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THE RELATIONSHIP BETWEEN NUTRITION AND HEALTH: THE PRESENT SITUATION IN AFRICA

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PREFACE

This report was carried out at IIASA in the spring of 1978 and is part of Task 2, the Nutrition Task, of the Food and Agriculture Program. One of the aims of this task is to investigate the food requirements nationwide and to find our standpoint amidst the extensive literature already available, which is often quite controversial. The present study gives a brief overview of the nutritional status in Africa. For this purpose the nutritional requirements have been estimated for each country and compared with the food supplies in that country.

SUMMARY

Africa is a continent where hunger (= undernutrition in energy and protein) is still a major problem. The aim of this report is to find the target countries in Africa of which the population is most likely to be undernourished or even starving. For this purpose, the African countries are arranged into five categories according to the nutritional status of each country. The main criterion for adequate nourishment is the fulfillment of the minimum energy and protein requirements, which are estimated by studying the population distribution. From this classification, the following results are obtained:

17% of the countries have excess caloric supplies;

20% have available more than 90% of their requirement, with an adequate supply of protein;

25% are deficient in calories but adequate in protein;

10% are deficient in protein but adequate in calories, and the remaining

6% are deficient in both protein and calories.

The diets in Egypt, Cameroon, Mali, Congo and Zaire, each of which is representative of one of the above mentioned categories, are examined for their composition of essential nutrients, i.e. calories, protein, fat, vitamins and minerals. The nutritional situation of a particular country is compared with its morbidity and mortality rates. The result of this investigation is that protein deficiency alone is not the major nutritional problem of the African continent. The problem is rather that there is not sufficient food available to fulfill the energy requirements.

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1. INTRODUCTION

The availability of sufficient food throughout the whole world is a current and a future problem of concern to everyone. Much effort has been expended in analysing the nature and the causes of the food deficiencies in various countries. Until recently, the problem was associated with a protein gap; and consequently, the fortification of cereal products, in which certain essential amino acids were generally missing, as well as the development of protein-rich varieties of cereals, were of main concern. However, since more sophisticated experiments on protein requirements have been performed, the major problems appear to be centered round an energy gap. In any case, whether there exists a protein, energy or energy-protein gap, this still does not tell us anything about the quality of the diet in the country. Even if sufficient calories and protein are consumed, there may still be a deficiency in minerals and vitamins and the whole diet may still be far from a 'good' one. On the other hand, if a country is deficient in calories and protein, it can be assumed that there is also a deficiency in all the other nutrients; the question still remains as to what might be the easiest and most effective way to supplement the diet.

Malnutrition is not only caused by insufficient availability of food in a country, but also by the uneven distribution of the food among the members of the different income groups. People in the lower income groups are quite often ignorant about the better quality foods and they may adapt to a low-subsistence diet. Very often religious taboos and customs restrict valuable foods, i.e. in the case of Hindus, Muslims and Jews.

The efforts to improve the quality of food, by introducing new technologies in the production and preservation of the main staple foods, and by finding new sources, have not been directed sufficiently towards the very poor who are the most malnourished. Better education and better medical care would probably effectively lessen the nutritional problems.

Africa is one of the continents where the present nutritional state of the population is of major concern (1-5) and where it may even deteriorate in the near future due to the high population growth rates (2), as has already happened in the Asian and Latin American countries. To counteract this fatal development as soon as possible, it will become necessary to reduce the birth rates, besides improving the agriculture and the economy of these target countries. Among other factors, such as education, sanitation, better medical care and so on, the nutritional status of the people is very important to the success of reaching that goal as may be clearly shown in the case of Sri Lanka and Kerala (6). In these two Asian countries, the low income groups were provided with subsidized cereals and better health care. The birth rates have fallen dramatically in conjunction with these improvements from 38.7 in 1953 to 28 in 1976 in Sri Lanka, and from 39 in 1961 to 26.5 in 1974 in Kerala. However, it is not sufficient to elaborate the countries where inadequate food is available for all people, it is even more crucial to determine the target groups in each country. It is a general fact that the richest income class will never suffer any dietary restrictions regardless of the overall nutritional situation of the country; only the poorest and perhaps the medium class will experience the shortage of food depending upon the overall situation. They will have to share, according to their income and their preferences, the remainder of the total food basket of the whole country after the richest class has taken its share. However, the first step in this task is to find the target countries, as is the goal of this paper, before looking more into detail.

The quality of the diet is closely related to health and mental development. Some dietary deficiencies lead directly to medical problems, whereas others are only indirectly related to diseases. The linkage between nutrition and health will be discussed briefly in this paper; more detailed information on this subject is widely available (7,8). In addition to the diseases related to dietary deficiencies, those associated with an affluent diet are also briefly considered.

To describe the quality of a diet, some essential biochemical parameters have to be established. As the science of human nutrition is still relatively young, there is a great deal of controversy regarding dietary requirements, and it is thus still difficult to define a satisfactory diet. Therefore, a brief overview of the currently used parameters is given before evaluating the diet of the African countries with their help. The results obtained herewith are discussed with respect to the availability of energy and protein for the different countries. The diet patterns of Egypt, Cameroon, Mali, Congo, and Zaire are evaluated in a more detailed way. Further on, the relationship between nutrition and health is shown for these countries.

2. DISEASES ASSOCIATED WITH MALNUTRITION

The connection between disease and nutrition was recognized as early as in the 16th and 17th century. The results were based mainly on observations and deficiencies in an essential nutrient were dealt with. In the early 20th century most of the vitamins and essential minerals were isolated enabling research to be carried out on the influence of individual nutrients. Nowadays, nutritional problems are not only associated with deficiencies, but also with an excess of nutrients, especially in the developed countries, opening up a whole new area of research.

2.1 Diseases Caused By Nutrient Deficiencies

2.1.1 Marasmus, Kwashiorkor and Marasmic Kwashiorkor

Protein and protein-caloric malnutrition are widely spread in developing countries, causing kwashiorkor, marasmus and marasmic kwashiorkor, an intermediate form.

Kwashiorkor is mainly observed in children of one to three years of age suffering from a protein deