims. It is a matter of prudence towards armed groups whose behaviour is sometimes closer to that of bandits than that of responsible advocates of their proclaimed cause.

3.4 *ETHICS CONCERNING DONORS*

Ethical behaviour towards donors consists firstly in supplying them with the complete information that justifies action, usually on the basis of preliminary assessments. It then involves operational implementation in compliance with operational ethics as discussed earlier,[19] and providing them with the demonstration that the funds they have released have been spent according to the agreed budget plan. Ethics also involves firmness in terms of operational principles and objectives. But donor interest can vary considerably, for example according to political and economic considerations; in some cases donors urge action, in others they discourage or even attempt to impede it. By virtue of

[19] See Section 3.1 in this Chapter.

the three fundamental principles of humanitarian action, the idea according to which there is no good or bad victim and all deserve the same attention must be actively defended. Otherwise, the politicization of aid and the tendency of some agencies to act only in high-visibility settings are encouraged. The funding released by donors is usually generated by their countries' taxpayers, and donors are just as accountable to their own citizens as humanitarian agencies are to them.

3.5 ETHICS CONCERNING OTHER HUMANITARIAN AGENCIES

Humanitarian action has become more professional over the last twenty years or so. Humanitarian agencies have also grown in size and resources. Their agenda may vary according to their mandate, their degree of development, the specificity of their operations, their relationships with States, and their financial capacity. Prime time media coverage facilitates the securing of the funds that are required to exist, and the "scramble for humanity" is harsh. Relationships between agencies grow more complex, especially in emergencies, when all rush to the site and confusion grows as to who is doing what, and how. The situation can then evolve towards two extremes, with several possible combinations. In the first extreme, the following aspects predominate:

⇨ competition over a territorial occupation at all costs; this leads to anarchy, a waste of resources, and a bad working spirit;
⇨ competition to be first on the spot, not bothering whether the resulting action is appropriately targeted, useful or even safe for the victims;
⇨ confrontation as to strategies, depending on the specific agendas of the different agencies and their attitude towards host authorities; this leads to confusion and the weakening of the agencies themselves when it is in the interest of the host authorities to divide and conquer;
⇨ inter-agency conflict, which can arise from confusions as to mandate, but also from competition for the prime position in terms of power, visibility, and operational magnitude;
⇨ coercion when the major agencies that hold the resources involve implementing partners, and impose upon them whom to assist and how, as defined by political motivations rather than humanitarian ethics.

In the other – and needless to say desirable – extreme, relationships between agencies are ethical, and then the following aspects predominate:

⇨ consultation, before and during the operation, enabling all to know the intentions and means of the others, including their anticipated timeframe, and allow for this in their own planning;
⇨ dialogue in order to define overall task attributions;
⇨ coordination to streamline the operations of all the agencies involved within an overall strategy, and to define overall objectives that enable the optimum attribution of tasks according to each agency's skills and resources;
⇨ collaboration, consisting of the joint resolution of problems, involving the designation of lead agencies and complementary or support agencies for each aspect of the problems;
⇨ cooperation, consisting of the efficient sharing of resources and services.

Field coordination is a powerful tool in determining inter-agency relationships. It cannot be imposed, but should be freely adopted, and it must be horizontal and not vertical. Finally, the coordinating agency or person must, if possible, be chosen by the agencies involved, and must be directly involved. All too frequently, coordination structures in the field are dominated by one agency or person, without them being directly involved in the field operations. This must be avoided at all costs. However, other systems allow for rotating chairmanship, in which each meeting is based on a clear, pre-agreed agenda that promotes flexibility and cooperation. Such systems clearly do not exclude non-member agencies (such as those not directly involved). This type of system is the best and most constructive by far.

CHAPTER X
ASSESSMENT AND PLANNING

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CHAPTER X
ASSESSMENT AND PLANNING

INTRODUCTION

Assessment and planning are indispensable to humanitarian action. They enable the understanding of the situation, the detection of problems, the definition of requirements for assistance, the design of a structured operational programme, the monitoring of a situation in order to adjust programmes when necessary, and the evaluation of their impact to improve them when appropriate.

They are fundamental because they encourage humanitarians to think, analyse, anticipate, plan, question, and keep an open mind – these are all pre-conditions to effective assistance.

Humanitarian assistance unfortunately often suffers from the emergency syndrome: the urge to rush into quick visibility through assistance activities. Clearly, media and donor pressure is difficult to resist, as is the spectacle of the "competition" settling in. Great is the temptation to be in the picture at all costs, even if the resulting haste is soon followed by panic. Moreover, emergency provides the perfect excuse to do just about anything and then catch the first train out, without further thought or planning. By the time this becomes obvious, it is usually too late to correct initial mistakes and, in conflict, great security risks can result, as observed alas all too often.

Assessment is particularly penalized by the emergency syndrome, because it is not spectacular, and costs time, money, and human resources; furthermore, a widespread and pernicious idea holds that needs are self-evident in emergencies, and that "there is no need to think to know what must be done". Seen as a waste of time, serious assessment is replaced by "rapid appraisals" that are botched up, or even neglected altogether. It is worth noting that the authorities of crisis-stricken areas often clamour for the quick delivery of relief; this is sometimes motivated by their sound knowledge of how to take advantage of the initial chaos in order to divert assistance.

This Manual insists on the need for appropriate assessment *prior* to deciding upon any type of operation, and to resist the pressure of politics, amateurism, profit, and visibility. The relevance and quality of the operation and the respect for victims are both at stake. Appropriate assessment is never harmful; on the other hand, misunderstanding the problem, the situation, and the real concerns of the victims can have serious consequences.

Assessment is most commonly understood as that leading to the definition of needs for assistance and operational planning. However, this is in fact preliminary appraisal, and two other types of assessment are just as important: monitoring, which is a continuous data collection process in order to follow developments in the situation and the implementation of the operation, and evaluation, which is conducted after the completion of the operation (these three types of assessment are discussed later in this Chapter). Preliminary appraisal may suffer from the emergency syndrome; monitoring and impact assessments usually suffer from the negligence syndrome that so often afflicts humanitarian agencies whose programmes are not systematically subjected to quality controls.

I. ASSESSMENT

1. DEFINITIONS AND GENERAL CONSIDERATIONS

Assessment consists in the methodical gathering and compilation of information, and concludes with its analysis.

The counterpart of this definition is that assessment teams must have an objective when conducting their work, and at least a theoretical understanding of the field of investigation; they will otherwise be unable to collect the appropriate data in a proper manner, or to interpret it.

Assessment rests upon a process that aims to establish and understand facts. The assessment process arises from a pre-defined strategy, and uses tactics adapted to circumstances. It follows a method that enables the collection and analysis of information, that is, information of direct interest, and that required to understand it. For example, the supervision of market prices involves their regular monitoring, but also the gathering of information to explain fluctuations. The same comment applies to the nutritional status of a given population: the best anthropometric assessment is useless without the information that permits the interpretation of the prevalence rates that it reveals.

The assessment process is not stereotyped. It adapts to circumstances, and optimizes the use of available methodologies, models and techniques in order to achieve an adequate degree of certainty (that rarely reaches 100%) without wasting time, thus facilitating decision-making. This means that the time that must be devoted to assessment is also determined by circumstances, and should clearly be kept as short as is efficiently possible.

Assessment must be strictly structured.

The following pre-conditions must be met before engaging in assessment.

1. The type of information that is sought and the reasons for gathering it, must be at least roughly outlined (in order, for example, to gain knowledge, act upon observations, inform, study something to improve understanding of it, appraise the impact of an operation, understand trends, etc.):
   - → the appraisal must be sure to provide useful additional knowledge;
   - → the assessment must be feasible;
   - → the objectives and the objects of the assessment must be clearly defined – is the purpose to appraise the impact of a given phenomenon (objective) on the feeding process (object), to define the eating habits (objective) in terms of weaning (object), to establish the economic self-sufficiency (objective) of a given population (the object here is the economy of the population), to define the nutritional status of a given population, to determine the need for assistance, to measure the prevalence or incidence rates of a specific deficiency, and so on – all these objectives can be the specific objectives of a more general objective, which is the understanding of the nutritional status of a given population;
   - → the necessary and sufficient information must be defined, as must the level of accuracy and certainty that are required to achieve the objectives;
   - → the assessment methodology and instruments must be defined;
   - → the means required for the conduct of the assessment must be defined and secured (time, funding, material and human resources, and formalities);

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→ a plan must be established for the assessment;[1]
→ the necessary assessment follow-up must be defined, as must the relevant indicators in such a case.

2. During the assessment itself, its relevance and assumptions must be verified continuously, to allow for adjustments if necessary. The resulting data must be classified and organized with a view to facilitating or even beginning (if feasible) its processing and analysis.
3. The collected data must then be processed and analysed in order to reach operational conclusions; results must be presented clearly in writing, thus enabling the planning of the next steps of the operation while at the same time providing a document for future reference if necessary.

Like nutritional vulnerability studies,[2] nutritional assessment often suffers from a harmful narrowness of mind. For many, it is restricted to measuring the nutritional status of a population sample in order to determine the prevalence of malnutrition among children under the age of 6 years. This assumes on the one hand that malnutrition rates and small children are the two objects that really matter and, on the other, that the knowledge of this rate enables the appraisal of the nutritional condition of the overall population. These assumptions have serious consequences, because they confine possible nutritional problems to the realm of infant malnutrition, and ignore the crucial earlier stages of the feeding process that affect adults. However, these are precisely the stages that shed light on the individual and overall nutritional condition. This restrictive approach also implies that, in the absence of infant malnutrition, there is no nutritional problem – it may however exist already, and simply not manifest itself in the nutritional status at this stage. Nutritional assessment can clearly be limited deliberately to measuring the nutritional status with a specific purpose; in such cases, it should be labelled according to its objective. Nutritional assessment, strictly speaking, appraises the nutritional condition of a given population, and this includes the following: the state of nutritional needs, the performance of the feeding process, the nutritional status proper, recent developments in the nutritional situation, and predictions as to future developments, according to the seasonal or cyclical milestones that influence the performance of the feeding process.

In addition, assessment should not be undertaken in the absence of the appropriate means to act upon observations, or of another agency in a position to step in. Field presence in such circumstances would amount to prying, which is a waste of valuable time and clearly incompatible with humanitarian ethics. The same comment applies to research into crisis disorders, if assistance cannot follow, or if research does not contribute significantly to the understanding of the circumstances with a view to acting.

The following sections discuss the different types of assessment, and the techniques and tools that they require.

2. THE DIFFERENT TYPES OF ASSESSMENT

Humanitarian action comprises six types of assessment, which are discussed below.

1. Preliminary appraisal.
2. Thorough investigation, which must necessarily follow preliminary appraisal.
3. Monitoring.
4. Evaluation.

[1] Plans are understood as a series of steps to be carried out or goals to be achieved according to a pre-set calendar.
[2] See Chapter VII.

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5. *Ad hoc* assessment regarding specific issues.
6. Intermediary assessment, which is conducted when new parameters may modify those that prompted action in the first place.

In addition, so-called "quick and dirty studies" are in fact rapid and succinct pilot studies, conducted prior to preliminary appraisal or sampling in order to obtain a first rough idea of the problem: they serve to define systematic data collection.

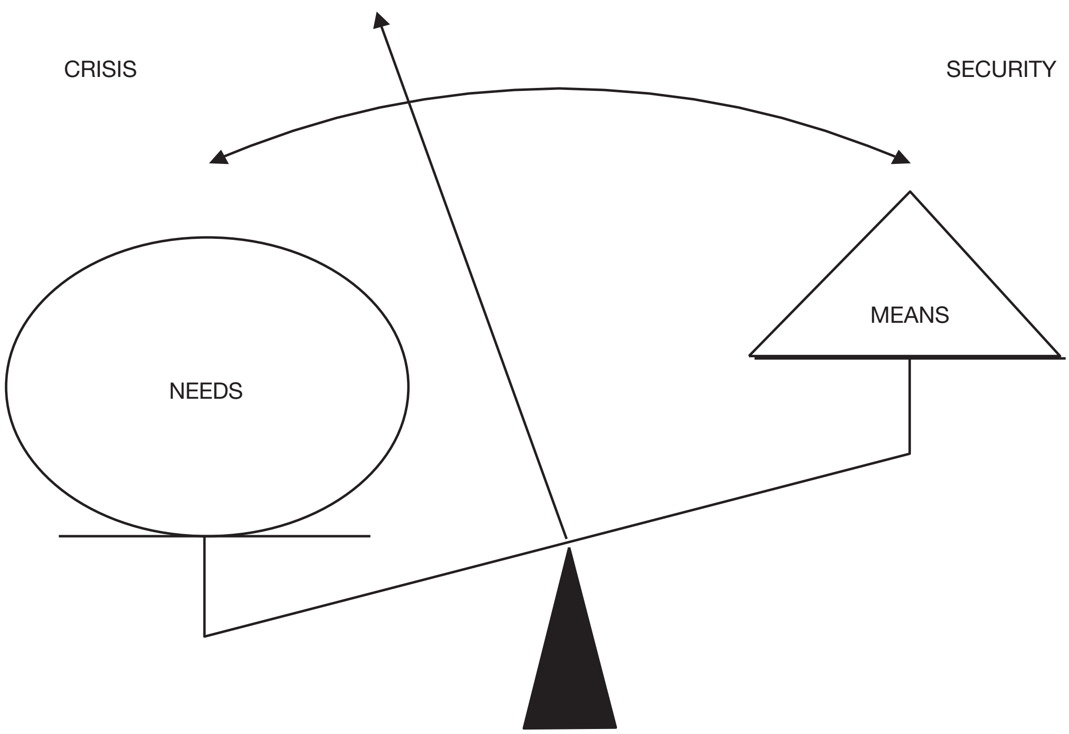
These different types of assessment differ in their purpose, but proceed from the same methodology and techniques, which are used to varying degrees.

2.1 PRELIMINARY APPRAISAL

2.1.1 Introduction, objectives, and stages

Preliminary appraisal deserves the most attention here, because it provides the basis for the other types of assessment. It considers a new situation that has attracted attention following a signal of the requirement for assistance, be it observed or anticipated. Its underlying principle is always the same: to determine whether the requirement for assistance is immediate or anticipated. Such requirements arise from an imbalance between the needs that must be satisfied and the means available to do so, as discussed in Chapter VII and illustrated in Figure 10.1 below.

Figure 10.1 Equilibrium model between needs and means



Firstly, some basic concepts of nutrition and crisis must be restated.

The completion of the exchange of matter and energy between the organism and its environment through the feeding process satisfies the nutritional need. For the feeding process to be efficient, all its activities must provide sufficient performance, according to biological and cultural determinism. In line with the three stages described in Chapter VI (the securing of food, its consumption, and its biological utilization), all the required means must therefore be available and utilized according to the standards that enable the covering of the need. Any deficit in the means and any deviation from the standard cause an imbalance between the demands arising from the need, and the satisfying of such demands. Chapter VI showed that imbalance may be normal: in this case, it usually expresses cultural and natural variations, which are allowed for by coping mechanisms that avert harmful consequences.

Sometimes, the magnitude and duration of events exceed the coping ability of security mechanisms. This heralds the beginning of crisis. Such events amount to phenomena that (directly or indirectly) cause attacks on the implementation of the feeding process, which has grown vulnerable to such events. The impact of such attacks is proportional to their force and to the degree of vulnerability; it also undermines the means to cover basic needs, either by inflating these needs, or by undermining the means to cover them. Excessive imbalance results between the needs and the means for survival. The only possible response is then abnormal, because the means are insufficient, or because their utilization is hazardous (for example, selling the family plough). If the means are lacking or are insufficient, crisis can result in disaster. The observation or prospect of this response justifies humanitarian attention.

"Means" is a general expression that applies to the economy, services, and physiology alike. Preliminary appraisal must detect the disorders that amount to an imbalance between needs and means, because such disorders determine the need for assistance.

The objectives of preliminary appraisal

General objective

The general objective is to identify the need for humanitarian aid in order to "alleviate and prevent human suffering" by protecting rights and providing material assistance.

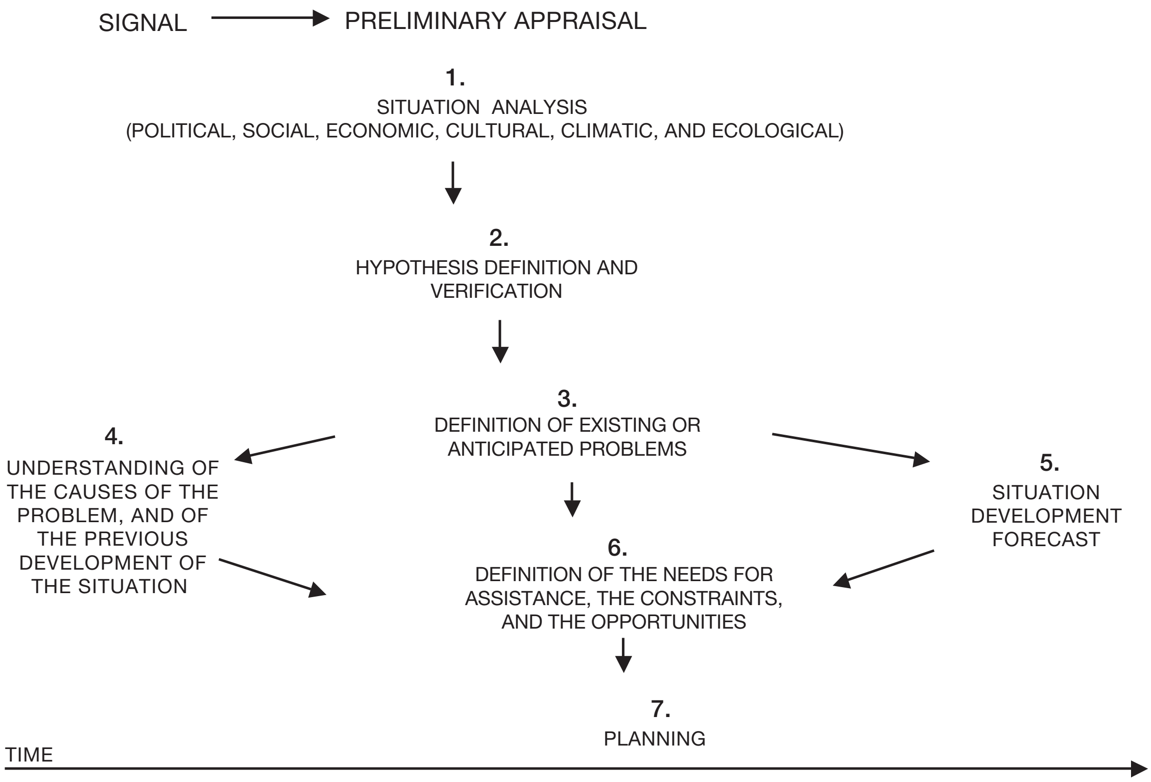
Specific objectives

1. According to the signals that prompt the preliminary appraisal, to define the existing or anticipated harm caused by the combination of phenomena and vulnerability, and whether the performances of the feeding process are abnormally insufficient, or likely to become so.
2. In the presence of existing or anticipated harm, to define whether it poses a problem and, if so, of what type; this amounts to determining the presence (or anticipated presence) of an abnormal imbalance between needs and means, and locating it within the different levels of the feeding process.
3. To define the resulting needs for assistance, their respective priority, and the opportunities and constraints that may influence the delivery of the required assistance; this is achieved through retrospective analysis (present and future) of disorders and their causes.

The subsequent planning consists in defining operational proposals based upon the necessary priorities; these proposals must combine the need for assistance, the opportunities, and the constraints in a realistic programme.

These objectives fall within the framework of the preliminary appraisal process as illustrated in Figure 10.2 below.

Figure 10.2 The stages of preliminary appraisal



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2.1.2 The methodology of preliminary appraisal

The implementation of a preliminary appraisal follows the seven stages illustrated in Figure 10.2 above, in which each stage has its own justification and methodology.

Situation analysis

Situation analysis consists in conducting a more or less formal pilot assessment, with a twofold objective.

1. To approach the natural and human environment that provides the setting for assessment; this is achieved thanks to baseline data and a first contact with the field. During this approach, landmarks and benchmarks are located for the future collection of information. This raises the credibility of investigators in the eyes of stakeholders, and is usually appreciated. Adapting attitude to local customs further enhances credibility.
2. To verify briefly whether the warning signal that prompted preliminary appraisal is well founded, and how it manifests itself. According to findings, basic hypotheses may be formulated for assessment proper.

Defining and testing hypotheses (assessment strategy)

Hypotheses must be defined in order to decide what is sought, where, and how. This definition is determined by findings resulting from the preliminary appraisal, and by the scrutiny of the actual warning signal. Two scenarios can arise, and they may combine:

⇨ the signal amounts to phenomena that are assumed to influence the feeding process of a given population;
⇨ the signal amounts to harm caused by such phenomena.

Verifying the possible impact of phenomena

The underlying hypothesis that phenomena influence the feeding process (or may do so) is tested by:

⇨ identifying the region where the phenomena occur or have occurred;
⇨ identifying the affected population;
⇨ attempting to determine which groups may present vulnerabilities according to existing risk factors;
⇨ verifying the existence of such vulnerabilities;
⇨ attempting to determine whether such vulnerabilities have given rise to such phenomena in the past and, if so, with what type of harm; or if they may do so in future, and with what likely harm.

If the answer to the last point is a positive, then the hypothesis is confirmed, and the process continues according to its planned stages. If the answer is a negative, then the origin of the warning signal should be investigated, in order to decide upon a relevant course of action – this may include, for example, the introduction of surveillance systems with respect to relevant risk factors.

The main risk factors are the following.

1. Risk factors that are associated with armed conflict:
   → arbitrary decision on the part of the military and politicians of the parties to the conflict;
   → ethnic, religious, social, and cultural discrimination;
   → displacement of population;
   → destruction of infrastructure and resources;
   → disruption of communication channels;
   → disruption of agriculture;
   → perturbations in the market and other productive economic activities;
   → disruption of public and private services;
   → settlement of displaced populations;
   → inaccessible or remote areas.
2. Risk factors that are associated with the environment and the economy:
   → ecologically unfavourable areas;
   → potentially hazardous climatic phenomena;
   → significant demographic pressure;
   → disrupted economic activities, and weakened market forces;
   → growing inflation;
   → rising unemployment;
   → disrupted public and private services;
   → disrupted communication channels;
   → loss of harvest and livestock;
   → deterioration of industrial infrastructure;
   → population displacement;
   → inadequate access.
3. Cultural risk factors:
   → ethnic identity;
   → religious identity;
   → cultural practices;
   → social status;
   → economic status.

Verifying the existence of harm

The location and the population that is assumed to suffer the harm indicated by the warning signal are identified; the underlying hypothesis that such harm does indeed exist is then tested. If the harm exists, its causes must be investigated, that is, what phenomena have combined with what vulnerabilities to produce such harm, and the assessment process continues according to the stages described above. If harm does not exist, then the origin of the warning signal and its meaning should be investigated, in order to decide upon a relevant course of action – this may include, for example, the introduction of surveillance systems with respect to relevant risk factors.

These two approaches define the assessment strategy: detecting a phenomenon and verifying its impact, or detecting and verifying harm, identifying its causes and predicting its consequences.

The appraisal of harm is performed at the following levels:

⇨ at the level of the household economy (impact on the means of production, resources produced, reserves, and survival mechanisms) in terms of the securing of food;[3]
⇨ at the level of the functioning of the family cell (impact on the quality of food preparation and attribution, the quality of the attention devoted to dependants, and diet) in terms of food consumption;[4]
⇨ at individual level (impact on the nutritional status, and on the health status) in terms of the biological utilization of food;[5]

These aspects may be illustrated by the following example.

In 1997, the *El Niño* climatic phenomenon was conjectured to cause an unprecedented drought in Irian Jaya, resulting in the risk of famine. This signal prompted a preliminary appraisal. The situation analysis involved theoretical research into the region, its climate, its inhabitants and their living conditions, and the factors that may influence the assessment itself. This research revealed that, drought notwithstanding, some areas could experience significant rainfall. The terrain was extremely difficult, access to villages required the use of helicopters. The population relied almost entirely on the cultivation of sweet potato and gathering. Its access to healthcare was virtually non-existent, malaria was endemic, and interpreters were indispensable. This information provided the basis to prepare the necessary field equipment and perfect the understanding of the cultivation and food value of sweet potato. Logistics being significantly restricted, it was clear from the onset that any assistance operation would meet with substantial constraints.

Once in the field, the rumours of drought and famine were confirmed, without it being possible to verify their effects unless direct access was possible. The following hypothesis resulted: drought did exist, but its effects required verification owing to the population's well-known resilience thanks to hunting, gathering, and fishing. It was therefore not necessarily vulnerable to the drought phenomenon, which would then have had little impact on the performance of the people's feeding process. In reality, the first visit to a village revealed generalized signs of severe malnutrition. The approach was adjusted accordingly, malnutrition was measured in order to calibrate the existing harm, and the hypothesis was formulated according to which malnutrition resulted from the drought, and revealed famine (it could have revealed contagious disease). The hypothesis was then tested in discussions with the entire population and in visits to the cultivation areas in order to

[3] Household economy is discussed in Chapter VI, Sections 3.3 to 3.8; Figures 6.8, 6.9, 6.10, 6.12, 6.13, 6.14 and 6.15 illustrate its main aspects.
[4] See Chapter VI, Section 4.
[5] See Chapter VI, Sections 5 and 6.

understand the chain of circumstances that could have caused this situation. The drought was found to have indeed caused the problem, and proved to be so serious that its impact was equally severe on the natural reserves, which were no longer sufficient. The overall health status was found to be undermined by malaria, respiratory infection, and diarrhoea, whose incidence was on the rise owing to the resumption of the rains and the onset of cold weather. This showed clearly that the overall performance of the feeding process was insufficient, and that the population could not compensate through its economic alternatives or physiological defences. The disorders were obvious, and the definition of the needs for assistance was facilitated accordingly.

Identifying existing or anticipated problems

Following hypothesis testing, existing and anticipated problems must be detected; this consists in demonstrating that the population's response to harm is or will be insufficient and/or dangerous.

⇨ In order to demonstrate insufficiency, the qualitative and quantitative gap between the available/produced means and the needs must be measured. The more insufficient the means are, the more the response to harm will be insufficient, and the more serious the problem becomes. Gaps at this level indicate an insufficient performance.

⇨ In order to demonstrate danger, the qualitative and quantitative gap between normal behaviour and the observed behaviour must be measured. The further the observed behaviour departs from normal behaviour, the more likely the response to harm will be abnormal, and the more serious the problem becomes. Gaps at this level indicate difficulty in preserving a sufficient performance, and the additional risks in attempting to do so.

The magnitude of such gaps is proportional to the existing harm, and to the vulnerability to a further deterioration of the situation; it reflects the severity of the crisis.

The securing of food

Problems arise from a reduction in production activities and/or in production options, an absolute or relative drop in yield, and restricted options for exchange.

The gap between means and needs

The gap between means and needs is not always obvious, unless the famine stage has been reached, marked by a clear deterioration of the nutritional status of the population (this case provides an indirect, but reliable, indication that the gap is significant and has existed for some time). Otherwise, a balance study must compare the unavoidable expenses, the resources produced, and their yield[6] which is meant to cover these unavoidable expenses. The proportion of overall available resources allocated to food must also be investigated, bearing in mind that the closer this proportion lies to 80%, the more critical the situation becomes if the proportion is normally lower. Qualitatively, the gap between available resources and needs to be met is measured by comparing what is available at the time of the assessment with what would normally be used. For example, gathering activities may normally provide high food-value nuts and fish, whereas at the time of assessment, they only secure leaves and wild grass seeds whose energy content is low. Normally, activities that supplement production may be the brewing of beer (which provides good cash yield); at the time of assessment, they may rest solely on the sale of firewood that is found far from the home and sold at low prices

[6] The critical stages of yield are illustrated in Chapter VI, Figures 6.8 and 6.9.

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owing to the saturation of this sector. Quantitatively, the gap may be appraised through the remaining food reserves and the state of the current or anticipated food production, and the estimation of their adequacy to cover the needs, and by studying the relative market value of available resources and basic goods and services.

Furthermore, the gap between means and needs may also be defined by comparing the available economic resources and the minimum economic resources normally necessary for self-sufficiency. The approach can be honed by determining the type and amount of resources that qualify a household as being poor, average or rich, and the normal proportion of households in each category (i.e. wealth ranking).

Appraising the adequacy of resources to secure food, verified by food consumption (i.e. the type and quantity of food ingested, and the frequency of meals), clarifies the gap between means and needs, since the food consumed is directly determined by food-securing activities.

The behavioural gap[7]

The behavioural gap amounts to the manner of obtaining and utilizing economic resources at the time of assessment, in comparison with the manner of doing so in normal circumstances (i.e. neither exceptionally good, nor exceptionally bad), as defined by local criteria. However, the existence of such a gap alone is not enough; it remains to be seen whether the gap reveals a problem, and whether the latter may worsen over time. Ultimately, the idea is to determine what level of the famine process[8] the population has reached at the time of assessment (adaptation, impoverishment, capital loss, or starvation), and the probable evolution of its economic behaviour and performance. Problems, as defined here, arise when the population has exhausted its specific reserves, that is, when it no longer has any other option but to resort to its survival reserves (see Figure 6.14). This option is dangerous, because it undermines the economic production capacity and the functional capacity of the organism.

In practical terms, "normality" must be defined in consultation with the affected population in order to investigate possible gaps. It may then be compared with the situation at hand. The resources used for survival indicate which level of the famine process has been reached.

This approach may be illustrated by the following example.

A drought-stricken population defines normality (i.e. the usual way of producing and utilizing resources) as follows:

- ⇨ 40% of the required resources are generated by agriculture;
- ⇨ 30% by gathering;
- ⇨ 20% by wage-labour;
- ⇨ 10% by social obligations within the family.

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[7] The conceptual approach that facilitates the understanding of behavioural gaps (understood here as economic behaviour) is provided in the Section that discusses the famine process in Chapter VIII.

[8] Reaching a given level within the famine process does not necessarily mean that famine is inevitable (this aspect is discussed in Chapter VIII), but certainly that the population faces problems. The question then arises as to the probable evolution of the process (improvement, stabilization or deterioration).

At the time of assessment, the economic adjustment response aimed at increasing the use of the most profitable means of production in order to compensate the production loss caused by the drought, is as follows:

⇨ 20% of the required resources are generated by agriculture;
⇨ 20% by gathering;
⇨ 30% by wage-labour;
⇨ 10% by social obligations;
⇨ 20% by reserves set aside for this use.

In the above example, the population under consideration is still at the adaptation level of the famine process – in other words, its food-securing performance is still satisfactory. A qualitative gap appears, but it is not yet quantitative. The hypothesis that drought causes problems is not confirmed in this first stage of the feeding process. It may however be verified with respect to the consumption and biological utilization of food because, at these stages, adaptation may translate into changes in the time devoted to the different essential activities, and in the functioning of the family cell. Small children in particular may suffer from neglect, causing repercussions on their food consumption and its biological utilization. Such problems may generate the need for assistance, but rather medical than nutritional, and action is most likely to be relevant in terms of improving access to healthcare. It would on the other hand be useless, even counter-productive, to introduce a sanitary education programme when the problem results from the lack of time and means rather than ignorance.

The following alternative can be considered. At the time of assessment, the required resources are generated as follows:

⇨ 5% by agriculture;
⇨ 10% by gathering;
⇨ 25% by wage-labour;
⇨ 10% by social obligations;
⇨ 20% by survival reserves.

Such a gap indicates that the available means can only satisfy 70% of the needs, and the shortfall is thus 30%. It also indicates that the behaviour that consists in utilizing survival reserves threatens the household's economic self-sufficiency. The response to the drought is here both insufficient and dangerous, and highlights the serious problems already encountered at the food securing stage, which will have consequences later in the feeding process. It is worth noting that behavioural gaps are observed in terms of the type of production activity and of the utilization of available resources, but also in terms of the time devoted to the different production activities. For example, if a given population must devote most of its time to gathering activities for its survival during the season when it would normally prepare its fields for sowing, then these activities are detrimental to the possible recovery of their economic self-sufficiency.

Another approach involves the definition of normality in consultation with the affected population, followed by the definition of the worst-case and best-case scenarios that this population can recall (the elderly provide invaluable information in this type of enquiry), and the comparison of the results with the observed situation. This also enables the comparison of the crisis at hand with respect to what the population is culturally accustomed to, providing a better idea of its current resilience.

The diagnosis may be sharpened and confirmed by reviewing all the normal and resilience resources that are available to satisfy needs. The precise use of these resources must then be defined, according to the different stages of the famine process following a phenomenon such as drought. This is not easily done, because the consulted population must clearly understand the purpose of the enquiry. An example is provided in Table 10.1below.

Table 10.1 Example of ranking of the use of resources to cover needs and their respective roles in crisis

		Resilience			
Resources	**Normally**	**Adaptation**	**Impoverishment**	**Capital loss**	**Starvation**
Agriculture	40%	20%	10%	5%	5%
Gathering	30%	20%	15%	10%	10%
Wage-labour	20%	30%	25%	25%	20%
Social obligations	10%	10%	10%	10%	10%
Petty trade			5% [a]	5% [a]	
Credit			10% [a]		
Specific reserves		20%	10% [a]		
Survival reserves			10% [a]	20% [a]	5% [a]
Needs coverage	100%	100%	95%	75%	50%

[a] Activities considered as dangerous, insofar as they are not normally resorted to, and their appearance during the impoverishment phase is an indication of deterioration itself.

The analysis of Table 10.1 invites the following observations. Gathering varies like agriculture, which is logical in drought; the labour supply is inelastic; social obligations do not vary according to the severity of crisis; petty trade is not a seriously considered option (possibly because resorting to it signals economic difficulty, and thus promotes speculation); this population does not rely heavily on credit. These observations must then be verified in the light of the real potential of each option.

In order to confirm hypotheses as to the impact of specific phenomena, and in order to verify how resilience activities are resorted to, the population is requested to describe the recent history that has led it from normality to its present circumstances. This is done by drafting a calendar and a detailed description of experienced phenomena and difficulties, and the reaction they prompted. An example is provided in Table 10.2 that illustrates the development of famine between 1992 and 1994 in a region of southern Sudan. The collection of the data contained therein required a fortnight of field work, involving household interviews, the measurement of the nutritional status, reference to previous reports and experience in the area, group discussions, and interviews with key informants (traditional leaders, and military and political authorities).

Table 10.2 Access to food (by order of importance), phenomena, difficulties, and response during a famine process in southern Sudan, 1992–1994

Access	**Phenomena and difficulties**	**Response**
Milk from the herd (normal access)	1991 – 1992 Attacks on the herds Seasonal migration	Agriculture Fishing Gathering Marriage Wage-labour Social obligations

Sale of livestock for sorghum (normal access)	1989 – 1994 War	Agriculture Wage-labour
Agriculture (normally a secondary seasonal activity)	1993 Drought 1993 and 1994 Insect damage Lack of inputs Seasonal factors 1988 – 1992 Forced displacement	Fishing Gathering Wage-labour Social obligations
Fishing (normally a secondary seasonal activity)	1993 Drought Lack of inputs Seasonal factors 1988 – 1992 Forced displacement	Gathering Wage-labour Social obligations Restricted food consumption
Gathering (normally a secondary seasonal activity)	1993 Drought Seasonal factors Competition for natural resources	Wage-labour Social obligations Restricted food consumption
Wage-labour (a complement in case of need)	The supply for this type of work exceeds the demand Insecurity impedes the search for employment Insufficient functional capacity	Social obligations Restricted food consumption
Social obligations (reciprocal assistance)	Poor overall community economy Absence of relatives	Restricted food consumption 1993 Humanitarian aid
Humanitarian aid (erratic, rather rare)	1994 Political constraints Seasonal access factors 1994 Donor fatigue	Restricted food consumption
Restricted food consumption (crisis response)	Damaged physiological reserves	No further option Significant increase in mortality

The consumption of food

Problems arise from insufficient and/or abnormal consumption.

The gap between means and needs

This gap is defined by analysing the consumption of food.

The behavioural gap

The behavioural gap may manifest itself in the following:

⇨ the quality and quantity of food consumed at the moment of assessment, in comparison with normality;
⇨ the time devoted to the preparation of food;
⇨ the distribution and attribution of food;
⇨ the time devoted to caring for and feeding dependants;
⇨ the health status, which influences the consumption of food.

For example, the consumption of cereals that would normally be kept as seeds is not an abnormal consumption, but an abnormal *use of resources*. In this example, an apparently normal behaviour in terms of consumption in fact reveals a serious disorder in the securing of food. Assessment in crisis must therefore question what may appear normal as well as apparent abnormalities.

The biological utilization of food

Problems arise here from an insufficient food intake and poor health. Gaps may not be measured directly, because this phase takes place within the organism; however, gaps may be estimated by appraising the nutritional status and the health status, because the standard is defined as an absence of debilitating disorder and an acceptable nutritional status.[9]

To conclude the identification of problems, it is worth noting that a given phenomenon may have no impact on the feeding process at the time of assessment, but may have at a later stage. As a result, the probability of this, and the possible resulting harm and problems must be appraised. The key and purpose of early warning rests in predicting the evolution of a crisis process when it is still in the warning signal stage, in order to avert its development or effects. On the other hand, problems may be difficult to appraise, especially when the crisis is still latent, or if its effects are unobtrusive. Precisely at this stage, results must be cross-checked.

Identifying the causes of problems

Identifying and demonstrating the causes of problems that may result in crisis amounts to clarifying the interaction of phenomena, vulnerabilities, and impacts. This is necessary in order to define the need for assistance, in both time and content. For example, a drought may threaten to cause famine in a given subsistence agriculture area; this threat is likely to disappear during the following rainy season if the latter is normal. As a result, action should persist at least until the following normal harvest, and will consist chiefly of food and agricultural inputs. If famine results from the inability to cultivate owing to armed conflict, the cause is more complicated because the evolution of conflict is more difficult to predict. However, it is safe to say that food assistance must persist until its recipients regain access to their land, and that action must involve representations reminding the authorities of their duties towards civilians. Furthermore, action must be as preventive as possible, that is, address the causes of the problem, hence the need to identify them properly.

In practice, the following criteria may be applied in defining cause and effect relations.

1. The exposure to the phenomenon must precede the problem (this defines the chronological sequence).
2. The risk of facing the problem is significant for those who have been exposed to the phenomenon, and minor or non-existent among those who have not (this defines the force of the cause and effect relation).
3. The risk of facing the problem is greater for those who have been exposed to the phenomenon seriously than for those whose exposure was lower (this defines the risk according to the degree of exposure).
4. No other factors (independent of the phenomenon) could cause a serious risk of facing the problem (this defines the specificity of the cause and effect relation).
5. The risk of facing the problem disappears with the phenomenon (this also defines the force of the cause and effect relation).
6. The cause and effect relation may be demonstrated by different independent types of information (this defines the corroboration of results).

The above criteria are not easily verified because of the number of variables they involve; strictly, this would demand cohort and case-control studies in order to identify the causes of the problem

[9] The concept of a good nutritional status is discussed in Chapter VI.

accurately. In statistics, cohort studies follow subjects that meet certain criteria, and compare them over time with another group that is not affected by that condition; case-control studies on the other hand compare subjects that meet certain criteria ("cases") with another group that is not affected ("controls"). Both methods contribute to defining the force of the cause and effect relation; however, such studies are usually difficult to conduct in the circumstances surrounding humanitarian action.

Predicting developments

Predicting the evolution of a given situation is just as important as identifying the causes of the problem in order to define the need for assistance and to plan operations. Indeed, planning is often determined by this, since the nature of its causes can significantly influence the duration of the crisis. Predicting the evolution of the situation also enables the setting of a timeframe for the operation, and enables the anticipation of the evolution of the need for assistance, according to the different possible scenarios.

Defining the need for assistance, constraints, and opportunities

The need for assistance is usually simple to define, as it amounts to the gap between available resources and needs, assistance being aimed at bridging this gap. In other words, a performance of the feeding process that cannot be ensured by the usual means and cannot be compensated by coping and survival mechanisms must be balanced through assistance, up to the level of what the population can do for itself without running further risks. However, the coverage of the need for assistance may face opportunities or constraints; these must be identified together with the need for assistance itself, in order to allow for them during the planning phase.

The main constraints that may impede the assistance process are the following.

⇨ **Political:**
- → insecurity;
- → inappropriate operation as viewed from a military or political perspective;
- → administrative problems.

⇨ **Logistical:**
- → inadequate means of transport;
- → inadequate communication means and infrastructure;
- → storage difficulties.

⇨ **Negative side effects:**
- → negative impact on the surrounding economy;
- → attraction (or "magnet effect");
- → exacerbated tension.

⇨ **Means:**
- → lack of financial and human resources.

Opportunities include all locally available resources that could contribute to the operation, such as local organizations, competencies, infrastructure, and goods and services. They must be resorted to carefully: will they continue to function beyond the crisis proper?

The combination of needs for assistance, constraints, and opportunities permits the translation of what should be done into what can be done.

Data to be collected during preliminary appraisal

The data that should be collected in order to shed light on a given situation and, where appropriate, decide upon an appropriate form of assistance are as follows.

1. The geographic location of the affected area.
2. The identification of the groups that react differently to the development of the crisis – differences are determined by exposure and vulnerability to the phenomenon, and by existing harm.

Then, the following must be determined for each group.

3. Wealth ranking (poor, average and rich) and the economic profile (quantity and type of economic resources) for each category, and of the proportion of its members in each:
   → in conditions that are considered to be normal;
   → at the moment of assessment.
   This information is collected in consultation with the affected population. Ranking is useful in defining the economic profile of a given area (or food economy zone), for future reference; it is less important in overt crisis, when assistance cannot distinguish easily between wealth groups (and may not intend to in view of the implied discrimination).
4. The relative importance and attention that each segment of the population (or wealth group) attributes to the different components of its economy:
   → when the situation is considered to be normal;
   → in the worst situation that the population can recall;
   → in the best situation that it can recall;
   → at the moment of assessment.
   Likewise, the quality and quantity of unavoidable expenses and food consumption must be defined with respect to these different situations.
5. The minimum economic resources required to achieve economic self-sufficiency (and not exceed it) when the situation is normal.
6. The normal variability of economic and climatic phenomena, according to the population's experience and the manner of adapting to them by adjusting the relative importance of the utilization of the components of the economy, and the manners of using resources (this sets the limits of adaptation).
7. The circumstances (or phenomena) that cause specific difficulties, that is, those that exceed normal variations.
8. The type of abnormal behaviour (with respect to the resource base) that may result from extreme difficulty, and the nature of the danger it represents.
9. The level that has been reached within the famine process.
10. The causes of the current situation.
11. The developments (or phenomena) that may affect the situation, their probabilities, and the prognosis as to the evolution of the situation.
12. The remaining potential for resilience (type and sustainability) at the time of assessment – this determines whether the population under consideration is still economically self-sufficient or not:
    → if so, for how long and at what cost?
    → if not, to what extent is economic performance insufficient, and why?
13. The problems the population is facing.
14. The need for assistance, according to the affected population, and according to the assessment team, ranked by priority.

15. The possible effects of the programmes required to cover the needs for assistance.
16. The measures required to avert crisis, if assistance is necessary.
17. The necessary monitoring measures, in the presence or absence of assistance.

Clearly, in extreme cases such as generalized famine or the accommodation in camps of refugees and displaced persons, the above approach can be considerably simplified.

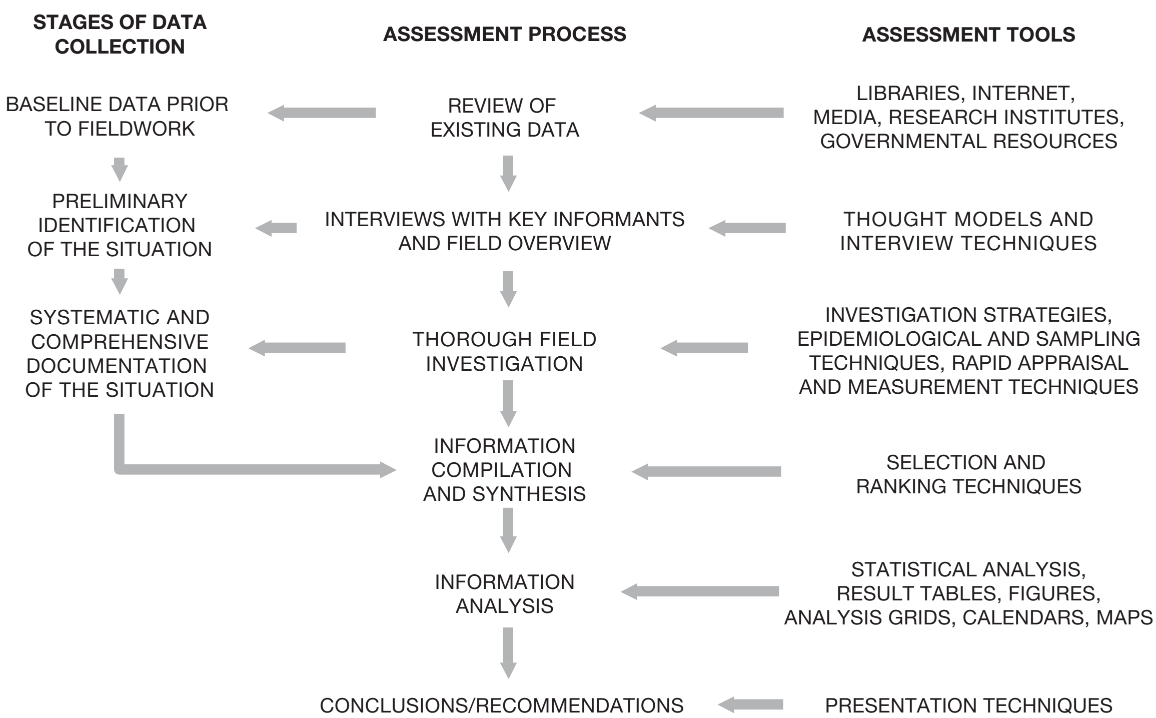
2.1.3 The process of preliminary appraisal

In practice, assessment takes place according to a process that runs from the collection of information and the definition of its stages, to the analysis of the resulting data and the need for assistance, which imply the need for action. The assessment process consists of:

⇨ the review of existing information (i.e. secondary data review), which enables the establishment of baseline data before the inception of fieldwork;
⇨ interviews with key informants and a first overview of the field in order to achieve a preliminary understanding of the situation;
⇨ thorough investigation at field level in order to secure a systematic and comprehensive documentation of the situation;
⇨ information compilation and synthesis;
⇨ information analysis;
⇨ the drafting of conclusions and recommendations.

The organizational chart that describes the process of preliminary appraisal is summarized in Figure 10.3 below, adapted from an assessment model suggested by ICRC agronomist P-M. Perret.

Figure 10.3 Organizational chart for preliminary appraisal



2.2 THOROUGH INVESTIGATION

Preliminary appraisal adopts optimal ignorance[10] to save time, and this usually does not promote a thorough understanding of the social fabric. Moreover, according to the severity of the crisis and its evolution, victims eventually behave atypically and the interpretation of behaviour as a reflection of cultural determinism grows increasingly difficult, even dangerous. Therefore, the objectives of preliminary appraisal must be achieved first, without delving into superfluous data that may be misleading. The operation must then quickly take form. At this stage, the functioning of the society must be understood in order to modulate action. In the Somali famine of the 1990s, for example, a completely exhausted displaced group that faced significant mortality claimed to have lost everything (including the hope of return), and believed it was permanently condemned to dependency on humanitarian aid. Two months later, the survivors approached assistance teams in order to negotiate the delivery of resettlement assistance to those who could return home in time for the harvest, whereas those who could not would continue to receive assistance on-site. This revealed that this group had had time to prepare and sow its fields, in spite of an already seriously advanced famine, and had then fled as a last resort, but leaving prospects for the future behind. This had escaped assistance teams, who had therefore overlooked the fact that this group faced relatively close production deadlines. Likewise, it had not occurred to this group to inform assistance teams of this state of affairs at the time it was admitted to the programme. In view of the desperate situation that it faced, it may indeed have abandoned all hope of one day returning. Such are the aspects that thorough investigation must clarify, in addition to the issues that may initially go unnoticed, but exist nevertheless and appear as the situation grows clearer.

The objectives of thorough investigation

General objective

The general objective is to adjust action to local reality. This approach allows appropriate corrective measures to be taken early, thanks to an adequate understanding of the situation, the culture, the economy, the stakeholders, the issues, and the prospects as perceived by the stakeholders themselves.

Specific objectives

1. To monitor the evolution of the situation and the needs for assistance better, by completing the understanding of the economy, particularly survival mechanisms.
2. To understand the secondary and negative effects of the operation better, by improving the understanding of the reaction caused by the operation.
3. To detect individual vulnerabilities, and the possible needs for sensitization to nutrition, by improving the understanding of the cultural behaviour towards nutrition: normal securing of food, eating habits, possible discrimination in the attribution of meals, infant feeding methods and weaning practices, attention to infants, role of the parents and children in production, etc.
4. To understand the issues and risk areas better by completing the analysis of stakeholders and issues, and of relative vulnerability.
5. To obtain the clearest possible vision of the field, by completing maps.

In the course of action, it may be useful to conduct a scientific investigation that contributes more to improving the understanding of a well-defined subject than the overall setting. Such research is not discussed here.

[10] "Optimal ignorance" consists in seeking only the information that is strictly necessary, and no more. See Section 3.1.1 in this Chapter.

2.3 MONITORING

Monitoring is a continuous, or at least a regular, process; it seeks to detect changes in the nutritional situation of a given population, and to supervise the practical implementation of the operation if relevant. In terms of nutritional monitoring, assessment rests upon pre-defined indicators, and takes place according to a plan that allows for events that may affect the different stages of the feeding process. It includes balance studies at regular intervals (or compliant with critical stages), in order to use the resulting data.[11] The difference between monitoring and follow-up lies in the fact that monitoring refers to the overall process, whereas follow-up refers to a specific activity. The follow-up of the nutritional status is part of nutritional monitoring. Programme follow-up involves the supervision of its implementation according to the initial plan.

The objectives of monitoring

General objective

The general objective is to lead to relevant operational decisions. This is achieved by securing continuous and regular information on the nutritional condition of a given population or individuals, on the factors that influence it, and on any others that may affect the conduct of the operation.

Specific objectives

1. To monitor the evolution of factors (phenomena, vulnerabilities, impacts, and problems) that prompted humanitarian action in the first place.
2. To follow the evolution of the feeding process (activity implementation and performance).
3. To derive the evolution of the needs for assistance from the previous two points.
4. To predict the probable evolution of the nutritional situation and of the need for aid, in order to plan the rest of the operation.
5. To monitor the practical implementation of aid programmes by verifying that the resources are utilized as initially planned.

This may be illustrated by the following example.

On the Angolan Planalto, in a rural environment, minimal monitoring consists in verifying the availability of production inputs and the access to land prior to the two planting seasons in July and October. It then involves supervising plant growth and appraising the harvest potential, according to the climatic conditions and the action of non-human predators. It also consists in detecting the action and impact of human and non-human predators at the time of harvest, to determine whether the harvest was collected prematurely or not and, if so, why. Finally, it involves the documentation of how farmers use their harvest, and how they describe the current and future (i.e. until the next harvest) situation, their intentions, expectations, and demands, and whether the latter amount, objectively, to a need for assistance. The capacity of local health services (dispensaries, hospitals, nutritional rehabilitation centres) at the onset of the rains must also be appraised, because this season is usually marked by epidemics of contagious diseases, causing a significant increase in severe malnutrition. If a food distribution programme is in progress, the timing and content of the distributions, the real capacity of logistics to follow the plan, and the accuracy of beneficiary lists must all be verified, and possible attempts at abuse must be detected and dealt with.

[11] The use of assessment data may seem self-evident; unfortunately, field practice shows that data collection is frequently treated as an end in itself, and does not lead to the appropriate exploitation of results.

2.4 EVALUATION

Evaluation serves to determine whether operational objectives have been achieved. If evaluation only takes place at the end of the operation, it can merely draw lessons from the past. This is only useful if the agency has the means to integrate findings into future action. Evaluation is more relevant if it is continuous or regular (like monitoring), in order to adjust current programmes in a timely fashion. This means that, like monitoring, programme appraisal must be planned ahead, with pre-defined indicators, and must rest upon a plan that includes regular balance studies, or that are timed according to critical stages.

The objectives of evaluation

General objective

The general objective is to compare what is expected of a programme with its actual outcome. Like monitoring, evaluation also facilitates operational decision-making.

Specific objectives

1. To determine whether the quantity and quality of resources are adapted to the needs, whether the provided services are relevant, and whether the indicators used in the appraisal vary as expected.
2. To determine the secondary, and possibly negative, effects of the operation.

In the above example of food distributions on the Angolan Planalto, the objective was to reduce severe malnutrition prevalence rates from 30% to 10%, and those of moderate malnutrition from 40% to 20% within three months. The operation may be evaluated by measuring the nutritional status on a monthly basis, in order to detect trends early enough, and combine this measure with the collection of data as to the nature of the observed malnutrition, the impact observed by the population itself, and secondary and negative effects.

Monitoring and evaluation may be performed in parallel, in order to optimize the use of available means and avoid assessment activities becoming too cumbersome.

2.5 INTERMEDIARY ASSESSMENT

Intermediary assessment is justified whenever events occur that may influence the needs for assistance, by changing the condition of the beneficiaries of a given operation, or by aggravating the circumstances of the previously unaffected, but monitored, population. The magnitude of the event distinguishes this type of assessment from monitoring because it changes the situation significantly. The principle of intermediary assessment is identical to preliminary appraisal, but intermediary assessment is simpler because it relies on information gathered by previous and ongoing assessment.

2.6 PILOT STUDY

Pilot study is important to direct and streamline thorough investigation, when the situation is not self-evident. It enables a quick appraisal of the circumstances, and the verification that they do agree with the assumptions of the assessment. For example, if a perturbing phenomenon is suspected to cause a given population difficulty in securing food, one sounding may be conducted in the sub-group that is assumed to be most affected, and another in the sub-group that is assumed to be less affected. This avoids having to collect comprehensive data for the entire population from the onset. Another advantage of a pilot study is the use of soundings that contributes to determining the type and size of a sample.

3. GENERAL ASPECTS OF ASSESSMENT METHODS

Assessment consists in gathering and analysing information in line with the overall objective. Guiding principles are required in this effort, followed by techniques for the collection and analysis of information, information-access tools, and reflection and presentation tools. This discussion concentrates chiefly on preliminary appraisal, as these considerations also apply to most other types of assessment (except evaluation, which requires statistical and epidemiological analysis tools that lie outside the scope of this Manual).

3.1 A CONCEPTUAL APPROACH TO ASSESSMENT

The three basic concepts underlying data collection in preliminary nutritional assessment are the same as those that have been suggested for rapid rural appraisal or “RRA” (McCracken, 1988).

3.1.1 Optimal ignorance

This concept rests upon the idea that only the information that is strictly necessary should be sought, and no more. This concept is simple to grasp, and its application is important, but this is not always easily done. The idea is for preliminary appraisal to enable rapid response in order to avert the deterioration, or the continued deterioration, of a situation. Data to be collected must therefore be limited to the strict minimum required for decision-making. To this end, assessment must follow a plan, and not seek information blindly. The data required for this plan must be identified, and its use defined, as must the complementary measures that will provide an adequate understanding of the problem and facilitate the definition of needs. The difficulty may lie in distinguishing what is essential from what is not, both in terms of the scope of investigation without direct connection with the identification of problems and needs for assistance, and the precision and detail that translates into waste of time, without really improving the resulting data. For example, if access to food is suspected to be insufficient, should this be verified through the measure of the nutritional status of a sample of children under 6 years, through interviews with key informants, or through the direct observation of what people are eating? Each method has its advantages and its drawbacks, and the ultimate choice is determined by the specificity of the situation itself – and this may require all three. If simple random sampling is used on the assumption that prevalence rates have reached 45% of severe malnutrition, is the preferred confidence interval ±2% or ±6%, knowing that in the first case, 2,000 children must be measured, and in the second only 200? For practical purposes, the second option is usually acceptable.

What information is indispensable before engaging in field assessment? In some cases, it may be best to know as little as possible and to keep an open mind. In other circumstances, good general knowledge saves time and facilitates dialogue. However, an apparently superficial understanding may prove both invaluable and dangerous. Having raised these problems, it appears clearly that nothing permits a better individual application of optimal ignorance to the field than field experience and knowledge, combined with common sense. In terms of the implementation of assessment, the best option is to send in a multidisciplinary team. This saves time, because more data is collected, and the experts who understand the concept of optimal ignorance are able to collect the required data quickly. It also ensures the quality and relevance of information in each field of investigation. Multidisciplinary teams also speed up data processing and analysis, and improve the consistency of approaches and the formulation of proposals, thus conveying the credibility required to persuade decision-makers quickly. Moreover, responsibility-sharing within a team usually speeds up operational implementation. Typically, preliminary appraisal teams should possess skills in nutrition, public health, water and habitat, and in the sector of the economy that is affected by the crisis at hand. This may be agro-economy in the case of subsistence agriculture in Africa; in the case of former Yugoslavia, it would preferably require a sound understanding of general economics, and familiarity with urban and war-affected economies.

3.1.2 Triangulation

This concept is fundamental to organize data collection, in order to define reality as accurately and quickly as possible. As such, triangulation reinforces the concept of optimal ignorance. Triangulation consists in combining different sources and means to obtain information. Accuracy and the completion of assessment are achieved by resorting to several indicators, each of which requires the use of different sources of information. Reality appears as assessment progresses, by corroboration, convergence and consistency of the information obtained, by combining indicators and the different sources of information pertaining to each indicator. Until data is corroborated, contradiction and divergence must be investigated by reviewing the initial hypotheses, by reformulating questions, by consulting stakeholders as to these contradictions and divergences, and by seeking to identify misunderstandings related to perception and language. Triangulation is clearly optimized by resorting to multidisciplinary assessment teams. The triangulation concept is illustrated in Figure 10.4 below.

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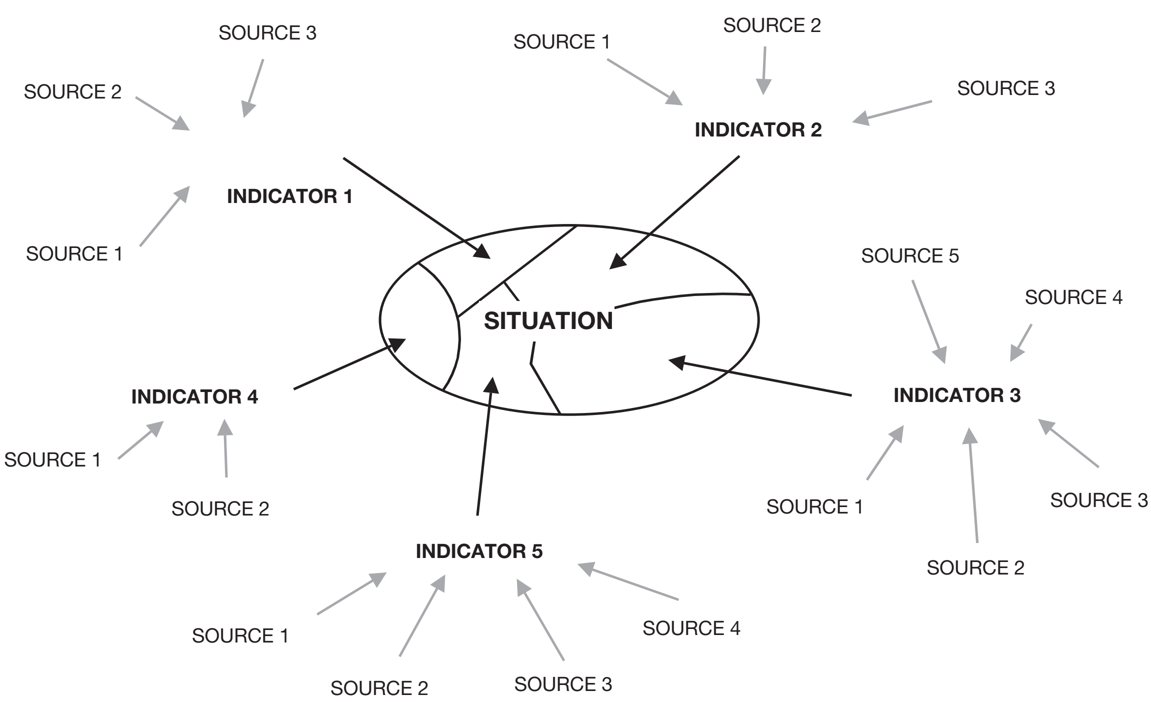
Figure 10.4 The triangulation concept – appraising a situation via triangulation



3.1.3 Flexibility

This concept implies the constant adjustment of assessment as it progresses and as the understanding of reality becomes more accurate, according to developments, new avenues to be explored, and changes in direction or method. Flexibility is not an excuse for chaos or scattering. It simply indicates an ability to adjust to circumstances, while pursuing a specific objective that cannot be questioned without valid reason. This concept consists in:

- ⇨ proceeding in steps, each of which incorporates the results of previous steps – this means that the assessment process is not set rigidly from the onset, but that it evolves with the situation;
- ⇨ demonstrating creativity and the ability to adapt techniques and methodologies to circumstances, especially constraints;
- ⇨ encouraging interaction between team members and their respective areas of expertise in order to promote overall understanding – this in turn facilitates an overall approach to observed problems and their solutions;
- ⇨ conducting semi-structured interviews which rest upon structured thought, but enable the exploration of information opportunities as they appear, and do not require questions to follow a specific order;
- ⇨ developing field knowledge mainly in contact with the population and its environment;
- ⇨ basing the approach on participation, because the local population has the soundest perception, understanding and interpretation of the problems it faces – likewise, action must rest upon participation if it is to succeed.[12]

3.2 *DATA TO BE COLLECTED DURING ASSESSMENT*

The purpose of assessment is to collect data, which is based on variables that are used as indicators.

3.2.1 Data

Data collected during assessment is quantitative or qualitative – this is not to be confused with qualitative and quantitative variables. Quantitative data is expressed in numbers (e.g. prevalence rates). Qualitative data is collected in a manner that produces information that can only be expressed in words: why the local population believes that a well should not be dug in this specific location, explaining the panic following an increase in market prices, quoting a key informant, etc. Quantitative data can be produced from both qualitative and quantitative variables. Qualitative data may also be converted into quantitative data, for example, by indicating what proportion of the group shows a given behaviour, or expresses a given opinion.

3.2.2 Variables

Variables may have different values (e.g. height), different aspects (e.g. habitat), and present or absent features. Each variable may have only one value or state for a given subject at a specific moment. Quantitative variables are expressed as a quantity: birth weight, cholesterol level, age of the mother at her first delivery, etc. Qualitative variables on the other hand express a condition: sick or healthy, severely malnourished, nationality, sex, etc.

[12] Participation contributes to respect for professional ethics in humanitarian action, as discussed in Chapter IX.

Variables can be "dependent" or "independent". Independent variables can be chosen, but cannot be influenced; they in fact influence the dependent variables that are the object of the assessment. Dependent variables therefore change according to the independent variable, and their dependency relates to the object under scrutiny. They are measured and collected as data. For example, atmospheric pollution levels affect morbidity rates; different pollution levels can be chosen (the independent variable) in order to examine their effect on morbidity rates (the dependent variable). Similarly, the appraisal of corpulence resorts to weight-for-height. In this example, weight is the dependent variable (it is determined directly by food intake and health status); it is compared to height, which is independent of corpulence. On the other hand, the height-for-age index is used to appraise statural growth, and height becomes the dependent variable (it is determined by food intake and health status), whereas age is the independent variable in this case.

3.2.3 Indicators

Variables are meaningless on their own; they must be converted into indicators, for example by combining them in indexes and, above all, by providing them with a meaning with respect to a more complex variable, or a vulnerability or risk factor. For instance, an anthropometric variable (such as weight) is converted into an anthropometric index by referring it to the reference value for the subject's height. This weight-for-height index is then converted into an indicator of nutritional status, by applying thresholds that permit the definition of malnutrition.

Interpreting indicators

The use of indicators assumes that they have meaning. To be valid, the variability of the indicator must be related mainly to the variability of what the indicator is intended to reflect; the two must also be connected directly and quantitatively. For example, purchasing power may be taken as an indicator of access to food: in this case, access to food must vary like purchasing power, indicating that the latter is the main means of access to food, independently of the circumstances. If, on the other hand, access to food is also influenced by gathering activities and home production for self-consumption, then purchasing power on its own is not a good indicator of access to food. Obvious indicators warrant caution: the incidence and prevalence rates of diarrhoea, for example, are frequently interpreted instantly as reflecting poor water and environmental hygiene – high rates may, in fact, indicate pellagra.

Indicators can have direct and indirect meanings. An anthropological corpulence indicator is a direct indicator of both the nutritional situation and health status, since food intake and the presence or absence of sickness are the two main determinants of corpulence. A corpulence indicator may therefore also be an indirect indicator of factors underlying food access and the presence or absence of sickness, for example economic status, the state of health services, water and environmental hygiene, and the ability on the part of mothers to take care of their children. Because corpulence can provide an indirect indication of so many different factors, it must be used as an indicator of the dimension it is most closely associated with, and combined with direct indicators of underlying factors. This returns to the concept of triangulation to corroborate results, by resorting to different sources of information and, thus, to a host of different indicators.

As a result, the choice of indicators must rest upon a clear idea of their real significance, both direct and indirect, in order to ensure the appropriate interpretation of assessment results. In case of doubt, their relevance must be checked in terms of the subject and its evolution in order for them to be applied correctly.

The quality of indicators

Clearly, the quality of indicators is determined mainly by their relevance in terms of detecting or documenting the subject of assessment. The quality of indicators is also influenced by their ease in use, their variability when handled by different investigators and, sometimes, their acceptability. A major aspect of indicator quality is its validity, which may be expressed mathematically. The validity of an indicator corresponds to its suitability for revealing the object of assessment. Its two components – sensitivity and specificity – oppose. With respect to a given feature sought within a given population:

⇨ indicator **sensitivity** corresponds to the proportion of cases detected by the indicator as presenting the defined feature;
⇨ indicator **specificity** corresponds to the proportion of cases detected by the indicator that do not present the defined feature.

It is important to understand that indicators are simply a means to approach reality, and thus entail a risk of error. The more sensitive an indicator is, the more cases with the defined feature (**true positives**) it reveals, but at the same time it will reveal more cases to appear that seem to share this feature but in fact do not (**false positives**). The greater the sensitivity, the lower the ability to select only true positives is. Inversely, the more specific an indicator is, the greater its ability to detect cases that are not positive (**true negatives**), but it also detects more cases that appear not to share the feature when they in fact do (**false negatives**). The greater the specificity, the lower the ability to detect all true positives is. Anthropometric indicators provide a good illustration: if the severe malnutrition threshold is set at –2 standard deviations of the MUAC-for-height reference value, then the resulting indicator is highly sensitive and reveals all cases of severe malnutrition, but also many cases of moderate or mild malnutrition. If on the other hand the threshold is set at –4 standard deviations, the indicator is highly specific and discards *all* subjects that are not severely malnourished; but it also discards many subjects that are in fact severely malnourished. The challenge therefore lies in determining thresholds that allow for the best sensitivity index as well as the best specificity index. The same comment applies to the use of weak purchasing power as an indicator of low food access: a high threshold provides a sensitive indicator, whereas a low threshold provides a specific indicator. The validity of purchasing power as an indicator of food access may then be improved by combining it with other indicators, such as the ability to gather and produce food.

In epidemiology, sensitivity and specificity indicators are expressed mathematically, based on a 2×2 table:

		Feature	
		Present	Absent
Indicator	Reveals the feature	true positive	false positive
	Does not reveal the feature	false negative	true negative

The sensitivity index is expressed as follows, based upon the table above, and multiplied by one hundred to provide a percentage:

$$\textbf{sensitivity index} = \frac{\textbf{true positives}}{\textbf{true positives + false negatives}} \times \mathbf{100}$$

X

And the specificity index as follows:

$$\textbf{specificity index} = \frac{\textbf{true negatives}}{\textbf{true negatives + false positives}} \times \mathbf{100}$$

The **positive predictive value** (PPV) of the indicator can then be derived from the above 2x2 table: PPV is the probability that a given subject, revealed by the indicator as sharing the feature, really does. PPV may be computed as follows:

$$\textbf{positive predictive value} = \frac{\textbf{true positives}}{\textbf{true positives + false positives}} \times \mathbf{100}$$

Clearly, in order to determine the validity of an indicator, a testing method is required. This is rarely available in the settings of humanitarian action. However, validity must always be considered in order, firstly, to realize the risk of error that is associated with the indicator and, then, to decide whether, given the circumstances, high sensitivity or high specificity is preferable.

The expression of indicators

Indicators can be expressed qualitatively (such-and-such an aspect does or does not exist) or quantitatively (the average wage is X; X millimetre rainfall measured during the last quarter; X individuals suffer from measles; X individuals express a given opinion, etc.). Quantitative data is often expressed in the form of rates, the commonest of which are provided below.

Incidence and relative risk

The incidence rate can be described as the number of new cases during a specified period of time as a proportion of a specific group at risk. For example, the incidence rate of looting during one month is the ratio between the number of cases reported during that month and the total number of houses in the dwelling, multiplied by one hundred to provide a percentage. A more common example is the ratio between infection arising during a given period and the overall population that is exposed to that risk. Monitoring the incidence rate at regular intervals provides invaluable information as to the evolution of the situation. Incidence rates are rarely available at the stage of preliminary appraisal; they can, however, be obtained through monitoring:

$$\textbf{incidence rate} = \frac{\textbf{number of new cases during a given period}}{\textbf{overall number of individuals at risk}} \times \mathbf{100}$$

Incidence rates enable the calculation of relative risk, which is the risk faced by subjects who are exposed to a phenomenon (or risk factor) as compared to subjects who are not. Relative risk is expressed as follows:

$$\textbf{relative risk} = \frac{\textbf{incidence rate among exposed subjects}}{\textbf{incidence rate among unexposed subjects}} \times \mathbf{100}$$

Prevalence

The prevalence rate is the number of cases at a given moment as a proportion of a specific group at risk. For example, the prevalence rate of malnutrition among children between 1 and 5 years is the ratio between the number of malnourished children between 1 and 5 and the overall number of children between 1 and 5, multiplied by one hundred to provide a percentage. The same reasoning may be applied to the prevalence of a given opinion: in this case, the ratio between the number of individuals that hold the opinion and the overall population, multiplied by one hundred (this is frequently done in election polls, for instance):

$$\textbf{prevalence rate} = \frac{\textbf{number of cases at a given moment}}{\textbf{overall number of individuals at risk}} \times \mathbf{100}$$

Prevalence rates reflect the magnitude of an event at a given moment in time. They must be accompanied by some comment as to its causes, and predictions as to its most probable evolution, in order to be used correctly in terms of action.

Mortality

The mortality rate is the number of deaths during a specified period of time as a proportion of the overall population, measured at the middle of that period, expressed in per 1,000, per 10,000, or per 100,000. Mortality rates are commonly calculated for age or sex groups, or in relation to the causes of a specific situation. Cause-specific mortality rates are useful to determine the severity of a problem, provided that valid comparison points exist.

Morbidity

The morbidity rate reflects the prevalence of a given illness – it is the number of cases of illness as a proportion of the overall population. It is expressed as follows:

$$\textbf{morbidity rate} = \frac{\textbf{number of cases at a given moment}}{\textbf{overall number of individuals at risk}} \times \mathbf{100}$$

The usefulness of indicators

Indicators are necessary in all types of assessment; this implies that preliminary appraisal must already determine what type of indicators will be used later for reference and impact appraisal.

Types of indicators[13]

Indicators can refer to anything that characterizes or influences a nutritional situation directly or indirectly. The following types of indicators may therefore be used:

[13] A list of examples is provided in Annex 7.

- ⇨ demographic
- ⇨ epidemiological
- ⇨ ecological and environmental
- ⇨ economic
- ⇨ social
- ⇨ political

By virtue of the concept of optimal ignorance, only essential indicators should be selected; it is preferable to add indicators as assessment proceeds and as they are required, rather than wasting time collecting useless information.

3.3 DATA COLLECTION

3.3.1 Targeting preliminary appraisal

Data collection is always targeted. The key to the target is provided by the aggressive phenomena, recognized vulnerabilities and, in the case of preliminary or intermediary assessment, existing harm that corresponds to the warning signals. Preliminary appraisal must define assessment areas and groups that may share the same needs because they face the same problems. Targeting regions and population groups for assessment is derived firstly from the warning signals, and later broadens in order to include all regions and groups that face the same risk, or will do so. It may also be useful to collect information from groups that are not exposed to the phenomenon but share similar features to those that are, in order to obtain comparison and reference data with a view to determining normality. The objective is to determine, in an area affected by one or several phenomena, groups and sub-groups that are affected or at risk and show identical characteristics with respect to the crisis. This amounts to identifying groups that are homogenous with respect to the problem and require assistance, working from general identification factors towards specific ones:

- ⇨ firstly define the geographical regions that are affected by the crisis or the risk of crisis (geographical identification);
- ⇨ secondly identify, within these regions, the areas that may present different vulnerabilities (vulnerability identification);
- ⇨ thirdly identify, within these areas, the homogenous groups that may present different vulnerabilities because of their different ethnic, economic, social, cultural and political traits, which constitute different risk factors.

Each of these groups should be homogenous with respect to the crisis, and thus becomes a specific target for assessment.

3.3.2 Obtaining data

There are four ways of obtaining the data required to achieve the objectives of assessment:

- ⇨ the review of existing data
- ⇨ interviews
- ⇨ observation
- ⇨ measurement

They resort to different sources of information that must be used with the triangulation concept. Prior to assessment, it is important to reiterate the type of information that is sought, how it may and should be obtained, where, and what resources this requires. Checklists that summarize the information gathering process and content provide useful reference, and can be adjusted in the course of assessment.

Secondary data review

This is important, both in preliminary appraisal and thorough investigation. Much data is already available in books, reports and collective memory, and there is therefore no need to waste time seeking it in the field. This review must be performed before and during assessment (possibly afterwards also, in order to document specific points more thoroughly).

Prior to assessment, it serves the following purposes.

⇨ To acquire a basic or minimum understanding of the country and region chosen for assessment. This approach avoids excessive confusion at the onset, eases contact and builds bridges with the local population, and this is usually appreciated. This is natural courtesy, and incidentally saves time.
⇨ To obtain relevant information before conducting the assessment itself. Practically the entire world has been studied; most regions that require humanitarian attention have suffered crises before. As a result, it is usually possible to obtain useful information, whatever the location may be.
⇨ To prepare psychologically and intellectually for the task ahead by entering a data collection mindset. This stage permits immersion before departure.

The available sources of information are many.

⇨ The internet is today an unprecedented source of information that permits the collection of data in most of the areas of interest relevant to a preliminary appraisal: humanitarian agencies, the media and universities all have their own website, and their use is usually free of charge. Many of these sites also offer the opportunity to consult and correspond with authors via electronic mail.
⇨ Libraries, bookstores, and press agencies can also provide abundant and useful documentation.

Useful baseline information before assessment includes the following data.

⇨ Country-specific data:
  → geographical (good maps, especially);
  → demographic;
  → climatic;
  → cultural;
  → economic;
  → political.
⇨ Data related to the warning signal that prompted assessment initially:
  → existing data regarding previous similar phenomena;
  → reports of previous humanitarian action;
  → the most recent information regarding the current situation;
  → information regarding possible future constraints and opportunities;
  → practical information regarding local administrative procedures and living conditions.

During assessment, existing data provides a benchmark for the comparison and completion of information gathered in the field. Libraries, bookstores and public facilities usually provide important technical documentation regarding the national and regional economy and culture, and first-rate information. In the example mentioned earlier, documents supplied by the Ministry of Agriculture regarding the cultivation of sweet potato in Irian Jaya shed substantial light on the rural economy, and immediately provided a topic for conversation with the local population in spite of major language limitations. Charities, religious or humanitarian development organizations, and United Nations agencies are other major sources of information. Consultation clarifies what has already been done, facilitates coordination or the attribution of tasks, and limits the duplication of efforts.

Existing data also accounts for much of the assessment report baseline data.

Interviews

Except in disaster, when facts speak loudly enough, interviews are the key method for attempting to understand a given situation. They promote dialogue and confidence. Interviews may involve individuals or small groups (e.g. households), key informants (e.g. the local authorities, organizations, specialists or public servants), or larger groups that represent the community.

The procedure consists first of all of introducing and briefly explaining the purpose of the assessment. Interlocutors must understand that the assessment aims to understand a situation, that there is no danger in providing the required information or, for that matter, in withholding it. They must also understand that assessment aims at detecting and documenting possible needs for assistance, and not at satisfying requests without further ado. The interview then rests upon a limited number of key elements, and allows for the investigation of new parameters as they arise in conversation (this method is frequently called “semi-structured interviews”). In order to preserve this flexibility, it is best to abstain from written questionnaires, which tend to formalize the conversation and introduce an artificial distance.

According to circumstances, individual or group interviews may be organized ahead, or improvised on the spot, but courtesy is essential at all times. However, interviews with key informants should in principle be prepared well in advance in order to ensure their earliest availability: such interlocutors are usually very busy.

Individual and household interviews clarify the victims’ perception of their situation and behaviour, and facilitate the decision as to what should be done. This information is clearly biased, and such interviews must as a result be multiplied and involve enough groups that are different with respect to the crisis. There is however no rule as to the ideal number of interviews. The consistent pattern that gradually appears in answers shows that an adequate number of sources has been reached. Interviews with key informants provide information regarding the functioning of systems, services and institutions. Such informants can also suggest orientations for assessment, and relevant vulnerable groups for consultation. Here again, the resulting information may be biased by individual interests; this must be acknowledged and documented. Interviews with larger groups or the community provide an idea of how they view the crisis and react to it, provided that the entire community can express itself.

Interviews produce good results if the following principles are observed.

⇨ Interviewers should remain courteous, neutral and relaxed (this does not imply being distant or aloof) in order to encourage informants to express their own views, without being side-tracked by visible approval or disapproval on the part of interviewer; interviewers should avoid interrupting or suggesting answers – if the question causes difficulty, it must be rephrased.

- ⇨ Open-ended questions should be preferred to leading questions. For example, "*how do you see the situation?*" is preferable to "*is the situation bad?*"
- ⇨ Questions should be kept short and simple, especially if translation is required. If it is, the translation must be literal. If informants appear not to have understood, wording and meanings must be verified with them. For example, a word as common as "food", when translated into the vernacular, has proven on occasion to have more complex meaning, causing serious misunderstandings.
- ⇨ Questions should be cross-checked in order to corroborate the information obtained – this can, to some extent, be prepared in advance.
- ⇨ An open-minded countenance helps to reassure informants that they really do know better, and encourages them to speak more freely.
- ⇨ Interviewers must keep control of the interview, in order to avoid answers becoming too lengthy, or the domination of specific individuals or groups (they may be more articulate, more influential, or simply have a specific interest in steering the interview towards a given issue – or away from it). This requires great concentration throughout the interview, and a keen observation of the behaviour of informants. Interviewers must be capable of putting an end to the conversation, even if it has not produced the desired results; interviews should not be prolonged unduly.
- ⇨ Hasty conclusions should be avoided, whereas apparent inconsistencies need not be set straight at all costs. Results that appear to contradict one another warrant further investigation on the basis of renewed interviews and rephrased questions.
- ⇨ Interviews are the only method of establishing contact with the population, stakeholders, and key informants. Interviewers must remain courteous in all circumstances, must never lose their temper because there is no excuse for rudeness and, besides, the image of the agency and, sometimes, even personal safety is at stake.

Observation

Direct observation consists in examining the environment, which is usually the source of invaluable information. The systematic observation of the indicators selected for assessment (such as the condition of crops, the methods of waste disposal, or the water supply) is simple. However, the more permanent, informal observation that amounts to "reading the environment" is a different matter: it is an investigation method in its own right, which may seem self-evident but demands experience and alertness. The quality of clothing and habitat, the presence of animal excreta, the contents of waste disposal facilities, the behaviour of key groups or individuals can all provide vital clues to confirm impressions, suggest avenues for investigation, or corroborate or invalidate information obtained otherwise.

Measurement

Measurement produces quantitative data, which is useful in determining the seriousness of a given situation and the need for urgent action. In the humanitarian context, only anthropometric measurements are *specific* to nutrition (see below). Many other dimensions can clearly be measured, counted, or weighed in order to document observations or interviews, such cultivated area, the number of food bags in storage and their weight, or the volume and weight of food consumed.

3.3.3 The time required

Time matters mainly in preliminary appraisal, as it must quickly produce conclusive evidence in order to permit decision. Repeated assessments that relate to monitoring and evaluation are easier to plan, and the resources that they require can be anticipated. Preliminary appraisal therefore usually resorts to so-called "rapid appraisal" techniques, which were devised in the 1970s to examine rural development projects. Rapidity is understood here as a substantial reduction in the duration of assessment, which could previously involve several years of investigation to produce results that frequently proved to be useless. According to the complexity of the matter, rapid appraisal can involve a few weeks or many months. Therefore, the time required to understand a situation cannot be arbitrarily set, and the duration of preliminary appraisal cannot be determined in advance. At best, the exercise attempts to comply with budgetary or decision-making deadlines; however such deadlines must under no circumstances interfere with the quality and reliability of the information gathered.

The conditions that are conducive to efficient and fast assessment are the following:

⇨ preparation;
⇨ multidisciplinary assessment teams;
⇨ concept.[14]

Then, either the problem and the need for assistance are obvious, and action can be launched within days, or the crisis is either still in its early stages or about to be resolved, and several weeks may be necessary to reach conclusions and issue proper recommendations.

3.4 SELECTING SUBJECTS

Valid data by definition must provide an accurate reflection of reality, and this accuracy is influenced by how it is collected. For example, the average size of agricultural land can hardly be determined on the basis of a single visit to one farm; all the farms in the area of interest must be visited, either that or at least a certain number that is representative of the whole. In this case, strict sampling is required to ensure that selected farms are indeed representative of the whole. The same comment applies to the measurement of nutritional status, or opinion surveys as to the effects of a given phenomenon. The data is collected via a sample, or comprehensively from the entire population. Between these two extremes, it is also possible to shape an idea as soon as the information obtained for a given variable shows sufficient convergence, be it through triangulation or repetition. But some expertise is necessary to decide whether to leave it at that or continue.

3.4.1 Sampling

Basic principles

Sampling is a tool for assessment that minimizes the costs and time spent collecting data by selecting a limited number of subjects within the overall population under scrutiny. However, selecting a sample must comply with a number of rules, and this may result in a lengthier process than a comprehensive survey. Here again, it is a matter of adapting to circumstances. The principle of sampling argues that information obtained on the sample should reflect reality as accurately as possible – nothing short of a comprehensive survey will yield fully accurate results.

[14] See Section 3.1 in this Chapter.

The quality of sampling rests upon three principles:

- ⇨ the sample must be taken from a group that is as homogenous as possible with respect to the variable under scrutiny;
- ⇨ all individuals in the group must have equal probabilities of being selected for inclusion in the sample (probability sampling);
- ⇨ the result must be sufficiently accurate.

Group homogeneity

Sampling consists in selecting individuals from a group (or "population") so that, by studying the features of this sample, the results may fairly be extrapolated to the group from which the sample was taken; the group must therefore be homogenous with respect to the variable, or characteristic, under consideration and to its affecting factor. For example, it would be absurd to test the hypothesis that displacement affects nutritional status by measuring – within the same sample – the nutritional status of both residents and displaced persons. In this example, it is best to select one sample of displaced persons, and another of residents, for comparison. Likewise, drought in southern Sudan probably does not affect pastoralists, farmers and fishermen in the same way. Any variable associated with the impact of drought on these three groups and investigated through sampling would imply a separate sample for each group.[15] Following the same logic, in measuring the nutritional status of a given group, if specific age groups or sex constitute a vulnerability or discrimination factor, then sampling must be performed in each age group and for each sex. To ensure that group homogeneity is observed, sampling must always be based upon the study of documents or pilot study in the field that detects groups that may differ from one another with respect to the variable under scrutiny. Pilot studies can also serve to estimate the prevalence rate of a given variable, if the latter is to be measured later by sampling. In case of doubt as to homogeneity, different sampling methods may be used.

Probability sampling

All individuals in the group must have equal probabilities of being selected for inclusion in the sample. This requires the use of random selection and a fair understanding of the group (or population) under scrutiny. Selection methods are determined by the sampling method, which is influenced by the accuracy of sampling, and by constraints of time, resources, and access.

Accuracy

The accuracy of the result is determined by the size of the sample, which is set mainly by the sampling method.

Simple random sampling

This is statistically the most orthodox method in terms of random selection. Theoretically, this method requires the availability of lists (e.g. census data) of all numbered subjects (individuals or objects) of the population under consideration, and implies that they are all accessible. The number of subjects amounting to the size of the sample is then randomly chosen. This may be done by resorting to tables (an example is provided in Annex 19), mixing tickets up in a hat, rolling dice, or

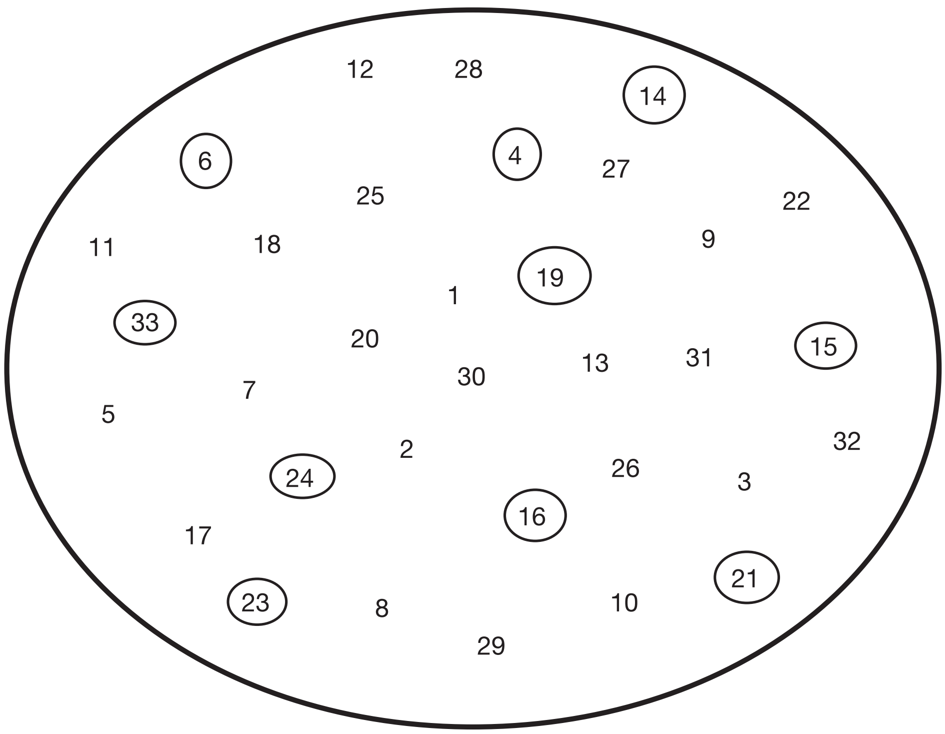
[15] This may be done by using the stratified random sampling method (or proportional or quota random sampling, see below), which involves the division of a heterogeneous population into homogenous sub-groups (in the examples quoted here: displaced persons and refugees, or pastoralists, farmers, and fishermen), and then taking a random sample from each sub-group.

mechanical sampling performed by a calculator (or computer spreadsheets) that generates random numbers.[16] Selected numbers are then all subjected to the survey itself. It is often impossible to conduct a comprehensive census, or to have access to the entire population, and the process can be quite costly and time-consuming. Systematic and cluster sampling methods reduce this type of constraint substantially.

Another (less rigorous) random sampling method produces accurate results, provided that the enquiry area is homogenous with respect to the variable under scrutiny. The observer places an empty bottle (or a pencil on a book) as close as possible to the centre of the area under consideration, spins it, and systematically selects all subjects in the direction indicated by the bottleneck, and as far as the area extends in that direction. If the number of subjects is insufficient, the exercise may be repeated as often as necessary. This method saves the effort and time required for census or accurate subject counting.

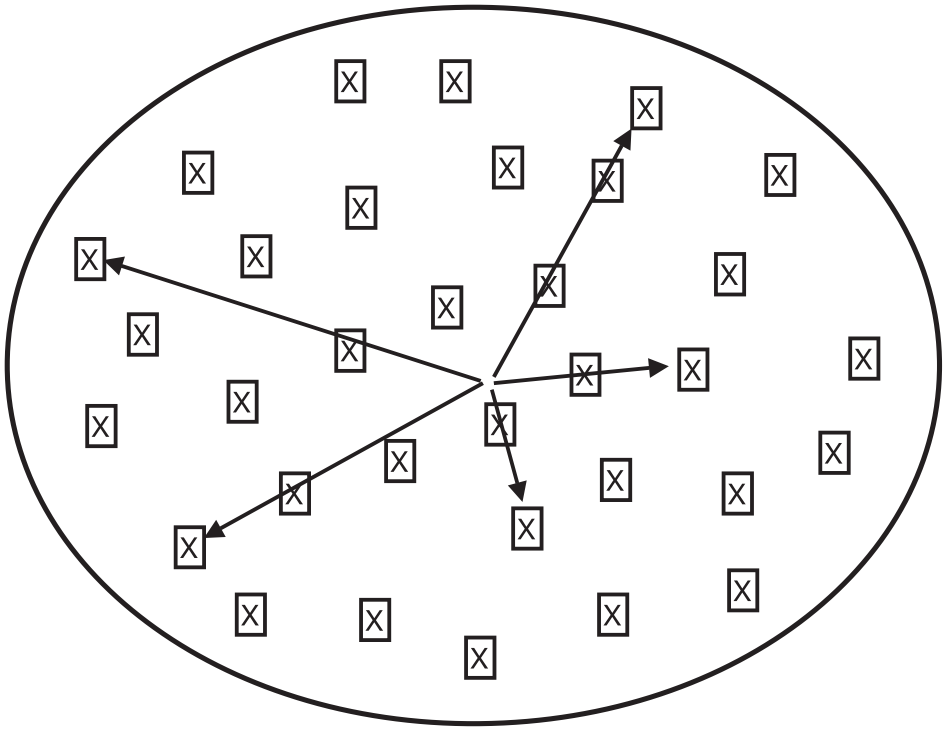
Simple random sampling is illustrated in Figures 10.5 and 10.6 below.

Figure 10.5 Simple random sampling – example 1



[16] Of course, these are not perfect random numbers because they are generated using an algorithm, but they are near enough for all practical purposes. In the case of EXCEL computer spreadsheets, all the names, or subject identities, are pasted in one column; the next column should then contain the function =RAND() – this produces random numbers between 0 and 1, which can then be sorted.

Figure 10.6 Simple random sampling – example 2



In Figure 10.5, the subjects are numbered and randomly pre-selected; in Figure 10.6 they are not identified individually prior to sampling, but are selected according to a general random direction, within an area that is sufficiently homogenous for all individuals to be representative of the overall population.

Systematic random sampling

Systematic sampling consists in selecting subjects at regular intervals (for example, every fifth individual), starting from the first subject, which is selected randomly. This method implies a comprehensive census and numbering of the population under scrutiny; it also requires a sound understanding of the local geographic or spatial organization in order to, in this case, count all subjects and then select those (in this example, every fifth) to be included in the sample. The underlying principle is that random selection of the first subject complies with the rules of chance, whereas subsequent subject selection is simplified by the introduction of an interval size.

The approach may be expressed as follows:

N = the overall population, say 100
n = the number of subjects in the sample, say 20
N/n = a = the interval size, in this case 5

The first subject is selected randomly within the first interval, in this case, between 1 and 5, say 3. Then, the other subjects to be included in the sample are every fifth subject (because the interval is 5) starting at 3 (the first subject): 8, 13, 18, 23, 28, …, 93, 98.

Applying this to the example of a survey aimed at estimating the prevalence of parasite infection in maize crops, the total number of plants in the field (N) must be estimated as accurately as possible, and the sample (n) and interval sizes (a) are then defined. If the area of the field is one hectare (100 x 100 m), and the maize grows in rows at 75 cm intervals, and the distance between rows is also 75 cm, then the field includes 133 rows, each of 133 plants, i.e. 133 x 133 plants = 17,733 plants in total (N). If the sample size is 350 plants (n), then the interval size (a) is 17,733 / 350 = 50.7. For practical purposes, the interval size in this example is rounded down to 50; this also increases the sample size somewhat and, thus, accuracy. The first plant is then randomly selected between 1 and 50, say 32; this provides the starting point of the sample: 32 + 50 = 82; 82 + 50 = 132; 132 + 50 = 182, and so on.

In the case of the nutritional status of children between 6 and 59 months accommodated in tents in a refugee camp, the average number of children aged 6 to 59 months housed in each tent must be estimated first; multiplying this estimation by the total number of tents provides the overall population number (N). As an indication, if each tent accommodates one mother, then the proportion of children in this age group is approximately 15%. If the total number of tents is 4,000, and the total camp population is 20,000, then the number of children corresponding to the criteria is approximately 3,000 (N), i.e. 0.75 children per tent. If the sample size is 350 (n), then 466.7 tents (350 / 0.75) must be visited (rounded up to 467). The interval size is 4,000 / 467 = 8.57 tents, rounded down to 8. The first tent is selected randomly between 1 and 8, and sampling continues by selecting every eighth tent thereafter. If the proportion of children between 6 and 59 months accommodated in each tent is unclear, it is best to conduct a pilot study into thirty or so tents in order to document this important aspect of the survey in terms of the interval size.

Systematic sampling is illustrated in Figure 10.7 in which the interval size is 5, and the randomly selected first tent is number 3.

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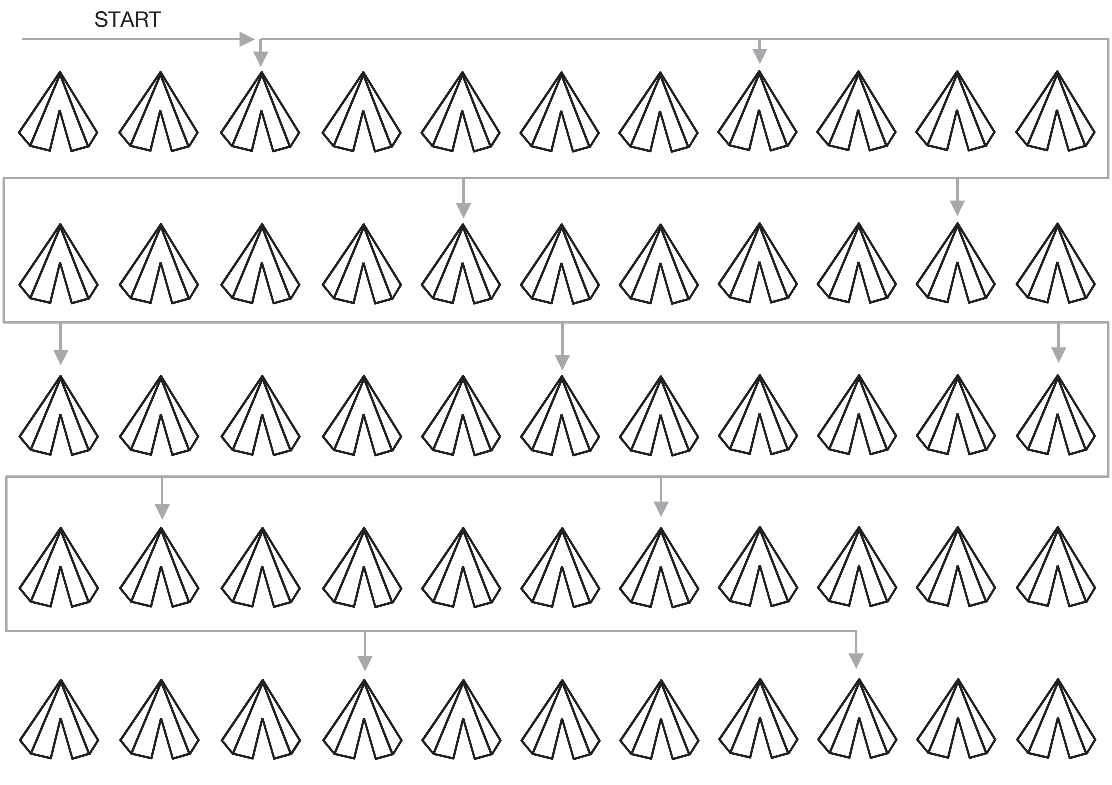
Figure 10.7 Systematic random sampling



Cluster random sampling

Simple method

Cluster sampling makes things easier when the overall population is large, for example in the case of an entire region. The method involves dividing a geographical area that is homogenous with respect to the variable under consideration into comparable clusters (usually along administrative or geographical lines), sampling some of these clusters randomly, and measuring subjects within the sampled clusters. All the clusters are represented graphically on a map and numbered; then, the number of clusters – referred to as "k" – to be assessed are chosen randomly. In order to choose the subjects, the sample size "n" is divided by "k" (the number of clusters to be assessed), which gives the number of subject to select in each chosen cluster. Subjects may then be randomly selected within these clusters, or selected systematically according to the interval approach; alternatively, all the subjects that lie within a given direction are selected (this is the systematic approach to cluster sampling, see below).

Systematic method

A more sophisticated approach, similar to systematic sampling, consists in dividing up a given geographical area into sections, which are not strictly clusters, and obtaining for each section an acceptable estimation of the total number of subjects. The resulting data is then reflected in a five-column table as follows:

⇨ column 1 indicates the section names or numbers;
⇨ column 2 indicates the estimated overall population within the section;
⇨ column 3 indicates the aggregate population (i.e. the population of previous sections added to that of the current section);
⇨ column 4 indicates the overall numbers corresponding to each section;
⇨ column 5 indicates the number of clusters in each section.

Table 10.3 below is based on the example of a total population of 30,000 subjects.

Table 10.3 Systematic cluster sampling – example

Section	Total estimated population	Aggregate population	Numbers corresponding to the section	Number of clusters per section
Section 1	350	350	1 – 350	
Section 2	2,800	3,150	351 – 3,150	
Section 3	410	3,560	3,151 – 3,560	
Section 4	4,200	7,760	3,561 – 7,760	
…	…	…	…	
		30,000	… – 30,000	
Total	30,000			30

The number of clusters per section is then defined in order to complete column 5; this is done by defining an interval size "a" that amounts to the total population divided by the total number of clusters "k" (in this example, 30). The interval size in the above example is 30,000 / 30 = 1,000. A number is randomly selected between 1 and 1,000 to provide the starting point for cluster selection, say 455. The first cluster is then attributed to the sub-section that corresponds to 455, in this example, sub-section 2. The following clusters are obtained by adding 1,000 (the interval) to the first number (455): 1,455; 2,455 (both are included in section 2, like the first value 455); 3,455 (section 3); 4,455; 5,455; 6,455; 7,455 (all included in section 4); and so on.

The advantage of this method is that the number of clusters taken from each section is proportional to the population of the section. According to results, significant differences may appear between sections, and the causes may then be investigated more thoroughly. This advantage is however of secondary importance because it is not the objective of this sampling method to compare sections.

The selection of subjects within clusters requires the preliminary determination of the number of subjects per cluster by dividing the size of the sample by the number of clusters ("k"). For each cluster in the sub-section, the observer then spins a bottle or pencil (as described above) in the centre of the area under consideration, and systematically selects all subjects in the direction thus indicated. If the required number of subjects is not produced by this method, the exercise may be repeated as necessary.

The method may be fine-tuned by selecting the first subject in a given direction; this involves counting all subjects in that direction, and then observing them according to a given interval.

Simple random sampling is often referred to as "two-stage sampling": the first stage is the selection of clusters, and the second is the selection of subjects within clusters. Systematic random sampling involves three stages: the first is the identification of sub-sections, the second is the identification of clusters within the sub-sections, and the third is the selection of subjects within the clusters. Cluster random sampling is illustrated in Figures 10.8 and 10.9 below.

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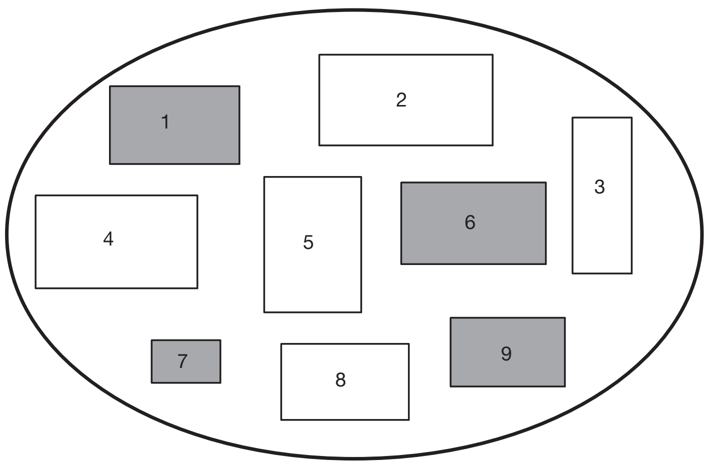
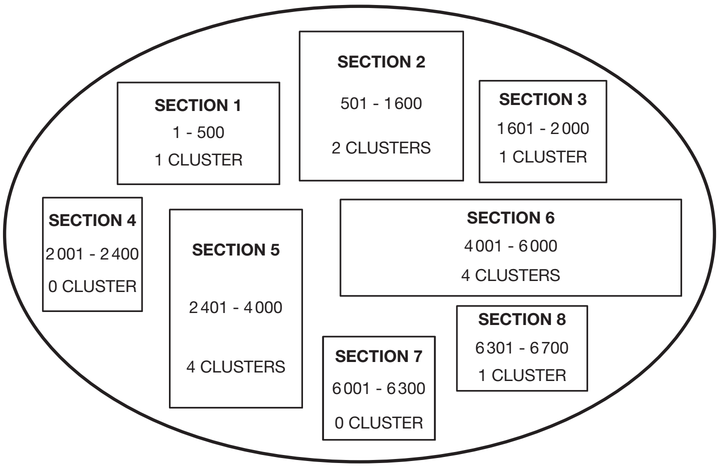
Figure 10.8 Simple cluster random sampling – example



SHADED CLUSTERS ARE SELECTED RANDOMLY

Figure 10.9 Systematic cluster random sampling – example



The example of systematic cluster random sampling provided in Figure 10.9 reflects the division of the area into 8 sub-sections. The interval size used to attribute clusters to sub-sections is 500, and the first subject selected randomly is 450.

Stratified random sampling

Stratified random sampling consists in defining, within a given area, groups (based on sex, age, professional activity, number of children per family, etc.) that are known to share specific features with respect to the variable under scrutiny. Each group is then subjected to the sampling method that is most appropriate in the circumstances. This amounts to considering each stratum as a specific target for investigation. This method is illustrated in Figure 10.10 below.

Figure 10.10 Stratified random sampling – example

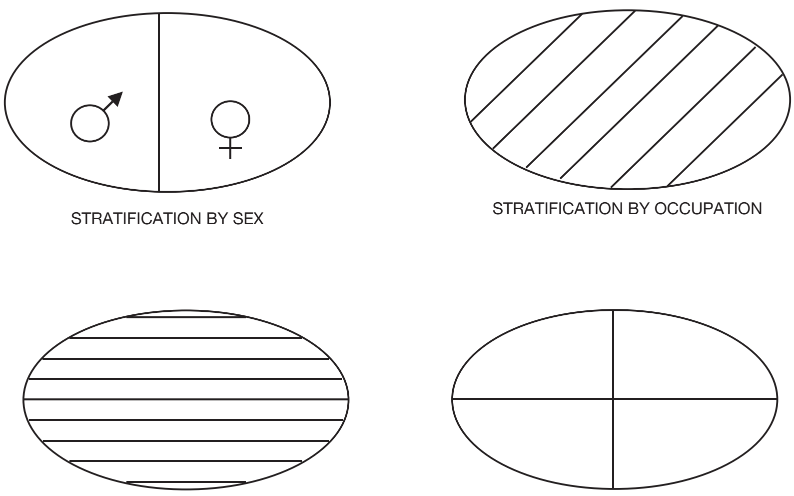


Figure 10.10 illustrates three "orthodox" stratification methods and one (by region) that is not. Stratification, which consists of identifying specific strata within a homogenous population, is easily confused with assessment targeting, which involves the identification of specific regions or populations that are more or less affected by a variable pertaining to the feeding process. Stratification, in fact, amounts to refined assessment targeting.

Depending on the ultimate purpose of the exercise, sampling methods may be combined and adapted according to situations – this approach is called "multi-stage sampling". This method is usually most relevant to field work, as it allows for complex situations or populations. Combining and adapting methods nevertheless demands considerable expertise in statistics, and whatever method is chosen, it must be reflected in assessment reports accordingly (rationale, implementation methodology, and accuracy levels).

The choice of sampling method

Classical nutritional assessment is all too frequently restricted to the definition of malnutrition rates based upon overly detailed sampling. As a result, sampling virtually becomes an end in itself, to the point of obscuring the issue: human beings for whom malnutrition is far more important than spreadsheets and figures. In nutritional assessment, sampling is only a tool that must be used carefully, and is by far not the best manner of obtaining information as to the performance of the feeding process and the circumstances. Before choosing the methodology, it is essential to determine what will be most useful in terms of use and interpretation of data concerning a variable. This demands some understanding of the different data collection methods, and the different possible indicators. Depending on the ultimate purpose, the answer may well be to refrain from both comprehensive assessment and sampling. In case of doubt, experts or colleagues faced with similar circumstances must be consulted. The answer is not necessarily reassuring, but dialogue allows for considering the problem from different angles, and facilitates the definition of the required course of action, if only by accepting the uncertainty risk related to constraints.

Once the purpose of sampling is clearly established, the following general recommendations facilitate the choice of sampling method.

- ⇨ **Simple random sampling** is ideal in its orthodox form. This involves the complete and updated census of subjects, and unrestricted access to the entire population, because all subjects must have equal probability of being selected. Census itself may be performed independently, but is time-consuming. The region under consideration may be restricted deliberately to accessible areas; and data for inaccessible areas must then be obtained indirectly. Time can represent a major constraint if the subjects are scattered and difficult to locate.
- ⇨ **Systematic random sampling** is recommended in regions where subjects are geographically distributed (this facilitates their location).
- ⇨ **Cluster random sampling** is recommended for large, scattered populations that may not be homogenous, without it being possible or necessary to define more homogenous sub-groups.

Sample size

The underlying principle here is that, whatever the issue under investigation, the size of the population from which the sample is taken is infinite. As a result, the size of the sample is not determined by the size of the population. Exceptions exist, in the case of small groups whose size is well known; in such cases, the sample size may be recalculated (see below). The paradox lies in the fact that the total population must be known in order to draw the sample, or to define the interval size. The most important concept, however, is that sample size is determined primarily by whether the variable under consideration is qualitative or quantitative.

Quantitative variables

Because of their nature, biological dimensions (such as anthropometric variables, seric rates, and birth weight) usually follow a distribution that corresponds closely to normal law.[17] This translates into the fact that even with a limited number of sample values ("n"), the average ("m") of these "n" values is rather reliable. Reliability is considered to be adequate as of 30 values; hence, in the case of biological quantitative variables, the sample size is sufficient if it reaches 30 values; any number above is considered to be a large sample. The result of quantitative variable sampling is expressed by an average "m", and its standard deviation "s" (m ± s). A calculator or computer spreadsheet can provide the average and standard deviation.[18]

Qualitative variables

For qualitative variables, sample size is primarily determined by the sampling method. It is then influenced by the sampling error that is considered as acceptable, the determined confidence interval, the expected prevalence rate (the *actual* prevalence rate is what is sought), and the total population when it is small. The result of qualitative variable sampling is expressed in prevalence rates "p" subject to the obtained degree of accuracy, which amounts to more or less a given percentage "b" around "p": p ± b%.

Simple random sampling

Any value obtained experimentally by sampling is of course liable to differ from the real value, as obtained by comprehensive investigation. It is best, therefore, to define the acceptable risk that experimental values are really different from real values, and an acceptable confidence interval within which the real value is likely to be found, according to the sampling error – without it being possible to know where exactly in that interval it is located. Usually, the sampling error is set at 5%; in other words, it is accepted that there are 5 chances out of 100 that the real value is not included in the confidence interval at all. The confidence interval itself is determined by the intended accuracy: a 5% accuracy around the experimental result is usually considered as acceptable, but this depends on circumstances. For example, in comparing results with those obtained six months before, confidence intervals must not overlap, and this may require smaller confidence intervals. Moreover, a 5% confidence interval around a 50% prevalence rate is perfectly acceptable, but would be meaningless for a 3% prevalence rate.

The expected prevalence rate raises one of the two difficulties of understanding of the sampling process (the second being that population size does not influence sample size, except for small populations). It seems odd to use a sampling method to determine the prevalence rate of a given variable, when that rate is required as a preliminary for calculating sample size. This involves a preliminary estimation of results, which is influenced by the knowledge of the field and of existing problems, or the results of pilot studies. When a prevalence rate cannot be estimated with sufficient accuracy, it is arbitrarily set at 50% – this rate gives the largest sample (for equal sampling error and confidence intervals) according to the formula below. This avoids unpleasant surprises in the calculation, because the further the real rate is located from 50% (plus or minus), the greater accuracy will be achieved for a given sample.

[17] See Annex 8.
[18] In the case of EXCEL computer spreadsheets, the function is respectively =AVG(range) and =STDEVPA(range).

Once the intended accuracy is determined for a 5% sampling error and that expected prevalence rates have been set, sample size "n" may be calculated based on the following formula:

$$\mathbf{n} = \varepsilon^2 \times \frac{\mathbf{p} \times \mathbf{q}}{\mathbf{d}^2}$$

Where:
n = the number of subjects in the sample
ε = 1.96, the factor determining the sampling error at 5%
p = the expected prevalence rate, say 20%
q = 100 – p
d = the required accuracy expressed in ± d%, say ± 5%

The resulting equation for this example is then as follows:

$$\mathbf{n = 1.96^2 \times \frac{20 \times (100\text{-}20)}{5^2} = 246}$$

If the sampling error is reduced to 1%, then ε equals 2.576 and, consequently, the sample size "n" rises to 425. Similarly, if accuracy is increased to ± 3%, for a 5% sampling error, the sample size rises to 683. Finally, if the prevalence rate cannot be estimated and is therefore arbitrarily set at 50% to minimize the risk of inaccuracy, the sample size for a 5% sampling error and a ± 5% accuracy is 384.

Generally speaking, the lower the sampling error, the smaller the confidence interval and the closer the expected prevalence lies to 50%, the larger the sample is. Usually, the expected prevalence rate and the sampling error cannot be adjusted in order to reduce sample size; however the intended accuracy can be reduced, provided that this still produces results that are relevant to operations, that is, that permit decision-making. Intended accuracy has the greatest impact on sample size.

Correction for small populations

Population size does not in principle influence sample size. However, in small populations, a correction factor may be used. A small population is one in which the sample "n" as calculated above exceeds 10% of the total population "N". In such cases, the corrected sample is calculated as follows:

$$\textbf{corrected n} = \mathbf{n / [1 + (n / N)]}$$

Referring to the above example:
n = 246
N = the total population, say 2,000 subjects

$$\textbf{corrected n} = \mathbf{246 / [1 + (246 / 2{,}000)] = 246 / (1 + 0.123) = 219}$$

In this example, the sample size is reduced by 11%. Had the total population been 1,000 subjects, the corrected sample size would be 197 subjects, that is, a 20% reduction in sample size.

Sample size for systematic random sampling, and for each unit in stratified sampling, is calculated in the same way as for simple random sampling.

Cluster random sampling

Sample size is calculated in the same way as simple random sampling, but the greater uncertainty, and the inevitable heterogeneity associated with clusters must be allowed for. The formula is therefore completed with a "c" cluster factor, which increases sample size in order to preserve the degree of accuracy. Experience shows that a factor of 2 (c = 2) is usually sufficient: doubling the sample size obtained through the simple sampling formula adequately allows for the cluster effect. The adapted formula is as follows:

$$\mathbf{n} = \varepsilon^2 \times \mathbf{c} \times \frac{\mathbf{p \times q}}{\mathbf{d}^2}$$

Where the cluster factor c = 2.

In the case of cluster sampling intended to determine the experimental value of a prevalence rate expected to be of 20%, the sample size is the following:

$$\mathbf{n = 1.96 \times 1.96 \times 2 \times [(20 \times 80) / 5^2] = 492}$$

And 492 is twice 246 (because c = 2).

The number of clusters must then be determined: for example, 10 clusters amount to 49.2 subjects per cluster. The number of subjects per cluster must then be rounded up, preferably upwards to increase accuracy, in this case 50. However, it is also possible to take 20 clusters of 25 subjects each: this still totals 500 subjects. The question therefore is whether it is best to have many clusters, and fewer subjects per cluster, or few clusters and more subjects in each. The purpose of cluster sampling is to minimize the effect of assumed heterogeneity in the area, because it is not possible or desirable to target more precisely. This minimization involves the scrutiny of prevalence rates in several sites, rather than the entire area, hence the choice of clusters. Usually then, it is best to select many clusters containing fewer subjects each.

Another approach consists in deciding arbitrarily to select 30 clusters of 30 subjects each. This practice is common in humanitarian assessment, and avoids tedious calculation and sampling error, and provides good results. For a 5% sampling error, the expected accuracy in relation to different expected prevalence rates is the following:

Prevalence rate	Accuracy
10 %	± 2.8 %
20 %	± 3.7 %
30 %	± 4.3 %
40 %	± 4.6 %
50 %	± 4.7 %

Once the assessment has been completed, accuracy must be corrected by applying a formula that allows for the cluster effect. The closer the results for different clusters match, the closer accuracy is to the above figures.

Cluster sampling does not require correction for small populations: it is best to use the largest possible sample anyway, and cluster sampling is usually applied to populations that are larger than ten times the sample.

Correction for accuracy following sampling

If sampling serves to estimate the prevalence rate of a qualitative variable, sample size is calculated according to intended accuracy and expected prevalence rates mainly as described in Section 3.4.1 under Qualitative variables. Subsequent investigation provides prevalence rates that usually differ somewhat from expected rates; likewise, actual sample size may differ from expectations. As a result, confidence intervals probably differ slightly from those used to calculate sample size, and must be corrected for the appropriate expression of results. In simple, systematic and stratified random sampling, the formula used to calculate accuracy is the following:

$$\textbf{accuracy} = \pm\, \varepsilon \times [\mathbf{p} \times (\mathbf{100} - \mathbf{p}) \,/\, \mathbf{n}]^{1/2}$$

Where:
ε = 1.96, the factor determining the sampling error at 5%
p = the actual prevalence rate
n = the actual sample size.

In the example used earlier, the factor determining sampling error was 1.96, the sample size was 246 for a 5% sampling error with ± 5% accuracy, and the expected prevalence rate was 20%. Assuming that actual values are in fact as follows:

p = the actual prevalence rate = 35%
n = the actual sample size = 220.

Then actual accuracy is the following:

$$\textbf{accuracy} = \pm\, \mathbf{1.96} \times [35 \times (100\text{–}35) \,/\, 220]^{1/2} = \pm\, \mathbf{6.3\%}$$

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The final result is thus 35 ± 6.3%, the actual accuracy being ± 6.3% and not ± 5% as suggested by the initially chosen accuracy.

In cluster random sampling, the formula used to obtain actual accuracy is not determined by sample size, but by the differences in results from different clusters. The resulting formula is the following:

$$\textbf{accuracy} = \pm\, \varepsilon \times \{\Sigma_{\mathbf{i = 1\ to\ k}} (\mathbf{p_i} - \mathbf{p})^2 \,/\, [\mathbf{k}(\mathbf{k} - \mathbf{1})]\}^{1/2}$$

Where:
p = the actual overall prevalence rate in the entire sample, say 30.1%
k = the total number of clusters included in the sample, say 5
i = a given cluster within the overall sample (numbered 1 to k)
p_i = the actual prevalence rate in cluster i
n = the actual sample size = 220
Σ = the sum of all values

If the results obtained from the 5 clusters in the sample are 28.5%, 24.2%, 33.1%, 27.2% and 30.9%, the sum of $(p_i - p)^2$ is calculated as follows:

$$\mathbf{(28.5\text{–}30.1)^2 + (24.2\text{–}30.1)^2 + (33.1\text{–}30.1)^2 + (27.2\text{–}30.1)^2 + (30.9\text{–}30.1)^2 = 55.42}$$

This then permits the calculation of accuracy itself:

$$\textbf{accuracy} = \pm\, \mathbf{1.96} \times [\mathbf{55.42 \,/\, (5 \times 4)}]^{1/2} = \pm\, \mathbf{3.3\%}$$

And the final result is then 30.1 ± 3.3%.

3.4.2 Complete enumeration

In some cases, it may be easier and faster to avoid sampling altogether, and observe all subjects within the overall population. This is the case, for example, in anthropometry, especially in using mid-upper arm circumference (MUAC) or MUAC-for-height, which are faster to measure than weight and height. If almost all the subjects in a village or neighbourhood can be gathered in a central location, it is usually possible to measure them all in a matter of hours; sampling on the other hand involves counting houses or people and verifying lists first, not to mention the work involved in selecting samples and sampling methods. Complete enumeration is often more acceptable for the subjects than sampling, especially if the decision to engage in assistance is to be determined by such measurements. Clearly, ensuring the reliability of results requires a good understanding of the overall population and the proportion of subjects included in the height or age category under consideration.

Assuming an overall population of approximately 6,000 individuals, and a proportion of target subjects of 20%, then 1,200 subjects must be measured. The advantage is that results reflect reality directly, and avoid the use of sampling error and confidence intervals. The process may nevertheless be undermined by an unexpectedly low turnout of subjects due to estimation mistakes (these subjects may simply not exist) or absenteeism. Investigation must therefore determine whether the entire population has indeed been measured and, if not, why. The ensuing process is determined by the magnitude of the possible error, and the objectives of the assessment. Returning to the previous example, if only 1,000 subjects are measured, 13% of assumed subjects are missing: how does this influence results? To provide an answer, the 200 missing subjects are arbitrarily included in the severe or normal category: these are both extremes and highly unlikely, but doing so provides an indication as to most optimistic and pessimistic results. If among 1,000 subjects, 20% have shown severe wasting, 50% moderate wasting, and 30% an acceptable nutritional status, the 200 missing subjects should first be considered as severely wasted. The adjusted distribution is then 33% severe wasting, 42% moderate wasting, and 25% acceptable nutritional status. The 200 missing subjects are then classified as "acceptable", and the adjusted distribution becomes 16% severe wasting, 42% moderate wasting, and 42% acceptable nutritional status. Both distributions are possible, and the situation must be investigated in order to determine whether it results from the absence of subjects (absenteeism). Corroboration of the feeding process and/or renewed measurements should then establish whether the result is closer to 33% or 16% of severe malnutrition, which is, after all, a substantial difference. Whether the objective is to obtain a rough idea of severe malnutrition rates or to compare such rates with previous or future rates, the sampling error is too significant for results to be simply accepted as final. This example shows that complete enumeration may indeed be faster than sampling, but may also involve serious delays if its results are questionable.

Complete enumeration is also useful in group discussions, when attempting to distinguish controversial issues, and in making decisions once all opinions have been voiced. The group must in such cases be gathered in an appropriate location to enable all concerned to express their views. This permits discussion with large groups, and the exchange of views then proceeds in waves, from one sub-group to another. Provided that the discussion is well organized and that participants are well aware of the purpose and can express their concerns, this method usually yields excellent results. The decision-making process is shared by all involved, the risk of erring is reduced, and humanitarian "imperialism" is less likely to take over. Moreover, if the group has understood the issues and has made its own decisions, implementation is facilitated and is less likely to encounter problems or unexpected opposition; it also minimizes secondary and, above all, negative effects.

4. ASSESSMENT TOOLS

The use of appropriate tools improves the quality of assessment results. Some tools, such as analytical grids, mapping and ranking, have two specific advantages in addition to serving their direct purpose: their design itself involves thought and analysis, and is a simple and efficient manner of developing discussion and the exchange of views.

The use of such tools may be illustrated by referring to the summary of data to be collected during the preliminary appraisal discussed earlier,[19] and by providing examples of tools that could be useful in doing so. Clearly, the same tool may serve different objectives, different topics may be examined with other tools, and the approach suggested here is not absolute because assessment must adapt to circumstances.

Table 10.4 Data to be collected

Data		Tool
1.	Geographic location	Maps and transects
2.	Differentiated response to crisis	Relative vulnerability analysis, functional classification
3.	Wealth ranking	Functional classification, proportional ranking
4.	Economic resource appraisal	Proportional ranking, economy models (Figures 6.8, 6.9, 6.10, 6.11, 6.12, 6.13, 6.14, 10.11, 10.12), food consumption analysis, possibly via questionnaires
5.	Minimum economic resources	Household economy model (Figure 10.11), budget balance model (Figure10.12)
6.	Normal variations	Proportional ranking, seasonal calendars
7.	Phenomena that exceed normal variations	Proportional ranking
8.	Abnormal behaviour	Economy models (Figures 6.14, 10.11), proportional ranking
9.	Famine process level	Household economy models, nutritional anthropometry, assessment of the adequacy of resources to feed the household
10.	Causes of the current situation	Flow charts, graphic illustration of market data
11.	Prognosis and probability	Analytical grids, tables, flow charts
12.	Resilience	Chapter VI models, market analysis, nutritional anthropometry
13.	Problems	Priority ranking, nutritional anthropometry
14.	Listed needs for assistance	Priority ranking
15.	Possible effects of the programme	Stakeholder analysis, SWOC analysis[a]
16.	Measures to avert crisis	Analytical grids
17.	Monitoring measures	Decision tree, tables

[a] SWOC: strengths, weaknesses, opportunities, constraints.

[19] See Section 2.1.2 in this Chapter.

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4.1 REFERENCE MODELS

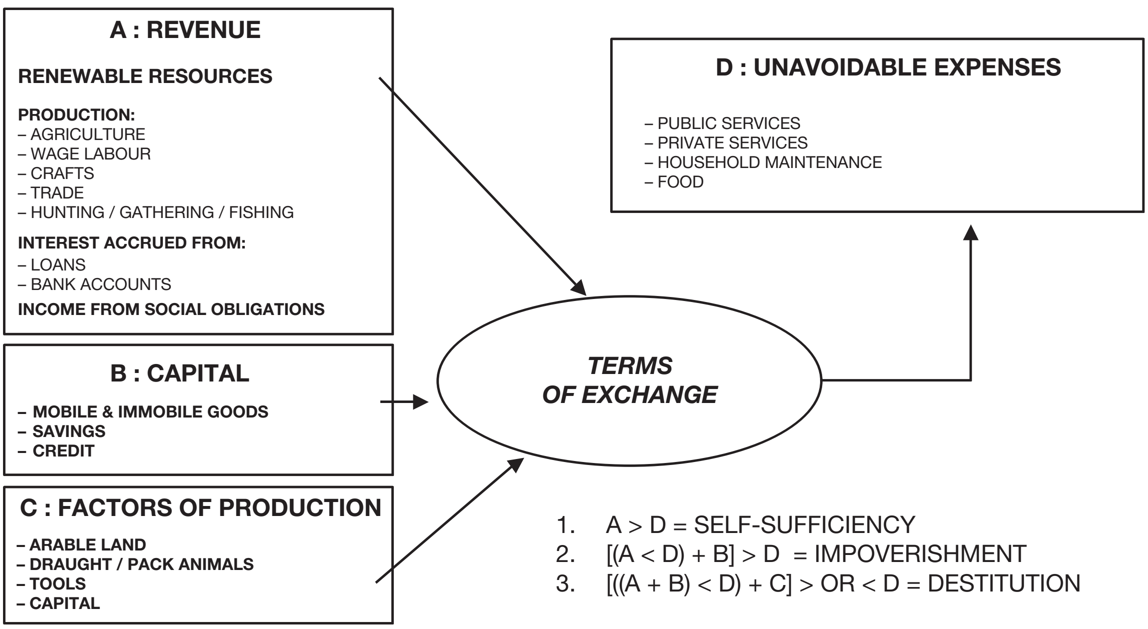
Nutritional surveys may be compared to gathering mushrooms: excursions to the woods are not the end, they serve a purpose. Locating edible mushrooms involves some knowledge as to toxicity, and of where, when and how they may be found. This cannot be done effectively by a beginner referring continuously to a textbook, because academic research and field investigation are not simultaneous activities. As a result, a certain minimum knowledge or the presence of an expert is required, or the excursion is fruitless and may even be dangerous. The same comments apply to nutritional surveys: comprehensive nutritional expertise is not necessary, but investigators must know where to find information in case of doubt, and must bear some basic conceptual models in mind. Economic performance models,[20] household economy models,[21] and the feeding system model[22] are especially helpful in this respect. Two additional models are provided here: the simplified household economy model and the household budget balance model.

4.1.1 Simplified household economy model

The simplified household economy model uses relevant variables; it defines the conditions for household self-sufficiency, and the level of the crisis process that has been reached accordingly. Figure 10.11 below presents this model for the example of an agricultural household.

Quantifying the importance of relevant variables and the relative market value of commodities permits the definition of the household economic situation, from which the need for assistance may be determined.

Figure 10.11 Simplified household economy model

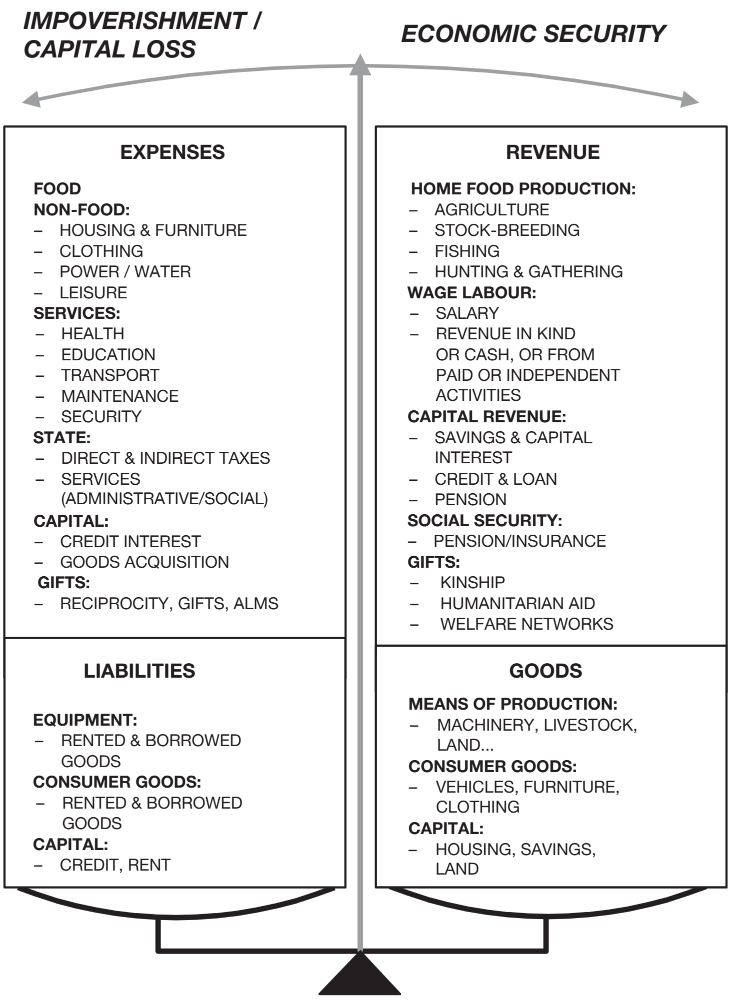


[20] See Chapter VI, Figures 6.8 and 6.9.
[21] See Chapter VI, Figure 6.11 to 6.14.
[22] See Chapter VI, Figure 6.15.

4.1.2 Budget balance model

This model complements the previous model, which provides its basis. It has been designed by ICRC economist, G. Carbonnier. The model rests upon the two groups of variables that shape the household budget balance. Figure 10.12 below illustrates this concept.

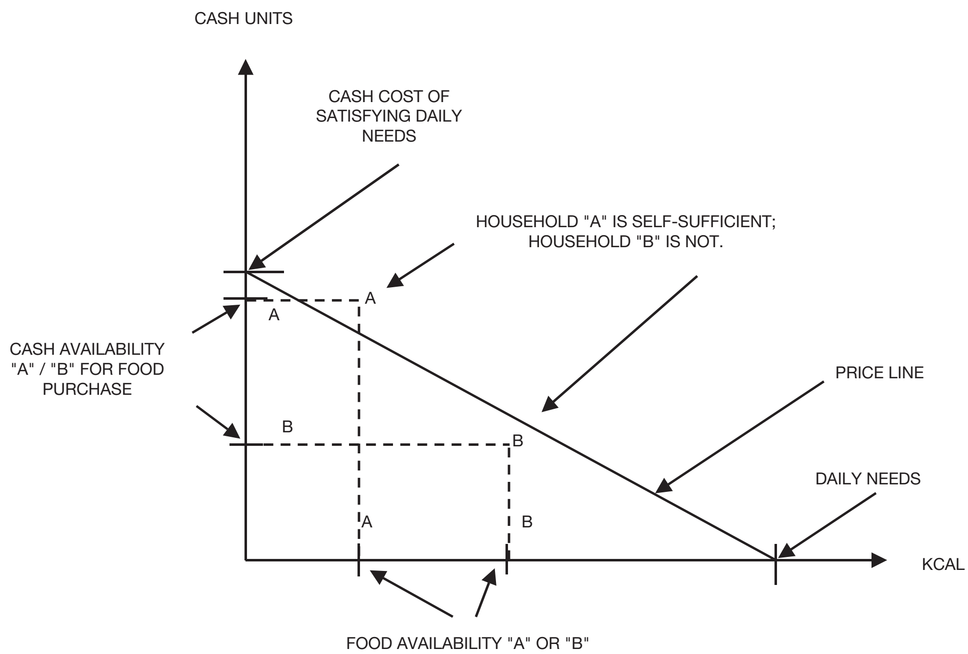
Figure 10.12 Variables influencing budget balance



4.2 APPRAISING THE RESOURCES TO SECURE FOOD

Graphic illustration helps to appraise the gap between the resources available to secure food and household needs. The figure below reflects food availability within the household, in terms of needs and for an identical production and consumption frequency. The abscissa (or x-axis) indicates food production and the food reserves available for consumption expressed in calories; the ordinate (or y-axis) reflects the purchasing power available to secure food on the market, expressed in monetary units. The average household calorie requirement is then estimated, and converted into its cash equivalent in local market prices, in compliance with eating habits. The resulting calorie value is indicated on the abscissa, the resulting cash value is indicated on the ordinate, and a straight line is drawn to connect them: this is the price line. This approach permits the appraisal of real food availability, by combining the amount of food (expressed in calories) that the household has produced, gathered or stored and intends to eat (abscissa), and the revenue that it has generated and can use to purchase food (ordinate). The point where cash and food availability coincide may lie below or above the price line: above, the household is considered to be self-sufficient, below it is not, and must resort to its reserves to compensate for its production shortage. The gap between the needs and the means is clearly visible. Figure 10.13 below illustrates this method, in a case of daily food production and consumption.

Figure 10.13 The adequacy of resources to secure food



This method nevertheless entails the difficulty of determining actual production in the case of households that combine various activities and resort to the informal economy. That being said, the search for maximum accuracy and reflecting data on such a graph requires thorough field research and analysis. Moreover, unobtrusive or invisible sources of revenue may nevertheless be significant: for example, livestock herds grazing far from the village, remittances, and savings may all go unnoticed, and results must be verified accordingly.

4.3 APPRAISING FOOD CONSUMPTION

The examination of food consumption permits the quantitative and qualitative definition of what people eat. It provides information as to dietary adequacy and food sources. As is done for production activities, what is *normally* eaten must be established first, and how it is usually prepared. Qualitatively, this amounts to eating habits. Then the situation at the moment of assessment must be defined for the sake of comparison. It is usually not possible to observe absolutely everything the household eats over a given period; sampling however produces reliable results. Therefore, samples consisting of 30 to 40 households are questioned systematically in order to establish what they eat during a 24-hour period. It is worth noting that the assessment of food consumption must include direct observation and measurements (weighing the food). The scrutiny of the diet of infants and small children is especially important to understand the nutritional and health risks that they may face. This involves obtaining information as to breastfeeding practices, the number of daily meals, and the specificity (or its absence) of infant feeding, especially during weaning.

X

In terms of analysis, food composition tables (or the computer programmes intended for this use) permit the comparison of real food intake and nutritional needs and, thus, the definition of the adequacy of the food ration. The origin and price of food define how heavily it weighs within the unavoidable expenses.

4.4 NUTRITIONAL ANTHROPOMETRY

Nutritional anthropometry consists in measuring the physical dimensions of the human body in order to appraise its nutritional status. It provides information as to ponderal growth (i.e. the weight achieved for a given height) and statural growth (the height achieved for a given age). It also facilitates the understanding of nutritional compartments, such as lean mass and adipose tissue, for example through the measurement of mid-upper arm circumference and skin folds. Nutritional anthropometry is a non-invasive method that is cheap and relatively easy to handle; it relates to both individuals and entire populations. It enables the understanding of the nutritional status of the former on a quantitative basis, and to monitor it during treatment, for example. In populations, it reveals the overall nutritional status based on, for example, the prevalence rate of weight deficit. It also permits the monitoring of this status in the course of surveillance or the evaluation of programmes intended to improve it. This rate is measured through what is called anthropometric survey, either of a representative sample, or of the entire frame population.

The measurement of the nutritional status of a given population provides reasonably accurate data regarding its nutritional condition. Its strength lies in the clear credibility of quantitative data, and high malnutrition rates prompt immediate action. Its weakness however lies in the fact that it is often considered as the prime method to decide upon humanitarian action. This is a conceptual aberration, because data in itself does not explain the lead-up to the situation nor its evolution in any way.

As discussed in Chapter VI, measuring nutritional status provides a single indicator of the entire feeding process and its overall functioning. This indicator however only permits late action, particularly if it provides the main criterion for assistance. As a result, it does not meet the objectives of humanitarian action, which for example cannot be delayed until 30% of a given population has lost 20% of its weight. Aid would in this case be too late; but it may also be too late if the situation improves before its delivery – aid would then be redundant. Rather than a poor nutritional status, the risk of deterioration should be the criterion for action. Nutritional status is in this case an indicator among others in the decision-making process. In assessment, it serves to test hypotheses, to monitor developments, to measure the impact of operations or the severity of a situation and, for example, to select individuals for inclusion in therapeutic feeding programmes. Consequently, anthropometric survey is not necessarily a priority in preliminary appraisal.

4.4.1 Anthropometric variables and their measurement

The commonest anthropometric variables are age, weight, height, and mid-upper arm circumference (MUAC, or brachial circumference). This section also discusses the detection of oedema, which is not an anthropometric variable, but is usually investigated together with nutritional anthropometry.

Age

The age of small children is a necessary parameter in evaluating statural growth and, to a certain extent, ponderal growth.

Age is not always easy to ascertain if births are not systematically registered and in the absence of health cards. Mothers must in such cases be consulted, and they may not remember the exact birth date of their child. Usually however, local staff can estimate the child's age by consulting the mother. If the problem persists nevertheless, it may be useful to summarize the past five or six years in the form of a calendar in consultation with the local population, and indicate remarkable events on this calendar accordingly. Such events usually fall into the following categories:

⇨ cultural events, such as initiation (or coming-of-age) rites that are performed at a precise age, yearly celebrations, etc.;
⇨ agricultural events, such as the sowing season, the harvest, etc.;
⇨ astronomic events, such as moon phases;
⇨ political events, such as meetings of elders, successions, and presidential elections;
⇨ disasters, such as drought, floods, and warfare.

This method usually clarifies the approximate (i.e. within a few months) age of children, especially by comparing siblings and measuring other anthropometric variables such as weight and height. However, creating such calendars is not simple and takes time; therefore, the value of the information relating to age must be such as to justify the effort involved. As a last resort, Bailey suggests the following method: adding 6 to the number of visible teeth (whose crown is entirely visible) provides a reasonable approximation of the child's age in months (Bailey, 1963). This method is simple, and easy to remember.

Weight

Weight must be established to evaluate ponderal growth and corpulence.

The measurement of weight provides an approximation of nutritional reserves; but the measurement of weight involves measuring the entire organism, including:

⇨ intestinal parasites, which may be likened to antimatter because they are counted as nutritional reserves when they, in fact, consume part of the food and nutritional reserves; the burden of intestinal worms can exceed 1 kg;
⇨ sub-clinical oedema, which is an accumulation of fluid;
⇨ abnormal liver and spleen enlargement (hepatomegaly and splenomegaly) – splenomegaly is particularly common where malaria is endemic;
⇨ non-oedematous fluid accumulation associated with infection and inflammation (parasite inflammation can double the weight of the intestine);
⇨ body waste that has not yet been excreted.

Moreover, moderate dehydration can also cause weight to be underestimated. These biases are frequently observed in the field, and can substantially alter the value of measurements as an indication of nutritional reserves (Jellife, 1966).

For measurement, proper baby scales should be used for children up to the age of 1 year. In case these are not available, they should be measured like children from 1 to 5 years old. Children are placed, preferably naked,[23] in a special sling that is attached to a Salter-type spring balance, itself solidly fastened to a tripod or another adequate support. The child must hang freely and must not be able to grab anything until the needle stabilizes – this is not always easily done. If the child

[23] In some circumstances (climatic or cultural), it may be best not to undress the child completely.

struggles and shrieks it is best to wait for it to catch its breath and record the measurement to the nearest 100 g. The result must be read at eye-level and facing the dial squarely to avoid distortion, a common cause for mistakes. Weight must be recorded immediately by an assistant, and checked by the operator. Contrary to common practice, the "expert" should not sit and take notes while more or less trained assistants do the measuring: the most experienced and skilled individual must do the measuring, and regularly check that results are appropriately recorded. It is useful to keep a few spare slings in case of … minor mishaps during the weighing. In the case of particularly recalcitrant children, an adult scale may be used, and mothers are in this case weighed alone first, and then with their child in order to deduct the mother's weight and thus obtain the child's.

Children above 5 years of age should be weighed using adult scales or Salter-type spring balances of a 50-kg capacity and equipped with a horizontal bar that the child hangs from by the hands.

There are different types of scales. Salter-type scales are most common and practical for children. Beam balances, usually equipped with a counterweight, are useful for adolescents and adults – such scales are found in most medical practices; spring balances and electronic scales may also be used. Beam balances are the most robust by far, but are unwieldy and difficult to transport; they also require a perfectly level surface.

Spring balances must be zero-checked before each use, and must be transported carefully by blocking or removing their plate. The transport of electronic scales also requires care, and they need batteries. All types of scales must be checked before any weighing, ideally with two different known weights. The scale is set with one weight, and the second serves to test its accuracy. If the test fails, the spring must be changed.

Height

Height must be established in order to measure statural growth and corpulence.

Children under 2 years old are placed horizontally on their backs, barefoot, on an accurately graduated height board, whose "0" value extremity is fitted with a fixed perpendicular head board. The child's head is held firmly against this board, its buttocks must rest fully on the table, and the legs are held extended by pressing on the knees. The measurement cursor lies perpendicular to the table, and is then slid against the heels, with the feet kept at right angles to the legs. The cursor is maintained firmly while the child is removed and its height (or length) is recorded to the nearest millimetre (for example, 65.2 cm).

Children above 2 years old are measured standing as erect as possible, barefoot, against a vertical height board or tape measure fastened to a flat surface. The back of the head, the shoulder blades, the buttocks, and the heels must connect with the board, and the legs must be fully extended. The head must be straight, the shoulders relaxed, and the arms must hang naturally. A set square is lowered firmly onto the crown of the head (particular care must be taken here in the case of thick hair), and height is recorded to the nearest millimetre (for example, 85.6 cm).

Arm circumference (AC)

Arm circumference, also called mid-upper arm circumference (MUAC) or brachial circumference, is used to estimate lean mass and adipose tissue, being the two compartments of nutritional reserves. In this respect, it is therefore more accurate than weight.

MUAC is measured on the left arm, which must hang relaxed or be held against the torso if the subject is struggling. The value is measured at the mid-point between the tip of the shoulder (acromium) and the tip of the elbow (olecranon). A common tape measure can be used, but it is safer to use a special graded (sometimes colour-coded) insertion strip that is adjusted in the reading window located at one end to read the measurement accurately at the "0" gradation mark. The strip must connect with the entire arm circumference, and this is done by applying finger pressure; it must not be too tight and cause skin bulges around it, nor leave space between it and the skin. It is best to slide it through the reading window without pulling the ends. The circumference is recorded to the nearest millimetre.

Oedema

Oedema of the lower limbs is not an anthropometric variable, but is documented in the course of the appraisal of the nutritional status simultaneously with anthropometry; as a result, it is discussed here. In children, oedema of the lower limbs usually indicates kwashiorkor-type severe malnutrition.[24] Oedema can be recognized by applying strong finger pressure to the arch of the foot or the inside ankle for approximately three seconds; in the case of oedema, this pressure leaves a depression or pit (pitting oedema) that can be seen and felt easily. Oedema must then be sought on the other leg also: only bilateral oedema has nutritional implications. As a reminder, bilateral oedema of the lower limbs in adolescents and adults equally indicate severe malnutrition. However, since adult oedema may have different causes, their nutritional origin must be established, especially in the sedentary elderly, and this is not easily done.

4.4.2 Measurement standardization or normalization

It is best to practice before each measurement session or assessment in order to ensure that measurements are properly made, reproducible, and are similar. A dozen volunteers should be selected and measurements should be made by field workers, under the supervision of an experienced operator. The latter records results and the mistakes that he or she observes; the operator then measures each subject him or herself, and records results as the reference value. Results obtained by the other participants are then discussed in detail, and workers repeat their measurements while the operator comments and corrects mistakes as they arise. Ultimately, each participating worker should produce at least five successive results within 1 mm or 100 g of the reference value in the case of MUAC or weight; in the case of height, accuracy must be of the order of ± 0.5 cm . A more complex normalization method is described in a WHO manual (WHO, 1983).

4.4.3 Anthropometric indexes and measurement units

Mid-upper arm circumference can provide an indication of the nutritional status for children between 1 and 5 years old on its own, and oedema for all age groups. No other anthropometric variable can provide indications of nutritional status on their own: they must be combined with another variable to provide an index. Moreover, all anthropometric indexes must be compared with reference values that are defined from a population of healthy subjects (reference population). Such values are processed in reference tables.[25] Cut-off points must be set for each index in order to define specific nutritional status categories.

Most nutritional indexes combine so-called dependent variables and independent variables.

[24] See Chapter VIII, Section 2.4.4 for a more detailed discussion of kwashiorkor and oedema.

[25] See Annex 4.

The commonest indexes are the following:

	Dependent variable	Independent variable
1.	weight	age
2.	weight	height
3.	height	age
4.	MUAC	height
5.	MUAC	age

For the index to have a meaning, the dependent variable must be compared with the reference value that relates to the independent variable. For example, the use of the weight-for-height index involves measuring weight (say 8 kg for a boy) and height (say 80 cm), and comparing the recorded weight with the reference weight value for the subject's height (in this case, 11 kg).

The resulting weight-for-height index may then be expressed. This is done, as for all types of indexes, by way of units, which serve both to define categories based upon cut-off points, and to locate a measurement accurately with respect to reference values. Nutritional anthropometry thus resorts to three types of units:

⇨ percentage
⇨ centiles
⇨ standard deviation.

Percentage of the median

Results are expressed as a percentage of the median in the reference population, and the formula is simple:

$$\frac{\textbf{observed value of the dependent variable}}{\textbf{median reference value}} \times \mathbf{100}$$

The disadvantage of this unit is the fact that it does not have the same malnutrition meaning for all points of the independent variable because standard deviation varies according to points. For example, 80% of the weight-for-height median in boys corresponds to –2.2 standard deviations for an 80 cm height, and to –2.3 standard deviations for a 130 cm height.

In the example used earlier, an 80 cm boy weighs 8 kg, and the median of the reference weight for his height is 11 kg. The percentage is then as follows:

$$\mathbf{(8/11) \times 100 = 72.7\%}$$

Reference population centiles

Centile numbers reflect a position within a total of 100. Centile 50 corresponds to the median of the reference population: precisely half of this population shows values that exceed the median, and the other half shows lower values. For example, a measured value corresponding to the tenth centile indicates that the subject's value is equal to or greater than 10% of the individuals within the reference population. However, there is by definition no value below the third centile: an index lower than that falls in the general category of malnutrition, and it remains unclear whether it is a severe or moderate case.

In the above example, an 8 kg weight for an 80 cm height is lower than the third centile of the reference population, meaning that the boy is malnourished, but without indication as to whether he is severely or moderately so.

Standard deviation from the median

Standard deviation[26] is also called Z-score. Its use is spreading, because it is the best index to compare populations (and, thus, surveys) and individuals. Variables that are characteristic of a reference population usually follow a normal distribution of 2 standard deviations around the median, and this includes approximately 95% of the reference population. In biology and medical science, values lying outside this bracket are considered as abnormal or pathological. The expression of the index in standard deviations or Z-scores is as follows:

$$\frac{\textbf{observed value – median}}{\textbf{standard deviation}} = \textbf{weight-for-height index in standard deviations or Z-scores}$$

In the above example the standard deviation below the median is 1 kg, therefore:

(8–11) / 1 = –3 standard deviations or –3 Z-scores

All the above calculations require the use of reference tables indicating the median, standard deviations, and centiles or anthropometric data processing computer programmes.

4.4.4 Anthropometry in children

Weight-for-age or Gomez index

Advantages: a good basic indicator that combines ponderal and statural growth and is useful in the monitoring of programme performance; sensitive to slight variations (although many variables can account for weight changes).

Drawbacks: does not distinguish wasting from growth retardation (stunting), because a tall, lean child may reflect the same weight-for-age ratio as a short, stout child; it requires accuracy in setting age, which is usually difficult to ensure; weight is influenced by variables that may alter the interpretation of results; weight is not always easily measured.

Conventional cut-off points and classification:

- ⇨ > 90%: normal nutritional status
- ⇨ 90 to 75%: mild malnutrition (first degree)
- ⇨ < 75 to 61%: moderate malnutrition (second degree)
- ⇨ ≤ 60%: severe malnutrition (third degree).

[26] Standard deviation measures statistical dispersion, or the average distance of values from the mean if the values are normally distributed (see Annex 8).

Height-for-age

Advantages: a good indicator of past nutritional and health disorders that result in growth retardation.

Drawbacks: of little use for programme monitoring, because height progresses slowly in humans; the method requires two different techniques: reclining position for children below 2 years old and standing position for older children, when the two categories must be measured simultaneously (which is usually the case); height is not easy to measure accurately; it requires the participation of two persons; it requires accuracy in setting age, which is usually difficult to ensure.

Conventional cut-off points and Waterlow classification:

⇨ ≥ 95% or	≥ –1 Z-score:	adequate growth
⇨ 94 to 90% or	< –1 Z-score to –2 Z-scores:	mild growth retardation
⇨ 89 to 85% or	< –2 Z-scores to –3 Z-scores:	moderate growth retardation
⇨ < 85% or	< –3 Z-scores:	severe growth retardation.

Weight-for-height

Advantages: a good indicator of wasting, regardless of age.

Drawbacks: weight is influenced by variables that may alter the interpretation of results; weight is not always easily measured (see above, weight-for-age); it requires that two measurements be accurately recorded, which is not easy, and the participation of two persons; measurements are time-consuming, as is data processing (unless results are entered into a specific computer programme such as EPINUT, which is also time-consuming and introduces the risk of mistakes associated with the transcription of data).

Practical improvement: J. Vernet and Dr D. Nabarro of the London School of Hygiene and Tropical Medicine have developed a diagram that combines weight and height and provides three cut-off points: subjects may thus be classified in one of four nutritional categories. The method presents the advantage of removing the need for accurate height measurement, which saves time, human resources, and calculations.

Conventional cut-off points and classification:

1. CDC classification:

⇨ > 85%:	normal nutritional status
⇨ 85 to 80%:	moderate malnutrition
⇨ < 80%:	severe malnutrition.

2. Waterlow classification:

⇨ ≥ 90% or	≥ –1 Z-score:	satisfactory nutritional status
⇨ 89 to 80% or	< –1 Z-score to –2 Z-scores:	mild malnutrition
⇨ 79 to 70% or	< –2 Z-scores to –3 Z-scores:	moderate malnutrition
⇨ < 70% or	< –3 Z-scores:	severe malnutrition.

MUAC-for-height

Advantages: a very good indicator of wasting; it provides a more accurate reflection of the real nutritional reserves of the organism than weight (which explains its stronger correlation with mortality than with weight). According to circumstances and concurrent infection, overall weight loss is frequently proportionately lower than lean mass and adipose tissue loss (parasite infection, and sub-clinical inflammation and oedema). Measuring brachial circumference amounts to measuring tissue that serves as nutritional reserves (i.e. lean mass and adipose tissue), and any variation in this circumference indicates variation in these tissues exclusively. The method is independent of age. It is not more difficult to measure than height or weight, but is faster. Doctor Briend considers that combining MUAC and height does not significantly improve the estimation of nutritional status (Briend, 1995). Indeed, arm circumference only increases by about 1.5 cm between 1 and 5 years; in other words, the 13.5 cm cut-off point corresponds to 85% of the reference in a 1-year-old infant, and to 78% in a 5-year-old child.

Drawbacks: it requires two measurements, one of which is not easy to take, and the participation of two persons.

Practical improvements: the choice of two cut-off points with respect to the reference permits the construction of a height board that combines height and arm circumference and subjects may then be included in one of three categories of nutritional status: acceptable nutritional status, moderate malnutrition, and severe malnutrition. The method presents the advantage of removing the need for accurate height measurement, which saves time, human resources (two persons are no longer required), and calculations. This method is called QUAC Stick (for Quaker Arm Circumference – a team of Quakers initially developed the method during the Biafran war).[27]

Conventional cut-off points and classification

⇨ > 85% or	> –2 Z-scores:[28]	satisfactory nutritional status
⇨ 85 to 75% or	–2 Z-scores to –3 Z-scores:	moderate malnutrition
⇨ < 75% or	< –3 Z-scores:	severe malnutrition.

MUAC

Mid-upper arm circumference changes little in children aged 1 to 5 years. As a result, it may not need to be combined with another measurement in order to be compared to reference values.

Advantages: a good indicator of wasting; it requires a single, simple measurement and is thus fast; age need not be specified.

Drawbacks: the method is less accurate than the QUAC Stick method.

Conventional cut-off points and classification:

⇨ > 14 or 13.5 cm:	satisfactory nutritional status
⇨ 14 or 13.5 to 12.5 cm:	moderate malnutrition
⇨ < 12.5 cm:	severe malnutrition.

[27] The method is described in Annex 9.

[28] Z-scores according to the table provided in Annex 4.3. See Annex 9 for comments as to the choice of reference.

4.4.5 Anthropometry in adults

The index that is most commonly used for adults is the Body Mass Index (BMI) or Quételet index. This method reveals wasting; the BMI is calculated by dividing weight expressed in kilograms by height (expressed in metres) squared:

$$\mathbf{BMI} = \frac{\mathbf{weight\ (kg)}}{\mathbf{height^2\ (m)}}$$

BMI is independent of height: if the index is identical for subjects of different heights, then the nutritional reserves of the organism are comparable. Variables that influence the interpretation of weight measurements are far less significant in adults than in children.

Table 10.5 Body mass index classification (Quételet index)

Classification of the adult nutritional status according to BMI				
	Obesity	Normal nutritional status	Moderate malnutrition	Severe malnutrition
Women	> 28.6	23.8 – 18.7[a]	18.6 – 15.5	< 15.5
Men	> 30	25 – 20.1[b]	20 – 16	< 16

[a] Desirable average: 20.8 (WHO, 1985).
[b] Desirable average: 22 (WHO, 1985).

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This classification is derived from the thresholds provided in a WHO report on energy and protein requirements (WHO, 1985). A more recent WHO technical report on anthropometry suggests different cut-off points for adults, without distinction of sex. However, the weight of women is lower than that of men for the same height (WHO; 1995). According to this classification, a BMI greater than or equal to 18.5 indicates a normal nutritional status; between 18.4 and 17 the subject is mildly malnourished, between 16 and 16.9 it is moderately malnourished, and below 16, it is severely malnourished.

The choice of 18.5 as the cut-off point for normality is explained by the fact that health problems are not observed in BMI cases located above that threshold. However, experience in prisons in several countries shows that most adults whose BMI lies between 18.5 and 20 are wasted with respect to the nutritional status that would be theirs if access to food were sufficient, and that their physical capacity is substantially diminished. This observation was in fact confirmed in the case of a specific prison in which undernourished and highly wasted inmates finally gained unlimited access to an adequate diet. Their food consumption initially rose dramatically, and then stabilized. Measurements taken three weeks after stabilization indicated an average 22 BMI, with a 1.9 standard deviation. Clearly, a balance had been found between dietary intake and energy expenditure. As a result, the new WHO classification may tend to underestimate mild malnutrition in adult males; this can have serious consequences for humanitarian action. Moreover, the suggested brackets imply a 7.5% weight loss between mild and moderate malnutrition, and only a 6% one between moderate and severe malnutrition: is such sophistication really necessary? This Manual therefore prefers to refer to the previous classification discussed above; it matches reality more closely, and its cut-off points are more relevant to humanitarian action.

4.4.6 Anthropometry in adolescents

Weight-for-height expressed as a percentage of the median is the best method for adolescents, using the combined table provided in Annex 4.4, and the cut-off points suggested by Waterlow (see above, weight-for-height). BMI-for-age is used to distinguish malnourished adolescents from healthy individuals, the cut-off point being the 5th centile. This method is however of little practical relevance to humanitarian action.

4.4.7 Reference populations[29]

In order to define nutritional status, measurements must be compared with standards or reference points taken from a reference population. The choice of the reference is a controversial issue; however this is not critical so long as the choice is an informed one. Anthropometric reference is established through the greatest possible number of measurements of supposedly healthy individuals (200 per measurement). Available reference tables relate to white European and North American subjects. Well-known tables include the Boston and Harvard tables established between 1930 and 1939 based upon a small sample of reasonably well-fed white Caucasian children, the Tanner tables based upon a homogenous English population in order to set growth standards for the United Kingdom; and the US National Center for Health Statistics (NCHS) tables based upon large samples randomly selected in different ethnic and economic groups in the USA.

The current trend is to recommend NCHS tables for general adoption. The question therefore arises as to the relevance of such tables for other populations, especially in the developing world. Two schools of thought exist, but practical considerations must be included also.

The first school of thought is that the genetic growth potential is roughly identical for all humans up until adolescence. As a result, all individuals should reach their full growth potential, and any deviation below would indicate malnutrition. The human genetic potential cannot be defined absolutely, the bodily standards observed in “well-fed” and “healthy” populations are accepted as approaching this ideal. Clearly, anthropometry is influenced by living conditions and changes with them. There is therefore no justification to penalize already precarious populations by applying growth standards that are by definition lower than in the wealthy West.

The second school of thought promotes the use of reference values obtained from apparently healthy subjects from the directly affected population. This approach rests on two arguments:

- ⇨ on the basis of NCHS references, 25 to 40% of children in the developing world are considered to be malnourished to some extent – no country has the means to run programmes for 30% of its children;
- ⇨ most such children show no sign of malnutrition, they simply have different growth characteristics that are adapted to the local ecology (socio-economic and environmental parameters); as such, they are “false positives” – clearly, people cannot be condemned to living in unfavourable ecological conditions; but in view of resource limitations and the absence of clinical signs of malnutrition in such subjects, it is preferable to rely on reference values that detect individuals that are really at risk.

[29] Readers are also referred to Chapter VIII, Section 2.4.5 regarding nutritional dwarfism, which also discusses the choice of reference tables.

In practical terms, the lack of local tables usually obliges humanitarian actors to resort to NCHS, Harvard or Tanner tables anyway. What really matters, then, is a sound knowledge of the limitations and the risks associated with their use and, above all, not to interpret anthropometric measurements wrongly in the light of such references. This raises the issue of the value of anthropometric indicators in reflecting nutritional status.

4.4.8 The value of anthropometric indicators in reflecting nutritional status

Measuring nutritional status usually consists implicitly in appraising the prevalence of malnutrition based on a given classification (the use of cut-off points), for a given index. What reasoning, then, leads to the conclusion that prevalence measured below a given cut-off point actually reflects pathological disorder?

The following example sheds some light on the issue. In June 1985, approximately 40% of the children in the Ethiopian region of Tigre rated lower than 80% of the weight-for-height reference. All required intensive care in therapeutic feeding centres to some extent, and morbidity and mortality were quite high in such centres. At the same moment on the desert fringe in Eritrea, similar prevalence rates were recorded in children, but only very few required intensive care. The difference is explained by the fact that, in Tigre, nutritional status was estimated according to weight, and commonly overestimated because of parasite infection; the combination of such infections (and others) with malnutrition had serious consequences on health. These problems were significantly diminished in Eritrea. The first case clearly amounts to a public health emergency, whereas the second is closer to successful adjustment.

The *interpretation* of small weight or height is therefore especially important. What really matters is the relation between physical dimension and functions such as the immune system, stamina, intellectual performance, and the ability to survive. In relation to anthropometric indexes, is there then a critical threshold, or a kink in the curve below which the risk of dysfunction increases unambiguously? Specialized literature provides many clues, and the answer is clearly negative. The cut-off point corresponding to the same risk of mortality varies according to circumstances.

In some cases, and according to indexes, the risk curve is quite regular, without discontinuities; in such cases, shifting cut-off points always results in an excessive number of false positives or false negatives, thus posing a serious operational problem. This is not surprising in view of the many possible causes of pathological malnutrition. Anthropometry therefore remains a sound indicator of nutritional reserves or past growth patterns, but only provides an estimate of nutritional status.

The choice of index

Anthropometry nevertheless remains essential in many circumstances. The points discussed here are intended to facilitate the selection of an index that is relevant to the dimension under investigation. The cut-off points discussed earlier are commonly used, but their meaning requires some attention. It goes without saying that the choice of index and cut-off points is determined by the overall purpose in doing so. However, choices are still all too often dictated by imitation or habit, rather than by actual thought as to the investigated issue. Anthropometric indexes provide indicators for different conditions or risks.

Indicator of wasting

As mentioned earlier, anthropometric indexes provide an estimate of nutritional status, and not a proper reflection of a dysfunction. All the more so because the extreme form of wasting (marasmus) that results from a metabolic adjustment to an insufficient dietary intake, is not necessarily pathological in itself, as frequently confirmed in famine: individuals may be very thin without actually being sick. Thresholds must be placed very low for indicators to detect specifically – apart from severe physical weakness – dysfunctions in the organism resulting from an insufficient energy intake.

However, the loss of nutritional reserves impairs survival capacity; it also indicates dysfunctions of the organism and/or the feeding process, which must be addressed. As a result, it is useful to refer to indicators of wasting, which ultimately causes marasmus, and death.

The most appropriate indicators of wasting are MUAC, MUAC-for-height, and weight-for-height. MUAC is a better warning of mortality than weight-for-height. The use of MUAC alone is adequate to select individuals, but the measurement of the nutritional status of an overall population is best done with MUAC-for-height. Many sources consider weight-for-height to be the best indicator (or reference indicator) for wasting; however, this is not backed by scientific evidence. To distinguish between anthropometric indicators according to their reflection of wasting, they must be compared to another indicator that can serve as reference. Such an indicator may be obtained by clinical observation of specific signs, or the accurate measurement of lean mass and adipose tissue – this can usually not be done in the field. On the basis of clinical observation, the author of this Manual has noticed repeatedly that MUAC-for-height corroborates clinical classification of marasmus better than weight-for-height. This observation is confirmed by a study led by Van Loon, which concludes that MUAC-for-age followed by MUAC-for-height are more appropriate than weight-for-height in defining marasmus (Van Loon, 1987).

The nomenclature of the categories defined by classification (the positioning of cut-off points) is strictly conventional and results must also be analysed and commented in order to avoid sometimes serious misunderstandings. For example, the 70% weight-for-height cut-off point (or –3 Z-scores) is more relevant as a criterion for admission into therapeutic feeding centres than as a threshold for the analysis of the overall nutritional status in a public health perspective, because it is both severe and specific. However, the current tendency is to consider only individuals that fall below this threshold when qualifying the severity of the nutritional situation in the overall population. From a public health angle, cut-off points must be selected in order to appraise the situation more sensitively, and to measure changes occurring over short periods of time in order to determine whether they are significant or not. The different uses of cut-off points are due to the fact that action which targets communities differs from that which targets individuals, and to the confusion between cut-off points that qualify a situation as pathological, and the cut-off points that, for a pathological situation, determine action. For example, all children registered lower than –2 Z-scores in weight-for-height are wasted, but only those registered lower than –3 Z-scores are admitted to therapeutic feeding centres.

Indicator of mortality

MUAC, related or not to age or height, provides the best indicator of mortality (Chen, 1980; Trowbridge, 1981; Briend, 1987).

Indicator of growth

Height-for-age is the best indicator by far. Weight-for-age is sometimes used, and may provide an idea of the growth of pre-school children.

Indicator of change

This implies the longitudinal study (i.e. over time) of individuals or groups. Weight, MUAC and height may also be used independently, without reference to age or height. Weight is most appropriate for individual monitoring, and MUAC for group monitoring. Clearly, if operators change in the course of the monitoring, the method used initially must be applied throughout; if necessary, it may be combined with another measurement.

Indicator of reference point

It may be best to set reference points, especially in preliminary appraisal. Indicator selection is determined by:

⇨ the purpose of the measurement: growth and/or tissue mass;
⇨ available resources;
⇨ available time;
⇨ the sampling method;
⇨ existing data where available.

MUAC, alone or related to height, is more suitable than weight measurements.

Screening indicator

MUAC-for-height provides the most accurate indication of wasting, but MUAC alone is quite acceptable, and is faster. Depending on the purpose of screening and available resources, thresholds may be set that differ from conventional cut-off points.

4.4.9 Magnitude of the malnutrition problem according to its prevalence

The measured nutritional status of a given population must be adequately interpreted. However, the magnitude of malnutrition is not to be confused with the seriousness of the nutritional situation. For example, a serious primary wasting rate of 30% indicates a serious malnutrition problem, but if this rate is registered shortly before the harvest, which is anticipated to be exceptionally good, this does not justify alarm as to the overall population's nutritional status. Likewise, a serious primary wasting rate of 10% does not indicate a major malnutrition problem, but if it is recorded shortly before the hungry season, it may justify concern as to the nutritional situation. Table 10.4 below provides the data required to qualify the severity of the malnutrition problem.

Table 10.6 Magnitude of the malnutrition problem according to its prevalence

Indicator	Minor problem	Moderate problem	Serious problem	Major problem
Weight-for-height < –2 Z-scores	< 5%	5 – 9.9%	10 – 25%	> 25%
MUAC-for-height < –3 Z-scores	< 5%	5 – 9.9%	10 – 25%	> 25%
Height-for-age < –2 Z-scores	< 20%	20 – 29.9%	30 – 40%	> 40%

4.5 *MARKET ANALYSIS*

The field study of local markets is fundamental, because it provides a good idea of the local economy. Market analysis enables the definition of the relative value of commodities and its evolution, the evolution of prices, and their value in terms of purchasing power. It shows who is buying what, cash and commodity flows, supply and demand related to basic commodities (that is, commodities the demand for which is rather inelastic[30]). The investigation and monitoring of market trends involves recording the following at regular intervals:

⇨ the price of the main essential commodities;
⇨ salaries in kind or cash for the main occupations;
⇨ official and unofficial (i.e. informal) local currency exchange rates for the most commonly used foreign currency;
⇨ inflation rates (if possible), which reveal real price fluctuations.

Market data collection must not be passive and confined to recording and processing prices at regular intervals. It must be accompanied by some analysis and comment as to developments. Its ultimate purpose is to shed light on the various players on the market, according to their production and its relative market value, and their purchasing power, in order to identify those that may require assistance.

In data collection, observers must also pay attention to possible attempts at interference on the part of stakeholders, who may supply wrong information especially if the collection of data is regular and frequent.

4.6 FUNCTIONAL CLASSIFICATION

Functional classification is an approach developed by Payne (Pacey & Payne, 1985); in humanitarian action, it consists in defining homogenous population groups with respect to their living conditions. It involves the definition of administrative regions, followed by the definition of ecological sub-regions and/or those affected by the phenomenon that has prompted action. In each sub-region, population groups are defined according to their livelihoods and/or social status. Classification may be fine-tuned by determining the demographic structure for each group. As the survey proceeds, functional classification may be completed with morbidity and mortality data, or any other characteristic specific to homogenous groups.

The following is an example of functional classification based on El Salvador, for which the approach was first devised.

1. Regional division based upon the administrative structure.
2. Ecological sub-regions or those corresponding to the cause for attention.
   Sub-regions include, for example:
   → urban areas;
   → rural areas:
      → grazing areas;
      → domestic food production areas (i.e. intended for self-consumption):
         – maize and bean production areas;
         – potato production areas;
         – sweet potato production areas;
      → commercial food production areas (i.e. intended for sale):
         – sesame production areas;
         – cotton production areas;
         – fruit production areas.

[30] Market mechanisms are discussed broadly in Chapter VI, Section 3.2.2.

3. Livelihoods and social status of groups in each sub-region:
   - → urban areas:
     - → recently arrived migrants employed in the informal sector;
     - → labourers, classified according to the type of work;
     - → tradesmen, classified according to the type of trade;
     - → employees in the trade sector;
     - → employees in the tertiary sector (civil servants);
   - → rural areas:
     - → farmers that generate a surplus;
     - → farmers verging on self-sufficiency;
     - → farmers compelled to generate additional revenue otherwise for survival;
     - → landless farmhands;
     - → wealthy nomads;
     - → poor nomads.
4. Demographic breakdown in each population group:
   - → by age group and sex, and by occupation;
   - → prevalence and incidence of major illnesses by age group and sex.

Functional classification is useful in defining survey areas and geographical and/or group homogeneity prior to sampling. It also helps to design relative vulnerability matrixes. As the survey progresses, the knowledge it generates permits the detection of vulnerable groups and the definition of operational priorities.

4.7 RELATIVE VULNERABILITY ANALYSIS

The following is adapted from F. Grunewald (Grunewald, 1997).

Victims of a crisis do not all suffer identically because their vulnerabilities differ. In other words, the need for assistance is not equally significant and urgent for all, and those that face the greatest risk must be identified accordingly. To this end, hypotheses are formulated as to the relative vulnerability of different groups with respect to a given phenomenon (e.g. drought); population categories are then ranked by order of decreasing vulnerability (e.g. in relation to their distance from the drought-affected area, or on the basis of functional classification). The features that appear to be most important in mitigating vulnerability (e.g. the type of livelihood) are then determined and ranked according to their contribution to needs coverage. Finally, these two classifications are combined in an analysis matrix whose boxes indicate dwellings and their number of inhabitants, according to cross analysis. This provides a synthetic representation of the groups that are considered to be most at risk, that is, those located above the diagonal connecting the lower left-hand corner and the upper right-hand corner of the matrix. The diagonal may be moved upwards for greater specificity, or downwards for greater sensitivity. The relative vulnerability hypothesis is then tested. The relative vulnerability matrix is an assessment tool; in the course of hypothesis testing, it becomes an analytical tool and, following hypothesis confirmation, a presentation tool.

Constructing a relative vulnerability matrix requires that diversity be qualified in terms of:

- ⇨ vulnerability factors;
- ⇨ population types;
- ⇨ ability to cope with crisis, that is, resilience.

It also requires the formulation of hypotheses relating to problems caused by crisis and their consequences. The matrix permits the identification of priorities according to operational content, location, and beneficiaries.

Table 10.5 below provides a theoretical example of a relative vulnerability matrix in relation to Sahelian conditions. The vulnerability factor is drought, and the survey is conducted during the fourth successive year of drought. Resilience to drought is determined by the main economic activities performed by the various population groups affected. The area under investigation accommodates three towns located on major international communication routes, six rural dwellings located along a river, camps that house nomads displaced by the drought and located on the outskirts of towns, and nomad pastoralist camps near remaining watering points in the semi-arid and arid areas. Three population types are defined according to where they live, their relative vulnerability to drought being related to their proximity to the drought-stricken area; livelihood independence with respect to drought is assumed to determine resilience to drought (working hypothesis). The following categories are increasingly independent with respect to drought:

⇨ social obligations;
⇨ pastoralism;
⇨ agricultural wage-labour;
⇨ independent agriculture;
⇨ informal sector;
⇨ urban wage-labour;
⇨ crafts;
⇨ trade.

The above provides the basis for the relative vulnerability matrix.

Table 10.7 Relative vulnerability matrix

Production activity	**Environment**		
	Desert	Rural	Urban
Social obligations			Displaced nomad camps (10,500)
Pastoralism	Camps near watering points (20,000 to 50,000)		
Agricultural wage-labour		Farmhands (3,000)	
Agriculture		Rural dwellings (12,000)	
Informal sector			Migrant nomads
Urban wage-labour			Employees and civil servants (30,000)
Crafts		(2,000)	(20,000)
Trade		(500)	(10,000)

The above matrix shows that groups located in the white areas do not require urgent action, whereas those that are located in the shaded boxes do, and the further towards the upper left-hand corner they are, the greater their need for assistance.

The matrix validity must then be tested by field surveys, and its contents adjusted as required. For example, farmers located along the river may turn out to be less vulnerable to drought than initially assumed, if their land is irrigated.

4.8 STAKEHOLDER ANALYSIS

The following is adapted from Serge Ghinet (Ghinet, 1997).

Humanitarian action evolves in a diverse human context in terms of vulnerability to crisis factors, but also in terms of social and functional dimensions, and diverging interests and issues at stake. These diversification factors permit the definition of the different stakeholders involved in a given environment.

The general objective of stakeholder analysis is to ensure that operations will run in the best possible conditions. To this end, the interests, activities and needs of stakeholders are identified, and allowed for in dialogue efforts, in order to reach the best possible compromise. Practically, this involves:

- ⇨ identifying affected people and groups in a specific environment;
- ⇨ defining who does what, when, how, where, and why;
- ⇨ identifying individual interests;
- ⇨ understanding power relations;
- ⇨ defining the need for assistance;
- ⇨ understanding operational strengths and opportunities.

Stakeholders can be:

- ⇨ individuals;
- ⇨ interest groups;
- ⇨ local authorities;
- ⇨ services.

Stakeholders are identified according to various criteria:

- ⇨ their features:
  - → social status (their position in the social structure);
  - → identity (their image in a system of communication and exchange);
  - → project (their purpose or objective as determined by circumstances and available resources);
  - → power (their ability to influence other stakeholders);
- ⇨ their function and role within the social system under consideration;
- ⇨ their interests;
- ⇨ the issues at stake for them arising from specific events, and especially from humanitarian action.

Stakeholder analysis is conducted for each of the above parameters, based on an analysis matrix. Stakeholders determine its columns, and issues determine its rows. Table 10.6 below provides an example for issues related to a general food distribution (GFD).

X

Table 10.8 Stakeholder analysis matrix – example of a GFD

Issues	Persons displaced by war	Farmers' association	Tradesmen	Authorities	Garrison
Inclusion in the GFD	Yes (they are hungry)	No	Yes (to control it)	Yes (to show goodwill)	Yes (to sell it)
Ensure GFD delivery	Yes	(depends on timing and harvest)	No (if they cannot control it)	Yes	Yes
Prevent GFD delivery	No	(depends on timing and harvest)	Yes (if they cannot control it)	Yes (if tradesmen pay them enough)	Yes (if tradesmen pay them enough)
Avoid negative GFD side effects	Yes (if this ensures GFD continuation)	Yes	Yes (the GFD may cause drops in the price of basic commodities)	Yes (to avoid unrest and pressure)	(depends on how such effects may affect their role and influence)

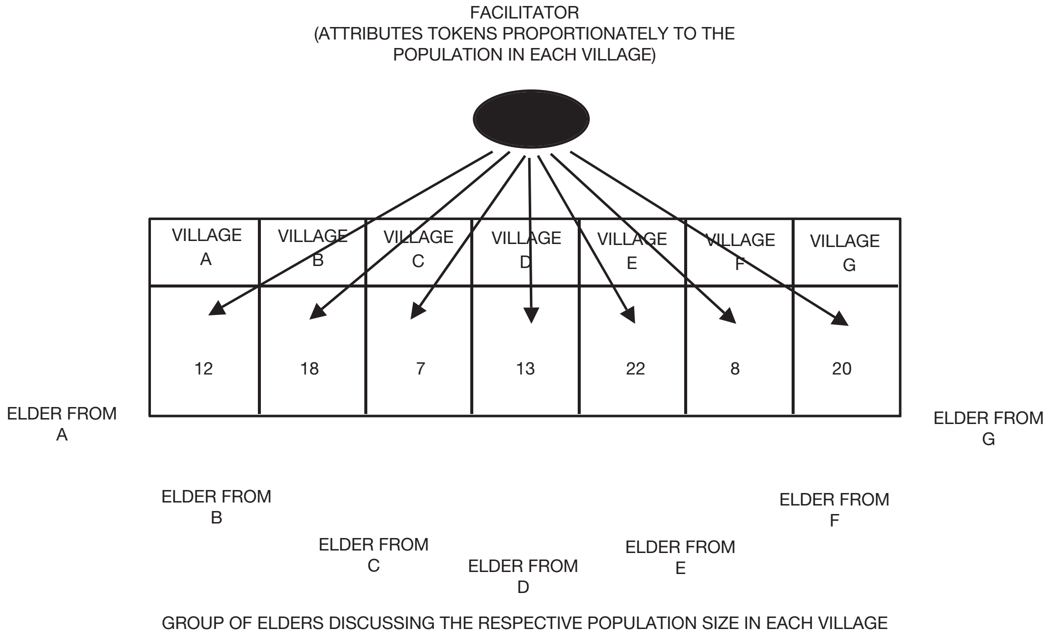
The above simplified matrix does not include such stakeholders as the humanitarian agency involved in the GFD, donors, and third parties that support the war effort. Stakeholders must be analysed in this example according to their relevance to the GFD; necessary negotiation must be undertaken in order to ensure the smooth delivery of the planned food assistance, that is, its acceptance by all stakeholders. Here again, participatory dialogue is the only possible approach.

4.9 PROPORTIONAL PILING

Proportional piling is a simple tool that reflects preferences, which can then be expressed quantitatively. It involves the participation of those concerned, because they must define the actual proportionality. Specific variables are defined first: for example, time, food, population. Boxes are then drawn up, each corresponding to an object in relation to which the variable must be examined. Informants are then requested to place a number of tokens, such as beans or stones, in each box proportionately to each object. The total number of tokens must be 100 (to reflect 100%).

For example, a survey is conducted prior to the distribution of seeds in an area that includes many remote or inaccessible villages. The population (i.e. the variable) of each village (in this case, the object) must be defined for the appropriate allocation of seeds. The community elders (that is, the informants who are assumed to hold most legitimacy within the community) are invited and informed of the purpose and conduct of the survey; they are then requested to define the population in each village. The elders must know one another well, and have a fairly accurate idea of the population in the different villages, or the consultation is useless. One person is put in charge of placing the tokens, or beans, in the boxes traced on the ground or a large sheet of paper, where each box represents one village. The 100 tokens are distributed based upon the information provided by each participating elder and the comments of the others, until the entire group of participants agrees upon the resulting attribution – this then determines the allocation of the seeds to be distributed. One or several accessible villages are then visited in order to perform a head count and thus translate percentages into numbers. Figure 10.14 below illustrates this example of proportional piling.

Figure 10.14 Proportional piling – example



In this example, investigators then visit village A in order to perform a head count; if the latter produces a total of 501 persons, then 1 bean corresponds to approximately 42 persons (501 persons / 12 beans = 41.75 persons per bean). Thus, the population in the remaining villages can be estimated; also, the resulting data may be used for the attribution of seeds, or of any other type of assistance that is determined by population size.

Proportional piling can also shed light, for instance, on the time allocated to various household activities, or the contribution of different food sources to the family diet.

4.10 PAIRED RANKING

Ranking is a participatory method that permits the definition of priorities (or relative importance). For example, several informants may be asked to indicate their problems or needs by order of priority, and investigators can then verify the consistency of answers. Alternatively, wealth categories can be defined and described in terms of means and occupation, while differences between very poor, poor, average, and rich households are established. Proportional piling may then be used to attribute population percentages to each wealth group.

Paired ranking (sometimes called pairwise ranking) is also a useful method to define preferences or priorities. For instance, to determine the importance of food sources (i.e. the item) informants are asked to indicate which sources they rely on. These different items (in this case sources), are then entered in the rows and columns of a matrix; the heading of column 1 is identical to that of row 1, that of column 2 is identical to that of column 2, and so on. Items are then compared to one another once, and informants asked to state their preference; for example, "*do you prefer item 1 or item 2?*", or "*which is more important: source 1 or source 2?*". The answer is then recorded in the corresponding box. The item, or source, that most frequently provides the answer is the most important (i.e. it has the highest priority); this permits the ranking of all items or sources by order of importance. This example is illustrated in Table 10.7 below.

Table 10.9 Paired ranking – example of food sources

Food source	Production	Purchase	Gathering	Gift
Production		Production	Production	Production
Purchase			Gathering	Purchase
Gathering				Gathering
Gift				

In the above example, totals are as follows:

- ⇨ production was found to be more important three times: 3
- ⇨ gathering was said to be more important twice: 2
- ⇨ purchase was said to be more important once: 1
- ⇨ and gift was not once said to be more important than another source.

In other words, the most important food source in the opinion of this group is clearly its own production, followed by gathered and purchased foods. This group appears to rely on gifts only minimally.

4.11 SWOC ANALYSIS

This tool permits the analysis of the **S**trengths, **W**eaknesses, **O**pportunities and **C**onstraints (SWOC) of a given programme. To do so, a four-box matrix is used, each box corresponding to one trait; Table 10.8 below provides an example for a general food distribution.

Table 10.10 SWOC analysis matrix – example of a GFD

STRENGTHS – Distributions regular; – Ration adequate; – Appropriate distribution method; – Appropriate distribution frequency.	**WEAKNESSES** – Ration monotonous, discourages the appetite of small children; – Occasional insecurity on the way home; – Beans difficult to cook.
OPPORTUNITIES – Monitoring of the health status of children; – Registration for the therapeutic feeding programme; – Vitamin A supplementation; – Discussion sessions regarding developments.	**CONSTRAINTS** – The attitude of armed groups; – Distance between dwellings and distribution point; – Heavy load to carry home.

The resulting SWOC analysis provides the basis for further improvement of strengths, for the investigation of opportunities, the resolution (where possible) of weaknesses and constraints, and for the explanation of the inevitability of some of the latter.

4.12 GRAPHIC ILLUSTRATION

This method is a useful way of presenting information visually, making it easier to understand, provided that it is supported by some form of explanation. All types of graphic illustration require interpretation, and thus imply analysis and thought. As such, they are also sometimes useful in preparing a survey. The different forms of graphic illustration described below are all useful in presenting and analysing data.

4.12.1 Graphs

Graphs are widely used in humanitarian action; they are useful mainly to represent distributions, the evolution of a given characteristic with respect to another parameter (malnutrition, the price of basic food commodities, etc.), and the relationship between two varying characteristics. They commonly comprise a horizontal axis (x-axis, or abscissa), which usually reflects the independent variable, and a vertical axis (y-axis, or ordinate), which reflects the dependent variable. Two-axis graphs may be represented in different ways; graphs may also be used to reflect proportions, by subdividing a given area (pie charts, horizontal, vertical or aggregate column charts, etc.). Figure 10.15 provides an example related to the evolution of staple cereal prices over time.

Figure 10.15 Evolution of maize prices on market X during the year 2000

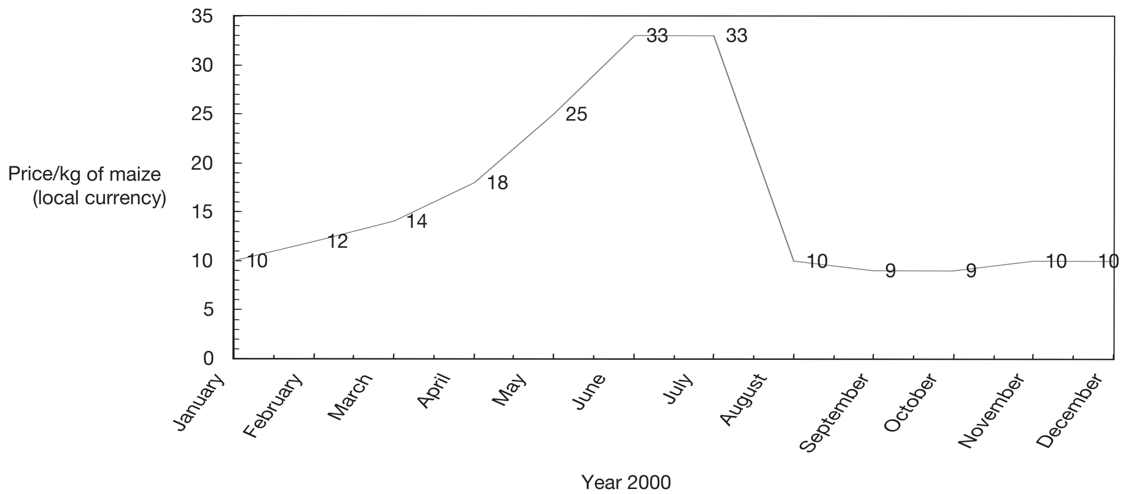


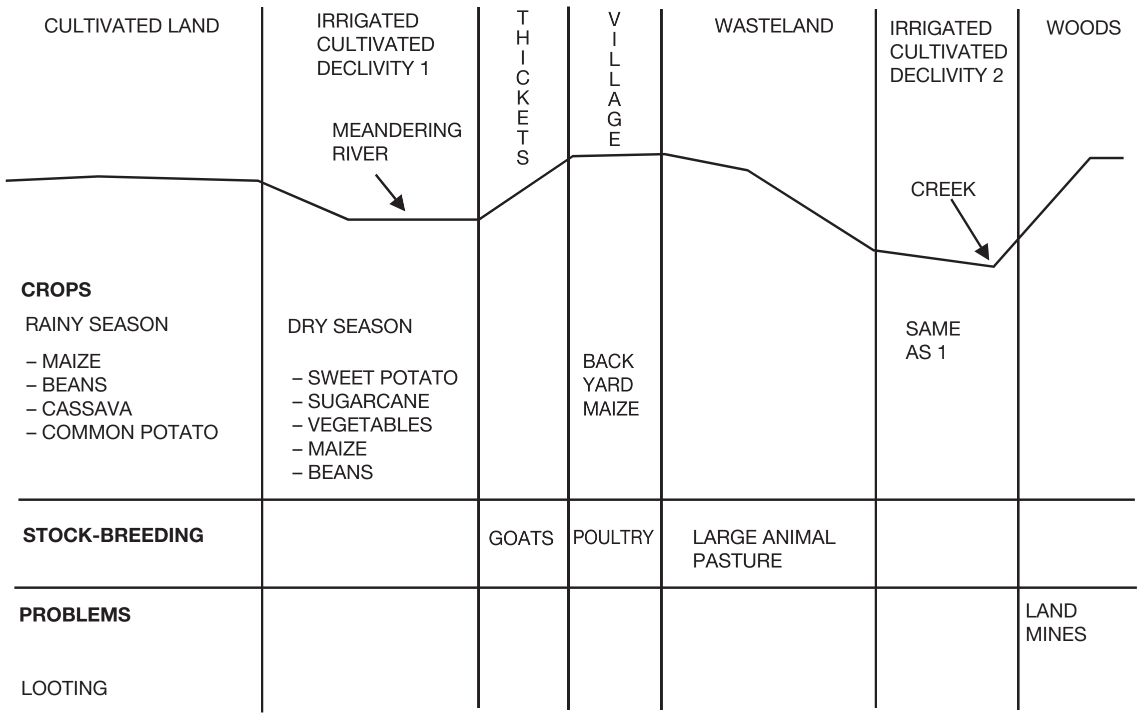
Figure 10.15 reflects a substantial (more than three times) and steady increase in maize prices between January and June 2000, and an abrupt drop in August. These developments warrant explanation, which must be detailed in the report. Nowadays, most computers are equipped with software for quick and easy graphic illustration.

4.12.2 Maps and transects

Maps and transects reflect space and its occupation in order to facilitate orientation within this space and reach chosen destinations more easily. Like graphs, maps are in common use in humanitarian action, and usually show physical features such as overland routes, dwellings, administrative boundaries, infrastructure, waterways (hydrography) and relief. It is best to simplify them as much as possible for field use, and restrict them to their necessary aspects (in accordance with optimal ignorance) as their interpretation may otherwise be complicated. Maps can be produced easily (should they be unavailable or to suit specific purposes) by using a compass and a speedometer mile count, or any other more or less artisanal method.

Transects show the main sub-areas according to land use within an overall area, according to the most relevant section. They are particularly useful in identifying critical spots and in describing individual ecosystems and agricultural systems (McCracken, 1988). Figure 10.16 below provides an example of transect for an African village.

Figure 10.16 Transect diagram of a village



4.12.3 Seasonal calendars

Seasonal calendars are useful in rural environments where production varies throughout the year. They can reflect all significant events occurring during the year. Seasonal calendars should ideally be established for a period of 18 months, in order to reflect seasonal cross-over periods. Calendar design is usually based on a normal year, thus facilitating the subsequent deduction of deviances observed during assessment. Whatever the ultimate approach, calendars must indicate the reference year. It is best for seasonal calendars to be made to begin at a significant period of the year (rather than, for example, on 1 January).

Seasonal calendars should include the following, row after row:

⇨ months;
⇨ the local name for seasons and their meaning in terms of activities and production;
⇨ climatic features (mainly rainfall patterns);
⇨ stock-breeding practices:
  → seasonal feeding variations;

- → livestock migration patterns according to species;
- → breeding seasons according to species;
- → birth periods according to species;

⇨ animal production:
- → milk production;
- → meat production;
- → wool and hide production;
- → animal sales;

⇨ plant or agricultural production (detailed according to the type of crops, and its use – sale, fodder, home consumption, etc.):
- → land preparation and ploughing;
- → sowing and harvest period according to crop;
- → weeding;
- → parasite and pest control;
- → surplus sale/complementary food purchase;
- → seasonal market price variations;

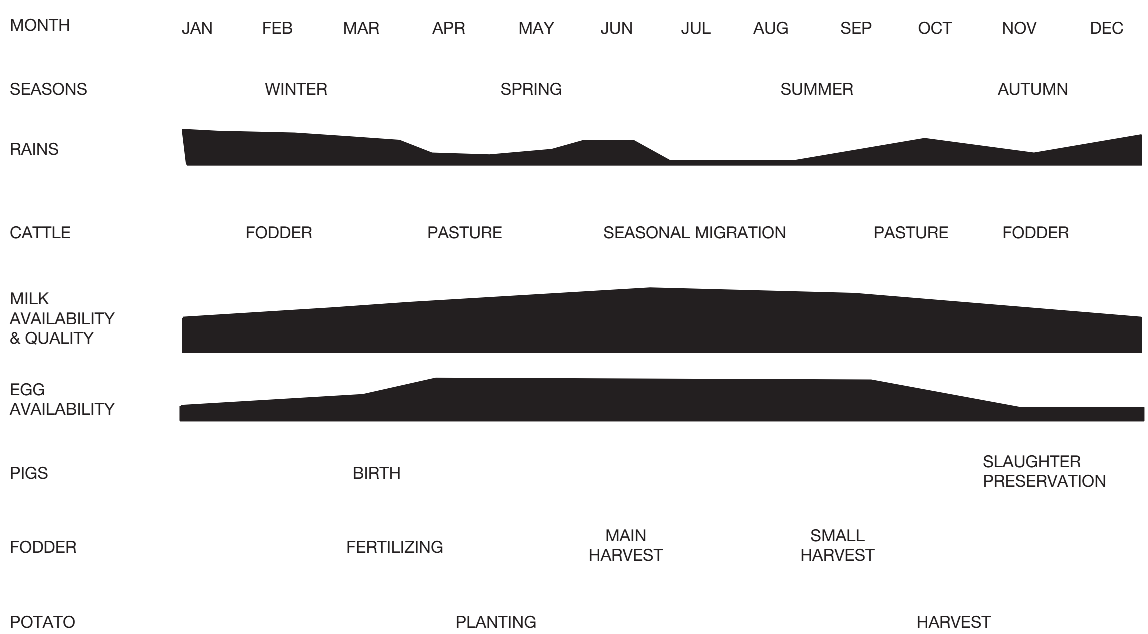
⇨ the calendar of secondary production activities according to: type, location, operator and contribution to the household economy;

⇨ required work intensity and attribution:
- → women;
- → men;
- → children;

⇨ problems:
- → hungry season;
- → cross-over periods;
- → water shortage.

Figure 10.17 below provides an example of a simplified seasonal calendar restricted to 12 months for easier illustration.

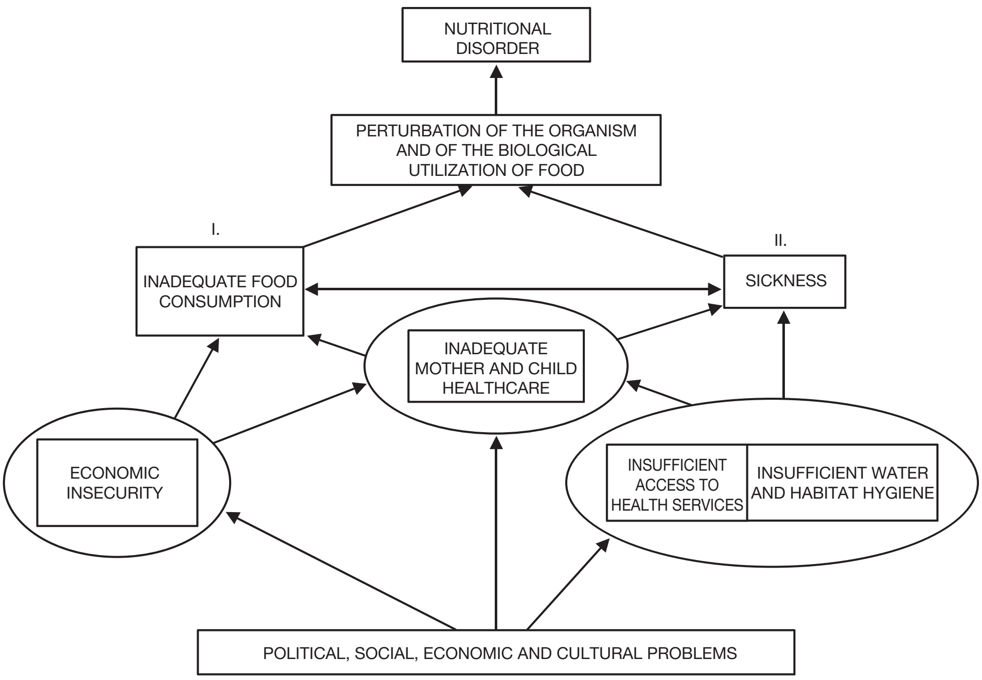
Figure 10.17 Seasonal calendar – example



4.12.4 Flow charts

Flow charts are the most frequently used tool in this Manual. They show the connections and relationships between the variables of a given feature, and their direction and sense. Flow charts are an invaluable tool for analysing how variables relate, and to qualify them as dependent or independent; this also permits the definition of cause and effect relations. Flow charts usually provide the basis for thought models and conceptual illustration. Figure 10.18 below provides an example of a flow chart; it has been used to illustrate the causes of nutritional disorder in Chapter VIII.

Figure 10.18 Flow chart – ranking of the causes of nutritional disorder

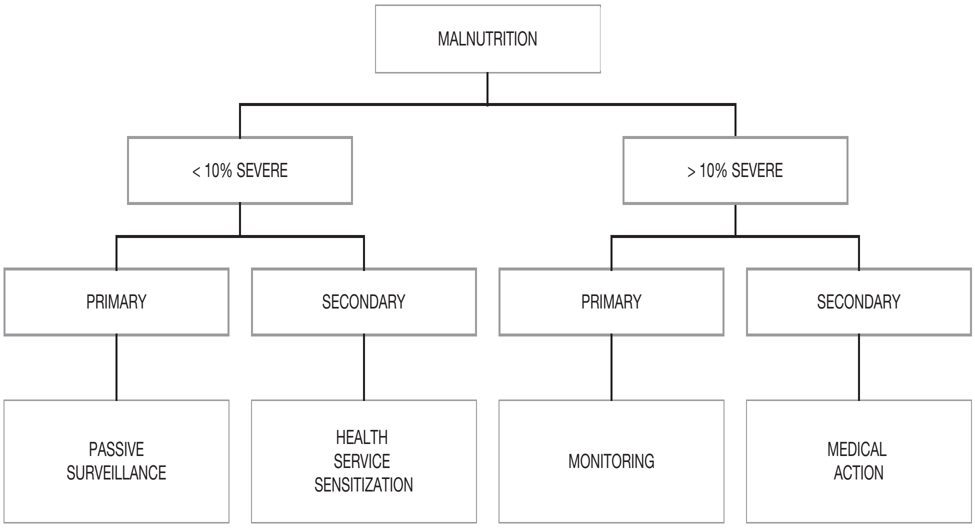


4.12.5 Decision trees

Decision trees illustrate the different stages of decision-making according to circumstances. They are used to design a plan to achieve an objective. They also serve as models for decision-making, for example in a surveillance system, and to define diagnoses. As such, they are designed to facilitate decision-making. Figure 10.19 below provides an example of a decision tree.

X

Figure 10.19 Decision tree



4.13 CHECKLISTS

Checklists are good reminders of all the different aspects that must not be omitted in an assessment. It is therefore useful to consult them while preparing the assessment, in order not to forget anything, but also after each survey, or data collection exercise, to confirm that all their points have indeed been covered, or explore avenues related to points that were previously not included in the lists. This being said, it is best not to consult them during assessment proper, as they may sidetrack investigators, or cause them to overlook unexpected aspects. Checklists should not be used as assessment guidelines by inexperienced field staff, because they do not permit the understanding of a given situation, in spite of sometimes giving that impression.[31]

4.14 QUESTIONNAIRES

Questionnaires permit the systematic collection of information. Like checklists, their use ensures that no aspect is forgotten, and they permit the systematization of the information provided by different sources. However, inexperienced staff risks being closed into restrictive thinking, without the necessary latitude to explore unexpected aspects and adapting their understanding to the progress of the assessment. To improve the usefulness of questionnaires, they should be combined with the obligation for investigators to interpret results; failing that, questionnaires can turn into sterile sources of endless information, as observed all too often. The commonest example is that of market price monitoring: it is usually useless, unless the investigator is specifically required to provide explanations as to fluctuations (or their absence).

[31] An example of checklists may be found in Annex 10.

4.15 ASSESSMENT REPORTS

Assessment reports are an essential tool for analysis and synthesis. As such, they also serve as basic reference documents for the subsequent conduct of operations (monitoring and evaluation), and "assessment archives". Finally, they provide the basis for operational planning.

Assessment reports must contain the following:

- reference details:
  - reference numbers and filing codes;
  - the name of their authors;
  - the dates of the assessment;
- a one-page summary (executive summary) for readers who need to know the basics without immediate reference to details;
- an introduction to explain what prompted assessment in the first place;
- the objectives of the assessment;
- lists of participants, main interlocutors and major interviews;
- the assessment calendar and geographical scope;
- an introductory description of the situation actually encountered by assessment teams;
- a description of the methodology used (hypotheses, hypothesis testing method, data collection and processing method, possible data collection weaknesses);
- the assessment results, which describe:
  - phenomena;
  - vulnerabilities;
  - impact;
  - problems;
  - causes of problems;
  - prognoses;
  - the state of the need for assistance and its probable evolution;
  - affected populations (who, where, how many, cultural features, functional classification);
- proposals and recommendations for action;
- technical attachments.

II. PLANNING

1. DEFINITION

Planning usually follows preliminary appraisal, or should do so. It consists in the thorough examination of assessment findings, in order to formulate realistic operational proposals, their priorities, and their objectives. These proposals translate the need for assistance, constraints, and opportunities into an operational strategy that combines the different programmes in the most efficient manner in terms of achieving general operational objectives.

2. OBJECTIVES

2.1 MAIN OBJECTIVE

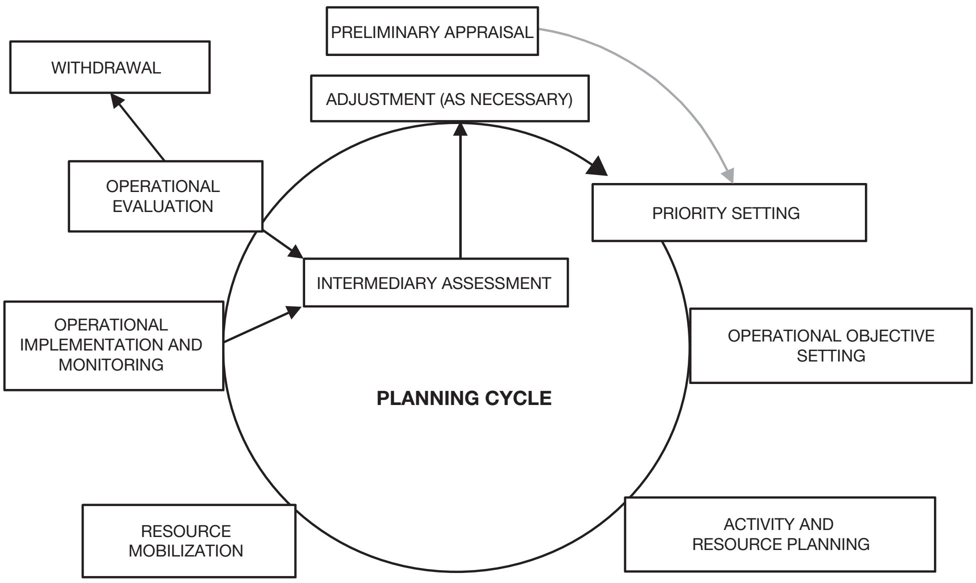
The main objective is to plan an operation within a logical framework and according to a set calendar based upon the needs for assistance as revealed by preliminary appraisal.

2.2 SPECIFIC OBJECTIVES

1. Setting priorities.
2. Setting operational objectives.
3. Planning the activities and resources necessary to achieve operational objectives.
4. Planning the mobilization of resources.
5. Planning the implementation of specific operational and monitoring activities.
6. Planning operational evaluation.
7. Allowing for operational adjustments, if relevant.
8. Planning withdrawal.

The specific objectives of planning interrelate in a cycle as illustrated in Figure 10.20.

Figure 10.20 The planning cycle



3. PLANNING STAGES

3.1 SETTING PRIORITIES

Crisis results in many different needs for assistance, which are usually not equally urgent, and may not always have an immediate, comprehensive answer.[32] Setting operational priorities is therefore essential, and the urgency to act must be viewed as the primary criterion. However, as discussed earlier in this Chapter, the concept of emergency itself is ambiguous: the primary emergency that relates to saving lives is in opposition with the more strategic emergency of avoiding a deterioration of the crisis, by eliminating the underlying causes of mortality and morbidity. Moreover, the degree of emergency in implementing a given response varies according to the stage of the crisis process that has been reached. As a result, setting priorities must allow both for the relevant strategic guidelines, and for whatever is most critical at the specific moment of action in terms of the development of the crisis.

As a reminder, the various operational modes and the corresponding nutritional programmes are the following, according to the strategic guidelines:

⇨ the protection of rights when their inobservance is a primary cause of crisis (representations); the protection of rights persists throughout the entire operation;

[32] Constraints may prevent some needs from being met.

- ⇨ economic support in order to arrest the impoverishment process in developing crisis (general food distributions combined with nutritional information campaigns where relevant);
- ⇨ survival relief when the population's own production is no longer adequate to ensure its self-sufficiency (general food distributions, therapeutic feeding, combined with supplementary feeding and nutritional information campaigns where relevant);
- ⇨ economic rehabilitation, when crisis is about to be resolved (general food distributions combined with nutritional information campaigns where relevant).

It is worth reiterating that priorities must be set in a manner that guarantees the consistency of nutritional programmes with others, in line with the priorities illustrated by the health pyramid and overall economic security.

In nutrition strictly, the protection of rights and general food distributions are effective at all levels of action in averting a deterioration of the health status, unlike curative nutritional means such as therapeutic and, sometimes, supplementary feeding. If general food distributions are necessary but cannot be implemented, it is useless to resort to another form of nutritional action that is of secondary importance to such distributions in the operational strategy.

Logistical or security constraints may involve targeting areas of secondary importance first. At all times, it is necessary to attempt to resolve such constraints in order to return to the primary objectives as dictated by observed needs. Moreover, it is worth noting that the sprinkling of food (as opposed to the systematic distribution of adequate rations) is useless. Priority areas must be selected according to the severity of the problem, or agreements must be reached with recipients regarding the use of available resources until the intended approach may indeed be implemented.

3.2 SETTING OBJECTIVES

Setting objectives amounts to stating clearly what is to be done in order to cover the need for assistance. This consists of the practical translation of general operational objectives: the prevention and alleviation of suffering. Objectives are defined in reference to the following points:

- ⇨ the nature of the objective; this includes stating the problem;
- ⇨ the beneficiaries of the operation;
- ⇨ the number of beneficiaries;
- ⇨ the location of the operation;
- ⇨ the expected results of the operation;
- ⇨ the timeframe set to achieve the objectives.

This is itself a translation of an overall objective into specific objectives. If, for example, the intention is to reduce the prevalence rate of severe malnutrition in pre-school children from 35% to 5%, and severe malnutrition is both primary and secondary, then objectives may be formulated as follows (comments appear in italics).

- ⇨ Overall operational objective:
  - → to prevent and alleviate the suffering of the population, estimated at 300,000 persons, located in region X, and experiencing famine.
- ⇨ General objective:
  - → to reduce the rate of severe malnutrition among children under 6 years of age from 35% to 5% between 15 July and 30 December; this general objective assumes that children under 6 years of age are most vulnerable to famine, that their malnutrition rate is the indicator of

the impact of the programme, and that operations will indeed begin on 15 July.
It does not provide indications as to their nature, which remains to be defined in more specific objectives.

⇨ Specific objectives:
- → to distribute rations of 2,250 kcal/day to 300,000 persons in region X from 15 July up until the March harvest of the following year – the expected impact here is not reiterated, as it is clearly stated in the general objective.
- → to vaccinate at least 90% of the children under 6 years old against measles by the end of July – the expected impact here is defined indirectly by the vaccination coverage, and the indication of location would be redundant.
- → to ensure that all water supply points in region X provide safe drinking water by the end of October – the expected impact here is a corollary of the nature of the objective, and implies that the water is so far unsafe and its consumption thus entails a risk of secondary malnutrition.
- → to supply the 23 existing health centres with essential drugs;
- → to establish 9 therapeutic feeding centres of an individual capacity of 500 patients each by mid-September, in order to admit 25% of the most serious cases of severe malnutrition in children under 6 years old.

Each of the above specific objectives must then be converted into precise activities, such as:

⇨ the monthly distribution of 10 kg of cereals, 2 kg of enriched cereals, 2 l of enriched oil, and 3 kg of pulses to each of 300,000 persons in region X;
⇨ the monthly provision of X tonnes of aluminium sulphate required for the operation of the water supply system in region X;
⇨ and so forth.

This increasingly precise operational description shows that specific objectives are the means to achieve general objectives. This logical sequence of means and objectives frequently causes confusion in drafting objectives. Ranking the objectives and defining them precisely contribute to:

⇨ the exact description of intended action;
⇨ the quantitative and qualitative appraisal of the implementation of objectives;
⇨ the setting of realistic objectives that can indeed be achieved;
⇨ the relevance of activities and specific objectives to the general objective;
⇨ the acceptability of specific objectives for all stakeholders;
⇨ the setting of realistic and specific timeframes.

This leads to the general rule regarding objectives, which must be SMART:

⇨ **S**pecific;
⇨ **M**easurable;
⇨ **A**chievable;
⇨ **R**elevant;
⇨ **T**ime-bound (or time-dependent).

The definition of objectives must include indicators from the onset: they are essential to the subsequent monitoring and evaluation of the operation.

Logical frameworks provide a practical summary of the definition of objectives; Table 10.9 provides an example of a logical framework matrix.

Table 10.11 Logical framework matrix – example of objective setting

Stages	Description	Indicators	Means of verification	Critical external factors
General objective				
Specific objectives				
Expected results				
Activities				

In logical frameworks, the means of verification amount to the sources of information that are used. Critical external factors are uncertainties that arise during the operation; those implementing the operation have little or no control over them, and their impact on its implementation and, thus, its success can be significant. They amount to the various assumptions regarding developments in the situation, possible constraints, the risks involved in implementing the operation, and its possible negative side effects. Clearly, if the definition of critical external factors raises doubts as to its feasibility, then objectives have been set poorly. In such cases, the entire planning process must be revisited.

3.3 PLANNING ACTIVITIES AND RESOURCES

Planning consists in defining what activities must be implemented, their precise combinations, in order to achieve specific objectives; it also sets their timing. This effort amounts to operational tactics, which must not be confused with the overall strategy. The strategy sets the combination and coordination of the different operational measures in order to achieve an overall objective; the tactics on the other hand are subjected to the strategy and permit the practical implementation of the necessary measures, as dictated by the need for assistance and the context-specific constraints and opportunities.

Resource planning consists in the qualitative and quantitative definition of the human, material, logistical and financial inputs that are necessary for the operation to satisfy the need for assistance, in line with set priorities and objectives, and planned activities.

3.4 PLANNING RESOURCE MOBILIZATION

Planning the mobilization of resources consists of determining appropriate:

⇨ headhunting: how to find and employ skilled staff;
⇨ procurement: how to secure the necessary material and logistical resources;
⇨ donor relations: how to select and approach donors in order to secure funding and in-kind donations;
⇨ timing: the best timeframe for the availability and use of resources.

3.5 PLANNING IMPLEMENTATION AND MONITORING

Implementation planning consists in determining:

- ⇨ the roles and responsibilities of staff members;
- ⇨ the logistics chain;
- ⇨ the activity calendar or timeframe;
- ⇨ administrative aspects (staff accommodation, labour regulations, codes of conduct and security guidelines);
- ⇨ the operational methodology;
- ⇨ coordination with other stakeholders.

Monitoring planning consists in determining:

- ⇨ situation (or context) tracking methods;
- ⇨ indicators in relation to situation tracking and operational progress;
- ⇨ operators who will be in charge of monitoring;
- ⇨ the monitoring timeframe;
- ⇨ reporting lines and methods.

3.6 PLANNING EVALUATION

Planning the evaluation in the operation consists in developing procedures that must include:

- ⇨ methods and indicators to appraise the impact of the operation;
- ⇨ the calendar of evaluation surveys;
- ⇨ the external contributors (individuals and/or agencies) who will lead the exercise;
- ⇨ reporting lines, methods, and deadlines.

3.7 ALLOWING FOR ADJUSTMENT

It may seem strange to allow for adjustment; this aspect, in spite of being the corollary of monitoring and evaluation, is frequently overlooked because of routine and/or because the history of past experiences is lost, and adapting an operation usually entails costs in terms of resources and additional effort. Adjustment or adaptation is therefore often resisted wrongly. Allowing for adjustments is however essential, and simply consists in the regular and timely review of monitoring and evaluation results, in order to determine whether actual adjustments are required or not.

3.8 PLANNING WITHDRAWAL

Anticipating withdrawal is just as important as defining objectives and implementation proper. It consists in determining the criteria for and modalities for pulling out. It is all the more important in view of the uncertainty surrounding the actual success of the operation, because of precarious security among others.

A number of circumstances may prompt withdrawal:

- ⇨ the operational objectives have been achieved;
- ⇨ other agencies are better equipped to continue the programme;
- ⇨ changes in the situation make the operation obsolete;
- ⇨ the operational objectives can no longer be met owing to factors such as:
  - → insecurity;
  - → negative side effects of the operation;
  - → unacceptable political circumstances;
  - → accidents related to insecurity;
  - → unforeseen resource shortages;
  - → unacceptable humanitarian competition;
  - → political conditions imposed upon the operation;
  - → administrative, bureaucratic and political hassles;
  - → logistical difficulties.

Withdrawal modalities determine:

- ⇨ whether withdrawal is complete or partial – if the latter, what is maintained and why;
- ⇨ the timeframe for withdrawal from the moment the first condition for withdrawal appears;
- ⇨ staff withdrawal modalities;
- ⇨ the utilization of remaining resources;
- ⇨ the manner and timeframe of handover to other agencies;
- ⇨ the possible follow-up after withdrawal.

The stages of planning must be compiled in an action plan that provides the basis and reference for the entire duration of the operation.

CHAPTER XI
THE PROTECTION OF RIGHTS

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CHAPTER XI
THE PROTECTION OF RIGHTS

INTRODUCTION

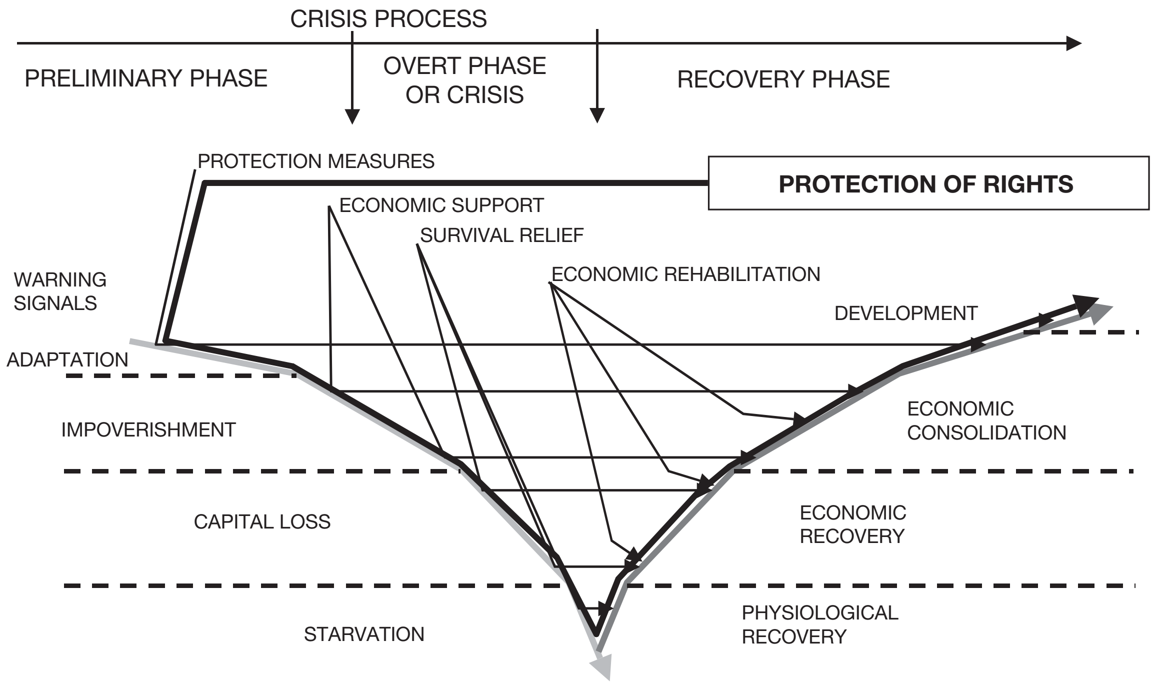
If the strategy defined earlier (Chapter IX) is accepted, then the protection of rights[1] is no doubt one of the most fundamental aspects of humanitarian action. Rights are in fact the shield that societies and mankind have devised to protect themselves against abuse which, while it exists everywhere, is nevertheless universally felt as an unacceptable injustice by its victims. In this lies the paradox of their enforcement. The statement of rights amounts to establishing cultural standards in order to avoid penalizing specific individuals or groups, one of the conditions for the preservation of peace. Many legal instruments exist to protect the right to adequate feeding. They may be difficult to enforce literally, but their consistent reiteration, the promotion of dialogue on the issue, and attempts at persuasion are essential nevertheless. In fact, if persuasion meets with success, then prevention is guaranteed to be as efficient as possible. Even if it fails, it should nevertheless persist: a given right may not apply, strictly speaking, to a given set of circumstances, but its underlying principles may be converted to suit such circumstances, and thus provide the basis for persuasion efforts. Advocacy for the respect of rights must therefore underpin humanitarian action from beginning to end within the crisis process, whether the need for assistance results from deliberate abuse, neglect or incompetence.

1. POSITION IN HUMANITARIAN ACTION

When the inobservance of rights and/or abusive behaviour causes or contributes to the development of crisis, putting a halt to them is a constant priority in humanitarian action, from the beginning to the end of the crisis process. Figure 11.1 below provides an illustration of this approach.

[1] The term "rights" also engulfs the duties of States and authorities towards the population under their control, such populations having the right that these duties be observed.

Figure 11.1 Position of the protection of rights within humanitarian action



2. RIGHTS RELATING TO NUTRITION

The rights that, if unobserved, affect nutrition and that may be invoked accordingly are:

⇨ those contained in the United Nations International Bill of Human Rights, the Universal Declaration of Human Rights, and the International Covenant on Economic, Social, and Cultural Rights (ICESCR), which apply at all times;
⇨ those contained in international humanitarian law (IHL), which applies in armed conflict;
⇨ those contained in customary law, which contribute substantially to the conduct of economic activities and resources management – these rights are not discussed further here because they are specific to individual cultures, and usually only apply within that specific culture; field staff, however, should always attempt to identify and apply them because they are by definition more context-specific.

2.1 THE UNIVERSAL DECLARATION OF HUMAN RIGHTS

Article 22

"Everyone, as a member of society, has the right to social security and is entitled to realization, through national effort and international cooperation and in accordance with the organization and resources of each State, of the economic, social and cultural rights indispensable for his dignity and the free development of his personality."

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Article 23

"1. Everyone has the right to work, to free choice of employment, to just and favourable conditions of work and to protection against unemployment.
2. Everyone, without any discrimination, has the right to equal pay for equal work.
3. Everyone who works has the right to just and favourable remuneration ensuring for himself and his family an existence worthy of human dignity, and supplemented, if necessary, by other means of social protection.
4. Everyone has the right to form and to join trade unions for the protection of his interests."

Article 25

"1. Everyone has the right to a standard of living adequate for the health and wellbeing of himself and of his family, including food, clothing, housing and medical care and necessary social services, and the right to security in the event of unemployment, sickness, disability, widowhood, old age or other lack of livelihood in circumstances beyond his control."

It is worth noting that, following the 1996 World Food Summit held in Rome, the inclusion of the right to adequate food in human rights is under consideration. The United Nations High Commission for Human Rights is in charge of this project.

2.2 THE INTERNATIONAL COVENANT ON ECONOMIC, SOCIAL, AND CULTURAL RIGHTS

Article 7

"The States Parties to the present Covenant recognize the right of everyone to the enjoyment of just and favourable conditions of work, which ensure, in particular:

a) remuneration which provides all workers, as a minimum, with:
i) fair wages and equal remuneration for work of equal value without distinction of any kind, in particular women being guaranteed conditions of work not inferior to those enjoyed by men, with equal pay for equal work;
ii) a decent living for themselves and their families in accordance with the provisions of the present Covenant;"

Article 11

"1. The States Parties to the present Covenant recognize the right of everyone to an adequate standard of living for himself and his family, including adequate food, clothing and housing, and to the continuous improvement of living conditions. The States Parties will take appropriate steps to ensure the realization of this right, recognizing to this effect the essential importance of international cooperation based on free consent.
2. The States Parties to the present Covenant, recognizing the fundamental right of everyone to be free from hunger, shall take, individually and through international cooperation, the measures, including specific programmes, which are needed:
a) to improve methods of production, conservation and distribution of food by making full use of technical and scientific knowledge, by disseminating knowledge of the principles of nutrition

and by developing or reforming agrarian systems in such a way as to achieve the most efficient development and utilization of natural resources;
b) taking into account the problems of both food-importing and food-exporting countries, to ensure an equitable distribution of world food supplies in relation to need."

2.3 OTHER LEGAL INSTRUMENTS GOVERNING HUMAN RIGHTS

Many legal provisions forbid all form of discrimination based on race, employment, occupation, pay and sex (United Nations, 2002). The many other international human rights instruments should, in combination with those discussed above and provided they are observed and applied, avert or at least mitigate nutritional crisis arising from abuse.

2.4 INTERNATIONAL HUMANITARIAN LAW

- ⇨ Article 14 of Protocol II of 1977 Additional to the Geneva Conventions of 1949 states: "*Starvation of civilians as a method of combat is prohibited.*" (see also article 54, paragraph 1, of Protocol I of 1977 Additional to the Geneva Conventions of 1949);
- ⇨ Article 54, paragraph 2 of Protocol I states: "*It is prohibited to attack, destroy, remove or render useless objects indispensable to the survival of the civilian population, such as foodstuffs, agricultural areas for the production of foodstuffs, crops, livestock, drinking water installations and supplies and irrigation works, for the specific purpose of denying them for their sustenance value to the civilian population or to the adverse Party, whatever the motive, whether in order to starve out civilians, to cause them to move away, or for any other motive.*" (see also article 14 of Protocol II);
- ⇨ Article 17, paragraph 1, of Protocol II states: "*The displacement of the civilian population shall not be ordered for reasons related to the conflict unless the security of the civilians involved or imperative military reasons so demand. Should such displacements have to be carried out, all possible measures shall be taken in order that the civilian population may be received under satisfactory conditions of shelter, hygiene, health, safety and nutrition.*"
- ⇨ By virtue of articles 70 of Protocol I and 18, paragraph 2, of Protocol II, it is the duty of the High Contracting Parties to consent to relief actions for the civilian population which are of an exclusively humanitarian and impartial nature and which are conducted without any adverse distinction.

The above provisions, like any others that generally protect civilians against the effects of warfare, express the principle that belligerents cannot resort to just any means in order to overcome the enemy. In terms of civilians, the underlying principle of such rules is the distinction between bearers of weapons and civilians. The principle of this distinction is reiterated in article 48 of Protocol I, and provides the basis for the rule set out in articles 51 of Protocol I and 13 of Protocol II, according to which civilians shall not be the object of attack.

Thus, starvation may be a common reality in armed conflict; it is fortunately not accepted as inevitable by the international community, which has converted this refusal into international humanitarian law.

Clearly, this area of international humanitarian law is especially sensitive, because limitations to the conduct of hostilities must allow for military priorities. Embargo and blockade remain legal forms of weakening the enemy. However, the humanitarian space remains greater than it may seem. Violence may be tolerated, but only in its legal, military form. Not only must civilians not be mishandled, but "collateral" damage in the exercise of "legitimate" violence must also be avoided as much as possible. This implies, among others, that indiscriminate weapons not be used, and the choice of proportionate force with respect to a given military target, in order to minimize incidental civilian losses and damage. The principle of proportionality, which is also accepted as compelling, in fact imposes that belligerents refrain from attack on military targets if foreseeable civilian incidental damage is excessive with respect to the military importance of the target.

The prohibition of the use of starvation against civilians as a means of warfare is stated in Protocol I (article 54) and Protocol II (article 14); it is completed by many provisions that contribute to its application. The 1977 Protocols Additional to the Geneva Conventions of 1949 are more specific in this respect than the Conventions that provide their basis: the problems had grown clearer in the meantime. For instance, the prohibition of starvation as a means of warfare is translated into the prohibition of specific types of behaviour, and leads to the special protection of objects that are indispensable to the survival of the civilian population; likewise, such objects (like any civilian property) must not be made the object of reprisals according to article 54 of Protocol I.

Protocol I indicates that protected objects may be used in part for the sustenance for the members of armed forces; however, in no event shall actions against these objects be taken which may be expected to leave civilians with such inadequate food or water as to cause their starvation or force their movement. (article 53, paragraph 3 b).

Therefore, the development of international humanitarian law is not abstract, and takes the reality of military operations fully into account. It allows for the difficulty of ensuring an exclusively civilian use of foodstuffs, and attempts to limit exceptions to their strict minimum. An expansion of exceptions would, in fact, severely undermine the prohibition of starvation of civilians as a means of warfare.

In view of the difficulty of ensuring an exclusively civilian use of foodstuffs, it is legitimate to wonder whether foodstuffs should be included in blockades or methods of control.

In terms of the provision of relief, Protocol I also develops the dispositions of the Geneva Conventions of 1949, and addresses the following features:

- ⇨ the principle applies to situations in which the civilian population is not adequately provided with indispensable supplies such as foodstuffs, medical supplies, clothing, bedding and emergency shelter;
- ⇨ the principles applies to all civilians, and not only restrictive categories;
- ⇨ the parties to the conflict are required to *"protect relief consignments"* and *"facilitate their rapid distribution"* (article 70, paragraph 4 of Protocol I);
- ⇨ the *"effective international coordination"* of such relief actions is encouraged (article 70, paragraph 5 of Protocol I).

The overall idea that seems to emerge from international humanitarian law provisions regarding relief actions is that the natural manner of avoiding starvation in armed conflict is the dispatch of food relief to starving populations. However, the experiences of the past twenty years or so demonstrate that this approach may sometimes be inevitable, but nevertheless requires great care. The autonomy of civilian populations (and, thus, their dignity) must be preserved as much as possible, even in war.

The observance of other humanitarian law provisions is therefore a prerequisite: this applies to the prohibition of forced movement, of attacks on and looting of objects that are indispensable to the survival of civilians, or of means of warfare (such as the indiscriminate dissemination of landmines) that prevent the cultivation of agricultural land.

3. A PRACTICAL APPROACH TO THE PROTECTION OF RIGHTS

The above discussion shows that legal instruments do exist to protect the feeding system, both in peace and in times of armed conflict. The major challenge lies in their application and enforcement, and can be addressed through three main approaches that can combine:

⇨ one extreme approach involves the enforcement of law by force;
⇨ an intermediary approach consists of reminders or reprimands in the hope that the alleged authors of abuse will comply;
⇨ the other extreme involves persuasion that the observance and application of legal provisions is good, or at the very least is not counter-productive.

It is not the role of humanitarian agencies to impose law by force, and they do not have the means to do so. The remaining question therefore relates to the pertinence of a forcible imposition of humanitarian action – the right for "humanitarian intervention". The issue continues to fuel much heated debate, and reaches well beyond the scope of this Manual.

Humanitarian agencies can on occasion resort to reprimands or reminders based upon their observations. Some may even refer to the media to exert pressure: however, this approach inevitably leads to a direct confrontation that can ultimately prove counter-productive for the victims. These aspects pertain to the politics and policies of humanitarian action, and their associated risks need to be balanced accordingly. Clearly, authorities that rule rather than serve are unlikely to accept interference lightly, or to act upon reprimands. It is therefore best to resort to persuasion: this method is less risky and cheaper, and is most efficient when it succeeds. Efforts at positive and constructive dialogue based upon facts, and which refrain from immediate accusation involve stakeholders in humanitarian thinking; this encourages them to feel part of the overall action at all levels. This approach also promotes security best, and even sometimes strengthens it, a crucial parameter in humanitarian action. Nutrition workers play an essential part in this framework, owing to their direct contact with the field: they are especially well placed to voice the concerns of crisis victims. Persuasion is a logical companion of the diplomacy, courtesy, and patience that is required of them; it also requires restraint and polite firmness in all circumstances, and whatever the status or rank of the interlocutor.

All too often, the protection of rights does not yield the expected results and, in such cases, material assistance is necessary. When food assistance (see Chapter XII) is required as a form of economic support or survival relief, it must be delivered by true professionals that master its logistical, nutritional and medical aspects, and also understand the social and cultural environment: even when these conditions are met (and this is not always the case), such action can still have harmful consequences for its recipients, their society, and their culture. Moreover, if food assistance is called for because of the inobservance of rights, it is a statement of failure in terms of the efforts required for the dissemination and application of law.

CHAPTER XII
GENERAL FOOD DISTRIBUTION

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CHAPTER XII
GENERAL FOOD DISTRIBUTION

1. GENERAL CONSIDERATIONS

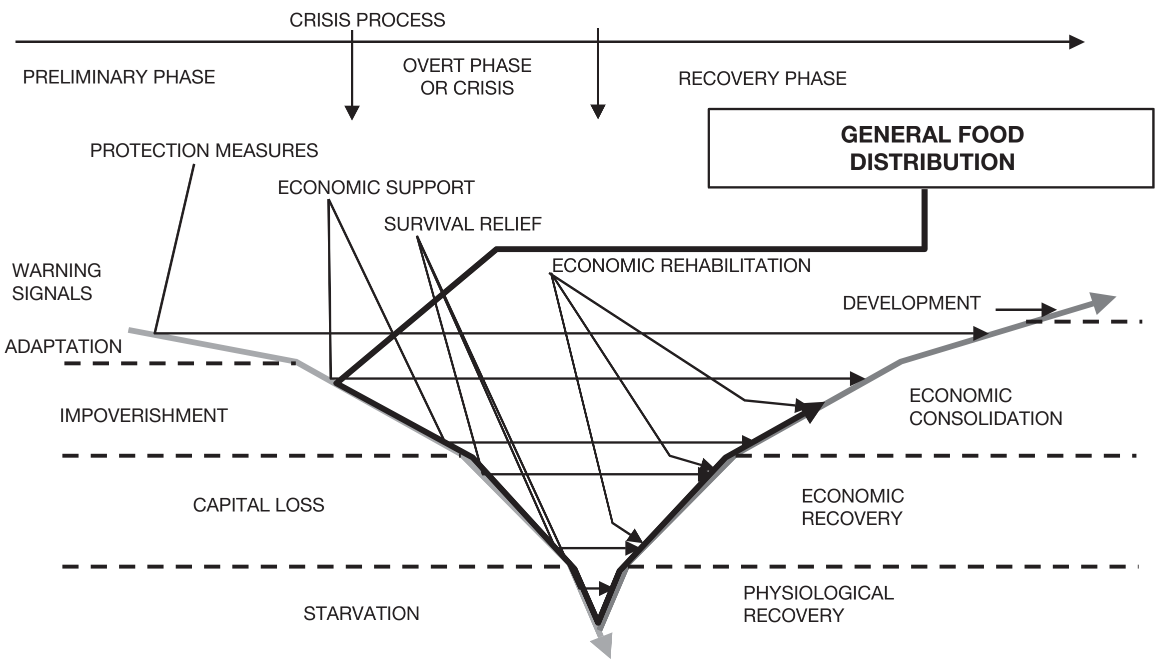
1.1 DEFINITION

A general food distribution (GFD) consists in supplying an entire group with food rations based upon the households or families that make up the group. In some cases however, GFD may target specific households owing to their particular economic vulnerability. GFD is understood in contrast to supplementary feeding, which targets individuals with specific conditions rather than households, as discussed in Chapter XIV. The specific conditions that justify supplementary feeding relate to physiological vulnerability (for example, the malnourished, pre-school children, pregnant and breastfeeding women, the elderly and the sick) or environmental vulnerability (that is, associated with living conditions – for example in hospitals, orphanages, asylums, homes for the elderly, and prisons). Obviously, this does not preclude GFD in such circumstances.

1.2 GFD IN HUMANITARIAN ACTION

In humanitarian action, GFD relates both to economic support and to survival relief, and can contribute to economic rehabilitation and, consequently, can serve different purposes, as discussed later. Figure 12.1 below shows the different levels at which GFD fits into the crisis process.

Figure 12.1 General food distribution within humanitarian action



As discussed in Chapter IX, GFD (like any other type of programme) must fit consistently into the overall operational strategy. It may be called for to complement other programmes, or vice-versa.

1.3 THE OBJECTIVES OF GFD

In the framework of humanitarian action, the objective of GFD is usually understood as mitigating hunger. Hunger in this sense refers to classic situations of famine, which deprive groups of their access to food because of extreme destitution and/or insufficient food availability (whatever the group's resources to secure it); the expression also applies to situations in which displaced persons or refugees depend exclusively on external assistance. In such cases, GFD amounts to survival relief, and aims at:

ensuring adequate food access, through the provision of food where the primary role of that food is to provide nutrients.

Such action is expected to preserve or improve the nutritional status, that is, to protect or restore the functional capacity of household members. This implies that food rations be adapted to circumstances, and distributed regularly according to plan.

In earlier stages of the famine process, during recovery from it, and in the case of groups that have remained in their usual environment, GFD also serves to compensate an insufficient economic performance that affects access to food. In such cases, GFD compensates food scarcity where that exists, and also frees time and resources that would otherwise be used to feed the household to the detriment of other basic activities and economic sustainability. In such cases, GFD also amounts to economic support, and the respective importance of the nutritional and economic contributions must be weighed carefully according to the needs in both categories. In such circumstances, (in addition to ensuring adequate food access), GFD also aims at:

preserving the activities and resources required for the survival of the household.

To this end, it may pursue the following specific objectives:

1. avoiding premature (i.e. untimely) harvesting and, thus, mitigate the effects of the forthcoming hunger season;
2. avoiding consumption of seed grains in cases of food scarcity;
3. protecting the workforce by sparing recipients the search for scarce food;
4. preserving the time required for essential activities, such as infant care;
5. limiting food prices on local markets, thus making food more accessible;
6. providing an economic resource that may be sold or exchanged, and thus open access to other essential goods and services in the absence of alternatives;
7. saving recipients from the decline into impoverishment and capital loss through the forced disposal of their essential assets in order to obtain food;
8. enabling recipients to rehabilitate their means of production in order to recover their economic self-sufficiency.

1.4 OPERATIONAL PRIORITY

In a nutritional crisis, GFD is usually an operational priority as (provided that it meets the criteria below) one of the only available means to humanitarian agencies to improve the economic system of crisis victims in a polyvalent way. By preventing impoverishment, capital loss, and starvation, GFD therefore usually takes precedence over other "nutritional" measures such as supplementary or therapeutic feeding, and nutritional sensitization and information. On the other hand, it must be supported by representations aimed at enforcing the respect of fundamental rights.[1] It may be secondary to more urgent operations in the field of water and habitat; it must often combine with non-food relief, in order to enhance its nutritional benefits.[2]

1.5 CRITERIA FOR INTERVENTION

Since food is an economic resource, the criteria for GFD rest less on the nutritional status of the proposed recipients than on their ability to secure food, and at what cost. Their nutritional status is simply an additional variable that improves accuracy as to the level of the famine process that has been reached; it however also provides indications as to the possible impact of infectious disease.

With reference to the crisis process,[3] the causes of famine, and coping mechanisms,[4] GFD is necessary when a given group:

⇨ has lost its access to food (whatever the reasons);
⇨ faces insufficient access to food, whatever the means deployed to obtain it, and whatever the dangers entailed by this (see Section below);
⇨ still retains access to food, but this access entails dangers:
  → excessive time must be devoted to the securing of food, to the detriment of other activities required for individual and household survival;
  → assets that are required for household survival must be disposed of in order to obtain food (capital loss stage);
  → unusual or toxic foods or seeds must be eaten (chemically-treated seeds are also toxic), or unripe food from premature harvesting;
  → obtaining food entails security risks (especially for women);
⇨ retains access to food, but this access will shortly be insufficient;
⇨ can only access the goods and services required for its survival in exchange for food.

GFD must be implemented only if the anticipated duration of the problem is sufficient and the operation proper can begin early enough for it to have an impact. For example, a population may suffer from famine, but its forthcoming harvest is anticipated to be good within a couple of months, and the GFD cannot be set up within that timeframe – in this case, a GFD is pointless.

Because of the range of circumstances and conditions that justify the implementation of a GFD, GFD food rations can clearly not be set rigidly. Besides, GFD provides a resource whose purpose is not limited to the supply of nutrients. Furthermore, this resource is sufficiently substantial to entail secondary and negative effects (the role of food and the possible effects of GFD are discussed in the following two points).

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[1] See Chapter VI.
[2] See Sections 1.6 and 1.7 in this Chapter.
[3] See Chapter VII.
[4] See Chapter VIII.

1.6 THE BROADER ROLE OF FOOD

GFD should provide nutrients, and caloric nutrients provide the quantitative reference. Therefore, GFD rations are usually defined according to the energy requirements of the target group. Beyond the difficulty of setting the calorie level of rations on a nutritional basis, the fact that food represents more than just nutrients and calories must also be considered. Indeed, its fundamental nutritional role provides it with social, economic and political dimensions that shape its use, and often makes it a vital issue.

1.6.1 The social dimension of food

Food must be consumed daily in order to meet the nutritional need of humans. In primitive societies, most production activities are related to the securing of food, which thus plays a central role. This role has been preserved in all societies up to now, and food is no doubt the most fundamental commodity and symbol of social exchange. The banquets of Antiquity, ritual mediaeval meetings or reconciliation feasts, modern day business lunches, and hospitality etiquette all reflect the essential role of the sharing of food in political, economic, and social activities in all cultures. In particular, the use of specific foods demonstrates the individual's inclusion in the group. Such behaviour is not abolished in nutritional crisis, and this can have a significant impact on the ultimate use of GFD rations (for example, their exchange for more acceptable or socially necessary commodities). The implementation of GFD must therefore permit the detection and understanding of such behaviours, and allow for them.

1.6.2 The economic dimension of food

Food must be acquired on a regular basis, be it produced, gathered, hunted, fished, or purchased with a means for exchange. As man began to choose particular areas of activity and specialize in them instead of being a self-sufficient all-rounder, food acquired an economic dimension.

At the same time, as discussed in Chapter VI, man increases the range of non-food commodities that he needs for cultural integration. That is, he creates essential material needs of a cultural nature: these include simple objects such as spears, teapots and clothes, and latterly more technically developed items such as laptop computers, telephones, and automobiles. The less self-sufficient households are in producing all the goods required to satisfy their basic needs, the greater must be their purchasing power to secure the lacking commodities. Purchasing power is provided mainly by money, but food is still a major exchange commodity in many societies, for example those that rely on subsistence agriculture or stock-breeding. Furthermore, the sale of GFD rations can be the main means of securing purchasing power, as often observed in refugee camps and famine situations where food is the only available resource. Humanitarian agencies usually find it difficult to accept the economic dimension of food, when recipients do not use donations as planned: in such cases, beneficiaries are accused of diversion. In fact, in such circumstances, GFD food is inevitably both a source of nutrients and a convertible commodity, and its recipients use it according to their needs and the best yield they might expect from it.[5]

[5] The recipients of humanitarian aid of course do not all have the same ability or means to draw the most benefit from food assistance, see Section 1.7.1 in this Chapter.

1.6.3 The political dimension of food

Food is a basic commodity that is sometimes difficult to secure and, as such, is a major instrument for exchange, conflict, and power. As a result, food production, stocks and exchanges are often political issues that must be identified and controlled, especially in armed conflict. The political dimension of food is one of the major constraints of humanitarian assistance. It gives rise to problems of neutrality, power balances, ethics, and security. The only option is to refer to legal provisions[6] and to operate in complete transparency, closely involving recipients and relevant authorities, be they traditional, administrative, or political, according to the modalities that are accepted by all; it must also be ensured that the food reaches its intended recipients. For this, however, humanitarian agencies must be certain to keep absolute control over GFD.

1.7 NEGATIVE AND SIDE EFFECTS OF GFD

GFD induces side effects that are a direct consequence of the crucial role of food. The commonest side effects are the use of food as a convertible commodity in an attempt to optimize the use of available resources, changes in market prices, and changes in the economic recovery behaviour of recipients, which seek to maximize the impact of the GFD in terms of recovering their economic self-sufficiency. Side effects are negative if they are harmful. For example, a drop in market prices may be beneficial if it improves the access to food for those who are not directly included in the GFD but nevertheless face economic stress. The effect is however negative if it triggers off speculation and armed groups support it and exercise retaliation, which in turn causes serious security problems, both for the recipients of food aid and for those delivering it. Agencies must be aware of this pitfall and anticipate it as much as possible: negative effects may be limited or avoided if all stakeholders are well informed of the operation, and comply with assistance modalities.

Table 12.1 below describes the most common negative side effects and the means to avoid or reduce them.

Table 12.1 Negative side effects and the means to avoid them

Negative effects	Remedy
Attracting an excessive number of victims and concentrating them in a limited area; this saturates existing infrastructure, creates a risk of epidemics, and exceeds the available logistical means.	Scattering delivery points in order to avoid excessive population concentrations.
Maintaining dependency.	Rehabilitating the victims' factors or means of production and improving the value of the output of their productive activities.
Competing with local agriculture.	Defining the criteria for termination in consultation with the recipients from the onset (planning stage); allowing for the local purchase of at least part of the GFD food if the interests of recipients and farmers differ.
Discouraging the trade of the national food production.	Purchasing at least part of the GFD food domestically.

[6] See Chapter XI.

Negative effects	Remedy
Ill-considered local purchases may deplete national reserves and contribute to the rise of market food prices.	Understanding the national surplus production capacity and balancing GFD food sources through imports accordingly.
Undermining local micro-economic coping and survival mechanisms.	Understanding the critical thresholds beyond which the survival of victims is threatened, and beyond which GFD is called for.
Recipients may be exposed to looting and abuse.	Ensuring the security of recipients at home, in transit, and at distribution points beforehand. Taking appropriate measures through dialogue with relevant authorities.
Recipients may be exposed to adverse acts on the part of authorities (e.g. political propaganda, police surveillance, conscription, taxation, forced displacement).	Informing relevant authorities of the necessary conditions for the GFD beforehand; obtaining their formal commitment to these.
GFD may fuel conflict by indirectly supplying armed groups with food.	Informing armed groups of the necessary conditions for the GFD to proceed beforehand; obtaining their formal commitment to these. Controlling the distributions and their immediate aftermath.
Participating in the politics of armed groups and authorities by assisting the victims of such policies.	Intervening politically in order to protect the population against abuse, being aware of the paradox of humanitarian assistance, which saves victims while contributing to the perpetuation of abuse, and assisting the population according to needs.
Obscuring problems and responsibilities.	Being clear with those responsible for the crisis, showing that the real situation is known, and persuading them to comply with their duties and improve the situation.
Threatening the profit of speculators and of those who control the food market, which can be dangerous for recipients and implementing agencies alike.	Understanding the food market beforehand, including the forces that control it, maintaining a thorough information policy in terms of assistance operations, obtaining the commitment of all stakeholders and allowing for threats, and negotiating with those who issue them.
Developing the assistance syndrome.	Defining the criteria for GFD termination (as done in formulating exit strategies) in consultation with the recipients.
Recipients may sell food rations.	Adapting food and non-food assistance to needs.

1.7.1 Remarks regarding three controversial negative effects

Food assistance fuels crisis

If, in armed conflict, authorities and armed groups divert humanitarian aid to their profit, humanitarian agencies are accused of fuelling the crisis. Should humanitarian assistance be questioned as a result? And what about humanitarian ethics? Clearly, in such circumstances, the victims have little choice, if any. They are penalized by their own authorities and the armed groups that violate their most basic rights. As such, they deserve to be protected *via* representation efforts and material assistance. Politicians, donors, and humanitarian agencies should therefore not penalize them further by depriving them of assistance under the pretext that the latter contributes to the crisis. It is rather a matter of attributing tasks, and how duties are complied with. Humanitarian agencies must assist the victims of crisis, as a matter of humanitarian ethics: the issue is not to endorse or support a policy of abuse, but simply to address its effects and bear witness to them through bringing such assistance. At the same time, politicians and donors must engage relevant authorities and armed groups in order to persuade them to change their behaviour. If responsibility is not taken at these two levels, the condemnation of assistance as fuelling crisis is fallacious. If, however, tasks and duties are properly complied with, the quandary is resolved. The corollary of this approach is that dialogue involving all stakeholders in the crisis is a fundamental pre-condition for any humanitarian operation.

The assistance syndrome

A common opinion holds that GFD, at best, runs counter to motivating its recipients to self-help or, at worst, encourages them to sit back and wait for assistance. Indeed, recipients include GFD in their survival and economic recovery strategies, and not always as anticipated. This does not necessarily indicate the development of an assistance syndrome. The author has in fact never observed such a development – on the contrary, people who need GFD rations for survival and must queue to receive them struggle to retrieve their economic and dietary self-sufficiency, and their dignity, as soon as possible, in order to escape from a monotonous diet and the humiliation of begging. Recipients must simply be involved from the onset in the choice of implementation and withdrawal criteria; such criteria are shaped by the logic of economic security on the one hand, and by the available means and constraints on the other. Finally, the interest of relevant authorities in prolonging assistance may be viewed as the development of an assistance syndrome among its recipients, when this is in fact not the case.

The sale of rations

Another commonly quoted negative effect is the use of food to other ends than those intended, and the deduction by observers that rations exceed actual needs. This may indeed be the case – rations can be overly abundant or unbalanced, and their recipients may in such cases sell the surplus. This indicates mistakes in the definition of rations, and amounts to a negative side effect. Usually, however, the sale or exchange of food indicates an optimized utilization of resources available for reconstruction, or forced transaction.

If, however, the purpose of selling food rations is to strengthen survival and economic recovery strategies, this should encourage the investigation of more appropriate means of support, for example the provision of vouchers in order to secure the necessary goods and services. The latter must clearly be available, and not be subjected to speculation. Cash distributions and credit facilities are another option, but they demand professional input. Either way, the sale of food in order to optimize the utilization of resources is not a negative effect itself, and certainly does not invite moral judgment.

Forced transaction on the other hand can occur because the assistance delivered does not provide all the appropriate vital commodities: typical additional commodities include foodstuffs that complement the delivered ration, milled cereals (if cereals are distributed in grain, some payment must be supplied for their milling), cooking utensils, fuel, clothing, and construction material. If GFD rations constitute the only resource and are calculated on energy requirements alone, then they will be insufficient to satisfy both nutritional and economic needs. In such cases, malnutrition persists where it already exists, or it develops. Clearly, then, the sale or exchange of food rations cannot be viewed as a negative effect; what is negative is providing insufficient assistance, and then accusing its destitute recipients of diverting it. On the contrary, assistance must be corrected as early as possible in order for it to satisfy the overall need for aid. This may be done by supplying the lacking essential goods and services or, when this is not feasible, by increasing rations in order for them to ensure adequate feeding and provide the surplus required to acquire the goods and services necessary for survival.

2. PLANNING GFD

Planning GFD consists in converting the need for aid as observed during preliminary assessment into practical dimensions documenting the following topics:

⇨ compendium of the need for and relevance of a GFD;
⇨ GFD feasibility;
⇨ inclusion of the GFD in the overall operational strategy;
⇨ GFD recipient selection;
⇨ GFD objective(s);
⇨ required type of GFD ration in order to achieve objectives and satisfy the need for aid;
⇨ distribution methods;
⇨ GFD termination criteria;
⇨ resource mobilization.

The above issues must be dealt with systematically and recorded in writing for future reference. They are discussed here mainly from a conceptual and theoretical angle; the actual implementation of GFD and its general practical features are discussed in Section 3 below.

2.1 COMPENDIUM OF NEED AND RELEVANCE

Planning GFD must rest upon a convincing demonstration of the need for the operation. This demonstration must be summarized in the planning document. It must follow assessment (usually preliminary assessment, but possibly also *ad hoc* monitoring depending on developments that may have occurred after preliminary assessment). Planning rests on a sound understanding of the economic problems and living conditions faced by the affected population and the resulting needs; it also rests on the demonstration that a GFD is indeed an appropriate response to one or more of these needs. This approach anchors the operation on solid foundations, and ensures that appropriate complementary measures are taken, in a broader operational perspective.

The major issues that must be clarified by assessment relate to the following.[7]

⇨ **Target population:**
→ geographic location;
→ habitat (urban, rural, camp accommodation, etc.);
→ climate;
→ estimated numbers;
→ status (resident, displaced, refugee, or returnee);
→ cultural parameters (ethnic, religious, etc.);
→ social position by age group, sex, and occupation.

⇨ **Economic and nutritional aspects:**
→ access to food, according to cultural standards;
→ eating habits;
→ pre-crisis stability, according to cultural standards;
→ normal variability of the factors affecting access to food;
→ usual cultural coping mechanisms to address this variability;
→ critical thresholds that indicate that variations exceed the norm;

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[7] See Chapter X, Section I.

→ cultural survival mechanisms with respect to variations that exceed the norm;
→ survival mechanisms considered as dangerous by the population.

⇨ **Situation at the time of assessment:**
→ main disruptive factors regarding access to food;
→ effects of such factors on regional food availability, and the access of households to it;
→ crisis process level reached at the time of assessment, in terms of normality or abnormality of the observed response of the population to its problems;
→ status of the relative value of commodities (terms of trade) and self-sufficiency levels;
→ food consumption;
→ access to essential non-food goods and services;
→ nutritional and health status of the population in general, and infants in particular, and factors affecting the biological utilization of food;
→ prognosis regarding the development of the crisis.

⇨ **The need for assistance as highlighted by assessment***:*
→ the needs for assistance classified according to programme;
→ required complementary programmes.

2.2 FEASIBILITY

The feasibility of a GFD is determined by access to the target population, the danger of negative side effects, prevailing security conditions, and available means. Access to the target population is in turn determined by the endorsement of the GFD on the part of relevant authorities and, in case of armed conflict, by all parties involved. This endorsement is an operational imperative, because GFD involves heavy logistics and high visibility; as such, it is highly vulnerable to measures ranging from bureaucratic interference to armed attacks. In view of the cost of GFD and its considerable duration, these aspects cannot be dealt with lightly. Access to target populations is also determined by communications (such as the road network) and transport facilities: they must be sufficiently reliable for GFD to run smoothly. Expected negative effects – as described above in Section 1.7.1 – must be averted or controlled if possible. Security is not only ensured by local authorities (governmental or irregular), because humanitarian operations are carried out in increasingly unstable settings which involve many different stakeholders – in such circumstances, unbridled violence, vandalism, crime and systematic looting are common fare. Such parameters may prevent the conduct of GFD altogether, and field workers must be well aware of them. Security conditions must ensure that:

⇨ humanitarian staff operate without foreseeable danger;
⇨ GFD recipients are not endangered as a result of their inclusion, and can commute to distribution points without hindrance;
⇨ supply is regular enough to ensure the conduct of the GFD according to plan.

As already mentioned in relation to ethics, a GFD must only be planned if funding and resources in terms of staff, infrastructure, logistics, and food is adequate, that is, that such means are sufficient to carry it out to its completion.

2.3 INTEGRATION INTO THE OPERATIONAL STRATEGY

General distribution is seldom an isolated operation because it usually contributes to a general goal. As such, it enhances the overall consistency of an operation in the fields of economics, representation for the respect of rights, water and habitat, and access to healthcare. This comment underscores the close connection between the different measures required in a crisis. In a famine, for example, a

GFD may be an indispensable prerequisite for a therapeutic feeding programme, but it may also call for indispensable accompanying measures such as the provision of inputs to prepare food (e.g. milling facilities, fuel, cooking utensils), access to safe drinking water, and access to other goods and services essential for survival.

2.4 BENEFICIARY SELECTION

In principle, beneficiaries are selected in the course of preliminary assessment, when populations requiring assistance are identified. However, all households may not need to be included in a GFD; targeting individual households is not always possible, either because cut-off points are difficult to set or because targeting is not acceptable or tolerated. The issue of targeting is discussed further in Section 3.3 below.

2.5 OBJECTIVES AND EXPECTED IMPACT

As discussed in Section 1.3 above, a GFD may serve different purposes separately or in parallel; planning must specify this or these objectives clearly. This encourages planners to examine the relevance of the GFD closely (thus enabling the anticipation and prevention of possible negative effects), and to identify indicators required for monitoring and evaluation beforehand.

2.6 SETTING RATIONS TO ACHIEVE OBJECTIVES AND MEET THE NEED FOR AID

The composition of food rations depends on the ultimate objective, according to the two roles ascribed to food: nutritional and economic (in terms of exchange commodity). It is useful to reiterate here that food should only be distributed as an exchange commodity if the necessary essential goods and services cannot be provided directly. In terms of the nutritional role of a GFD, ration composition is determined by whether they only complement the food that recipients can secure independently, or cover their nutritional needs altogether.

This approach leads to the definition of three different types of ration.

1. **Full ration**: this type is intended to meet nutritional needs entirely, as is the case in institutions (e.g. prisons, hospitals, orphanages, asylums, and homes for the elderly), camps for refugees or displaced persons, and most famine situations.
2. **Complementary ration**: this type is intended to complement the food that recipients can still secure independently, either directly or indirectly through their production activities.
3. **Economic support ration**: this type amounts to a more or less predominant economic exchange commodity, in addition to its nutritional purpose.

There is no simple way of setting rations according to these three types owing to the uncertainty surrounding the need for assistance and the manner in which it is distributed; in addition, political, logistical and economic constraints often result in the distribution of minimal, very simple rations. Furthermore, the definition of ration types remains highly theoretical because circumstances often call for hybrid compositions – the practical composition of rations is discussed in Section 3.1 below.

2.7 DISTRIBUTION METHODS

Direct distributions involve the delivery of rations to their ultimate recipients by the operating agency itself; in indirect distributions, rations are handed over to the community, which then distributes them to its members. Direct distribution is always best, especially in armed conflict, in order to ensure that the food does indeed reach its intended beneficiaries. Misuse and corruption are all too common in the case of indirect distribution, and they are impossible to correct later. The legitimacy of the operating agency and donors is also at stake. Indirect distribution is an option in the case of small communities that are easy to control and, above all, with which mutual confidence has been established. Indirect distribution can be an option if physical access to the victims is hindered by political or security constraints; this being said, such settings are precisely those in which the danger of misuse is greatest. Indirect distribution should therefore be seen as a last resort, when no alternative exists and the life of recipients is at stake – even in such extreme cases, the approach often fails.

Direct distribution involves the use of food in two forms: take-away rations and meals to be eaten, if possible, on the spot (Section 3.5 on distribution modalities below discusses the criteria for selecting the best form). Take-away rations are delivered in the form of survival rations, parcels that contain the entire ration (and possibly other relief items), or distribution from bulk consignments (e.g. scooping). The use of parcels and survival rations simplifies distribution, but they are more expensive and easier to steal. Similarly, planners must decide how far the delivered commodities can and should be transported. It is usually unnecessary to deliver them to the recipients' doorstep, but a fair compromise must be found between the constraints of the operating agency and those of the victims. Circumstances determine this. Distributions have been made to recipients' homes, and others to central points located several days' walk away from their recipients' homes. In both cases, the choice was determined by security considerations.

2.8 TERMINATION CRITERIA

It is usually accepted that the termination criteria of a GFD must be set at its planning stage, because that implies a complete overview. They are also necessary for the mobilization of resources and fundraising. Clearly, there are no universal criteria for the termination of a GFD. On the other hand, they are by definition set at the outset of the operation, because they are determined by:

⇨ the operational and GFD objectives;
⇨ the implementation criteria (i.e. those related to the need for assistance).

Logically, then, the two criteria for termination are:

⇨ the operational and GFD objectives have been achieved;
⇨ the implementation criteria are obsolete (i.e. the needs have been met).

In other words, the simple fact that a GFD has achieved its objectives is not sufficient to terminate the operation. For example, a given population may face insufficient access to food, and the GFD objectives are thus to restore access and avoid a deterioration of the nutritional status; nevertheless, once these objectives have been achieved the GFD remains necessary until the *causes* of this inadequate access have been resolved.

On the basis of these two criteria the termination of a GFD is usually predictable, depending on knowledge of the seasonal, climatic, economic, and political developments that affect the access to food and economic self-sufficiency of the beneficiaries.

2.9 RESOURCE MOBILIZATION

The author is not an expert in the mobilization of resources, and the issue reaches beyond the scope of this Manual; as such, it is discussed only briefly here. Resource mobilization involves the collection of means in cash and kind, the logistics set-up (food transport, storage, and distribution), the purchase and hire of goods and services, and the recruitment of competent staff.

2.9.1 Obtaining means

For donors to commit the necessary means for a GFD, they must be convinced of its relevance and approve the chosen approach. Persuasion is rather simple, provided that reliable and documented data is available to support the operation, that the justification for the operation rests on its underlying humanitarian principles, that reporting is context-specific, and that donors deal with competent staff. In this respect, donors like to engage directly with field staff in charge of assessments and distributions proper.

Political parameters discourage some donors from supporting given operations; others on the contrary support them, even if they are not necessary. Here again, persuasion should be given adequate thought, on the basis of humanitarian and technical justification. In such cases, it is best to rely on several donors with different interests, in order to preserve operational independence.

2.9.2 Setting up logistics

The three criteria for good logistics are the final delivery of quality material, as fast as possible, and at the lowest possible cost. However, these three criteria are not necessarily compatible. Fast delivery and quality are not usually cheap, and emergency may impose compromises. Consequently, logistics staff must be informed of criteria ranking as early as possible in order to clarify their operational constraints. Furthermore, "cheaper" may not necessarily mean "less costly": for example, a bean consignment may be obtained at a very low price, but require sorting and repacking, say with a 25% loss, and this would have to be taken into account. Another logistical challenge is commodity storage and turnover; this implies that warehouse capacity permits the storage of reserves in anticipation of "pipeline" disorders. The rate of supply must also match the rate of distribution, allow for the most appropriate reserves, and follow the "first in/first out" principle. The greater the reserves, the more variable the commodity flow can be, and the lower the risk of shortages is; however in that case, storage conditions also require more attention, in order to prevent the deterioration of the commodities. On the other hand, the smaller the reserves, the more constrained the commodity flow is because of the greater risk of shortage; however, spoilage related to storage is of course less likely. Large, immobile stocks are expensive, and generate significant risks in terms of commodity expiry, lack of use and theft. Humanitarian agencies must accept these dangers: limiting stocks reduces risks and costs for the operating agency, but exposes victims to the risk of shortage. Humanitarian action deals with uncertainty, and the best possible compromise must therefore be found – this is usually based on experience.

The efficiency of logistical support is contingent upon the information necessary to plan ahead, in order to organize transport, mobilize resources in good time, establish contingency stocks, and thus be in a position to cope with the unexpected. The staff involved in a nutritional assessment plays a central role in facilitating such efforts, by informing logistics staff of survey developments as early as possible.

2.9.3 Purchasing and hiring goods and services

Logistical services must purchase and hire goods and services, and this demands professional expertise. Standard procedures exist, especially for foodstuffs:

- ⇨ calling for several tenders in each case from known and reliable suppliers;
- ⇨ setting quality specifications, in compliance with the FAO *Codex Alimentarius* or the European Community on the one hand, and with domestic regulations in the country of import on the other (if the commodities are not purchased locally);
- ⇨ accepting compromise in terms of quality on minor aspects only, in consultation with qualified nutritionists, and only if the outcome is considered to be the best option;
- ⇨ setting and enforcing delivery deadlines;
- ⇨ ensuring commodity inspection before and after delivery by independent, registered and recognized verification groups; where relevant, ensuring complementary testing by food-hygiene laboratories.

Clearly, the investigation of options and contacts with suppliers should not be delayed to the point where plans of action are finalized and approved; coordination and consultation between assessment and logistics teams is essential in guaranteeing a speedy and efficient response.

2.9.4 Recruiting competent staff

Operational success is determined by the quality of field staff and its professional expertise, which is in turn shaped by its training, experience, and common sense. GFD is not particularly complicated to run in terms of the actual distribution of commodities. On the other hand, field staff must be close to the recipients, open to their concerns, and able to detect attempts at abuse. It must have some knowledge of nutrition in order to comprehend the factors that influence the feeding process, and to understand and interpret behaviour. High-standard professionals are not easily found to conduct food distributions because this activity does not amount to a profession as such, and those who do conduct it do not do so for long. It is thus best to set up mixed teams led by a limited number of experienced workers who also coach the beginners.

3. GFD IMPLEMENTATION

3.1 OPERATIONAL ORGANIZATION

Before discussing the practical aspects of GFD as such, it is worth repeating that its success depends on organization. The staff in charge must be available, have the means to operate (i.e. accommodation, vehicles, and material), and tasks must be clearly defined and attributed. Of particular importance is the establishment of an operational centre, which ensures liaison with logistics staff and a reporting system to record the conduct of the operation (for instance in the form of logbooks) – this in time constitutes a sort of archive of developments, decisions, setbacks, and solutions. Such archives facilitate the programme evaluation process subsequently, and also promote consistency when teams rotate. In principle, reports should be produced after every distribution, indicating the number of recipients, the overall tonnage for each commodity, and remarks regarding situation updates and operational progress.

3.2 SETTING RATIONS

A GFD targets households or family groups, and not individuals. This is important in order to reinforce family and social cohesion, which is frequently undermined in a nutritional crisis. Besides, a GFD cannot allow for individual nutritional needs; even if it could, the effort would be pointless as the several rations would in any case end up in the communal cooking pots and be allocated according to eating habits and priorities set by the family and not the distributing agency. Moreover, if the family does not consume the entire ration, then the lengthy process of setting individual rations would lose its purpose altogether. It is therefore best to define the average nutritional need of the overall target population, according to its demographic distribution, its average level of physical activity (expressed as a multiplication factor of the basal metabolism) and, where relevant, its environment. The number of rations that each household receives is determined by the number of its members; and the amount of food received by each household is usually sufficient because each household is more or less a microcosm of the overall population. The allocation of food among household members (or among households) is an internal matter, and the operating agency should examine the process only with a view to improving its understanding of the utilization of food and to adjusting its programme if necessary.

3.2.1 Full rations

In view of the above, the assumption of the complete absence of food in the given environment on the one hand, and that distributed food will not be sold or exchanged on the other leads to a rather theoretical approach. Such an assumption is anyway seldom completely true, except in institutions (such as homes for the elderly, asylums, hospitals, and orphanages).[8]

The exercise is useful nevertheless for two main reasons.

1. It involves the review of the main factors that must be allowed for in setting rations.
2. It facilitates the definition of reference rations that will be useful should the need for urgent action arise without the possibility of conducting proper needs assessment first. Albeit theoretical, reference rations should serve to feed a given population at least initially; they must then be adjusted to reality. Because this adjustment may not take place, however, efforts must be made from the onset in order for food rations to match needs as closely as possible.

The following sections therefore discuss the various aspects that must be allowed for in setting full rations, on the assumption that they will be used mainly as a source of food and that no alternative exists.

Full rations should in principle supply all essential Type I and II nutrients.[9] They are set according to eating habits and macro- and micro-nutrient requirements. Flavour, appeal, and factors that could justify ration increase must also be taken into account.

Eating habits

Eating habits must be respected for two main reasons. The first relates to ethics in rejection of the pretext that "anything goes" in the face of starvation. The second is physiological: small children especially would rather eat less than consume unfamiliar food. This rejection is stronger still in psychologically traumatized children suffering from anorexia due to illness and malnutrition. Chapter V indicated that, in most cultures whose food is supplied by agriculture rather than livestock, cereals and legumes are often combined. This greatly facilitates food aid, because both are dried and stored, and their nutrients are thus preserved in their most concentrated form. This is

[8] Prisons are not mentioned here: in developing countries especially, food plays not only a nutritional, but also an economic and social role in such settings, and can contribute substantially to power and dependency relations.

[9] See Chapter VIII, Section 2.2.1.

not the case for tubers (roots) and plantains, which spoil quickly. Populations that mainly eat tubers and bananas therefore require appropriate alternatives, as do those that rely traditionally on fishing and stock-breeding. Nowadays, hardly any region remains completely untouched by the outside world, and thus excluded from foodstuffs similar to those that food aid can supply. As a result, acceptable rations can always be defined. To this end, the recipient group must describe its main staples and accompanying foods. It must then be requested to define acceptable alternatives and indicate options that are culturally unacceptable (owing to religious or cultural beliefs and taboos, and eating habits). The information thus collected provides a list of options and non-options.

The combination of cereals and legumes by cultures whose subsistence revolves around agriculture is certainly not accidental. Chapter V discussed the importance of this combination to ensure and balance protein and B-group vitamin intake. Food aid must comply with this interrelation insofar as its purpose is to compensate a lack of access to food, usually associated with a substantial reduction in food diversity. However, because food aid programmes are so difficult to implement, cereals are frequently distributed alone and this increases the risk of specific deficiencies.[10] A maize-based diet induces pellagra, but also beriberi in the case of industrially processed, low extraction flour; a diet based on polished rice also results in beriberi. Pellagra and beriberi are specific deficiencies that can cause much damage in crisis situations. The simple distribution of legumes with cereals, in adequate proportions, avoids such epidemics. There is usually no good reason not to do so; in such a case, alternatives must be examined and applied.

Macro-nutrient requirements

Qualitative aspects

Food rations must supply enough energy and protein, and energy requirements take precedence over all others. Rations must satisfy these requirements first, or severe malnutrition may develop rapidly. The staples that contribute to the ration are therefore usually the following:

- ⇨ a main source of energy, usually cereals which also supplies a substantial amount of protein and micro-nutrients;
- ⇨ a concentrated source of protein, usually legumes, which provides both energy and micro-nutrients;
- ⇨ a concentrated source of energy in the form of vegetable oil or fat.

These three types of foods must be balanced, with an acceptable variation in the order of ±5% that is usually determined by logistical constraints at distribution level.

The lipid energy/overall energy ratio

According to different recommended intakes, the contribution of lipids should represent 10 to 20% of the overall calorie supply; only de Ville de Goyet recommends 20–40% (de Ville de Goyet, 1978). Oil is included in food rations because it is a concentrated source of energy and is essential in some cooking methods; it also enhances flavour. This concentrated source of energy contributes especially to increasing the energy density of the diet of infants, and is evidently important in nutritional rehabilitation. Moreover, it alleviates the logistical burden in terms of transport. As a result, a ration that supplies approximately 20% of the overall energy in the form of oil is no luxury; this is therefore the minimum recommended here for basic rations that contain no other fat-rich foods. As a reminder, diets that are poor in lipids and aim at preventing cardio-vascular disease

[10] See Chapter VIII, Section 2.5.

are called "low-fat" when their contribution represents 30% of the overall energy intake; if their contribution is 22%, they are called "very low-fat diets" (Shils, 1994).

The protein/energy ratio

In the discussion on nutritional needs, Chapter III demonstrated that diets that supply enough energy usually supply enough protein also. This is noted especially in the case of food rations that combine cereals and legumes. The proportion between protein and energy is expressed as a percentage of the energy value[11] of the protein and the overall energy supply: this is the "P/E%" ratio below.

$$\mathbf{P/E\% = \frac{G \times Kp}{Kr} \times 100}$$

Where:
G = the protein weight in the ration
K = the calorie value
Kp = the calorie value of the protein contained in the ration (kcal/gram, or kJ/gram)
Kr = the overall calorie value of the ration (kcal or kJ)

For example, a ration that supplies 2,400 kcal (10,032 kJ) in total, with 70 g of protein, translates into the following P/E% ratio:

$$\mathbf{P/E\% = \frac{70\ g \times 4\ kcal/g}{2{,}400\ kcal} \times 100 = 11.7\ \%}$$

A P/E% ratio of 10 to 13% is usually adequate to satisfy protein requirements, provided that energy requirements are met. The P/E% ratio of cereals is approximately 11%, that of legumes at least 23%. Practically then, a ration that supplies 65% of its energy in cereals, 20% in oil, and 15% in legumes amounts to a P/E% of 11.5%. If the ration supplies 20% of its energy in the form of oil, and the remainder in cereals only (i.e. to the exclusion of legumes), the P/E% drops to 9% or below. The proportion of legumes to be included in order to cover protein requirements must always be 10 to 15% of the overall energy supply.[12]

Setting full rations usually involves the inclusion of other foodstuffs in order to supply micronutrients and improve their diversity and flavour. Such foods normally only represent a small proportion of the energy intake, and do not affect the above principles in a significant way (even if, for instance, part of the oil is replaced with sugar).

In some circumstances, it may be necessary to replace staple foods with others; this must then be done within the limits set by:

⇨ eating habits;
⇨ food quality;
⇨ their requirements in terms of preparation, and the compatibility of the latter with the recipients' possibilities.

From a nutritional perspective, all cereals are understood as being equivalent, so are legumes, and so are fats and oils. Oil may be partly replaced with sugar or oilseeds based on calorie equivalents, but

[11] The energy value of protein is 4 kcal/g or 16.72 kJ/g.
[12] See Chapters III, IV and V.

should always account for at least 10% of the overall calorie intake. Cereals must not be replaced with legumes, because the latter are not easily digested and are sometimes slightly toxic; legumes should not account for more than 15% of the overall calorie intake. Legumes cannot be replaced with cereals either, as this would result in a protein and vitamin deficit with respect to energy; in brief, cereals and legumes are not interchangeable. On the other hand, legumes and cereals may both be partly replaced with foods that supply identical amounts of energy and protein, while also supplying an additional benefit in terms of flavour and micro-nutrients: frequently, these are cereal and pulse flour blends enriched in vitamins and minerals (e.g. corn soy blend, or CSB), but also meat or fish preserves.

Quantitative aspects

The amount of food that makes up the ration is determined by the average energy requirement. In the case of a nutritionally healthy population at the onset, the average requirement is calculated based upon:

- ⇨ the demographic composition of the population under scrutiny;
- ⇨ the average weight per age and sex groups;
- ⇨ the level of physical activity;
- ⇨ the average ambient temperature.

Demographic composition

Clearly, the demographic composition of each population is specific to itself. An average composition that is representative of all groups living in a given situation must therefore be defined. This definition results in two profiles: one applies to economically developed countries, and the other to underdeveloped or developing countries. These two profiles are provided in Table 12.2 below.

Average weight per age and sex group

The population must be divided into age and sex groups, because these groups correspond to different average weights, and because basal metabolisms differ according to weight and sex. What matters here is the average weight per group or stratum, and it may differ significantly between populations of adolescents and adults. In Table 12.2, adult men included in the WHO 1 population weigh 65 kg on average, and women 55 kg. In the WHO 2 population, men weigh 60 kg, and women 52 kg. In the WHO 3 population, men weigh 67 kg, and women 58 kg. Latham, for his part, suggests a reference population in which the average adult male weight is 63 kg, and 55 kg for women, in developing countries (Latham, 1997).

Physical activity

The level of physical activity influences energy expenditures (and, hence, energy requirements) significantly. The basal metabolism is multiplied to calculate energy requirements according to the level of physical activity. WHO proposes the use of the following multiplication factors for calculating average daily energy requirements according to physical activity (WHO, 1985):

	Light activity	**Moderate activity**	**Heavy activity**
Men	1.55	1.78	2.1
Women	1.56	1.64	1.82

In practice, the daily energy expenditure of a man weighing 65 kg with a basal metabolism[13] of 1,633 kcal/day (6,826 kJ) is thus 2,530 kcal (10,580 kJ), 2,910 kcal (12,150 kJ) or 3,430 kcal (14,330 kJ), depending on his level of physical activity (i.e. light, moderate, or heavy).

[13] Chapter III provides the equations that are used to calculate basal metabolism according to sex and weight.

Ambient temperature

Ambient temperature influences energy requirements[14] substantially. The lower the temperature, the higher the energy cost of thermo-genesis. It goes without saying that rations should not be automatically increased in harsh climatic conditions: habitat material must be supplied first in order to protect their recipients against the cold (shelter against rain or snow and wind, heating material, etc.), and clothing and blankets for thermal comfort. Such measures against the cold are usually taken once only (one-off supplies), whereas adjustments to food rations must then be adhered to permanently, involving a significant increase in the overall cost of the operation. That being said, increasing rations is sometimes justified, and the decision must involve nutritionist input. It is worth noting here that, if the organism cannot maintain its normal temperature, the resulting hypothermia is usually fatal below 25°C. The chilling of a malnourished individual, poorly clad and exposed to the elements (as is often the case in disaster), is extremely rapid. In famines, malnutrition becomes generalized and extreme, and mortality among the homeless peaks at night-time and in rainy conditions. Clearly, humanitarian ethics demand that acceptable habitat and thermal comfort conditions be ensured whenever feasible. If these conditions are satisfactory, rations must nevertheless be adapted to the ambient temperature, in compliance with the recommendations issued by the World Food Programme (WFP) and the Office of the United Nations High Commissioner for Refugees (UNHCR). Both agencies have set an individual daily basic ration for an average ambient temperature of 20°C, and propose to increase it by 100 kcal (418 kJ) for each 5°C below that threshold (WFP, 1997).

Calorie content

The above parameters being set, the calorie content of food rations must be defined in order to satisfy all the energy requirements of the target population. In terms of temperature, specific recommendations exist, provided that the necessary complementary measures relating to habitat and thermal comfort are taken. The average weight per age and sex groups, the level of physical activity and the demographic profile are defined by direct observation and measurements in each individual situation. However, the definition of reference rations for planning purposes rests upon standards used to define the average weight according to age and sex group (especially for adults), the level of physical activity (i.e. light, moderate or heavy), and demographic composition.

Table 12.2 below provides three examples of ration calorie content:

⇨ **WHO 1**: this ration is based on recommended intakes for a population whose demographic profile is found in developing countries (de Ville de Goyet, 1978);
⇨ **WHO 2** is recommended by the World Health Organization, the WFP and the UNHCR as a reference ration for humanitarian action in developing countries (WHO, 2000);
⇨ **WHO 3** is recommended by the World Health Organization as a reference ration for humanitarian action in developed countries (WHO, 2000).

[14] See Chapter III, Section 1.1.4.

Table 12.2 Daily calorie values for humanitarian aid rations

WHO 1		
Age (years)	%[a]	Energy requirements (kcal) ((kJ))
0 – 1	3	820 (3,290)
2 – 3	9	1,360 (5,680)
4 – 6	8.7	1,830 (7,650)
7 – 9	8.5	2,190 (9,150)
10 – 14 male	6.3	2,800 (11,700)
10 – 14 female	6.2	2,450 (10,240)
Adult male	29.2	3,000 (12,540)
Adult female	26.2	2,200 (9,200)
Pregnancy	1.5	2,550 (10,660)
Breastfeeding	1.4	2,750 (11,490)
Average		**2,350** (9,820)

WHO 2		
Age (years)	%	Energy requirements (kcal) ((kJ))
0 – 4	12.37	1,290 (5,390)
5 – 9	11.69	1,860 (7,770)
10 – 14	10.53	2,210 (9,240)
15 – 19	9.54	2,420 (10,120)
20 – 59	48.63	2,230 (9,320)
60 +	7.24	1,890 (7,900)
Pregnancy (supplement)	2.4	285 (1,190)
Breastfeeding (supplement)	2.6	500 (2,090)
		2,080 (8,690)

WHO 3		
Age (years)	%	Energy requirements (kcal) ((kJ))
0 – 4	6.16	1,290 (5,390)
5 – 9	6.67	1,880 (7,860)
10 – 14	6.81	2,220 (9,280)
15 – 19	6.83	2,480 (10,370)
20 – 59	55.24	2,340 (9,780)
60 +	18.28	1,990 (8,320)
Pregnancy (supplement)	1.2	200 (840)
Breastfeeding (supplement)	0.3	500 (2,090)
		2,180 (9,110)

[a] Approximate age group proportion within the population according to its profile.

In Table 12.2 above, the level of adult physical activity and their weight account for most of the discrepancies between WHO 1 and WHO 2 average requirements. In WHO 1, adults are assumed to be moderately active, with an average weight of 65 kg for men, and 55 kg for women. In WHO 2, adults are lightly active, with an average weight of 60 kg for men, and 52 kg for women. The WHO recommends an average supplement of 140 kcal (585 kJ) for a moderately active population, and 350 kcal (1,460 kJ) for a highly active population; this raises the WHO 2 average ration to 2,220 kcal (9,280 kJ) and 2,430 kcal (10,160 kJ) respectively. Transposing adult intakes recommended in WHO 1 to WHO 2 raises the average daily ration to 2,270 kcal (9,470 kJ). With respect to the intakes recommended by Latham for developing countries, the reference adult male weighs 63 kg, and his average daily energy requirements are 2,895 kcal (12,100 kJ); the reference adult female weighs 55 kg, and her average daily energy requirements are 2,210 kcal (9,240 kJ) (Latham, 1997). Applying this level of requirements to WHO 2 adults raises the average daily ration to 2,243 kcal (9,375 kJ).

On the basis of the information above, the question arises as to which of the following recommendations should be chosen.

⇨ WHO, the WFP and UNHCR have recently chosen to round the WHO 2 ration up to 2,100 kcal (8,780 kJ) as the reference ration for initial planning. This ration is somewhat restrictive, as it rests upon a rather low adult weight and only light physical activity. In camp settings, the population is indeed often rather inactive; in most situations, however, populations targeted for GFD assistance are moderately, or even heavily, active. In this respect, it is worth reiterating that they may depend on general distributions, but their economic performance is in failure, and they attempt to correct this by a range of substitution activities when they are not actually working on the agricultural task that is under way.

⇨ In the early 1980s, the ICRC chose to round the WHO 1 ration (i.e. 2,350 kcal, or 9,820 kJ) up to 2,400 kcal (10,030 kJ) as its reference; this permits the coverage of the energy requirements in moderately active populations according to the recommendations issued by the WHO in force at the time (de Ville de Goyet, 1978).

The large United Nations agencies have chosen a ration that may seem limited; it nevertheless represents a 10% increase of the previously applied standard of 1,900 kcal (7,940 kJ). This standard had in fact been imposed in 1988 by Seaman and Rivers, at the end of the "Nutrition in Time of Disaster" conference (USAID, 1989), when some participants held the view that this recommendation remained excessive in spite of the nutritional disasters that had resulted from the delivery of lower rations. The 1,900 kcal standard is the absolute minimum for populations whose demographic profile is that of a developing country, whose energy expenditure hardly reaches maintenance (that is, inferior to that required for light physical activity), whose nutritional status verges on moderate malnutrition, and that live in a hot climate. Seaman and Rivers deserve credit for having imposed, for the first time, a decision based on physiological criteria, and which enables the calculation of supplements for all relevant situations. Moreover, many agencies considered that basic rations for vulnerable groups needed to be supplemented. However, in practice it has been found to be nearly impossible to increase rations once logistics have been set up for a given ration. As a result, and in view of extensive field experience, the major agencies have now adopted the WHO recommendation of 2,100 kcal (8,780 kJ) for planning purposes. As indicated above, the author believes that this reference ration is too low because it tends to underestimate essential parameters such as weight and physical activity. That being said, a 2,400 kcal ration may indeed be exaggerated in the light of recent data on recommended energy intakes; the latter are today set on the mean, and were previously set 2 standard deviations above the mean in order to ensure an adequate supply for the entire population.[15] It is worth noting that, at the time, recommended intakes were mainly intended for development planning in poor countries, where malnutrition was the main problem; nowadays, experts refer rather to obesity in wealthy countries, which is clearly inappropriate for humanitarian action.

After all, a 2,100 kcal (8,780 kJ) ration is only 13.5% lower than a 2,400 kcal (10,030 kJ) ration. This is not much in view of context-specific and biological variations, which influence the nutritional need and its coverage. As any experienced field worker knows, this small difference lies within the variation and adjustment margin of logistical systems.

The author prefers a planning ration that amounts to modern recommended energy intakes for moderately active populations. The application of intakes recommended by Latham for adults in developing countries (Latham, 1997) to the WHO 2 ration provided in Table 12.2 above results in a ration of 2,243 kcal (9,375 kJ) that can be rounded up to 2,250 kcal (9,400 kJ). This ration is neither restrictive nor exaggerated and, combined with a ±50 kcal (±210 kJ) tolerance margin, makes ethical and nutritional sense.

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[15] See Chapter IV.

Table 12.5 below provides examples of rations that total approximately 2,250 kcal (9,400 kJ).

Food shortages may occur in some cases because of the sheer number of victims, or because the logistics set-up has not yet been completed.

⇨ In the first case (as witnessed by the ICRC in Somalia in the early 1990s), rations may be restricted to 1,900 kcal (7,940 kJ), as defined by Rivers and Seaman in 1988 (USAID, 1989). This ration keeps people alive, and checks mortality. In Somalia, however, rations were delivered in the form of meals, and the ICRC could ensure that all individuals received the same ration and consumed it on the spot, in order to limit redistributions and the splitting of already restricted rations. The underlying idea is that if all individuals consume 1,900 kcal (7 940 kJ), children up to 9 or 10 years of age are likely to regain an acceptable nutritional status. Adolescents are less likely to do so, and such a ration only permits the maintenance of adults weighing 50 kg. General distributions of take-away rations on the other hand lead to their reallocation within the family and the use of food rations to other ends than those intended, and thus complicate the practical application of the "minimal ration" concept.

⇨ In the second case, when temporary shortage is expected (2 to 3 months), it is best to consult the target group as to possible options based on available rations. The decision is then made jointly, whatever the level of famine. Reactions are unlikely to be the same everywhere. Nutritionists in such cases should provide professional advice as to the possible consequences of the options under scrutiny, in order for affected groups to make informed decisions.

It is worth noting that energy requirements are still not completely clear, and they are still under considerable scrutiny (Scrimshaw, 1996); the rations defined for planning purposes (known as planning rations) are therefore likely to be adjusted further in coming years. However, the search for more accuracy must be compatible with field reality, which is subject to great variability. The smaller the corrections are, the less impact and meaning they really have. Moreover, the definition of rations for planning purposes is highly theoretical, and must not necessarily reflect a specific reality. Realistic planning rations is a contradiction in terms, as are rations that correspond exactly to the needs of target groups. The corollary of these remarks is that agencies must secure the means for adjusting planning rations to reality as closely as possible. This implies the introduction of monitoring systems to follow up general distribution. In this respect (because average adult weight influences the average nutritional need), the body mass index (BMI) of an adult population sample may be recorded at the time of distribution in order to determine its nutritional status and the average weight for ration calculation. The recorded weight cannot be that prevailing in the case of malnutrition, but must be at least the minimum still considered as a good nutritional status according to BMI categories used in this Manual: at least 18.7 for women and 20.1 for men.

Micro-nutrient requirements

Full rations should supply all essential micro-nutrients (i.e. vitamins and essential minerals), in line with recommended intakes.[16] There are 35 essential micro-nutrients, some of which are "Type II" micro-nutrients, meaning that they must be supplied in a stoechiometric[17] relation. The micro-nutrient requirements of groups that rely entirely on food aid are certainly most difficult to satisfy. The challenge lies in including all the foodstuffs required for a full ration; however, it also lies in persuading decision-makers of the inclusion of some foodstuffs that may seem to be a luxury, whereas it is simply a matter of taking full responsibility and feeding needy groups in such a way as to preserve their health.

[16] See Chapter V.

[17] Stoechiometry (or stechiometry) is the relationship between the exact proportions of elements that combine in a reaction to form a compound. This reasoning is extended by analogy to the field of nutrition.

Foodstuffs that supply macro-nutrients also contain significant amounts of micro-nutrients, but not all such foodstuffs contain *all* micro-nutrients, or in sufficient amounts. Several means exist to ensure comprehensive micro-nutrient supply, but none is entirely satisfactory unless varied (even fortified if necessary) foods are provided in the form of meals. Needless to say, this is difficult to do in GFDs. On the other hand, several methods permit the best possible supply of micro-nutrients, and the commonest are discussed below.

Supplying foods to complete staple foods

This is no doubt the best way by far of providing all essential nutrients, because complements enhance flavour and dietary variety. Its major drawback relates to the fact that such complements are fresh foods (such as vegetables, fruits, and animal products), which spoil quickly. This implies that they must be found locally or sufficiently close to ensure that they are still fresh enough at the time of distribution. Furthermore, they must be distributed sufficiently frequently and in adequate amounts (at least 150 g of fruits and vegetables per person per day, that is, 4.5 kg per person per month) to ensure appropriate intakes, because some micro-nutrients are not stored in the organism. This entails significant complication of the necessary logistics set-up and, usually, the supply chain (and it may turn out to be impossible altogether). An alternative consists in supplying such foods in the form of preserves that can be fortified. This option nevertheless also entails logistical complications as such products usually contain much fluid. Preserved or canned foods are also frequently unfamiliar and expensive; in addition, they translate into a serious pollution problem, which may nevertheless be resolved through appropriate waste disposal systems.

Supplying rations that contain all essential nutrients

This type includes survival biscuits and rations that supply concentrated foods; it is useful in the short term. It draws its appeal from its simplicity: it limits distribution to a single type of commodity that requires no specific preparation. Its disadvantage lies in its cost, its lack of acceptability in some circumstances, its monotony, and the fact that armed groups find such products especially attractive.

Supplying specifically fortified foods

The distribution of fortified foods is the best way of preventing specific deficiencies, and is the most widely recommended accordingly. Biscuits, flour, blended foods, groundnut paste, seasoning cubes or pastes can all be fortified in micro-nutrients, according to the amounts required to complete basic rations. The best-known are corn soy blend (CSB) and Unimix, which combine cereal and legume flours, and are enriched in vitamins and minerals.

100 g of CSB supply 380 kcal (1,590 kJ) and 18 g of protein, and contain the following:

- ⇨ 1,700 IU of vitamin A;
- ⇨ 40 mg of vitamin C;
- ⇨ 0.7 mg of thiamine;
- ⇨ 0.5 mg of riboflavin;
- ⇨ 4 µg of vitamin B_{12};
- ⇨ 8 mg of niacin;
- ⇨ 0.2 mg of folic acid;
- ⇨ 800 mg of calcium;
- ⇨ 3 mg of zinc;
- ⇨ 18 mg of iron.

Practically speaking, 60 g of CSB included in food rations supply sufficient amounts of thiamine, riboflavin, vitamin C, and iron for all age groups – except pregnant and breastfeeding women in the case of iron (Tool, 1995).

Unimix contains less of the above vitamins and minerals.

In the light of the above, agencies should as a priority agree on standard products adapted to different types of situations, which satisfy all micro-nutrient requirements for all age groups.

Fortified foods that require cooking raise the difficulty of vitamin C preservation (as it is largely lost in the cooking process). Nowadays preparations exist that have been cooked prior to their enrichment: this limits cooking times and, thus, vitamin loss. Flour enrichment is difficult because the chemical compounds used in the process have different particle sizes that complicate the production of truly homogenous blends. Moreover, chemical compounds must be chosen in such a way as to ensure that they do not inter-react. Such fortified foods must only be used to complement basic rations, and not for weaning or nutritional catch-up purposes, for which they are not adapted. Fortified foods must also be consumed by all household members.

In addition to fortified foods that supply several micro-nutrients, some exist that contain only one (or two at most); these are useful in terms of the micro-nutrient under consideration. Examples include iodized salt, which resolves iodine deficiency, and vitamin A enriched oil (sometimes also enriched in vitamin D), which are both usually consumed by all household members. The disadvantage of oil is that it is often partly sold, or used in culinary preparations that are later sold; its anticipated impact is therefore not always achieved, especially because losses occur during its transport and storage (5 to 10% depending on circumstances), and when it is used for frying (up to 50%).

Supplying tablets or powders

In some circumstances, it may be necessary to supply micro-nutrient tablets or powders to be added to meals after their cooking. Tablets must be distributed regularly and frequently (i.e. at least once a week) because vitamin C and B group vitamins are not stored in the organism. As a result, the distribution of tablets demands significant investment in terms of logistics and work. By the same token, their recipients usually tire of them and tend to take them less and less, especially if they can sell them. Powders on the other hand usually raise a problem of flavour and mixing; they can be used only in combination with wet feeding (i.e. the supply of prepared meals).

Supplying basic rations that permit their exchange for complementary foods

This approach is the most practical for humanitarian agencies, which thereby transfer the search for complementary foods to recipients. However it provides no guarantee that recipients will indeed satisfy their micro-nutrient requirements. Economic priorities usually take precedence over nutritional concerns when the amount of food is more or less sufficient to satiate hunger. In the absence of nutritional knowledge, specific deficiencies are unfortunately often overlooked, and clinical symptoms are not connected to dietary disorders in time. Moreover, if the demand for complementary foods is high, then their price rises and consequently their availability diminishes, and alternatives must be considered sooner or later. On the other hand, the exchange of part of the basic rations for complements that are considered to be essential limits epidemics of specific deficiencies. This has for example been observed in Ethiopia; it is worth noting that, in this specific case, relative value relations (or local terms of trade) were detrimental to beneficiaries, and severe malnutrition stabilized at high levels for many months, without prospect for improvement. That being said, the sale of part of the rations also served other essential economic purposes.

Supporting the agricultural production of complementary foods

Such an approach is useful especially when target groups are accustomed to cultivating most of their food, and provided that agricultural land and water (e.g. rain, rivers, and recycled waste water) are available. Garden or backyard cultivation may also be encouraged for the production of vegetables and aromatic herbs in the case of groups that are unfamiliar with such practices. In all cases, the resulting production must begin to be consumed within two months after the first distribution, if it is to compensate inadequate rations. Even in the case of adequate rations, all local production initiatives that diversify the diet are to be encouraged. Local production may also be promoted in the case of institutions that have some access to agricultural land. Unfortunately, the resulting production is all too frequently sold by the directors of such institutions, and the inmates who have done the work are not compensated appropriately; this is often the case in prisons.

Refraining from supplying complements where they are available

This option can only be chosen if the population is clearly used to securing complementary foods by producing or gathering them. The understanding of gathering practices requires sound knowledge of eating habits, and natural resources and their potential. Here again, much certainly remains to be investigated by examining all traditional methods that contribute to a varied diet and account for micro-nutrient supplies. Some such methods may probably be replicated successfully elsewhere.

Setting priorities

On principle, all essential micro-nutrients should be included in full rations, in conformity with recommended intakes. However, some specific deficiencies *must* be avoided at all costs as their health consequences are especially serious.[18] The corresponding micro-nutrients are: vitamin A, vitamin C, folic acid, niacin, thiamine, iron, and iodine (these are all Type I nutrients).

Vitamin A

A prevalence rate of Bitot's spots equal to or above 0.5% in children under 6 years of age indicates vitamin A deficiency to the point of becoming a public health problem that demands general measures. Even sub-clinical vitamin A deficiency has serious consequences. As a result, vitamin A complements should be included in any GFD, and their inclusion is compulsory if deficiency is suspected. This consists in supplying vitamin A enriched foods (i.e. oil containing approximately 6,000 IU of retinol/100 g, or cereal blends containing approximately 1,700 IU of retinol/100 g) in order to ensure a basic intake. Because significant vitamin A losses occur during cooking and because oil rations are frequently sold off, preventive measures must be taken from the outset, such as the distribution of vitamin A capsules to all children under the age of 10.[19] The advantage of vitamin A relates to the fact that it is stored in the liver in rather large amounts. The posology is 200,000 IU (110 mg of retinol palmitate or 66 mg of retinol acetate) per dose, administered orally, for all ages above 1 year; half that amount, that is, 100,000 IU (55 mg of retinol palmitate or 33 mg of retinol acetate) per dose, administered orally, is recommended for infants between 0 and 12 months. Preventive treatment should be avoided during pregnancy, and instead a single 200,000 IU dose should be administered straight after delivery. Vitamin A capsules are usually found in 100,000 IU and 200,000 IU doses. If no 100,000 IU capsules are available for small infants, a 200,000 IU capsule may be punctured, and three drops extracted from it for oral administration. The above dosage protects against deficiency during approximately 6 months; as a result, vitamin A capsules should be distributed every 4 to 6 months at least. Moreover, the distribution of vitamin A enriched foods (oil or cereal blends) extends vitamin A protection to individuals that are not included in prevention measures involving the administration of capsules (especially women of childbearing age, for which high preventive doses may be teratogenic).[20]

Vitamin C

Vitamin C poses the greatest challenge as it is only found in fresh (and thus perishable) products, or in enriched foods that risk considerable loss through oxidation during storage and cooking. Consequently, apart from the distribution of tablets as discussed earlier, vitamin C can only be supplied in the form of specifically fortified foods or biscuits. This method is however only effective

[18] Chapter III describes the different types of deficiencies.

[19] Prevention recommendations involve the distribution of vitamin A capsules to all children under 6 years, mainly because xerophthalmia primarily affects pre-school children. However, because of the role of vitamin A in protecting against infectious disease, prevention should extend to all children up to at least 10 years.

[20] See Chapter III, Section 2.2.5.

if everyone consumes these foods and this may be difficult to ensure. An alternative consists in sprouting the cereals and legumes that are usually contained in basic rations. Sprouting (or germination) produces substantial amounts of vitamin C (100 g of legumes produce between 10 and 20 mg of vitamin C after three days' sprouting); however, in spite of its advantages, the author has never seen it applied on a large scale. Ensuring adequate vitamin C intakes is important because of its specific function within the organism, and because it promotes iron absorption.

Iron and folic acid

Here again, iron and folic acid can only be distributed in the form of tablets or fortified foods and biscuits in order to ensure their adequate intake.

Thiamine and niacin

In principle, there should be no thiamine or niacin deficiency if basic rations that supply macro-nutrients are properly defined. Proper rations include legumes that complete cereals in the proportions indicated above, and cereals that are milled with the lowest possible extraction rate. If rice is the cereal supplied, it should be parboiled.

Iodine

Iodine deficiency is a major specific deficiency that entails serious consequences, and there is no excuse for it in humanitarian assistance. The distribution of iodized salt (30 to 50 mg of iodine per kg of salt) is a highly effective prevention method. Alternatively, iodized oil may be injected (providing protection for at least three years), or administered orally (providing protection for approximately one year).

Summary

The above shows that there is no single solution to the supply of essential micro-nutrients in the case of groups that rely exclusively on humanitarian aid. On the other hand, combining the above methods usually provides a satisfactory answer to all situations. In addition, time-scales must be allowed for. In the early stages of food aid, the most comprehensive ration is usually best; later, adjustments must be made to accommodate local resources. This requires considerable monitoring.

The fact remains that, all too frequently, humanitarian agencies are unable to supply comprehensive rations. The reasons for this are manifold, and only some of them are reasonable. Consequently, efforts must be maintained throughout the operation in order to ensure adequate food intakes. Such efforts must involve the following:

⇨ humanitarian agencies must secure the means to distribute the most adequate rations as possible, according to their available knowledge and means;
⇨ humanitarian agencies must pool their efforts in order to standardize the use of enriched foods, and to engage donors with a view to securing the availability of such foods in time and in the necessary amounts;
⇨ humanitarian agencies, academics, and donors must cooperate to ensure the continuation of research efforts in order to improve the satisfaction of micro-nutrient requirements in nutritional crises.

Flavour

Besides the fact that they are seldom comprehensive, humanitarian food rations are usually quite monotonous – to the point, in fact, that it is fair to question the view that food aid leads to dependency in its recipients and a disinclination to overcome the crisis. Full rations, especially if they are distributed over a significant period, however must include ingredients that enhance their flavour. Besides pertaining to humanitarian ethics, this method also encourages consumption, especially in small children who can quickly become malnourished and anorexic. Ingredients that enhance flavour can also, in part, be those that supply micro-nutrients (such as biscuits). Depending on local eating habits, they may also include spices that season staple foods, sugar, tea, or coffee. Much social interaction occurs around a cup of coffee or tea, and most of it aims to preserve or restore the economic system. In this framework therefore, ration diversity reaches beyond strictly nutritional objectives, and allows for the social dimension of food. In fact, people always seek to obtain the spices and foodstuffs that are socially and culturally necessary. This is usually done to the detriment of basic rations, part of which are exchanged for such commodities. As a result, it is important to include them in GFD, or to increase rations in order to permit such exchanges. The inclusion of this type of additions should not be based on routine recommendations, but rather be adapted to circumstances.

Other factors justifying ration increase

The basic factors that must be taken into account when setting full rations are:

⇨ the demographic profile of the group under consideration;
⇨ the real or desired average weight per age and sex group;
⇨ the average level of physical activity;
⇨ the average ambient temperature.

The definition of standard conditions facilitates the definition of reference rations for planning purposes, as described earlier. Rations may need to be adjusted to the above factors, and this may involve their increase or reduction. In settings where the above factors are familiar and well understood, such adjustments may already be made during the planning phase.

Two additional factors may call for ration increase: nutritional catch-up and post-distribution losses.

Nutritional catch-up

Nutritional catch-up is costly. Weight gain of 1 g of tissue that contains an average of 16% of protein and 25% of lipids involves in the process a consumption of approximately 5 kcal (21 kJ) (WHO, 1985 and Waterlow, 1982). Thus, desired nutritional catch-up rates may be planned. In prisons for example, intakes can sometimes be easily controlled, and field workers can set deadlines for the BMI of inmates to reach an acceptable level; the results are then observed and compared with the initial objective. The same type of calculation may be applied to malnourished groups assisted through GFD. The catch-up component must then be defined. If, as indicated above, the catch-up of 1 g of tissue involves the consumption of 5 kcal, and one gram of tissue contains approximately 16% of protein, then 0.2 g of protein must be supplied (of which approximately 80% will be used), in addition to the 5 kcal.

Clearly, catch-up ingredients must include both macro-nutrients and micro-nutrients. In terms of macro-nutrients for example, if an adult is to catch up 5 g of weight per kilo and per day, and initially weighs 45 kg, then approximately 1,500 kcal (6,270 kJ) and 34 g of protein for maintenance, plus 1,125 kcal (4,700 kJ) and 45 g of protein for catch-up purposes must be supplied, that is, 2,625 kcal (10,970 kJ) and 79 g of protein in total. In line with the principles defined earlier in relation to the setting of rations for planning purposes (15% of the energy supplied in the form of legumes, 20% in oil, and 65% in cereals), rations that supply the calories required for catch-up and maintenance only supply 75 g of protein. Protein is therefore slightly limiting, and catch-up will only reach up to 4.5 g/kg/day. The same calculation applied to a man initially weighing 50 kg leads roughly to the same result, in which protein is slightly limiting. If catch-up is less ambitious and is limited to 2 g/kg/day, then protein is no longer limiting. In other words, protein may limit the nutritional catch-up rate in adults; in small children, however, the nutritional catch-up rate is usually only limited by energy because their protein maintenance requirements are lower with respect to energy than those of adults. The protein requirements of a 3-year-old child are 1.15 g for 100 kcal (4.8% P/E%); those of an adult man are 1.7g/100 kcal (6.8% P/E%). Nutritional catch-up implies higher P/E% ratios than maintenance, and the P/E% ratio must therefore be approximately 10% in order to enable a 3-year-old to catch up 20 g/kg/day; this is covered by basic foods. In the case of an adult weighing 45 kg, it is in the order of 15%, which cannot be covered by standard basic foods.

These remarks on catch-up requirements show that it is necessary to clarify the objective of increasing full food rations in order to contribute to nutritional catch-up. Micro-nutrients must also be supplied according to the desired catch-up.[21] Micro-nutrients must clearly permit the catch-up of specific deficiencies and weight, and this involves significantly greater amounts than those allowed for in recommended intakes. Type II micro-nutrients must be supplied in the stoechiometric amounts defined in the following Chapter. It is pointless to increase only the protein and energy content of rations if adequate catch-up is sought. Experience in nutritional centres before and after the introduction of the Briend & Golden Protocols (Briend & Golden, 1993) on micro-nutrients shows a catch-up jump from 2–3 g/kg/day to 15–20 g/kg/day for equal amounts of protein and energy, in identical conditions.[22]

Post-distribution losses

GFD beneficiaries can suffer commodity losses, for example in the course of cereal milling (if it is distributed in grains), and despoiling.

In the case of milling, loss is determined by the type of milling itself and the cost involved. According to the type of mill and local eating habits, milling itself causes 10 to 20% losses or more, and also involves substantial vitamin, protein, and mineral loss.[23] The cost of milling on the other hand is determined by supply and demand; crises involving considerable population concentrations can raise demand significantly and, thus, result in price increases (up to one-third of the milled product). Recipients may therefore prefer to save this amount by consuming the grains whole, but this entails lengthier cooking, and the necessary fuel then becomes expensive. It would then be reasonable to ask why cereal grains are distributed at all. The answer is that grain travels better, is easier to store and keeps longer. Its handling entails fewer losses, and grain is more easily assembled and repacked if its bags are damaged; it is also cheaper than flour. It is commonly argued, moreover, that cereal grain is more nutritious than flour; this justification is however specious here because the grain will need to be milled prior to its consumption, and local milling can involve greater losses than if it is carried out in the producing country.

The advantage of milled cereal lies in the fact that it is ready for consumption, does not entail milling losses or costs and, above all, it may be enriched in micro-nutrients (which can limit deficiency disorders substantially). Furthermore, if the distributed cereal is genetically-modified (GM), its supply in the form of flour prevents its being used as seed – sowing such seed could ultimately prove disastrous for the local economy. Comparing the respective advantages of grain and flour shows that the use of grain mainly benefits donors and distributing humanitarian agencies to the detriment of its recipients; the distribution of flour on the other hand benefits its recipients, at the cost of additional work and expenses for donors and distributing agencies. If milling costs devolve upon the ultimate recipients, losses and expenses can be substantial, and it is best in such cases to resort to flour (if possible enriched in micro-nutrients, in order for recipients to obtain the intended food ration). If cereal grain is distributed, then milling losses must be allowed for, and the amount must be increased accordingly. Such an increase raises the corresponding logistics and costs by at least 20% (at least 10% material loss and 10% milling costs), which results in more expenses than preliminary industrial milling.

[21] See Chapter XIII on therapeutic feeding.

[22] That is, the same group, in the same location, the same season, with the same factors causing severe malnutrition, the same treatment schemes, and the same methods of admission and care.

[23] See Chapter V, Table 5.2.

Despoiling is a more sensitive issue, especially if it is organized and systematic on the part of armed groups. In some situations, opposing groups have been known to agree on equal taxation systems and successively visited recipients to help themselves unhindered, as a part of the deal. In cases where malnutrition persists because of such practices, should losses be compensated? If they are, humanitarian agencies will inevitably be accused of supporting the war effort of such armed groups. Moreover, increasing rations can only encourage greed, and cause humanitarian agencies to be seen as profitable sources of income. Representation efforts and achievements may be destroyed altogether. It is best therefore not to increase rations to compensate losses resulting from pillage. However, measures must nevertheless be taken in order to ensure acceptable security conditions: armed groups must be engaged in dialogue and the best interest of the victims must be put forward as much as possible. If this fails, alternatives must be considered; apart from withdrawal pure and simple (which may be inevitable), options include the provision of meals to be eaten on the spot (armed groups lose interest in prepared meals as they are hardly willing to queue outside soup kitchens), and refraining from distributing commodities that are attractive in terms of quality or easy transport (such as meat and fish preserves, and survival biscuits and rations).

Composition

In short, foodstuffs used in full GFD rations usually include the following items.

1. A basic food, usually cereals, supplied whole, milled or manufactured (e.g. pasta). Family parcels may include wheat flour, pasta and rice; if wheat flour is included for bread production, yeast must be available or supplied also.
2. A concentrated source of energy in the form of fat or oil, which is compatible with local eating habits and enriched in vitamin A if possible. Palm oil contains much provitamin A, but it is difficult to distribute because it congeals at ambient temperature. The same reservation applies to clarified butter (which is in any case nowadays less available to humanitarian agencies because of the reduction in the dairy surpluses of Western countries). Most edible vegetable oils are acceptable. Sugar is another palatable source of energy that can complement oil.
3. A source of protein in the form of legumes, or canned or dried fish or meat (e.g. the East African biltong, which is however an expensive, less common option). Powdered milk should not be included in GFD because it discourages breastfeeding, and requires appropriate hygiene conditions and the availability of safe water, which is seldom found in crises. Exceptions exist, but they must be approved by competent medical staff following the thorough examination of the situation.[24]
4. Salt that is iodized up to 30 to 50 mg of iodine per kg of salt. The inclusion of iodized salt is very important in view of the substantial geographical spread of iodine deficiency.
5. Complements to ensure micro-nutrient intake: fresh animal or vegetable products, fortified biscuits, or blends such as CSB mentioned earlier. Such complements must satisfy the daily recommended intakes of essential micro-nutrients for all age groups. They should in principle be enriched according to the amounts that are already supplied by basic rations if the latter include cereals, legumes, oil, and iodized salt.
6. Ingredients that enhance flavour: spices and seasonings, tea, coffee, or sugar.
7. If necessary, tablets supplying all essential micro-nutrients according to recommended intakes or in therapeutic doses if nutritional catch-up is urgent.
8. Alternatively, survival rations or biscuits may be distributed alone provided that they contain all essential nutrients in adequate amounts. This option is expensive, it is very monotonous for its recipients, may entail security hazards, and can result in environmental pollution.

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[24] See Annex 3.

It may be chosen when take-away rations cannot be composed with basic foods, or if recipients are unable to cook and they cannot be supplied with prepared meals. The commonest example is that of groups that must abruptly move leaving all their possessions behind.

Examples of food rations

A number of examples of full rations are provided below. It is worth reiterating here that breastfeeding must be encouraged, restored and protected actively in all circumstances as the best method of infant feeding, and an invaluable nutritional and emotional complement during weaning.

Full rations must be designed on the basis of simple and easily found foods and ingredients. Table 12.3 below suggests a list of such foodstuffs, indicating their average protein and energy content, in addition to ingredients that are included in order to enhance flavour and diversity. Calorie and protein variations clearly occur according to the type of foodstuff chosen, but they are usually minimal with respect to the uncertainty related to context-specific calorie requirements. The foodstuffs indicated below represent the major food groups that can be included in GFD. Other foods may of course be included, provided that they comply with local eating habits.

Table 12.3 Foodstuffs and ingredients that may be included in GFD rations

Foodstuffs or ingredients	Energy [(kcal/100 g) ((kJ/100 g))]	Protein (g/100 g)
Cereals, pasta	350 (1,460)	10
Legumes	340 (1,420)	23
Oil[a]	900 (3,760)	
Corn soy blend (CSB)[b]	380 (1,590)	18
Fortified biscuits	450 (1,880)	14.5
Sugar	400 (1,670)	
Fresh fruit/vegetables[c]		
Canned fish[d]	300 (1,250)	22
Canned meat	220 (920)	21
Dried fish	270 (1,130)	47
Dried meat	250 (1,045)	39
Fresh fish	120 (500)	21.6
Fresh meat	120 (500)	20.6
Salt[e]		
Spices/powdered seasonings		
Tea or coffee		
Micro-nutrient tablets[f]		

[a] Oil should be enriched in vitamin A (approximately 6,000 IU of retinol/100 g).
[b] CSB should supply the micro-nutrients that are lacking in rations containing only cereals, legumes, and oil according to recommended daily intakes.
[c] Fruits and vegetables supply micro-nutrients and enhance the flavour of the diet. Their calorie and protein content does not affect ration calculation.
[d] Canned fish is understood as preserved in oil and not brine.
[e] Salt must be iodized (30 to 50 mg of iodine per kg of salt, in the form of potassium iodate).
[f] Tablets must satisfy daily recommended micro-nutrient intakes if they complete basic rations, like biscuits and CSB. The supply must be adjusted if the purpose is to address deficiencies.

Table 12.4 converts Table 12.3 into quantitative terms.

Table 12.4 Amounts for distribution and corresponding nutritional values

Foodstuffs or ingredients	Amount (g/day)	Amount/ month	Energy (kcal/day) ((kJ/day))	Protein (g/day)
Cereals	400	12 kg	1,400 (5,850)	40
Legumes	33.3	1 kg	113.3 (474)	7.7
Oil	30	1 l	270 (1,130)	
CSB	66.7	2 kg	253.3 (1,060)	12
Biscuits	50	1.5 kg	225 (940)	7.25
Sugar	16.7	0.5 kg	66.7 (280)	
Fresh fruit/vegetables	150	4.5 kg		
Canned fish	50	1.5 kg	150 (627)	11
Canned meat	50	1.5 kg	110 (460)	10.5
Dried fish	33.3	1 kg	90 (376)	15.7
Dried meat	33.3	1 kg	84 (351)	13
Fresh fish	50	1.5 kg	60 (251)	10.8
Fresh meat	50	1.5 kg	60 (251)	10.4
Iodized salt	5	150 g		
Spices/powdered seasonings	1 – 2	30 – 60 g		
Tea or Coffee	5 – 10 or 10 – 20	150 – 300 g or 300 – 600 g		

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Table 12.5, based upon the data contained in Table 12.4 above, provides some examples of individual daily reference rations, whose calorie content is approximately 2,250 kcal ± 50 kcal (9,400 kJ ± 210 kJ), in line with the planning recommendations made in this Manual.

Table 12.5 Examples of full reference rations for planning purposes

Foodstuffs or ingredients	Amount in grams per person per day ration No.						
	1	2	3	4	5	6	7[a]
Cereals[b]	400	400	400	400	400	420	400
Legumes	33.3	33.3	33.3	33.3	66.7	30	100
Oil	30	45	45	30	45	40	60
CSB	66.7	66.7	33.3	33.3		60	
Biscuits[c]				50	50		

Sugar	16.7	16.7	16.7	16.7		20	
Fresh fruit/ vegetables	150	150	150	150	150	150	
Canned fish	50						
Canned meat				50			
Dried fish ***or*** dried meat			33.3				
Fresh fish ***or*** fresh meat		50					
Iodized salt	5	5	5	5	5	5	5
Spices/ powdered seasonings	1 – 2	1 – 2	1 – 2	1 – 2	1 – 2	1 – 2	
Tea or Coffee	5 – 10 or 10 – 20	5 – 10 or 10 – 20	5 – 10 or 10 – 20	5 – 10 or 10 – 20		5 – 10 or 10 – 20	
Micro-nutrients							include
Energy (kcal) ((kJ))	2,253 (9,420)	2,300 (9,610)	2,200 (9,000)	2,311 (9,660)	2,257 (9,430)	2,240 (9,360)	2,280 (9,530)
Protein (g)	70.7	70.4	69	71.4	62.6	59.7	63
P/E (%)	12.5	12.2	12.6	12.4	11.1	10.7	11
OE/TE (%)[d]	12[e]	17.6	18.4	11.7[f]	17.9	16	23.7

[a] Ration 7 is an example of a ration that cannot be diversified (as is the case, for instance, in prisons). It must in this case imperatively be combined with the distribution of tablets or powders that contain the essential micro-nutrients that are lacking in the basic ration.
[b] If the cereal is distributed in the form of flour and is to be used to produce bread, yeast must also be supplied.
[c] 66.7 g of CSB may be replaced with 50 g of biscuits, provided that this completes the micro-nutrient content of the basic ration.
[d] OE/TE = energy supplied by oil/total energy supplied.
[e] The proportion of oil is low, but it is compensated by the oil contained in the canned fish.
[f] The proportion of oil is low, but it is compensated by the biscuits and the canned meat that are rich in lipids.

Other combinations, based upon Tables 12.4 and 12.5, may be devised to accommodate constraints and opportunities. The energy and protein value of rations indicated in Table 12.5 is calculated from the average value of relevant food groups. In practice, the energy and protein value is adjusted according to the foodstuffs that are actually selected for inclusion; however their amounts must not be changed in order to reach equivalent calorie values. For example, if ration 2 provides the reference, 400 g of cereal are included, be it maize or rice, and the amounts of other ration components are not changed either, even if the energy and protein content of the resulting ration is slightly different. On the other hand, amounts should be adjusted if observation indicates that the factors determining the ration are different from those used in designing the reference ration. For example, if recipient groups must rebuild their habitat and tend to their crops manually, the cereal ration should be increased by 100 g per person per day in order to compensate for the additional physical effort.

As mentioned earlier, it may be necessary to distribute full rations that ensure mere survival. This option has proven successful in the distribution of meals in Somalia and Angola. Its application to take-away GFD is much riskier because of family redistribution and the utilization of distributed food for other ends than those initially intended. It is worth noting here that, in terms of calories, minimal survival rations are only approximately 15% lower than the planning rations discussed in this Manual, and only 10% lower than those recommended by the WFP and the WHO. Circumstances must therefore be very restrictive indeed to prevent logistical adjustments aimed at increasing rations by 10 to 15%, and improving their adequacy accordingly. In such extreme circumstances, the foodstuffs chosen for inclusion must have the highest possible energy content (i.e. cereals, legumes, oil, biscuits, and CSB), and canned foods should be avoided. Spices and seasonings and, possibly, coffee or tea, should nevertheless be included, and fresh products should also be supplied if they are locally available. In principle, biscuits and CSB should fully complement basic rations in terms of micro-nutrients, failing which powders or tablets must be supplied. Table 12.6 below provides some examples of minimal rations; like Table 12.5, it is based on Tables 12.3 and 12.4.

Table 12.6 Examples of minimal full rations (1,900 kcal or (7,940 kJ))

Foodstuffs or ingredients	**Amount in grams per person per day** ration No.						
	1	2	3	4	5	6	7[a]
Cereals[b]	300	300	400	400	400	300	400
Legumes	33.3	66.7	66.7			100	66.7
Oil	45	45	30	30	30	30	30
CSB	66.7			33.3	66.7		
Biscuits[c]		50				50	
Sugar				16.7		16.7	
Fresh fruit/ vegetables	150	150	150	150	150	150	150
Dried fish ***or*** dried meat	33.3						
Fresh fish ***or*** fresh meat			50	50			
Iodized salt	5	5	5	5	5	5	5
Spices/ powdered seasonings	1 – 2	1 – 2	1 – 2	1 – 2	1 – 2	1 – 2	1 – 2
Tea or Coffee				5 – 10 or 10 – 20		5 – 10 or 10 – 20	
Micro-nutrients							include
Energy (kcal) ((kJ))	1,912 (7,990)	1,907 (7,970)	1,957 (8,180)	1,923 (8,040)	1,923 (8,040)	1,952 (8,160)	1,896 (7,930)
Protein (g)	65.4	52.6	66	56.6	47.3	60.2	55.4
P/E (%)	13.7	11	13.5	11.8	9.8	12.3	11.7
OE / TE (%)[d]	21.2	21.2	13.8	14	14	13.8	14.2

[a] Ration 7 is an example of a ration in which only basic foods can be included. It must in this case imperatively be combined with the distribution of tablets or powders that contain the essential micro-nutrients that are lacking in the basic ration.
[b] If the cereal is distributed in the form of flour and is to be used to produce bread, yeast must also be supplied.
[c] 66.7 g of CSB may be replaced with 50 g of biscuits, provided that this completes the micro-nutrient content of the basic ration.
[d] OE/TE = energy supplied by oil / total energy supplied.

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As is the case for the rations indicated in Table 12.5, other combinations may be found to accommodate constraints and opportunities. In practice, nutritive values are adjusted according to the foodstuffs actually chosen for inclusion, but without changing the amounts provided in Table 12.6.

3.2.2 Complementary rations

Complementary rations are used when the target group cannot secure enough food and/or when doing so is dangerous. As a result, if a given group clearly still has access to food, but insufficiently so or in a way that exposes it to risks, complementary rations supply the food commodities that the group cannot secure, or replace what the group obtains or consumes in a way that threatens its survival.

The concept is rather simple; however its implementation is usually more complicated, and involves the following stages.

1. Listing all staple and complementary foods that the target group usually eats, including habitual amounts and proportions.
2. Determining how the target group usually secures such foods.
3. Listing the foods consumed by the target group in the current circumstances, and determining how these foods are obtained.
4. Defining the deviation with respect to normality in terms of consumed food types, amounts, and foods that are no longer consumed and how they could be obtained.
5. Establishing what is dangerous (or potentially so), and what may be beneficial.
6. Selecting responses in order to mitigate risk.

This approach illustrates the fact that, in an abnormal dietary behaviour, it is not only the nutritional aspects that matter.

Possible hazards include the following, which are briefly quoted as examples.

- ⇨ **Dietary hazards**: overall insufficient (energy) and unbalanced food consumption; consumption of toxic foods without the possibility of detoxification; consumption of unfamiliar foods that are difficult to prepare or are improper for weaning.
- ⇨ **Economic hazards**: excessive time spent on obtaining food directly or indirectly to the detriment of other essential activities, such as those that contribute to household economic self-sufficiency, or care of dependants; excessive increase in the supply of goods or services, reducing the relative market value of commodities offered by the target group (i.e. unfavourable domestic terms of trade); exchange of survival reserves for food, causing dangerous impoverishment or even capital loss;[25] disproportionate utilization of income to the detriment of access to healthcare or education.
- ⇨ **Social and political hazards**: the conduct of production activities that undermine social status (harmful survival mechanisms such as prostitution); competition for activities and commodities that generate tension and violence; seizing of goods or land (which also gives rise to tension and violence); survival behaviours that are unacceptable to the authorities, to specific population segments or the host community and so lead to reprisals and exclusion.
- ⇨ **Physical hazards**: gathering and the collection of fuel material (e.g. firewood) can involve exposure to landmines and attacks, rape is one of the most serious and widespread dangers.
- ⇨ **Environmental hazards**: exhaustion of the natural reserves that generate gathering, hunting, and fishing products; destruction of woodlands and thickets in order to produce and sell fuel; over-exploitation of marginal zones.

[25] See Chapters VII and VIII.

The above hazards often coincide. The selection of most appropriate responses implies that operating agencies can predict the duration and degree of abnormality, and its possible deterioration until the access to food of the affected groups returns to normal. With respect to duration, the following must then be appraised:

⇨ the resilience of affected groups (i.e. what they still possess, what they can still utilize, with what consequences);
⇨ the harm already caused by the current situation;
⇨ the anticipated harm;
⇨ the time required for resources mobilization in order to assist affected groups.

The foodstuffs that complement rations must not necessarily exactly replace the foods that are lacking, or those that are unfamiliar or can only be obtained at excessive cost. The conditions prevailing on local markets must be taken into account, as must the anticipated impact of the distribution of a given commodity on its local price and availability. In a crisis, basic foods are often those that are most scarce and, thus, most expensive. Their distribution in sufficient amounts may therefore improve access to other food commodities, either by lowering their price, or by permitting their exchange. What can actually be exchanged must therefore also be determined. Defining complementary rations involves the same considerations as those applied in planning GFD, as discussed previously.

A number of inevitable complications nevertheless remain in defining complementary rations.

⇨ Target populations are not homogeneous in terms of access to food. It may be necessary to target groups that are especially vulnerable or, where this is not possible, to set ration levels that satisfy the need for assistance as effectively as possible. This however implies that some will receive too much, and others too little; the latter may require additional safety measures such as the establishment of supplementary and therapeutic feeding centres in order to treat moderate and severe malnutrition.
⇨ Coping mechanisms and the economic potential of available resources can be difficult to appraise, and may be unclear if target groups are still at the stage of exploring available opportunities.
⇨ Over time, GFD beneficiaries usually improve their economic efficiency and their nutritional status, and this may justify ration adjustments. However, field workers must not follow impressions blindly, and they must remember that GFD rations sometimes provide a nutritional and an economic contribution simultaneously. Food access possibilities alone must therefore not influence ration adjustments; the economic situation of ration recipients must be appraised in the light of overall operational objectives.[26]

In conclusion, the views and behaviour of target groups are once again crucial elements of the decision-making process.

Clearly, the more complex the problems and the more volatile the situation, the closer and more frequently field workers must monitor access to food and the local economy.

In practical terms, the rations provided in Tables 12.5 and 12.6 may be used fully or in part to set complementary rations. To this end, foodstuffs that make up the rations are selected, and then adjusted according to the sub-multiples and distribution frequency in order to reach required amounts.

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[26] See Chapter IX.

3.2.3 Setting rations that also serve as economic exchange commodities

The problem

It must be clear from the outset that food aid should not serve as a currency. This is a waste of resources and effort, not to mention that its relative value is then usually lower than if cash were distributed instead. This is especially true when many recipients sell the same commodity in order to purchase scarce goods. Humanitarian aid must strive to meet all needs for aid involving economic goods and services necessary for survival, in order to prevent the use of food to other ends than nutritional, or its exchange for essential foodstuffs that are not supplied through GFD. That being said, it is well-known that people utilize donated resources in their own best interest, which reaches far beyond immediate survival. Therefore, part of distributed rations is inevitably exchanged; what matters here is to limit this phenomenon as much as possible. In this respect, the close monitoring of the utilization of resources and in-depth dialogue with their recipients should permit the adjustment of assistance in order to optimize its impact.

When humanitarian assistance does not satisfy (deliberately or owing to negligence) all the needs for aid in terms of survival, food will inevitably serve as an exchange commodity. Such developments are not surprising: the victims cannot be blamed for such behaviour and it is too late to do anything but deplore the resulting malnutrition. In such circumstances, rations that have been set in order to satisfy physiological needs cannot do so – the deficit being determined by what had to be exchanged – and malnutrition will be proportional to the destitution of the victims. This leads to the fundamental paradox in which the more destitute and hungry people are, the more food aid they need to devote to non-nutritional purposes if food is their only resource.

As a result, the utilization of food as an exchange commodity should only be planned as a last resort, when no alternative exists, or when this is the only way of opening access to essential goods and services. In any case, such a decision must rest on thorough assessment.

Practical aspects

The distribution of food rations is seldom intended to supply an exchange commodity only; in principle it usually aims at two objectives, whose relative importances vary according to circumstances.

1. The nutritional objective: the approach is identical to that applied in setting full or complementary rations. Readers are therefore referred to Sections 3.2.1 and 3.2.2 above.
2. The economic objective: the approach consists in supplying a complement that should permit its exchange for commodities that are considered to be essential by the operating agency and its recipients, with a view to optimizing the utilization of available resources. Such additions may serve as revenue, as general economic support, or as a means of exchange for specific and identified goods and services. Consequently, the minimum necessary revenue or the local price of desired goods and services must be clearly established. Basic complements or additions are determined by participatory surveys, and the examination of local markets, in order for relative market values to be set and known before launching distribution. Clearly, the commodities that are most valuable in terms of achieving set goals must be examined closely. Their profitability is here not restricted to their economic purchase yield, or to the practical resolution of the problem faced by the operating agency; it includes all ethical, social, economic, political, and environmental aspects of the process. The latter must moreover be sustainable, without entailing a significant deterioration of market relations. It should preferably be tested beforehand, and should be formally agreed upon

by all stakeholders. These conditions cannot always all be met; in some circumstances, they may even be inadvisable. Field knowledge and a sound understanding of the problem should determine the answer.

The operation must be monitored thoroughly in order to detect the inevitable deviations and, if appropriate, correct them as early as possible.

3.3 TARGETING GROUPS

The decision to target specific groups within a given population for GFD aims at limiting the waste of resources committed by donors, and at excluding those that do not really require assistance.

Targeting involves three levels of identification.

1. The geographic identification of areas and populations that are affected by adverse phenomena.
2. The identification within such populations[27] of communities that face crisis because of their functional or cultural features.
3. The identification within such groups of the households that really require assistance.

The first level usually involves no difficulty.

The second should not either, provided that common sense and assessment techniques combine appropriately. However, a given community may be singled out as requiring specific attention, but it may be impossible to target it if other communities oppose what they see, rightly or wrongly, as unacceptable discrimination. Insisting on targeting then becomes dangerous, mainly for the intended beneficiaries who may face reprisals or ostracism, entailing a deterioration of the social climate and risks of violence, but also for the operating agency, which is resented and may become the target of attacks. Humanitarian agencies should not run this risk, and they may anyway be avoided through dialogue with the parties that feel disadvantaged.

The third level is determined by parameters of need and feasibility, and is discussed below.

3.3.1 The need to target only the most needy within communities

Three types of justification exist for this level of identification.

1. Socio-economic discrepancies internal to the community are such as to result in some of its members needing aid, and others not.
2. GFD could demotivate the community from finding its own solutions to the problem.
3. Available resources are insufficient to assist all households, even if they all more or less require support.

[27] The expression “population” is understood as groups of individuals living within a given territory; “communities” on the other hand are bound by family ties, their origin, and their functional and cultural features. For example, the population of a given town may include one or more communities of displaced persons, a community of craftsmen, another of tradesmen, etc. These communities are in contact with one another, but they are primarily organized associations whose survival takes precedence over that of the overall population and, sometimes, over the survival of individuals within the community itself (see Chapter VI).

Socio-economic discrepancies are documented in the course of assessment – it may be difficult to ascertain their mere existence, and the exercise must be thorough and unbiased. In the absence of socio-economic discrepancies, all community members are considered to need aid (or not), and the issue is resolved. If disparities have been detected on the other hand, means must be found to identify the households that do require assistance by use of appropriate indicators. The second question then arises: is this feasible?

In relation to the risk of demotivating recipients, assessment should, here also, demonstrate the actual need for assistance. This having been clarified, the population's resilience, the advantage of extending assistance and the risk that it may be diverted to other ends must then be allowed for. As discussed earlier in this Manual, resorting to coping mechanisms should only be encouraged up to a certain point, because such action always increases vulnerability. Driving a given population to additional efforts for survival in an environment that is already hostile, or is feared soon to become so, is dangerous, and humanitarian agencies may not have the necessary skills to do this. Strengthening survival mechanisms is indeed a fashionable pursuit. However, coping mechanisms are often confused with survival mechanisms (these permit mere survival and have their limits), to the detriment of exploring new, sustainable forms of resource utilization that could ensure durable economic security. Granted, need can open the way for innovation and creativity; however this is by far not a general rule. The investigation of alternative avenues should not provide a pretext to delay action when a given group faces deteriorating economic circumstances, or to target only those that that are already in poor shape. This attitude is one of the causes that can lead to famine, and it undermines efforts to impose early warning and prevention. Humanitarian agencies must remain pragmatic and avoid being overly influenced by the latest trend in received wisdom. In this respect, the idea of the victims' loss of motivation because of assistance is a figment of bias rather than reality.

In the case of limited resources, targeting must be done in close collaboration with the community under consideration in order to find the best possible compromise. It is worth reiterating here that humanitarian agencies should only engage in assistance operations if they have the means to do so. Targeting that is justified by a lack of resources should therefore only be a passing problem arising from unexpected developments. The incessant and popular claim that humanitarian aid always lacks resources can seriously undermine the credibility of operating agencies; the latter must therefore not surrender to difficulties and encourage such views. Politically-correct assistance can always rely on ample (even sometimes excessive) resources. Donors must therefore be persuaded of the minimum level of assistance required in the given circumstances.

3.3.2 Feasibility

It may be difficult to single out specific households within a given community. The exercise entails two major challenges. The first relates to the targeting itself, which may not be acceptable to the community and/or their leaders. Some cultures require that assistance be shared among all members of the community, and targeting specific households is pointless in this case. Such cultures usually rest upon strong social obligations, and the redistribution of wealth to the poor is automatic; reciprocity mechanisms are strongly respected in such settings and, even in the case of targeting, redistribution will probably occur. Field workers must be aware that recipient communities may pretend to abide by the process – if this sets the condition for receiving the goods – and later will do what they consider best, regardless of the operating agency's own objectives. The most needy may precisely be marginalized and ostracized within their own community for social, cultural, or political reasons; alternatively, those who receive State salaries (such as public servants or members of the armed forces) may be excluded. If their exclusion is felt to be arbitrary, serious complications can ensue. Wherever resources are insufficient, or the decision is made to restrict their distribution to selected recipients, attempts at pressure and manipulation in order to secure them are observed, and targeting results in serious negative effects; this is all the more obvious in armed conflict. Paradoxically, it is when famine affects entire communities physiologically that they are observed to be most tolerant to targeting; on the other hand, they are less tolerant in times of impending destitution or economic reconstruction. However, targeting is most called for when crisis does not affect all community members alike, that is, when the struggle for survival is fiercest. Either way, the community must, here too, be involved directly in the targeting process in order to find the best possible compromise. Field workers must then ensure that it is adhered to accordingly. If compromise cannot be found, however, targeting must not be attempted, and aid may need to be cancelled altogether. Nevertheless, the humanitarian agency running a GFD must retain control over targeting processes, precisely in order to avoid diversion and limit pressure on local authorities. It goes without saying that results are influenced above all by the quality of human relations and mutual trust, and this does not just arise from decisions or goodwill but from sustained interaction, which is often utopian in times of crisis.

In addition to targeting, the second challenge lies in the definition of selection criteria that are practical and unambiguous. This may generate a technical problem whose magnitude grows with diminishing vulnerability levels and rising numbers of individuals in the critical bracket. The local population and its leaders should participate in the identification of those who require assistance as a priority. But the seriousness of the situation and its potential for deterioration may complicate participation to the point of causing more problems than it resolves. The cost of targeting in terms of time and personnel must also be allowed for; if the identification of recipient households absorbs all available resources, the effort can be counter-productive. Finally, targeting only makes sense if the situation is stable, and durably so. Otherwise, targeting procedures must be adapted in line with changes that arise, and this is usually simply impossible.

In short, targeting vulnerable communities in situations of crisis is self-evident (but may not be feasible), however targeting specific households within a given community is considerably more complicated. Five reasons explain this:

- ⇨ the difficulty of defining economic discrepancies within the community objectively;
- ⇨ the difficulty arising from the acceptability of screening and attempts at diverting resources;
- ⇨ the difficulty of setting acceptable cut-off points that correspond to a tangible reality for the community;
- ⇨ the difficulty of identifying households once cut-off points have been set;
- ⇨ crisis dynamics that quickly make targeting modalities obsolete.

Consequently, each of the above parameters must be weighed carefully prior to targeting the most vulnerable within a given community, in order to determine whether the objective is really worth the effort.

Passive targeting is a completely different alternative targeting option, which can also yield good results. It involves the supply of food in a form that is acceptable only for those who have no other option, at very low cost or free of charge. This approach does not require initial census or registration, but attendance monitoring (possibly combined with registration), and strict monitoring in order to adjust the operation.

3.4 ATTENDING TO GROUPS

A GFD involves taking responsibility for its beneficiaries. This responsibility is informal, consisting of relations of trust with the population and its traditional leaders as from preliminary assessment. Once the decision has been made to engage in GFD, its beneficiaries must be counted and registered, and they must receive cards that grant them access to the GFD. GFD modalities must also be discussed with them in terms of location, frequency, and quantities and they must be informed that monitoring and follow-up efforts will be conducted. These stages are crucial in order to avoid or at least limit the abuse, misunderstandings and frustration that may arise and generate substantial complications and security problems. Except in operations involving passive targeting, beneficiary population census and registration are indispensable, and must be as accurate as possible. The professional, thorough and firm conduct of this process then promotes the respect of the population and its traditional leaders; this respect is also the only realistic security guarantee in many settings, especially in armed conflict. In addition to facilitating the implementation of GFD, proper registration is crucial for logistics and in terms of operational credibility towards donors, the media, and political authorities (unless the latter intend to control the food commodities involved). Whatever the chosen method, registration involves the physical counting of all individuals present, based upon prior information to the population, and the presence of all individuals living in the group under consideration.

Census and registration are necessary both for direct and indirect distribution,[28] and may even be more important in the case of indirect distribution. The operating humanitarian agency is accountable for its doings and for its thoroughness in reaching its intended beneficiaries; at the same time, it has the right and the duty not to be abused. Indirect distribution practically deprives operating agencies of means of control. As a result, registration efforts provide a unique opportunity to meet all beneficiaries at least once, and to inform them of the process, its purpose, and its modalities.

Clearly, if indirect distribution is chosen because of the absence of access to the intended beneficiaries, then census and registration cannot be conducted either. The risks that such an option entails have been discussed earlier, and it is worth reiterating that it should be avoided if at all possible.

Census and registration are based on demographic data and maps or sketches produced by preliminary assessments.

The successive steps of census are the following.

1. Informing local authorities and securing their consent.
2. Planning census proper (i.e. method, number of individuals and teams involved, the necessary material and vehicles, location, and organization of the population) by involving community representatives who must understand the approach, take part in it, and accept its general benefits. If community representatives disagree, the intended beneficiaries must be persuaded that the proposed approach is the only option, and be requested to persuade their representatives in turn. If this also fails, the relevance of the planned operation should be seriously questioned. The census, registration and inclusion of hardship cases must also be considered and defined.
3. Training and organizing teams (each team should include at least one person in charge of organization, assistants, and interpreters where necessary), informing all team-members of their role and the standard procedure in case of complications.
4. Informing the community with the help of its representatives that census and registration for distribution are about to take place. The following in particular must be explained:
   → **location** if the process involves gathering the population, the chosen location must be large enough, sufficiently sheltered from the sun or the elements, and it must be possible to cordon it off with clearly marked entry and exit points;

[28] See Section 2.7 in this Chapter.

→ **timing**;
→ **required attendance**: census and registration are performed on individual basis, or based upon residence (McMahon, 1999);[29]
→ **procedure and follow-up** e.g. monitoring, timing of the first distribution;
→ **material required of the beneficiaries** according to circumstances – personal identification, chairs, food for children, personal protection against the sun or rain, etc.;
→ **the need to comply with the procedure**: the population must understand that the distribution cannot take place without proper census – thorough preliminary information must be delivered to the population in order to ensure proper registration, whichever way it may ultimately be performed.

5. Preparing the material required – tables, chairs, stationery, registration lists and ledgers, rope and poles in order to channel queues, megaphones, markers to identify registered persons, etc.
6. Performing census and registration proper.

3.4.1 Individual census and registration

This approach consists in gathering the population in one or more locations, and registering all its members on the same day, if possible at the same time in order to avoid people registering twice in different locations. All able persons, young and old, must report. Exceptionally, sick, helpless, or absent individuals may be registered provisionally, provided that the reasons are valid (for example, persons who have had to remain in the village or neighbourhood to watch over it in the absence of its population), but each case must be verified independently. The population must understand that only individuals who have reported and been registered on the set date will receive assistance, and that no exception other than those stated above will be made. Concessions are a sure way of losing control, and make the whole exercise pointless or even counter-productive. This individual approach is useful in rural settings where enough space can be found, and inhabited areas are easy to supervise. It is also the best method in the absence of regular access to the population, and if the latter must travel to central locations. In such cases, it is best to combine registration with the first food distribution in order to spare recipients unnecessary journeys. In 1985 in Ethiopia, some groups undertook journeys of several days on foot in order to be registered and receive their rations.

Census locations must be large enough to accommodate considerable numbers of individuals comfortably, and to enable them to commute unhindered between entry and exit points. Registration is performed according to geographical unit (e.g. village or neighbourhood), or any other practical denominator. The population is asked to stand in line behind its traditional leaders, who help to enforce organization and order. The population reports as families, with the mother of the children registered as family head, and the husband with his first wife in case of polygamy.

Once the queues are established and orderly, two procedures may be followed.

1. The population is ushered, one family at a time,[30] to a table where last names and the number of family members are recorded in a ledger, in addition to a varying number of details (such as age, first names, and vaccination details);[31] family heads (it is usually preferable for mothers to be considered as such) must be recorded in ledgers, and then receive cards that grant them access to the GFD.[32] Each individual is then marked in some way, for example by having a little

[29] See Sections 3.4.1 and 3.4.2 in this Chapter.
[30] The expression “family” is understood as the local definition of a household unit – such units may include only one individual.
[31] For subsequent monitoring purposes, family names and card reference number must appear in ledgers: if cards are claimed to be lost or stolen, operating agencies can then nevertheless verify the relevant entries accordingly.
[32] See Section 3.4.3 in this Chapter.

finger dipped in gentian violet, and proceeds to the next attention point (e.g. vaccination, nutritional measurement, vitamin A supplementation, or food ration distribution), or returns home. In this way, the entire procedure is performed at once: census, registration, and card distribution. However, the process is rather slow, and people are permanently on the move, which may cause disorder or unrest.

2. The population is seated in rows, according to the same organization as above. In this case, however, registration teams move along the rows. They give each family head a GFD beneficiary card; teams record the card reference number and the number of family members included in the card in ledgers (or in scrap-books that will later be transcribed into central ledgers); once all the cards have been distributed in this way, registration teams know the exact number of registered families and individuals. In this process, the population remains immobile during the entire registration process, and this may avoid much disorder. Only when all the cards have been distributed does the registered population proceed to the next attention points, where names and other necessary information are finalized in the central ledgers; this second stage may even occur at a later date, in smaller groups.

As mentioned earlier, some means must be found to assist hardship cases in consultation with local authorities.

3.4.2 Census and registration according to residence

This method consists in identifying dwellings and their occupants in order to list them. All members of all family units of a given dwelling or defined group of dwellings (i.e. clusters) must be present. This method is useful in urban settings, provided that enough teams are working in parallel in order to discourage attempts at abuse. This approach involves three steps.

1. A perimeter is set to include dwellings or clusters within an overall area that is identified according to geographic or political denominators; these dwellings or clusters are then marked with chalk with the help of local civilian authorities. This coding provides an indication of the area or neighbourhood, and the individual dwelling or cluster reference number; it also provides an indication of the number of family units that live in the dwelling or cluster. For example, an individual may live alone (e.g. an elderly or handicapped person) but depend on a specific family unit for his/her food; this individual does not correspond to a family unit, but is to be included in that of the family that supplies his/her food. If, on the other hand, an individual lives alone and is fully independent, he/she amounts to a family unit and is entitled to his/her own card. As mentioned earlier, hardship cases warrant separate attention with the help of local authorities.

   Coding example:
   N1/14/c

   Where "N1" is neighbourhood number 1, 14 the fourteenth house registered in this neighbourhood, and "c" indicates that three families live under the same roof in house number 14.

2. Subsequently or simultaneously to coding (depending on circumstances), beneficiary lists are established, which involves the registration according to family units of all individuals living in each dwelling or cluster. Persons who are absent or do not return home every night are not included. The data that is recorded in ledgers usually includes: name, age, sex, and village or neighbourhood of residence. The individual cardholder must be identified. Other information may be gathered also, provided that this does not endanger GFD beneficiaries (e.g. sensitive information that may entail risks for their personal safety). Additional data can be used subsequently to adjust rations according to the demographic profile, or for vaccination or general health activity purposes. If lists are established after the completion of

coding exercises, they can be drafted by the agency in charge of the GFD or by mixed teams that include the agency in charge, local authorities and the beneficiaries themselves, or by local authorities alone. In the latter case, lists must be verified carefully, and rejected if errors appear. Verification is conducted without warning through the random selection of family units, based upon the sampling techniques discussed in Chapter X on Assessment.

3. After coding and the establishment of lists, the codes are indicated on house doors with permanent paint. At the same time, GFD distribution cards are handed over to the heads of family (preferably women)[33] – this is the last opportunity for comprehensive verification.

Census and registration validity must be verified regularly in case of population movements. It may even be necessary to register the population again or find means of registering new members specifically. If cheating and confusion spread, the entire census and registration process must be repeated; distribution rounds may have to be cancelled to do so.

It is often said that census and registration are not possible for security reasons and should be dropped; this is a complete aberration. If the prevailing security conditions prevent census and registration, then they will certainly prevent the GFD itself. On the contrary, proper census and registration provide the only real security guarantees when problems arise at that level. That distribution is urgent is no better excuse: if the process is performed properly by motivated teams, it can be conducted during the logistics set-up phase. Indeed, haste is common in humanitarian action, but entails so many negative effects that it must be resisted at all costs. In one specific case, the emergency situation and poor security caused the registration of beneficiaries and the distribution of food rations to be left in the hands of traditional leaders who were manipulated by guerrilla forces. This development resulted in inflated beneficiary lists, serious food diversions, widespread frustration among the population that did not receive its entitlements, an aggressive and dangerous attitude on the part of the guerrilla and local authorities, and grave resentment on the part of the political authorities that witnessed the lapse. Once efforts were made to regain control over the operation, it was already too late, and insecurity had escalated to such an extent that the operation could not be carried out – the situation continued to deteriorate until the operation had to be terminated. Proper professional implementation of the GFD would have prevented this development; disorder would not have resulted, and the operation would have remained under control.

3.4.3 Distribution cards

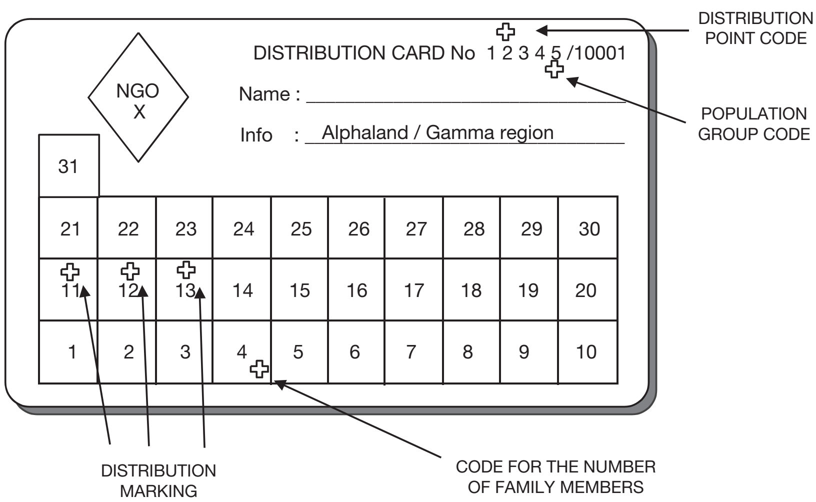
GFD cards acquire crucial importance in crisis settings. For the operating agency, they contribute substantially to the monitoring of beneficiaries; for the beneficiaries, they give access to the GFD. As such, they are of considerable value. The end justifying the means, the creative ingenuity shown in forging or tampering with cards knows no limits. Consequently, the thorough checking of cards is of crucial importance.

Distribution cards indicate a number, which corresponds to the registration number recorded in the ledger, a code for the number of family members, a code that indicates at what distribution point the card is valid, a code for the registration criterion of the population group the cardholder belongs to, and its last and first names. Cards must also show the logo of the operating agency or, alternatively, that of the agency supplying the food to the distributing agency.

[33] See Section 3.4.3 in this Chapter.

Cards should be made of flexible but solid plastic, and preferably marked through their thickness in order to complicate forgery. They usually contain two types of information: cardholder details (this part also indicates the pre-printed individual card number), and numbered boxes for different coding purposes and for the tracking of the rations received by the cardholder. It is best to use perforators or punches with unusual patterns for both coding and ration tracking, and the perforators must be kept carefully by the staff in charge of the distribution. Card coding calls for creativity and the key to codes must be recorded in the GFD logbook, which must be accessible to the overall GFD supervisor only. Figure 12.2 below provides an example of card and coding.

Figure 12.2 Distribution card – example



Distribution rounds may be marked in the second and third row, for example, where box 11 corresponds to round 1, box 12 to round 2, and so on. The numbers corresponding to distribution points, beneficiary groups, and distribution dates are recorded in the GFD logbook, which also indicates their key.

Whatever census and registration method is chosen, cards could be given to all individuals. This would however multiply the risk of abuse, traffic, sale, and forgery accordingly. If each family or household holds only one card, the motivation is also greater to keep it safely in order to preserve access to food distributions. Moreover, the verification of a single card per family greatly facilitates the GFD itself. Provided that this does not expose them, it is best for women to hold the family card, because women tend to use them more in the direct and immediate interest of the household than men do. In anticipation of card loss or theft, cardholders are requested to remember their card number or to write it down on a piece of paper so that they may be identified in card-holder ledgers. They must also be asked to report card loss or theft if possible before the distribution date, or at least before the distribution begins. The distribution then also provides the opportunity to verify whether the missing card has indeed been lost or stolen, or whether the report is an attempt at abuse or misuse.

What is considered as attempted abuse and its sanctions must be clearly defined prior to the distribution itself, in consultation with the local authorities. GFD beneficiaries must be made aware of the resulting agreement and its details. There are no universal sanctions for abuse; the chosen approach must combine flexibility and firmness. For example, a family of five, among which three children suffer from severe malnutrition, cannot be excluded under the pretext that one parent tried to cheat. The reaction must be a sanction ranging from simple reprimand to culturally effective forms of reparation or fines. If the problem spreads, registration must be repeated, and the distribution may need to be suspended, while attempting to understand the reasons behind this spread. General cheating may indicate abuse, but may equally indicate forced behaviour resulting from circumstances unnoticed by inexperienced observers. Different underlying causes clearly call for different types of reaction.

3.5 DISTRIBUTION MODALITIES

Food may be distributed directly to its recipients, or indirectly through their local or traditional leaders. However, indirect distribution requires the application of means to control its quality; it should only be resorted to in the absence of alternative, as it usually results in lapses that are difficult to correct subsequently. Direct distribution involves the provision of take-away rations or food to be eaten on the spot. Food is supplied in take-away form if its recipients have the means to prepare it themselves, when security conditions permit it, or when recipients must move abruptly. In this case, it is best to distribute survival rations and biscuits – the provision of meals is preferred in the circumstances discussed in Section 3.5.2 below.

3.5.1 Take-away rations

The distribution of take-away food rations must ensure the regular and sufficient food consumption of its recipients. It must be organized in a way that complies with a set frequency, involving the intended amounts and timeframes, and avoids interruptions at all costs. This implies that the logistics supply chain can indeed run smoothly, and that its staff is informed in time of the required amounts to be delivered to specific distribution points. Recipients must be involved in the distribution planning phase, especially in striking the best balance between distribution frequency and the amounts to be carried home. Full rations should be distributed at least once a month if the population must carry it on foot. As a reminder, full rations for one month weigh roughly 18 kg; a family of five, of which three are infants (and, thus, cannot carry their ration), must then carry away 90 kg at once, that is, 45 kg per adult – this is extreme. The frequency of distribution rounds must therefore be set by referring to common sense, and adapt to circumstances. If recipients face a four-day journey on foot to reach distribution points, they can hardly be expected to undertake such a journey more than once a month. In camp settings, on the other hand, it may be most practical to conduct distributions on a weekly basis. The ultimate decision must also allow for the constraints of the distributing agency in terms of staff and logistics, with respect to the number of recipients and the time required for the distribution itself.

Take-away food rations may be distributed in the form of separate commodities, individual or family parcels, or survival rations and biscuits. Separate food commodities and parcels are preferred. If parcels are chosen, distribution frequency must be discussed in detail beforehand, as this determines their content – once they have been assembled, their content can no longer be changed. Parcels are useful if several commodities (e.g. toiletries) are to be distributed in small amounts. Besides, parcels and separate commodities may be combined: for example, complements, flavour-enhancing ingredients, and small non-food items can be gathered in parcels, while flour is distributed from bulk consignments.

GFD goods are delivered to the recipients' home, or handed out in central distribution points. In actual fact, home delivery is rare, and is restricted to specific cases: examples include attention to small, scattered communities, and the anticipation of security problems for the recipients. Home delivery usually entails no specific difficulty. When distribution is conducted in a central location, the key to its success lies in informing recipients of procedures, and proper organization. Here again, its beneficiaries must be involved in the operation from beginning to end.

Informing the population

Distribution dates

The population must be informed of the first distribution round sufficiently in advance, so that it may organize itself, especially if it must travel long distances to reach distribution points. Provided that frequency is regular and plans are adhered to, simple confirmation should suffice thereafter. If plans must be modified on the other hand, timely information must be delivered accordingly.

Location

There must be no possible confusion as to where the distribution will take place.

Attendance

In some cases, it may be best that all beneficiaries attend, and assistance only be delivered to persons who are present accordingly (especially if attempts at abuse have been noted). Distributing agencies may on the other hand choose to meet only cardholders accompanied by a limited number of their relatives who are there to help the cardholder transport the distributed goods.[34] The extent of required attendance is also determined by the other types of activity that may be conducted at the same time as the GFD, such as child vaccination, nutritional measurement, or vitamin A supplementation. What matters here is that the modalities of the distribution and, in particular, its associated attendance requirements be made clear beforehand.

Material required of beneficiaries

In principle, distributing agencies do not supply the material required for carrying assistance items away. Recipients must therefore be told clearly what type of material they must bring to the distribution; however, distributing agencies must always keep some packing material for the completely destitute, but this must however remain the exception.

Ration type and size

Recipients must understand their entitlements, in order for them to organize their transport.

Distribution modalities

Recipients must be aware of distribution modalities, what other activities will be taking place at the same time where relevant, and what they are expected to do; this saves considerable time and effort at the beginning of the distribution itself, and limits disorder.

Organizing the distribution

Work plans

Distribution follows a plan, according to distribution points and beneficiary groups. Available means must permit distribution rounds to be carried out as planned, and be flexible enough to allow for unexpected delays (uncertainty is practically the rule in humanitarian action). For example, the use

[34] In such cases, only able-bodied relatives should be admitted; on the other hand, mothers must frequently report accompanied by their smaller children as they cannot leave them unattended.

of six distribution points, of which each serves two recipient groups on a fortnightly distribution basis, implies that each round be conducted in less than a fortnight, and that each group receive its rations every fortnight. If one group is served per day, then the round would be completed in 12 days; this is too long for a fortnightly cycle, because it leaves no leeway for unexpected delays. If on the other hand two groups are served every day, then the round would be completed in 6 days (for example, 4 days during the first week and 2 days during the following week). This would allow for delays, the drafting of reports, monitoring, the organization of the following round, the maintenance of vehicles, materials, and warehouses and, if necessary, would even permit the postponing of a given distribution. Rest for staff is necessary also, because assistance work is stressful. Proper work plans are a crucial element of a smooth logistical operation.

Recipient units

Food can be distributed according to a set number of members per family, a set number of individuals belonging to different grouped families, or on an individual basis. The set number of members per family reflects average family size, as observed during registration. If the average family size turns out to be four individuals, for example, then four individual rations will be distributed to each family, regardless of its actual size. The set number of individuals per group of families is more arbitrary, and is defined on criteria that facilitate distribution. For example, families are grouped in units of twelve individuals each, and an amount corresponding to twelve individual rations is distributed to each of these groups; the latter then reallocate the resulting assistance internally according to actual family size.

Set numbers of family members along demographic lines would seem a useful device for operating agencies, as it permits the preparation and distribution of standard rations. It is however not recommended, because it profits families that are smaller than average, to the detriment of larger families, without an automatic reallocation of the distributed resources to correct this imbalance.

Grouping families according to set numbers of individuals is time-consuming for recipients. If they can agree however, this option can be quite useful and fast (like set family sizes on a demographic basis).

Nevertheless, experience shows that individual distribution is usually best. Queues and handover points are organized according to the actual number of family members. As a result, each family receives its exact entitlement. Handover point staff is familiar with individual amounts, and this option saves time and confusion. Individual distribution is also surprisingly fast: it can permit the distribution of goods to as many as 25,000 persons per day in a single location.

Location

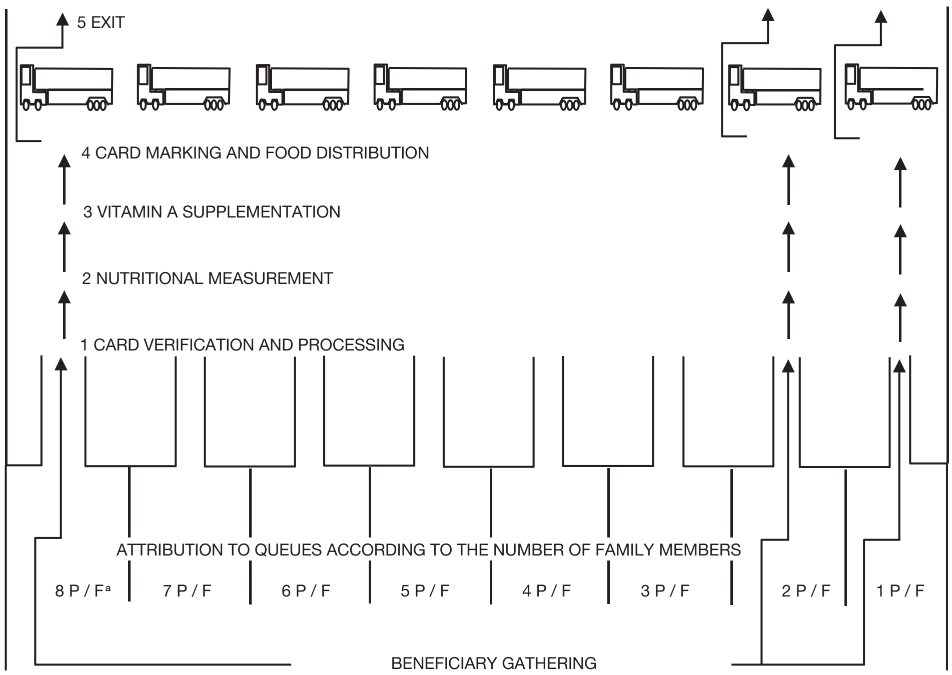
Distribution must be planned in a large, central location, which enables recipients to move around unhindered within its boundaries in an organized flow from the entry to the exit points. To this end, the chosen location must at least be cordoned off and guarded by organization staff and beneficiaries; the latter have a serious interest in avoiding chaos and excluding agitators who, for their part, have every interest in getting inside the secured perimeter and thus gaining access to assistance commodities. Distribution locations should be sufficiently distant from sensitive points such as garrisons, market places, or any other which may entail security complications. They may lie alongside warehouses, or even inside warehouses themselves, providing the organizers are sure to maintain control over the distribution and avoid undesired attendance. This option also saves the logistical complication of loading, transporting, and unloading commodities. In terms of comfort, recipients that exceed approximately one thousand people cannot be sheltered effectively against the elements. If distribution rounds are to be repeated frequently, latrines should be installed and first-aid facilities allowed for. In all cases, in hot conditions and if water is not available in the immediate vicinity, drinking water must be supplied at handover points and at the attention points where accompanying activities are conducted.

Crowd control

Beneficiaries should enter at one end of the distribution location, and exit at the other. Intersection of queues and backtracking must be avoided at all costs. The population gathers and splits into families at the entry point; each family is then referred to a specific queue according to how many members it comprises. Each queue is channelled by ropes, and leads to the card verification desk (see below). The population then reports to the other attention points (where relevant, for example nutritional measurement, or vitamin A supplementation) – food distribution points must always be the last stop. Cards are verified once again and perforated before beneficiaries receive their ration; this ensures that their hands are free to receive the goods, and at the same time avoids people evading the perforation process after receiving their entitlement and then queuing for a second delivery. If food delivery is the only activity, the cards may of course then be perforated at the first point of reporting.

Assistants who speak the local language should be posted at entry points and should use megaphones to explain the procedure and organize queues; this is particularly useful at the beginning of the distribution in order to channel beneficiaries. Special teams maintain order by enforcing the necessary rules. Figure 12.3 below provides a typical example of a distribution point, attention desks, and beneficiary movements.

Figure 12.3 Example of a food distribution point



[a] P/F = persons per family.

Food distribution

The distribution of individual parcels or survival rations is usually simple, as the number of parcels should amount to the number of cards. Distribution from bulk consignments (or "scooping", for example the distribution of flour out of bags) is usually more quickly and often more accurately done according to volume rather than weight. This involves the use of calibrated containers to ensure the

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distributed volume corresponds to the intended weight. To be calibrated, empty containers are used to zero the scale, and are then filled with the amount of the chosen commodity that corresponds to one ration (e.g. 12 kg of cereal). This level is then marked on the side of the container: this sets the volume representing the desired weight of that commodity per ration. Containers are then emptied and the mark reinforced in permanent ink or paint, in a fine but clearly visible line. During distribution, containers must be filled to a level surface up to the mark. The process may be simplified by cutting containers off at the required level instead of just marking them – then a ruler or board can be run across their top to produce a levelled quantity. Clearly, containers must all be calibrated on the same scales, which have been tested beforehand. It is best to use the same containers for the same type of foodstuff in order to avoid confusion. The calibration and general preparation of the required material must of course be done well before the first distribution round, and the staff in charge must practice beforehand. During distribution proper, the lighter foodstuffs or items (such as soap) must be handed over first.

Card verification

Cards must be verified at each distribution round in order to limit both claims and attempts at abuse. The verification process takes place at the queue, *before* recipients proceed to the different attention points. Verification includes the checking of distribution location codes, and those indicating the group due to receive assistance on that specific date. Cards that do not indicate the correct distribution location are withheld, their holders' identity is verified, and the reasons for this situation are examined. Card numbers are also verified in order to check them against those reported as stolen or lost. Card verification may be recorded in ledgers.

Notification to officials

Local authorities must be informed of the distribution due to take place, as they must also ensure that third parties are prevented from taking over. This does not suggest that police or army forces should ensure order at the actual distribution points; this duty devolves upon the distributing agency. However, they must be informed and accept that they cannot take advantage of the distribution to make political speeches, exercise control over the population, recruit or forcibly displace populations. Neither can they take credit for the distribution, or help themselves to commodities during or after the distribution.

The role of staff in charge of distribution

The staff in charge of the distribution has two main and equally essential roles. The first is to ensure the smooth conduct of the distribution itself. The second involves the understanding of the following parameters in their broadest sense:

- ⇨ the population, its reactions, and its needs for assistance;
- ⇨ the impact and effects of the GFD, as well as possible associated or resulting problems arising from organizational issues;
- ⇨ new developments in the situation.

This understanding develops through organized surveys, informal and spontaneous discussion, and the ability to observe and to listen. The staff in charge of distribution is by definition in close contact with the field; as such, it is well placed to analyse and provide the information that is relevant to humanitarian action. The ability to listen is also a security guarantee because it conveys a professional image of the operating agency and its staff, and promotes respect.

3.5.2 Rations to be consumed on the spot

Food can be distributed in the form of meals to be consumed on the spot in two types of circumstances.

1. In institutions (such as prisons, homes, asylums, hospitals, nutritional centres, and canteens for the elderly). As such, this approach does not amount to a GFD proper. Its practical implementation aspects are similar to those of soup kitchens (which are discussed below); however, the decision to provide meals in institutions is routine, and should not pose specific problems.
2. Wherever GFD cannot supply take-away rations. The alternative sometimes involves the introduction of soup kitchens, which in such cases however are closer to the large-scale distribution of meals – the expression "soup kitchen" is kept here.

Situations where soup kitchens are appropriate

In principle, soup kitchens are not recommended for the feeding of large populations. They are usually culturally inappropriate (even offensive), they are time-consuming for their beneficiaries, and may complicate the carrying-out of production activities that are essential to economic recovery. Food hygiene is difficult to ensure in the framework of soup kitchens, and the diet they provide is often monotonous. They upset the food consumption of small children, and do not permit the supply of the necessary daily four or five well-spaced snacks for infants; this often gives rise to problems, especially after weaning. Soup kitchens involve heavy workloads for a smaller yield than that of take-away GFD rations.

A GFD in the form of soup kitchens is therefore only an option in quite specific circumstances namely the following.

1. The beneficiaries cannot prepare their own meals because they lack the necessary space or material (such as cooking utensils and fuel). The provision of fuel is a major problem in GFD, and can cause widespread environmental damage because humanitarian agencies tend to neglect this fundamental aspect. Operating agencies must rather ensure that the use of fuel does not result in deforestation or the exhaustion of natural resources to the detriment of local populations, and does not give rise to tension.
2. Security conditions prevent beneficiaries from taking rations home (as was the case in Somalia between 1991 and 1993); prepared food on the other hand loses much of its appeal for human predators. In such cases, on-site reserves must be kept at a minimum in order to limit theft.
3. Beneficiaries cannot always be targeted. In such cases, only the most destitute report for registration in the kitchens. This can however pose a problem in terms of termination and withdrawal, if the beneficiaries include many hardship cases.
4. Malnourished individuals or those at risk must temporarily be targeted, until such a time as the entire population can be assisted in the form of take-away GFD rations; alternatively, only the malnourished must be targeted because most of the population can feed itself independently; in such cases however, operating agencies must be certain that the situation is unlikely to deteriorate because if it does, this can give rise to serious negative effects, such as those observed where supplementary feeding programmes target the malnourished without a proper GFD to ensure adequate food access for the overall population.

Provided that some conditions are met, soup kitchens nevertheless have clear advantages:

- ⇨ beneficiary diet is easy to control;
- ⇨ depending on admission criteria, they can be very useful in targeting the most destitute;
- ⇨ they permit direct contact with the affected population;
- ⇨ they facilitate the identification of the sick and severely malnourished, which may then be referred to hospitals and therapeutic feeding centres accordingly;

⇨ they enable additional activities, such as vaccination, vitamin A supplementation, parasite treatment, and ambulatory healthcare and nutritional surveillance if necessary;
⇨ they permit the collection of information on the evolution of the nutritional situation in its broadest sense: crop condition, economic activities, market supply, price trends, etc.

Soup kitchen rations

Rations are set according to the same parameters as those discussed earlier in Section 3.2, based on Tables 12.5 and 12.6. Both full and complementary rations require that the food supplied to the kitchens ensures an adequate daily food intake. In the case of full rations, the minimum objective is to avoid deterioration in the nutritional status of their recipients and, if possible, to permit those who are already malnourished to recover. Thus, kitchen rations must cover at least the absolute minimum maintenance needs, of the order of 1,900 kcal (7,940 kJ) and 50 g of protein per person per day. If such rations are consumed entirely, they permit nutritional catch-up for children up to the age of 9 or 10 years, but older subjects remain at sub-standard levels without however starving to death. In such minimal conditions, field staff must remember that environmental cold (i.e. below 18°C) increases the energy requirements of lightly-clad individuals substantially. Consequently, the provision of shelter material, clothing and blankets improves the impact of soup kitchen programmes if the rations just cover maintenance requirements. Soup kitchens may provide comprehensive and adequate rations or offer only complementary rations. Delivering food to institutions is seldom problematic: it is best to supply them with sufficient food rations.

Planning

Soup kitchens must be well planned – this is made easier by the fact that they operate on a daily routine. If the programme supplies only the strict minimum for survival, and especially if clinical malnutrition is the criterion for admission, organization is even more important in order to avoid confusion and perhaps riots. Good organization involves the following points.

Standard organization

All kitchens involved in the programme must observe the same:

⇨ beneficiary admission criteria;
⇨ beneficiary registration methods;
⇨ beneficiary control methods;
⇨ management;
⇨ supply;
⇨ meal times;
⇨ operational supervision;
⇨ operational evaluation;
⇨ staff compensation procedures;
⇨ ration amounts and quality;
⇨ beneficiary contribution procedures where applicable (such as the supply of firewood and water, support to assistants, the provision of edible foliage such as cassava leaves) – but under no circumstances must the beneficiaries be expected to pay for their meals.

Continuity

Once the programme has begun, interruptions must be avoided at all costs, especially in the case of malnourished subjects because their metabolism cannot easily adapt to interruptions early in the resumption of feeding – such interruptions can in fact be fatal.

Comprehensive coverage

The number of kitchens must be adequate, and they must be properly located in order to maximize their efficiency and coverage. All subjects who meet the admission criteria must clearly have access to a kitchen, and discrimination is a major cause of protest in conditions of survival.

Sufficient dietary intake

In order to reduce mortality significantly, full rations must supply at least 1,900 kcal (7,940 kJ) per person per day. Failing that, the exercise is a useless waste of resources and, worse, contradicts humanitarian ethics.

Beneficiaries

It is possible to admit all individuals who report spontaneously to soup kitchens, especially in the case of passive targeting. However, this usually entails a number of complications: complete disorder at mealtimes, upsetting logistics plans, and the risk of lapses in proportion to the magnitude of needs. It is therefore best to set criteria for admission from the outset, and these can be combined: obvious clinical malnutrition, age groups, lists of destitute families produced in some way, etc. Criteria must be applied identically to all kitchens that are included in the programme. Clearly, declared malnutrition is an appealing criterion because it is undisputable and limits admissions, but it does not avoid malnutrition. In order to make this criterion more humane, agencies can for example admit the entire family of severely malnourished individuals if the family is known to be destitute. This approach implies that the operating agency has the means to increase admissions gradually and to open new kitchens as the situation deteriorates and existing kitchens are at maximum capacity; the upper limit is about 2,000 persons per kitchen.

The task is not easy, but beneficiaries must be identified in some way. If beneficiaries cannot be identified individually by registration and nominal summoning, they must at least be identified according to the kitchen that serves them. Certainly the best option involves the use of bracelets that indicate the kitchen reference number and the beneficiary's identification code – this option is in any case preferable to the use of distribution cards. Ledgers must also be used and kept up to date: they are necessary to keep track of the number of beneficiaries and are thus important in the logistics chain, and they provide the number of admissions and their registration codes per date, which enables the evaluation of impact. Moreover, ledgers permit the identification of subjects who require special attention, such as patients undergoing medical treatment. Beneficiary registration takes time, and must therefore be done on set days during the week – once a week is usually adequate.

In addition:

- ⇨ attendance at meals must be monitored in some way to avoid disorder – beneficiary names or numbers can be called out and absentees recorded or, at least, beneficiaries must be confirmed to belong to a specific kitchen, and attending beneficiaries must be counted regularly;
- ⇨ discipline is important: if kitchens are well-organized and regulated, their beneficiaries will feel secure in visiting them – queues must be arranged in quiet and orderly fashion, and unregistered individuals must be politely but firmly turned away – these aspects are just as important as adequate and regular food supplies;
- ⇨ only two conditions justify the exclusion of beneficiaries:
  - → beneficiaries are managing to secure sufficient food independently, or through the distribution of adequate take-away rations, in which case their nutritional status is the deciding factor;
  - → misconduct (absenteeism, cheating, or any other form of pre-defined abuse).

Management

Kitchens must be managed systematically, and the following aspects deserve specific attention in this respect.

1. Kitchens must have easy and sufficient access to clean water. Options include piped supply, transport (e.g. water-trucking), catchments or wells located within the kitchen compound or in its close vicinity. In all cases, one or more tanks must be available to ensure water self-sufficiency, and these must at least cover supply during foreseeable breakdowns; rainwater can also be collected.
2. The infrastructure must be well identified and fenced in; it must include a covered but well-ventilated kitchen area, secure storage space that is adequate for the safekeeping of material and foodstuffs overnight, a canteen that is sheltered from the elements to accommodate beneficiaries during mealtimes, and sufficient free space to handle 1,000 to 2,000 persons in calm conditions. Garbage and waste water must be disposed of – they can for example be used to fertilize the vegetable plots. Latrines may be necessary.
3. The layout must include:
   → a specific entry point where bracelet reference numbers are verified and recorded in order to monitor attendance;
   → waiting space in front of the cauldrons for the delivery of meals;
   → clear access paths to the eating space, which allow for placing to begin at the back of the eating space and progress towards the front;
   → an exit point that is different from the entry point, which enables verification that meals have indeed been consumed on-site and are not taken away.
4. Staff numbers must permit rotations during rest days (at least one per week), holidays, and absences. Staff must observe precise working hours and tasks that are defined and consigned in writing according to position: direct supervisor, watchman, cook, distribution assistant, cleaner, local authority supporting and supervising the work (e.g. traditional leaders, local committee members, representative of the agency running the kitchen, etc.). The staff in charge of the preparation, organization, and distribution of meals must be compensated adequately, which also facilitates the supervision of its work. The staff must also be listed in central ledgers, again for supervision purposes. Beneficiaries may be requested to provide some form of contribution, for example firewood and water, or labour. This must however not result in privileges, discrimination, or exploitation of any kind.
5. Staff members must be trained in basic hygiene principles and must apply them to themselves and in performing their tasks. They must be provided with enough cleaning materials. The basic hygiene principles that must be observed are:
   → staff members must be clean and properly dressed; they must wash their hands regularly, especially after having been to the latrines;
   → kitchen utensils and cauldrons must be washed with soap and dried, if possible in the sun, following each meal;
   → the entire compound must be cleaned following each meal and food leftovers and waste that may cause contamination must be disposed of;
   → the water that is used to wash kitchen utensils and that used for the preparation of the meals must be potable, and the quality of the food must be good – this requires specific attention in terms of storage and transport;
   → cooked food must not be kept; leftovers must be distributed for immediate consumption or collected as animal feed (poultry, for example, may be kept to vary the diet occasionally);
   → the food (raw and cooked) must be kept covered and sheltered from flies;
   → kitchens must be equipped with garbage and water waste disposal systems; garbage is kept in plastic bags or watertight containers, and is evacuated at least once a day in a way that preserves environmental hygiene (for example, burnt, composted or buried at a reasonable distance from the kitchens and eating areas);

- → beneficiaries themselves must be clean and have access to healthcare – it is worth reiterating here the importance of combining GFD with programmes in terms of healthcare, water and habitat, and non-food assistance (such as clothing and toiletries).

6. Kitchens must be impeccably organized and managed:
   - → in the kitchens themselves (water, fuel, cauldrons and utensils): cooks are responsible for submitting their requests and remarks to the supervisor – the latter can clearly perform any type of task within the kitchen;
   - → between the kitchens and storage points: kitchen supervisors submit the daily food requirements to the central kitchen management, which in turn ensures the timely transfer of food to distribution points;
   - → storage spaces and their supply: central management is accountable for the adequate capacity of storage space and its quality (e.g. pallets, fumigation, stock management, "first in/first out" procedures, etc.), the means of transport, and the timely and sufficient (buffer stocks) delivery of imported goods;
   - → if several agencies are running soup kitchens simultaneously, the central kitchen management may be pooled (combining local authorities and humanitarian partners), or split into a coordination committee that combines the authorities and humanitarian agencies, and a central management unit for each agency.
7. Soup kitchens require energy and resources, and the return on this investment must be evaluated. The evolution of the nutritional status provides a useful indicator as it can be measured on all individuals or on specific subjects that have been registered on a set date. Permanent dialogue involving the beneficiaries, kitchen staff and the agency in charge permits adjustments to the work according to the evolution of the nutritional situation, and to the positive and negative effects of the kitchen programme.
8. The functioning of the kitchens must be supervised closely in order to avoid lapses such as irregular schedules, profits made from beneficiaries, external pressure on the staff, and food diversion. Here again, dialogue involving all stakeholders is of crucial importance, as is a strong working discipline.
9. The population must be informed widely and as early as possible of the programme in order to avoid unnecessary confusion and misunderstandings. The justification for the programme, its admission criteria, and the criteria for its termination and the withdrawal of the operating agency deserve specific explanations.

Meals

Full rations must be supplied in the form of two meals a day at least, preferably three, and obviously at set times, which must be observed by all kitchens involved in the programme (for example, 10:00 am and 3:00 pm, or 09:00 am, 1:00 pm and 5:00 pm). Kitchens must operate every day of the week.

Meals must imperatively be eaten on site, so as to ensure that the food is actually consumed by the beneficiaries, and in order to help small children and the sick with their meal.

The food must be of good quality, and it must be sorted and sieved if necessary. It must be cooked in time, but not too early in order to be served hot, and cooking utensils, crockery and cutlery must be properly washed after each meal. Water must be made available to the beneficiaries for their ablutions, in addition to drinking water (1 to 2 litres per person per day) if they have no other access to it.

If legumes are used, they must be washed and then soaked in cold water for ten to twelve hours before cooking; they must then be cooked with oil for approximately two hours and then seasoned with salt, etc.– kitchen staff is usually familiar with the optimum cooking time for staple foods if they correspond to local eating habits (which should of course be the case).

Important associated activities

Even if food distribution is the only planned activity, one must ensure that vaccination against measles has been done or is planned. It is in any case essential and compulsory.

Soup kitchens provide the ideal setting for:

- ⇨ the detection of sickness and severely malnourished subjects, and their referral to hospitals and therapeutic feeding centres;
- ⇨ the conduct of healthcare activities such as vaccination, vitamin A supplementation, parasite treatment, ambulatory healthcare if necessary, and nutritional catch-up monitoring and general nutritional surveillance;
- ⇨ the monitoring of the nutritional situation in its broadest sense: crop condition, economic activities, market supply, price trends, etc.;
- ⇨ non-food item distributions;
- ⇨ training and leisure activities according to the time beneficiaries spend at the soup kitchen.

If no other activities than food distributions are planned, kitchens must be visited by health staff in order to detect possible problems and recommend or take action if necessary.

Soup kitchen feeding is not appropriate for small children who are severely malnourished. In the absence of a therapeutic feeding centre, they can be supplied with therapeutic milk[35] in the close vicinity of the soup kitchen. In this case, specialized medical staff must be involved, and at least four to five meals must be supplied per day for a significant impact on malnutrition and mortality. The distribution of therapeutic milk (F-75 Formula) may be required for all kitchen beneficiaries (i.e. children, adolescents and adults) for a few days if they are all severely malnourished and cannot at first digest the food supplied by the kitchen.

3.6 MONITORING AND EVALUATION

Any GFD programme must be combined with monitoring and evaluation in order to determine:

- ⇨ that it is running according to plan and, if not, why not;
- ⇨ that it is achieving its objectives and has the intended impact and, if not, why not;
- ⇨ its side effects and negative effects, and their reasons;
- ⇨ the necessary corrective measures resulting from the three previous points;
- ⇨ developments in the situation in general, and that of the nutritional situation in particular, and their consequences for the conduct of the operation.

Regular, context-specific reporting is necessary to keep track of observations; such reports also invite their authors to keep some distance, and to devote thought to the operation itself.

Monitoring and evaluation follow the approach that is described in Chapter X on Assessment. It consists in verifying that beneficiaries in fact receive the intended ration, what happens to such rations after their distribution (e.g. consumption, taxes, resale, pillage, etc.), their acceptability and relevance, the possible effect of the GFD on local markets and on security, and the nutritional status of beneficiaries.

[35] F-100 or F-75 Formula depending on circumstances; Chapter XIII discusses therapeutic feeding.

3.7 GFD TERMINATION

The two criteria for the termination of a GFD are set during its planning phase: its objectives must have been achieved, and the implementation criteria must no longer apply (as demonstrated in monitoring and evaluation findings). In some circumstances however, GFD must be terminated earlier because unexpected negative effects have appeared, because security conditions no longer permit its continuation, or because monitoring and evaluation have revealed new parameters that require a thorough review of the rationale underlying the current GFD.

3.8 FOOD STORAGE

Food storage is an important aspect of GFD in order to ensure food quality and appropriate management.

⇨ The storage space or warehouse must be sheltered from the elements, and must therefore be structurally sound. In particular, its roofing must be adequate, its floor must be high enough to limit the risk of flooding, it must be well-ventilated and offer the least possible refuge to rodents and other pests. It must be cleaned daily if it operates permanently, and cleaning must be as easy as possible. In all these respects, modern structures are the best option. Warehouse access must be restricted to the personnel that run it, and be limited to their working hours. The keys to the warehouse must be kept personally by the supervisor in charge, and the supervisor should always be present when anybody is in the warehouse (this task may be delegated if necessary on the supervisor's personal responsibility).

⇨ The best way of keeping pests at bay is to clear any spillage immediately and introduce cats to hunt rodents. Warehouses must be fumigated regularly in order to control infestation; this operation requires the involvement of skilled staff.

⇨ The total warehouse surface must exceed the occupied space by at least 25%, in order to afford enough space between the walls and the stocks, and in the aisles between food rows.

⇨ One tonne of food in 50 kg bags stacked in pairs in crossed layers makes a volume of roughly 2 cubic metres. Bags must not be stacked directly on the floor, but rather on pallets raised to at least 10 cm off the floor. Bags must not be stacked too high in order to prevent the stacks from collapsing, which can be dangerous. Different commodities must be stacked separately.

⇨ Damaged bags must be stored separately, and repacked as soon as possible if their contents can still be used. For instance: damp grain can be dried, and flour contaminated by insects such as weevils can be sieved. If the food is damaged to the point of being unfit for human consumption it should be disposed of by being buried, incinerated, or used as animal feed (provided that it is still suitable for the latter).

⇨ The golden rule of warehouse management is for the commodities that enter first to be distributed first, in order to ensure proper stock rotations. Foodstuffs must be identified by tags and stock cards, and warehouse staff must check regularly that the tags fixed to the commodities in fact match the stock cards; warehouse staff must also conduct regular inventories and check stacks on all four sides and the top – stock theft can escape the attention of inexperienced staff. Stock cards must be updated following each commodity transfer without exception.

CHAPTER XIII
THERAPEUTIC FEEDING

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CHAPTER XIII
THERAPEUTIC FEEDING

1. GENERAL CONSIDERATIONS

1.1 DEFINITION

Therapeutic feeding deals with the treatment of severe malnutrition[1] and specific deficiencies.[2] Only the treatment of severe malnutrition is discussed here, and it consists of nutritional and medical care whose specificity is a prerequisite for a meaningful reduction of mortality rates.

The approaches to therapeutic feeding in humanitarian action and in hospitals are quite different. The hospital approach deals with disseminated malnutrition that is usually secondary, and targets individuals. In paediatric services especially, severe malnutrition usually affects subjects that are already vulnerable to sickness in normal living conditions in terms of their physiology. Medical disorders often complicate treatment, and patients require specific, often protracted attention – and in spite of this, mortality remains high. The hospital approach requires well-defined means and skills that are virtually impossible to deploy together in humanitarian action. Hospital facilities must also deal with social problems and/or endemic poverty, which humanitarian prevention programmes cannot easily address.

In times of crisis, however, severe malnutrition and specific deficiencies are more commonly primary than secondary, and their prevalence rates are usually serious. Therapeutic feeding within humanitarian action therefore follows a routine approach that includes all individuals suffering from the same type of deficiencies. Malnutrition that results from a rapid deterioration in the living conditions of entire communities is quite easy to deal with, provided that strict procedures are observed. Complex cases are rare in proportion, simply because such patients are usually the first to die when a general crisis develops. Action is therefore easier to implement in these circumstances than in hospital facilities, and is quite efficient in spite of the fact that only the more basic means are available in the field.

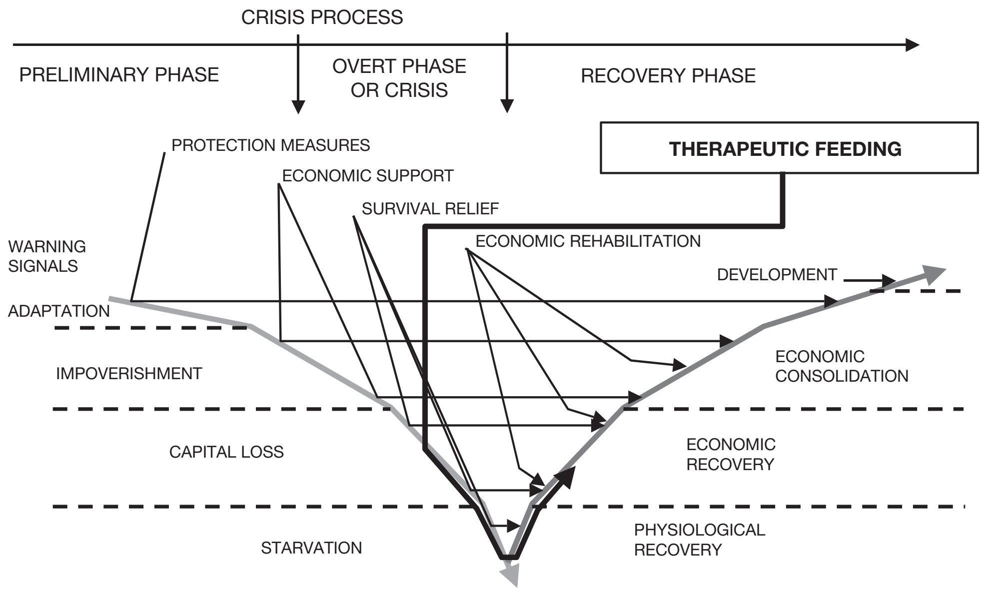
The principles of therapeutic feeding are the same for children, adolescents, and adults. This Chapter concentrates on the treatment of severe malnutrition as practised in therapeutic feeding centres (TFC) that are set up in response to crisis.

[1] This Manual prefers the expression “severe malnutrition” to the traditional term “protein-energy malnutrition” (PEM, see Chapter VIII).
[2] The main specific deficiencies are discussed in Chapter VIII, and the others in Chapter III.

1.2 THERAPEUTIC FEEDING IN HUMANITARIAN ACTION

Within the framework of humanitarian action in crisis, therapeutic feeding is part of survival relief[3] efforts and represents the last safety net before death (see Figure 13.1 below).

Figure 13.1 Therapeutic feeding within humanitarian action



Therapeutic feeding can also be implemented when malnutrition reaches epidemic proportions, caused by health problems associated with water and environmental hygiene, habitat and/or the inability of existing health services to address significant endemic or seasonal malnutrition effectively.

1.3 THE OBJECTIVE OF THERAPEUTIC FEEDING

The objective of therapeutic feeding is quite simple:

avoiding the death of severely malnourished individuals and restoring their nutritional status up to satisfactory levels.

A satisfactory level permits survival in a natural environment, provided that living conditions are adequate; the latter are usually the object of other types of humanitarian attention.

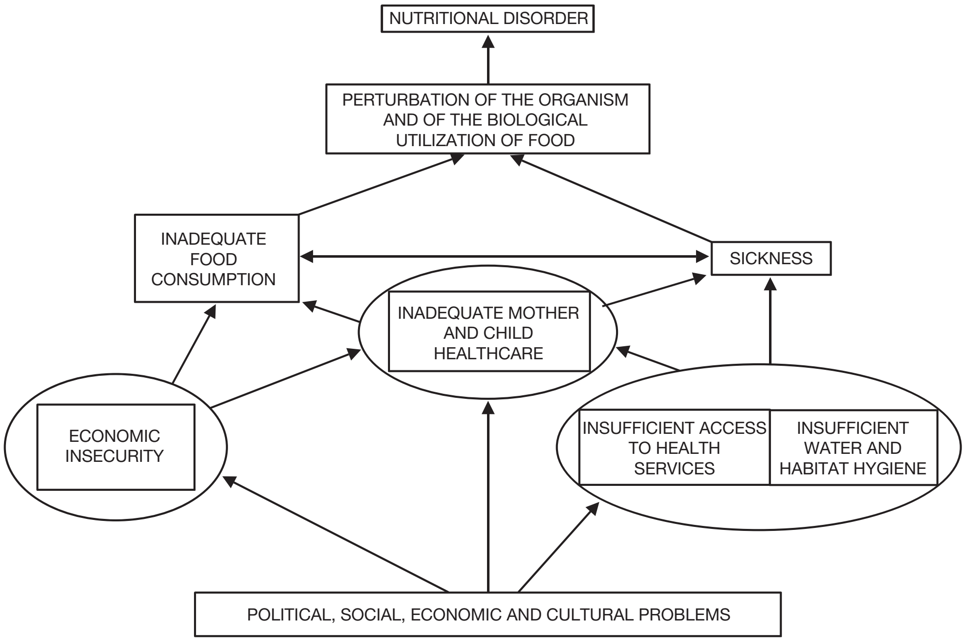
1.4 OPERATIONAL PRIORITY

Therapeutic feeding is a flagship of humanitarian action that attracts prime-time media attention and shocks the public, politicians and donors alike.

[3] See Chapter IX.

A deteriorated nutritional status and its resulting malnutrition are both a pathology that calls for treatment, and the symptom of other disorders that have already upset the feeding process. The mere existence of a therapeutic feeding programme thus indicates the failure of efficient prevention. Moreover, in the absence of prevention, therapeutic nutrition is pointless, and may even contradict humanitarian ethics: it is clearly unacceptable to treat and cure patients whose personal circumstances have caused their malnutrition, and who therefore risk relapse after their discharge. As a result, no overall operational strategy should be devised in response to severe malnutrition, but rather according to its causes and the problems that occur earlier in the process – and as far back as they can be addressed. As illustrated in Figure 13.2 below developed from the models suggested by Beghin and the UNICEF (Beghin, 1988; Alnwick, 1996), malnutrition comes last in the line of dysfunctions that can affect a population.

Figure 13.2 Causal model of malnutrition



Therapeutic nutrition is by no means a priority in the operational strategy. High severe malnutrition rates may appear to call for the urgent introduction of therapeutic feeding and curative health programmes; the priority however is the earliest possible mastery of the main causes of this situation (such as economic insecurity, inadequate mother and child healthcare, and/or insufficient healthcare and environmental hygiene). This comprehensive approach is needed to avoid the saturation of curative care facilities, and limit post-treatment relapse; it is also a matter of common sense and humanitarian ethics. Therapeutic feeding programmes may obviously be set up in parallel, but field workers must understand the fundamental contradiction between the strategy (i.e. long-term priorities) and the tactics that appear to be dictated by the emergency.

There is no question that general food distribution (GFD) occupies the first position in survival relief efforts, often alongside complementary prevention measures in the field of water and habitat, healthcare and, possibly, economic support.

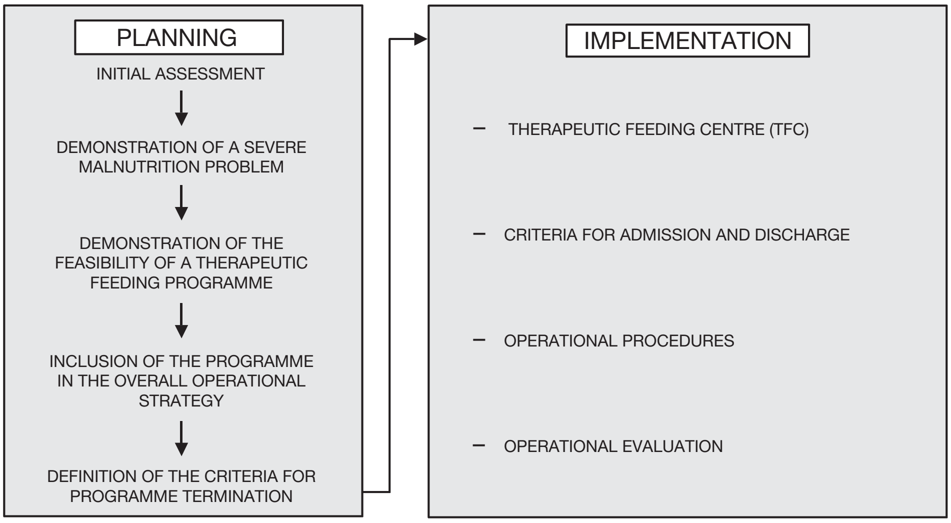
That being said, therapeutic feeding may be necessary simply because prevention measures could not be taken early enough. In such circumstances, operating agencies face a timeframe of at most two months after the start of the therapeutic feeding programme to apply such measures – this timeframe corresponds to that required for the treatment of a malnourished individual and his discharge from the feeding centre while limiting the chances of relapse.

XIII

2. PLANNING THERAPEUTIC FEEDING

Figure 13.3 below illustrates the planning process for the treatment of severe malnutrition and its implementation parameters.

Figure 13.3 Logical sequence for the treatment of severe malnutrition in a TFC



The planning – implementation sequence illustrated in Figure 13.3 above corresponds to an operational logic that permits:

⇨ the justification for the programme and its integration into the overall operational strategy;
⇨ the implementation of the programme with the best possible chances of success.

A therapeutic feeding plan is based on the following criteria:

⇨ a declared and adequately documented problem of severe malnutrition has been confirmed;
⇨ therapeutic feeding can be translated into a feasible programme;
⇨ the programme fits into an overall and consistent operational strategy;
⇨ the termination criteria of the programme have been defined from the outset.

2.1 *UNDERSTANDING THE PROBLEM AND THE SITUATION*

Therapeutic feeding programmes must be based on a convincing demonstration that they respond to a need in terms of the magnitude of the problem (the size of the affected population), its seriousness (severe malnutrition rates), the prognosis (rising, falling, or stable rates), and its causes (e.g. food insufficiency, inadequate care, and sickness). This understanding is gained through assessment, which not only sheds light on the types of problems that may be anticipated in the TFC, but also ensures that the necessary complementary measures are taken in a broader operational perspective.

2.2 FEASIBILITY

Once the need for a therapeutic feeding programme has been established, its feasibility must be ascertained in terms of sustainability and the number of beneficiaries. Its sustainability is determined by the following:

⇨ beneficiaries, allowing for their geographic dispersion (scattering), must have ready access to the TFC, without foreseeable hindrance;
⇨ security conditions must allow:
  → TFC staff to operate safely;
  → beneficiaries to report to and be treated in the TFC safely;
  → uninterrupted supplies for the TFC;
⇨ financial resources and means must be adequate in terms of staff, infrastructure, logistics, food and medicine, clothing and bedding, and the wherewithal required to complete the programme;
⇨ access to safe water must be sufficient and regular.

A programme is justified as from a given number of beneficiaries, which is determined by the magnitude of the malnutrition problem. In practice, crisis situations (where severe malnutrition rises, and national services are non-existent or saturated) must be distinguished from chronic situations (where severe malnutrition is endemic and seasonal, and national services are non-existent or insufficient).

In crisis situations, the number of patients is the determining parameter. In famine, the number of severely malnourished subjects is always sufficient to justify therapeutic feeding and the introduction of a TFC. However, a threshold number of individuals must be set when a given phenomenon affects the nutritional status only marginally, and when severe malnutrition is scattered. This number can vary between 20 and 100, depending on the operating agency and circumstances. The prevalence rate of severe malnutrition provides a useful indicator in setting this number, and this rate must then be compared to the size of the population, its geographic dispersion, and access to it. For example, in a camp that accommodates 10,000 persons whose demographic profile is that of a developing country, 10% rate of severe malnutrition recorded in children under 6 years of age means that 150 children from this camp require TFC attention. This is feasible, because camps are rather easy to manage: individuals can be targeted easily, distances are reasonable, and access to the population is ensured. The situation is quite different in the case of a population of 10,000 nomads scattered over several thousand square kilometres, without transport facilities. In such cases, the feasibility of a therapeutic programme must be thoroughly examined even if severe malnutrition rates reach 20 or 30% in children under 6 – difficulties of access, transport, family separation, and the identification of malnourished individuals are all serious limiting factors.

In situations of chronic marginal problems, programmes are justified if the incidence of severe malnutrition is sufficiently regular for even small therapeutic feeding units (i.e. with an accommodation capacity of 10 to 20 patients) to operate continuously. Such units can be attached to paediatric wards, or remain independent if the main paediatric disorder is malnutrition. Unit staff can also contribute to other healthcare tasks when the TFC is less busy.

2.3 INTEGRATION INTO THE OPERATIONAL STRATEGY

As seen in Section 1.3 above, therapeutic feeding is necessary but not a priority if malnutrition results from a general deterioration in living conditions and acquires epidemic proportions. This means that it must be included in the range of measures that constitute the overall operational strategy, and must not be applied in isolation; to avoid TFC saturation and ensure that discharged patients will not return to the living conditions that caused their malnutrition in the first place and thus risk relapse.

The differences between strategic priorities and those dictated by the emergency do not necessarily amount to an incompatibility. On the contrary, famine often highlights the inevitable interrelation between therapeutic feeding, general food distribution, preventive and curative healthcare, water and habitat programmes, and economic support and rehabilitation efforts.

Whatever their degree of specialization, humanitarian agencies have a duty to ensure that all measures necessary to resolve nutritional crisis are indeed taken – either by the agencies themselves or by other operators.

2.4 TERMINATION CRITERIA

It may seem paradoxical to set criteria for the termination of a programme before it has even begun. This aspect nevertheless pertains to good planning, because it encourages decision-makers to consider the programme in its overall context.

The termination of a therapeutic feeding programme, and the closure of a TFC, is called for when the number of patients no longer justifies its maintenance. This is the major practical criterion, provided that the reduction in admissions does indeed reflect an improvement in the situation. This is not always obvious. Improvements may be temporary or result from changes in the image of or access to the programme. As a result, this criterion requires particular assessment for its validation.

Malnutrition can recede either because the living conditions of the affected population have improved independently, or because the overall operation has succeeded in eradicating its causes and controlling its effects. Two criteria thus emerge as precursors to the practical criterion that the TFC has lost its purpose: an improved situation for the beneficiaries, and the efficiency of the overall operational strategy. These two additional criteria permit the anticipation of TFC closure, and facilitate the choice of solutions regarding the cases that remain – as such, they are of major importance. All the more so because they require constant monitoring of the situation and provide the basis for dialogue between TFC operators, the population, and humanitarian agencies in order to understand the evolution of the situation and draw practical conclusions.

Ultimately, the decision to close therapeutic feeding programmes is based upon the risk factors that can be anticipated, such as seasonal variations, probable population movements, and other phenomena that could upset the feeding process.

The closure of therapeutic feeding programmes depends on the monitoring of:

⇨ the dynamics and characteristics of severe malnutrition as observed within the feeding centre and in the target population;
⇨ the living conditions of the target population;
⇨ the impact of the overall operational strategy;
⇨ the probability that malnutrition will increase again.

Therefore, the termination of therapeutic feeding programmes may be considered when:

⇨ the living conditions improve independently;
⇨ humanitarian preventive action against malnutrition is sufficiently efficient in terms of:
  → measures that give access to food and other essential commodities;
  → measures in mother and child healthcare (MCH);
  → disease control measures taken by national or humanitarian health services;
  → water and environmental hygiene measures;

- ⇨ severe malnutrition is not expected to recur;
- ⇨ the level of TFC admissions no longer justifies its maintenance – this practical criterion is the last of the termination criteria, and determines the ultimate decision to close the programme.

Residual cases are then referred to existing healthcare facilities, whose ability to treat them (that is, their resources and skills) must be confirmed.

3. IMPLEMENTING THERAPEUTIC FEEDING PROGRAMMES FOR THE TREATMENT OF SEVERE MALNUTRITION

The implementation of therapeutic feeding programmes requires the following elements to be established:

- ⇨ the therapeutic feeding centre (TFC) (Section 3.1);
- ⇨ the criteria for admission and discharge (Section 3.2);
- ⇨ TFC operational procedures (Section 3.3);
- ⇨ TFC operational monitoring and evaluation (Section 3.4).

3.1 THERAPEUTIC FEEDING CENTRES

Therapeutic feeding programmes are run through therapeutic feeding centres (TFC). Such centres are organized so as to provide the indispensable services required to treat patients suffering from severe malnutrition. They must be located in the close vicinity of the beneficiary population, and of some healthcare facility to which patients that require special medical attention may be referred. The chosen location must be protected from the general risks prevailing, and its available space must permit extensions if necessary.

A centre's layout is determined by the anticipated number of patients, and by access.

- ⇨ The number of patients that can be admitted varies according to the magnitude of the problem and the number of TFC that can be opened in a given region. Centres have been known to accommodate between 100 and 1,400 patients. Smaller centres are easier to manage and their atmosphere is usually more relaxed and personal. Still, larger centres may be necessary in disasters, and are just as efficient as smaller structures, provided that they are adequately staffed. The number of patients determines the TFC layout and the magnitude of its facilities.
- ⇨ Access to the TFC is much influenced by its location. If the target population is close by and access is easy, there is no need for annexes for the permanent accommodation of patients and their carers (other than during initial treatment, when 24-hour attention is necessary) – this is usually the case in camps for refugees or the displaced, and in towns. If the target population is too distant however, the TFC must include a camp to accommodate patients and their carers, or locate the TFC in a facility that permits such an addition. The permanent presence of patients and carers does not require structural changes, but does require an admission facility, preferably within the centre or in its immediate vicinity, which is fenced in and supervised, equipped with an adequate water supply and disposal system and the means required for food preparation. It is worth insisting here on the need for carers to receive adequate food rations; the comment seems obvious, but carers have all too often been seen to go without food.

TFC include facilities and equipment that are more or less standard. However, the nature of such facilities varies according to circumstances. Tents, buildings of traditional materials, and modern brick and concrete buildings are all suitable – what matters is that they be suited to the climate and that their volume ensure satisfactory working conditions. Equipment may equally vary. In fact, a TFC can be set up with quite basic means, without altering the quality of its attention.

A common mistake is to wait for all the material and infrastructure to meet arbitrary standards, when a TFC could be improvised at once with locally available means, and be improved as more substantial and advanced means become available.

TFC must be planned according to its projected activities, as follows:

⇨ admitting and attending to beneficiaries and their carers;
⇨ accommodating beneficiaries and their carers;
⇨ treating the beneficiaries;
⇨ feeding beneficiaries and possibly their carers;
⇨ monitoring the programme and its beneficiaries;
⇨ managing and maintaining the TFC;
⇨ providing recreation, training, and occupation to beneficiaries and their carers.

To this end, a TFC is clearly laid out and protected from outside view by fences; it is equipped with a gate and is watched over day and night. It is best installed on a slight slope to permit the evacuation of rainwater, or equipped with adequate drainage.

3.1.1 Facilities

A standard TFC includes the following facilities.

⇨ Shelter for the watchmen, located next to the gates and inside the compound, which enables the supervision of the entrance and its immediate vicinity.
⇨ A room or office for registration, admissions, nutritional surveillance, and discharges. Depending on the size of the TFC, it may be best to separate the surveillance room and the admission room, in order to perform admissions, discharges, and surveillance on a daily basis.
⇨ An examination and treatment room, equipped with an examination bed and the necessary medical examination and care material, which must be kept under lock when not in use. The pharmacy should be located next to this examination room with direct access; *this must be the only access to the pharmacy*. Laboratory space must be allowed for if necessary, next to the pharmacy or the examination room.
⇨ One or several intensive care units (ICU), which are kept at a comfortable temperature and equipped with mosquito netting if necessary, where patients remain 24 hours a day in principle, and where they have access to water and oral rehydration salts (ORS) solutions.
⇨ Waiting rooms or spaces that are sheltered from the elements – examination and treatment take time.
⇨ An office, a cloakroom, and a place to relax for the staff.
⇨ A pharmacy, which is in fact the medicine store-room. It must be locked, as must be all the cupboards that accommodate valuable or dangerous material and medicine; medicine stocks are managed in the same way as food stocks. The duty nurse is responsible for the pharmacy keys, and must check the use of material and medicine if the task has been delegated to somebody else.
⇨ A warehouse for fuel and tools, and another for foodstuffs. Approximately 1 cubic metre of wood is required to boil 1,000 litres of water, and the adequate supply of firewood, or of another type of fuel, must be ensured accordingly. One staff member is responsible for the warehouse and its keys – the TFC manager keeps a second set of keys.
⇨ A kitchen with the capacity to supply the necessary meals in time and in the required amounts. In a TFC, it is best to separate the kitchen into two sections: one where the food

for initial treatment is prepared, and another where the food is prepared for the subsequent feeding phases (i.e. rehabilitation). The number of stoves is determined by cooking times and amounts, and cauldron capacity. Professional cooking material is often not available; in this case, stoves must be built in a way that optimizes fuel consumption and smoke evacuation. Kitchens must be well-ventilated and equipped with a waste water disposal system.

- ⇨ One or several spacious and well-sheltered canteens. They must be cleaned completely after each meal, preferably with chlorinated water (0.5% chlorine) – *this is in any case compulsory wherever "accidents" have occurred such as diarrhoea and vomiting.*
- ⇨ One or several protected tap stands that ensure an adequate access to safe drinking water (i.e. filtered, protected, covered and chlorinated with 0.5 mg of chlorine per litre). Access to water and sanitation within TFC is discussed in greater detail below.
- ⇨ One or several tap stands where people can drink and wash their hands before and after meals, including a water recycling or disposal system. Taps should be of a type that closes automatically to avoid waste (such as Talbot-type tap stands).
- ⇨ A sheltered location where oral rehydration solutions are administered. One staff member must be present to operate this unit in order to ensure proper distribution.
- ⇨ Latrines and ablution booths for the staff and for the beneficiaries and their carers; such facilities must be equipped with waste water disposal systems.

TFC facilities must be organized according to their function and grouped according to their use, in order to facilitate the work:

- ⇨ group 1: patient admission and examination;
- ⇨ group 2 : intensive care unit, rehydration unit, medical unit, examination and treatment room, pharmacy, and laboratory;
- ⇨ group 3: kitchen, food storage, water points, and canteen;
- ⇨ group 4: administration, and material storage;
- ⇨ group 5: habitat;
- ⇨ group 6: ablutions and showers;
- ⇨ group 7: latrines, waste disposal, and incineration.

The safest and most comfortable location must be found for ablution/shower points, latrines, incineration (according to prevailing winds), waste storage and waste water evacuation.

3.1.2 Water and sanitation

Access to water

Preliminary remarks

The setting up of water supply systems (especially for drinking water) requires technical skills that are often beyond those of the health staff running a TFC; this is particularly true because access to water varies significantly from location to location. The general rule is that all matters pertaining to water and sanitation in a TFC should be addressed by water and environmental engineers or technicians.

Beyond that, the major points pertaining to water access justify a reminder here.

Whatever the magnitude and seriousness of severe malnutrition, the absolute pre-condition for the setting up of a TFC is regular and sufficient access to safe water. Possible options include natural water points (such as springs, watercourses, and ground water) and artificial points (wells and reticulation networks, but the latter are exceedingly rare). The reliability of sources must first be verified in terms of regularity and flow, allowing for relevant seasonal, technical, economic, and political factors. Water quality must then be tested in terms of turbidity; supply points should preferably provide clear water. Usually, the chemical disinfection of clear water poses no problem, even if it is heavily laden with pathogens; treating turbid water is however more complicated, and involves an increased use of disinfectant. In such cases purification is usually achieved by passive or active sedimentation (flocculation with aluminium sulphate) and, to a lesser extent, by filtration. The method is chosen according to the type of particles present. Turbid water can also have a bad taste and discolour food (thus reducing its appeal), which should clearly be avoided in a TFC. If only turbid water is available and cannot be purified, it can only be disinfected by boiling, after decantation for as long as possible, and this depends on the availability of water tanks.

The water supply point must be protected in order to avoid contamination (Annex 12 briefly describes the methods for the improvement of water quality). For the sake of safety and autonomy, the TFC should be equipped with one or more tanks to allow for water shortages.

If water points are distant and there is no pipeline available, catchment, transport, and storage systems must be devised; clearly then, all the links in the supply chain must be absolutely reliable. As an indication, a TFC should at all times maintain at least a one-week reserve of water. Rather than arbitrary recommendations however, it is best to understand the water supply situation from the outset, and allow for the necessary corrective measures accordingly. Where water is scarce, rainwater recycling systems may be considered.

For water distribution, it is best to resort to pipes equipped with automatic taps (i.e. spring-off type) in key locations such as kitchens, treatment units, intensive care units, and ablution and laundry units. Alternatively, jerrycans and cooking cauldrons can be used, avoiding contamination in the process. One staff member must be specially assigned to water supply and management.

In a TFC, drinking water (filtered, protected, covered, and treated with 0.5 mg of chlorine per litre) is used for the preparation of food, drinking, the preparation of rehydration solutions, medical care, and personal hygiene. The water used for cleaning the centre, kitchen utensils, and clothing should be chlorinated at 0.2%. The necessary quantity of water is determined by the number of patients: usual recommendations are 30 to 50 litres per patient per day. This amount allows for all the water requirements of the centre (consumption, care, and cleaning), and corresponds to the needs commonly observed in disasters in developing countries. The absolute minimum is 10 litres per patient per day, and this involves drastic water saving and recycling measures.

In supplementary feeding centres where meals are consumed on the spot (see Chapter XIV), at least 10 litres of water per person per day must be allowed for.

Sanitation

Hygiene is very important in a TFC. The equipment must permit ablutions, the cleaning of material, and the disposal of garbage and waste water, and this with as little pollution as possible.

This equipment includes the following items and facilities.

⇨ Cleaning and disinfection material specific to each unit (for example, the material used to clean the intensive care unit must not be used to clean the kitchens or the latrines); adequate reserves of such material must also be kept.
⇨ Laundry space to disinfect and wash linen and bedding material, and ablution space for inpatients and their carers (at least a water point or a shower and washbasin for 25 persons, including relatives).

- ⇨ Latrines (at least one pit for 50 persons, relatives included) – separate latrines must be reserved for staff (one pit for 10 persons). Cultural standards may require the separation of female and male latrines. Latrines must be cleaned at least twice daily, and one staff member must be specially assigned to this task, and be equipped with material that is strictly reserved for this use. Every fortnight, one litre of used engine oil or kerosene should be poured into each pit in order to check the proliferation of insects; latrines can be disinfected twice weekly with quicklime, and to protect users from chemical burns care must be taken not to spill it on the edges of the latrine.
- ⇨ One or more garbage incinerators, especially for medical waste. Medical waste that cannot be incinerated must be disposed of separately.
- ⇨ Waste disposal systems or pits for the burying of garbage that cannot be incinerated or composted. Pits must be regularly covered in sand or soil, and disinfected with quicklime.
- ⇨ Waste water disposal systems.

Latrines and incinerators must be located according to prevailing winds, in order to avoid discomfort from odours and fumes. Waste water from the kitchen may be disposed of through irrigation systems that supply gardens or plantations.

3.1.3 Operational equipment

This material comprises the following items and item categories (Annex 13 provides detailed item lists for TFC, and Annex 18 provides them for Supplementary Feeding Programme):

- ⇨ furniture;
- ⇨ surveillance and monitoring equipment;
- ⇨ stationery and office material;
- ⇨ medical material;
- ⇨ stocks of medicine, food, fuel, and consumables;
- ⇨ kitchen utensils and material, crockery and cutlery;
- ⇨ cleaning and disinfection material;
- ⇨ maintenance and construction material and tools;
- ⇨ one or several water tanks;
- ⇨ an incinerator for medical waste that can be burned.

3.1.4 Human resources

The centre must be sufficiently staffed, and personnel must be properly paid, be aware of roles and responsibilities, and be appropriately trained. Each function within the centre must be supervised by specific staff members: security, cleaning, kitchens, surveillance, etc. The necessary number of persons is determined by the workload, which is itself defined by the number of beneficiaries, the level of care, and follow-up. Centres that include an intensive care unit that operates 24 hours per day for example require substantially more staff than ambulatory centres.

Generally speaking, a TFC must include the following staff members.

- ⇨ 1 overall supervisor (or manager), usually a nurse, and a deputy.
- ⇨ 1 assistant in charge of general supervision and deputy to warehouse supervisors in their absence.
- ⇨ If possible, 1 full-time or part-time general practitioner to ensure appropriate healthcare and/or 1 nurse, and 2 assistants for medical care.
- ⇨ 3 to 6 assistants for admissions and nutritional measurement.

- ⇨ 1 supervisor per 30 beneficiaries for the monitoring of attendance, and for organization, supervision, and assistance at mealtimes. One of these supervisors is responsible for oral rehydration, and should have a deputy.
- ⇨ 1 kitchen supervisor, seconded by 1 person specifically in charge of the kitchen for initial treatment. These persons are assisted by 1 person per 50 beneficiaries approximately (depending on the available equipment), one of whom is deputy for each kitchen if relevant. Additional staff must be available for miscellaneous tasks, especially cleaning – in a TFC kitchen cleaning must be specific to that area with its own set of materials, and kept separate from the cleaning of the rest of the centre.
- ⇨ 1 supervisor in charge of the food store, and 1 in charge of the material store – they both contribute to stock management accordingly. Maintenance staff is also necessary.
- ⇨ 1 general handyman for maintenance odd-jobs.
- ⇨ 4 to 6 persons in charge of cleaning and disinfection, depending on the size of the TFC.
- ⇨ 2 to 4 watchmen.
- ⇨ Where relevant, additional staff for home screening.
- ⇨ 1 person in charge of entertainment and associated activities.

Table 13.1 below provides an organized summary of the different points discussed above in Section 3.1.

Table 13.1 TFC overview matrix

Tasks	Facilities	Material	Staff[a]
Admission	Admission room, which may also be the examination room; sheltered waiting rooms.	Office furniture and equipment, nutritional measurement material.	1 nurse 3 assistants
Accommodation	Room(s) for beneficiaries who require 24-hour attention; water and hygiene points, latrines, water stocks; if necessary, camps to accommodate beneficiaries and their carers.	Beds, mattresses, mats, mosquito nets, blankets, clothing, and soap; access to water and ORS; cooking, cleaning and washing material.	1 supervisor 3 assistants per 20 children, 24-hours.
Care	Examination room, treatment room, pharmacy, laboratory where necessary; sheltered waiting rooms; oral rehydration salts (ORS) distribution points, non-incinerated medical waste disposal.	Examination bed, office furniture and equipment, locked cupboards, medical equipment, medicine, laboratory equipment, access to water, incinerator.	1 nurse 2 medical assistants Preferably 1 general practitioner (permanent presence or regular visits).
Feeding	Kitchen, food store, canteen, water points, garbage and waste water disposal.	Food, stoves, pots and pans, crockery, cutlery, cleaning material.	1 supervisor plus 1 assistant per 50 beneficiaries, 1 warehouse supervisor, staff for miscellaneous tasks.
Surveillance (additional to admission)	Surveillance room, possibly additional to the admission room.	Attendance-monitoring ledgers.	3 assistants if surveillance is performed at the same time as admission; 1 assistant per 30 children at mealtimes.

Management and maintenance	Office, staff resting room, material and tool store.	Office furniture and equipment, maintenance, repair, and construction material, tools.	1 supervisor 2 assistants 1 handyman 4 to 6 cleaners 1 to 4 watchmen
Entertainment/ training/ occupations	Recreation room or space, training room, crafts room, garden.	According to the type of activities.	1 supervisor

[a] Additional staff must be allowed for in anticipation of replacements during absences.

3.2 CRITERIA FOR ADMISSION AND DISCHARGE

3.2.1 Admission criteria

Logically, a TFC should only admit individuals who will have adequate access to food and living conditions after their discharge. This leads once again to the remark that nutritional feeding programmes must fit into a broader range of measures for the prevention of malnutrition – failing that, the TFC operation is useless and ethically unacceptable.

TFC are often restricted to children under 5 for practical and also cultural reasons:

⇨ this age group is the first to show signs of malnutrition in a developing crisis;
⇨ in small children, malnutrition is often complicated by concomitant health disorders;
⇨ children under 5 cannot survive independently.

The nutritional situation in a given region can deteriorate to the point that its entire population is severely malnourished. In such cases, it is clearly best to revise the usual age criterion for admission, because older children are easier to treat, their chances of survival after their discharge are greater (as they have already survived the hazards of infancy), and they represent a considerable emotional and economic investment – affected groups in fact often set this dimension as the priority. These comments lead to the following recommendation: a TFC should only admit individuals for whom the care that it delivers is vital. If screening is necessary, then the most urgent cases must be admitted first, but not desperate cases. Considerable experience is required to conduct screening at TFC entry points, and it is very difficult emotionally.

Screening

Patients admitted to a TFC must be identified in some way. This can be done in the following ways:

⇨ during registration ahead of GFD, or during GFD itself, when all beneficiaries are present;[4]
⇨ through systematic home visits;
⇨ through broad publicity asking the population to refer children to screening points (this is not advisable if the nutritional situation is already very bad, as this would soon saturate entry points and possibly the centres themselves);

[4] See Chapter XII.

- ⇨ through the selection of severely malnourished cases that report to health centres;
- ⇨ during the registration of displaced persons or refugees;
- ⇨ through the spontaneous reporting of patients to the centre.

Selection

Selection should always be done outside the centre; it is especially inhumane to accept a mother and her sick child into the compound, then simply to reject her for reasons that escape her, after lengthy waiting and clinical and anthropometric examination processes. Selection rests on the clinical appraisal of marasmus, oedema, associated disorders, the level of dependency and the ability to feed oneself. This process requires a sound knowledge of malnutrition, experience, and self-possession. All oedematous cases should be admitted. It may be useful to measure the mid-upper arm (or brachial) circumference (MUAC) in order to distinguish between individuals that share the same appearance. However, anthropometry should never provide the only basis for the admission of non-oedematous patients, especially if the method used is the weight-for-height index;[5] this index can in fact be quite misleading because it takes the entire organism into account, including sub-clinical oedema, intestinal parasites, and fluid retention resulting from infection and inflammation. As a result, a weight-for-height index of –3 Z-scores in humid and hot conditions, with high levels of intestinal parasites and infectious disease will probably not mean the same degree of wasting as the same index in dry conditions in the absence of parasitoses.

As mentioned earlier, substantial differences were noted between the Ethiopian highlands early in the rainy season and the desert fringes in arid conditions at the same moment. With the same weight-for-height index, the MUAC of highland children was much smaller than that of desert children. In other words, with the same MUAC-for-height, highland children were heavier than desert children, but they were nonetheless emaciated. Mid-upper arm circumference in fact reflects the state of the tissue that serves as nutritional reserves, that is, lean mass and adipose tissue; MUAC variations thus indicate variations in these two tissues exclusively. As observed by Briend, the measurement of mid-upper arm circumference therefore provides a better indication of mortality risks than does weight-for-height (Briend, 1995).

On the other hand, progress is measured in a TFC according to weight (once oedema, intestinal parasites, infection and inflammation have been treated), because weight gain per kilogram provides a reliable catch-up criterion. Furthermore, muscular catch-up may occur first in the lower limbs rather than the upper limbs, because the legs are solicited first when children recover their mobility and curiosity. In such circumstances MUAC does not reflect actual nutritional catch-up in the early stages of recovery.

When the author resorts to anthropometry, the selection criterion (or cut-off point) is a MUAC-for-height lower than 75% of the reference, or –3 Z-scores. Many agencies apply the cut-off point of weight-for-height inferior to –3 Z-scores. A MUAC inferior to 11 cm is sometimes used also – this is rather severe, because in children between 2 and 4 years old, this corresponds to a MUAC-for-height of 67 and 65% respectively. It is best not to wait until the last moment to admit a child to a TFC, but rather provide it with the most chances of recovery before it is too late.

[5] See Chapter X, Sections 4.4.1 (anthropometric variables and their measurement) regarding weight, and 4.4.8 (the value of anthropometric indicators in reflecting nutritional status).

Carers

Children under 6 years of age must be accompanied, preferably by their mother. If it is necessary to accommodate carers near the centre (because their home is too distant or owing to insecurity), then mothers must be accommodated together with their other children, even if they are not malnourished. Carers must be included in the general food distribution set-up if necessary.

Special cases

If AIDS, tuberculosis or an incurable sickness are suspected, the patient must not be admitted to the TFC. Such cases must be referred to appropriate healthcare facilities, or be sent home to die, provided that they are properly taken care of, or resort to social services and other specialized entities. If such cases are numerous, a specific attention point must be set up to ensure that they receive minimum healthcare and adequate feeding, and die in decent conditions.

Admitting adolescents and adults

Adolescents and adults should only be admitted to a TFC that caters for children if they are very seriously malnourished and sick, provided that their illness can be treated in the TFC. Admission criteria should be a weight-for-height index inferior to 70%, in compliance with the table included in Annex 4.4 for adolescents, and a BMI[6] inferior to 14 for adults. Kwashiorkor cases are only admitted if they are marasmic, in compliance with the above criteria. A TFC must not mistaken for a hospital, and seriously malnourished adults and adolescents that remain the exception warrant caution, because their malnutrition is usually secondary to a serious illness. However, when the number of seriously malnourished adolescents and adults is high (as seen in famines), it is best to set up separate facilities for them, in the form of a highly simplified TFC.[7]

3.2.2 Discharge criteria

Discharge following nutritional catch-up

For children, the criterion for discharge is the stabilization of their weight for two weeks at the level defined for their resumption of a normal diet. The anthropometric threshold for this shift can vary, as explained in Section 4.2.5 below. In addition, the child must be healthy, and it must have recovered its appetite. In some cases, the mother must also have acquired the knowledge to feed and take care of the child properly. This last criterion only very rarely applies to the context of humanitarian operations (it is more common in cases of social dysfunctions).

For adolescents and adults, the criterion is that they must be able to eat normal food.

Exclusion due to absenteeism or misconduct

Absences that exceed three days in a row, or five days spread over a fortnight *without* good reason, in spite of three warnings, leads to the exclusion of the patient from the programme. TFC operators must

[6] BMI: body mass index = weight (kg)/height (m squared). See Chapter VIII.

[7] See Section 4.7 in this Chapter.

nevertheless patiently and strictly attempt to understand such absences and possibly find a solution. It is clearly possible that TFC attendance has been complicated by problems that were previously unforeseeable, which may nevertheless be corrected once they have been detected. Likewise, cases of misconduct (such as theft, the refusal to obey set procedures, or misbehaviour) on the part of beneficiaries or their carers also leads to exclusion after three warnings, and following a serious attempt to understand the underlying reasons for such behaviour; in times of crisis, this problem usually indicates despair.

3.3 OPERATIONAL PROCEDURES

A minimum set of procedures is necessary to run a TFC properly; the application of such procedures calls for common sense, allowing for the circumstantial characteristics of each individual TFC.

3.3.1 Registration and admission

The registration of patients immediately follows their selection, unless selection is performed during home visits when appointments are set. Registration consists in recording the information required for individual monitoring and for the evaluation of the operation proper; patients are then issued with an identification bracelet, and admitted to the centre.

Collecting and recording personal data

Data collection consists of the following steps.

1. Registering the patient in a ledger (Annex 14 provides an example). The same row indicates the personal identification number (attributed by order of admission), the admission date, the name, age, sex, address of the patient, and the name of the carer. The following row contains the personal data of the next patient, and so on.
2. Performing anthropometric measurements and physical examination in order to detect possible illnesses, defining whether the observed malnutrition is primary or secondary, and setting up a personal monitoring sheet that indicates: clinical observations, the sickness and required treatment where relevant, the prescribed quantity of food during initial treatment according to weight, whether the child is breastfed and whether the mother requires attention in this respect.
3. Recording the information necessary for patient monitoring, on the line in the central ledger that corresponds to the individual patient: weight, height, mid-upper arm circumference, the possible presence of oedema, weight-for-height and MUAC-for-height indices, and coded descriptions of possible health disorders.

Identification bracelets

All patients must wear bracelets that indicate their personal identification numbers, codes that correspond to the centre they are assigned to, and the code or logo of the operating agency; this information also limits abuse. Bracelets can be colour-coded according to the phase of nutritional treatment.

Admission

Beneficiaries and their carers are admitted and receive routine attention accordingly (see Section 4.6.1 below), together with the medical treatment required by their condition, where applicable;

the process also includes providing information as to operational procedures and the layout of the centre. They should then be able to wash and receive clothes, blankets and soap (250 g per person per month), if appropriate.

3.3.2 Monitoring

The surveillance process is useful to monitor beneficiaries, and at the same time provides the indications required to evaluate the operation proper. The monitoring of the condition of the beneficiary is separate from that of attendance (or absenteeism).

Monitoring beneficiary condition and progress

The nutritional status of beneficiaries is measured at regular intervals, usually on the basis of rotations. Patients need not be measured daily, even during initial treatment; bi-weekly weighing is sufficient to monitor progress. Results must be compared immediately with the previous entry in order to detect possible complications and take appropriate measures. In addition, the assistants in charge of meals must permanently observe the condition of the beneficiary, and report any problem to medical staff immediately.

The health status of patients undergoing treatment should normally be monitored daily, and developments recorded on personal monitoring sheets. Deaths and their cause are recorded.

Monitoring attendance

It is essential for attendance to be regular in order to ensure adequate feeding and care. Attendance is monitored at each meal, and recorded in a special ledger that indicates the bracelet number and the name of the patient under consideration. Beneficiaries and their carers must be informed of the rules governing their presence at mealtimes and medical treatment sessions, and the consequences of absenteeism.[8]

3.3.3 Discharge

The criteria for discharge have been discussed earlier. In principle, patients should remain in the centre until their nutritional status has stabilized at the anthropometric discharge criteria for two weeks. However, a significant prevalence rate of severe malnutrition can impose faster rotations, and may lead to the reduction, or even the complete waiving of this safety period. In any case, TFC operators must ensure that discharged patients have followed the routine termination treatment,[9] and set a subsequent appointment in order to re-assess their condition one week after their discharge. Moreover, the precise reason for exits must be recorded systematically: catch-up, abandon, expulsion, death, or transfer.

[8] See Section 3.2.2 in this Chapter.

[9] See Section 4.6.3 in this Chapter.

3.3.4 Food preparation

The preparation of food must follow clear, illustrated protocols and figures, which must be posted visibly in the kitchen, alongside the compulsory schedules. Kitchens operate essentially in strict compliance with schedules that define the activities for each meal:

⇨ attendance monitoring, and the resulting acquisition and preparation of resources (fuel, water, and food), that is, as required by the number of beneficiaries and no more;
⇨ lighting up the stoves;
⇨ bringing the water to boil;
  → in parallel, preparing special blends or pre-mixes;
⇨ preparing and cooking the meals;
  → in parallel, preparing the bowls and spoons;
⇨ ration distribution;
⇨ cleaning the cauldrons, cooking utensils, and the kitchen;
⇨ collecting the bowls and spoons;
⇨ washing the bowls and spoons;
⇨ storing the material away from dust and pests.

Initially, kitchen tasks require some practice and consequent adjustments to the time allotted to each activity, in order to arrive at a realistic schedule. Kitchens must be organized in such a way as to minimize confusion in the preparation of meals according to the phases of nutritional treatment. To this end, it is best to distinguish clearly between the preparation of F-75 Formula for initial treatment (which requires intensive and special attention), and the preparation of other meals. TFC kitchens require constant attention. The preparation, distribution and consumption of food are most time-consuming; as such, they should be organized to perfection and be supervised constantly in order to ensure their quality and regularity.

3.3.5 Food distribution

The beneficiaries, their carers, and the staff must all know and observe mealtime schedules. During initial treatment, assistants can deliver the food directly to the patients in the intensive care unit, especially if the latter operates 24 hours per day. Otherwise, the beneficiaries and carers collect the food. They are asked to queue in an orderly way; their presence is recorded at each meal. They then wash their hands and proceed to the canteen; at its entrance, they receive their ration in a bowl, mug, or plate, with a spoon. They are asked to sit in rows in order to allow supervisors to check that the meal takes place as planned, and to assist children or helpless people if necessary.

Carers accompanying small children are instructed to allow the food to cool off (they may taste it) to avoid burns. Children must be made to eat without playing around or dawdling; they must however be allowed to eat peacefully – this is one operational condition for success. Inasmuch as possible, children above 2 years of age should report unaccompanied; assistants (1 for 30 beneficiaries) are precisely required to help such beneficiaries and give them attention and care. This practice limits attendance, and limits the risk of carers eating to the detriment of the patients. Obviously, carers can be issued with snacks, provided that this does not disrupt the TFC procedure. After the meal, beneficiaries wash their hands and supervisors collect the cutlery and crockery. The latter must be washed in hot water and detergent immediately, rinsed with drinking water, set out to dry (preferably in the sun), obviously in a clean place, and finally stored in a closed place, sheltered from insects and other pests.

3.3.6 Feeding

Feeding is the most important activity in a TFC – that is its justification. It is however also initially the most complicated, because severely malnourished subjects are apathetic and irritable, lack appetite, and are generally difficult to feed.

Success in this endeavour is determined by the observance of a number of rules.

1. Feeding bottles are strictly prohibited: they are difficult to clean and, above all, their use is harmful for breastfeeding.
2. Oral feeding is to be attempted at all costs from the outset, using a mug and spoon. Even infants under 1 month quickly grow accustomed to this practice. Patients may drink from the mug directly, or use a spoon; both methods have advantages and drawbacks. The author recommends the use of spoon at the beginning of initial treatment, when carers or assistants feed children; this option improves control over the process and keeps it slow, which reduces the risk of vomiting. As children regain their appetite, the use of mugs is probably preferable, because it speeds the process up, and reduces spillage, which can be collected in a saucer. If children need help to drink, mothers or carers must be instructed how to assist them: the child must sit in the lap of its helper, whose arm cradles it comfortably, while the other arm is used to feed it. If the child is agitated and the helper cannot collect spillage, another helper must do so for the child to consume its entire ration. This aspect is essential during initial treatment, because intakes are deliberately calculated to be only just sufficient to ensure maintenance.
3. Feeding must be resumed immediately, even in case of vomiting or diarrhoea. Feeding often induces diarrhoea in the first few days and this diarrhoea can only be corrected by feeding, which restores the intestinal wall.
4. Breastfeeding is a major priority for infants, and there is no excuse for suspending it, even at mealtimes in the TFC. Moreover, mothers should be actively encouraged and helped to breastfeed in all circumstances, and as long as possible (at least until the child is 2 years old). TFC provide an ideal setting to deliver training on weaning practices, allowing for local customs and food availability.[10]
5. During initial treatment, children can refuse to be fed; in such cases, they must be force-fed. This option is unpleasant and time-consuming, but can save lives. The mother or carer holds the child firmly in a reclining position; an assistant that is skilled in force-feeding gently but firmly pinches the child's nose and, as soon as it opens its mouth to breathe, quickly administers a teaspoon of F-75 Formula while simultaneously releasing the nose; the spoon must not be forced into the child's mouth to avoid wounds and unnecessary trauma. The child must be allowed to breathe a little between spoonfuls. Usually, such children finally accept food without further ado within one day.
6. During initial treatment, nasogastric (NG) feeding may be necessary in case of frequent vomiting or lesions of the mouth; otherwise, the use of NG tubes is unadvisable. Experience shows that oral feeding is almost always possible with a little patience, whatever the age and condition of the patient. In the case of young children, mothers must be informed clearly of the justification for nasogastric feeding in order to secure their acceptance, and to avoid them withdrawing their child from the TFC. In spite of nasogastric feeding, breastfeeding must be continued if possible, as must oral feeding, in small amounts at very frequent intervals. NG tubes should be removed as early as possible, and must be changed at least every second day. The proper insertion of an NG tube involves measuring its length, which corresponds to the distance between the nostril and the base of the sternum, plus a 20 cm buffer in order to fasten it to the temple with a strip of surgical tape and connect it to the supply syringe. The tip of the tube is

[10] See Chapter XV.

dipped in oil and inserted into the nose and then the oesophagus as far as the stomach; the child is asked to swallow in order to facilitate the operation. The tube must reach the stomach and not the lungs, which is confirmed by taking a sample with a syringe (the resulting fluid must be clear), or by injecting a few cubic cm of air into the tube; a stethoscope auscultation should amplify gurgling in the stomach. Feeding syringes should be small enough to avoid jolts and excessive pressure. NG feeding should be performed as slowly as spoon- or mug-feeding.
7. Feeding severely malnourished patients requires great patience and gentleness, and constant attention. This is especially true for young children whose need for affection is just as important as their need for food and medical care. They must therefore never be hustled, even if meals drag on, and TFC staff must be instructed clearly on appropriate behaviour.
8. Immediately after the distribution of food it can still be hot; it must therefore be allowed to cool off before it is fed to small children.
9. At the beginning of initial treatment and until appetite resumes and the TFC environment grows familiar, the presence of mothers or carers is essential to children. Subsequently however, experience has shown that their presence is rather a disadvantage, except for infants and the sick. As a result, patients must learn to feed themselves as quickly as possible, or to accept the help of TFC assistants.

3.3.7 Healthcare

Healthcare must be systematic,[11] and consist of medical examination and individual care. Medical examination is performed every time and as soon as patients present problems of a medical nature. It is performed daily for patients undergoing treatment (including rehydration), and at each weighing session during initial treatment and the first week of rehabilitation. Individual care is delivered to subjects whose medical disorder requires treatment. Except for the type of care that requires qualified medical staff, assistants in charge of supervising mealtimes must administer antibiotics and rehydration salts to patients undergoing treatment that are in their care. They must record what they have administered, to whom, and when in a special ledger that contains relevant instructions. For cases of diarrhoea and vomiting, rehydration salts that are adapted to malnutrition must be made available (such as ReSoMal[12]) in a specially allocated place.

3.3.8 Administration, management and maintenance

TFC require strict administration and management. This should not be seen as an excessive attention to detail: rigorous management ensures the detection of problems that may otherwise be overlooked, and sets an example to discourage slackness and misbehaviour.

Staff

Staff must be recruited according to what it is expected to do: each position and its corresponding schedule must be clearly set out. Respective responsibilities, reporting lines and compensation scales must be well defined. It may be difficult to secure a comprehensive set-up of qualified staff from the outset; in such cases, training schemes must be designed, and individual progress must be tracked and documented. The TFC manager or deputy must monitor all TFC activities regularly and without exception. This is necessary in order to ensure that the operation is running properly and to show interest in the work of each individual staff member, which is also a strong motivation.

[11] See Section 4.6 in this Chapter on routine treatment protocols.
[12] See Section 4.1.2 in this Chapter.

The behaviour and mood of staff members are usually good indicators that can signal a broad range of problems. Salaries must be paid punctually, and national labour laws and social compensation schemes must be observed.

Stocks

Although food stocks are discussed here, the following comments apply equally to medical and material stocks. The anticipation of needs, the rigorous monitoring of commodity movements, inventories and stock maintenance are all necessary in order to limit complications and temptation.

Anticipation of needs

Needs are anticipated according to weekly or monthly consumption patterns; this type of management allows for buffer stocks according to potential breakdowns in the logistics chain, and implies that orders be placed on time, according to usual delivery delays. While buffer stocks are necessary to allow for possible supply breakdowns, they must nevertheless be kept to a minimum to discourage looting. Storage conditions (heat and humidity) may also preclude the maintenance of large stocks.

Stock-flow monitoring

The systematic recording of the incoming and outgoing commodity flow provides an accurate overview of stock positions at any one moment.

Physical inventories

Inventories are performed at least fortnightly, and involve the physical counting of all commodities that are present in the warehouse. Resulting totals are compared with stock card entries, permitting the application of corrective measures if necessary.

Stock maintenance

Proper stock maintenance consists in rotating commodities on the "first in/first out" principle, and according to expiry dates. Warehouses should be cleaned daily. Commodities should be stacked on pallets, and be slightly removed from walls to allow air to circulate. The contents of damaged bags and packaging must be repacked, and contaminated foodstuffs (or those damaged beyond repair) must be disposed of. According to the size of stocks, vermin eradication measures (such as fumigation) may be called for. Food quality and expiry dates must be verified each time goods are transferred.[13]

Internal communication

If kitchens are to operate properly and produce adequate amounts of food, their staff must be informed every day of the attendance expected for the following day; the same comment applies to warehouse staff. TFC admission and discharge ledgers provide the necessary information for determining expected attendance. One staff member should be specifically entrusted with this task, and record this information in a special ledger, and impart it verbally to the colleagues concerned. The TFC manager must oversee the mobilization of resources, and ensure that it

[13] See also Chapter XII, Section 3.8, for food storage.

matches attendance numbers and the corresponding food quantities, and must verify regularly that the quantities prepared in the kitchens and distributed at mealtimes in fact match what has left the warehouses.

Equipment management

The material equipment and tools used in a TFC are valuable; they must be tracked through inventories and checked, and renewable items such as cleaning materials must be replaced in good time. The staff that uses them is held accountable, and sanctions for loss or misuse must be clearly understood.

Hygiene

The population of a TFC constantly changes. As a result, newcomers and their personal belongings must be treated against external parasites upon admission. Thereafter, bedding and clothing must be regularly disinfected, and TFC residents must wash and keep up the best possible personal hygiene. Taking part in sanitation information sessions and maintenance and cleaning chores are key aspects of raising awareness of issues related to hygiene.

TFC condition

The sheer magnitude of the task at hand can easily eclipse some supervision aspects. Here again however, unrelenting thoroughness is essential: the cleanliness of facilities and latrines, the condition of water supply and disposal systems, the infrastructural condition, and the general appearance of the TFC, all contribute to making the centre more welcoming. Repairs and replacements must be done without delay.

Data processing

Data processing is tedious; it is nevertheless essential in order to evaluate operational progress and impact, and for corrective measures to be taken if necessary. Data must be processed regularly enough to correct dysfunctions, but not so frequently as to disrupt operations; weekly analysis is usually adequate.

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3.3.9 Other activities

Activities that complement food distributions can be conducted within a TFC. Depending on available staff, its training and motivation, and available time, nutritional information sessions may be held in line with the recommendations made in Chapter XV. The substance of information sessions must be adapted to local circumstances and customs, and should include concrete examples, demonstrations, and the active involvement of beneficiaries and carers alike; this approach limits the academic tendency of such sessions, which is probably pointless anyway in view of the audience and its circumstances. Such sessions can address carers or mothers facing difficulties in feeding, breastfeeding, or caring for their dependants.

Other interesting options include handicrafts, stock-breeding, and gardening, and the latter two provide the additional benefit of varying the diet; they are however more difficult to manage. Gardening puts waste water to good use in the form of irrigation.

3.4 MONITORING AND EVALUATION

The monitoring of activities is useful to appraise the TFC's operation, and to understand how the situation is developing; evaluation on the other hand provides the opportunity to confirm that the operation is in fact achieving its objectives with the expected impact.

3.4.1 Monitoring

Monitoring serves to confirm that planned activities are being implemented according to set standards; it also permits the analysis of admissions and discharges, and of attendance at mealtimes and treatment sessions.

Monitoring should also provide information as to developments in the living conditions outside the TFC, and as to the factors that influence them.

- ⇨ The quality of the operation must remain stable and satisfactory, and comply with set standards. This type of monitoring devolves upon the manager or a deputy, and is conducted on a daily basis.
- ⇨ The analysis of admissions and readmissions sheds light on the seriousness of the situation prevailing outside the TFC. However when the TFC is saturated and admissions balance out discharges, the ratio between actual admissions and requested admissions becomes the determining factor. The analysis of admissions should not be restricted to numbers only; the origin and status of beneficiaries and the cause of their malnutrition must also be scrutinized. This information is essential for prevention operations that are conducted for the general population outside the TFC – and this is also where cooperation between the agency running the TFC and those operating outside is most profitable.
- ⇨ Attendance at mealtimes and treatment sessions is considered to be satisfactory if it exceeds 95%.
- ⇨ Information that is collected regularly in conversations with carers is an invaluable contribution to the understanding of the situation, and the coverage and impact of operations, outside the TFC. Such information should be shared with other stakeholders and operators, particularly during coordination meetings.

3.4.2 Evaluation

Evaluation consists in verifying nutritional catch-up rates, the duration of TFC residence (which is related to the catch-up rate), the recovery rate from sickness, and the rate of discharges due to recovery (objective achieved) and of exit through death, abandon, expulsion or referral to other therapeutic feeding or hospital facilities.

- ⇨ The nutritional catch-up rate should be 15 g/kg/day on average if rations are enriched in vitamins and minerals as per the formula provided in Annex 15; it should in no case be lower than 10 g/kg/day.
- ⇨ The duration of residence in the TFC should be 4 to 6 weeks at most.
- ⇨ The discharge rate following recovery should be no less than 90%.
- ⇨ The death rate (exit through death) should be lower than 3% among beneficiaries whose attendance at mealtimes and treatment sessions exceeds 95%.
- ⇨ The abandon rate (exit through abandon) should be lower than 10%; however abandon rates do not necessarily reflect upon the quality of the operation.
- ⇨ The transfer rate (exit through referral to other structures) should be lower than 1%.

It goes without saying that the above rates are interrelated; they should therefore be interpreted in an overall perspective.

4. TREATING SEVERE MALNUTRITION

The treatment of severe malnutrition is based on strict procedures that constitute the heart of therapeutic feeding; they must be strictly applied. Arrangements can be found in terms of the infrastructure, organization and functioning of a TFC and there is room for some flexibility; however, there is no lee-way regarding the treatment of patients.

The following treatment protocols are adapted from those provided in the WHO manual (WHO, 1999). The WHO manual was mostly written by Professor M. Golden, who has kindly given the author permission to consult and use its 1995 final draft (Golden, 1995). This part of the ICRC Manual concentrates on children under 6 years of age; however, the principles of therapeutic feeding apply to all age groups.[14]

The specific treatment of severe malnutrition is commonly considered to be feeding. However, severe malnutrition is frequently associated with a number of health disorders that can be fatal, upon which feeding alone has little impact. As a result, therapeutic feeding combines a number of nutritional and medical measures to address interrelated problems. Treatment protocols must be implemented by qualified nursing staff and, where relevant, by medical staff specialized in tropical medicine. The permanent presence of a general practitioner is not an absolute prerequisite, but one should be available for consultation at least once a week. Because of the often difficult circumstances surrounding humanitarian operations, intravenous (IV) infusions should be avoided. Likewise, the use of nasogastric (NG) tubes should also be kept to a minimum; they are seldom necessary in a TFC. Their improper use can inflate their significance in the eyes of mothers and carers, who may as a result lose faith in their ability to feed their severely malnourished child. Parenteral feeding (i.e. intravenous) must be avoided at all costs.

As a reminder, when a TFC is opened in response to crisis, therapeutic feeding follows a routine approach for all individuals suffering from the same type of deficiency. As a general rule, excessively difficult or miserable cases should not be accepted. This rule will doubtless seem restrictive to experienced medical staff; qualified staff should therefore decide for themselves, provided that they take full responsibility for prescribed treatments, and that the additional time and energy that is devoted to such cases is not detrimental to the overall TFC operation.

Some subjects show particular aversion to therapeutic feeding; such behaviour should suggest the presence of specific pathologies such as congenital anomalies, tumours, and disorders of the immune system and vital organs. These conditions also prevail where primary malnutrition due to poverty or famine is common. Such cases must be referred to hospital facilities.

The treatment of severe malnutrition occurs in three to four stages and their corresponding tasks.

1. **Initial treatment**: to correct mortality risk factors and metabolic imbalances, and to rectify the digestive function in order to prepare patients for a rich diet that permits quick nutritional rehabilitation.
2. **Nutritional rehabilitation**: to bring patients up to a satisfactory nutritional level.
3. **Resumption of normal feeding**: to prepare patients for the diet that will be theirs outside the TFC after their discharge, to ensure that patients maintain a good nutritional and health status during this period.
4. **Follow-up**: to re-assess patients at regular intervals after discharge in order to take appropriate measures in case of relapse.

[14] Chapter VIII describes the clinical and pathophysiological aspects of malnutrition, and major specific deficiencies; readers are referred to this Chapter accordingly.

The first two stages are essential; the third may be adjusted to circumstances, and the last, albeit strongly recommended, can be optional.

In addition, routine treatment is necessary, as discussed in Section 4.6. below.

4.1 INITIAL TREATMENT

Children are admitted to therapeutic feeding facilities because their lives are threatened. This threat arises from the fact that their nutritional metabolism is at its limit, and additional complications may occur, such as water and electrolyte imbalance, infection and, less commonly, functional disorder caused by specific deficiencies. Initial treatment aims at treating and preventing the direct causes of mortality in time.

Practically, the following tasks are involved (ranked according to their priority).

1. Treating or preventing hypoglycaemia and hypothermia.
2. Treating or preventing dehydration and restoring electrolyte and mineral balance.
3. Treating incipient or developed septic shock, if present.
4. Correcting the degradation of the nutritional status.
5. Treating and preventing infection.
6. Identifying and treating any other health problems.

Initial treatment should not exceed a fortnight; if the above steps are not resolved within that period, then the patient is failing to respond, and death is likely to ensue.

For greater clarity, each task is discussed separately, in spite of the frequent interrelation of problems that calls for a combined response. In famines however, severe malnutrition is sometimes strictly primary (and practically without complication), thus reducing the intensity of initial treatment.

4.1.1 Hypoglycaemia and hypothermia

Hypoglycaemia and hypothermia often combine, and the first precipitates the second. Both are major causes of mortality during the first days following admission.

Hypoglycaemia

Hypoglycaemia is caused by an interval of more than 4 to 6 hours between meals after the inception of initial treatment, and by severe systemic infection. Its prevention clearly consists of feeding patients at an adequate frequency and/or the administration of broad-spectrum antibiotics.[15] If manifestations of hypothermia, lethargy and mental disorder appear to indicate hypoglycaemia, immediate action is required in the form of oral administration of:

[15] See Section 4.1.5 in this Chapter.

⇨ F-75 Formula preferably;[16]
or
⇨ glucose or saccharose (sucrose, or kitchen sugar) in a 10% water-based solution (10 g of glucose or saccharose completed up to 100 ml with water), 50 ml for children under 5 years of age, 75 ml for children between 6 and 12 years old, and 100 ml for adolescents and adults.

The solution can be fed with a mug or spoon, or instilled slowly by inserting a syringe gently into the corner of the mouth.

After administering treatment solutions, operating staff must monitor patients until they become alert, feed them F-75 Formula regularly, and check for infection and treatment where relevant.

Hypothermia

Hypothermia is proportional to the seriousness of severe malnutrition. On the one hand, body temperature is sub-standard because the basal metabolism diminishes with malnutrition; on the other, the lower critical temperature[17] is higher, whereas the capacity for thermo-genesis of the organism diminishes with ambient temperature (among other things, malnourished children are unable to shiver). As a result, mortality peaks among famished, unsheltered groups occur at dawn and in rainy conditions. Hypothermia is prevented by feeding patients adequately and regularly, and supplying them with appropriate shelter, that is:

⇨ avoiding draughts;
⇨ ensuring an ambient temperature above 25°C;
⇨ supplying clothing and bedding;
⇨ maintaining direct contact with carers or close relatives.

Hypothermia (rectal temperature lower than 35.5°C) requires patients to be kept warm:

⇨ maternal contact is best: the mother lies on her back and her child is placed on her chest, in direct contact with her skin and covered with clothes (including its head) and blankets;
⇨ if this is not possible, the child must be wrapped in blankets and an incandescent filament lamp must be placed above it but at a safe distance and rectal temperature must be checked every half-hour, as hyperthermia can set in quickly.

If the child is unable to maintain a normal temperature independently within two days, death is almost inevitable (Perrin, 1985).

Because of the direct association between hypoglycaemia, hypothermia, and infection, any patient suffering from hypothermia should be treated for hypoglycaemia and systemic infection also, and be fed.

4.1.2 Dehydration and electrolyte and mineral imbalance

Dehydration is a very serious complication of severe malnutrition. As such, it must be detected and treated rapidly. Dehydration occurs in the following stages (Gentilini, 1986):

[16] See Section 4.1.4 in this Chapter.
[17] See Chapter III, Section 1.1.4.

- ⇨ mild dehydration: its clinical signs are thirst and agitation – fluid loss is roughly 40 to 50 ml/kg;
- ⇨ moderate dehydration: its clinical signs are thirst, irritation, tachycardia (accelerated heart rate), and rare and dark urine – fluid loss is roughly 60 to 90 ml/kg;
- ⇨ severe dehydration: its clinical signs are somnolence or anxiety, an accelerated and weak radial pulse, inelastic skin (persistent skin folds), sunken eyes, and the absence of urine for several hours – fluid loss is roughly 100 to 110 ml/kg.

Causes of dehydration

Dehydration frequently results from recent and profuse episodes of watery diarrhoea; diarrhoea is thus a good indicator in explaining substantial fluid loss. If dehydration is suspected, the patient's recent history of diarrhoea episodes must therefore be systematically documented. In a TFC in famine settings however, dehydration may also result from non-pathological losses that are not compensated by adequate fluid intake. This is commonly noted during admission, in patients who have travelled a long distance in the heat, without proper access to water. In other words, severe dehydration may be totally unrelated to diarrhoea or septic shock.

Preventing dehydration

The prevention of dehydration during initial treatment consists in administering rehydration solutions in order to compensate excessive loss due to diarrhoea and sometimes vomiting. In the absence of these two symptoms, patients must be made to drink regularly, through breastfeeding, fluid reanimation feeding, and drinking water.

Treating dehydration

Diarrhoea that combines with severe malnutrition causes substantial electrolyte and mineral imbalance; its treatment is therefore different from that recommended for diarrhoea that is unrelated to malnutrition.

1. In case of marasmus, the sodium pump activity slows down. This results in excess sodium and potassium deficiency in the cell, and potassium is excreted. This logically causes hyponatraemia.
2. In case of kwashiorkor, the sodium pump activity is faster than in healthy subjects. However, this does not prevent the increase of intra-cellular sodium and potassium loss, because membranes become abnormally permeable to these two ions. Moreover, extra-cellular sodium also increases, causing substantial sodium excess (Briend, 1997).
3. The tissue concentration of major minerals drops (zinc, copper, manganese, and magnesium, among others). They are lost at the same time as the cell reduces its metabolic activity, leading to a reduction in its components (Golden, 1982).
4. Zinc, magnesium, and copper deficiencies can themselves cause diarrhoea (Golden, 1995).

The above alterations have led Briend and Golden to recommend an adapted rehydration solution that differs from the standard WHO-recommended ORS solution (which aims at correcting diarrhoea in the absence of malnutrition). For the severely malnourished, ORS contains too much sodium and not enough potassium, and lacks minerals (Briend & Golden, 1993). Table 13.2 below provides the solution proposed by Briend and Golden, called ReSoMal (Rehydration Solution for Malnutrition).

Table 13.2 Composition of oral rehydration salts solution for severely malnourished children – ReSoMal (Briend & Golden, 1997)

Component	Concentration per litre
Copper	45 µmol
Glucose	10 g
Magnesium	3 mmol
Potassium	40 mmol
Selenium	0.6 µmol
Sodium	45 mmol
Sugar	25 g
Zinc	300 µmol

ReSoMal is isotonic (291 mOsm); it is available commercially in a slightly modified form (it contains no selenium[18]). However, ReSoMal can also be made by diluting one sachet of the standard WHO-recommended ORS in 2 litres of drinking water (instead of the usual 1 litre), and adding 50 g of sugar (25 g/l) and 4 g of potassium chloride (KCI, 2 g/l) (MSF, 1995).

The rehydration process must be slower in case of severe malnutrition than in the absence of malnutrition: between 70 and 100 ml of ReSoMal per kg of body weight is usually enough to restore normal hydration (WHO, 1999). This amount should be spoon-fed regularly over 12 hours in 5 ml doses (i.e. the approximate capacity of a standard teaspoon); it can also be instilled through a syringe that is gently inserted into the corner of the mouth. The total volume depends on body weight; however the individual dose and the overall duration of the process do not vary. As a result, the frequency can be adjusted, as can the number of spoonfuls that are administered at a set frequency. The author recommends the latter option (adjusting quantities while observing a set frequency), which corresponds to the posology indicated in Table 13.3 below, based on a rehydration of 85 ml per kg of body weight, administered at 5-minute intervals over 12 hours[19] with a standard teaspoon.

Table 13.3 Posology for rehydration with ReSoMal

Weight (kg)	Total quantity of ReSoMal (ml)	Number of spoonfuls/5 min
3	255	1/3 (1.7 ml)
5	425	1/2 (2.5 ml)
7	595	1 (5 ml)
9	765	1 (5 ml)
11	935	1 1/3 (6.7 ml)
13	1,105	1 1/2 (7.5 ml)
15	1,275	2 (10 ml)
17	1,445	2 (10 ml)

[18] From Nutriset, 76770 Malaunay, France.
[19] Frequencies and amounts should be adjusted to the evolution of the patient's condition.

Upon admission, severely malnourished patients are usually weak, apathetic, and exhausted, and are unwilling to drink. If they cannot be coaxed or forced to drink, ReSoMal may exceptionally be administered by NG tube, at the rate indicated in Table 13.3 above.

Rehydration is completed when the patient is no longer thirsty and passes urine. The possibility of over-hydration nevertheless warrants special attention: its signs are an increased respiratory rate, engorged jugular veins, or a distended abdomen. Over-hydration calls for the immediate suspension of the treatment.

ReSoMal given to maintain hydration in the case of persisting diarrhoea must be administered in amounts that are equivalent to the volume of the stool, until diarrhoea stops.

In case of persisting vomiting, ReSoMal must be administered by NG tube.

As soon as the patient becomes alert and is willing to drink, larger amounts of ReSoMal may be administered, but at longer intervals: this is in order to avoid vomiting and an undue acceleration of the overall rehydration rate.

In the course of rehydration, patients must also resume feeding as quickly as possible, that is, as soon as they become alert. Breastfeeding is the best approach, and the child should be encouraged to feed every 20 to 30 minutes from the onset of rehydration. It is worth reiterating here that breastfeeding is an absolute priority in the treatment of severe malnutrition, in all circumstances. Furthermore, F-75 Formula should be given as soon as possible (usually 2 to 3 hours after starting rehydration). As soon as the rehydration frequency diminishes with larger amounts of ReSoMal and feeding resumes, ReSoMal is alternated with F-75 Formula.

There is no risk of excess mineral concentrations if ReSoMal is *alternated* with F-75 Formula, especially in the case of potassium; both solutions in fact share roughly the same mineral concentration, which corresponds to requirements. However, ReSoMal must *never* be combined with F-75 Formula in the same solution, as this would double the potassium concentration and this could be fatal. Patients for their part limit their intake to their ability to drink.

Differentiated diagnosis of dehydration and septic shock

Dehydration is easily confused (or associated) with septic shock. However, experience with severely malnourished subjects in famines shows that septic shock is much less common than dehydration. Nevertheless, every case of severe dehydration should suggest septic shock. The disorder must hence be identified, but the differentiated diagnosis poses a sensitive problem:

⇨ the signs of shock overlap significantly with those of dehydration;
⇨ the typical signs of dehydration are misleading in the severely malnourished because sunken eyes, skin inelasticity, dryness of the mouth, and the absence of tears may all be due to malnutrition (Briend, 1997);
⇨ the typical signs of infection (fever, inflammation) are attenuated in the severely malnourished.

Table 13.4 below summarizes and compares the clinical features of dehydration and septic shock.

Table 13.4 Comparison of the clinical signs of dehydration and septic shock in the severely malnourished

Symptom	Dehydration	Septic shock
Watery diarrhoea	Yes[e]	Yes/No[f]
Mental state	Agitated[e] Lethargic[a]	Lethargic
Sunken eyes	Yes[e]	No[f]
Thirst	Yes[e,b]	No[f]
Cold hands and feet	No[e]/Yes[c]	Yes
Radial pulse	Weak	Weak
Urine flow[d]	Restricted	Restricted
Hypoglycaemia	Yes/No	Yes/No
Hypothermia	No	Yes[f]/No

[a] Mental state deteriorates as dehydration increases.
[b] Thirst diminishes as dehydration becomes severe, and as lethargy increases.
[c] Hands and feet grow colder as dehydration and septic shock increase, that is, when blood circulation diminishes.
[d] Urine flow diminishes as dehydration and septic shock increase.
[e] Reliable sign of dehydration.
[f] Reliable sign of septic shock.

It is tempting to recommend that dehydration and septic shock be treated systematically when dehydration is suspected, in order to avoid unnecessary risk. However, the excessive use of antibiotics should be avoided, and antibiotic treatment is recommended here only in case of kwashiorkor;[20] in such cases therefore, failure to diagnose septic shock upon admission is less serious. In case of marasmus on the other hand, it is best to avoid the use of antibiotics, and the ability to distinguish between simple dehydration and septic shock is therefore essential. The difficult task of differentiated diagnosis can be overwhelming for health staff that lacks practical experience in severe malnutrition, especially at a time when not a moment may be wasted. In doubt it is therefore best to treat both dehydration and septic shock. It is worth noting that this combined treatment has no harmful consequences early in initial treatment, but may have after a couple of days when recovery is underway; at that stage however, errors in diagnosis are less likely, because the risks of dehydration should have been mastered by then.

4.1.3 Incipient or developed septic shock[21]

As a complication of severe malnutrition, septic shock is rare when malnutrition is mainly primary, and prevailing hygiene conditions and access to water remain adequate. It is however common when malnutrition is secondary, associated with seasonal climatic variations and particular individual vulnerability.

Septic shock results from serious infection of the digestive, respiratory and urinary tracts, where the toxins released by bacteria stimulate the secretion of endogenous factors; the latter cause small arteries (arterioles) and veins to swell, and interfere with the metabolic pathways. Consequently blood flow does not diminish as such, but becomes insufficient because the capacity of the vascular system increases – this produces all the signs typical of poor blood flow (Golden, 1995).

[20] See Section 4.1.5 in this Chapter.

[21] It may seem odd to separate the discussion of septic shock from that on infection. However, septic shock itself is a serious problem, whose clinical signs are similar to those of dehydration in the severely malnourished – therefore, it is best discussed separately, immediately following dehydration.

The clinical signs that should suggest incipient or developed septic shock are (WHO, 1999):

- ⇨ signs of dehydration, but without a history of watery diarrhoea;
- ⇨ hypothermia or hypoglycaemia;
- ⇨ oedema and signs of dehydration.

It is worth noting that the combination of several infections can often associate dehydration, due to past diarrhoea episodes, with septic shock.

Septic shock is mainly treated by administering broad-spectrum antibiotics as soon as its is diagnosed. The recommended first-line treatment is the following (WHO, 1999):

- ⇨ Ampicillin: 50 mg/kg every 6 hours for 2 days, followed by amoxicillin, 15 mg/kg every 8 hours for 5 days (if amoxicillin is unavailable, ampicillin can be given – 25 mg/kg every 6 hours).

In combination with:

- ⇨ Gentamicin: 7.5 mg/kg once daily for 7 days.

The second-line treatment follows if the patient fails to respond, if improvement is weak, or if meningitis is suspected. First-line treatment should show results within two days; if it does not, chloramphenicol should be *added* to first-line treatment (25 mg/kg every 8 hours – every 6 hours if meningitis is suspected – for 5 days) (WHO, 1999). By then, the patient should show appetite and begin to gain weight. If not, second-line treatment must be started and first-line treatment must be extended to a total of 10 days; if no progress is noted by then, other complications such as AIDS and/or tuberculosis must be investigated. Clearly, any other treatment required by other specific infections must be given also.

Feeding must resume as soon as possible with F-75 Formula. This measure is essential to avert hypoglycaemia, which could be fatal. Hypothermia must also be prevented or treated. Rehydration is necessary in case of developed septic shock. Breastfeeding must continue as much as possible, and be encouraged accordingly.

4.1.4 Nutritional treatment of severe malnutrition

The treatment of severe malnutrition extends from initial treatment through rehabilitation to the resumption of a normal diet. The protocol follows a graded scale from fluids (highly diluted foods with low protein and energy contents) to solids that should be as similar as possible to those the child will be given following discharge from the TFC. As a reminder, severely malnourished children are usually anorexic; great patience is therefore required during their first meals.[22]

Feeding on admission

During initial treatment, the diet is fluid and consists of highly diluted foods with low protein and energy contents. Severe malnutrition upsets all metabolic functions; this results in the functional incapacity of vital organs (such as the kidneys, heart, and liver) to manage significant and/or unbalanced dietary intakes. Moreover, digestion is usually substantially impaired, further aggravating the overall ability of the organism to cope with excessive and/or unbalanced intakes, and solids.

[22] See Section 3.3.5 in this Chapter.

During initial treatment, feeding aims mainly at supplying just enough nutrients (in the form of weakly concentrated fluids) to stop the degradation of the nutritional status, prompt digestion, and normalize the metabolism; at this stage, weight gain is not attempted. Energy and protein intakes must therefore accurately balance maintenance requirements,[23] and no more. Moreover, mineral and vitamin intakes must permit the resumption of metabolic functions: this implies in particular that the Type II nutrient balance must be observed.

The above has led Briend and Golden to recommend the use of F-75 Formula, as detailed in Table 13.5 below (Briend & Golden, 1997); this diet is adapted to the initial treatment of severely malnourished individuals that present both kwashiorkor and marasmus. Briend and Golden have also devised the F-100 Formula, used during rehabilitation, which contains higher energy and protein concentrations, with the same micro-nutrient content.

Table 13.5 The preparation of F-75 Formula for initial treatment

Ingredient	Quantity	Energy	Protein
Dried skimmed milk	25 g	87 kcal (365 kJ)	8.7 g
Sugar	70 g	280 kcal (1,170 kJ)	
Vegetable oil	30 g	270 kcal (1,130 kJ)	
Cereal starch (rice)	35 g	120 kcal (500 kJ)	0.3 g
Potassium chloride	1.79 g		
Tripotassic citrate	650 mg		
Magnesium chloride	610 mg		
Zinc acetate	66 mg		
Copper sulphate	11.2 mg		
Sodium selenate	200 µg		
Potassium iodide	100 µg		
Thiamine	700 µg		
Riboflavin	2 mg		
Niacin	10 mg		
Pyridoxine	700 µg		
Cobalamin	1 µg		
Folic acid	350 µg		
Ascorbic acid	100 mg		
Pantothenic acid	3 mg		
Biotin	100 µg		
Retinol	1.5 mg		
Calciferol	30 µg		
Tocopherol	22 mg		
Vitamin K	40 µg		
Water	Complete up to 1 litre		
Total		757 kcal (3,160 kJ)	9 g

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[23] See Chapter III, Section 1.1.6.

F-75 Formula supplies roughly 75 kcal (313 kJ) per 100 ml (hence its name), with a protein-energy ratio[24] (P/E ratio) of approximately 5%, and a lipid-energy ratio of approximately 35%.

Opinions differ as to the use of F-75 Formula during initial treatment because its energy concentration is low, it introduces a new product and additional complications for kitchen staff to handle, while the use of more concentrated solutions has yielded equally good results. However, in severely wasted patients and those suffering from kwashiorkor, F-75 Formula is without question most appropriate and avoids, in particular, protein overload.

F-75 and F-100 Formulae were initially developed and commercialized by Nutriset, a French company, and are both widely used by humanitarian agencies; "Nutriset milk" has in fact become a common expression in the nutritional jargon.

If F-75 Formula is unavailable, traditional recipes involving the use of powdered milk, oil, and sugar[25] may be resorted to. The powdered milk, sugar and oil must be well blended in a "pre-mix" that can be stored for several days in clean and sealed containers. Pre-mix is used according to need, diluting it in water that has been previously boiled for at least 10 minutes. Health staff however sometimes increases protein supplies during initial treatment; this practice is dangerous because protein quickly becomes toxic in severely malnourished patients, as they cannot excrete excess nitrogen easily, and this can lead to kidney and heart failure – manifesting itself in oedema and ultimately death. In such cases, it is tempting to increase protein supplies because kwashiorkor oedema is all too often ascribed to protein deficiency, but this only worsens the situation. Hence the occasional reports of serious marasmus cases that developed kwashiorkor, and eventually died. In this particular case, oedema is totally unrelated to kwashiorkor, and results from kidney failure. This type of problem is possible if the P/E ratio of initial treatment feeding exceeds 6%.

In the absence of ready-made F-75 Formula, alternatives prepared with basic ingredients include the following.

1. Improvised F-75 Formula

F-75 Formula can easily be improvised in compliance with Table 13.5 above, from powdered milk, sugar, oil, cereal flour, and special vitamin and mineral complements.[26] The difference lies in the use of cereal flour instead of cereal starch – this increases the protein concentration, raising the P/E% to approximately 6.5%.

2. ReSoMal adjunction

In the absence of vitamin and mineral complements, ReSoMal may be used to produce a formula that is similar to F-75 (see Table 13.6 below); this alternative however lacks vitamins, which can be supplied in the form of tablets. On the other hand, in the absence of declared vitamin deficiency, minerals (especially zinc) are more important at this stage.

[24] The protein-energy ratio (P/E%) is the percentage of the protein contribution to the overall energy of the diet. As a reminder, 1 g of protein supplies 4 kcal. Consequently, the protein-energy ratio, expressed in %, is obtained by multiplying the number of grams of protein in the ration by 4, dividing the result by the overall energy content of the ration, and multiplying the final result by 100.

[25] Results are adequate, but such recipes lack several Type II nutrients (unlike F-75 Formula) whose interaction is essential in tissue synthesis.

[26] Annex 15 provides their composition and use.

Table 13.6 Recipe for an alternative formula containing ReSoMal

	Formula with dried skimmed milk			Formula with dried whole milk		
Ingredient	Quantity	Energy	Protein	Quantity	Energy	Protein
Dried milk	25 g	87 kcal (365 kJ)	8.7 g	35 g	175 kcal (730 kJ)	8.7 g
Vegetable oil	25 g	225 kcal (940 kJ)		20 g	180 kcal (752 kJ)	
Sugar	40 g	160 kcal (670 kJ)		30 g	120 kcal (500 kJ)	
Cereal flour	35 g	≈122 kcal (510 kJ)	≈3.5 g	35 g	≈122 kcal (510 kJ)	≈3.5 g
ReSoMal	For 1 litre	≈140 kcal (585 kJ)		For 1 litre	≈140 kcal (585 kJ)	
Water	Complete up to 1 litre			Complete up to 1 litre		
Total	1 litre	734 kcal (3,070 kJ)	12.2 g	1 litre	737 kcal (3,080 kJ)	12.2 g

The formula containing ReSoMal supplies approximately 74 kcal (313 kJ) for 100 ml, with a P/E% of 6.6%.

Pre-mix is prepared by blending the powdered milk, sugar, and ReSoMal powder, and then mixing in the oil until the blend is completely homogeneous. If pre-mix is not used immediately, it must be mixed again before use because oil tends to separate out. Milk is reconstituted with water that has been previously boiled for at least 10 minutes.

3. Formula without ReSoMal

In the absence of both vitamin and mineral complements and ReSoMal, a formula similar to F-75 may nevertheless be prepared; it however lacks the amounts of vitamins and minerals that are necessary for the optimal treatment of severe malnutrition. The amount of sugar is increased to compensate for the absence of ReSoMal. This formula has nevertheless proven efficient in initial treatment, and is presented in Table 13.7 below.

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Table 13.7 Recipe for an alternative formula without ReSoMal

	Formula with dried skimmed milk			Formula with dried whole milk		
Ingredient	Quantity	Energy	Protein	Quantity	Energy	Protein
Dried milk	25 g	87 kcal (365 kJ)	8.7 g	35 g	175 kcal (730 kJ)	8.7 g
Vegetable oil	25 g	225 kcal (940 kJ)		20 g	180 kcal (752 kJ)	
Sugar	75 g	300 kcal (1,250 kJ)		65 g	260 kcal (1,090 kJ)	

Cereal flour	35 g	≈122 kcal (510 kJ)	≈3.5 g	35 g	≈122 kcal (510 kJ)	≈3.5 g
Water	Complete up to 1 litre			Complete up to 1 litre		
Total	1 litre	734 kcal (3,070 kJ)	12.2 g	1 litre	737 kcal (3,080 kJ)	12.2 g

The above formula without ReSoMal contains approximately 74 kcal (313 kJ) for 100 ml, with a P/E% of 6.6%.

The preparation and utilization of this pre-mix is the same as for the formula containing ReSoMal.

Administering F-75 (and alternative formulae)

Daily intake

Care must be taken to avoid overloading digestion, while preventing a further deterioration of the nutritional status. Therefore, maintenance requirements must be met with respect to actual body weight. Daily intake is determined by body weight, whereas requirements per kg of body weight vary according to age. Table 13.8 below indicates F-5 Formula intake for different age groups; no distinction is made according to sex, as this would be illusory in a TFC. For more safety, intakes are calculated according to males, as their requirements are greater than female requirements.

Table 13.8 Daily intake of F-75 Formula per kg of body weight according to age

Age (years)	**Maintenance energy requirements** (kcal/kg/day) ((kJ/kg/day))	**Quantity of F-75 Formula** (ml/kg/day)
0 – 5	100 (418)	135
6 – 7	90 (376)	120
8 – 10	75 (314)	100
11 – 14	60 (251)	80
15 – 18	50 (209)	70
19 – 60	40 (167)	50
> 60	35 (146)	45

Intake frequency

Ideally, F-75 Formula should be administered continuously using a pump, as is commonly done in hospitals. This is usually impossible in humanitarian operations; it is therefore best to observe a high feeding frequency, in order to supply small amounts at a time. The purpose is to avoid hypoglycaemia/hypothermia resulting from excessive intervals between meals, and an overload of the digestive system. The usual recommendation for initial treatment in a TFC involves 24-hour feeding, based on 8 meals consumed every 3 hours. In circumstances that do not permit this, meals should be spread out evenly over working hours; in principle, the minimum working time should be 12 hours per day in a TFC, and no less than 5 meals should be given during this period.[27]

Food utilization

In order to avoid unnecessary repetitions, the utilization of food is discussed in Section 4.2.3 below, in the section on nutritional rehabilitation; field workers must be familiar with its contents.

The transition to rehabilitation

Initial treatment is completed when the patient's digestion is restored and medical complications have been treated and are receding accordingly – this is demonstrated by renewed appetite. The process takes 2 to 3 days at least, and 1 week at most after admission. Before engaging in rehabilitation, patients should be fed amounts of F-100 Formula equivalent to the amount of F-75 Formula they have been fed up until then; this makes the transition towards intensive nutritional rehabilitation easier.

Lactose intolerance

Diarrhoea is very common early in initial treatment, and is often ascribed to lactose intolerance.[28] There are three types of lactose intolerance: intolerance associated with digestive atrophy in the severely malnourished or patients suffering from digestive disorder, intolerance resulting from the suspension of milk consumption in weaned infants, adolescents, and adults, and intolerance related to a congenital inability to synthesise lactase (lactose digestion enzyme). The first two types in fact combine with diarrhoea, and disappear quickly in all age groups during initial treatment. The third type is irreversible, and requires a completely lactose-free diet. It is however very rare, because subjects who suffer from it usually die young since they are unable to digest maternal milk – unless parents can secure suitable substitution formulae. Consequently, this type of intolerance is very rare in a TFC; the author has never witnessed it. Congenital intolerance manifests itself in abundant watery diarrhoea soon after the ingestion of lactose; this diarrhoea stops when the ingestion of milk stops, and resumes with it. Should such cases appear nevertheless, the patient must be fed yoghurt or a lactose-free commercial formula. However, sudden and abundant watery diarrhoea should suggest cholera rather than congenital lactose intolerance.

4.1.5 Preventing and treating infection

Infection is a common complication of severe malnutrition. Several types of infection can coincide, as may hypoglycaemia and hypothermia. The typical signs of infection can be quite unobtrusive (even non-existent) in the severely malnourished, thus complicating their detection. Infection is therefore a serious danger and a major cause of mortality during initial treatment. As a result, preventive and curative measures to address infection are essential in a TFC.

Prevention

The prevention of infection includes the following measures, which are discussed within a number of sections in this Chapter:

[27] See also Section 4.2.4 in this Chapter.

[28] See also Chapter V, Section 1.9.6 on lactose intolerance.

- ⇨ breastfeeding (Section 4.3.1);
- ⇨ vaccination (Sections 4.6.1, 4.6.3);
- ⇨ vitamin A supplementation (Section 4.6.1);
- ⇨ water purification (Section 3.1.2);
- ⇨ TFC compound cleanliness (Section 3.3.8);
- ⇨ adequate numbers of latrines, and their regular cleaning and disinfection (Section 3.1.2);
- ⇨ rubbish/garbage and waste water disposal (Sections 3.1, 3.1.2);
- ⇨ regular disinfection of clothing and bedding (Sections 3.1.2, 3.3.8);
- ⇨ personal hygiene (beneficiaries and carers) (Section 3.3.8).

Treatment

The treatment of infection is an essential aspect of therapeutic feeding in a TFC, as it permits the checking of epidemics and the promotion of nutritional catch-up, and avoids fatal complications. It must be strict and disciplined, especially in terms of dosage.

Bacterial infections

The number of children suffering from respiratory, urinary, and systemic infection upon admission can be very high. This poses a problem insofar as diagnosis upon admission is complicated – hence the question as to whether treatment should simply be systematic. The WHO and MSF are rather in favour of this option (WHO, 1999; MSF, 1995); experience however shows that the answer should vary according to circumstances. In famines, where severe malnutrition is mainly primary and patients are above all malnourished but seldom sick, systematic treatment should be restricted to kwashiorkor cases; marasmus cases on the other hand should be carefully examined upon admission, and treated if infection is demonstrated by clinical signs and/or the patient's history. In circumstances where primary and secondary malnutrition combine, or where malnutrition is mainly secondary because of climatic variations or poor hygiene (that is, where malnutrition results rather from infection), it is best not to run unnecessary risks and resort instead to systematic treatment. The decision should ultimately be based on medical expertise and adapt to circumstances rather than follow strict guidelines.

As for the treatment of septic shock, broad-spectrum antibiotics and first-line treatment must be administered, allowing for second-line treatment in case of failure to respond to first-line therapy.

In case of systematic treatment, distinctions must be made between marasmus, marasmus with complications and kwashiorkor.

1. **marasmic children** with no apparent sign of serious infection and no hypothermia or hypoglycaemia should receive first-line treatment as follows:
   → Cotrimoxazole (25 mg of sulphamethoxazole + 5 mg of trimethoprim/kg), orally, twice daily for at least 5 days;
2. **marasmic children with complications** such as hypoglycaemia, hypothermia, septic shock, skin infections, respiratory or urinary tract infections, or lethargy; *and*
3. **kwashiorkor cases** with oedematous malnutrition – the presence of oedema is the criterion for systematic antibiotic treatment, whatever the accompanying complications.

Complicated marasmus cases *and* kwashiorkor cases should both receive first-line treatment as follows (the same as for septic shock, as provided in Section 4.1.3 above):

→ Ampicillin: 50 mg/kg (IM or IV) every 6 hours for 2 days, followed by amoxicillin, 15 mg/kg every 8 hours for 5 days (if amoxicillin is unavailable, ampicillin can be given – 25 mg/kg every 6 hours);

In combination with:
→ Gentamicin: 7.5 mg/kg (IM or IV) once daily for 7 days.

Second-line treatment is necessary if the patient fails to respond, if improvement is weak, or if the patient develops an infection.

First-line treatment should show results within two days; if it does not, chloramphenicol should be *added* to first-line treatment (25 mg/kg every 8 hours – every 6 hours if meningitis is suspected – for 5 days) (WHO, 1999). By then, the patient should show appetite and begin to gain weight. If not, second-line treatment must be started and first-line treatment must be extended to a total of 10 days; if no progress is noted by then, other complications such as AIDS and/or tuberculosis must be investigated.

If patients are not all systematically treated upon admission, then treatment is reserved for kwashiorkor cases and complicated marasmus cases, in line with the above recommendations regarding septic shock.

Eye infections

Eye infections must be treated with penicillin or tetracycline ointments. However, the traditional method of applying a few drops of maternal milk to each eye three times daily for a few days is quite effective. Maternal milk contains the specific antibodies necessary to counter germs in the environment; its antiseptic properties are therefore well-adapted to the pathogens that children are exposed to.

Intestinal infections

Intestinal infections usually manifest themselves through diarrhoea, which can be bacterial, parasitic, or viral. The difference is not easily made in a TFC, especially in the absence of laboratory facilities. Viral diarrhoea has no specific treatment, and accounts for 60% of all cases according to MSF (MSF, 1992). Consequently, most diarrhoea cases require no other treatment than the replacement of lost fluids, done with ReSoMal. If diarrhoea is combined with fever, the treatment for septic shock should be applied immediately. Bloody stool suggests the presence of shigellosis: this is treated for 5 days with cotrimoxazole (according to the prescription for simple marasmus provided above). If bloody diarrhoea persists for more than 2 days, the antibiotic must be replaced with one that is effective on the local shigellosis strain (WHO, 1999). If diarrhoea (bloody or not, with or without fever) persists beyond 5 days of treatment, metronidazole should be introduced (see below, parasite infections).

Viral infections

The worst viral infection in a TFC is measles. All children must be vaccinated against measles upon admission, and again upon their discharge (when their health and nutritional status is restored). In view of the mortality resulting from measles combined with malnutrition, the author recommends that all children between 9 months and 8 years be vaccinated. Children under 9 months are also vaccinated upon admission, bearing in mind that they must be vaccinated again when they reach 9 months.

Children who have the disease upon admission must also be vaccinated and receive a vitamin A dose in addition to the routine admission dose;[29] the dose must be renewed after one week[30] because measles often causes vitamin A deficiency, which may result in blindness and raises the

[29] See Section 4.6.1 in this Chapter.
[30] See Section 4.6.2 in this Chapter.

risk of mortality due to infection. In addition, antibiotic treatment must be initiated immediately in order to treat or prevent bacterial infection, which often complicates measles and accounts for much of the mortality associated with the disease. Antibiotic treatment is identical to that described above for septic shock.[31] Antipyretics should be given to patients whose body temperature exceeds 39.5°C.

Parasite infections

Protozoa and nematodes account for most parasite infections in a TFC.

Protozoa

The commonest protozoa infections are amoebiasis (*Entamoeba Hystolitica*) and giardiasis (or lambliasis, *Giardia Lamblia*). In the absence of laboratory facilities to analyse stool and if dysentery persists in spite of antibiotic treatment, amoebiasis or giardiasis should be suspected – both are treated orally with metronidazole, as per the posology provided in Table 13.9 below.

Table 13.9 Metronidazole posology for the treatment of amoebiasis and giardiasis

Age	2 – 12 months	1 – 5 years	6 – 15 years	Adult
Weight	4 – 7 kg	8 – 14 kg	15 – 35 kg	> 35 kg
Amoebiasis[a]	10 – 15 mg/kg 3 times daily (30 – 45 mg/kg/day)	10 – 15 mg/kg 3 times daily (30 – 45 mg/kg/day)	250 mg 3 times daily (750 mg/day)	500 mg 3 times daily (1,500 mg/day)
Giardiasis[b]		5 mg/kg 3 times daily (15 mg/kg/day)	125 mg 3 times daily (375 mg/day)	250 mg 3 times daily (750 mg/day)

[a] 10-day treatment.
[b] Two treatment cycles of 7 days each, with a 2-week interval.

Nematodes

Nematodes include intestinal roundworms (ascaris, *Ascaris Lumbricoides*), hookworms (ankylostomes, *Ancylostoma Duodenale* or *Necator Americanus*), and pinworms (oxyures, *Enterobius Vermicularis*). Nematode infection is so common that it should be treated systematically. However, the treatment is too brutal to be administered during initial treatment; it should only be administered once patients have progressed into rehabilitation, usually one week after admission.[32]

Scabies

Scabies is a parasite skin infection that causes rashes and intense itching. It spreads rapidly under crowded conditions where there is frequent skin-to-skin contact, and by contact with the clothing or bedding of infected persons. Treatment consists of cleaning the sores with a 2% copper sulphate lotion, and applying a 20–25% benzyl-benzoate solution twice at a 2-day interval to the infected area (preferably the entire body). Patients must be washed on the third day; clothing and bedding must be boiled, and the entire family treated.

[31] See Section 4.1.3 in this Chapter.
[32] See Section 4.6.2 in this Chapter.

4.1.6 Identifying and treating other health disorders

Specific deficiencies

These can affect the entire population, and usually do not require treatment in a TFC, unlike severe malnutrition. Treatment and prevention protocols therefore apply both inside and outside a TFC. Moreover, if specific deficiencies are substantial within a TFC, the problem is likely to be equally serious outside, requiring action accordingly. Ideally, the population outside the TFC should be provided with adequate feeding, and this is not always possible by far. Usually, then, action is limited to the distribution of vitamin supplements or tablets. Nevertheless, cases with clinical signs and requiring therapeutic treatment should be searched for as much as possible. In a TFC, only vitamin A deficiency requires a routine approach;[33] other specific deficiencies should only receive therapeutic treatment in the presence of declared clinical signs, in view of the fact that F-75 and F-100 Formulae contain all the necessary vitamins and minerals in appropriate amounts.

Congestive heart failure

Heart failure can result from over-hydration when standard ORS solution is given, or from severe anaemia. It is indicated mainly by fast breathing (40 breaths per minute or more in children between 2 and 12 months, and 30 breaths per minute in children between 1 and 5 years). Feeding and fluid intake must be stopped immediately until breathing slows down substantially – this can take between half a day and two days.

Kwashiorkor dermatosis

This is characterized by pigment loss (hypo-pigmentation) of the skin, shedding of the skin in flakes or scales, and skin ulceration. Provided that feeding follows the protocols indicated above, dermatosis recedes and heals quickly (within 2 to 3 days), mainly because of the zinc contained in the diet. Because kwashiorkor cases must in any case be subjected to antibiotic treatment upon admission, the risk of infection is controlled. Lesions may also be bathed daily with 1% potassium permanganate solution, inhibiting infection and enabling the wounds to heal.

Malaria

Malaria is widespread in the tropics and must be treated quickly, following the microscopic examination of a blood smear in order to determine plasmodium type. In endemic areas, blood testing should be systematic for any fever that exceeds 38.5°C. If testing material is not available, persistent fever must be treated in the absence of other signs of bacterial infection, as must fever that persists in spite of antibiotic treatment. Malaria treatment should follow national health and/or WHO protocols. Prescribed drugs vary from one region to another, and are regularly updated according to the development of resistance and progress in research. Should they not be available or in the case of recognized objection to the prescribed treatment by local health authorities, the following protocol remains valid:

[33] See Sections 4.6.1 and 4.6.2 in this Chapter.

⇨ *Plasmodium malariae, Plasmodium ovale, Plasmodium vivax*:
→ Chloroquine – children and adults:
10 mg base/kg on days 1 and 2 in a single dose;
5 mg base/kg on day 3 in a single dose;
⇨ *Plasmodium falciparum*:
→ Quinine – children and adults:
8 mg base/kg orally every 8 hours for 7 days.

4.2 NUTRITIONAL REHABILITATION

Resumed appetite and an improved general health status are the main criteria for the initiation of nutritional rehabilitation following initial treatment. During rehabilitation, medical treatment is completed, and patients are brought back to a satisfactory nutritional status. In the case of kwashiorkor, the disappearance of oedema terminates initial treatment; if oedema does not disappear within one week however, the diet should nevertheless be more concentrated than during initial treatment – failing that, malnutrition of a kwashiorkor-marasmus type can develop.

4.2.1 The nutritional aspects of rehabilitation

During nutritional rehabilitation, the amount of food should cover maintenance and nutritional catch-up requirements. This permits patients to gain weight quickly, and to promote the metabolic shift towards anabolism, that is, tissue synthesis. This change occurs through a modified balance and hormone control, and is not quickly reversible towards catabolism, which should nevertheless occur when energy requirements for maintenance exceed available nutrients. This is the case for example when the intervals between meals are excessive and daily energy intakes cover neither the catch-up underway (which is a priority in the anabolic phase), nor maintenance requirements, nor those associated with physical activity and/or thermo-genesis. As a result, a regular and adequate diet must be provided in order to avoid energy requirements not being met in time through a metabolic reversal towards catabolism. This usually entails hypoglycaemia, followed by hypothermia and death, especially in infants.

This aspect is all the more important in view of the fact that nutritional catch-up is calorie and energy-intensive, requiring 5 kcal (21 kJ) and 0.16 g of protein per gram of recovered tissue. Rapid catch-up (in the order of 20 g/kg/day) implies that the proportion of food that it requires is equal to or greater than maintenance requirements. For example, the maintenance requirement of a child weighing 10 kg is 1,000 kcal (4,180 kJ) per day. Based on a daily catch-up rate of 20 g/kg/day, this child will gain 200 g per day, which require 1,000 kcal (4,180 kJ) in addition to maintenance needs. Adequate and regular intake is therefore essential as soon as nutritional catch-up has begun – practically speaking, children under 5 years of age need an average intake of 200 kcal (840 kJ)/kg/day, provided that physical activity is moderate, and that thermo-genesis requirements are low.[34] If physical activity is heavy, the intake should be 250 kcal (1,050 kJ)/kg/day. With respect to protein, a corresponding P/E ration of 10 to 12% should be an adequate intake. In adolescents, energy requirements for catch-up much exceed maintenance requirements, whereas protein catch-up requirements convert into a P/E ratio of at least 11.5%.

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[34] In a TFC, proper admission and maintaining of a comfortable temperature in accommodation places should make thermo-genesis requirements negligible.

Take the example of a severely malnourished 14-year old girl weighing only 30 kg at the beginning of rehabilitation. Leaving aside the correction for her reduced basal metabolism because of malnutrition, her maintenance requirements for 30 kg is roughly 1,360 kcal (5,680 kJ) and 28.5 g of protein, that is, a P/E ratio of 8.4%. In order to achieve a catch-up of 20 g/kg/day (i.e. $20 \times 30 = 600$ g), she requires another 3,000 kcal (12,540 kJ) and 96 g of protein. Her total daily requirement is then 4,360 kcal (18,220 kJ) and 124.5 g of protein, for a P/E ratio of 11.4%.

The same calculation applies to adults, for example a severely malnourished man only weighing 42 kg. Still leaving correction factors aside, his maintenance requirements for 42 kg is approximately 1,600 kcal (6,700 kJ) and 31.5 g of protein, whereas the catch-up of 20 g/kg/day requires 4,200 kcal (17,560 kJ) and 131 g of protein. His total daily intake must then amount to 5,800 kcal (24,240 kJ) and 162.5 g of protein, for a P/E ratio of 11.2%.

These two examples show the extent of nutritional catch-up requirements in adolescents and adults.

In overt crisis, the individual sojourn in a TFC should be kept as short as possible in order to restrict the waiting time of potential patients to a minimum. Nutritional rehabilitation must therefore be fast, and the objective should be a catch-up of 20 g/kg/day. This goal can be unrealistic because of biological discrepancies and differences in health status, behaviour, and circumstances; an average catch-up rate of 15 g/kg/day is thus satisfactory. A lower than 10 g/kg/day average catch-up rate however suggests problems regarding the entire centre, and requires urgent action. The same warning applies to individual patients whose catch-up rate is lower than 10 g/kg/day during rehabilitation. These considerations are clearly based on the assumption that the diet supplies all nutrients in adequate amounts – especially Type II nutrients, whose absence would limit weight gain.

In Angola, before the days of the Type I–Type II nutrient theory and when adequate vitamin and mineral supplements were not available, catch-up was noted to be much lower than expected according to the protein-energy intake, and appetite loss tended to spread after approximately one or two weeks of nutritional rehabilitation. The foodstuffs were in this example powdered milk, sugar, oil, corn flour, and beans, combined into high-energy milk (twice daily), porridge (twice daily), and one normal meal per day. Early in rehabilitation, appetite was good but progress soon stopped, and dietary increases made no difference. The introduction of F-100 Formula in the same locations a few years later on the other hand produced spectacular results, leading to catch-up rates of 15 to 20 g/kg/day as from the first days of treatment, levelling out only when the nutritional status was again satisfactory.

4.2.2 Feeding during rehabilitation

During rehabilitation, the density and quantity of nutrients must be increased, and the diet must begin to diversify in order to re-accustom patients to a normal diet. In principle, the process begins with high-energy milk, subsequently alternates milk with porridge, and ends with normal meals that should be as similar as possible to the patient's after discharge. The progression of the diet is determined by staff resources, the overall workload, and the catch-up rate. The process can be gradual, and involve the supply of F-100 Formula only during the first 5 days, followed by the alternation of F-100 and porridge during another 5 days, and finally the replacement of the porridge with normal meals until the completion of rehabilitation. This option is very demanding on kitchen staff and supervisors; it may be eased somewhat by restricting the shifts from one diet to the next to two days per week at most. In more demanding settings, porridge may be alternated with F-100 Formula from the outset, followed by normal meals after one week of rehabilitation. The gradual approach should only be followed in case of mainly secondary malnutrition and significant medical complications.

F-100 Formula

F-100 Formula differs from F-75 Formula[35] in macro-nutrients and not micro-nutrients. The composition that supplies macro-nutrients is 80 g of skimmed dried milk, 50 g of sugar, and 60 g of oil for the preparation of 1 litre of formula. F-100 Formula supplies 100 kcal (418 kJ) and 2.8 g of protein for 100 ml, for a P/E ratio of 11.2%. Commercial ready-made preparations already contain vitamin and mineral supplements, and they are simply diluted in previously boiled water in compliance with the producer's directions: 190 g of powder are completed up to a final volume of 1 litre (and not 190 g for 1 litre of water).

Improvised F-100 Formula

F-100 Formula can easily be improvised in compliance with the above indications, and by adding the vitamin-mineral preparation used for F-75 Formula.[36] If only whole dried milk (and not skimmed dried milk) is available, the composition is 120 g of whole dried milk, 30 g of oil, and 40 g of sugar, plus the vitamin-mineral complement to prepare 1 litre of formula – this supplies approximately 100 kcal (418 kJ) and 3 g of protein for 100 ml, with a P/E ratio of 11.6%. If the formula is made from separate ingredients, a pre-mix must be prepared first by blending the milk powder, sugar, and vitamins and minerals homogeneously, and then adding the oil. This pre-mix can be kept for a few days in a clean, sealed container, it must however be mixed again before use. The milk is reconstituted by dissolving the pre-mix in hot, previously boiled water, whisking it in the process – it must be served immediately, as the oil tends to separate out. Care must be taken to *complete* the pre-mix up to the corresponding volume of milk: for example, pre-mix prepared for 50 litres of milk must be dissolved in 30 litres of water, and then completed up to a final volume of 50 litres (the pre-mix must not be added to 50 litres of water, as the resulting solution would be too diluted). This involves calibrating cauldrons first.

Basic F-100 Formula

Before the introduction of F-100 and F-75 Formulae, therapeutic feeding was more basic; its results were less spectacular, but efficient nevertheless. Should the formula be improvised in the absence of modern formulae and adequate measurement material, the previous recipe may be used; it is based on volumes as follows:

- ⇨ pre-mix:
  - → 6 volumes of dried skimmed milk;
  - → 2 volumes of oil;
  - → 1 volume of sugar;
- ⇨ the milk is reconstituted thus:
  - → 1 volume of pre-mix is dissolved in
  - → 4 volumes of hot water that has been previously boiled for 10 minutes at least.

This process produces high-energy milk that supplies approximately 100 kcal (418 kJ) and 4 g of protein for 100 ml. Its P/E ratio is thus 16% – this is quite high for kwashiorkor cases with medical complications and for very severe marasmus cases, but nevertheless permits most patients to be saved. In such circumstances, vitamin and mineral supplements are likely to be unavailable also; consequently, a catch-up rate of 10 g/kg/day is reasonable. Technically speaking, this option requires that the amounts necessary to prepare for example 25 or 50 milk rations of a given volume be well calibrated from the outset; this calibration then facilitates TFC supply planning.

[35] See Section 4.1.4 in this Chapter.

[36] Annex 15 describes its composition and utilization.

Porridge

Commercial products also exist for the preparation of nutritional rehabilitation porridge; like F-100 Formula, they contain all the necessary nutrients in adequate amounts (for example, ThP. 450 or ThP. 380 produced by Nutriset). This porridge supplies between 100 and 130 kcal (418 and 543 kJ)/ml, with a P/E ratio of 10%. If commercial formulae are not available, a basic alternative can be produced from basic ingredients and, if possible, adapted vitamin and mineral complements.

The following recipe has proven effective:

⇨ corn flour:	60 g	210 kcal (880 kJ)	6 g protein
⇨ dried skimmed milk:	30 g	105 kcal (440 kJ)	10.5 g protein
⇨ oil:	30 g	270 kcal (1,130 kJ)	
⇨ sugar:	15 g	60 kcal (250 kJ)	
⇨ water:	350–400 ml to reach a total volume of 1/2 litre.		

The pre-mix is prepared by blending the flour, milk powder, and sugar homogeneously, and then adding the oil. At the same time, the water is boiled for 10 minutes. Part of the water is blended into the pre-mix until all lumps have been absorbed. The remaining water is then added up to the total intended volume, and the resulting porridge is cooked gently for about 30 minutes, stirring frequently. Before serving, the vitamin-mineral complement[37] is added and mixed in well. This porridge supplies approximately 130 kcal (540 kJ) and 3.3 g of protein/100 ml with a P/E ratio of 10%.

Other foods

Other foods may also be supplied, for example to be taken home or eaten on site with or between meals. Such foods include high-energy biscuits (whose composition should be as close as possible to that of F-100 Formula), special peanut paste that is equivalent to one F-100 Formula meal (e.g. Plumpy'nut produced by Nutriset) that supplies 500 kcal (2,090 kJ) for one 92 g sachet, and fruit. Such products derive their appeal from the fact that they require no preparation or cooking. They are however dehydrated (except fresh fruit), implying that patients must be able to drink, and it is difficult to ascertain who has in fact consumed them. As a result, it is best not to introduce such foods before the second week of rehabilitation, and for them to account for less than 20% of the daily ration – practical constraints nevertheless often result in their greater contribution.

Normal meals

After 1 week of rehabilitation, 1 porridge meal should be replaced with a normal meal. Such meals must be prepared with local products or GFD foods (if the latter accounts for most of the food supply). Like porridge, meals must supply between 100 and 150 kcal (420 and 630 kJ) for 100 ml, with a P/E ratio of 11 to 12%, and account for at least 1/5 of the daily food intake.

[37] Annex 16 provides its composition and utilization.

4.2.3 Handling of food

Milk must be consumed immediately after its preparation, because milk contaminated by pathogens quickly becomes toxic. This is due to the following:

- its composition: it contains basic free nutrients that can be directly absorbed by microbes;
- its liquid state: the Brownian motion[38] quickly scatters contaminating bacteria, not to mention the shaking of containers by preparers and consumers;
- its consumption temperature for a long period corresponds to the optimum temperature for bacterial growth.

Furthermore, it can be quickly contaminated by the pathogens that thrive in a TFC. In the tropics especially, milk grows dangerous within an hour following its reconstitution, whatever the accompanying precautions.

Porridge is more resistant because it inhibits bacterial propagation, but it is nevertheless a sound culture medium and must be consumed without delay, within 2 hours following its preparation.

Normal meals are even more resistant than porridge. The risk of contamination exists nonetheless, and they must therefore also be eaten soon after preparation.

Leftovers must be distributed in supplements to beneficiaries who are still hungry or carers, or disposed of. The fundamental rule in a TFC is that leftovers must never be served again at the following meal.

4.2.4 Serving meals

During the first week, children should continue to consume 8 meals daily at 3 hour intervals, especially those who show complications in the course of treatment. Practically speaking, if intake is set at 200 kcal (840 kJ)/kg/day with F-100 Formula, then 8 rations of 25 ml each of F-100 Formula/kg/day must be supplied. Circumstances may prevent this, especially in case of night-time security problems or curfews, and if the TFC cannot include a camp for the permanent accommodation of carers. Therefore, feeding should begin as early as possible in the morning and end as late as possible at night. Experience has shown that 5 daily meals between 7:00 am and 5:00 pm yield good results, provided that they are regularly spaced (7:00 am, 9:30 am, 12:00 noon, 2:30 pm, and 5:00 pm) – however, the total number of daily meals should be no less than five.

It is usually not possible to distribute amounts that correspond to weight. The same amount must therefore be distributed to everyone, or beneficiaries must be divided into two or three categories with set amounts for each category:

- < 1 year with 300 ml/meal;
- 1–2 years with 400 ml/meal;
- 2 years with 500 ml/meal.

During famines, the chosen solution has usually been the systematic distribution of 500 ml/meal to all children, permitting the supervised redistribution of remainders to those who were still hungry or their carers.

[38] Brownian motion or movement: the random movement of microscopic particles suspended in a liquid or gas, caused by collisions with molecules of the surrounding medium.

Apart from infants up to 6 months, all children should receive milk, porridge, and normal meals because they will all face the same diet upon discharge, including children who are being weaned. It is important for even the youngest to grow familiar with solids, with the help of their mother and supervisors who can mash the food first. During famines, domestic weaning food is prepared with basic GFD foods, which must be familiar to all TFC children during their sojourn to limit relapse following their discharge.

4.2.5 Criteria for the transition to a normal diet

In principle, nutritional rehabilitation is achieved when the patient's nutritional status meets the following criteria:

⇨ weight-for-height index equal to or greater than –1 Z-score or 90%;
or
⇨ MUAC-for-height index equal to or greater than –2 Z-scores or 85%.

At this stage, most children will have substantially reduced their food intake, as their catch-up capacity is saturated. However, depending on the urgency resulting from the potential number of beneficiaries, and provided that food access at home is adequate, nutritional rehabilitation may be terminated as soon as the patient's nutritional status exceeds the criteria for moderate malnutrition according to the weight-for-height index, or 80% of the MUAC-for-height index. This option is recommended during famines. If the potential number of beneficiaries is high (and provided that access to food at home is adequate), rehabilitation may also be terminated as soon as the patients' nutritional status exceeds the criteria for *severe* malnutrition and their medical disorders are treated; such patients are then transferred to Supplementary Feeding Programme (SFP) centres.[39] This option however increases the risk of relapse, and slows down the catch-up process.

4.3 *ADDITIONAL ASPECTS OF INITIAL TREATMENT AND REHABILITATION*

4.3.1 Breastfeeding

Breastfeeding is an absolute priority in the treatment of severe malnutrition, and every effort must be made to encourage or restore it.[40] The importance of breastfeeding is even greater in a TFC because maternal milk is the best possible infant food: it protects against infection (which is often rampant in a TFC), and plays a fundamental role in the emotional balance of infants, which is usually upset by their living conditions and malnutrition.

4.3.2 Infant diet in a TFC

If a wet nurse cannot be found, orphans who have lost their mother cannot breastfeed. In such circumstances, readers are referred to the recommendations made in Chapter XV, Section 6.2.1 regarding alternatives to breastfeeding. Should the child be severely malnourished, the recommended amounts for each meal should simply be increased by 25 to 30%; if the child cannot ingest such amounts, feeding should be more frequent, involve smaller amounts, and be spread as evenly as

[39] See Chapter XIV.
[40] Chapter XV, Section 6.2.1 discusses the practical aspects of breastfeeding.

possible over 24 hours. F-75 and F-100 Formulae must be avoided because their salt content is too high, especially for children under 3 months of age.

4.3.3 Psychological support

When children in a TFC begin to smile, they are in principle saved.

Severely malnourished children are also emotionally harmed, and malnutrition itself impairs mental development. This impairment is partly caused by the child's restricted interaction with its physical and social environment resulting from its apathy, irritability, and reduced mobility. Consequently, the treatment of severely malnourished children involves emotional stimulation: this includes showing them affection, organizing recreational activities (such as games, songs, dances, and stories), the use of traditional musical instruments, and ensuring proper supervision by staff that is specially assigned to these tasks. Such staff should preferably belong to the same cultural group as most of the children. Carers must clearly participate actively. Psychological support activities do not only affect the child's emotional state, but also speed up its nutritional catch-up; as such, psychological support is a compulsory component of a TFC.

4.3.4 The use of locally produced foods

Gardening and poultry breeding are strongly recommended in a TFC in order to enrich meals with the resulting produce.

4.3.5 Failure to respond to treatment

Patients who do not gain weight at the minimum expected rate are not eating enough. They must be monitored closely in order to determine the reason for this as quickly as possible, and take corrective action. Often, failure to respond results from illness; however, four main reasons exist to explain this failure.

Absenteeism

The supervisor in charge of monitoring should be informed of unjustified absences without delay, in order for corrective measures to be taken. Absenteeism must under no circumstances be punished by exclusion, as this can amount to a death sentence. If carers cannot remain permanently with the child under their responsibility, someone must be found within the TFC to do so.

Illness

Healthy patients can develop infections that are not immediately detected; others can be admitted sick without their condition being detected owing to their state of malnutrition, or suffer from severe disorders such as tuberculosis or AIDS. These illnesses can manifest themselves in anorexia, vomiting, diarrhoea, malabsorption and an insufficient biological utilization of food. In addition, pathogens thrive on the feeding of patients. Meal supervisors and carers must report any dietary or health problem without delay. It is then up to the medical staff to find a solution if possible; it is pointless to feed severely malnourished patients suffering from tuberculosis if they are not treated for this condition. Such cases represent a serious threat to other TFC patients, and must be treated urgently or referred to appropriate hospital facilities. If this is not possible, such patients must be allowed to die at home, provided that they are properly cared for, or referred to relevant social services, or accommodated in separate, isolated facilities where they can be properly treated, fed, and allowed to die in dignity.

TFC or staff dysfunctions

The TFC may be badly organized or managed, mistakes may be made in the kitchens or in healthcare, staff may be incompetent or discriminate against some patients, or the general atmosphere prevailing in the TFC may be poor. TFC staff should detect such problems and inform the TFC manager; however, it may be reluctant or unwilling to do so. Consequently, the TFC manager must monitor operations systematically and comprehensively, including the quality of surveillance and the condition of each patient. Offenders should face drastic sanctions. Dysfunctions can have the most surprising causes: for example, in spite of undisputed efforts, patients have been known not to recover, without obvious reason. Investigation revealed that the capacity of the bowls was inferior by one-third to the supervisors' instructions, and that patients were therefore not receiving enough food. The timely and thorough examination of stock movements would have drawn attention to this problem.

Epidemics

Severe epidemics such as measles can be avoided; other, less harmful epidemics such as influenza or common cold cannot, and can affect a large number of patients quite abruptly. They are often associated with the climate, and their effects can be underestimated. Whoever has visited a TFC will remember the persistent sound of coughs and sobs, which grow familiar to the point of masking a relapse. The latter nevertheless indicate such epidemics, which impair nutritional catch-up significantly. Whooping cough epidemics can be especially spectacular in that regard.

4.4 THE RESUMPTION OF A NORMAL DIET

Following their nutritional rehabilitation, patients must be prepared for the diet that will be theirs upon their discharge from the TFC. This phase usually lasts 2 weeks during which at least 75% of the diet must be identical to the patient's normal diet, the nutritional status must remain stable, and possible health problems must have been resolved. During the first week of this preparation for discharge, meals are reduced to four per day, two of which are normal, one consists of milk, and the last of porridge; during the second week, three normal meals are combined with one meal of porridge or milk. If nutritional rehabilitation is terminated because the child is no longer severely malnourished and is transferred to an SFP centre, there is no need for the transition to a normal diet, as this process will take place within the SFP centre, where rations are consumed on the spot under supervision.

After 2 weeks, patients are ready for discharge from the TFC if their weight is stable and their medical problems resolved.

4.5 FOLLOW-UP

After discharge, children should preferably be monitored by measuring their nutritional status and developments in their health status. Discharged children should be visited 1 week, 2 weeks, 1 month, 3 months, and 6 months after their return home. This frequency facilitates action in case of relapse.

4.6 ROUTINE MEDICAL TREATMENT

Routine treatments must be performed in a TFC in order to prevent or treat problems.

4.6.1 Routine treatment upon admission

Measles vaccination

Measles is highly virulent and is frequently fatal in malnourished children. It can spread very fast in a TFC. All children should be vaccinated upon admission, except those that have clearly been vaccinated already (as registered in a vaccination card). Their sojourn in the TFC provides the opportunity to update their vaccinations.

Antibiotic treatment

All kwashiorkor cases must receive broad-spectrum antibiotic treatment, as described in Section 4.1.3 above. Section 4.1.5 discusses the extension of the treatment to all TFC patients.

Vitamin A

Malnourished children usually suffer from sub-clinical vitamin A deficiency. They must therefore be given vitamin A as follows:

⇨ all age groups above 1 year: one single dose of 200,000 IU (110 mg of retinol palmitate or 66 mg of retinol acetate) orally;
⇨ infants between 6 and 12 months: one single dose of 100,000 IU (55 mg of retinol palmitate or 33 mg of retinol acetate) orally.

In principle, breastfed infants under 6 months should not be given vitamin A (otherwise, the posology is a single 50,000 IU dose).

Siblings or children accompanying patients should receive vitamin A according to the above recommendation. In mothers and women of childbearing age, elevated doses can be teratogenic during pregnancy, and should be avoided. Instead, a single dose of 200,000 IU should be given to women who have just delivered, and a daily dose of 10,000 IU at most to all others. Vitamin A capsules can contain 10,000, 100,000, or 200,000 IU. In the absence of 100,000 IU capsules for infants between 6 and 12 months, a 200,000 IU capsule may be punctured to extract three drops.

External parasites

Fleas and lice are haematophagic dipterans (blood-sucking parasites) whose bite is often inflammatory and pruriginous, and causes dermatosis and itching. The insects multiply and transmit quickly and spread infection. Lice transmit exanthematic typhus and cosmopolitan recurrent fever; fleas transmit murine typhus, the plague, and two types of tenia. Patients must therefore be treated against these parasites upon admission to the TFC with pyrethroid insecticide (0.5% permethrin), and their clothing must be steamed (pyrethroid insecticide in the case of wool garments).

Intestinal parasites

All siblings or children accompanying patients must be treated with a single dose of 500 mg of mebendazole.

4.6.2 Routine treatment during rehabilitation

One week after admission, when diarrhoea and vomiting should in principle have stopped and infection is either fully or partially under control, the following treatment must be given:

Vitamin A

The treatment provided under Section 4.6.1 above should be repeated for all TFC patients.

Intestinal parasites

All patients should be given a single dose of 500 mg of mebendazole.

Anaemia treatment

All severely malnourished children suffer from anaemia to some extent. After 15 days, when infection should in principle be controlled, all patients should therefore be given 1 mg of folic acid and 100 mg of ferrous sulphate daily for the duration of their stay in the TFC.

4.6.3 Routine treatment upon discharge

Immunization

All children should have been vaccinated against measles upon their admission, and be vaccinated again before their discharge. Moreover, all children should be immunized according to national guidelines.

Vitamin A

All patients are given a last dose prior to their discharge, according to recommendations made in Section 4.6.1 above.

4.7 TREATING ADOLESCENTS AND ADULTS

As discussed in Section 3.2 in relation to admission criteria, only very severely malnourished and sick adolescents and adults should be admitted to a TFC (which is normally reserved for children), provided that their sickness can be cured within the TFC. However, if large numbers of adolescents and adults are severely malnourished (as can be the case in famines), it is best to establish special facilities for them, in the form of a highly simplified TFC. Adolescents and adults suffering from primary severe malnutrition are less fragile than young children, do not depend on a carer to feed themselves, and recover the ability to consume normal food faster. They usually recover and their digestion is restored within a few days – as a result, they can consume GFD foods almost immediately. The TFC admission criteria for adolescents and adults should be:

⇨ adolescents: weight-for-height index below 70% (according to the table provided in Annex 4.4 for adolescents);
⇨ adults: BMI below 14.

The treatment of severe malnutrition follows the same logic as for young children: F-75 type Formula should be given up to maintenance requirements during the first days, in addition to oral rehydration solution and basic medical care. After 3 to 4 days (1 week at most), treatment should be continued with F-100 Formula corresponding to approximately 2,000 kcal/day, 1 normal meal of 500 kcal, and biscuit supplements for the night. After 1 week of this treatment, the diet can be increased to reach 4,000 kcal if possible, with 2 to 3 normal meals per day for 1 week. Patients should then be discharged from the centre, provided that their food access at home is adequate (GFD or soup kitchens).

The criteria for discharge are therefore not based on anthropometry, but rather on the fact that patients are able to feed themselves with the food that is normally available. Severely malnourished adolescents and adults have also been treated in more primitive ways in Somalia (1992–1993), involving the direct transition from F-75 Formula during 2 or 3 days to soup kitchens; they adapted quickly, and without excessive abdominal disorder. However, the circumstances were extreme, and resources were limited in this case. In such conditions, soup kitchens may also be set up for very severely malnourished adolescents and adults to be given approximately 2,000 kcal of F-75 Formula daily for 3 or 4 days, then adding one normal meal, in order for them to consume only normal meals after 1 week. This very simple approach also yields good results, especially if kitchens are located close to a health centre where patients can go independently for care.

CHAPTER XIV
SUPPLEMENTARY FEEDING PROGRAMMES

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CHAPTER XIV
SUPPLEMENTARY FEEDING PROGRAMMES

1. GENERAL COMMENTS

1.1 DEFINITION

Supplementary Feeding Programmes[1] (SFPs) provide food supplements to individuals or groups of individuals considered as vulnerable within a given community. This vulnerability is either physiological (slightly to moderately malnourished individuals, pre-school age children, pregnant and breastfeeding women, the elderly and the sick), or related to specific living conditions to be found mainly in institutions such as hospitals, orphanages, homes for the elderly and prisons – this does not preclude general food distributions (GFD) in such environments. SFPs are thus understood in contrast to GFDs,[2] which target individuals forming overall households, and therapeutic feeding,[3] which is aimed at severely malnourished individuals.

SFPs are discussed after therapeutic feeding, owing to their hybrid role between the two really effective nutritional measures in crisis: GFDs to forestall malnutrition, and therapeutic feeding to address severe forms of malnutrition. If GFDs and therapeutic feeding perform well, SFPs are not indispensable. SFPs are nevertheless common in humanitarian interventions, and are therefore discussed here although their contribution should remain peripheral.

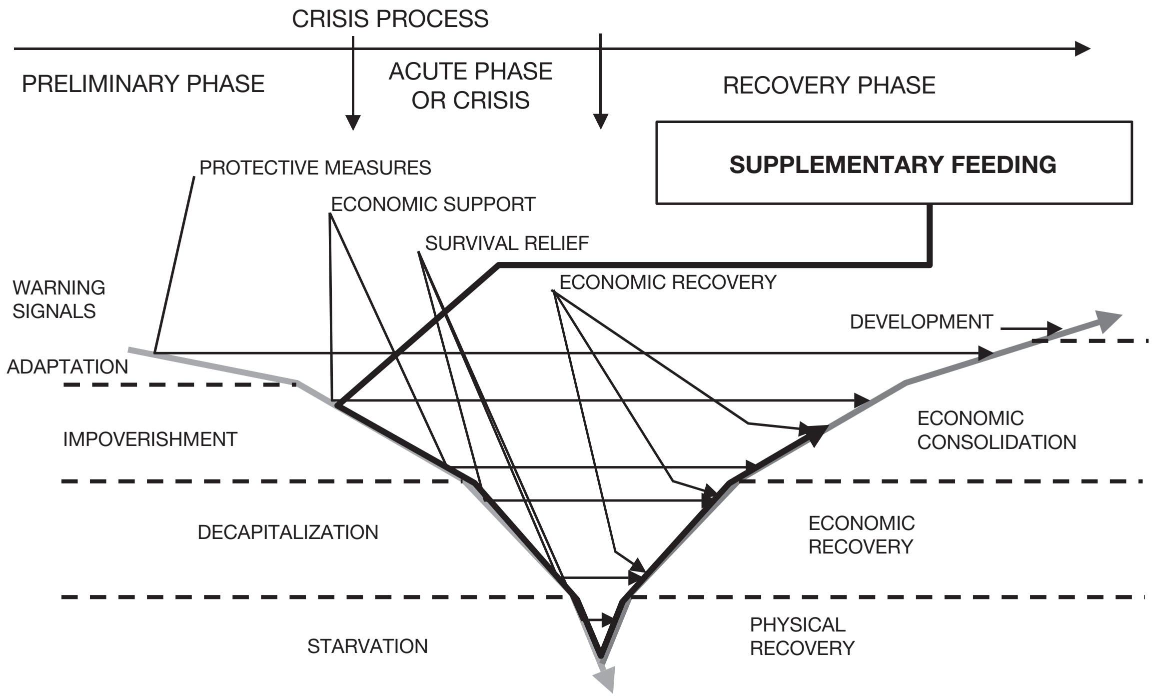
1.2 POSITION IN HUMANITARIAN INTERVENTION

SFPs play a double role in humanitarian intervention: they provide both economic support and survival relief. They can also complement economic rehabilitation programmes. Figure 14.1 below illustrates the possible levels of SPF implementation within the crisis process.

Like any other programme, SFPs must be integrated consistently into the overall intervention strategy.[4] While they can be necessary to complete other programmes, their peripheral role means that – for SFPs to be meaningful – other, more important programmes must generally take precedence.

[1] Food supplements can also be included in general food distributions.
[2] See Chapter XII.
[3] See Chapter XIII.
[4] See Chapter IX.

Figure 14.1 The position of SFP in humanitarian intervention



1.3 BACKGROUND TO SFPS

SFPs have evolved within the public health programmes of developing countries to address stable situations. They were initially intended to promote the nutritional recovery of moderately and slightly malnourished children, as well as preventing a deterioration of the nutritional status in specific circumstances: poverty, weaning, or an unfavourable environment, conducive to infectious disease – whose possible impact on the nutritional status has been discussed above.[5] Results vary greatly for a number of reasons; they have been discussed at length in a famous study by Beaton & Ghassemi (Beaton & Ghassemi, 1982) and summarized by Gillespie & Mason (Gillespie & Mason, 1991). One reason, which could not be considered at the time, was the fact that rations were rich in protein and energy, but could not always compensate deficiencies in Type II nutrients.[6] In that case nutritional recovery is quite slow, or even impossible, and cannot be confirmed by anthropometry if the indicator is weight for age.

In terms of crisis, SFPs developed especially during the great Sahelian famines of the late 1970s and early 1980s. These programmes were implemented in line with theories prevailing at the time (de Ville de Goyet, 1978). For a given population, general food distributions to households were intended to provide a basic daily ration amounting to 1,500 kcal (6,270 kJ) per person for an initial period of a few weeks until the logistics base was properly set up. It was to be increased thereafter to 1,800 kcal (7,525 kJ) per person, per day for a longer duration. The belief at the time was that it was impossible to supply rations covering the recommended daily intake (on average, 2,350 kcal (9,820 kJ) per person),[7] and that it was not always opportune to do so, out of consideration for those

[5] See Chapters VI and VIII.

[6] See Chapter VIII.

[7] Logistics constraints are sometime such that it is impossible to distribute enough. More frequently, however, ration insufficiency is due to political causes and poor ethics.

who did not have access to the GFD and had to make do with lesser food resources.[8] It was nonetheless necessary to compensate for inadequacy in the basic ration by resorting to food supplements for those most vulnerable to malnutrition: children under 5 years of age, pregnant and breastfeeding women, the sick, the elderly, and moderately malnourished children. Supplements were calculated to supply approximately 350 kcal (1,500 kJ) and 15 grammes of protein per person, per day.

In practice, a rift resulted between agencies using (frequently insufficient) GFDs and those preferring SFPs. Both theory and practice have sometimes led to disaster when the basic ration was inadequate (or even non-existent), and supplementary feeding programmes in fact supplemented very little, if anything. The consequence was a real eye-opener: the basis for relief, in an acute nutritional crisis, must be adequate GFD (IDS, 1986). In this case, SFPs become redundant, except at the very beginning of the intervention, until the GFD logistics set-up is effective, or if the GFD (albeit adequate to cover maintenance needs) does not allow nutritional recovery. Practice has not always followed, and still does not, because many agencies implementing GFDs still rely on SFPs to complement their input. Moreover, SFPs continue to mushroom owing to the fact that many agencies have specialized in this type of programme. The aims and relevance of SFPs in crisis situations therefore need to be carefully scrutinized. Publications listed in the footnote references shed light on the major debate still surrounding SFPs.[9]

1.4 THE OBJECTIVE OF SUPPLEMENTARY FEEDING PROGRAMMES

Supplementary feeding programmes concentrate on the following:

⇨ an existing nutritional deficiency (slight and moderate malnutrition according to the Waterlow classification,[10] in children under 5 years of age);
⇨ an increased susceptibility to nutritional deprivation (under 5, and sick people);
⇨ an increased need of nutrients (pregnant and breastfeeding women, individuals suffering from specific medical problems, particularly the wounded or patients that have undergone a major surgical operation).

These cases suggest a specific vulnerability to malnutrition, which SFPs aim to confront, prevent or remove altogether. When intended to confront vulnerability, SFPs are curative and target slightly or moderately malnourished individuals (i.e. targeted SFPs). When aimed at avoiding or removing vulnerability altogether, they are preventive, and directed towards the exposed group as a whole (non-targeted or blanket SFPs). Moreover, both types should serve to reduce morbidity and mortality, specifically by acting on the interaction between malnutrition and infection. However, no SFP can address the primary causes of malnutrition; this can only be achieved through GFDs, or economic, water and habitat, and health rehabilitation – all of which are priority programmes in crises. SFPs are thus essentially palliative in nature, and doomed to failure should the situation deteriorate in the absence of corrective steps.

[8] Today, this argument is no longer acceptable, as it promotes the sprinkling of assistance without, ultimately, resolving anything.
[9] Briend, 1995; Curdy, 1995; Godfrey, 1986; Inter-Agency Food and Nutrition Group, 1997; Shoham, 1995.
[10] See Chapter VIII.

The only realistic objectives of supplementary feeding programmes in crisis environments are the following.

- ⇨ Temporarily containing malnutrition, morbidity and mortality in the early stages of a developing crisis, until more relevant measures can be introduced efficiently. SFPs should either target cases of moderate malnutrition, with or without age limitations, or else risk the programme's scope expanding beyond control if all children under 5 are included, whatever their nutritional status, and in this case a significant risk of negative side effects exists.[11]
- ⇨ Addressing moderate malnutrition effectively where humanitarian intervention is belated, while malnutrition prevention measures are taken (GFDs, interventions in the realms of water and habitat, and access to health services).
- ⇨ Providing safety nets (similarly to therapeutic feeding) for the most vulnerable, for which previous measures have proven inadequate (even if they have been conclusive for most of the victims of the crisis).
- ⇨ Providing a relay for therapeutic feeding when therapeutic feeding centres (TFC) are overstretched, by including children as soon as they are no longer severely malnourished, with a view to completing their treatment.

For each of the above objectives, SFPs are clearly targeted. In crisis situations, therefore, non-targeted SFPs should be avoided. However, SFPs are sometimes implemented in transition periods,[12] and are discussed accordingly under Section 2.1.1 B below.

1.5 PRIORITY IN THE INTERVENTION STRATEGY

In view of the above, SFPs are the last choice but one in the intervention strategy. On the other hand, agencies specializing in SFPs can consider them as a priority intervention from a tactical perspective, and in an attempt to mitigate damage until more effective, but also more time-consuming and complex, measures are fully operational. This can be the case provided that they are not implemented in isolation, and that they contribute to the implementation of all the steps required to respond to the need for assistance. SFPs can then easily be changed to address persisting moderate malnutrition effectively, and act as safety nets – meaning that they are no longer consigned to simple food distributions.

1.6 INTERVENTION CRITERIA

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Usually in a nutritional crisis, SFPs should be curative; as a result, the criterion triggering their implementation is moderate malnutrition. It should also be possible to address this malnutrition efficiently, that is, the programme should aim at reducing moderate malnutrition rates rapidly, providing safety nets or a relay for therapeutic feeding once all necessary measures previously taken have proven ineffective. These circumstances are indeed those in which SFPs have the greatest impact, are most justified, and entail the least negative side effects. Where SFPs aim at temporarily containing the effects of a crisis, the moderate malnutrition criterion should also reveal restricted access to food, unless available means permit the implementation of a preventive SFP. This is uncommon; if it were the case, the criterion would be restricted access to food.

[11] See Section 1.7 in this Chapter.
[12] Being the intermediate phase between crisis and normality, which precedes or follows a crisis phase.

1.7 THE RISK OF NEGATIVE SIDE EFFECTS

Where SFPs aim at temporarily containing the effects of an acute or developing crisis – owing to the fact that preventive measures are inadequate – the risk of negative side effects is greatest. All the more so because some humanitarian agencies view SFPs as an almost standard response to inadequate basic rations, which translate into more or less serious malnutrition. Thus the rationale for SFPs in crisis is usually observed malnutrition rates and insufficient access to food for the majority of victims. This however is a double paradox. The more adequate the access to food, the lower malnutrition is, and the less relevant an SFP becomes; the greater restrictions to access, the more SFPs become the obvious choice in an attempt to mitigate damage. But this is precisely where SFPs are limited, owing to the general lack of resources, and the SFP's incapacity to resolve the shortage. This contradiction has led the ICRC to promote a response consisting of an adequate GFD and therapeutic feeding approach, avoiding SFPs altogether.

The contradiction is multi-faceted.

⇨ If the basic ration is adequate, an SFP is unnecessary.
⇨ SFPs favour specific individuals within families, in contradiction with cultural practices providing for the collective preparation of food for all members of the family or community, except infants.
⇨ If the basic ration is inadequate, an effective SFP would need to be combined with it in order to raise the overall resulting daily food ration to appropriate levels for each individual. This is however absurd, because the SFP would then result in the distribution of appropriate supplements to each household rather than to targeted individuals – it would thus no longer be selective and, if combined with a GFD, there would be no reason to run two parallel distribution systems rather than one.
⇨ SFPs are by definition selective – this is because they cannot serve all the households requiring food assistance and thus target only specific family members or individuals, while their relatives or other individuals nonetheless continue to suffer from hunger.

If SFPs cannot meet the needs of all the individuals affected by hunger, it risks causing the following negative side effects.

⇨ Where the distribution is aimed at already malnourished individuals, it is tempting to famish the others who might thus become eligible for inclusion in the SFP; moreover:
  → when the distributed ration is eaten at home, it will be shared among the family members according to domestic priorities that humanitarian agencies should not judge; the danger is for the beneficiary not to receive what he/she requires. One solution would be to distribute supplements to all the families accommodating malnourished members, without targeting the latter specifically; the danger, if the crisis is deteriorating, is the probability that other households will deliberately starve one or several of their members in order for them to be included;
  → when the ration is eaten in the SFP distribution centre, beneficiaries frequently receive nothing more at home, and their nutritional status either does not improve or even deteriorates as a result.
⇨ Where the SFP is aimed at specific groups prone to malnutrition, their members will be found in each family, and it will be necessary to distribute food to be eaten at home because distributing meals is unrealistic. Once again, the ration will probably be shared among the family members, and those most needing it will derive only a small benefit.

Furthermore, when access to food is inadequate (owing to an inadequate GFD, or insufficient individual resources), SFPs can give the impression that they compensate for this lack. They can then also provide the excuse for donors, officials or humanitarian agencies to spare the efforts required for an adequate GFD, and hence the necessary means to restore the population's economic self-sufficiency.

As a result, implementing SFPs as a temporary palliative measure must be combined with persuasion and mobilization efforts to ensure the timely application of effective preventive measures. It must be made clear to all involved that these SFPs serve a warning purpose by revealing the inadequacy of the current intervention. In practical terms, the question is whether the palliative SFP implementation criterion should be malnutrition thresholds – for instance, more than 15% of children rating two standard deviations less than the median weight-for-height index value. The answer should be negative – once again, the situation's specificity and common sense should take precedence over arbitrary thresholds.

In targeting moderate malnutrition specifically, the rate of this malnutrition will influence the decision to intervene less than the potential number of beneficiaries will, which can only increase as the crisis develops and preventive measures remain ineffective. If the population under consideration is large and concentrated, low rates of moderate malnutrition would justify the opening of one or several SFP centres; on the other hand, if the population is small and scattered, even high malnutrition rates may not necessarily be conclusive. Furthermore, the objective of the SFP is also the deciding factor: if the purpose is to contain a crisis, one can begin with twenty beneficiaries, while preparing to accommodate a thousand in the coming months. If it is to provide a safety net, one can also begin with a few dozens, for instance by linking the SFP centre with a health facility or paediatric service. The number of beneficiaries of an SFP centre varies greatly, and is contingent upon the available resources and infrastructure. It can range between 50 to 1,500 without posing major problems, provided the resources are adequate. Depending on the access to the population and its degree of concentration, it may be preferable to open several centres – or just one.

1.8 PROGRAMME EXIT CRITERIA

As in any other humanitarian intervention, defining programme modification and exit criteria from the outset is essential.

Where it targets groups most prone to malnutrition (i.e. a preventive approach), the SFP's exit criterion is the implementation of more efficient preventive measures (such as GFDs, sanitation, and access to healthcare), or crisis resolution. The programme can then be adapted to address existing moderate malnutrition more speedily, or to act as a safety net.

Where it targets moderately malnourished individuals (a curative approach), closing the programme is feasible when admissions have fallen below levels justifying the maintenance of the structure, either because preventive measures have proven efficient, or because living conditions have returned to normal and there is no danger of deterioration, at least in the medium term (six months to one year). Before abruptly closing a programme, it is still possible to adapt it by reducing it. When the decision has been made to exit from the programme altogether, the continued care of residual malnutrition cases by health facilities remaining in place must be guaranteed.

2. IMPLEMENTING SUPPLEMENTARY FEEDING PROGRAMMES

2.1 INTERVENTION MODES ACCORDING TO SFP OBJECTIVES

SFPs can pursue the following objectives in crisis situations:

⇨ temporarily containing malnutrition, morbidity and mortality;
⇨ contributing to a more effective response to moderate malnutrition;
⇨ providing a safety net;
⇨ providing a relay for therapeutic feeding.

The following recommendations relate to targeting, admission criteria according to targeting, and distribution modes for each scenario.

It is to be noted moreover that an SFP also calls for a participatory approach, in particular because of the negative side effects it may induce. The community under consideration must be aware of what it may expect from an SFP, its limitations, and the criteria for selection and screening. It must take part in the programme's design, implementation, assessment and proposed adjustments, if necessary.

2.1.1 Temporarily containing malnutrition, morbidity and mortality

Where this is the SFP's objective, it indicates a deteriorating or acute crisis, and signals that the main problem is inadequate access to food. Two targeting options result. The first concerns individuals depending on specific criteria. This is the only realistic modality,[13] and is incidentally by far the most frequent. The second, sometimes found in transition phases, targets the entire group that is likely to suffer nutritional deprivation.

A. Targeting individuals

In this approach, individuals are chosen according to:

⇨ their existing confirmed nutritional deficit (moderate malnutrition);
⇨ their increased probability of developing severe malnutrition;
⇨ their high exposure to the development of a synergy between malnutrition and infection.

At the inception of a crisis, such individuals usually belong to the group of children under 5 years of age; this instantly provides programme admission criteria, together with an idea of malnutrition rates through a previous assessment of the nutritional status. Following discussions with the population, it may be necessary to include excluded members of the community, the destitute elderly and the sick. It goes without saying that an SFP will be useless if malnutrition is so obvious as to render an enquiry rendundant, and if a GFD cannot be set up rapidly.

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[13] See Section 1.4 in this Chapter.

Criteria for admission: moderate malnutrition

Moderately malnourished children under 5 years of age are priority candidates. If their age is unknown, the criterion can be set as a height inferior to 110 cms. Moderate malnutrition can be assessed through mid-upper arm circumference (MUAC), MUAC-for-height, or weight-for-height. As noted by Briend, mid-upper arm circumference provides a better indicator of mortality risk than weight-for-height (Briend, 1995).[14] Mid-upper arm circumference can be used alone to select beneficiaries; it is faster but less accurate than MUAC-for-height. Admission thresholds – based on the different indicators – are as follows:

⇨ mid-upper arm circumference (MUAC): <13.5 to ≥12.5 cm;
⇨ MUAC-for-height expressed as a percentage of the median: <80% to ≥ 75%;
⇨ MUAC-for-height expressed in Z-scores: < –2 Z-scores to ≥ –3 Z-scores;
⇨ weight-for-height expressed as a percentage of the median: <80% to ≥ 70%;
⇨ weight-for-height expressed in Z-scores: < –2 Z-scores to ≥ –3 Z-scores.

Children rating less than these inferior thresholds must be referred to a therapeutic feeding centre, unless their health condition is still sufficiently good for supplementary feeding alone to help their recovery. Moreover, the use of the above criteria must be combined with clinical assessment. If a child is clearly very ill and is likely to meet the admission criteria in the following days, it should in principle be accepted immediately, and be subjected to adequate healthcare.

When targeting children under 5 years of age, attention must also be paid to their mothers' condition, especially when the child is younger than six months. Up to that age, if a child is malnourished, this is often an indication that the mother is malnourished herself, or that she is sick. If so, she also should receive food supplements to be eaten on the spot, as well as medical treatment if possible.

If stricter criteria are desirable, an additional systematic selection condition could be for children to also suffer from associated infectious disease, or introduce thresholds similar to those applied for admission to therapeutic feeding centres. But the latter should only be resorted to very briefly, shortly before the entire population is expected to enjoy adequate access to food. It would otherwise only be a desperate move and resolve nothing.

Criteria for discharge

For individuals to be discharged, their medical treatment must have been completed, and their nutritional status must have remained stable during the past fortnight and be equal or superior to the following thresholds:

⇨ mid-upper arm circumference (MUAC): 13.5 cm;
⇨ MUAC-for-height expressed as a percentage of the median: 80%;
⇨ MUAC-for-height expressed in Z-scores: –2 Z-scores;
⇨ weight-for-height expressed as a percentage of the median: 80%;
⇨ weight-for-height expressed in Z-scores: –2 Z-scores.

As long as the GFD is not adequate, discharge criteria may however not – or very slowly – be met; this is an indication that practically all moderately malnourished individuals must be included in the SFP for the programme to succeed.

[14] For further information on this topic, see Sections 4.4.1, 4.4.4 and 4.4.8 of Chapter X which discuss anthropometric indicators.

Ration distribution methods

In targeting individuals suffering from a confirmed nutritional deficit it must be possible to monitor impact and provide the required healthcare. As a result, beneficiaries must be admitted to an SFP centre where they eat their meals and benefit from medical care (these centres are described in Section 2.2 below). Demanding of beneficiaries that they be present on a daily basis may seem extreme, but nevertheless derives from two imperatives combined to counter the negative side effects discussed above. Rations intended to be eaten at home are usually shared among family members and thus do not benefit the malnourished individual as intended. If the ration is to be eaten on the spot, the targeted individual may receive no more at home. On the other hand, feeding beneficiaries on the spot and enforcing daily presence yield the following benefits:

- ⇨ ensuring that the beneficiary does eat his/her supplementary ration, and closely monitoring his/her nutritional status – this in turn provides the opportunity to take additional appropriate complementary assistance steps, to determine whether the child is fed at home, and to be in a position to intervene if it is not (or insufficiently so);
- ⇨ limiting the deliberate starvation of children to have them included in the programme – eating meals on the spot is time-consuming, and thus discourages this practice to some extent.

Beneficiary selection

This should occur at the entry point of and outside the centre, after having explained the latter's existence and objectives to the population. Measuring the brachial circumference facilitates the selection of beneficiaries, who are then admitted into the centre for registration. At the beginning of the programme, the number of admissions should not exceed the centre's daily capacity; it is useless to admit children who cannot receive adequate medical and nutritional care upon arrival. Once the programme is running at full capacity, admissions need to offset discharges. If the potential number of beneficiaries justifies the opening of another centre, it must be done; increased efforts will nevertheless be required to implement measures to forestall malnutrition, or the centres will be useless. If moderate malnutrition remains limited and the centre is not running at full capacity, it is possible to engage in the active search for cases on the basis of visits to households. In this case, the centre and registration date are agreed upon with the accompanying relative, and the beneficiary receives an identification card. However, when the situation deteriorates, this approach is adequate only if the available means permit the opening of as many centres as required.

Warning

When the purpose of an SFP is to contain malnutrition, morbidity and mortality temporarily until an adequate GFD is set up, a pitfall to be avoided at all costs would be to condition beneficiary admission on the distribution of a food ration to the rest of their family. It would appear that all needy families would thus be targeted; however, in practically all cases, this results in a large number of families depriving one of their children in order to gain access to the distribution. Beyond the harm done to the children, the agency running the SFP sometimes runs out of food resources (both for the SFP and for the family rations). This can lead to disaster if the GFD is delayed.

B. Targeting groups most exposed to malnutrition

When a supplementary feeding programme is anticipated to interrupt the development of malnutrition – for example, in a transition situation – and the available resources are adequate to target an entire group, it is possible to distribute food supplements to all children under 5 years of age (or whose height is inferior to 110 cm). The sick can possibly be included. On the other hand, specifically selecting pregnant and breastfeeding women is strongly advised against in a crisis, as this measure can be perceived as highly discriminatory by other women, and can also produce negative side effects. As for distribution methods, they usually consist of take-away rations – it is generally not realistic to have them eaten in the centre owing to the number of beneficiaries involved. In some cases, however, humanitarian agencies on the spot are numerous and have shared the workload in such a way as to facilitate the consumption of the rations in the SFP centres. This also provides the opportunity to deliver healthcare and nutritional information sessions. Selection of beneficiaries should if possible be completed in one day following information to the population, at the entrance to and outside the centre. Selected beneficiaries are admitted into the centre for registration.

Targeting all individuals belonging to vulnerable groups no longer makes sense once the general population's access to food has become adequate; the SFP's modalities can then be modified.

2.1.2 Contributing to a more effective response to moderate malnutrition

Once preventive measures are in place, SFPs can prove useful in accelerating the reduction of moderate malnutrition. This scenario illustrates what has been discussed in Section 2.1.1.A above, where the same criteria – children under 5 or whose height is inferior to 110 cm, suffering from moderate malnutrition – apply to admission and discharge. Feeding also takes place in an SFP centre, where beneficiaries have access to adequate healthcare and possibly nutritional information sessions. The selection of beneficiaries is made as described in Section 2.1.1.A. Furthermore, the public is informed of the active search for cases on the basis of household visits as soon as the SFP centres have the capacity to register new cases and the population is presenting fewer moderately malnourished children.

2.1.3 Providing safety nets

An SFP intending to provide a safety net relates to two different situations. In the first, measures are taken to counter malnutrition, especially in terms of guaranteeing regular access to adequate basic food rations. The purpose is then to complement the GFD once moderate malnutrition rates have fallen, but new cases continue to appear owing to new arrivals and/or persistently harsh living conditions (incapacity to deliver adequate healthcare, poor climatic conditions, precarious habitat and general survival).

In the second situation, a GFD is uncalled for, but economic living conditions can be precarious, and/or problems can arise in the field of health services, water and habitat, in turn promoting the appearance of scattered malnutrition cases. This scenario again illustrates the comments made in Section 2.1.1.A above on admission and discharge criteria and food distribution methods. Beneficiary selection can be made at the entry point to the centre, as soon as the population has been informed of the latter's existence and objective. The active search for individual cases on the basis of household visits is particularly recommended in such circumstances.

2.1.4 Providing a relay for therapeutic feeding

When therapeutic feeding centres (TFC) are overstretched, it may be preferable to complete the nutritional treatment in an SFP centre, linked to the TFC. Children must be transferred as soon as they are no longer severely malnourished. Implementation modalities are those described in Section 2.1.1.A above. When SFPs provide a relay for therapeutic feeding, it is crucial that the entire population have adequate access to food (GFD or adequate individual resources), and that the other measures against malnutrition be taken.

2.2 SUPPLEMENTARY FEEDING PROGRAMME CENTRES

Supplementary feeding programmes (SFP) translate into practice in centres which can moreover be linked to therapeutic feeding centres and health centres, unless they provide healthcare themselves. Two types of SFP centres exist, where the ration is to be either eaten on the spot or taken home. It is tempting to prefer take-away rations owing to their following advantages:

⇨ their organization is simpler;
⇨ they demand less resources;
⇨ more beneficiaries can be assisted;
⇨ accompanying relatives waste far less time;
⇨ the risk of beneficiaries transmitting infectious diseases is lower;
⇨ access to them is easier for scattered populations.

Take-away distributions nevertheless have disadvantages if there is a danger of attack, or if the household lacks the required wherewithal (fuel, cooking utensils).

In spite of the advantages of take-away rations, distributing rations to be eaten daily on the spot is preferable when targeting moderately malnourished individuals. It facilitates the monitoring of highly health-vulnerable beneficiaries, who can rapidly fall prey to negative side effects which can only be mitigated through strict control.[15] On the other hand, when an SFP targets a group rather than malnutrition specifically, it probably makes more sense to distribute take-away rations.

2.2.1 Activities in an SFP centre

In centres where food rations are eaten on a daily basis, the range of activities is wider than in a centre supplying take-away rations, where it consists of the registration and discharge of beneficiaries, monitoring their nutritional and health status, and the distribution of food. Activities pertaining to both set-ups are nevertheless discussed here together, for simplicity's sake.

Registration and admission of beneficiaries

These aspects are virtually identical to those of a therapeutic feeding centre's (TFC). Characteristics specific to SFPs are indicated below; the remaining are discussed in Chapter XIII, Section 3.3.1.

Identification through bracelets

In SFP centres, the use of bracelets not only facilitates identification, it also avoids the use of distribution cards to accompanying relatives or the beneficiary himself – distribution cards are always a source of problems and abuse. This practice applies both to centres distributing meals to be eaten on the spot and those providing take-away rations. Bracelets indicate the beneficiary's number, the identification code of the registration centre, and the code or logo of the agency in charge. This information in itself limits abuse.

[15] See Section 2.1.1.A in this Chapter.

Supervision

Supervision permits the monitoring of beneficiaries and their attendance at the centre, which also provides the data required to appraise the centre's efficiency.

Monitoring beneficiary status and progress

The nutritional status of beneficiaries is measured at regular intervals (usually once a week), often on a rotating basis or during distribution in the case of take-away rations. Beneficiaries and accompanying relatives must be informed of the date set for the check-up, and of the fact that the procedure takes time. In principle, an SFP targeting the moderately malnourished should lead to nutritional recovery, but – unlike therapeutic feeding centres – the feeding of beneficiaries is not entirely controlled, thus complicating the issuing of recommendations as to weight gain. As an example, if a child weighing 10 kg upon admission must gain 2 kg in the centre, with a 700 kcal supplementary daily ration, it will gain approximately 14 g per kilogramme per day if the ration is used strictly for recovery (i.e. assuming it is receiving an adequate ration at home). At a recovery rate of 14 grammes per kilogramme per day, it will need approximately two weeks to gain 2 kg. Under these circumstances, the centre is achieving its objective perfectly – this is a situation found only when SFPs are combined with efficient GFDs, and provide safety nets or relays for therapeutic feeding. In view of all the possible problems related to an inadequate basic ration and a sub-optimal health status, the recommended recovery rate is approximately 5 g/kg/day. A lower recovery rate usually indicates that feeding at home is insufficient, but the health status also needs to be verified. It must be noted that the 5 g/kg/day recommendation is valid only if the supplementary ration is properly enriched in vitamins and minerals according to the formula included in Annex 16.

The health condition of patients under treatment should normally be monitored on a daily basis, and progress consigned on an individual data sheet; deaths and their cause should also be registered.

Attendance monitoring

This monitoring is of utmost importance in ensuring appropriate beneficiary feeding. When meals are eaten within the centre, it is done during each meal, in a register indicating bracelet number and beneficiary name. The latter and accompanying relatives must be informed of meal, distribution and healthcare attendance rules. Absences on more than three consecutive occasions, or more than five days in two weeks, without proper reason, will exclude the beneficiary from the programme. Obviously, patience is called for just as much as strictness; the reasons for absence must be understood and solutions offered. It is indeed possible that visiting the centre poses problems that were impossible to anticipate prior to launching the programme, but can be resolved later. Attendance for take-away ration distribution should also be monitored and absences clarified systematically, especially insofar as take-away rations – which demand at most a weekly visit – provide practically no excuse for absence. If absence is unjustified, exclusion will follow the first absence after the warning.

Discharge of beneficiaries

The criteria for discharge have been discussed above. In principle, the beneficiary's nutritional status should have remained stable, equal to or above discharge thresholds, for a fortnight. However, depending on the severity of the situation, it may be necessary to accelerate the rotation of beneficiaries and, therefore, reduce or even waive this safety period. Furthermore, it is necessary to expel absentees and cases of bad behaviour (theft, refusal to abide by the rules of the centre, poor conduct), be they on the part of accompanying relatives or the beneficiary himself. Nevertheless, patience is called for here also, issuing three warnings prior to expulsion and attempting to understand the reasons for such behaviour. In a crisis, they often emanate from the need to confront a desperate situation with all possible means.

Food preparation

Recommendations for food preparation are identical for an SFP centre and a TFC, apart from the organization required in a therapeutic feeding centre (TFC) to prepare different ration types. Readers are therefore referred to Chapter XIII, Section 3.3.4.

Distribution of food rations

Take-away rations

In the case of take-away rations, beneficiaries and accompanying relatives must be aware that it is their responsability to provide containers, which should not preclude the storage of bags to assist those who have forgotten theirs or do not have any. Distribution should not be more frequent than once a week, nor less frequent than once a fortnight. In principle, four to five days per week should be devoted to distribution, with one day for stock replenishment, monitoring data management, and centre progress reporting. Alternatively, every business day can be devoted to distribution, with management and administrative tasks performed at the end of every day. Distribution days permit the verification of beneficiary status, bearing in mind that this takes more time than the distribution proper. Beneficiaries and their accompanying relatives must be informed of distribution dates, as they must imperatively be present on the planned day or the workload will quickly become untenable.

Meals to be eaten on the spot

In the case of rations to be eaten on the spot, distribution schedules must be known and respected both by beneficiaries and centre staff – the latter have their own constraints, but so do the beneficiaries and, above all, their accompanying relatives (especially time constraints). Furthermore, distributing snacks to accompanying relatives can prove extremely helpful when the crisis deteriorates and the basic ration at home is insufficient. The other features of meal distribution and consumption are identical to those of a therapeutic feeding centre (TFC). Readers are therefore referred to Chapter XIII, Section 3.3.5.

Provision of healthcare

Healthcare is, in principle, provided within the SFP centre, unless a health centre is located close by and intended also for this purpose. Nevertheless, an SFP centre should always be equipped to dispense basic care. A centre delivering weekly rations cannot provide healthcare. Systematic care is different from individual care.

Systematic care

Measles vaccinations
Measles is a particularly virulent disease, often fatal for malnourished children. It can propagate extremely fast in a feeding centre. It is therefore indispensable, systematically upon admission, to vaccinate children previously not vaccinated, doubtful cases and those without vaccination cards. Their presence in the centre provides the opportunity to update vaccinations.

Vitamin A distribution

The importance of vitamin A has been discussed in Chapters III and VIII. Malnourished children often suffer from sub-clinical vitamin A deficiency. Administering a prophylactic dose upon admission, as per the Figure provided in Chapter XIII, Section 4.6.1, is therefore essential. The administering of vitamin A should be repeated according to the same Figure upon discharge from the programme. Protracted SFPs targeting entire vulnerable groups require the quarterly repetition of vitamin A administration, except for women of childbearing age as discussed earlier.

Parasite treatment

Infestation by intestinal worms such as roundworm, hookworm and pinworm is so frequent that the general rule in an SFP centre is to treat all patients above the age of 1 systematically, upon admission, with mebendazole. Posology is a 500 mg single dose.

Iron and folic acid

Given that the SFP ration must be fortified according to recommendations in Annex 16, medicinal iron and folic acid should not be distributed in SFP centres.

Individual care

Individual care mainly addresses infections calling for antibiotic treatment, and the attention required in case of diarrhoea and dehydration, for which skilled nursing staff is necessary. Treatment outlines are provided in Chapter XIII.

Management of the centre

These features are the same for supplementary feeding programme (SFP) and therapeutic feeding centres (TFC). They have been discussed in Chapter XIII, Section 3.3.8.

Other activities

SFP centres delivering rations to be eaten on the spot offer the opportunity for other activities than meal distribution, healthcare and recovery monitoring – which must, nevertheless, remain the centre's central tasks. Such additional activities are described in Chapter XIII, Sections 3.3.9 and 4.3.3.

2.2.2 SFP centre structure, equipment and human resources

With a simplified structure and services, centres providing meals to be eaten on the spot are similar to the therapeutic feeding centres (TFC) discussed in Chapter XIII; readers should refer to Sections 3.1, 3.1.1, 3.1.2 and 3.1.3, and use common sense to adapt the recommendations they contain. Therefore, only aspects specific to SFP centres are discussed here.

In a centre restricted to the distribution of take-away rations, activities are limited to beneficiary registration and discharge, monitoring their nutritional and health progress, and the distribution of food. Its structure is accordingly simpler.

The SFP centre must be located as close as possible to the population it aims to support. Where rations are to be eaten on the spot, the centre must not be located further than a 30 minute walk away – 2 hours in the case of take-away rations. This is not because relatives could travel no further, but to allow time for beneficiary progress monitoring. The outline of an SFP centre structure providing rations to be eaten on the spot is to be found in Annex 17, Figure A. 17.1 The outline for centres providing take-away rations is somewhat simpler and presented in Annex 17, Figure A.17.2: the kitchen is unnecessary, as are the pharmacy and the treatment room, because proper healthcare cannot be provided on a fortnightly basis. In this case, beneficiaries and their sick relatives must have access to a health centre in the vicinity of their homes.

Human resources

The centre must be staffed with sufficient resources, properly paid, aware of their role and responsibilities, and trained to perform their tasks. Each task within the centre must be assigned to a person in charge: caretaking, cleaning, cooking, verification, etc.

For an SFP centre, the following positions are required.

⇨ 1 person in charge, usually a nurse, assisted by a deputy.
⇨ 1 assistant in charge of general supervision and providing back-up for the person in charge of the warehouse when the latter is on leave.
⇨ 1 assistant for healthcare.
⇨ 1 person per 50 beneficiaries for attendance control, organization, supervision and assistance at mealtimes; 1 of whom is in charge of oral rehydration with 1 deputy.
⇨ 1 person in charge of the kitchen, supported by 1 person per 50 beneficiaries (depending on the equipment), 1 of whom is his/her deputy.
⇨ 1 person in charge of the food warehouse and 1 in charge of the material (non-food) warehouse, sharing responsibility for stock management.
⇨ 1 handyman.
⇨ 2 to 4 persons in charge of cleaning and disinfection, depending on the size of the centre.
⇨ 2 watchmen.
⇨ Possibly staff for detection of cases through visits to households.

2.3 FOOD RATIONS

Whether the SFP aims to contain a crisis, contribute to the rapid eradication of moderate malnutrition, provide a safety net or a relay for therapeutic feeding, it will anyway involve substantial rations. When the objective is to contain a crisis, the child clearly does not receive enough food at home and, in view of the fact that it might face discrimination owing to its inclusion in a feeding programme, it should receive at least half its daily requirements, without expecting spectacular progress. For the other scenarios, the ration should allow the speediest possible recovery.

Take the example of a 3-year-old child, measuring 95 cm, and whose normal weight should be 14 kg. Assuming that its weight deficit is 3.5 kg and that the objective is for the child to gain 2 kg which will involve 10,000 kcal (41,800 kJ) overall, it will need to eat, in addition to the basic ration ensuring its maintenance, a ration supplying it with approximately the following:

⇨ 1,000 kcal (4,180 kJ)/day to recover within 10 days at the rate of 19 g/kg/day;
⇨ 700 kcal (2,930 kJ)/day to recover within 2 weeks at the rate of 13 g/kg/day;
⇨ 500 kcal (2,090 kJ)/day to recover within 3 weeks at the rate of 10 g/kg/day;
⇨ 350 kcal (1,460 kJ)/day to recover within 4 weeks at the rate of 6 g/kg/day.

The above data permits the formulation of practical recommendations for rations to be eaten on the spot and take-away rations alike.

2.3.1. Rations to be eaten on the spot

The ration should provide at least 500 kcal (2,090 kJ) per day, if possible 700 kcal (2,930 kJ), even 1,000 kcal (4,180 kJ), circumstances permitting. The protein contribution of these three levels of ration should then be 15 g, 21 g, and 30 g respectively, calculated on a 12% protein/energy ration (P/E ratio).

The ration can be composed of the following preparations.

⇨ A porridge made with commercial formula containing all necessary nutrients (for example, Nutriset's S.P. 450 or S.P.380, which provide 100 or 120 kcal (418 or 500 kJ) and 3 or 3.6 g of protein/100 ml depending on dilution, with a 12% P/E ratio.
⇨ A mix similar to CSB,[16] which is not specifically adapted for the treatment of moderate malnutrition, but is nevertheless suitable.
⇨ In the absence of a commercial preparation, a porridge prepared with basic ingredients and enriched with vitamins and minerals as per the formula described in Annex 16, respecting the following proportions:

→ maize flour:	60 g	210 kcal (880 kJ) 6 g protein
→ powdered skimmed milk :	40 g	140 kcal (585 kJ) 14 g protein
→ oil:	30 g	270 kcal (1,130 kJ)
→ sugar:	10 g	40 kcal (170 kJ)
→ water:	350-400 ml to complete a total volume of 1/2 litre.	

A pre-mix is prepared with the flour, the powdered milk and the sugar, then adding the oil. At the same time, the water is boiled for 10 minutes. Part of the boiled water is added to the pre-mix, stirring until particles dissolve. Then the rest of the water is added, up until the planned volume, and cooked over a low heat for 30 minutes, stirring frequently. At the very end of the cooking and not before, the vitamin and mineral supplement is added. The resulting porridge supplies approximately 130 kcal (540 kJ) and 4 g of protein/100 ml, with a 12% P/E ratio.

Since small children cannot eat large amounts of food at once, their ration has to be split into two meals, scheduled so as to leave enough time between them and meals taken at home. Supplementary feeding programmes aiming to contain a crisis should also include accompanying relatives for one or two meals compliant with local customs (e.g. semolina dish accompanied by beans and sauce) with, possibly, a porridge or a bowl of milk. There are no rules in this field, as long as the accompanying relatives are fed.

SFP meals are often considered to replace family meals, a misperception which must be avoided as much as possible. Regular weight monitoring is thus essential to verify whether the beneficiary is indeed receiving his/her share at home. This of course is illusory when the entire population's access to food is clearly insufficient.

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2.3.2 Take-away rations

For take-away rations, pre-mix is desirable. This can be either commercial or locally prepared (as described in Section 2.3.1 above) for mothers, properly trained, to cook at home. This is the safest way of ensuring that the child will eat most of its ration. Individual ingredients or biscuits should not be distributed, as they would likely be eaten by others. However, sharing with other family members

[16] Corn Soy Blend, see Chapter XII.

is frequent even in the case of porridge. It is therefore desirable to distribute rations supplying at least 1,000 kcal (4,180 kJ)/day, but this can easily be increased to 1,500 kcal (6,300 kJ). Here again, more so than for rations eaten within the centre on a daily basis, regular weight verification is indispensable to follow individual beneficiary progress, so that appropriate measures may be taken.

2.4 SUPERVISION AND ASSESSMENT

Supervising the activities of the centre facilitates the overall assessment of its performance and of developments in the circumstances, while assessment allows the verification that set objectives are being met.

2.4.1 Supervision

In terms of supervision, comments are the same as those found in Chapter XIII, Section 3.4.1, except for meal attendance. In an SFP centre, a higher than 90% meal attendance is considered satisfactory. A lower rate usually indicates problems external to the centre rather than doubts about the quality of the services it provides. Understanding the reasons for lower than expected attendance rates is therefore necessary for appropriate steps to be taken.

2.4.2 Assessment

This consists in verifying the rate of nutritional recovery, the duration of stay (related to the recovery rate), the speed of recovery from sickness and the discharge or exit rate *versus* recovery (objective met), death, drop-out, absenteeism, and transfer to therapeutic feeding centres or hospitals. In other words:

- ⇨ the nutritional recovery rate should be at least 5 g/kg/day, provided the ration is enriched in vitamins and minerals as described in Annex 16;
- ⇨ the duration of stay should not exceed two months;
- ⇨ the recovery rate should be no less than 80%;
- ⇨ the death rate should be lower than 5% among beneficiaries whose meal and healthcare attendance rate has been above 90%;
- ⇨ the dropout rate should be lower than 15%, but dropping out is not necessarily a reflection on the quality of the centre;
- ⇨ the transfer rate to therapeutic feeding centres should be less than 3% for beneficiaries in good health;
- ⇨ the transfer rate to hospitals depends upon the living conditions outside the centre, and it is thus impossible to set an arbitrary standard.

Of course, the above factors are interrelated and must be interpreted as such.

CHAPTER XV
NUTRITIONAL INFORMATION

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CHAPTER XV
NUTRITIONAL INFORMATION

INTRODUCTION

This last Chapter on humanitarian action discusses the practices leading to an adequate diet. Such practices are those usually addressed in so-called "nutritional education programmes"; however, the expression "information" is considered more appropriate than "education", and is preferred here accordingly. The term "education" is misleading in humanitarian action, as it suggests that the victims owe their sufferings partly to their ignorance. In actual fact, ignorance and lack of access to education are never the causes of major humanitarian crisis; such crises arise from inadequate protection and resources.

Nutritional information usually addresses the mothers of small children because the latter suffer from crisis first. Here again, however, an increase in infant mortality does not result from maternal ignorance, but rather from the deterioration of one or more of the following parameters that shape living conditions:

- ⇨ available economic resources;
- ⇨ the time that can be devoted to small children;
- ⇨ access to healthcare;
- ⇨ the quality of water and habitat;
- ⇨ physical and emotional wellbeing.

Information as such is therefore not the priority (it in fact ranks last in the strategy); what matters is the restoration of decent living conditions. Besides, training that is given in inadequate living conditions can only meet with failure. Information and key messages must be delivered at the right time, to groups whose attention is at its strongest, that is, once the major dangers are under control.

1. THE LIMITS OF NUTRITIONAL INFORMATION

Gillespie and Mason have analysed common and chronic nutritional problems that relate mainly to structural and cultural issues (Gillespie & Mason, 1991); this approach provides a useful illustration of the foregoing, and facilitates the positioning of nutritional information within humanitarian action. The first signal is inadequate food security at household level (which in this Manual corresponds to economic insecurity). The second signal is the association between malnutrition and infection,[1] and the third is the insufficient control of women over household resources, and their lack of the necessary means for adequate child care. These three main problems can be resolved by the following measures (Gillespie & Mason, 1991).

[1] See Chapter VIII.

In terms of economic security:

⇨ macro-economic adjustments that are adapted to issues of poverty;
⇨ policies that promote employment;
⇨ agricultural policies;
⇨ policies affecting food prices;
⇨ social safety nets in the form of appropriate assistance policies.

In terms of the connection between malnutrition and infection:

⇨ antenatal care and nutritional assistance to mothers-to-be;
⇨ the promotion of breastfeeding;*[2]
⇨ mother and child healthcare (MCH);
⇨ water and habitat quality improvement programmes;
⇨ nutritional education on weaning practices;*
⇨ supplementary feeding programmes;[3]
⇨ adequate healthcare (quantity, location, quality, and access);
⇨ the inclusion of nutritional expertise in healthcare services;
⇨ other types of action in domains that affect health and nutrition indirectly.

In terms of the means necessary for women to control household resources and devote adequate attention to their children:

⇨ the empowerment of women in order for them to allocate income according to needs;
⇨ the reduction of household constraints in order to free the necessary time for mothers to care for their children, perform their domestic chores, and contribute to the production of resources;[4]
⇨ education for women;
⇨ the equitable distribution of food between household members;
⇨ improved infant feeding practices;*
⇨ preventive healthcare;
⇨ generalized family planning;
⇨ increased day-care availability;
⇨ nutritional education programmes.*

Out of more than 20 types of action, only four (i.e. those marked with an asterisk) are associated with nutritional education. It follows that poor practice is by no means a major cause of the nutritional problems that are common outside crisis situations.

Gillespie and Mason provide the following remarks on this issue:

> *"Significant progress can only be made through action that addresses resource constraints. Nutritional education can nevertheless have significant impact when clear changes occur, such as migration to cities, or the transformation of resource production modes. Nutritional education can also be effective when resources are not a constraint and the population is open to suggestions of improved practices. However, the following questions must be answered at this stage:*

[2] Action types accompanied by an * involve nutritional education.
[3] See Chapter XIV.
[4] See Chapter VI.

1. *What groups face nutritional problems?*
2. *What are the problems?*
3. *What type of message is required?*
4. *To whom should nutritional information be directed?*
5. *What behavioural change is expected?*
6. *Is this change relevant, practical, and accessible in terms of local social and cultural values, and the available revenue and time of the target group of the education programme?*"
(Gillespie & Mason, 1991)

This statement shows the limits of nutritional information outside crises, and highlights the precautions that should be taken before engaging in such programmes. A crisis that calls for humanitarian action practically by definition implies a lack of economic resources and services, which limits the impact of nutritional information. The latter may nevertheless be useful if the living conditions of the target group have changed to the point of modifying feeding practices or if harmful cultural practices are noted, provided that the group is open to such information and has the necessary resources to apply recommendations.

2. KEY STAGE OF NUTRITIONAL INFORMATION WITHIN THE FEEDING PROCESS

In a crisis, the only stage of the feeding process that may be addressed by nutritional information is the food consumption stage. At that level, poor practice resulting from a lack of knowledge and motivation always gives rise to health problems. The main objective of nutritional information is then to improve the health of target groups by reducing the prevalence, incidence, and seriousness of such disorders. In developing countries, they affect mainly small children, the elderly and persons who depend on institutions, especially when this involves internment in some form. In small children, malnutrition and sickness often combine, and it is difficult to distinguish the respective contributions of feeding practices, poor hygiene, inadequate access to preventive and curative healthcare, and the virulence of communicable disease. The elderly face nutritional disorder because of their physical and mental health, poverty, isolation, or abandon; when they are cared for by relatives, nutritional disorders usually result from health problems. The nutritional disorder of institutional inmates usually results from neglect on the part of the institution. For example, nutritional, health, and hygiene problems are commonplace in prisons, and even more so in psychiatric asylums and orphanages, where living conditions can be worse. In the industrialized West, poor feeding practices can be found in practically all social strata owing to excess and imbalance. Interestingly, health disorders related to nutrition (such as type 2 diabetes, high blood pressure, obesity, and cardio-vascular disease) regress substantially in times of crisis; for such groups, crisis may in fact be qualified as beneficial in dietary terms.

3. THE OBJECTIVE AND PREMISE OF NUTRITIONAL INFORMATION

Within the framework of humanitarian action, nutritional information aims at replacing poor practices with others that are more appropriate. To this end, preliminary assessment must first demonstrate that:

- ⇨ observed nutritional problems arise from poor practice;
- ⇨ such poor practice results mainly from lack of knowledge and/or motivation, and not from the inadequacy of basic resources (time or material means) or other priorities taking precedence;
- ⇨ nutritional information is an appropriate and effective way of dealing with such practice.

The only objective of nutritional information is to change individual behaviour by improving knowledge and motivation. It must not entail a significant increase of expenditure and effort because crisis already complicates the coverage of unavoidable expenditure; crisis also often precludes additional effort on the part of its victims owing to lack of time, fatigue, and other more pressing priorities.

Nutritional information can only succeed if behavioural change (which requires little additional investment) is expected to improve the nutritional situation rapidly. The remaining issue requiring clarification is whether the programme should address primarily those responsible for poor practice, or extend to the entire community from the outset. If malnutrition has multiple causes, it can for example be implemented first within feeding centres and healthcare facilities; if it is successful, its extension can then be attempted. It may nevertheless be best to target the entire community from the outset if poor practice appears to be general and is feared to have serious consequences. The ultimate decision should be circumstantial, based on constraints and opportunities. The extension of the programme to the entire community may seem complicated at first, especially in terms of access. It need not be however, because nutritional information always combines with assistance operations, and these require broad-based and regular contact with target groups. If this contact provides the entry point for nutritional information, dialogue and participatory approaches necessarily follow, this time in relation to issues of culture and living conditions – these contacts also produce much additional information and strengthen informal interaction by addressing issues that are only of indirect economic relevance.

4. CONVEYING NUTRITIONAL INFORMATION

4.1 DEMONSTRATING THE RELEVANCE OF NUTRITIONAL INFORMATION

In a crisis especially, nutritional information programmes must be supported by survey data that clearly demonstrates their relevance and pertinence. This may be achieved in two ways. A causal model can be designed from all cases that present a given pathology, by backtracking to the causes of this pathology, and demonstrating that they can be resolved through information. Alternatively, local nutritional and care practices can be compared with recommended procedures, and possible discrepancies then investigated in order to determine whether the local practice is harmful or not. These two approaches can clearly be combined.

The following then needs to be documented:

⇨ the individuals or groups that face nutritional problems resulting from poor practice;
⇨ the nature of such problems;
⇨ the specific practice resulting in such problems;
⇨ the reasons for such poor practice;
⇨ the type of message required;
⇨ the audience;
⇨ the type of behavioural change that is required;
⇨ the relevance, practicality, and accessibility of such changes in terms of social and cultural values, available income and time of the target group.

4.2 TRAINING COMPONENTS

Field staff must have the means (time and resources) to engage in dialogue with target groups; it should avoid restricting training sessions to academic lectures that in fact do little for the audience.

4.2.1 Basic principles

The following are basic pre-conditions for success.

- ⇨ Target communities should be involved in the operational planning, implementation, and evaluation processes.
- ⇨ Proposed changes should be simple, context-specific, and be expected to improve health substantially; they should comply with cultural standards and not upset them.
- ⇨ Proposed changes should refer to positive deviants[5] as examples in order to avoid becoming excessively theoretical.
- ⇨ Key messages should be kept clear and simple, they should be repeated regularly, and be tested as often as possible. The three guiding principles of teaching are: what is only heard is forgotten, what is seen is more likely to be recalled, but only what has been practised is remembered.
- ⇨ Each session should be limited to the delivery of one key message only.
- ⇨ Each session should conclude with its evaluation.
- ⇨ Key messages should be identical for all.
- ⇨ Regular sessions should be organized for the audience to share its experiences and suggest improvements or changes – endorsement by the audience is the only guarantee of success.
- ⇨ Training staff should follow trainees closely until the delivered instructions are spontaneously applied in practice.
- ⇨ Programme indicators should reflect expected behavioural change clearly; in crisis, indicators should relate to the reduction of the incidence and seriousness of sickness, rather than to growth performance and nutritional status, which cannot improve dramatically in highly precarious living conditions.

Nutritional information programmes may need to be accompanied by similar efforts in the fields of water and habitat, domestic healthcare, and the timely referral to available healthcare services.

4.2.2 Practical aspects

Planning and organizing sessions

Once the problems and key messages have been determined, the programme is planned in a sequence of sessions that address one problem at a time, proceeding from the simplest to the more complex.

Sessions should be scheduled in such a way as to disrupt essential community activities as little as possible; a weekly frequency is usually adequate. The location chosen for sessions should be welcoming, and be sheltered from the elements. The audience should be limited to 20 or so participants in order to give each the time to express views, observe, and experiment, and for trainers to devote adequate time to each individual. Theoretical components should be kept short (10 minutes at most), the remaining time (one hour at most) being devoted to discussion, demonstrations, and

[5] Positive deviants are those that succeed when others fail in identical conditions.

experimentation. Active participation should be encouraged as much as possible by presenting the exercise as an exchange rather than a one-way lecture. The audience usually has much to say and demonstrate with respect to daily life. Likewise, trainers should encourage community bonds and initiatives to promote health and the key messages delivered during sessions.

Sessions must be prepared carefully in order to proceed smoothly: to this end, the different stages are described, the required material is handy and ready for use, and positive deviants are identified, as is their behaviour.

Trainers must be skilled, courteous, enthusiastic, and patient.

Content of sessions

Trainers should:

⇨ begin the session with a brief description of the problem under consideration;
⇨ invite participants to provide their views on the problem and its causes;
⇨ compare such views with the behaviour of positive deviants, and describe the approach that averts the problem;
⇨ describe best behaviour in a discussion with the audience;
⇨ proceed to the demonstration and experimentation stage if relevant, by involving one or more participants as assistants;
⇨ summarize the session and introduce the next (wrap-up);
⇨ evaluate impact through home visits during the days following the session in order to observe whether behaviour has changed, and if it has not, why not;
⇨ if relevant, review the approach according to evaluation results.

5. THE THEMES OF NUTRITIONAL INFORMATION

At the level of food consumption, the commonest health disorders arise in relation to the following aspects – these provide the themes of nutritional information:

⇨ food hygiene, which is of capital importance in infant and child feeding;
⇨ infant and child feeding;
⇨ diet.

Training sessions, based on the observation of poor practice, may revolve around one or more of the above themes. Good practice is indicated here in rather abstract terms and for ideal conditions. For example, cooks have adequate working space, many utensils, and appropriate cleaning equipment – in a crisis, this is clearly seldom the case. Key messages must therefore be adapted to local circumstances (i.e. the type of poor practice and living conditions), with a view to limiting risks realistically rather than attempting to eliminate them altogether. Trainers must put themselves in the place of their audience, and derive key messages from available evidence.

5.1 FOOD HYGIENE

A significant proportion of infectious disease results from poor food hygiene, and is the main cause of infant morbidity and mortality. Foodstuffs can contain intestinal parasites from the beginning, but they can also be contaminated later by microbes that cause gastro-intestinal and respiratory infection, in addition to hepatitis, tuberculosis, poliomyelitis, and typhoid fever. Some of these microbes also produce toxins that may cause fatal poisoning. The water used for cooking and drinking can also contain such pathogens. Food can be contaminated by contact with dirty hands, insects, animals, dust, water, cooking utensils, previously contaminated kitchen benches and, clearly, other previously contaminated foods. Hands can be soiled through previous contact with food, clothing, objects, contaminated hair, or the use of sanitary facilities without subsequent washing.

Pathogens multiply quickly in food, because the latter is their own food or culture medium. Multiplication is faster in food that is moist or contains elementary nutrients such as sugar, and in hot conditions. Strict food hygiene is therefore the pre-condition for the control of infectious disease. However, good food hygiene seldom arises from a scientific understanding of the connection between microscopic pathogens and infection. The limits of early warning in incipient famine have been discussed earlier; here however, the connection between impoverishment, capital loss, and hunger-related sickness is only understood through practical reasoning and the observation of usually visible signs. The recipients of humanitarian aid cannot reasonably be expected to understand the concept of invisible pathogens, which attack some organisms more fiercely than others. Humanitarian staff is often thoughtless in attempting to impose highly theoretical knowledge on audiences that are unprepared for it; such staff in fact sometimes does not apply common sense and elementary rules to its own daily life. Moreover, food hygiene only makes sense in terms of general household and personal practices, as part of a broader hygiene concept. Finally, environmental parameters are often impossible to control. A food hygiene training session conducted for expatriate staff deployed in very hot and humid environments provided a telling example: in spite of using means that most of the local population lacked, few participants succeeded in reconstituting powdered milk without it spoiling within half an hour – in conditions that amounted to those of the wealthy in the industrialized West.

This introduction goes to underline that food hygiene is not self-evident. Moreover, it requires some knowledge as to the local perception of disease transmission: if infectious disease is locally thought to be of supernatural origin, the message that epidemics result from simple mechanisms that can be controlled will be difficult to deliver. Only practical and conclusive experimentation can influence beliefs. This requires time and means, which humanitarian agencies sometimes lack, especially in overt crisis. Finally, the more risky the medium, the greater the need to apply strict hygiene standards – the degree of risk is defined by the quality of the water, access to safe water, disposal of waste water and garbage, habitat, vector control, and climate (temperature and humidity). Clearly, if the risk of infectious disease results mainly from an insalubrious environment, then water and habitat programmes are the first defence against such risks, rather than lectures on food hygiene, however convincing they may be. This example again demonstrates the importance of tackling problems through multi-faceted integrated approaches.

5.1.1 Poor practice resulting in food contamination

The risk of consuming contaminated food is associated with the following behaviours:

- ⇨ the use of visibly contaminated foods;
- ⇨ the premature preparation of food: it increases the risk of contamination before consumption, and harmful bacteria that have resisted the preparation process have more time to multiply;
- ⇨ insufficient cooking, which spares parasites and harmful bacteria;
- ⇨ contamination through contact (contaminated workbenches, utensils, and hands) and transfer to other foods (cross-contamination).

5.1.2 Hygiene and food

Food storage and preservation

Quality food storage is the first stage of hygiene. Foodstuffs must be sheltered from rodents, birds, and insects; these can contaminate them directly, and/or open the way for additional contamination through the damage they cause. Foodstuffs must be sheltered from humidity, heat, and dust in order to avoid the spread of mould and bacteria, but also from light, which can likewise cause degradation. Storage space must be clean, closed but ventilated, easy to clean, and be sheltered from humidity and the elements. Cupboards, shelves protected by metal mesh (such as fine-meshed chicken wire), and suspended bags all offer good protection against insects and rodents. The food storage space must be treated against infestation regularly. Cats and mousetraps are also useful. Time must then be taken to inspect and supervise stocks and eliminate uninvited visitors and food commodities that have become unfit for consumption. Some foodstuffs must be processed specially in order to protect them from rotting and mould; options include salting, drying, smoking, sterilization and/or preservation in a special medium such as brine, vinegar, sugar, alcohol, or fat. Such processes are however not without risk if they are performed domestically: utensils must be kept perfectly clean, foodstuffs must be washed and peeled carefully, and they must be prepared with previously boiled or safe drinking water. Preserved foodstuffs must then be regularly checked, spoiled items and traces of mould must be removed, and preservation ingredients added.

Choosing foodstuffs

Only quality foodstuffs must be selected according to the following criteria.

⇨ The wrapping of deep-frozen foods must be intact, and the expiry date must not be past. Deep-frozen foods must be thawed in their intact wrapping, sheltered from contamination (especially from flies). Thawed foods must not be refrozen.
⇨ The odour and appearance of fresh foods must be pleasant; they must be devoid of bruises, mould and traces of predators. They must not be overripe or withered.
⇨ Dried foods must be as dry as possible – any trace of humidity indicates probable contamination. They must be devoid of mould, traces of predators, scraps, foreign bodies, and soiling. Their wrapping must be intact and clean.
⇨ Preserves can cause fatal infection (botulism). Swollen or distended cans must be destroyed, as must jars or tins that release gas when opened. Rusted cans and tins, and those damaged during transport that leak are unfit for human consumption, as are those that are past their expiry date.

Soiled and partly damaged foodstuffs can often be cleaned by removing the spoiled parts of fresh foods and washing them, by sieving flours, and by sorting stones or debris found in legumes for example. However, such foods must then be cooked well.

Protecting foodstuffs

No food must be left uncovered in kitchens, even briefly; flies need mere seconds to fly from latrines to kitchens, and the dust in the air carries germs.

Contact between foodstuffs

Foodstuffs that are not prepared together, especially cooked and raw foods, should be kept separate; indirect transmission through kitchen utensils, linen and workbenches must also be avoided.

Preparing foodstuffs

Foodstuffs should only be prepared for immediate consumption. Foods that are eaten raw should be washed carefully with clean water, or peeled. They may be soaked in salted or chlorinated water. Fresh foods are in principle prepared the same day in the absence of refrigerators; even refrigerated meat, fish, and milk can usually only be kept for two days at most. Food that is ready for consumption must be sheltered from dust, splashes, and predators.

Cooking foodstuffs

Food should be cooked through, especially animal products that must be brought to a temperature of 70°C at least; milk, in particular, must be boiled.

Consuming foodstuffs

Prepared and cooked food must be consumed immediately in order to avoid the proliferation of pathogens that may have resisted cooking, or have contaminated the food after cooking (for example through contact).

Keeping prepared foodstuffs

In principle, cooked food should not be kept after the meal, unless this can be done at a temperature above 60°C or below 5°C. Neither option is practical (especially the sudden cooling to 5°C), and both can only be done in very small quantities. In any case, infants must never be fed items that have not been prepared immediately before.

Reheating cooked food

The reuse of cooked food implies that it be reheated throughout at a temperature of at least 70°C. Such foods are nevertheless also unsuitable for infants.

5.1.3 Hygiene measures to avoid contamination

Kitchen cleanliness

Together with sanitary facilities, the kitchen should be the cleanest location in any home. It must be cleaned regularly and equipped with the specific material and cleaning linen for each task: cloths that are used to clean kitchen utensils are not the same as those used to clean workbenches, floors, or hands. Cleaning material must itself be cleaned regularly: cloths that are in contact with food and kitchen utensils and hand towels must be changed several times a week (ideally daily), and boiled. Food must be prepared on a special surface intended for this use and easily cleaned; any items falling from it must be cleaned and washed carefully. Kitchen utensils must be washed completely with soap and a brush in hot water after each meal. They should ideally be boiled because their apparent cleanliness is no guarantee of the absence of germs. Clearly, the same cleanliness standards apply to cutlery. Domestic garbage and waste water should be removed from the kitchen as quickly as possible, to distant locations intended for this use, and which inhibit vector proliferation (flies and mosquitoes). Leftovers can be recycled as compost or fed to animals, but the latter must not be admitted to the kitchens.

Personal hygiene

In terms of personal hygiene, hands must be washed with water and soap, and dried with an immaculate towel or else air-dried. A soiled soap or towel can easily turn into a culture medium. Soap should be rinsed and drained after each use. Hands should be washed before handling food or sitting down at the meal table, following each interruption of kitchen chores – especially in order to visit sanitary facilities or change diapers, and between chores (for example, after handling raw meat and before dealing with the vegetables). Fingernails are best kept short. Wounds should be dressed, especially in case of infection, and dressings should be changed often enough to keep their outside clean. Hand cleanliness is only the last indication of personal hygiene: clean hair and clothing, and the use of a handkerchief to blow one's nose or cough into are other means of limiting food contamination.

Water used for food preparation and washing

The water used for the preparation and washing of food is usually the same as drinking water, and is a common source of contamination and infection. In case of doubt, it should be boiled for at least 10 minutes. The securing of safe drinking water is one of the greatest hygiene problems in poor countries and in a crisis. Access to water, and to the fuel required to boil it, is often complicated. Generally speaking, water must be collected and kept in a clean, covered container that is cleaned frequently. The equipment used to draw water must serve no other purpose, and must be cleaned regularly. Water should be kept in different containers according to whether it is intended for drinking, the preparation of meals, domestic cleaning chores, or personal hygiene. If fuel is scarce, boiling may be limited to the water used to prepare the meals of small children and for drinking.

5.2 FEEDING INFANTS AND SMALL CHILDREN

The diet of infants and small children is crucial for their development and health. Breastfeeding and weaning practices play a major role in this framework. Feeding follows three phases: 0 to 4–6 months, 4–6 months until the completion of weaning (whose duration varies), and weaned infant feeding.[6]

[6] Chapter VI discusses the general aspects of food consumption.

5.2.1 Feeding infants (0 to 4–6 months)

Poor practice

Infants between 0 and 4–6 months should be exclusively breastfed. In the industrialized West however, breastfeeding is often replaced by bottle feeding with milk reconstituted from special powdered formulae. Clearly, the quality of such milk does not match maternal milk, and the use of bottles does not provide the same emotional bond between mother and child as breastfeeding does. The process itself does not entail immediate danger however, provided that it is properly followed; at the worst, it can increase the risk of obesity later. Therefore, refraining from breastfeeding in principle does not amount to poor practice. In a crisis however, it can expose the child to danger if manufactured substitutes happen to run out, and if the prevailing hygiene conditions preclude the safe preparation and preservation of milk which are essential in averting gastro-intestinal infection. On the other hand, where artificial feeding replaces breastfeeding without the material and cultural pre-conditions for the proper use of bottles and infant formula, the risk of morbidity and mortality is significantly increased; in a crisis, they can reach disastrous proportions. In a crisis therefore, breastfeeding should be preserved or strengthened – this is doubtless one of the most effective ways of limiting the risk of infant morbidity and mortality.[7]

The following types of poor practice are potentially most dangerous for health.

⇨ The inobservance of strict hygiene standards in preparing milk in order to avoid its contamination by agents inducing gastro-intestinal infection and dehydration that can be fatal. Contamination may result from bad quality water, unclean bottles, teats and kitchen utensils, or excessive delays in the consumption of prepared milk. Poor practice may also stem from lack of knowledge as to basic food hygiene rules (see above) in general, or of those governing milk preparation in particular, or the lack of the means necessary to sterilize water, bottles, and teats, and to wash them and the kitchen and required utensils properly. Moreover, whatever the circumstances, reconstituted milk does not keep – it must be consumed immediately.

⇨ The excessive dilution of milk powder, resulting in an insufficient dietary intake and primary malnutrition. The reason for this is usually a lack of resources on the part of the mother to purchase enough milk powder; it may also be her inability to understand the manufacturer's instructions, or her inability to feed her child properly.

⇨ The insufficient dilution of milk powder, causing kidney overload, dehydration, and possibly brain damage. This may result from the mother's inability to understand the manufacturer's instructions, or a misplaced intention to supply a more concentrated diet.

As a result, breastfeeding should be generalized in countries where crises recur frequently. It is the only option open for consideration and should be promoted actively by humanitarian agencies. The promotion of breastfeeding is based on the following information.

General information regarding breastfeeding

Breastfeeding is the best and most natural way to feed infants. In most cases, breastfeeding alone is enough from birth up to 4 to 6 months because maternal milk is a complete and balanced food whose composition evolves over time and also with the child's own development. The volume of

[7] Annex 3 discusses the utilization of maternal milk substitutes in humanitarian operations.

milk produced by the mother increases steadily during the fortnight following birth, eventually reaching a daily average of 700 to 800 ml during the first 6 months of breastfeeding. Individual variations can be substantial in terms both of production and of demand (Cameron & Hofvander, 1983). As from 4 to 6 months, maternal milk no longer covers the child's requirements in terms of energy, protein, iron, and thiamine. Other foods must therefore be introduced gradually until the child is fully weaned. After the weaning process has begun, breastfeeding continues for a duration that varies according to culture and the constraints faced by the mother. The prolonged continuation of breastfeeding (i.e. for 6 to 18 months or more) in principle guarantees the quality of dietary intake during the critical phase of weaning and exposure to infectious disease, provided that the child has access to enough other foods. Protracted breastfeeding also provides a good protection against infectious disease, and promotes the child's emotional development. The quality of maternal milk is hardly affected by her nutritional status, because milk synthesis takes precedence. Only if the mother consumes less than 1,200 kcal per day and is severely malnourished do the quality and quantity of her milk decline significantly. Moreover, if the mother suffers from deficiencies in vitamins and minerals that are not stored in the organism (especially thiamine), her milk will contain inadequate amounts, and her child will quickly develop deficiency itself – infantile beriberi is a classic example.[8]

The advantages of breastfeeding

Besides containing all necessary nutrients (provided that the mother does not suffer from deficiencies in vitamins and minerals), maternal milk has other advantages that cannot be matched by any other method of infant feeding.

- ⇨ Maternal milk protects against environmental bacterial and viral infection because it contains the defences that the mother herself secretes against the infectious agents to which she is exposed. It contains protection factors such as:
  - → lactoferrin, which inhibits the attachment of bacteria to the intestinal membrane,
  - → lysozyme, which destroys some dangerous bacteria and viruses,
  - → interferon, which appears to inhibit the activity of some viruses,
  - → and the so-called "bifid factor" that contributes to the growth of healthy bacteria of the intestinal flora – these, through their growth and production of lactic acid, inhibit the growth of other bacteria and parasites.
- ⇨ Statistically, the infertility period immediately following delivery is proportional to the duration of breastfeeding; individual variations are however substantial, and breastfeeding is not a reliable contraceptive method.
- ⇨ Maternal milk protects against allergy, especially infantile eczema (or atopic dermatitis).
- ⇨ Breastfeeding during the first months of life reduces the chances of later obesity.
- ⇨ Breastfeeding strengthens the emotional bond between the mother and her child, and promotes the child's emotional development.
- ⇨ Breastfeeding reduces the risk of breast cancer and of cancer of the uterus.
- ⇨ Breastfeeding is highly practical because it involves no preparation or equipment, and is permanently available.
- ⇨ Breastfeeding is substantially cheaper than artificial feeding. Together with its anti-infectious properties, this aspect makes it especially important for poor families and in times of crisis.

[8] See Chapter VIII.

Furthermore, comparing the nutritional value of human and cow's milk clearly reveals the advantages of maternal milk.

- ⇨ **Energy**: cow's milk and maternal milk share roughly the same energy content, but their energy density gradient is not the same.
- ⇨ **Protein**: cow's milk contains close to three times more protein than human milk does – this raises the urea plasma concentration beyond the norm and causes kidney overload. Moreover, cow's milk protein is less digestible than maternal milk protein.
- ⇨ **Lipids**: maternal milk lipids are more easily absorbed than those of cow's milk.
- ⇨ **Glucides**: the higher lactose content of maternal milk promotes the development of a specific intestinal flora that increases the acidity of the medium and inhibits the growth of pathogenic germs.
- ⇨ **Minerals**: the higher concentration of calcium, phosphorus, and magnesium, and the lower calcium/phosphorus ratio in cow's milk could be one of the causes of neonatal tetany. Moreover, the higher electrolytes in cow's milk result in kidney overload, making it unsuitable for children under 3 months of age. In fact, the weak sodium excretion capacity, combined with fluid loss (diarrhoea) can cause hypertonic dehydration leading to convulsions, sometimes neurological damage, and may be fatal depending on the degree of dehydration. The iron and zinc contained in maternal milk are also more easily absorbed.
- ⇨ In the case of powdered milk, skimmed or partly skimmed milk has a low energy content and has lost most or all of its fat-soluble vitamins (dried skimmed milk should in principle be fortified in vitamins A and D). Nowadays, manufactured baby milk is available commercially in the form of "humanized" cow's milk, which is close to the nutritional composition of human milk. This option however does not provide the other benefits of breastfeeding, especially protection against infection, and its emotional and economic advantages.

Generally speaking, breastfeeding limits the risk of infant morbidity and mortality in developing countries, and reduces morbidity in the industrialized West.

The implementation of breastfeeding

The pre-conditions for successful breastfeeding are the following.

1. The mother must feel capable of breastfeeding, and be at ease in doing so. This attitude can be encouraged by the mother's family and healthcare staff. In societies where breastfeeding is traditional and the use of substitutes and bottles is practically unknown, breastfeeding in principle involves no problems. In societies that are familiar with artificial infant feeding, it is common to find mothers who feel insecure and lack confidence in their ability to feed because they cannot control doses the way they can with substitutes. They should be encouraged to try nevertheless, and understand that, especially in a crisis, breastfeeding is the best guarantee for their child's health. Regular monitoring helps to detect possible (rare) complications, and to demonstrate the efficiency of breastfeeding to the entire community. Building confidence, reassuring, debunking, explaining the physiological and psychological benefits of breastfeeding, referring to mothers that feed with confidence, pride and success as examples, and intervening if necessary are all key to persuading mothers of the benefits of breastfeeding.
2. The child must be given to the breast at birth (at most one hour after birth). In most cases, neonates begin to suckle immediately, thus stimulating milk production and at the same time promoting the emotional bond with their mother.
3. The child must be left with its mother permanently after birth, as this promotes milk production. The child must be fed on demand, as soon as it becomes agitated or cries – in most cases this indicates nothing but hunger. During the first weeks, neonates may need to feed up to 10 times per 24 hours.

4. Breastfeeding should start immediately after birth to allow neonates to consume colostrum[9] during the first week. Colostrum is essential not only because its consumption stimulates milk production, but also because it is the perfect "first food" for infants and protects them against neonatal infection.
5. During the first months, the child should be fed on demand, which varies considerably from one child to another. This demand is natural and legitimate, and must be satisfied – it is a guarantee for the child's mental and physical health. After all, simple observation of mammal behaviour clarifies the concept of feeding on demand night and day. In this respect, man only differs from other mammals because its offspring is not mobile shortly after birth, and can therefore not seek its mother's teat independently.
6. In order to avoid sore nipples, they must not be washed too often, and soap should not be used; a daily wash with clean water is usually enough. Allowing a few drops of milk to dry on the nipple after feeding also protects it against infection and dryness. In this respect, a few drops of maternal milk several times daily applied to minor abrasions and irritated eyes are the best remedy against external infection in neonates. Maternal milk is an excellent antibiotic.
7. Maternal milk alone is no longer sufficient beyond 4 to 6 months; breastfeeding should nevertheless continue for as long as possible (12 to 18 months), as maternal milk complements weaning foods perfectly, and continues to protect the child against infection.
8. Breastfeeding must sometimes be interrupted (sick child or mother, absent mother); it can however always be maintained or resumed, even after some weeks. In order to stimulate milk secretion, the milk should be expressed to avoid bloating and continue stimulation. In order to reinitiate breastfeeding, the child must be fed frequently (every hour, or every second hour, for several minutes). In principle, normal breastfeeding resumes within a few days. Meanwhile, it may be necessary to feed the child supplements in the form of baby milk formula or porridge.
9. Child sickness does not necessarily call for the interruption of breastfeeding. On the contrary, the child should be encouraged to feed as often as possible in order to avoid dehydration or the development of primary malnutrition, and the loss of the valuable antibodies transferred by its mother.

Substituting maternal milk

In some cases, breastfeeding is not possible (sick or deceased mother, or insufficient milk secretion[10]), and a wet-nurse cannot be found; in such cases, the child must be fed maternal milk substitutes, or baby milk formulae. In the industrialized West and among the more affluent groups in the developing world, this is usually no problem. Artificial feeding is in fact sometimes a deliberate choice on the part of the mother who can usually afford it. On the other hand, the poor who are unaware of the dangers of artificial feeding face high chances of failure (and thus mortality), mainly because of difficulties to access/procure an expensive commodity that is usually imported; this is especially true in a crisis. The product must then be prepared in impeccable hygiene conditions, in compliance with the manufacturer's instructions. Economic constraints notwithstanding, it must not be diluted beyond recommended proportions – it may otherwise result in malnutrition due to insufficient dietary intake. It must not be insufficiently diluted either (through good intentions or the poor application of instructions), as this can cause kidney overload. Finally, the formula

[9] Colostrum is the milk produced during pregnancy and the early days after delivery. It is yellowy orange in colour, and thick and sticky. It differs from the milk that is secreted later by the fact that it is rich in nutrients and anti-infectious elements. In some cultures, it is unfortunately not fed to neonates, which are fed sweetened water or other substitutes instead.

[10] Insufficient milk secretion is uncommon, but can become frequent in crisis situations.

should be administered on demand and properly. In humanitarian operations and in the absence of alternatives, powdered milk may be prescribed and distributed in healthcare centres or therapeutic feeding centres, in combination with the proper information for the mother or carer of the child, and with the adequate medical follow-up of the child.

In terms of information, the following key messages should be conveyed.

The use of substitution formulae (according to Cameron & Hofvander, 1983)

The total volume for children up to 6 months of age is 150 ml of substitution formula per kg of body weight per day, to be spread out over 5 meals per day, that is, 30 ml per kg of body weight per meal. Meals should be spaced out according to 3 to 4 hour intervals, and children should be fed on demand (as for breastfeeding). Because of the constraints of formula preparation however, it is best to observe a set schedule, as is done in therapeutic feeding centres.

The use of cow's milk

Cow's milk should be boiled in order to destroy potentially pathogenic microbes and improve the digestibility of its protein; boiled water and sugar should then be added in the following proportions:

⇨ 125 ml of boiled milk;
⇨ 75 ml of boiled water;
⇨ 15 g of sugar.

This procedure produces approximately 200 ml of milk preparation, supplying roughly 70 kcal (290 kJ) and 2 g of protein per 100 ml.

The use of dried whole milk

In order to achieve the same concentration as with the previous recipe using cow's milk, whole dried milk should be reconstituted with one weight unit of milk for 11 weight units of water (or one *volume* unit of milk for 5 *volume* units of water). The water should be previously boiled and allowed to cool off completely; sugar should be added. In other words:

⇨ 15 g of milk powder;
⇨ 170 ml of boiled and cooled water;
⇨ 15 g of sugar.

This procedure produces 200 ml of milk, supplying 70 kcal (290 kJ) and 2 g of protein per 100 ml.

The use of dried skimmed milk

Dried skimmed milk should not be used as a substitute for maternal milk; in a crisis however, this option can sometimes not be avoided. In such cases, it should be reconstituted according to the same proportions as for dried whole milk, and sugar and oil must be added as follows:

⇨ 10 g of milk powder;
⇨ 170 ml of boiled and cooled water;
⇨ 15 g of sugar;
⇨ 5 g of oil.

This procedure produces 200 ml of milk, supplying 70 kcal (290 kJ) and 1.8 g of protein per 100 ml.

If dried skimmed milk is used, it must be enriched with vitamins A and D – alternatively, these vitamins must be supplied in the form of tablets.

The use of special maternal milk substitution formulae

Commercially-available substitution formulae must be reconstituted with previously boiled water, in compliance with the manufacturer's instructions, and without further addition.

The three formulae provided above do not contain enough minerals or vitamins to cover neonatal requirements; consequently, it is best to supply fluid pharmaceutical mineral and vitamin supplements intended for this specific use. Unfortunately, it is precisely in crises, when substitution formulae must be improvised, that such supplements are most difficult to find. These three formulae nevertheless ensure infant feeding up to weaning, especially if the latter begins earlier with the use of porridges. The child's growth will probably be somewhat slower; this retardation is however by no means irreversible provided that the weaning diet as from 4 months is adequate, and that the child receives the necessary attention and care.

Formula preparation

Formulae must be prepared with previously boiled water and utensils that have been sterilized in boiling water for 5 to 10 minutes. It may not be possible to sterilize utensils after each meal; in such cases, they must be sterilized at least once or twice daily. If sterilization is impossible altogether, utensils must at the very least be washed in hot water and detergent, and be rinsed in clean drinking water or salted water, and left to dry in the sun if possible. If basic hygiene rules are not strictly observed, the child is highly likely to develop gastro-intestinal infection, especially in hot and humid climates.

Formula administration

In most crisis settings, the use of bottles and teats is highly dangerous, because their proper cleaning and sterilizing is virtually impossible to guarantee. It is therefore best to use spoons, even if this option initially requires patience and time. The use of bottles and teats is strongly advised against here, because children can be spoon-fed from day one, provided that they are gently and patiently coaxed into the method. The use of bottles also suggests that such utensils are necessary, and this can provide a bad example.

Any leftovers must be disposed of or fed to somebody else – they must *never* be kept for the following meal. Leftovers can become a dangerous culture medium within tens of minutes depending on the climate and environmental contamination. Artificially-fed infants must be able to drink water when they are thirsty – this is usually the case in hot climates and in the case of diarrhoea or fever. Sickness should not cause the child to receive less food or fluids.

Medical care

Children that are not breastfed run greater risks of developing infections. Special attention must therefore be devoted to any suspicion of health disorders, especially diarrhoea and loss of appetite. In case of problems, the child must be referred to a healthcare facility immediately.

Mother-to-child HIV infection

In the last thirty years, the promotion of breastfeeding has been viewed as a priority in limiting infant morbidity and mortality. Significant progress has resulted, both in terms of breastfeeding trends and of commercial and humanitarian practice. Today however, the HIV/AIDS pandemic is a serious threat to past efforts and achievements because HIV infection (especially HIV-1) can be transmitted by the mother to her child through her milk. The overall risk of mother-to-child HIV transmission is 15 to 25% in the case of mothers who do not breastfeed, and 25 to 45% in mothers who do.

In populations where breastfeeding prevails, approximately one-third of all infant HIV infection results from breastfeeding. Many aspects of HIV transmission through breastfeeding still require investigation, especially of the actual mechanisms of transmission. The risk of transmission is greater if the mother has only recently been infected or if she is vitamin A deficient, and it increases with the duration of breastfeeding. This information collected by the WHO (WHO, 1998) highlights the following quandary:

> *"When children born to women living with HIV can be ensured uninterrupted access to nutritionally adequate breast-milk substitutes that are safely prepared and fed to them, they are at less risk of illness and death if they are not breastfed. However, when these conditions are not fulfilled, in particular in an environment where infectious diseases and malnutrition are the primary causes of death during infancy, artificial feeding substantially increases children's risk of illness and death."(WHO, 1998).*

Furthermore, it remains unclear to what extent breastfeeding influences HIV development in mothers. The observation that the combination of a good nutritional status and appropriate healthcare substantially limit the progress of the illness is, in a sense, alarming (McAskill, 2000). It indicates that breastfeeding and the resulting drainage of maternal nutritional resources in favour of the child could increase the mother's vulnerability – this would tend to argue in favour of substituting maternal milk with artificial alternatives if feasible.

This poses a serious problem for humanitarian action, which often deals with groups that face increased health problems in all fields, and cannot be treated individually (unless they are gathered in camps). Ultimately, the theoretical answer to mother-to-child HIV transmission through breastfeeding is to supply HIV-positive mothers with appropriate maternal milk substitutes, and the means to prepare them in line with the hygiene standards discussed earlier. The remaining question is then one of feasibility, which is determined by the possibility of:

- ⇨ detecting AIDS cases among pregnant and breastfeeding mothers, without stigmatizing them;
- ⇨ obtaining appropriate maternal milk substitutes;
- ⇨ ensuring the safe preparation and administration of such substitutes in a durable way;
- ⇨ ensuring that other agencies shall indeed follow the cases of these mothers and their children after the completion of the humanitarian operation proper.

The difficulty is recent and many questions remain. As a result, the above option will need to be investigated on a case-by-case basis, according to available resources and contextual constraints. Nevertheless, whether or not HIV-positive mothers can be targeted within humanitarian action (which is transient), it is best to continue to promote breastfeeding. The temporary introduction of infant feeding methods that are not sustainable beyond the timeframe of the humanitarian operation is irresponsible; this option leaves mothers, who are already weakened by the threat posed by the sickness, at a complete loss as to how to feed their child. Besides, the HIV-positive prevalence rate may be high in mothers, for example 30%; considering that 30% of the children of HIV-positive mothers risk infection owing to breastfeeding, then 10 children out of 100 are likely to become HIV-positive as a result of breastfeeding – this is low in comparison with the mortality risks associated with maternal milk substitutes. For the time being, until research and practice have produced better tools for analysis and action, it is therefore best to promote breastfeeding and adapt to circumstances. This confusion reveals the present uncertainty surrounding the question. As such, this major challenge is not limited to the WHO and scientific research, it extends to humanitarian agencies and their networks as front-line actors in the field.

5.2.2 Weaning

In relation to food consumption, Chapter VI discusses weaning as the crucial stage in the survival and development of infants. Poor practice during this phase can have disastrous consequences.

Poor practice

The mortality associated with weaning can be very high, owing to the following factors:

- ⇨ local habits can involve abrupt weaning that causes emotional shock in the child, and serious health risks if its food is inadequate and contaminated by infectious agents;
- ⇨ varied and high-energy density foods are not always available or affordable;
- ⇨ knowledge of good practice is lacking;
- ⇨ hygiene is often sub-optimal, and it may be difficult to improve owing to lack of means and/or ignorance;
- ⇨ healthcare services are insufficient or inaccessible (distance, limited resources);
- ⇨ the care given by the mother to her child may be inadequate – time constraints and the lack of means are usually more to blame than ignorance.

All these reasons promote the development of infection, malnutrition, and their combination; in economic crisis and famine, these factors deteriorate.

Nutritional information intended to improve weaning practices relates to the following:

- ⇨ the duration and role of breastfeeding during the weaning process;
- ⇨ weaning foods;
- ⇨ the administration of meals;
- ⇨ the observance of food hygiene rules;[11]
- ⇨ the quality of attention (watchfulness as to health problems).

Most of the following considerations are inspired by Cameron and Hofvander (Cameron & Hofvander, 1983).

The transition between breastfeeding and weaning

In smooth breastfeeding conditions, the weaning process should begin at 4 months at the earliest, 6 months at the latest. Some societies begin it during the second month already. Moreover, occupational constraints and changing living conditions can cause mothers to adopt weaning practices that are not cultural but rather result from forced adaptation to new parameters. This subject must be understood properly before advising mothers.

Breastfeeding should be replaced as gently and gradually as possible. Weaning foods initially consist of milk complements, before the latter are replaced with complements to weaning foods that should increasingly match the adult diet. In these conditions, maternal milk continues to protect the child against infection, while remaining a major source of essential nutrients. Moreover, the

[11] See Section 5.1 in this Chapter.

extension of breastfeeding also prolongs the privileged bond that it creates between mother and child. Breastfeeding up to 12 months is a minimum, and 18 months is preferable. Clearly, the birth of a sibling meanwhile will put a natural end to the process.

Weaning foods

Introducing weaning foods

Semi-solid foods are introduced first in the form of porridges or stews that are easy to chew and swallow; they are administered in small portions initially, in order for breastfeeding to predominate. It is best to supply them after breastfeeding, beginning with a single type of food and waiting for a few days for the child to grow used to it before introducing another flavour. The first food can be cereal porridge, mashed boiled tubers, or fruit stew (ripe banana is a good option). Initially, the equivalent of 2 teaspoonfuls is enough, fed in small amounts – it should always be fed with a spoon, and not by hand. The exercise requires patience, and the child must be allowed to taste, test, enjoy, and spit without haste. In other words, it must be allowed to grow accustomed to new sensations. After some time, the child realizes that these new foods satiate its appetite, and accepts them without difficulty.[12] Assuming that weaning begins at 4 months (6 months at the latest), meals that complete breastfeeding should increase from one to three or four daily within the following two months – at this stage, maternal milk is no longer sufficient.

The energy density of weaning foods

The energy density of weaning foods is of little importance early in the process; this importance however increases as the child grows and breastfeeding diminishes. This progression results from the substantial energy requirements per kilogram in infants, considering that their stomach is small and that they can only be fed small amounts at a time (150 ml between 6 and 12 months old, and 200 to 300 ml between 2 and 3 years). The energy density of weaning foods must therefore be sufficient, and this is usually only achieved by adding fats; fats must nevertheless not account for more than 30% of the energy intake. Fats also make porridges smoother, which consequently do not require the addition of water as they cool off and congeal.

For example, a 12-month child weighing 10 kg, whose energy requirement is approximately 1,000 kcal (4,180 kJ), one-quarter of which is supplied by maternal milk, will need the rest to be supplied in the form of 220 g of a cereal-legume blend if no oil is added; this represents a cooked food volume of roughly 800 ml, to be fed in five meals at least. The addition of oil up to 30% of the energy intake that completes breastfeeding reduces this volume to approximately 550 ml – this amount can be ingested easily in four meals. In the case of potato-legume blends, in which the potato content accounts for 75% of the calorie intake, the total volume is 1.2 litres, which should consequently be spread over eight meals. The substitution of part of the potato content with oil up to 30% of the calorie intake that completes breastfeeding reduces the total volume to approximately 800 ml, which can be fed in five meals. The energy density and the frequency of meals can therefore be adjusted to feed infants. However, the administration of four to five meals of approximately 150 ml each is time-consuming for the mother: at least one hour is needed to feed the child, plus the time necessary for preparation and breastfeeding (she must also interrupt her other tasks to do so). This example illustrates the need to add fats to weaning foods, and the advantage of cereals over tubers as basic foods.

[12] Difficulties arise at a later stage, when the child begins to try everything; education should only begin then.

Variety

As breastfeeding diminishes, the child needs more varied foods in order to satisfy its nutritional requirements.

The principle is rather simple: breastfeeding should be complemented with four types of foods, as follows.

1. One basic food, preferably a cereal.
2. One protein food (legumes or animal products) that also supplies vitamins and minerals. Legumes are not easily digested (especially by infants) and cause flatulence. They should therefore be soaked, shelled, and fully cooked until they grow soft. Initially, it is best for the protein content to be made up of half legumes and half animal products.
3. One energy complement, preferably fats rather than sugar.
4. One fruit and vegetable complement that supplies the lacking minerals and vitamins (especially vitamins A and C) in order to avoid potentially very serious deficiencies.

The basic food should account for roughly 50 to 60% of the energy intake if it is in the form of a cereal or potato; the protein complement then accounts for 10 to 20% of the energy intake, and the energy complement 30%. The fruit and vegetable content should be approximately 40 g per meal. If the basic food is cassava, it should account for no more than 40% of the energy intake, implying that the protein complement supplies approximately 30%. The drawback of cassava is its low protein content. As an illustration, a 1-year-old child, three-quarters of whose protein requirements are to be met in the form of boiled cassava (the remainder being covered by breastfeeding), must consume 1.2 kg of this cassava and this is nearly impossible. On the other hand, if the protein complement accounts for 30% of the energy intake with a P/E ratio of 25%, then protein requirements are satisfied, and only 200 g of cassava need be ingested. In developing famine unfortunately, cassava is usually the last remaining foodstuff; it is then impossible to complement it properly with protein complements, and kwashiorkor (in this case dietetic kwashiorkor) can reach epidemic proportions as seen in Angola, Mozambique, and Uganda.

Foodstuffs belonging to the above four categories can be found everywhere. As a result, they should be identified in each context, and their utilization and relative proportions should be explained accordingly.

Meals

A 6-month-old infant should be fed 4 to 6 times daily, in addition to breastfeeding. Early in the weaning process, meals should follow breastfeeding and not precede it, in order to encourage the infant to suckle vigorously and thus continue to stimulate the secretion of milk. Between 2 and 3 years, meals can be reduced to 3 per day, provided that 25 to 30% of the energy intake is in the form of fats. Failing that, the number of daily meals should be 4 to 6. The best way of adapting intake is to adjust it to appetite, in the absence of sickness. It is unrealistic to claim to satisfy recommended intakes, and to expect a given population to understand what this means. It is difficult for laymen to apply recommended intakes in practice. On the other hand, children who are breastfed and weaned with traditional foods as described above regulate their diet according to their actual requirements – they stop when they are satiated, and protest if they are still hungry, providing an unambiguous indicator. Provided that the above principles are observed, and that the child is growing, is active during waking hours, sleeps well and is generally healthy, there is no cause for dietary concerns.

Early in the weaning process, infant foods must be prepared specially, but the cooked foods consumed by the rest of the family may be equally appropriate provided that they are not excessively salted or spiced. As from 9 months, children should begin to eat the same foods as adults. As long as they are reasonably balanced, most adult foods are appropriate for weaning, and may simply be crushed in a sieve in order to produce a smooth semi-solid porridge. At around 2 years old, the child should be able to eat most adult foods. As mentioned earlier, infants may be spoon-fed practically as of birth. The use of cups and mugs is more complicated, and should not begin before 5 months. At the age of 2, children eat approximately half of what adults do. Their dishes may therefore be easily prepared by halving a standard adult ration and allowing the child to eat at its own speed. It is worth noting that 2-year-olds can easily be taught to use a spoon.

Food hygiene

The strict observance of basic hygiene rules is essential for infant health during the weaning process, when breastfeeding provides less and less protection against environmental pathogens – this moment unfortunately coincides with a substantial increase in the exposure to such germs.

The following is a brief reminder of hygiene rules that are specific to the weaning process:

- ⇨ only impeccable, washed, and freshly prepared foodstuffs should be used, and they should be peeled if necessary;
- ⇨ the persons who prepare the food and feed the child must wash their hands first – the infant's hands should also be washed as it is likely to handle the food and touch its mouth;
- ⇨ utensils must be scrubbed to remove all traces of food that may cause contamination; they must then be washed in detergent and preferably boiled and left to dry (in the sun) and remain covered when not in use;
- ⇨ food must also be covered in order to protect it against flies and soil;
- ⇨ porridge should be boiled for at least 5 minutes in order to kill microbes, whereas mashed tubers must be prepared immediately after boiling;
- ⇨ prepared weaning foods should not be kept for more than one hour, unless they are refrigerated below 4°C.

Quality attention and healthcare

During the weaning process, infants need much attention and require appropriate care quickly if infections appear. Furthermore, they should be regularly treated for parasites and vaccinated against infant diseases; these especially include measles and whooping cough, but also other dangerous infections such as poliomyelitis, diphtheria, and tetanus. Attention and healthcare are the two complements of feeding. Children suffering from infection must continue to be fed and hydrated, even and above all if their condition involves vomiting or diarrhoea. The child must be given the means to fight infection with the food it consumes regularly rather than with its reserves. Unfortunately, children suffering from infection are anorexic.[13]

[13] See Chapter VIII.

The following principles should be observed:

⇨ breastfeeding should continue at all costs, as it provides the best feeding in such circumstances;
⇨ fluids should be provided without restriction in order to quench thirst: maternal milk, boiled water, or oral rehydration salts in case of diarrhoea;
⇨ the food should be easily chewed and swallowed, preferably appetizing, and be supplied in small amounts;
⇨ in case of severe infection, foods should be enriched in vitamin A or provitamin A, and a single dose of 200,000 IU of vitamin A should be administered if possible;
⇨ during convalescence, it is especially important for the child to be fed according to these principles, and that its appetite be satiated in order to facilitate its recovery.

In addition to the above domestic care, any deterioration should be referred to healthcare services; such complications include persistent fever and diarrhoea, vomiting, refusal to eat, and signs of dehydration or malnutrition. Such symptoms usually appear late in the process, and are not easily recognized. On the other hand, persistent fever, diarrhoea, and lack of appetite can be detected by laymen, and should prompt the referral of the child to competent health staff.

5.2.3 Feeding children up to 6 years old

There is no nutritional information that is specific to the age bracket between 2 and 6 years. However, from the completion of weaning up until 5 to 6 years, children remain particularly vulnerable to infectious disease such as infant sicknesses, microbial and viral intestinal infections, respiratory infections and parasite infections. As their independence grows, they also receive less continuous attention, and their exposure to infection rises. The birth of a sibling also causes them to lose priority. These factors all increase vulnerability. Children in this age bracket consequently deserve extra watchfulness, in terms of diet, hygiene, and the necessary care (domestic or qualified) if sickness develops. Feeding must follow the same principles as those provided earlier in relation to the weaning process, and the following diets.

5.3 *DIETS*

Human diets vary substantially, and are determined mainly by the following:

⇨ what the natural environment produces;
⇨ culture, according to:
  → the degree of economic development;
  → eating habits, which determine overall preferences, tastes, beliefs, and taboos;
⇨ individual households, according to:
  → food access possibilities;
  → personal preferences.

In nutritional crises, most food consumption problems result primarily from an inadequate access to food; this type of problem cannot be resolved through nutritional information, but rather through the provision of adequate resources. Nevertheless, poor practices that concern the population as a whole can occur, and their consequences can be highly dangerous. They arise from the predominance of a given staple food, which causes imbalance, and the insufficient consumption of fruits and vegetables. Since the excess disorders that are specific to the industrialized West in times of peace are highly uncommon in such circumstances, this Manual does not discuss obesity, coronary cardiopathy, cerebral vascular disease, and dietary cancers.

This discussion is limited to the basic principles that should guide feeding, and which moreover apply in all circumstances; these should be applied by humanitarian agencies as much as possible. These principles can provide the material for nutritional information; they consist in observing recommended intakes and ensuring nutrient balance and food group balance. The following recommendations should be applied durably in order to avoid ultimately harmful consequences on health. Imbalance or excess, or temporary and exceptional shortage, usually has no significant impact.

5.3.1 Nutrient balance

The balance between different nutrients is determined mainly by recommended intakes. However, energy may equally be supplied in the form of lipids or glucides (simple or complex, see below) as in the form of protein. In order to limit statistical health risks,[14] the necessary balance between macronutrients in order to satisfy energy requirements are summarized below.

The contribution of lipids to the overall energy intake

Lipids should account for 15 to 30% of the overall energy intake (WHO, 2003).

The contribution of saturated and unsaturated lipid to the overall energy intake

The proportion of lipids within the overall energy supply (i.e. 30%) should combine 20% unsaturated lipids – of which 2.5% essential lipids – and no more than 10% saturated lipids (WHO, 2003; European Commission, 1993).

The contribution of protein to the overall energy intake

The energy value of protein is 4 kcal (16.7 kJ)/g. Protein should account for 12 to 13% of the overall energy intake (WHO, 1988b). In actual fact, protein should account for at least 10% and at most 15% of the overall energy intake (WHO, 2003); this 10-15% bracket is not an objective: it provides a tolerance range.

The contribution of simple glucides to the overall energy intake

Simple glucides are products that are used to sweeten foodstuffs, such as cane or beetroot sugar, as opposed to complex glucides, mainly the starch chains (long glucose molecule chains) that form most of the tubers, and cereal and legume seeds. Simple glucides should account for no more than 10% of the overall energy intake (WHO, 1988b).

The contribution of complex glucides to the overall energy intake

Subtracting the lipid and protein contribution from the overall energy intake indicates that complex glucides should account for between 55 and 75% of the overall energy intake. This recommendation does not allow for the possible intake of alcohol and simple glucides, whose harmful effects on health require no further demonstration.

[14] Statistical health statistics risks are those revealed by epidemiological surveys and are expressed in the form of mortality or morbidity rates over the duration of the survey. They do not concern individuals, but instead the proportion of individuals at risk of sickness or death.

Fibre

The dietary contribution of fibre cannot be deduced from the overall energy intake because fibre does not contribute to the coverage of the nutritional need. Fibre is nevertheless important, because it promotes digestion, helps to eliminate cholesterol, and contributes to the prevention of intestinal disorders. It is found in vegetables, fruits, cereals, and legumes; the recommended intake is approximately 20 g of fibre per person, per day (WHO, 2003). The fibre content of foods is difficult to establish, because fibre includes both cellulose and the parts of starch chains that cannot be degraded by digestive enzymes. Nevertheless, animal products contain no fibre, underscoring the importance of plant products in diet.

5.3.2 Food group balance

Chapter V discusses the different food groups consumed by man; as a general rule, diets should comprise five types of food.

1. One basic food (or "staple food", cereal or tuber). In crises, this type must be consumed in sufficient amounts in order to avoid the development of severe malnutrition.
2. One protein food (legumes, oilseeds, meat, fish, dairy products, eggs). This type also prevents the development of severe malnutrition and of specific deficiencies, notably pellagra and beriberi.
3. One energy complement (vegetable oil or animal fat,[15] oilseeds, sugar). This type is especially important in avoiding the development of severe malnutrition in infants.
4. One vitamin and mineral complement (fresh fruits and vegetables). This type limits the development of specific deficiencies, particularly vitamin A and C deficiency.
5. One flavour-enhancing ingredient (garlic, onion, herbs, spices and seasoning, including salt). This type enhances usually monotonous diets, stimulates appetite, and thus helps limit the risk of malnutrition substantially.

These are the basic principles, but many variations are possible and they are not necessarily harmful, as seen in some stock-breeding communities or among hunters and gatherers. This again underscores the importance of gathering information as to eating habits, their origin, duration, transformations, and deviations from the standard, and the reasons for such change. In crises especially, normal conditions must be determined and be compared with observations at the time of the survey, and the reasons for differences must be understood.

The best balance between food groups may be defined from the necessary balance between macro-nutrients. Moreover, food groups can combine in many different ways depending on local habits. The following indications provide a yardstick, with a view to ensuring an adequate intake for the most vulnerable. Table 15.1 below indicates the role of different foods in different countries.

Staple foods

Several possibilities exist: the staple food is cereals or tubers (or a combination of the two), or a combination of foodstuffs pertaining to different food groups. It is important for the cases where the staple food is mainly cereals or tubers to be discussed here, as it must in such cases be complemented with an adequate protein supplement. In the case of cereal as discussed in Chapter V, it must be

[15] Vegetable oil is preferred to animal fat, which increases the risk of cardiac coronary and cerebral vascular disease.

complemented with at least 60 g of legumes; this amount applies to all age groups and supplies approximately 200 kcal (840 kJ) and 14 g of protein. Considering that the energy complement must supply between 15 and 30% of the overall energy intake in some form, then the cereal content must account for 75 to 60% of the overall energy intake in a 2,400 kcal (10,000 kJ) ration – this amounts to roughly the daily ration of an adult man with light physical activity. In this ration, the protein complement balances the amino-acid intake, which is especially important in small children.

If tubers account for most of the staple food, protein complement in the form of legumes should exceed 60 g in the case of cassava, plantain, or sago: if the staple food (for example cassava) accounts for approximately 70% of the overall energy content of a 2,400 kcal (10,000 kJ) ration, the rest being supplied by the energy and protein complements, then the protein intake is 7 g of protein approximately. In that case, at least 38 g of protein are lacking in order to match recommended intakes, without even considering digestibility and the biological utilization of protein. In that case, the protein complement supplies the lacking protein – it is no longer then a matter of balancing the amino-acid intake, but in fact the basic protein intake. In view of the respective contributions of the legume, tuber, and lipid contents to satisfying the protein and energy requirements, close to 200 g of legumes must be supplied in order to meet the protein requirement. The energy supplied by the staple food then accounts for 57 to 42% of the ration if the energy complement provides between 15 and 30%.

It is worth noting that low-extraction cereal flour and polished, non-steamed rice lack vitamins and minerals, and must be complemented accordingly, which can be done with legumes.[16] In terms of nutritional information, target groups must be made aware of the dangers of overly refined cereals, in addition to supplying them with complements to compensate the losses resulting from refining.

Protein

The protein complement in the form of legumes should be approximately 60 to 200 g (200 to 680 kcal (840 to 2 840 kJ)), according to whether the staple is in the form of cereal or a protein-poor tuber. It may be supplied by way of other protein-rich foodstuffs – what then matters is to ensure the protein equivalent of what the legumes supply, that is, approximately 15 g of protein if the latter complement cereals, or 45 g if they complement the abovementioned tubers. In both cases, correction factors must be applied that allow for the digestibility and biological utilization of protein.

The following recommendations are a practical alternative to strict calculations in the case of protein complements other than legumes, and the results nevertheless lie within dietetically-safe brackets.

- ⇨ **Fresh peanuts**: 100 g to complement cereals, or 350 g to complement tubers. If they complement tubers, peanuts become the staple food by supplying the greatest proportion of energy; their cost and availability however may restrict their appropriateness in some circumstances.
- ⇨ **Dried peanuts**: 60 g to complement cereals, or 200 g to complement tubers. Like fresh peanuts, they become the staple food in the case of tubers.
- ⇨ **Nuts**: 100 g to complement cereals. They are not useful to complement tubers, as this would involve consuming 350 g of nuts, which would amount to 90% of the overall energy content of the ration; in that case, the tubers would become the energy complement to the nuts. This is however sometimes the case, for example in southern Africa, where the mongongo nut is sometimes the staple food.

[16] See Chapter V.

- ⇨ **Oilseeds**: 60 g to complement cereals, or 200 g to complement tubers. Here also, the oilseed contribution to the overall energy intake is equal to or greater than that of the tubers, which may be unrealistic in some circumstances owing to the cost and availability of oilseeds.
- ⇨ **Fish**: 60 g to complement cereals, or 200 g to complement tubers.
- ⇨ **Meat**: 60 g to complement cereals, or 200 g to complement tubers.
- ⇨ **Fresh cow's milk**: 400 ml to complement cereals, or 1 litre to complement tubers;
- ⇨ **Eggs**: 100 g (approximately 2 eggs) to complement cereals, or 300 g (approximately 6 eggs) to complement tubers – the latter is unrealistic.

It is clearly best to combine different protein complements in order to enhance ration diversity and flavour. Given the constraints usually faced in the field however, it is most practical to resort to legumes mainly, complemented by animal products.

Finally, it is worth noting that protein complements are also important vitamin and mineral complements, especially if the staple food is high-extraction cereal flour or polished, non-steamed rice.

Energy

The energy complement should account for 15 to 30% of the overall energy intake; in terms of a 2,400 kcal (10,000 kJ) ration, this converts roughly into the following:

- ⇨ 40 to 80 g of oil;
- ⇨ 50 to 100 g of butter;
- ⇨ 60 g of sugar with 15 to 55 g of oil;
- ⇨ 65 to 130 g of dried peanuts;
- ⇨ 60 to 120 g of nuts;
- ⇨ 70 to 140 g of oilseeds.

In dietary terms, the population of wealthy countries whose physical activity is light should observe the lower values provided above for oil, butter, and sugar, and adjust its energy intake with its staple food.

Vitamins and minerals (fruit and vegetables)

The minimum daily intake recommended by the WHO is 340 g. This amount however far exceeds that consumed in many settings, especially in the industrialized West. On the other hand, it takes into account epidemiological data related to cancer risks and the continuous problems arising from vitamin A and iron deficiencies, which may be resolved by consuming foodstuffs that are rich in carotene and ascorbic acid (WHO, 2003).

Flavour

In this framework, salt deserves to be quantified; the WHO sets the upper limit for consumption at 6 g per day (WHO, 2003).

Special cases

Sugar and alcohol are popular foodstuffs that are both equally harmful if overindulged.

Sugar

As mentioned earlier, sugar should not account for more than 10% of the overall energy intake (WHO, 2003; WHO, 1988b).

Alcohol

Rather than ignoring alcohol deliberately because of its harmfulness in many respects, and in view of its widespread consumption in the world, this Manual prefers to set the upper limit for its consumption, which is identical to that for sugar. Alcohol should not account for more than 10% (ideally less, even not at all) of the average required overall energy intake of nutritionally healthy adults. With respect to an overall energy requirement of 2,400 kcal (10,000 kJ), being that of a lightly active adult male weighing 60 kg, this upper limit amounts to 240 kcal; this amount converts daily into 3 dl of wine, 7 dl of light beer (5% alcohol/volume), or 0.8 dl of liquor (40% alcohol/volume).

Application

The above principles provide a general framework for a dietetic approach to diets. Table 15.1 below illustrates their practical application, by suggesting family diets built upon the eating habits of different regions; it is adapted from Latham (Latham, 1997).

Table 15.1 Examples of diets

Region	Rural Mozambique	Philippines	Uganda	Mexico	Masai Country	Santiago de Chile	India
Foodstuffs:							
Staple	Millet 400 g Cassava 200 g	Rice 500 g	Plantain 1 kg Sweet potato 200 g	Maize tortilla 500 g	Milk 2 l	Bread 400 g Rice 100 g	Rice 500 g
Protein complement	Curdled milk 150 ml Peanuts 50 g	Fish 100 g Beans 150 g	Meat 50 g Beans 150 g	Meat 50 g Beans 150 g	Blood 100 ml	Eggs 30 g Meat 100 g Milk 60 ml	Fish 100 g Lentils 150 g
Energy complement	Bambara nut[a] 75 g	Oil 15 g	Oil 15 g	Oil 15 g	Maize 150 g Banana[b] 200g	Butter 25 g Sugar 30 g	Oil 20 g Peanuts 75 g
Vitamin and mineral complement	Tomato 100 g Cassava leaves 100 g Baobab fruit 30 g	Green vegetables 100 g Fruit 100 g Coconut 50 g	Sweet potato leaves 150 g Tomato 50 g	Tomato 100 g Oranges 100 g Onion 50 g	Leaves 100 g Other fruit 100 g	Carrot 100 g Green leaves 50 g Banana 100 g	Pawpaw 150 g Vegetables 200 g
Flavour	Salt 10 g	Salt 15 g	Salt 10 g	Salt 10 g	Salt 15 g	Salt 10 g	Salt 10 g

[a] Bambara nut is also a protein complement.
[b] Banana is also a vitamin and mineral complement.

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Table 15.2 below indicates the contribution of the different foodstuffs included in Table 15.1 above to the food types that diets should contain (with the exception of flavour-enhancing ingredients).

Table 15.2 Analysis of Table 15.1 diets according to the types of food that diets should contain

Region	Rural Mozambique	Philippines	Uganda	Mexico	Masai Country	Santiago de Chile	India
Foodstuffs:							
Staple (kcal) ((kJ)) % of the overall energy intake	1,700 (7,100) 75%	1,750 (7,310) 71.4%	1,420 (5,940) 65.7%	1,800 (7,520) 75.9%	1,360 (5,680) 63.2%	1,350 (5,640) 69.2%	1,750 (7,315) 62.5%
Protein complement (g)	12.6	52	43	32	18	24	52
Energy complement (% of the overall energy intake)	12[a]	5.5	6.2	5.7	32[b]	15.7	15.8
Vitamin complement[c] (g)	230	250	200	250	200	250	350
Overall energy intake (kcal) ((kJ))	2,300 (9,610)	2,450 (10,240)	2,160 (9,050)	2,370 (9,920)	2,150 (8,990)	1,950 (8,150)	2,800 (11,700)

[a] Bambara nut is also a protein complement.
[b] Maize is also a protein complement.
[c] The vitamin complement is not allowed for in the overall energy intake; it would increase it by approximately 5%.

ANNEXES

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ANNEX 1
ENERGY COST OF SPECIFIC OCCUPATIONS: EXAMPLES

The cost is expressed as a multiple of the basal metabolism (BM). Adapted from WHO (WHO, 1985).

Table A.1 Energy cost of male occupations

Light activity: 1 – 2.5 × BM	**Moderate activity:** 2.6 – 4 × BM
Sleep: **1.0**	Sweeping: **2.7**
Seated clerical work: **1.3**	Industrial machine work: **3.1**
Calm standing position: **1.4**	Walking: **3.2**
Kneeling position (e.g. sorting): **1.6**	Bamboo cutting: **3.2**
Domestic kitchen chores: **1. 8**	Masonry work: **3.3**
Printing work**: 2.0**	Hunting: **3.5**
Seated weaving work: **2.1**	Harvesting sweet potato: **3.5**
Tractor driving: **2.1**	Walking with a 10-kg load: **3.5**
Line fishing: **2.1**	Motor engine maintenance: **3.6**
Playing cards: **2.2**	Golf, sailing: **2.2 – 4.4**

Moderate/heavy activity: 4.1 – 5.5 × BM	**Heavy activity**: > 5.5 × BM
Cutting firewood: **4.1**	Normal climbing and jungle walking: **5.7**
Easy climbing**: 4.7**	Shovelling: **5.7**
Machette grass-cutting: **4.7**	Pickaxe mining work: **6.0**
Driving a cart: **4.8**	Digging holes: **6. 2**
Weeding and hoeing: **2.5 – 5.0**	Football, athletics, jogging, rowing: **6.6+**
Repairing a fence: **5.0**	Normal climbing with a 10-kg load: **6.7**
Excavation: **5.2**	Farm work using a fork: **6.8**
Pulling an empty trolley: **5.3**	Loading sacks onto a truck: **7.4**
Clearing land (depending on the terrain): **2.9-7.9**	Felling trees with an axe and manual sawing: **7.5**
Dancing, swimming, tennis : **4.4 – 6.6**	Pedalling a cycle taxi with one passenger: **8.5**

For equal work, the energy cost of the various occupations is roughly the same for women and men. However, the following provides data for occupations that have been especially studied in women.

– Seated occupations (e.g. braiding, making mats):	1.5
– Normal climbing:	4.6
– Climbing with a load:	6.0
– Domestic sweeping and laundering:	3.0
– Shelling/peeling:	1.5
– Stirring porridge:	3.7
– Milling cereals:	3.8
– Pounding:	4.6
– Laundering:	3.4
– Weeding:	2.9
– Hoeing:	4.4
– Using a spade:	4.8
– Sowing:	4.0
– Threshing grain:	5.0
– Planting sweet potato:	3.9
– Harvesting sweet potato:	3.1
– Clearing brushwood:	3.8
– Cutting grass with a machette:	5.0

ANNEX 2
FOOD GROUPS CONTAINING THE FOUR MAJOR VITAMINS

Values indicated below refer to raw foods (cooking can result in substantial vitamin loss). This information is drawn from the food composition tables developed by Randoin and his team (Randoin *et al*, 1982), and Platt (Platt, 1962).

Table A.2 Vitamin content

Vitamin C mg/100 g PRI[a]: 45 mg	**Thiamine (B1)** mg/100 g PRI: 0.4 mg/1,000 kcal	**Niacin** mg/100 g PRI: 6.7 mg/1,000 kcal	**Vitamin A** mg/100 g and (IU) PRI: 0.7 mg (2,330)
200 – 101 Cabbage, guava, parsley, chilli pepper.	> 1 – 0.6 Dried peanuts, black-eyed peas, dried peas, soybeans, cashew nuts, sesame and sunflower seeds, lean pork.	20 – 11 Dried peanuts (17), dried larvae.	15 – 2 (50,000 – 6,700) Poultry and livestock liver, palm oil.
100 – 50 Lemon, papaya, strawberries, broccoli, cauliflower, dark green leaves (e.g. spinach).	0.5 – 0.3 Wholemeal flour (wheat, maize, barley, sorghum, *teff*), oats, millet, fresh and dried green beans, lentils, fresh peanuts, chickpeas, hazelnuts, walnuts, chicken eggs, oranges, peas, pork.	10 – 4 Wholemeal flour (wheat, barley), fresh peanuts, sesame and sunflower seeds, fish, meat, mushrooms.	1 – 0.3 (3,300 – 1,000) Butter, cheese, eggs, oily fish, broccoli, cabbage, carrot, dark green leaves (e.g. spinach), red chilli, green pulses, apricot, mango, papaya, pineapple.
40 – 20 Eggplant, cauliflower, white cabbage, pineapple, tangerine, orange, grapefruit, mango, leek, potato, radish, tomato, green legumes, sprouted legumes, liver.	0.2 – 0.1 Banana, carrot, cabbage, green vegetables, white flour, wholemeal bread, pasta, potato, sweet potato, taro, fish, meat, mushrooms.	3 – 1 Dried and green legumes, barley, wholemeal corn flour, millet, sorghum, rice, *teff*, fresh cassava, potato, taro, broccoli, dark green leaves (e.g. spinach), leek, parsley, dried dates, guava.	0.1 – 0.001 (333 – 3) Milk, lean fish, meat, poultry, banana, guava, sweet potato, lentils, peas, sprouted legumes, lettuce, tomato.
15 – 5 Apricot, banana, cherries, peaches, pears, apples, pumpkin, leek, lettuce, onion, fresh peanuts.	0.09 – 0.02 Cheese, milk, fresh fruit, lettuce, white bread, white rice, cassava (fresh and flour), plantain.		

[a] PRI : Population Reference Intake.

ANNEX 3
THE USE OF ARTIFICIAL MILKS IN RELIEF ACTIONS

This paper is an annex to the International Red Cross and Red Crescent Movement's policy on nutrition.

1. Introduction
2. Policy
3. The value of milk
4. Problems associated with using artificial milk in relief actions
5. Mixed diet
6. The safe usage of artificial milk in relief actions
7. Conclusions

1. INTRODUCTION

In times of disaster, artificial milks[1] are frequently requested or donated for distribution to the victims. This almost inevitable response has arisen because such products have become readily available in recent years and because there is a widespread belief in the particular properties of milk as a food.

2. POLICY

Because there have been problems associated with the indiscriminate distribution of milk, the International Red Cross has found it necessary to draw up the following policy for its distribution in relief actions.

2.1 In relief actions the International Red Cross will only distribute artificial milks to those populations who traditionally use milk in their diets and only then under strictly controlled and hygienic conditions.

2.2 The International Red Cross will not use artificial milk as an item for general distribution (dry rations) nor as a "take-away supplement".

2.3 Donations of artificial milks for Red Cross relief actions should only be made following a specific appeal for the same through the International Red Cross.

2.4 The International Red Cross will not use unsolicited donations of artificial milk if it is not satisfied that it can be used according to 2.1. Donors will be advised that they should withdraw their donation or that it will be safely disposed of.

[1] For the purpose of this paper "artificial milks" refer to any non-fresh milk such as powdered (including infant formula), evaporated, condensed or otherwise modified milk.

2.5 The International Red Cross will not supply or distribute dried skimmed milk unless this has been fortified with Vitamin A.

2.6 The International Red Cross will not supply or distribute artificial milks packaged in liquid or semi-liquid form.

3. THE VALUE OF MILK

Milk is a versatile food. It is a rich source of essential proteins. Being liquid it can be consumed by the very young, the very weak and the sick. It can be eaten soured, as cream, as yoghurt, as cheese or as an ingredient with other foods.

3.1 Human breast milk is the perfect balanced food for the human baby. Breast milk alone will provide all the nutrients a baby needs for at least the first 4 months of life. If breast milk is not available for the small baby, alternative milks (most commonly cow's milk) can be used to feed the child during this critical time.

3.2 With the introduction of a mixed diet and the development of teeth, the importance of milk declines steadily. Milk is rarely a major part of the adult diet except in pastoral populations who move with and largely live off their animals.

3.3 Table 1 shows the food values of human milk compared to cow's milk.

Table A.3.1[2] Food values of human milk compared to cow's milk

Type of milk	Water (ml)	Energy (kcal)	Protein (g)	Fat (g)	Vitamin A (i.u.)	Vitamin C (mg)
Human	87	75	1.3	4.6	160	4.0
Cow	88	64	3.3	3.6	150	1.0

Table 2 shows the food values of milk *before dilution*. Dried whole milk (DWM) which retains its full cream content, if properly reconstituted will provide values much the same as for fresh cow's milk. Dried skimmed milk (DSM) will have a very low energy value (between 30–40 kcal per 100 ml of liquid milk after reconstitution). Skimmed milk will also have had the fat soluble vitamins removed (most important being Vitamin A).

Table A.3.2[3] Food values of milk before dilution

Type of milk	Water (ml)	Energy (kcal)	Protein (g)	Fat (g)	Vitamin A (i.u.)	Vitamin C (mg)
DWM	4	500	25.5	27.5	1,200	13.0
DSM	4	357	36.0	1.0	40	17.0

[2] Values for 100g of edible portion taken from MRC Special Report Series No. 302.
[3] Values for 100g of edible portion taken from MRC Special Report Series No. 302.

4. PROBLEMS ASSOCIATED WITH USING ARTIFICIAL MILK IN RELIEF ACTIONS

4.1. General: the indiscriminate distribution of artificial milk in relief actions instils or perpetuates the belief that milk is an essential food and threatens to change long established food habits and to create unnecessary economic pressures.

4.2. Management of supplies: as with any other food with high water content, liquid or semi-liquid milks should not be transported or distributed since the high costs involved cannot be justified. (See also 4.3.1).

Powdered milk in air-tight sacks or sealed tins should have a shelf-life of at least one year except for dried skimmed milk fortified with Vitamin A when the shelf life is *six* months. This requires careful supervision of supplies. Damaged sacks or tins should not be salvaged. *Contaminated milk must not be used for human consumption.*

4.3. Health: the health hazards associated with indiscriminate distribution of artificial milks in relief actions are undocumented, but have been recognized if not recorded by relief workers for many years. Even those familiar with using artificial milks in normal times will face many problems in their proper preparation in disaster conditions.

4.3.1 Contamination

There is always a risk in times of disaster that the water supply will be inadequate and/or impure. Insufficient water can mean that containers and utensils used for mixing the milk are dirty and the milk will quickly become contaminated. Milk powder which is reconstituted with impure water will create the perfect medium for proliferation of harmful organisms. If drunk immediately after mixing, the milk is probably no more dangerous than the contaminated water, but if left for even a short time (1 hour) at "room" temperature, the bacteria multiply dramatically and, if consumed, can cause serious diarrhoea.

Since disaster victims will almost certainly not have access to refrigeration and, since they will be loath to dispose of a half-consumed tin of evaporated or condensed milk or the remains of an undrunk cup of reconstituted milk powder, these are likely to become real health hazards.

4.3.2 Dilution

Children whose main source of food is over-diluted milk powder will inevitably become malnourished. Children who are constantly fed under-diluted milk powder can become dangerously ill as a result of the high concentration of salt.

When powdered milks are distributed from large sacks it is unlikely that the recipients receive proper guidance on dilution. Such instructions are not even always written on the sacks.

Instructions, written on tins of milk powder are often in an unknown language or otherwise unintelligible. Different brands/types of milk powder require different dilutions of water to one part of powder by volume. Instructions (if any) given to the recipients are unlikely to be changed with different consignments of milk powder.

4.3.3 Lactose intolerance

If milk is given to people who are not used to consuming it, it is likely to cause abdominal discomfort and to provoke severe diarrhoea. This is due to the absence of the enzyme lactose which is needed to absorb the milk sugar lactose}. Most young children, because they drink milk still have this enzyme in their intestines, however, once they stop taking milk the enzyme ceases to be produced and this can cause problems for some older children and adults.

4.3.4 Infant feeding

Unlike the above, the hazards associated with using artificial milks for infant feeding are widely known and very well documented. It is not unreasonable to assume that these hazards are greatly magnified in times of disaster.

Artificial milk distributed indiscriminately to disaster victims will inevitably be fed to babies and young children. It is vital to promote breast feeding for as long as possible under such conditions. Maternal illness, malnutrition and stress can lead to "failure of lactation", but the emphasis must always be on restimulation of lactation rather than on giving artificial milk to those vulnerable children.

5. MIXED DIET

5.1 It is now recognized that to prevent malnutrition it is necessary to get enough energy (calories). If a person can eat enough of a mixed diet to satisfy his energy requirements he will automatically be satisfying his protein requirements. This is true for growing children as well as for adults. Milk being a liquid (nearly 90% water) is a very dilute source of energy and a baby after the first 4–6 months of life cannot satisfy his energy requirements from milk alone, but needs solids which are a more concentrated source of energy.

5.2 It is necessary to eat several foods to obtain the variety of nutrients found in fresh milk. The usual "food basket" for general distribution in relief actions consists of:

⇨ an appropriate staple food – usually a cereal
⇨ a rich source of protein – grain legumes
⇨ a rich source of energy – usually a vegetable oil

Quantities should be sufficient to provide an average of 2,000 calories and 50 g of protein per person per day.

If the population is malnourished higher energy intakes will be required to rehabilitate it.

5.3 If the disaster victims are to remain dependent on such a diet for more than a month, every effort must be made to provide fresh fruit or vegetables or cash to purchase these. Where a specific nutrient deficiency is anticipated, it is vital to supply food which provides the relevant nutrient in sufficient quantities to prevent deficiency-related disease.

5.4 Using the "food basket" ingredients suggested above it is relatively easy to prepare weaning foods or semi-solid foods for invalids which satisfy energy and protein requirements without resorting to artificial milks.

6. THE SAFE USAGE OF ARTIFICIAL MILK IN RELIEF ACTIONS

Where people traditionally use milk in their diets it is acceptable to provide artificial milks under controlled and hygienic conditions (usually from special feeding centres).

6.1 Milk powder used as an ingredient: the safest way to use milk powder is to add it to a cooked porridge or soup for “on the spot” feeding. The milk will then be a useful, easily absorbed and safe source of protein and of limited quantities of minerals and vitamins.

6.2 Liquid milk: dried whole milk (DWM) can be reconstituted and distributed in liquid form under controlled and hygienic conditions from feeding centres. Because of the low energy value of milk (a 200 ml. cup will provide less than 150 Kcal, it should be given with other food items if used for the supplementary feeding of the malnourished.

Dried skimmed milk (DSM) must be reconstituted with edible oil (and sugar to make it palatable) before using it in liquid form. To correctly combine four ingredients is a complicated process and should only be attempted in well-supervised feeding centres.

7. CONCLUSIONS

The understanding and cooperation of National Societies is being sought in order to regularize the use of artificial milks in relief actions.

Since such products are potentially hazardous if improperly used, National Societies are being asked to give careful consideration before requesting, donating or accepting consignments.

Where a National Society sees a real need for artificial milk and appeals for such through the International Red Cross, they must be prepared to take responsibility for its safe distribution and usage.

ANNEX 4.1

WEIGHT-FOR-HEIGHT TABLES (WHO, 1983)[1]

Table A.4.1.1 Weight-for-height of boys between 49 and 138 cm (up to 9 years)

Height (cm)	Median	–1 Z-score	–2 Z-scores	–3 Z-scores
49	3.1	2.8	2.5	2.1
49.5	3.2	2.9	2.5	2.1
50	3.3	2.9	2.5	2.2
50.5	3.4	3.0	2.6	2.2
51	3.5	3.1	2.6	2.2
51.5	3.6	3.1	2.7	2.3
52	3.7	3.2	2.8	2.3
52.5	3.8	3.3	2.8	2.4
53	3.9	3.4	2.9	2.4
53.5	4.0	3.5	3.0	2.5
54	4.1	3.6	3.1	2.6
54.5	4.2	3.7	3.2	2.6
55	4.3	3.8	3.3	2.7
55.5	4.5	3.9	3.3	2.8
56	4.6	4.0	3.5	2.9
56.5	4.7	4.1	3.6	3.0
57	4.8	4.3	3.7	3.1
57.5	5.0	4.4	3.8	3.2
58	5.1	4.5	3.9	3.3
58.5	5.2	4.6	4.0	3.4
59	5.4	4.8	4.1	3.5
59.5	5.5	4.9	4.2	3.6
60	5.7	5.0	4.4	3.7
60.5	5.8	5.1	4.5	3.8
61	5.9	5.3	4.6	4.0
61.5	6.1	5.4	4.8	4.1
62	6.2	5.6	4.9	4.2
62.5	6.4	5.7	5.0	4.3
63	6.5	5.8	5.2	4.5
63.5	6.7	6.0	5.3	4.6
64	6.8	6.1	5.4	4.7
64.5	7.0	6.3	5.6	4.9
65	7.1	6.4	5.7	5.0

1 As per US National Center for Health Statistics (NCHS) reference values. The discrepancy between data for a 86.5 cm height and for 87 cm is explained by the fact that children under 24 months and those aged 24 months or more belong to two different populations, and that children under 24 months were measured lying down, whereas those aged 24 months or more were measured standing up.

Height (cm)	Median	–1 Z-score	–2 Z-scores	–3 Z-scores
65.5	7.3	6.5	5.8	5.1
66	7.4	6.7	6.0	5.3
66.5	7.6	6.8	6.1	5.4
67	7.7	7.0	6.2	5.5
67.5	7.8	7.1	6.4	5.7
68	8.0	7.3	6.5	5.8
68.5	8.1	7.4	6.6	5.9
69	8.3	7.5	6.8	6.0
69.5	8.4	7.7	6.9	6.2
70	8.5	7.8	7.0	6.3
70.5	8.7	7.9	7.2	6.4
71	8.8	8.1	7.3	6.5
71.5	8.9	8.2	7.4	6.7
72	9.1	8.3	7.5	6.8
72.5	9.2	8.4	7.7	6.9
73	9.3	8.6	7.8	7.0
73.5	9.5	8.7	7.9	7.1
74	9.6	8.8	8.0	7.2
74.5	9.7	8.9	8.1	7.3
75	9.8	9.0	8.2	7.4
75.5	9.9	9.1	8.3	7.5
76	10.0	9.2	8.4	7.6
76.5	10.2	9.3	8.5	7.7
77	10.3	9.4	8.6	7.8
77.5	10.4	9.5	8.7	7.9
78	10.5	9.7	8.8	8.0
78.5	10.6	9.8	8.9	8.1
79	10.7	9.9	9.0	8.2
79.5	10.8	10.0	9.1	8.2
80	10.9	10.1	9.2	8.3
80.5	11.0	10.1	9.3	8.4
81	11.1	10.2	9.4	8.5
81.5	11.2	10.3	9.5	8.6
82	11.3	10.4	9.6	8.7
82.5	11.4	10.5	9.6	8.8
83	11.5	10.6	9.7	8.8
83.5	11.6	10.7	9.8	8.9
84	11.7	10.8	9.9	9.0
84.5	11.8	10.9	10.0	9.1
85	11.9	11.0	10.1	9.2
85.5	12.0	11.1	10.2	9.3
86	12.1	11.2	10.3	9.3
86.5	12.2	11.3	10.4	9.4
87 (24 months)	12.6	11.5	10.3	9.2
87.5	12.7	11.6	10.4	9.3
88	12.8	11.7	10.5	9.4

Height (cm)	Median	–1 Z-score	–2 Z-scores	–3 Z-scores
88.5	12.9	11.8	10.6	9.5
89	13.0	11.9	10.7	9.6
89.5	13.1	12.0	10.8	9.7
90	13.3	12.1	10.9	9.8
90.5	13.4	12.2	11.0	9.9
91	13.5	12.3	11.1	9.9
91.5	13.6	12.4	11.2	10.0
92	13.7	12.5	11.3	10.1
92.5	13.9	12.6	11.4	10.2
93	14.0	12.8	11.5	10.3
93.5	14.1	12.9	11.6	10.4
94	14.2	13.0	11.7	10.5
94.5	14.3	13.1	11.8	10.6
95	14.5	13.2	11.9	10.7
95.5	14.6	13.3	12.0	10.8
96	14.7	13.4	12.1	10.9
96.5	14.8	13.5	12.2	11.0
97	15.0	13.7	12.4	11.0
97.5	15.1	13.8	12.5	11.1
98	15.2	13.9	12.6	11.2
98.5	15.4	14.0	12.7	11.3
99	15.5	14.1	12.8	11.4
99.5	15.6	14.3	12.9	11.5
100	15.7	14.4	13.0	11.6
100.5	15.9	14.5	13.1	11.7
101	16.0	14.6	13.2	11.8
101.5	16.2	14.7	13.3	11.9
102	16.3	14.9	13.4	12.0
102.5	16.4	15.0	13.6	12.1
103	16.6	15.1	13.7	12.2
103.5	16.7	15.3	13.8	12.3
104	16.9	15.4	13.9	12.4
104.5	17.0	15.5	14.0	12.6
105	17.1	15.6	14.2	12.7
105.5	17.3	15.8	14.3	12.8
106	17.4	15.9	14.4	12.9
106.5	17.6	16.1	14.5	13.0
107	17.7	16.2	14.7	13.1
107.5	17.9	16.3	14.8	13.2
108	18.0	16.5	14.9	13.4
108.5	18.2	16.6	15.0	13.5
109	18.3	16.8	15.2	13.6
109.5	18.5	16.9	15.3	13.7
110	18.7	17.1	15.4	13.8
110.5	18.8	17.2	15.6	14.0
111	19.0	17.4	15.7	14.1

Height (cm)	Median	–1 Z-score	–2 Z-scores	–3 Z-scores
111.5	19.1	17.5	15.9	14.2
112	19.3	17.7	16.0	14.4
112.5	19.5	17.8	16.1	14.5
113	19.6	18.0	16.3	14.6
113.5	19.8	18.1	16.4	14.8
114	20.0	18.3	16.6	14.9
114.5	20.2	18.5	16.7	15.0
115	20.3	18.6	16.9	15.2
115.5	20.5	18.8	17.1	15.3
116	20.7	18.9	17.2	15.5
116.5	20.9	19.1	17.4	15.6
117	21.1	19.3	17.5	15.8
117.5	21.2	19.5	17.7	15.9
118	21.4	19.6	17.9	16.1
118.5	21.6	19.8	18.0	16.2
119	21.8	20.0	18.2	16.4
119.5	22.0	20.2	18.4	16.6
120	22.2	20.4	18.5	16.7
120.5	22.4	20.6	18.7	16.9
121	22.6	20.7	18.9	17.0
121.5	22.8	20.9	19.1	17.2
122	23.0	21.1	19.2	17.4
122.5	23.2	21.3	19.4	17.5
123	23.4	21.5	19.6	17.7
123.5	23.6	21.7	19.8	17.9
124	23.9	21.9	20.0	18.0
124.5	24.1	22.1	20.2	18.2
125	24.3	22.3	20.4	18.4
125.5	24.5	22.5	20.5	18.6
126	24.8	22.8	20.7	18.7
126.5	25.0	23.0	20.9	18.9
127	25.2	23.2	21.1	19.1
127.5	25.5	23.4	21.3	19.2
128	25.7	23.6	21.5	19.4
128.5	26.0	23.8	21.7	19.6
129	26.2	24.1	21.9	19.8
129.5	26.5	24.3	22.1	19.9
130	26.8	24.5	22.3	20.1
130.5	27.0	24.8	22.5	20.3
131	27.3	25.0	22.7	20.4
131.5	27.6	25.2	22.9	20.6
132	27.8	25.5	23.1	20.8
132.5	28.1	25.7	23.3	21.0
133	28.4	26.0	23.6	21.1
133.5	28.7	26.2	23.8	21.3
134	29.0	26.5	24.0	21.5

Height (cm)	Median	–1 Z-score	–2 Z-scores	–3 Z-scores
134.5	29.3	26.7	24.2	21.6
135	29.6	27.0	24.4	21.8
135.5	29.9	27.3	24.6	22.0
136	30.2	27.5	24.8	22.1
136.5	30.6	27.8	25.0	22.3
137	30.9	28.1	25.3	22.4
137.5	31.2	28.4	25.5	22.6
138	31.6	28.6	25.7	22.8

Table A.4.1.2 Weight-for-height of girls between 49 and 137 cm (up to 9 years)[2]

Height (cm)	Median	–1 Z-score	–2 Z-scores	–3 Z-scores
49	3.3	2.9	2.6	2.2
49.5	3.4	3.0	2.6	2.2
50	3.4	3.0	2.6	2.3
50.5	3.5	3.1	2.7	2.3
51	3.5	3.1	2.7	2.3
51.5	3.6	3.2	2.8	2.4
52	3.7	3.3	2.8	2.4
52.5	3.8	3.4	2.9	2.5
53	3.9	3.4	3.0	2.5
53.5	4.0	3.5	3.1	2.6
54	4.1	3.6	3.1	2.7
54.5	4.2	3.7	3.2	2.7
55	4.3	3.8	3.3	2.8
55.5	4.4	3.9	3.4	2.9
56	4.5	4.0	3.5	3.0
56.5	4.6	4.1	3.6	3.0
57	4.8	4.2	3.7	3.1
57.5	4.9	4.3	3.8	3.2
58	5.0	4.4	3.9	3.3
58.5	5.1	4.6	4.0	3.4
59	5.3	4.7	4.1	3.5
59.5	5.4	4.8	4.2	3.6
60	5.5	4.9	4.3	3.7
60.5	5.7	5.1	4.4	3.8
61	5.8	5.2	4.6	3.9
61.5	6.0	5.3	4.7	4.0
62	6.1	5.4	4.8	4.1
62.5	6.2	5.6	4.9	4.2
63	6.4	5.7	5.0	4.4
63.5	6.5	5.8	5.2	4.5
64	6.7	6.0	5.3	4.6
64.5	6.8	6.1	5.4	4.7
65	7.0	6.3	5.5	4.8
65.5	7.1	6.4	5.7	4.9
66	7.3	6.5	5.8	5.1
66.5	7.4	6.7	5.9	5.2
67	7.5	6.8	6.0	5.3
67.5	7.7	6.9	6.2	5.4
68	7.8	7.1	6.3	5.5

[2] The discrepancy between data for a 86 cm height and for 86.5 cm is explained by the fact that children under 24 months and those aged 24 months or more belong to two different populations, and that children under 24 months were measured lying down, whereas those aged 24 months or more were measured standing up.

Height (cm)	Median	–1 Z-score	–2 Z-scores	–3 Z-scores
68.5	8.0	7.2	6.4	5.6
69	8.1	7.3	6.5	5.8
69.5	8.2	7.5	6.7	5.9
70	8.4	7.6	6.8	6.0
70.5	8.5	7.7	6.9	6.1
71	8.6	7.8	7.0	6.2
71.5	8.8	8.0	7.1	6.3
72	8.9	8.1	7.2	6.4
72.5	9.0	8.2	7.4	6.5
73	9.1	8.3	7.5	6.6
73.5	9.3	8.4	7.6	6.7
74	9.4	8.5	7.7	6.8
74.5	9.5	8.6	7.8	6.9
75	9.6	8.7	7.9	7.0
75.5	9.7	8.8	8.0	7.1
76	9.8	8.9	8.1	7.2
76.5	9.9	9.0	8.2	7.3
77	10.0	9.1	8.3	7.4
77.5	10.1	9.2	8.4	7.5
78	10.2	9.3	8.5	7.6
78.5	10.3	9.4	8.6	7.7
79	10.4	9.5	8.7	7.8
79.5	10.5	9.6	8.7	7.9
80	10.6	9.7	8.8	8.0
80.5	10.7	9.8	8.9	8.0
81	10.8	9.9	9.0	8.1
81.5	10.9	10.0	9.1	8.2
82	11.0	10.1	9.2	8.3
82.5	11.1	10.2	9.3	8.4
83	11.2	10.3	9.4	8.5
83.5	11.3	10.4	9.5	8.6
84	11.4	10.5	9.6	8.7
84.5	11.5	10.6	9.6	8.7
85	11.6	10.6	9.7	8.8
85.5	11.7	10.7	9.8	8.9
86	11.8	10.8	9.9	9.0
86.5 (24 months)	12.2	11.1	10.0	8.9
87	12.3	11.2	10.1	9.0
87.5	12.4	11.3	10.2	9.1
88	12.5	11.4	10.3	9.2
88.5	12.6	11.5	10.4	9.3
89	12.7	11.6	10.5	9.3
89.5	12.8	11.7	10.6	9.4
90	12.9	11.8	10.7	9.5
90.5	13.0	11.9	10.7	9.6
91	13.2	12.0	10.8	9.7

Height (cm)	Median	–1 Z-score	–2 Z-scores	–3 Z-scores
91.5	13.3	12.1	10.9	9.8
92	13.4	12.2	11.0	9.9
92.5	13.5	12.3	11.1	9.9
93	13.6	12.4	11.2	10.0
93.5	13.7	12.5	11.3	10.1
94	13.9	12.6	11.4	10.2
94.5	14.0	12.8	11.5	10.3
95	14.1	12.9	11.6	10.4
95.5	14.2	13.0	11.7	10.5
96	14.3	13.1	11.8	10.6
96.5	14.5	13.2	11.9	10.7
97	14.6	13.3	12.0	10.7
97.5	14.7	13.4	12.1	10.8
98	14.9	13.5	12.2	10.9
98.5	15.0	13.7	12.3	11.0
99	15.1	13.8	12.4	11.1
99.5	15.2	13.9	12.5	11.2
100	15.4	14.0	12.7	11.3
100.5	15.5	14.1	12.8	11.4
101	15.6	14.3	12.9	11.5
101.5	15.8	14.4	13.0	11.6
102	15.9	14.5	13.1	11.7
102.5	16.0	14.6	13.2	11.8
103	16.2	14.7	13.3	11.9
103.5	16.3	14.9	13.4	12.0
104	16.5	15.0	13.5	12.1
104.5	16.6	15.1	13.7	12.2
105	16.7	15.3	13.8	12.3
105.5	16.9	15.4	13.9	12.4
106	17.0	15.5	14.0	12.5
106.5	17.2	15.7	14.1	12.6
107	17.3	15.8	14.3	12.7
107.5	17.5	15.9	14.4	12.8
108	17.6	16.1	14.5	13.0
108.5	17.8	16.2	14.6	13.1
109	17.9	16.4	14.8	13.2
109.5	18.1	16.5	14.9	13.3
110	18.2	16.6	15.0	13.4
110.5	18.4	16.8	15.2	13.6
111	18.6	16.9	15.3	13.7
111.5	18.7	17.1	15.5	13.8
112	18.9	17.2	15.6	14.0
112.5	19.0	17.4	15.7	14.1
113	19.2	17.5	15.9	14.2
113.5	19.4	17.7	16.0	14.4
114	19.5	17.9	16.2	14.5

Height (cm)	Median	–1 Z-score	–2 Z-scores	–3 Z-scores
114.5	19.7	18.0	16.3	14.6
115	19.9	18.2	16.5	14.8
115.5	20.1	18.4	16.6	14.9
116	20.3	18.5	16.8	15.0
116.5	20.4	18.7	16.9	15.2
117	20.6	18.9	17.1	15.3
117.5	20.8	19.0	17.3	15.5
118	21.0	19.2	17.4	15.6
118.5	21.2	19.4	17.6	15.8
119	21.4	19.6	17.7	15.9
119.5	21.6	19.8	17.9	16.1
120	21.8	20.0	18.1	16.2
120.5	22.0	20.1	18.3	16.4
121	22.2	20.3	18.4	16.5
121.5	22.5	20.5	18.6	16.7
122	22.7	20.7	18.8	16.8
122.5	22.9	20.9	19.0	17.0
123	23.1	21.1	19.1	17.1
123.5	23.4	21.3	19.3	17.3
124	23.6	21.6	19.5	17.4
124.5	23.9	21.8	19.7	17.6
125	24.1	22.0	19.9	17.8
125.5	24.3	22.2	20.1	17.9
126	24.6	22.4	20.2	18.1
126.5	24.9	22.7	20.4	18.2
127	25.1	22.9	20.6	18.4
127.5	25.4	23.1	20.8	18.6
128	25.7	23.3	21.0	18.7
128.5	25.9	23.6	21.2	18.9
129	26.2	23.8	21.4	19.0
129.5	26.5	24.1	21.6	19.2
130	26.8	24.3	21.8	19.4
130.5	27.1	24.6	22.1	19.5
131	27.4	24.8	22.3	19.7
131.5	27.7	25.1	22.5	19.9
132	28.0	25.4	22.7	20.0
132.5	28.4	25.6	22.9	20.2
133	28.7	25.9	23.1	20.4
133.5	29.0	26.2	23.4	20.5
134	29.4	26.5	23.6	20.7
134.5	29.7	26.8	23.8	20.8
135	30.1	27.0	24.0	21.0
135.5	30.4	27.3	24.3	21.2
136	30.8	27.6	24.5	21.3
136.5	31.1	27.9	24.7	21.5
137	31.5	28.2	25.0	21.7

ANNEX 4.2
HEIGHT-FOR-AGE TABLES (WHO 1983)[1]

Table A.4.2.1 Height-for-age of boys between 0 and 59 months

Age (months)	–3 Z-scores	–2 Z-scores	–1 Z-score	Median	+ 1 Z-score	+ 2 Z-scores
0	43.6	45.9	48.2	50.5	52.8	55.1
1	47.2	49.7	52.1	54.6	57.0	59.5
2	50.4	52.9	55.5	58.1	60.7	63.2
3	53.2	55.8	58.5	61.1	63.7	66.4
4	55.6	58.3	61.0	63.7	66.4	69.1
5	57.8	60.5	63.2	65.9	68.6	71.3
6	59.8	62.4	65.1	67.8	70.5	73.2
7	61.5	64.1	66.8	69.5	72.2	74.8
8	63.0	65.7	68.3	71.0	73.6	76.3
9	64.4	67.0	69.7	72.3	75.0	77.6
10	65.7	68.3	71.0	73.6	76.3	78.9
11	66.9	69.6	72.2	74.9	77.5	80.2
12	68.0	70.7	73.4	76.1	78.8	81.5
13	69.0	71.8	74.5	77.2	80.0	82.7
14	70.0	72.8	75.6	78.3	81.1	83.9
15	70.9	73.7	76.6	79.4	82.3	85.1
16	71.7	74.6	77.5	80.4	83.4	86.3
17	72.5	75.5	78.5	81.4	84.4	87.4
18	73.3	76.3	79.4	82.4	85.4	88.5
19	74.0	77.1	80.2	83.3	86.4	89.5
20	74.7	77.9	81.1	84.2	87.4	90.6
21	75.4	78.7	81.9	85.1	88.4	91.6
22	76.1	79.4	82.7	86.0	89.3	92.5
23	76.8	80.2	83.5	86.8	90.2	93.5
24	76.0	79.2	82.4	85.6	88.8	92.0
25	76.7	79.9	83.2	86.4	89.7	92.9
26	77.3	80.6	83.9	87.2	90.6	93.9
27	78.0	81.3	84.7	88.1	91.4	94.8
28	78.6	82.0	85.4	88.9	92.3	95.7
29	79.2	82.7	86.2	89.7	93.1	96.6
30	79.9	83.4	86.9	90.4	94.0	97.5
31	80.5	84.1	87.6	91.2	94.8	98.3
32	81.1	84.7	88.3	92.0	95.6	99.2

[1] As per US National Center for Health Statistics (NCHS) reference values. The discrepancy between data for 23 months and for 24 months is explained by the fact that children under 24 months and those aged 24 months or more belong to two different populations, and that children under 24 months were measured lying down, whereas those aged 24 months or more were measured standing up.

Age (months)	–3 Z-scores	–2 Z-scores	–1 Z-score	Median	+ 1 Z-score	+ 2 Z-scores
33	81.7	85.4	89.0	92.7	96.4	100.1
34	82.3	86.0	98.7	93.5	97.2	100.9
35	82.9	86.7	90.4	94.2	98.0	101.7
36	83.5	87.3	91.1	94.9	98.7	102.5
37	84.1	87.9	91.8	95.6	99.5	103.3
38	84.7	88.6	92.4	96.3	100.2	104.1
39	85.2	89.2	93.1	97.0	101.0	104.9
40	85.8	89.8	93.8	97.7	101.7	105.7
41	86.4	90.4	94.4	98.4	102.4	106.4
42	86.9	91.0	95.0	99.1	103.1	107.2
43	87.5	91.6	95.7	99.7	103.8	107.9
44	88.0	92.1	96.3	100.4	104.5	108.7
45	88.6	92.7	96.9	101.0	105.2	109.4
46	89.1	93.3	97.5	101.7	105.9	110.1
47	89.6	93.9	98.1	102.3	106.6	110.8
48	90.2	94.4	98.7	102.9	107.2	111.5
49	90.7	95.0	99.3	103.6	107.9	112.2
50	91.2	95.5	99.9	104.2	108.5	112.8
51	91.7	96.1	100.4	104.8	109.1	113.5
52	92.2	96.6	101.1	105.4	109.8	114.2
53	92.7	97.1	101.6	106.0	110.4	114.8
54	93.2	97.7	102.1	106.6	111.0	115.4
55	93.7	98.2	102.7	107.1	111.6	116.1
56	94.2	98.7	103.2	107.7	112.2	116.7
57	94.7	99.2	103.7	108.3	112.8	117.3
58	95.2	99.7	104.3	108.8	113.4	117.9
59	95.7	100.2	104.8	109.4	114.0	118.5

Table A.4.2.2 Height-for-age of girls between 0 and 59 months

Age (months)	–3 Z-scores	–2 Z-scores	–1 Z-score	Median	+ 1 Z-score	+ 2 Z-scores
0	43.4	45.5	47.7	49.9	52.0	54.2
1	46.7	49.0	51.2	53.5	55.8	58.1
2	49.6	52.0	54.4	56.8	59.2	61.6
3	52.1	54.6	57.1	59.5	62.0	64.5
4	54.3	56.9	59.4	62.0	64.5	67.1
5	56.3	58.9	61.5	64.1	66.7	69.3
6	58.0	60.6	63.3	65.9	68.6	71.2
7	59.5	62.2	64.9	67.6	70.2	72.9
8	60.9	63.7	66.4	69.1	71.8	74.5
9	62.2	65.0	67.7	70.4	73.2	75.9
10	63.5	66.2	69.0	71.8	74.5	77.3
11	64.7	67.5	70.3	73.1	75.9	78.7
12	65.8	68.6	71.5	74.3	77.1	80.0
13	66.9	69.8	72.6	75.5	78.4	81.2
14	67.9	70.8	73.7	76.7	79.6	82.5
15	68.9	71.9	74.8	77.8	80.7	83.7
16	69.9	72.9	75.9	78.9	81.8	84.4
17	70.8	73.8	76.9	79.9	82.9	86.0
18	71.7	74.8	77.9	80.9	84.0	87.1
19	72.6	75.7	78.8	81.9	85.0	88.1
20	73.4	76.6	79.7	82.9	86.0	89.2
21	74.3	77.4	80.6	83.8	87.0	90.2
22	75.1	78.3	81.5	84.7	87.9	91.1
23	75.9	79.1	82.4	85.6	88.9	92.1
24	74.9	78.1	81.3	84.5	87.7	90.9
25	75.6	78.8	82.1	85.4	88.6	91.9
26	76.3	79.6	82.9	86.2	89.5	92.8
27	77.0	80.3	83.7	87.0	90.4	93.8
28	77.6	81.0	84.5	87.9	91.3	94.7
29	78.3	81.8	85.2	88.7	92.1	95.6
30	79.0	82.5	86.0	89.5	93.0	96.5
31	79.6	83.2	86.7	90.2	93.8	97.3
32	80.3	83.8	87.4	91.0	94.6	98.2
33	80.9	84.5	88.1	91.7	95.4	99.0
34	81.5	85.2	88.8	92.5	96.1	99.8
35	82.1	85.8	89.5	93.2	96.9	100.6
36	82.8	86.5	90.2	93.9	97.6	101.4
37	83.4	87.1	90.9	94.6	98.4	102.1
38	84.0	87.7	91.5	95.3	99.1	102.9
39	84.5	88.4	92.2	96.0	99.8	103.6
40	85.1	89.0	92.8	96.6	100.5	104.3
41	85.7	89.6	93.4	97.3	101.2	105.0
42	86.3	90.2	94.0	97.9	101.8	105.7

Age (months)	–3 Z-scores	–2 Z-scores	–1 Z-score	Median	+ 1 Z-score	+ 2 Z-scores
43	86.8	90.7	94.7	98.6	102.5	106.4
44	87.4	91.3	95.3	99.2	103.1	107.1
45	87.9	91.9	95.8	99.8	103.8	107.8
46	88.4	92.4	96.4	100.4	104.4	108.4
47	89.0	93.0	97.0	101.0	105.1	109.1
48	89.5	93.5	97.6	101.6	105.7	109.7
49	90.0	94.1	98.1	102.2	106.3	110.4
50	90.5	94.6	98.7	102.8	106.9	111.0
51	91.0	95.1	99.3	103.4	107.5	111.6
52	91.5	95.6	99.8	104.0	108.1	112.3
53	92.0	96.1	100.3	104.5	108.7	112.9
54	92.4	96.7	100.9	105.1	109.3	113.5
55	92.9	97.1	101.4	105.6	109.9	114.1
56	93.4	97.6	101.9	106.2	110.5	114.8
57	93.8	98.1	102.4	106.7	111.1	115.4
58	94.3	98.6	102.9	107.3	111.6	116.0
59	94.7	99.1	103.5	107.8	112.2	116.6

ANNEX 4.3

MID-UPPER ARM CIRCUMFERENCE (CM) FOR AGE AND HEIGHT BETWEEN 6 AND 60 MONTHS (BOTH SEXES)[1]

Table A.4.3 Mid-upper arm circumference (cm), both sexes

Age (months)	Height (cm)	Median	–1 Z-score	–2 Z-scores	–3 Z-scores	85%	75%
6	66.9	14.3	13.2	12.0	10.9	12.2	10.7
7	68.5	14.6	13.4	12.2	11.0	12.4	11.0
8	70.0	14.8	13.6	12.4	11.2	12.6	11.1
9	71.3	14.9	13.7	12.5	11.3	12.7	11.2
10	72.7	15.1	13.9	12.7	11.5	12.8	11.3
11	74.0	15.2	14.0	12.8	11.6	12.9	11.4
12	75.2	15.4	14.1	12.9	11.7	13.1	11.6
13	76.3	15.5	14.2	13.0	11.7	13.2	11.6
14	77.5	15.6	14.3	13.1	11.8	13.3	11.7
15	78.6	15.7	14.4	13.1	11.9	13.3	11.8
16	79.6	15.8	14.5	13.2	11.9	13.4	11.9
17	80.6	15.8	14.5	13.2	12.0	13.4	11.9
18	81.6	15.9	14.6	13.3	12.0	13.5	11.9
19	82.6	15.9	14.6	13.3	12.0	13.5	11.9
20	83.5	16.0	14.7	13.4	12.1	13.6	12.0
21	84.4	16.0	14.7	13.4	12.1	13.6	12.0
22	85.3	16.1	14.7	13.4	12.1	13.7	12.1
23	86.2	16.1	14.8	13.4	12.1	13.7	12.1
24	85.0	16.1	14.8	13.5	12.1	13.7	12.1
25	85.9	16.2	14.8	13.5	12.2	13.8	12.2
26	86.7	16.2	14.9	13.5	12.2	13.8	12.2
27	87.5	16.2	14.9	13.5	12.2	13.8	12.2
28	88.4	16.3	14.9	13.5	12.2	13.9	12.2
29	89.2	16.3	14.9	13.6	12.2	13.9	12.2
30	89.9	16.3	14.9	13.6	12.2	13.9	12.2
31	90.7	16.3	15.0	13.6	12.2	13.9	12.2
32	91.5	16.4	15.0	13.6	12.2	13.9	12.3
33	92.2	16.4	15.0	13.6	12.3	13.9	12.3
34	93.0	16.4	15.0	13.7	12.3	13.9	12.3
35	93.7	16.4	15.1	13.7	12.3	13.9	12.3
36	94.4	16.5	15.1	13.7	12.3	14.0	12.4

[1] This table is based on US National Center for Health Statistics (NCHS) reference values (WHO, 1983; WHO, 1995).

Age (months)	Height (cm)	Median	–1 Z-score	–2 Z-scores	–3 Z-scores	85%	75%
37	95.1	16.5	15.1	13.7	12.3	14.0	12.4
38	95.8	16.5	15.1	13.7	12.3	14.0	12.4
39	96.5	16.6	15.2	13.8	12.4	14.1	12.5
40	97.1	16.6	15.2	13.8	12.4	14.1	12.5
41	97.8	16.6	15.2	13.8	12.4	14.1	12.5
42	98.5	16.7	15.3	13.8	12.4	14.2	12.5
43	99.1	16.7	15.3	13.9	12.4	14.2	12.5
44	99.8	16.8	15.3	13.9	12.5	14.3	12.6
45	100.4	16.8	15.4	13.9	12.5	14.3	12.6
46	101.0	16.8	15.4	13.9	12.5	14.3	12.6
47	101.6	16.9	15.4	14.0	12.5	14.4	12.7
48	102.2	16.9	15.5	14.0	12.5	14.4	12.7
49	102.9	17.0	15.5	14.0	12.5	14.5	12.8
50	103.5	17.0	15.5	14.0	12.6	14.5	12.8
51	104.1	17.0	15.5	14.1	12.6	14.5	12.8
52	104.7	17.1	15.6	14.1	12.6	14.5	12.8
53	105.2	17.1	15.6	14.1	12.6	14.5	12.8
54	105.8	17.2	15.6	14.1	12.6	14.6	12.9
55	106.3	17.2	15.7	14.1	12.6	14.6	12.9
56	106.9	17.2	15.7	14.1	12.6	14.6	12.9
57	107.5	17.3	15.7	14.1	12.6	14.7	13.0
58	108.0	17.3	15.7	14.2	12.6	14.7	13.0
59	108.6	17.3	15.8	14.2	12.6	14.7	13.0
60	109.1	17.4	15.8	14.2	12.6	14.8	13.1

ANNEX 4.4
WEIGHT-FOR-AGE AND WEIGHT-FOR-HEIGHT OF ADOLESCENTS[1]

In humanitarian operations, the indicator of nutritional status that must be measured is usually corpulence. Unfortunately, there are no weight-for-height tables that apply to adolescents. This Manual therefore combines existing tables for height for age and weight for age for girls and boys aged between 2 and 18 years (WHO, 1983). Results are provided within one centimetre, rounded up to the closest category as an approximate where necessary. Height rounded up to the closest centimetre is indicated between brackets alongside the approximate height. The values that are rounded up to the closest centimetre and the corresponding median weight values are underlined. The 90%, 80% and 70% thresholds are only calculated for these underlined values; calculations begin at 10 years of age. This process preserves all age, height, and weight values supplied by reference tables, and thus provides comprehensive anthropometric data. This process is not strictly orthodox, but permits the evaluation of corpulence in adolescents. It is worth noting that the values provided here are close to the tables developed by Baldwin-Wood, which were converted into metric values by Jellife (Jellife, 1966). The tables developed by Baldwin-Wood were published in 1923, and result from measurements performed on children born in the United States. They provide slightly lower values than the table below (the difference does not exceed 5%).

Table A.4.4.1 Weight for height and age of boys aged between 10 and 18 years

Age (years months)	Height (cm)	Weight (kg)			
		Median	90%	80%	70%
10 0	137.5	31.4	28.3	25.1	22.0
10 1	<u>138.0</u>	<u>31.7</u>	28.5	25.4	22.2
10 2	138.4	32.0			
10 3	138.9 <u>139.0</u>	<u>32.4</u>	29.2	25.9	22.7
10 4	139.4	32.7			
10 5	139.9 <u>140.0</u>	<u>33.0</u>	29.7	26.4	23.1
10 6	140.3	33.3			
10 7	140.8 <u>141.0</u>	<u>33.6</u>	30.2	26.9	23.5
10 8	141.3	33.9			
10 9	141.8 <u>142.0</u>	<u>34.3</u>	30.9	27.4	24.0
10 10	142.3	34.6			
10 11	142.8 <u>143.0</u>	<u>35.0</u>	31.5	28.0	24.5

[1] According to US National Center for Health Statistics (NCHS) reference values (WHO, 1983).

Age (years months)		Height (cm)	Weight (kg)			
			Median	90%	80%	70%
11	0	143.3	35.3			
11	1	143.8 (144.0)	35.6	32.0	28.5	24.9
11	2	144.3	36.0			
11	3	144.8 (145.0)	36.4	32.8	29.1	25.5
11	4	145.3	36.7			
11	5	145.8 (146.0)	37.1	33.4	29.7	26.0
11	6	146.4	37.5			
11	7	146.9 (147.0)	37.8	34.0	30.2	26.5
11	8	147.4	38.2			
11	9	148.0	38.6	34.7	30.9	27.0
11	10	148.5	39.0			
11	11	149.1 (149.0)	39.4	35.5	31.5	27.6
12	0	149.7	39.8			
12	1	150.2 (150.0)	40.2	36.2	32.2	28.1
12	2	150.8 (151.0)	40.6	36.5	32.5	28.4
12	3	151.3	41.0			
12	4	151.9 (152.0)	41.4	37.3	33.1	29.0
12	5	152.5	41.8			
12	6	153.0	42.3	38.1	33.8	29.6
12	7	153.6	42.7			
12	8	154.2 (154.0)	43.1	38.8	34.5	30.2
12	9	154.8 (155.0)	43.6	39.2	34.9	30.5
12	10	155.3	44.0			
12	11	155.9 (156.0)	44.5	40.1	35.6	31.2
13	0	156.5	45.0			
13	1	157.0	45.4	40.9	36.3	31.8
13	2	157.6	45.9			
13	3	158.2 (158.0)	46.4	41.8	37.1	32.5
13	4	158.7	46.8			
13	5	159.3 (159.0)	47.3	42.6	37.8	33.1
13	6	159.9 (160.0)	47.8	43.0	38.2	33.5
13	7	160.4	48.3			
13	8	161.0	48.8	43.9	39.0	34.2
13	9	161.5	49.3			
13	10	162.1 (162.0)	49.8	44.8	39.8	34.9
13	11	162.6	50.3			

Age (years months)		Height (cm)	Weight (kg)			
			Median	90%	80%	70%
14	0	163.1 (163.0)	50.8	45.7	40.6	35.6
14	1	163.6	51.3			
14	2	164.2 (164.0)	51.8	46.6	41.4	36.3
14	3	164.7	52.3			
14	4	165.2 (165.0)	52.8	47.5	42.2	37.0
14	5	165.7	53.3			
14	6	166.2 (166.0)	53.8	48.4	43.0	37.7
14	7	166.7	54.3			
14	8	167.2 (167.0)	54.8	49.3	43.8	38.4
14	9	167.6	55.2			
14	10	168.1 (168.0)	55.7	50.1	44.6	39.0
14	11	168.6	56.2			
15	0	169.0	56.7	51.0	45.4	39.7
15	1	169.4	57.2			
15	2	169.9 (170.0)	57.7	51.9	46.2	40.4
15	3	170.3	58.1			
15	4	170.7	58.6			
15	5	171.1 (171.0)	59.1	53.2	47.3	41.4
15	6	171.5	59.5			
15	7	171.8	60.0			
15	8	172.2 (172.0)	60.4	49.0	48.3	42.3
15	9	172.6	60.8			
15	10	172.9 (173.0)	61.3	55.2	49.0	42.9
15	11	173.2	61.7			
16	0	173.5	62.1			
16	1	173.8	62.5			
16	2	174.1 (174.0)	62.9	56.6	50.3	44.0
16	3	174.4	63.3			
16	4	174.7	63.7			
16	5	174.9 (175.0)	64.0	57.6	51.2	44.8
16	6	175.2	64.4			
16	7	175.4	64.7			
16	8	175.6	65.1			
16	9	175.8	65.4			
16	10	175.9	65.7			
16	11	176.1 (176.0)	66.0	59.4	52.8	46.2

Age (years months)	Height (cm)	Weight (kg)			
		Median	90%	80%	70%
17 0	176.2	66.3			
17 1	176.3	66.6			
17 2	176.4	66.8			
17 3	176.5	67.1			
17 4	176.6	67.3			
17 5	176.7	67.6			
17 6	176.7	67.8			
17 7	176.8	68.0			
17 8	176.8	68.2			
17 9	176.8	68.4			
17 10	176.8	68.6			
17 11	176.8	68.7			
18 0	176.8 (177.0)	68.9	62.0	55.1	48.2

Table A.4.4.2 Weight for height and age of girls aged between 10 and 18 years

Age (years months)		Height (cm)	Weight (kg)			
			Median	90%	80%	70%
10	0	138.3 (138.0)	32.5	29.2	26.0	22.7
10	1	138.8 (139.0)	32.9	29.6	26.3	23.0
10	2	139.4	33.3			
10	3	139.9 (140.0)	33.6	30.2	26.9	23.5
10	4	140.4	34.0			
10	5	140.9 (141.0)	34.4	31.0	27.5	24.1
10	6	141.5	34.7			
10	7	142.0	35.1	31.6	28.1	24.6
10	8	142.6	35.5			
10	9	143.1 (143.0)	35.8	32.2	28.6	25.1
10	10	143.7	36.2			
10	11	144.2 (144.0)	36.6	32.9	29.3	25.6
11	0	144.8 (145.0)	37.0	33.3	29.6	25.9
11	1	145.3	37.3			
11	2	145.9 (146.0)	37.7	33.9	30.2	26.4
11	3	146.5	38.1			
11	4	147.0	38.5	34.7	30.8	27.0
11	5	147.6	38.8			
11	6	148.2 (148.0)	39.2	35.3	31.4	27.4
11	7	148.8 (149.0)	39.6	35.6	31.7	27.7
11	8	149.3	40.0			
11	9	149.9 (150.0)	40.4	36.4	32.3	28.3
11	10	150.4	40.8			
11	11	151.0	41.1	37.0	32.9	28.8
12	0	151.5	41.5			
12	1	152.1 (152.0)	41.9	37.7	33.5	29.3
12	2	152.6	42.3			
12	3	153.1 (153.0)	42.7	38.4	34.2	29.9
12	4	153.6	43.1			
12	5	154.1 (154.0)	43.5	39.2	34.8	30.5
12	6	154.6	43.8			
12	7	155.0	44.2	39.8	35.4	30.9
12	8	155.5	44.6			
12	9	155.9 (156.0)	45.0	40.5	36.0	31.5
12	10	156.3	45.4			
12	11	156.7	45.7			

Age (years months)	Height (cm)	Weight (kg)			
		Median	90%	80%	70%
13 0	157.1 (157.0)	46.1	41.5	36.9	32.3
13 1	157.5	46.5			
13 2	157.8 (158.0)	46.8	42.1	37.4	32.8
13 3	158.2	47.2			
13 4	158.5	47.6			
13 5	158.8	47.9			
13 6	159.0	48.3	43.5	38.6	33.8
13 7	159.3	48.6			
13 8	159.5	49.0			
13 9	159.8	49.3			
13 10	160.0	49.6	44.6	39.7	34.7
13 11	160.2	50.0			
14 0	160.4	50.3			
14 1	160.5	50.6			
14 2	160.7	50.9			
14 3	160.8	51.2			
14 4	161.0	51.5	46.4	41.2	36.1
14 5	161.1	51.8			
14 6	161.2	52.1			
14 7	161.3	52.4			
14 8	161.4	52.7			
14 9	161.5	52.9			
14 10	161.6	53.2			
14 11	161.7	53.4			
15 0	161.8	53.7			
15 1	161.9	53.9			
15 2	161.9	54.1			
15 3	162.0	54.4	49.0	43.5	38.1
15 4	162.0	54.6			
15 5	162.1	54.8			
15 6	162.1	55.0			
15 7	162.2	55.1			
15 8	162.2	55.3			
15 9	162.3	55.5			
15 10	162.3	55.6			
15 11	162.4	55.8			

Age (years months)		Height (cm)	Weight (kg)			
			Median	90%	80%	70%
16	0	162.4	55.9			
16	1	162.5	56.0			
16	2	162.5	56.1			
16	3	162.6	56.2			
16	4	162.6	56.3			
16	5	162.7	56.4			
16	6	162.7	56.4			
16	7	162.8	56.5			
16	8	162.8	56.6			
16	9	162.9	56.6			
16	10	162.9	56.6			
16	11	163.0	56.7	51.0	45.4	39.7
17	0	163.1	56.7			
17	1	163.1	56.7			
17	2	163.2	56.7			
17	3	163.2	56.7			
17	4	163.3	56.7			
17	5	163.3	56.7			
17	6	163.4	56.7			
17	7	163.5	56.7			
17	8	163.5	56.7			
17	9	163.6	56.7			
17	10	163.6	56.7			
17	11	163.7	56.6			
18	0	163.7 (164.0)	56.6	50.9	45.3	39.6

ANNEX 5
THE CODE OF CONDUCT FOR THE INTERNATIONAL RED CROSS AND RED CRESCENT MOVEMENT AND NGOs IN DISASTER RELIEF

Purpose

This Code of Conduct seeks to guard our standards of behaviour. It is not about operational details, such as how one should calculate food rations or set up a refugee camp. Rather, it seeks to maintain the high standards of independence, effectiveness and impact to which disaster response NGOs and the International Red Cross and Red Crescent Movement aspire. It is a voluntary code, enforced by the will of the organization accepting it, to maintain the standards laid down in the Code.

In the event of armed conflict, the present Code of Conduct will be interpreted and applied in conformity with international humanitarian law.

The Code of Conduct is presented first. Attached to it are three annexes, describing the working environment that we would like to see created by Host Governments, Donor Governments and Inter-governmental Organizations in order to facilitate the effective delivery of humanitarian assistance.

Definitions

NGOs: NGOs (Non-Governmental Organizations) refers here to organizations, both national and international, which are constituted separately from the government of the country in which they are founded.

NGHAs: For the purposes of this text, the term Non-Governmental Humanitarian Agencies (NGHAs) has been coined to encompass the components of the International Red Cross and Red Crescent Movement – The International Committee of the Red Cross, The International Federation of Red Cross and Red Crescent Societies and its member National Societies – and the NGOs as defined above. This code refers specifically to those NGHAs who are involved in disaster response.

IGOs: IGOs (Inter-Governmental Organizations) refers to organizations constituted by two or more governments. It thus includes all United Nations Agencies and regional organizations.

Disasters: A disaster is a calamitous event resulting in loss of life, great human suffering and distress, and large-scale material damage.

The Code of Conduct

Principles of Conduct for the International Red Cross and Red Crescent Movement and NGOs in Disaster Response Programmes.

1. **The humanitarian imperative comes first**
   The right to receive humanitarian assistance, and to offer it, is a fundamental humanitarian principle which should be enjoyed by all citizens of all countries. As members of the international community, we recognize our obligation to provide humanitarian assistance wherever it is needed. Hence the need for unimpeded access to affected populations is of fundamental importance in exercising that responsibility. The prime motivation of our response to disaster is to alleviate human suffering amongst those least able to withstand the stress caused by disaster. When we give humanitarian aid it is not a partisan or political act and should not be viewed as such.
2. **Aid is given regardless of the race, creed or nationality of the recipients and without adverse distinction of any kind. Aid priorities are calculated on the basis of need alone**
   Wherever possible, we will base the provision of relief aid upon a thorough assessment of the needs of the disaster victims and the local capacities already in place to meet those needs. Within the entirety of our programmes, we will reflect considerations of proportionality. Human suffering must be alleviated whenever it is found; life is as precious in one part of a country as another. Thus, our provision of aid will reflect the degree of suffering it seeks to alleviate. In implementing this approach, we recognize the crucial role played by women in disaster-prone communities and will ensure that this role is supported, not diminished, by our aid programmes. The implementation of such a universal, impartial and independent policy, can only be effective if we and our partners have access to the necessary resources to provide for such equitable relief, and have equal access to all disaster victims.
3. **Aid will not be used to further a particular political or religious standpoint**
   Humanitarian aid will be given according to the need of individuals, families and communities. Notwithstanding the right of NGHAs to espouse particular political or religious opinions, we affirm that assistance will not be dependent on the adherence of the recipients to those opinions. We will not tie the promise, delivery or distribution of assistance to the embracing or acceptance of a particular political or religious creed.
4. **We shall endeavour not to act as instruments of government foreign policy**
   NGHAs are agencies which act independently from governments. We therefore formulate our own policies and implementation strategies and do not seek to implement the policy of any government, except in so far as it coincides with our own independent policy. We will never knowingly – or through negligence – allow ourselves, or our employees, to be used to gather information of a political, military or economically sensitive nature for governments or other bodies that may serve purposes other than those which are strictly humanitarian, nor will we act as instruments of foreign policy of donor governments. We will use the assistance we receive to respond to needs and this assistance should not be driven by the need to dispose of donor commodity surpluses, nor by the political interest of any particular donor. We value and promote the voluntary giving of labour and finances by concerned individuals to support our work and recognize the independence of action promoted by such voluntary motivation. In order to protect our independence we will seek to avoid dependence upon a single funding source.
5. **We shall respect culture and custom**
   We will endeavour to respect the culture, structures and customs of the communities and countries we are working in.
6. **We shall attempt to build disaster response on local capacities**
   All people and communities – even in disaster – possess capacities as well as vulnerabilities. Where possible, we will strengthen these capacities by employing local staff, purchasing local materials and trading with local companies. Where possible, we will work through local NGHAs as partners in planning and implementation, and cooperate with local government

structures where appropriate. We will place a high priority on the proper coordination of our emergency responses. This is best done within the countries concerned by those most directly involved in the relief operations, and should include representatives of the relevant UN bodies.

7. **Ways shall be found to involve programme beneficiaries in the management of relief aid**
   Disaster response assistance should never be imposed upon the beneficiaries. Effective relief and lasting rehabilitation can best be achieved where the intended beneficiaries are involved in the design, management and implementation of the assistance programme. We will strive to achieve full community participation in our relief and rehabilitation programmes.
8. **Relief aid must strive to reduce future vulnerabilities to disaster as well as meeting basic needs**
   All relief actions affect the prospects for long-term development, either in a positive or a negative fashion. Recognizing this, we will strive to implement relief programmes which actively reduce the beneficiaries' vulnerability to future disasters and help create sustainable lifestyles. We will pay particular attention to environmental concerns in the design and management of relief programmes. We will also endeavour to minimize the negative impact of humanitarian assistance, seeking to avoid long-term beneficiary dependence upon external aid.
9. **We hold ourselves accountable to both those we seek to assist and those from whom we accept resources**
   We often act as an institutional link in the partnership between those who wish to assist and those who need assistance during disasters. We therefore hold ourselves accountable to both constituencies. All our dealings with donors and beneficiaries shall reflect an attitude of openness and transparency. We recognize the need to report on our activities, both from a financial perspective and the perspective of effectiveness. We recognize the obligation to ensure appropriate monitoring of aid distributions and to carry out regular assessments of the impact of disaster assistance. We will also seek to report, in an open fashion, upon the impact of our work, and the factors limiting or enhancing that impact. Our programmes will be based upon high standards of professionalism and expertise in order to minimize the wasting of valuable resources.
10. **In our information, publicity and advertising activities, we shall recognize disaster victims as dignified humans, not hopeless objects**
    Respect for the disaster victim as an equal partner in action should never be lost. In our public information we shall portray an objective image of the disaster situation where the capacities and aspirations of disaster victims are highlighted, and not just their vulnerabilities and fears. While we will cooperate with the media in order to enhance public response, we will not allow external or internal demands for publicity to take precedence over the principle of maximizing overall relief assistance. We will avoid competing with other disaster response agencies for media coverage in situations where such coverage may be to the detriment of the service provided to the beneficiaries or to the security of our staff or the beneficiaries.

The working environment

Having agreed unilaterally to strive to abide by the Code laid out above, we present below some indicative guidelines which describe the working environment we would like to see created by donor governments, host governments and the inter-governmental organizations – principally the agencies of the United Nations – in order to facilitate the effective participation of NGHAs in disaster response.

These guidelines are presented for guidance. They are not legally binding, nor do we expect governments and IGOs to indicate their acceptance of the guidelines through the signature of any document, although this may be a goal to work to in the future. They are presented in a spirit of openness and cooperation so that our partners will become aware of the ideal relationship we would seek with them.

Annex I: Recommendations to the governments of disaster affected countries

1. Governments should recognize and respect the independent, humanitarian and impartial actions of NGHAs: NGHAs are independent bodies. This independence and impartiality should be respected by host governments.
2. Host governments should facilitate rapid access to disaster victims for NGHAs: if NGHAs are to act in full compliance with their humanitarian principles, they should be granted rapid and impartial access to disaster victims, for the purpose of delivering humanitarian assistance. It is the duty of the host government, as part of the exercising of sovereign responsibility, not to block such assistance, and to accept the impartial and apolitical action of NGHAs. Host governments should facilitate the rapid entry of relief staff, particularly by waiving requirements for transit, entry and exit visas, or arranging that these are rapidly granted. Governments should grant over-flight permission and landing rights for aircraft transporting international relief supplies and personnel, for the duration of the emergency relief phase.
3. Governments should facilitate the timely flow of relief goods and information during disasters: relief supplies and equipment are brought into a country solely for the purpose of alleviating human suffering, not for commercial benefit or gain. Such supplies should normally be allowed free and unrestricted passage and should not be subject to requirements for consular certificates of origin or invoices, import and/or export licences or other restrictions, or to importation taxation, landing fees or port charges. The temporary importation of necessary relief equipment, including vehicles, light aircraft and telecommunications equipment, should be facilitated by the receiving host government through the temporary waiving of licence or registration restrictions. Equally, governments should not restrict the re-exportation of relief equipment at the end of a relief operation. To facilitate disaster communications, host governments are encouraged to designate certain radio frequencies, which relief organizations may use in-country and for international communications for the purpose of disaster communications, and to make such frequencies known to the disaster response community prior to the disaster. They should authorize relief personnel to utilize all means of communication required for their relief operations.
4. Governments should seek to provide a coordinated disaster information and planning service: the overall planning and coordination of relief efforts is ultimately the responsibility of the host government. Planning and coordination can be greatly enhanced if NGHAs are provided with information on relief needs and government systems for planning and implementing relief efforts as well as information on potential security risks they may encounter. Governments are urged to provide such information to NGHAs. To facilitate effective coordination and the efficient utilization of relief efforts, host governments are urged to designate, prior to disaster, a single point-of-contact for incoming NGHAs to liaise with the national authorities.
5. Disaster relief in the event of armed conflict: In the event of armed conflict, relief actions are governed by the relevant provisions of international humanitarian law.

Annex II: Recommendations to donor governments

1. Donor governments should recognize and respect the independent, humanitarian and impartial actions of NGHAs: NGHAs are independent bodies whose independence and impartiality should be respected by donor governments. Donor governments should not use NGHAs to further any political or ideological aim.

5. Donor governments should provide funding with a guarantee of operational independence: NGHAs accept funding and material assistance from donor governments in the same spirit as they render it to disaster victims; one of humanity and independence of action. The implementation of relief actions is ultimately the responsibility of the NGHA and will be carried out according to the policies of that NGHA.

3. Donor governments should use their good offices to assist NGHAs in obtaining access to disaster victims: donor governments should recognize the importance of accepting a level of responsibility for the security and freedom of access of NGHA staff to disaster sites. They should be prepared to exercise diplomacy with host governments on such issues if necessary.

Annex III : Recommendations to inter-governmental organizations

1. IGOs should recognize NGHAs, local and foreign, as valuable partners: NGHAs are willing to work with UN and other inter-governmental agencies to effect better disaster response. They do so in a spirit of partnership which respects the integrity and independence of all partners. Inter-governmental agencies must respect the independence and impartiality of the NGHAs. NGHAs should be consulted by UN agencies in the preparation of relief plans.
2. IGOs should assist host governments in providing an overall coordinating framework for international and local disaster relief: NGHAs do not usually have the mandate to provide the overall coordinating framework for disasters which require an international response. This responsibility falls to the host government and the relevant United Nations authorities. They are urged to provide this service in a timely and effective manner to serve the affected State and the national and international disaster response community. In any case, NGHAs should make all efforts to ensure the effective coordination of their own services. In the event of armed conflict, relief actions are governed by the relevant provisions of international humanitarian law.
3. IGOs should extend security protection provided for UN organizations, to NGHAs: where security services are provided for inter-governmental organizations, this service should be extended to their operational NGHA partners where it is so requested.
4. IGOs should provide NGHAs with the same access to relevant information as is granted to UN organizations: IGOs are urged to share all information, pertinent to the implementation of effective disaster response, with their operational NGHA partners.

ANNEX 6
RED CROSS POLICY ON NUTRITION[1]

TWENTY-FIFTH INTERNATIONAL CONFERENCE OF THE RED CROSS
Geneva, October 1986

ICRC/LEAGUE[2] POLICIES IN EMERGENCY SITUATIONS: NUTRITION POLICIES

CONTENTS

[1] This policy is somewhat dated with regard to recent developments in humanitarian interventions. However , most of the basic principles it presents are still valid today. Furthermore, this policy is important for the Red Cross because it was approved by the entire International Red Cross and Red Crescent Movement and by the governments which take part in the International Conferences of the Red Cross and Red Crescent Movement, during the twenty-fifth Conference, held in Geneva in 1986.

[2] The League is now the International Federation of Red Cross and Red Crescent Societies.

1. INTRODUCTION TO NUTRITION POLICIES

A satisfactory level of health depends on some basic needs being met. The most important of these are water, food and a safe environment. When these needs are not met and when conditions exist which threaten people's health status, it is essential that the actions taken in response to the identified problems are appropriate and effective. Nutrition is an essential component of health and requires specific consideration within the comprehensive approach to the provision of healthcare.

Red Cross and Red Crescent Societies involved with relief operations have increasingly felt the need for nutrition policies which would guide the planning, implementation and evaluation of relief activities and help to ensure that the responses are consistent and relevant to the defined needs. Such policies are particularly important because of the many factors which affect food availability and usage.

The nutrition and food donation policy papers are based on National Society, League and ICRC experiences and have evolved from consultations between these and other relevant organizations, and from meetings both in the field and in Geneva. The people who contributed to these papers had a sufficiently wide range of experience and knowledge to ensure that the policies reflect the lessons learnt from previous relief operations and recent advances in the fields of health and nutrition.

2.1 THE RED CROSS POLICY ON THE NUTRITIONAL ASPECTS OF RELIEF OPERATIONS

The Red Cross[3] recognizes that the causes of "nutritional emergencies" and the problems arising from them are many and complex. A large number of factors have to be taken into consideration in responding to such emergencies and the aim of any action must always be to restore or maintain the self-sufficiency of the affected population.

Although these policies deal only with the nutritional aspects of relief operations, it is essential that they be seen within the overall context of the physical, mental and social health of the community. This has important implications for understanding nutritional problems and initiating appropriate responses.

To this end, the following Policy has been drawn up by the League and the ICRC in collaboration with National Societies, Red Cross delegates and experts in the fields of nutrition, health and relief and is intended to make Red Cross relief operations in response to nutritional emergencies appropriate and effective.

This policy will provide a guide for decision-makers of the ICRC, LORCS and the National Societies concerning:

a) their response to nutritional emergencies at all stages from initial assessment and planning through to programme implementation, surveillance and evaluation;
b) the recruitment and training of personnel in the nutritional aspects of relief and rehabilitation operations;
c) the technical support to this policy is contained in guidelines under preparation.

[3] Red Cross in the context of this paper is: the International Committee of the Red Cross, the League of Red Cross and Red Crescent Societies and the National Societies of the Red Cross and the Red Crescent.

National Societies are requested to assist with the dissemination, implementation and interpretation of this policy throughout the Movement. This policy will only be effective if the Red Cross has the support of National Societies and other agencies working in this field. It will be asking participating National Societies to support surveillance systems for gathering information and the costs of the carrying out of early, comprehensive surveys. They will also be asked to support earlier programme intervention and schemes for the strengthening of operational capacity/preparedness.

A) Disaster preparedness and prevention

i The Red Cross should establish through its network of National Societies, contacts with other institutions and agencies involved in the collection of data, which provide an early warning of developing nutritional emergencies. Such information will be used to supplement and assist with the interpretation of subsequent surveys in the area, and will help to ensure an effective, appropriate and above all, timely response.

ii The Red Cross/Crescent will use standardized techniques for nutritional assessment. The collection of accurate and reliable nutritional data is an integral part of the initial survey. This information will be essential for determining the type of response (if any) to be made, and will provide a baseline against which the effectiveness of any nutritional intervention can be measured.

iii Standard terminology must be used in all nutritional reports.

iv The Red Cross/Crescent must develop the technical and management expertise necessary to implement effective relief programmes. This will require the employment and training of suitable personnel e.g. nutritionists, engineers and health professionals. Contacts should be made with institutions and individuals who have experience in the relevant fields so that they may make a contribution to improving the Red Cross capacity for responding effectively in nutritional emergencies. Emphasis should be given to utilizing local expertise.

B) Emergency relief

i Initial assessment

A Red Cross programme in response to nutritional emergencies must be based on comprehensive surveys organized by the National Society affected using experienced personnel. The initial survey must assess the level of malnutrition, analyse the causes and indicate what resources are either available or are required to deal with the emergency.

ii Planning

After consideration of the information resulting from the initial survey the decision to intervene or not will be made. If intervention is to be made a comprehensive plan of action must be drawn up covering the requirements for supplies, personnel, funding and giving indications of the type of programme to be established, given the constraints of the situation and the activities of other agencies. The initial planning should take into consideration the long-term needs of the affected community.

iii Intervention

Recognizing that vulnerability is greatly increased if a population migrates from their normal environment, early intervention is recommended, with emphasis placed on support to the family unit. Priority should be given to the provision of adequate supplies of water and food, the prevention of measles, Vitamin A deficiency and diarrhoeal diseases and attention to other priority health problems.

iv Food supplies

Food donated or bought for the purposes of relief distribution must be subject to the conditions and principles outlined in the food donation policy.

v Nutrition programmes

a) Provision of basic rations

When food is needed, an adequate basic ration must be assured either by the Red Cross complementing the available food, or when necessary, by taking the responsibility for the full ration.

Whether wholly or partly responsible for the basic ration, *the Red Cross must ensure that there is an adequate basic ration for all family members.* This basic ration must take into consideration the many factors, which may affect the nutritional requirements of different communities. It must be calculated so that it enables the population to sustain reasonable activity as well as normal growth and should also allow a margin for nutritional rehabilitation.

During a relief operation, specific technical advice is essential for food distribution if the basic ration is inadequate.

b) The care of the malnourished

Every effort must be made to assist these groups through the basic ration distribution rather than by setting up separate programmes: given sufficient quantities of appropriate food and adequate support, mothers are the best people to rehabilitate mildly or moderately malnourished children. The initiation of a therapeutic feeding programme should depend on the place which severe malnutrition takes in the overall hierarchy of health priorities.

c) Community health workers

The training and supervision of community health workers is an essential part of any nutritional intervention programme. They will ensure early “case finding”, follow-up of malnourished individuals, nutrition education and surveillance. Community health workers will also be fundamental to the development of primary healthcare activities.

vi Surveillance and evaluation

The effectiveness of nutritional interventions must be monitored regularly using standard methods. The results should be compared with the objectives outlined in the original plan of action and programmes should be modified in response to this information.

Phasing out of nutritional interventions should be considered when the criteria established in the original plan of action have been met. At this stage, it will be essential to further strengthen development activities, which will reduce the vulnerability of the affected population.

vii Development of National Societies

During all phases of responding to nutritional emergencies every opportunity should be taken to increase the National Societies’ capacity to plan, implement monitor and evaluate relief operations.

2.2 FOOD ISSUE IN RELIEF FOOD DONATION POLICY

A) Introduction

Food supplies are frequently part of Red Cross response to emergencies. However, it is essential in each situation to first establish that food supply is a correct response and then that the composition is defined and described after an adequate comprehensive survey. In every instance it is necessary to ensure that food donations are culturally and nutritionally appropriate for the affected population and that the costs of their purchase, transportation, storage and distribution is kept to a minimum.

Food which is inappropriate for whatever reason causes suffering for the victims of the disaster, embarrassment and frustration for those responsible for their distribution and brings well-earned discredit on the agency responsible for the donation. Thus it is the ICRC/League's responsibility to ensure as far as possible that any appeal for food assistance is both necessary and appropriate before sharing that appeal with National Societies and other donors. The ICRC/League in coordination with other relevant agencies are also responsible for establishing the energy and nutrient content of the rations, indicating the suitable food items to achieve this. They must also ensure that the response is in line with policy and that distributions of each donation are carried out fairly, efficiently and economically.

All offers of food assistance must be cleared by ICRC/League and accepted by the operating Society.

B) General principles

1. Foods should be appropriate to the beneficiaries to:
   → meet nutritional needs;
   → maintain traditional food habits;
   → avoid waste and large scale sale on black markets;
   → economize on scarce fuel;
   → avoid creation of new tastes;
   → avoid dependency on external food resources;
   → avoid disruption of local markets.
2. Local knowledge on each emergency situation will be the basis for the establishment of the food ration.
   Together with the National Society, a comprehensive survey should be carried out to ascertain the present nutritional status of the affected population, and if possible, the previous level, as well as to establish food requirements suitable in both type and amount.
   Other local relevant agencies should always be consulted and contact should be established with local nutritional expertise.
3. The ICRC/League action, and the food that it *will* provide, will be determined by consideration of needs (as determined above) and the action of other agencies. Contacts with all relevant government departments and with other agencies both locally and at headquarters must be made to gather and exchange information which will promote coordination.
4. Purchase of local foods in the country or in the region must always be considered in the early planning of food aid. This will make it possible to provide traditional foods and will usually be more cost-effective than sending foods from donor countries. This may be particularly necessary in the early stages of a relief action.
5. Information on local foods and their use is always available in-country, at institutions or in specialist organizations.
   ICRC/League have a responsibility to ensure access to these sources and to provide advice suitable to each situation. Clearance and comments must be sought from each operational Society.

6. The following information is available from the ICRC/League.
   (a) A table to include:
      → basic nutritional requirements
   (b) A table on nutritional values of:
      → typical donated food items;
      → typical rations of commonly used foods, particularly cereals;
      → commonly used "food baskets", i.e. mixtures of different food items;
      → recipes of typical mixtures of weaning foods or local recipes, etc.;
      → weight/volume measures of commonly used foods.
   (c) A list of locally available foods
      This will inform all partners involved on the relative values of foods in order to allow calculation of the nutritional content to meet the needs of the group to be assisted. This will also assess the suitability of food items in stock in the donor countries.
7. National Societies, proposing to provide food other than that requested must seek the clearance of the ICRC/League. The Red Cross nutrition policy will otherwise be jeopardized, the consistent approach disrupted and confusion created.
   As outlined in Rule 24 of Principles and Rules for Red Cross Disaster Relief unsolicited food donations may be used at the discretion of the operating National Society. They may be sold and the cash paid to the relief operation account and used for a more beneficial purpose for the affected population. The ICRC/League must, however, be informed about such transactions.
   The League/ICRC should explicitly register separately gifts in response to League appeals and those not in response. (General Assembly October 1985).
   In certain circumstances, changes in the operational situation and/or a very large provision of certain items by donors may lead to a situation where it is desirable for the effective management of the operation, to exchange requested food items provided in abundance for others which are in scarce supply. In this case,
   → the National Society/ICRC/League must consult with donors before making any exchanges;
   → care must be taken by the National Society/ICRC/League to avoid situations where exchanged food items become available for sale or are distributed to groups other than needy civilians and re-bagging should be considered;
   → subject to the above, donors are urged to respond positively and quickly to such requests.
   Excess supply or imminent expiry date is not sufficient reason to accept cheap or free food.

C) Recommendations

8. a)	Food in unmilled form especially cereals is preferable.	Food in umilled form usually has longer shelf life, higher nutritional value, more identifiable taste and lower cost.
b)	Donors of whole grains should ascertain that local milling facilities are available. Displaced persons and refugees need special consideration.	Whole grain must be milled to release full food value. Some traditional methods retain more nutrients and should therefore be encouraged and supported.
9.	Protein requirements should preferably be supplied by cereals, beans, peas and lentils.	Due to lack of understanding with regard to quality and amount of protein contents of some vegetables, especially those mentioned, requests are often made for expensive fish or meat products. Local fish or meat may be a preferred option when available, but imported varieties should be avoided.

10. a)	Long-term food relief should include small quantities of locally purchased food items which add the traditional flavour to the meals e.g. spices (red pepper etc.) condiments (fish and soy sauce) dried fruits and vegetables.	While these food items may be of negligible nutritional value, they improve the palatability and acceptability and so encourage consumption of nutritious food.
b)	Salt and sugar are necessary food items in most dietary habits.	Salt is especially essential in hot climates. In addition sugar and salt are the main ingredients in the home-made solution given to prevent dehydration from diarrhoea.
c)	Tea and coffee may also be considered.	Tea and coffee are essential in the social habits in many areas of the world. Their high psychological/ social value makes them important components of the food basket.
11. a)	The shelf life of food should normally be at least 6 months after arrival in the country and stored in such a way to keep the food quality in terms of taste, texture and nutritional content. Packages of food should be labelled with production date and expiry date. Donated foods must be packaged in a way to stand hot, humid climates and rough handling. Guidelines to good warehouse management should be provided and followed to prevent unnecessary wastage.	
b)	Fortified foods must be accurately and clearly labelled.	
12.	All foods should be in appropriate packages and clearly labelled in the official international language used by the recipients regarding its contents or ingredients and instructions for use.	This facilitates the acceptability from a cultural and religious point of view and ensures proper usage. This is particularly important for tinned foods and blended dried foods in sacks.
13.	The National Society purchasing is responsible for ensuring that the specifications and quality of the donation are met.	
14.	Metric measuring containers should accompany the first food donation.	These will assist in identifying local containers, which have equivalent volume and so ensure adequate equal rations.
15.	Provision of fuel and improvement to the water supply must at times be considered. ICRC/League and National Societies should consult a local institute, which has experience in local appropriate methods to find a realistic solution.	This problem is particularly important when disaster victims migrate and congregate.
16.	Cooking utensils for family use, of the type commonly used, should be provided.	Displaced and refugee families are most likely to be in need. Preparation of meals in a family setting must be encouraged and supported.

Restricted use

17.	Precooked or instant foods (e.g. instant C.S.M.) that require reconstitution with cold water before consumption should be avoided.	They are expensive and require special instruction and supervision in preparation. Clean water is necessary for the safe use of these products and when this is not available, there are increased health hazards. They may be used very occasionally in porridges/stews in the initial phase of an operation and where fuel is scarce.
18.	Certain foods produced in industrialized countries should be used restrictively and only in exceptional situations when well monitored. These concerns are especially true for:	
a)	milk products – the above are the subject of a special ICRC/League policy, *The Use of Artificial Milk in Relief Actions*, 1985.	These are of special concern when used in infant feeding and are the subject of the International Code of Marketing of Breastmilk Substitute (WHO) 1981.
b)	“high protein” or “high energy biscuits/tablets” are not suitable substitutes for food – restricted use as the night meal in therapeutic feeding may be considered.	A widely held, but erroneous view is that these products contain condensed energy. They may therefore contribute to under-nutrition. They are frequently too sweet, influencing children away from traditional foods. They are expensive. They must never be used as incentives or for convenience.

Not recommended

19.	Liquids and foods with high water content should not be included in food aid.	Energy dense food, i. e. solid, dry or powdered foods and oil provide maximum nutritional contributions per weight and volume and therefore have lower transportation cost.
20.	Certain foods are inappropriate in relief operations. Donors should never consider the consignment of any of the following items: canned baby foods, canned fruits, vegetables, cheese and soups, canned or bottled juices and syrups;	These goods have high water content (see above). They are also unfamiliar and processed.
	confectionery;	These products are too sweet and change eating habits, especially for children.
	frozen or refrigerated foods;	Storage facilities do not exist.
	slimming products;	Food, which is low in energy and high in bulk, is not suitable.
	breast milk substitutes, processed weaning food;	Donations are against the code mentioned in 18.
	military-type survival rations.	These rations are unfamiliar.
21.	The ICRC/League and National Societies should not undertake to conduct acceptability trials of food products on behalf of manufacturers.	

Evaluation

22.	The effects of food donations should be evaluated. This should be based on the principles outlined in the paragraph 1.	

2.3 DRAFT RESOLUTION

Nutrition and food donation policy in Red Cross emergency operations

The 25th International Conference of the Red Cross

- → aware that the physical and mental health of victims is affected during any emergency,
- → recalling that during health assessment of damage caused by any emergency, nutritional problems often represent the major component,
- → recognizing that due to the complexity of nutritional problems which cannot always be solved by food distribution alone, a professional approach is of utmost importance,

therefore, in order to obtain the maximum results from emergency operations with limited financial and manpower resources,

1. recommends that any Red Cross nutritional action and food distribution be undertaken within the framework of a clearly established nutritional programme,
2. recommends that any Red Cross nutritional programme be considered as an integral part of a general Health programme within the context of emergency operations,
3. urges ICRC, the League and National Societies to develop all their nutritional programmes in accordance with the "Nutrition and Food Donation Policy in Red Cross Emergency Operations" supported by recommendations of specialists,
4. recommends that each National Society and Governments wishing to participate in a nutritional action and food distribution through League/ICRC emergency operations or on a bilateral basis with the involvement of a National Society, follow "The Red Cross Food Donation Policy" in order to achieve the best possible effect for victims, to avoid unsolicited food donations and thus to prevent waste of limited food and financial resources.

ANNEX 7
NUTRITIONAL SURVEY INDICATORS: EXAMPLES

Table A.7 Nutritional survey indicators

Categories	Risk factors	Variables	Indicators	Useful references for interpretation
Economy Subsistence agriculture:	Decline in production.	Rainfall, temperature, parasites, plant sickness.	Rainfall calendar and amount, yield forecasts, cultivated surface, harvested amounts, proportion of sick plants, parasite damage.	Amount of food necessary for the family, purchasing power generated by the sale of production surplus.
Subsistence pastoralism:	Decline of the herd and its productivity.	Rainfall, stock disease, water and pasture availability.	Rainfall calendar and amount, prevalence and incidence of stock disease, compatibility between water points, grazing land and campsites, amount of milk produced. Value of the economic performance, unemployment rates, price and salary trends.	Minimum herd size for economic self-sufficiency, amount of milk required to feed the family.
Wage labour:	Unemployment, salary cuts, increase of the cost of essential goods and services.	Economic recession and inflation, non-indexation of salaries, reductions in supply.		Minimum necessary salary for the purchase of essential goods and services.
Health Collective health status:	Deterioration.	Weight, height, mid-upper arm circumference, age.	Proportion of individuals below critical cut-off points.	Proportion of individuals below critical cut-off points in normal circumstances.
Food consumption Breastfeeding:	Early termination of breastfeeding.	Factors that lead to the early termination of breastfeeding.	Average weaning age (i.e. the age at which 50% of children are no longer breastfeed). Types and amounts of food consumed, number of meals per day.	Average weaning age in normal circumstances.
Eating habits:	Changes in eating habits.	Types of food consumed, meal frequency.		Types/amounts of food consumed and meal frequency in normal circumstances.

ANNEX 8
NORMAL DISTRIBUTION (SCHWARTZ, 1963)

The normal distribution or law (also called Gaussian distribution) is a probability law that applies to quantitative, continuous, and non-limited variables. The equation of normal distribution is provided in Figure A.8.1 below.

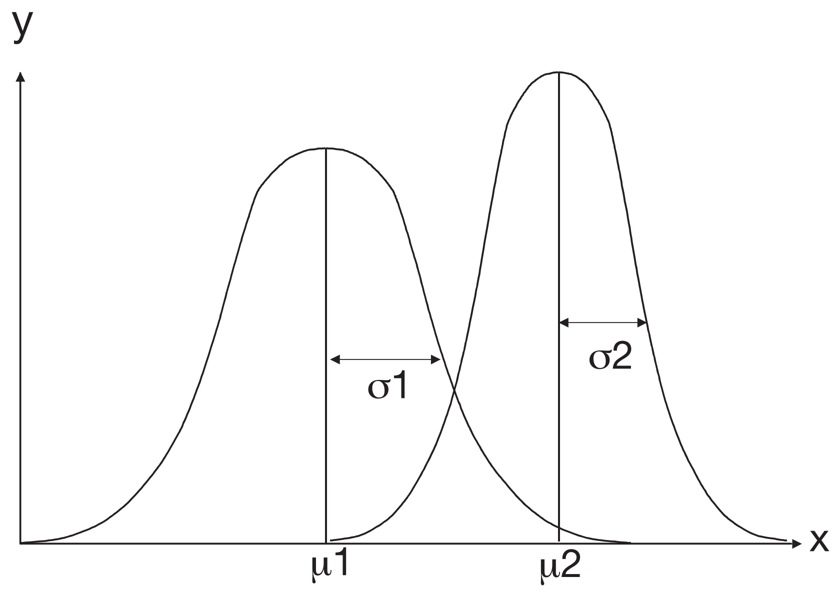
Figure A.8.1 Probability density function

$$y = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

Where
μ is the average
σ is the standard deviation
e is the base of natural logarithms (approx. 2.718…)
x is the variable under scrutiny

The standard deviation value represents the variability of the variable under scrutiny (x). The graphic representation of normal distribution is also called a Gaussian curve. In the following example (Figure A.8.2), two curves are represented: in the first the average value of variable x is lower than the second, but its variability is greater.

Figure A.8.2 Normal distribution

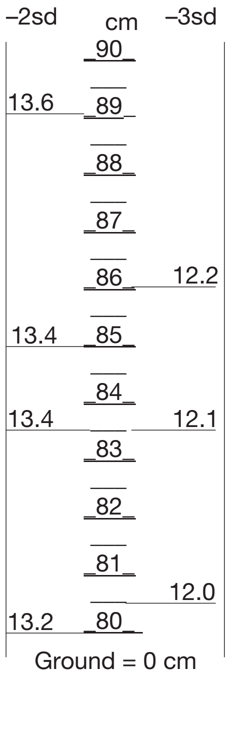


ANNEX 9
THE QUAC STICK ANTHROPOMETRIC METHOD (FROM DE VILLE DE GOYET, 1978)

1. MAKING A QUAC STICK OR HEIGHT SCALE (FIGURE A.9)

1.1 Find a 150 cm (height) by 10 cm (width) board.
1.2 Sandpaper one of its sides in order to draw gradients or fasten a ready-made adhesive tape (see below) on it.
1.3 Down the middle of the length of the board, mark each centimetre (0 at ground level) up to 115 cm, indicating 1/2 cm; alternatively, a measuring tape may be fastened down the middle of the board.
1.4 On the left hand side, mark the mid-upper arm circumference corresponding to –2 standard deviations or 85 % of the median, with a mark opposite the corresponding height, following one of the tables provided below.
1.5 On the right hand side, mark the mid-upper arm circumference corresponding to –3 standard deviations or 75% of the median, with a mark opposite the corresponding height, following one of the tables provided below.
1.6 Adhesive tapes may be produced in the above format, which indicate the data of stages 1.3 to 1.5 above – they may then simply be pasted onto the board.

Figure A.9 The QUAC stick – example



2. CHOOSING THE REFERENCE AND THRESHOLDS

The data usually used to make QUAC sticks are those provided by de Ville de Goyet (de Ville de Goyet, 1978), as indicated in Table A.9.1 below. Moderate malnutrition is indicated by a mid-upper arm circumference (MUAC) of less than 85% of the median, and severe malnutrition by one lower than 75% of the median. The 85% cut-off point is usually considered to be overly sensitive, whereas the 75% cut-off point is neither too sensitive nor too specific in order to determine severe wasting.[1]

The US National Center for Health Statistics (NCHS) reference tables for mid-upper arm circumference (WHO, 1995; Mei, 1997) provide median MUAC-for-age and MUAC-for-height values with their standard deviation. Unfortunately, the standard deviation is low in MUAC-for-height tables (Mei, 1997), causing the –2 Z-scores and especially the –3 Z-scores thresholds to be too sensitive to determine moderate, and especially severe, malnutrition accurately. For example, for a child measuring 92 cm, the –2 Z-scores threshold is 13.9 cm, the –3 Z-scores threshold is 12.8 cm. The corresponding values for 85% and 75% of the median are 13.9 and 12.2 respectively according to de Ville de Goyet. Sensitivity grows with height, causing an increasing specificity loss.

On the other hand, the combination of MUAC-for-age tables (WHO, 1995) and height-for-age tables (WHO, 1983) supplies MUAC-for-age and MUAC-for-height values with the standard deviation of MUAC-for-age. The –2 Z-scores threshold is more specific than 85% of the median values used by de Ville de Goyet; the –3 Z-scores threshold is roughly identical to 75% of these median values. The –2 Z-scores and –3 Z-scores thresholds tend to become more specific above 100 cm in height. This Manual recommends that the –2 Z-scores threshold be used for moderate malnutrition, and the –3 Z-scores threshold for severe malnutrition, as provided in Annex 4.3. Table A.9.2 below provides the data for the QUAC stick.

Table A.9.1 Data for QUAC sticks according to de Ville de Goyet (de Ville de Goyet, 1978)

Height (cm)	Mid-upper arm circumference (cm), 85% of the median	Height (cm)	Mid-upper arm circumference (cm), 75% of the median
72	13.25	72	11.75
80	13.5	84	12.00
88	13.75	92	12.25
96	14.00	100	12.50
101	14.25	105	12.75
106	14.50	108	13.00
109	14.75	113	13.25
112	15.00		

[1] The 75% cut-off point may be considered to be too sensitive for admission to therapeutic feeding centres, depending on circumstances.

Table A.9.2 Data for QUAC sticks according to Annex 4.3

Height (cm)	Mid-upper arm circumference (cm). –2 Z-scores	Height (cm)	Mid-upper arm circumference (cm). –3 Z-scores
74	12.8	74	11.6
76.5	13.0	77.5	11.8
80	13.2	80.5	12.0
85	13.5	83.5	12.1
89	13.6	86	12.2
93	13.7	92	12.3
96.5	13.8	96.5	12.4
101.5	14.0	100	12.5
104	14.1	103.5	12.6
109	14.2	110	12.7

3. USING THE QUAC STICK

1. Ensure that the height scale is held firmly vertical on a plane surface.
2. Select all children between 74 and 109 cm in height (i.e. roughly between 1 and 5 years old) for measurement.
2. Measure mid-upper arm circumference as described in Chapter X, Section 4.4.1.
3. Stand the child upright with its back flat against the height scale.
4. Observations may be interpreted in two ways; they lead to the same result, but may cause confusion.
   → The child's actual mid-upper arm circumference is found on the left-hand scale (–2sd). If the child is shorter than the corresponding height indicated on the scale, the child is not wasted. If on the other hand, it is taller than the reference height for its MUAC, it is wasted, and the height corresponding to its MUAC value must be sought on the right-hand scale (–3sd). If the child is shorter than this reference, it is moderately wasted; if the child is taller, then it is severely wasted.
   → Conversely, the child's MUAC value should be located above the child's height on the left-hand scale – if this is the case, the child is not wasted. If the MUAC value is indicated below the child's actual height, then the child is wasted, and its values must be sought on the right-hand scale accordingly. If the child's MUAC value is indicated above its height, it is moderately wasted; if the child's MUAC is indicated below its height, it is severely malnourished.

Thus, the QUAC stick method is an easy and fast way of distributing children into three nutritional status groups: good nutritional status, moderate wasting, and severe wasting.

ANNEX 10
PRELIMINARY ASSESSMENT CHECKLIST: EXAMPLES

1. ASSESSMENT REFERENCE DATA

- ⇨ Assessment date(s)/Name of the assessor(s).
- ⇨ Name and type of location visited (hill *W*, camp *X*, village *Y*, suburb *B* of town *Z*, etc.).
- ⇨ District/province.
- ⇨ Local population (individuals).
- ⇨ Roadmap and/or GPS coordinates.
- ⇨ Closest location indicated on the map, and distance to assessed location (km).
- ⇨ Authorities met, and names of officials and counterparts.
- ⇨ Local administration (type, key counterparts, staff).
- ⇨ Reasons for the assessment.
- ⇨ Hypotheses underlying the assessment.
- ⇨ Objectives of the assessment.
- ⇨ Assessment methodology and tools.

2. DEMOGRAPHIC AND BASIC DATA

- ⇨ Population type (residents/displaced/detainees, etc.).
- ⇨ Information regarding displaced persons: date of arrival in their present location, origin, reason for the movement, duration of the journey and its conditions, sustained losses and damage, anticipated return (i.e. necessary conditions), anticipated date of return, belongings that could be taken along.
- ⇨ Population breakdown according to age and sex, and population density.
- ⇨ Population movements, dates, and numbers involved.
- ⇨ Epidemiological data (mortality and morbidity rates).
- ⇨ Cultural data (ethnicity, religion, usual languages, possible discrimination, major economic activities).
- ⇨ Condition of the population (appearance, clothing, physical and mental health);
- ⇨ Vulnerable population groups.
- ⇨ Physical geography of the location (hills, swamps, plains, rainwater runoff, type of soil, vegetation).
- ⇨ Climatic data (altitude, average and extreme temperatures, seasonal cycle and duration, rainfall).
- ⇨ Existing types of organization (type, activities, level of collaboration/coordination).
- ⇨ Existing assistance (type and number, theoretical and actual).
- ⇨ Involvement of the target population in programmes and the administration;
- ⇨ Local services (effectiveness and efficiency).
- ⇨ Existing communications and their condition (roads, airfields, railroads, waterways, ports, postal services, telephone, etc.).
- ⇨ Skills existing within the population (type).

3. NUTRITION

- ⇨ **Feeding system of the observed population**
  - → ***Production:***
    - → contribution of the agricultural and pastoral production to the overall economy in normal conditions and at the time of the assessment;
    - → access to land and production inputs (seeds, fertilizer, pesticides, irrigation, veterinary services, animal feed);
    - → crop and herd types;
    - → seasonal calendar;
    - → cultivated surface, herd size, and possible yield;
    - → presence of pests and diseases affecting crops and/or herds;
    - → possible and anticipated losses;
    - → harvest utilization (domestic consumption/sale);
    - → surplus storage and preservation;
    - → contribution of production to the economy, and anticipated evolution of this contribution;
    - → existing compensation systems for production shortages.
  - → ***Purchase:***
    - → contribution of income-generating activities to the economy in normal conditions and at the time of the assessment;
    - → access to income-generating activities;
    - → type of income-generating activities;
    - → yield of income-generating activities;
    - → relative purchasing power for essential goods and services (market survey in terms of goods, services, and labour and their evolution, status of supply and demand for essential goods and services);
    - → contribution of purchasing power to the economy, and anticipated evolution of this contribution;
    - → existing compensation systems for purchasing power inadequacies.
  - → ***Gathering:***
    - → contribution of gathering activities to the economy in normal conditions and at the time of the assessment;
    - → type and yield of gathering activities;
    - → contribution of gathering activities to the economy, and anticipated evolution of this contribution;
    - → existing compensation systems for inadequacies in gathering activities.
  - → ***Social obligations:***
    - → contribution of social obligations to the economy in normal conditions and at the time of the assessment;
    - → type of existing social obligations at the time of the assessment, beneficiaries, contribution to the household economy;
    - → anticipated evolution of this contribution.
- ⇨ Where relevant, the causes for discrepancies between the situation observed at the time of the assessment and that prevailing in normal conditions.
- ⇨ Comparison of the observed situation with past crises.
- ⇨ Conditions causing changes in the nutritional need (habitat conditions, climate, lack of clothing and shelter, changes in physical activity, etc.).
- ⇨ Compendium of the ability to satisfy the nutritional need and other essential economic needs according to production activities studied within the feeding system.
- ⇨ Anticipated evolution of this ability.
- ⇨ Eating habits (staple foods and their complements, utilization of animal products, fruits, vegetables, nuts, fats and sugar, utilization of gathered foods, alcohol intake, the rules governing food consumption, taboos, breastfeeding and weaning practices).

- ⇨ Food consumption patterns at the time of the assessment.
- ⇨ Where relevant, the causes for discrepancies between food consumption patterns observed at the time of the assessment and usual eating habits.
- ⇨ The risks arising from such discrepancies.
- ⇨ Nutritional status.
- ⇨ Appraisal of present and anticipated nutritional disorders (according to assessors and according to their informants).

4. IMPORTANT COMPLEMENTARY ISSUES

- ⇨ The overall health situation, condition of existing healthcare facilities (infrastructure, staff, equipment, supply), and their ability to cope with the present situation, the cost of healthcare and medicine.
- ⇨ Water and habitat (access to water, water quality, water access for herds, the risk of contamination of drinking water sources, existing waterborne disease, runoff, human waste and garbage disposal, problems related to this disposal, personal hygiene, vector control and possible problems, habitat quality and appropriateness, risks related to habitat).
- ⇨ Issues related to the protection of individuals, their resources and rights, possible abuse on the part of relevant authorities (rape and violence, theft and looting, illegal taxation, absence of control measures, legal violations, discrimination based on sex, ethnicity, religion, and/or economic status).

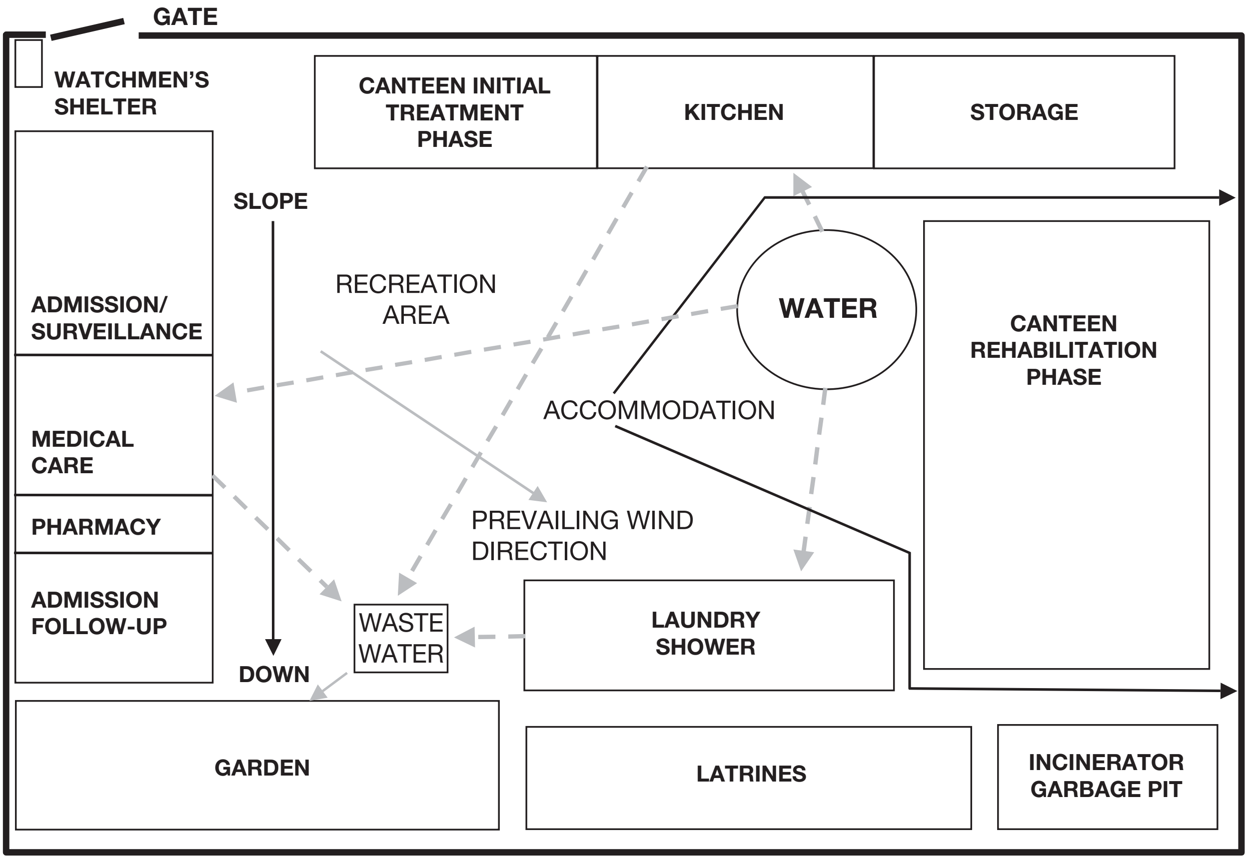
5. PRELIMINARY ON-SITE CONCLUSIONS

- ⇨ The comments and appraisals of key stakeholders should be included.
- ⇨ Compendium of hypothesis testing.
- ⇨ Compendium of the assessment objectives.
- ⇨ Adjustment of chosen methodologies and tools to reality.
- ⇨ Appraisal of existing problems and their cause (i.e. “what”, “because of what”).
- ⇨ Appraisal of the need for assistance (i.e. “what”, “why”, “for whom”, “how much”, “for how long”).
- ⇨ Priority ranking.
- ⇨ Appraisal of opportunities and constraints.
- ⇨ Appraisal of necessary accompanying protection measures (assistance and representation).
- ⇨ Necessary decisions following the assessment, and required follow-up.

ANNEX 11

THERAPEUTIC FEEDING CENTRE LAYOUT

Figure A.11 Therapeutic feeding centre



ANNEX 12
IMPROVING WATER QUALITY IN A THERAPEUTIC FEEDING CENTRE

Both the quality and the quantity of the water supply must be adequate in a therapeutic feeding centre (TFC) in order to ensure appropriate care and feeding. The recommended amount of water is usually 30 l per patient and per day; 10 litres are the absolute minimum. This amount applies to the type of TFC that is common in disasters in developing countries; it may however be much greater in modern facilities equipped with flush toilets, showers, pressure cookers, and laundry machines. These are usually connected to water supply networks, and in that case the water need not be filtered or purified.

Improving the water quality in a TFC involves the use of several methods, which may be combined according to need and available means: sedimentation, filtering, and purification.

Sedimentation is the process used to purify turbid water. It describes the motion of particles in suspension in response to an external force such as gravity, centrifugal force or electric force. Such particles can then be eliminated. It may be necessary to eliminate particles prior to filtration, and they must in any case be eliminated prior to purification. Depending on the nature and turbidity of the water, the filtration process can cause particles in suspension to clog filters completely. Proper chemical purification of turbid water can be difficult, and the process involves large amounts of disinfectant. Sedimentation can be passive, involving the storage of water in a container or the slow, spontaneous, passage of water through a settlement (or decantation) trough so that particles settle spontaneously; it can also be active, which is faster and involves the flocculation of particles with aluminium sulphate. Sedimentation rates vary considerably according to the size and nature of the particles in suspension.

Filtration refers to a broad range of processes, which all aim at separating two or more substances. Slow filtration involves passing the water through sand (0.2 m per hour), so that solids are trapped, while the fluid passes through. This principle relies upon the size difference between the particles making up the fluid, and the particles making up the solid. The process substantially improves the microbiological quality of the water by trapping or destroying most types of virus, bacteria, protozoan cysts and helminthic (worm) eggs. Trapping and destruction occur within the top layers of the filter through the development of a micro-flora whose biological activity kills micro-organisms, whereas the formation of a layer of waste strengthens the filter through a clotting process (Cairncross & Feachem, 1993). Sand filtration requires no more than a simple barrel filled with alternating layers of sand and gravel. Oxfam material is commonly used in humanitarian operations; this equipment is highly effective, and consists of three reservoirs. The first is a storage (and, thus, sedimentation) reservoir that contains the untreated water. The second is a filter, and the third is a purifier. As indicated above, passive or active sedimentation must be performed before filtration according to water turbidity.

Purification describes a chemical or thermal treatment that kills germs. Chemical purification with chlorine is the most common method; it must be performed by an expert, and this Manual therefore limits itself to only describing its principle. The different chemicals used for chlorine purification are distinguished according to their specific active chlorine concentrations. This concentration must therefore be allowed for in order to achieve a given concentration of chlorine in the water. In contact with water, the chemical dissolves and releases free chlorine. This free chlorine sets on the particles, notably organic particles that contain carbon, through oxidation. Particles that are living organisms (e.g. virus, bacteria) are destroyed by chlorine oxidation. Water purification is completed when all particles have been bound by the chlorine. Free chlorine is thus consumed by purification; consequently, the process may be considered to be completed when free chlorine remains in the water after a given contact period (this period varies according to the amount of water). Residual free chlorine is easily measured: following the required contact period, 0.5 mg of free chlorine per litre of water should remain – this amount is usually effective against possible subsequent contamination. However, the transfer of purified water to unclean containers can deplete residual free chlorine entirely resulting in the preservation of some pathogens. Consequently, 0.5 mg free chlorine water is intended for immediate use – it should not be kept or exposed to sources of contamination. It is worth noting that chlorine has a great affinity for metals; as a result, water should not be chlorinated or stored in metal containers because chlorine oxidizes metal, and the metal lining of containers can absorb the purification chlorine entirely (much more, in fact, than the amounts of chlorine usually used for water purification). In practice, it may be difficult to chlorinate all the water used in a TFC from the onset. In such cases, water should be differentiated according to its ultimate use: water intended for cleaning (which need not be treated), and that used for consumption and treatment. Consumption water can then be disinfected by boiling it for at least 10 minutes. The water used for treatment should be purified using Katadyn-type filters, and can then be further purified with chlorine tablets intended for a given volume (1 or 5 l of filtered water). Clearly, consumption water should be purified through boiling only if it cannot be chlorinated, as the former method is energy-intensive (boiling 1 l of water involves using 1/2 kg of firewood).

ANNEX 13
THERAPEUTIC FEEDING CENTRE EQUIPMENT

1. NUTRITIONAL EQUIPMENT

Oxfam kits provide the basis of nutritional equipment. Should they not be available, the following lists detail the necessary materials, which can usually be found locally and more cheaply than actual kits. The use of kits on the other hand saves time, they are complete and easily transported. MSF also provide kits that are similar to Oxfam kits.

1.1 KIT 1: ANTHROPOMETRY

⇨ Suspended scales (Salter type), 25 kg, 100 g graduation, with 3 slings, 1 suspension bar	2
⇨ MUAC strips	50
⇨ Notebooks	4
⇨ Calculator	1
⇨ Manual counters, metal	2
⇨ Rope (10 m x 6 mm), roll	1
⇨ Pencils	12
⇨ Clipboards, A4	4
⇨ Assessment forms	40
⇨ Evaluation forms	2
⇨ Plastic A4 folders, open on two sides	10
⇨ Erasers	5
⇨ Permanent markers, broad, black	4
⇨ Notes on revised Oxfam kits (English)	1
⇨ Notes on revised Oxfam kits (French)	1
⇨ Scissors, 17cm	1
⇨ Graphic millimetre paper (pad)	1
⇨ Ballpoint pens, black	10
⇨ Transparent plastic rulers, 30 cm	4
⇨ Adhesive tape, rolls	2
⇨ Tape measures, metric, fiberglass	2
⇨ Backpacks	2
⇨ Weight-for-height percentage tables, combined sexes, plastic-coated	4
⇨ Random number tables, plastic-coated	4
⇨ Weight-for-height Z-score tables, combined sexes, plastic-coated	4
⇨ Pencil sharpeners, metal	4
⇨ Height and length scales	2

Reference documents:

⇨ Food scarcity and famine (Oxfam Practical Guide No. 7)	2
⇨ MSF Nutrition Guide (French and English)	1
⇨ Refugee Health Care (Oxfam Practical Guide No. 9, French and English)	1
⇨ Selective Feeding Programme (Oxfam Practical Guide No. 1, French and English)	1

The above Anthropometry Kit is designed for two assessment teams or two nutritional centres.

1.2. KIT 4: THERAPEUTIC FEEDING

⇨ Kitchen scales, 5 kg	1
⇨ Suspended scales, 50 kg, 200 g graduation	1
⇨ Washbasins, 20 l	4
⇨ Jerrycans, plastic, collapsible, with tap	10
⇨ Bowls, 500 ml	200
⇨ Candles, box	1
⇨ Scrubbing brushes	4
⇨ Calculator	1
⇨ Milk cards	500
⇨ Teaspoons, 5 ml, metal	50
⇨ Teaspoons, 5 ml, plastic	250
⇨ Spoons, metal, 30 cm handle	2
⇨ Whisks, metal, 76 cm handle	3
⇨ Mugs, 500 ml	200
⇨ Petrol lamps	4
⇨ Ladles, metal, 43 cm handle, 250 ml volume	4
⇨ Cauldron, 100 l	1
⇨ Cauldrons, 50 l	2
⇨ Graduated measures, transparent plastic, 1 l	4
⇨ Graduated measures, transparent plastic, 2 l	4
⇨ Alarm clock, mechanical	1
⇨ Notes on revised Oxfam kits (English)	1
⇨ Notes on revised Oxfam kits (French)	1
⇨ Can openers, metal	2
⇨ Zinc oxide surgical tape, rolls	2
⇨ Batteries for electrical torches	16
⇨ Baby potties, suitable for stacking	10
⇨ Soap (box of 24 bars @ 100/200g)	1
⇨ Buckets, plastic, graduated, with lid, 8.5 l	12
⇨ Disposable syringes, 10 ml	100
⇨ Disposable syringes, 60 ml	50
⇨ Spatulas, wood, 89 cm handle	3
⇨ Paediatric stethoscope	1
⇨ Electrical torches	4
⇨ Nasogastric tubes, size 10	30
⇨ Nasogastric tubes, size 6	10
⇨ Nasogastric tubes, size 8	30

The reference documents are the same as for the Anthropometry Kit, in addition to the Médecins Sans Frontières (MSF) Clinical Guide (French and English).

The above Therapeutic Feeding Kit is designed for 100 children. Should the centre accommodate more children, it is better to complete it with 1 or 2 Supplementary Feeding Kits (Annex 18), designed for 250 children, than to add 3 or 6 Therapeutic Feeding Kits. Beyond these dimensions, it is best to set up a second centre.

1.3 KIT 4/2: REGISTRATION FOR THERAPEUTIC FEEDING

⇨ Notebook, bound, A4	1
⇨ Filing box for A4 forms	1
⇨ Alphabetical cards A–Z, A4, series	1
⇨ Identification bracelets, red	400
⇨ Milk cards	500
⇨ Monitoring cards A4	500
⇨ Erasers	4
⇨ Notes on revised Oxfam kits (English)	1
⇨ Notes on revised Oxfam kits (French)	1
⇨ Graphic millimetre paper, A4, pad	1
⇨ Ballpoint pens, black	10
⇨ Permanent markers, broad, black	2
⇨ Permanent markers, broad, red	2
⇨ Pencils	10
⇨ Pencil sharpeners, metal	4
⇨ Ledger, bound, A3	1
⇨ Transparent plastic rulers, 30 cm	4
⇨ Scissors, 17 cm	2
⇨ Stapler	1
⇨ Staples, box @ 1,000 pcs	1

The Registration Kit is provided together with the Feeding Kit. It is designed for 100 children for three months. It should be renewed every 3 to 6 months, and it may be ordered separately.

2. MEDICAL EQUIPMENT

Medical equipment should be provided in kits (dispensary/paediatric), and be renewed in time. The TFC pharmacy should contain the following:

- ⇨ Ampicillin/amoxicillin
- ⇨ Gentamicin
- ⇨ Cotrimoxazole
- ⇨ Chloramphenicol
- ⇨ Tetracycline ointment
- ⇨ Metronidazole
- ⇨ Mebendazole
- ⇨ Chloroquine
- ⇨ Quinine
- ⇨ ReSoMal or ORS
- ⇨ Paracetamol
- ⇨ Vitamin A
- ⇨ Iron and folic acid
- ⇨ Gentian violet
- ⇨ Permethrin
- ⇨ Benzyl benzoate

It should also contain:

⇨ First-aid material (disinfectant, dressing material, surgical tape, bandages, poultices for burns, scissors);
⇨ Basic medical material (stethoscope, otoscope, thermometer, disposable gloves, syringes, needles);
⇨ A dozen Katadyn-type water filters to purify the water used for medical care;
⇨ Scales and measuring tapes for adults and adolescents in case they are taken in by the TFC (this equipment is also useful to weigh the examiner and the patient together and deduce the patient's weight accordingly, for instance for reluctant or weak children);
⇨ Basic laboratory material (microscope, glass plates, solvents and tincture, especially for the detection of malaria);
⇨ The means to vaccinate against measles quickly and at all times.

3. TOOLS AND MISCELLANEOUS EQUIPMENT

⇨ Wheelbarrows	2
⇨ Shovels	2
⇨ Pickaxe	1
⇨ Padlocks for gates and doors	4
⇨ Padlocks for cupboards	8
⇨ Axe	1
⇨ Wood saw	1
⇨ Hoes	2
⇨ Machetes	2
⇨ Strong knives	2
⇨ Hammer	1
⇨ Wire, rolls	2
⇨ Wire-cutter (cutting pliers)	1
⇨ Screwdriver, slotted	1
⇨ Screwdriver, cross-point	1
⇨ Screws, box	1
⇨ Nails, box	1
⇨ Rope, 5 mm section, 10 m rolls	5
⇨ String, rolls	5
⇨ Adhesive tape, rolls	5
⇨ Paraffin lamps	5
⇨ Paraffin, litres	50
⇨ Matches (boxes of) and/or lighters	10
⇨ Tarpaulin, sheets	10
⇨ Barrels	4

The above equipment is designed for TFC maintenance and does not allow for additional requirements related to infrastructural construction or modification. TFC staff should also be equipped with Swiss army knife type material.

4. STATIONERY AND OFFICE EQUIPMENT

In addition to such material included in Oxfam kits, it is best to allow for equipment that is especially allocated to office work, such as perforators, envelopes, notepads, staplers, scissors, pens, pencils, erasers, rulers, and pencil sharpeners.

5. CLEANING MATERIAL

In addition to Oxfam kits, the following items should also be provided: detergent (soap, laundry powder, dishwashing liquid), sponges, kitchen towels, floor cloths, brooms, buckets that are only used for cleaning purposes, water chlorination kits, and used engine oil and quicklime for the disinfection of latrines.

6. FURNITURE

⇨ Benches	5
⇨ Chairs	20
⇨ Tables	5
⇨ Cupboards and padlocks	2
⇨ Pharmacy shelves	
⇨ One warehouse wall should be equipped with shelves	
⇨ Medical examination bed	1

7. BEDDING

⇨ Mattresses/mats, corresponding to the number of beneficiaries
⇨ Blankets, corresponding to the number of beneficiaries

8. WATER AND SANITATION

Provided that the water supply system is reliable 24 hours per day, there is no need for high-capacity water tanks. Otherwise, the TFC must have a reserve capacity of at least 100,000 l (500 children $\times$ 30 l /day $\times$ 7 days = 105,000 l), and a dozen 100 l tanks equipped with taps or gravity water distribution ramps connected to the main tank.

An incinerator must be combined with the latrines and garbage pit; incinerators are easily made from an empty standard 200 l oil barrel.

ANNEX 14
TFC LEDGER: EXAMPLE

No.	Date	Name	Age	Sex	Address	Carer	Weight kg	Height cm	MUAC cm	K	W/H	MUAC/H	Sickness	Date examination 1		Date examination 2	
														Weight	MUAC	Weight	MUAC
1																	
2																	
3																	

No.: personal identification number as indicated on the child's bracelet.
K: kwashiorkor.
W/H: weight-for-height, in % of the reference value or in Z-score.
MUAC: mid-upper arm circumference.
MUAC/H: MUAC-for-height, in % or Z-score.

The easiest way of registering data is to spread it across two facing pages (i.e. double spread), and to then continue entering examination data on the following double spread. Subsequent admissions are then registered only on the third double spread, and so on.

ANNEX 15
VITAMIN AND MINERAL FORMULA FOR THERAPEUTIC FEEDING

This formula is based on the recommendations of Briend and Golden (Briend & Golden, 1993). The commonest commercial form is manufactured by Nutriset (therapeutic vitamin and mineral complex, CMV); 6.35 g of this powder (i.e. one dose) must be added to 2 litres of previously boiled milk for nutritional catch-up (see Chapter XIII, recipes). This process produces the equivalent of F-100 ou F-75 Formula.

6.35 g of therapeutic CMV contain:

Vitamins: vit. A (3,000 µg), vit. D (60 µg), vit. E (44 mg), vit. C (200 mg), vit. B_1 (1.4 mg), vit. B_2 (4 mg), vit. B_6 (1.4 mg), vit. B_{12} (2 µg), vit. K (80 µg), biotin (0.2 mg), folic acid (700 µg), pantothenic acid (6 mg), and niacin (20 mg).

Minerals: potassium (2 340 mg) magnesium (146 mg), zinc (40 mg), copper (5.7 mg), iron (0 mg), iodine (154 µg), and selenium (94 µg).

ANNEX 16
VITAMIN AND MINERAL FORMULA FOR SUPPLEMENTARY FEEDING

This formula is based on the recommendations of Golden *et al.* (Golden *et al.*, 1995) for flour preparations used in therapeutic and supplementary feeding. The commonest commercial form is manufactured by Nutriset (supplementary vitamin and mineral complex, CMV); 24 g of this powder (i.e. 4 doses of 6 g each) are added to each kilogram of flour after cooking.

6 g of supplementary CMV contain:

Vitamins: vit. A (2,560 IU), vit. D (360 IU), vit. E (38.4 IU), vit. C (76.8 mg), vit. B_1 (1.44 mg), vit. B_2 (1.92 mg), vit. B_6 (0.864 mg), vit. B_{12} (1.92 µg), folic acid (384 µg), niacin (12.5 mg), and pantothenic acid (9.60 mg).

Minerals: potassium (1,790 mg), magnesium (171 mg), calcium (768 mg), phosphorus (330 mg), iron (5.8 mg), zinc (15.4 mg), copper (0.7 mg), and iodine (240 µg).

ANNEX 17
SUPPLEMENTARY FEEDING PROGRAMME LAYOUT

Figure A.17.1 Supplementary feeding programme centre, rations consumed on site

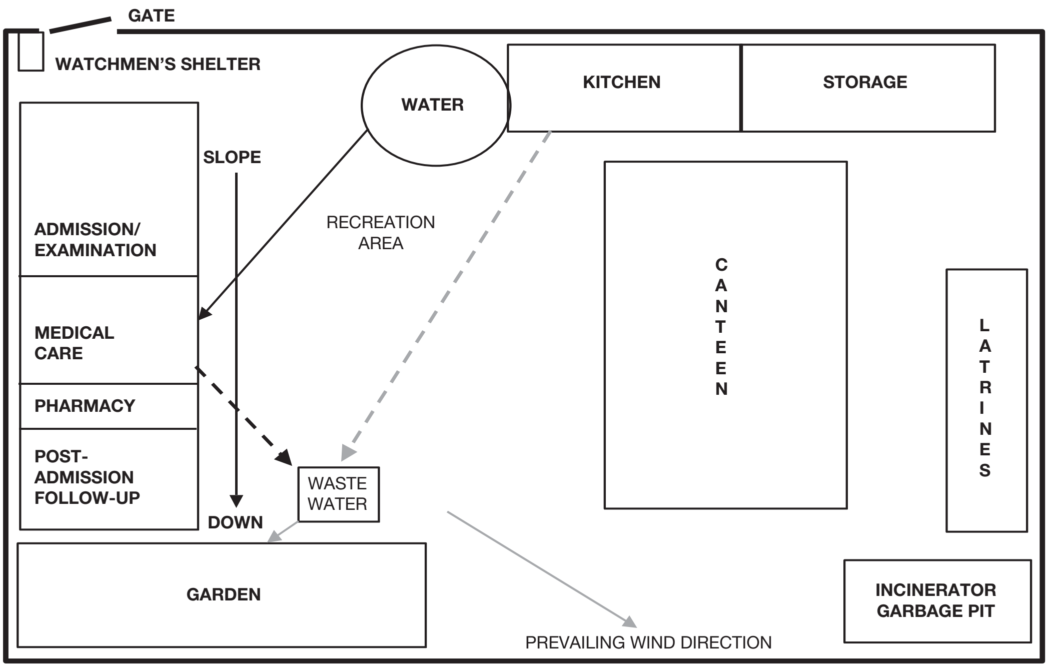
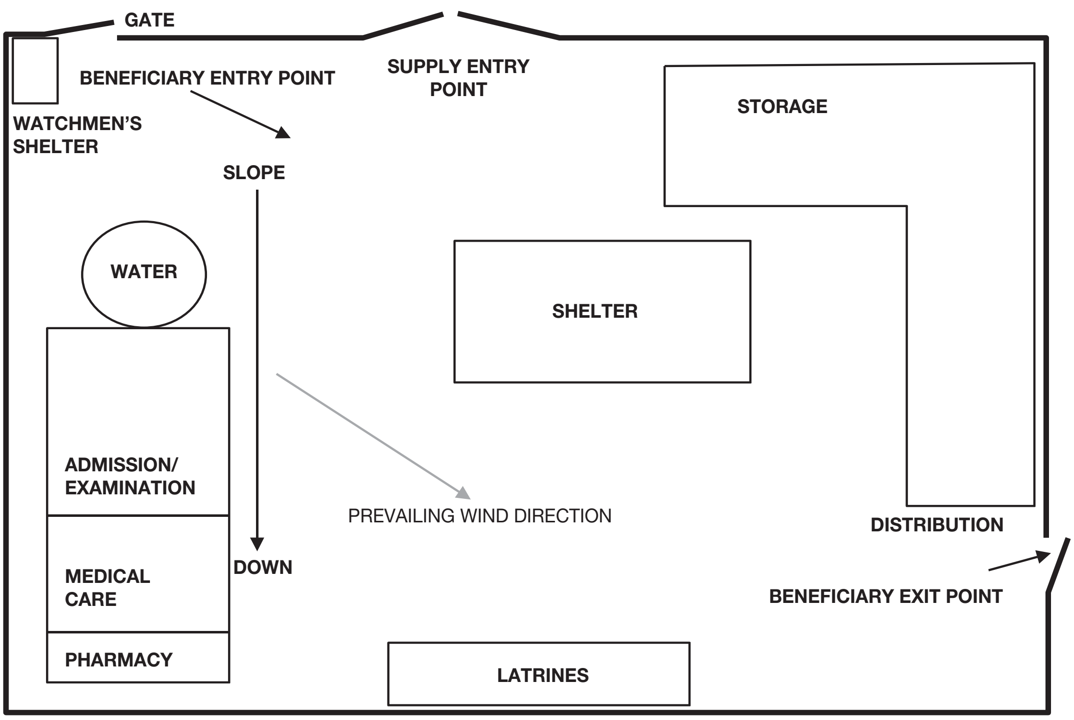


Figure A.17.2 Supplementary feeding programme centre, take-away rations



ANNEX 18
SPECIAL FEEDING PROGRAMME EQUIPMENT

1. NUTRITIONAL EQUIPMENT

Oxfam kits provide the basis of nutritional equipment. Should they not be available, the following lists detail the necessary material, which can usually be found locally and more cheaply than actual kits. The use of kits on the other hand saves time, they are complete and easily transported. MSF also provide kits that are similar to Oxfam kits.

1.1 ANTHROPOMETRY KIT (12 BOLD)

⇨ Suspended scales (Salter type), 25 kg, 100 g graduation, with 3 slings, 1 suspension bar	2
⇨ MUAC strips	50
⇨ Notebooks	4
⇨ Calculator	1
⇨ Manual counters, metal	2
⇨ Rope (10 m x 6 mm), roll	1
⇨ Pencils	12
⇨ Clipboards, A4	4
⇨ Assessment forms	40
⇨ Evaluation forms	2
⇨ Plastic A4 folders, open on two sides	10
⇨ Erasers	5
⇨ Permanent markers, broad, black	4
⇨ Notes on revised Oxfam kits (English)	1
⇨ Notes on revised Oxfam kits (French)	1
⇨ Scissors, 17cm	1
⇨ Graphic millimetre paper, pad	1
⇨ Ballpoint pens, black	10
⇨ Transparent plastic rulers, 30 cm	4
⇨ Adhesive tape, rolls	2
⇨ Tape measures, metric, fiberglass	2
⇨ Backpacks	2
⇨ Weight-for-height percentage tables, combined sexes, plastic-coated	4
⇨ Random number tables, plastic-coated	4
⇨ Weight-for-height Z-score tables, combined sexes, plastic-coated	4
⇨ Pencil sharpeners, metal	4
⇨ Height and length scales	2

Reference documents:

⇨ Food scarcity and famine (Oxfam Practical Guide No. 7)	2
⇨ MSF Nutrition Guide (French and English)	1
⇨ Refugee Health Care (Oxfam Practical Guide No. 9, French and English)	1
⇨ Selective Feeding Programme (Oxfam Practical Guide No. 1, French and English)	1

The above Anthropometry Kit is designed for two assessment teams or two nutritional centres.

1.2 KIT 2: SUPPLEMENTARY FEEDING (RATIONS TO BE CONSUMED ON SITE)

⇨ Kitchen scales, 5 kg	1
⇨ Suspended scales, 50 kg, 200 g graduation	1
⇨ Washbasins, 20 l	4
⇨ Jerrycans, plastic, collapsible, with tap	10
⇨ Bowls, 500 ml	300
⇨ Scrubbing brushes	4
⇨ Calculator	1
⇨ Teaspoons, 5 ml, metal	10
⇨ Teaspoons, 5 ml, plastic	400
⇨ Spoons, metal, 30 cm handle	2
⇨ Attendance sheets, 50-sheet pads, numbered 1–500	2
⇨ Whisks, metal, 76 cm handle	3
⇨ Mugs, 500 ml	400
⇨ Ladles, metal, 43 cm handle, 250 ml volume	4
⇨ Cauldron, 100 l	1
⇨ Cauldrons, 50 l	2
⇨ Graduated measures, transparent plastic, 2 l	4
⇨ Notes on revised Oxfam kits (English)	1
⇨ Notes on revised Oxfam kits (French)	1
⇨ Can openers, metal	2
⇨ Soap (box of 24 bars @ 100/200g)	1
⇨ Buckets, plastic, graduated, with lid, 8.5 l	4
⇨ Spatulas, wood, 89 cm handle	3

The reference documents are the same as for the Anthropometry Kit, in addition to the MSF Clinical Guide (French and English).

The above Supplementary Feeding Kit is designed for 250 children.

1.3 KIT 2/2: REGISTRATION FOR SUPPLEMENTARY FEEDING (ON-SITE CONSUMPTION)

⇨ Attendance sheets, 50-sheet pads, numbered 1–500	2
⇨ Notebook, bound, A4	1
⇨ Filing boxes for A4 forms	2
⇨ Alphabetical cards A-Z, A4, series	2
⇨ Identification bracelets, blue	600
⇨ Monitoring cards A4	600
⇨ Erasers	4
⇨ Notes on revised Oxfam kits (English)	1
⇨ Notes on revised Oxfam kits (French)	1
⇨ Graphic millimetre paper, A4, pad	1
⇨ Ballpoint pens, black	10
⇨ Permanent markers, broad, black	2
⇨ Permanent markers, broad, red	2
⇨ Pencils	10
⇨ Pencil sharpeners	4
⇨ Ledger, bound, A3	1

⇨ Transparent plastic rulers, 30 cm	4
⇨ Scissors, 17 cm	2
⇨ Stapler	1
⇨ Staples, box @ 1,000 pcs	1

The Registration Kit is provided together with the Feeding Kit. It is designed for 250 children for three months. It should be renewed every 3 to 6 months, and it may be ordered separately.

1.4 KIT 3: SUPPLEMENTARY FEEDING (TAKE-AWAY RATIONS)

⇨ Kitchen scales, 5 kg	1
⇨ Suspended scales, 50 kg, 200 g graduation	1
⇨ Calculator	1
⇨ Rope (10 m x 5 mm), roll	1
⇨ Attendance sheets, 50-sheet pads, numbered 1–500	2
⇨ Graduated measures, transparent plastic, 2 l	4
⇨ Notes on revised Oxfam kits (English)	1
⇨ Notes on revised Oxfam kits (French)	1
⇨ Plastic containers, volume 100 to 120 l	1
⇨ Plastic bags, volume 4 to 5 l	1,000
⇨ Soap (box of 24 bars @ 100/200g)	1
⇨ Buckets, plastic, graduated, with lid, 8.5 l	4
⇨ Spatulas, wood, 89 cm handle	2
⇨ Aprons, resistant plastic	6

The reference documents are the same as for the Anthropometry Kit.

The above Supplementary Feeding kit is designed for 500 persons.

1.5 KIT 3/2: REGISTRATION FOR SUPPLEMENTARY FEEDING (TAKE-AWAY RATIONS)

⇨ Attendance sheets, 50-sheet pads, numbered 1–500	1
⇨ Notebook, bound, A4	1
⇨ Filing boxes for A4 forms	4
⇨ Alphabetical cards A-Z, A4, series	2
⇨ Identification bracelets, white	1,000
⇨ Monitoring cards A5	1,000
⇨ Erasers	4
⇨ Notes on revised Oxfam kits (English)	1
⇨ Notes on revised Oxfam kits (French)	1
⇨ Graphic millimetre paper, A4, pad	1
⇨ Ballpoint pens, black	10
⇨ Permanent markers, broad, black	4
⇨ Permanent markers, broad, red	4
⇨ Pencil	10
⇨ Pencil sharpeners	4
⇨ Ledgers, bound, A3	2
⇨ Transparent plastic rulers, 30 cm	4

- ⇨ Scissors, 17 cm 4
- ⇨ Staplers 2
- ⇨ Staples, box @ 1,000 pcs 2

The Registration Kit is provided together with the Feeding Kit. It is designed for 500 children for three months. It should be renewed every 3 to 6 months, and it may be ordered separately.

2. OTHER EQUIPMENT

The remaining equipment needed in an SFP centre is the same as for a TFC. Readers are therefore referred to Annex 13 for the selection of additional items according to planned activities and working modalities.

ANNEX 19
RANDOM NUMBER TABLE

The random numbers indicated in the Table below have been generated by a Hewlett-Packard 15C calculator.[1]

Table A.19 Random number table

92523	04766	06117	90764	57694	90696	38358	94068	76013	07183
55985	31214	22132	87810	40114	23712	96073	07465	80955	92412
34079	41959	49241	08671	53800	78973	19340	30848	70246	75081
52278	67173	31589	08752	50692	78236	61012	97449	94773	49014
44174	39913	83779	34280	26724	53218	42672	40793	90088	09867
50862	71185	69610	32725	91918	03377	28089	11843	65227	43629
00924	42414	15028	94235	48303	18299	98092	14349	06540	06930
45110	57397	65359	02145	21703	78779	08923	08483	14606	85240
40581	96633	77719	31467	34306	71462	16965	13642	53121	55830
08403	25692	28262	03021	53677	80737	61511	30106	57429	31190
73653	34079	41959	49241	08671	53800	78973	19340	30848	70246
32475	52278	67173	31589	08752	50692	78236	61012	97449	94773
34855	44174	39913	83779	34280	26724	53218	42672	40793	90088
86852	50862	71185	69610	32725	91918	03377	28089	11843	65227
27890	00924	42414	15028	94235	48303	18299	98092	14349	06540
36150	45110	57397	65359	02145	21703	78779	08923	08483	14606
10736	40581	96633	77719	31467	34306	71462	16965	13642	53121
26288	08403	25692	28262	03021	53677	80737	61511	30106	57429
92523	04766	06117	90764	57694	90696	38358	94068	76013	07183
55985	31214	22132	87810	40114	23712	96073	07465	80955	92412
75081	43701	15255	49690	07755	30996	21764	23204	99266	14698
49014	24999	36356	25513	43698	30940	96066	96704	19282	59028
09867	76237	02105	17181	47971	97785	26729	31713	26443	21429
43629	27236	01037	34821	63173	65484	45940	13530	62042	50064
06930	20589	05385	51985	63858	37272	41294	97792	61436	99692
85240	79133	35834	55691	79850	70261	89672	81630	50483	41380
55830	50998	56651	59619	95529	28809	32688	69192	69151	12192
31190	35895	32854	40174	12762	22328	37378	03222	21966	32520
95364	13145	77913	31858	21966	80026	02626	31153	31796	75543
50503	76697	85262	63265	50574	19859	56586	39023	18239	98102
03977	18197	44995	82080	23961	41944	64138	55452	97592	69067
80983	82989	89068	17009	49399	13628	61882	51150	23219	84679
72828	13913	08814	76201	47539	47099	71946	71951	29780	40902
20268	53895	89810	36360	42693	78758	15303	03874	56821	27292
06743	70032	08088	95737	56609	43131	16531	26837	92878	82281
90590	48685	36114	38983	80202	99477	33317	95030	54725	19308
18182	80301	27287	49330	41416	83333	19671	39816	57957	93082
15279	19239	52249	29378	18493	20263	48156	08439	80181	95250
06661	36688	73077	84576	20731	91892	49207	64623	10888	41551
94937	45556	82255	44262	59606	25113	86413	17933	02901	13345

[1] This method is not absolutely rigorous because the calculator produces numbers using an algorithm, and this implies that they are not random.

ANNEX 20
ENERGY AND PROTEIN CONTENT OF COMMON FOODS

Readers are referred to Chapter V, Annex 2, and the food composition tables provided by Platt, 1962; Randoin *et al.*, 1982; and Souci *et al.*, 1989.

Table A.20 Energy and protein content of common foods: edible portion of 100 g of raw food

Foodstuff	Energy (kcal(kJ))	Protein (g)	Foodstuff	Energy (kcal(kJ))	Protein (g)
Rough cereal			***Oilseeds***		
Oats	388 (1,622)	12	Nuts[b]	650 (2,717)	14
Wheat	344 (1,438)	11.5	Seeds[c]	550 (2,300)	23
Maize	363 (1,517)	10			
Millet	355 (1,484)	10			
Barley	339 (1,417)	12	***Purified fats***	900 (3,762)	
Brown rice	360 (1,505)	7.5			
Rye	350 (1,463)	8			
Sorghum	355 (1,484)	10.4	***Meat***	266 (112)	17
Teff	345 (1,442)	8.5	Beef (sirloin)	225 (940)	18
			Mutton (leg)	290 (1,212)	16
Refined rice			Pork (fillet)	220 (920)	20
– steamed	354 (1,480)	8	Poultry	120 (502)	22
– polished white	352 (1,471)	7	Venison		
Flour			***Fish***	80 (334)	17.8
Wheat, white	350 (1,463)	10	– lean	170 (710)	17.8
Maize, 96% ext.[a]	362 (1,513)	9.5	– fatty		
Maize, 60% ext.	354 (1,480)	8		158 (660)	13
			Eggs		
Legumes					
Beans	330 (1,379)	21	***Dairy products***	68 (284)	3.5
Lentils	340 (1,421)	24	Cow's milk[d]		
Peas	337 (1,409)	25	Dried skimmed milk	373 (1,560)	38
Soya bean	385 (1,609)	35	Dried whole milk	500 (2,090)	25
Peanut, fresh	332 (1,388)	15	Butter	750 (3,135)	
Peanut, dried	579 (2,420)	27			
			Vegetables[e]	35 (146)	1.8
Starches					
Plantain	128 (535)	1	***Fruits***[f]	60 (250)	+ / –0.5
Yam	104 (435)	2			
Cassava, fresh	153 (640)	0.7	***Refined sugar***	400 (1,672)	
Cassava, flour	342 (1,430)	1.5			
Sweet potato	114 (476)	1.5			
Common potato	75 (313)	2			
Taro	113 (472)	2			

[a] 96% extraction rate.
[b] Average value for nuts.
[c] Average value for seeds (sunflower, sesame, pumpkin, etc.).
[d] The detailed values of different milk types may be found in Table 5.9.
[e] Average value.
[f] Average value.

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Including acronyms

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MISSION

The International Committee of the Red Cross (ICRC) is an impartial, neutral and independent organization whose exclusively humanitarian mission is to protect the lives and dignity of victims of war and internal violence and to provide them with assistance. It directs and coordinates the international relief activities conducted by the Movement in situations of conflict. It also endeavours to prevent suffering by promoting and strengthening humanitarian law and universal humanitarian principles. Established in 1863, the ICRC is at the origin of the International Red Cross and Red Crescent Movement.

ICRC

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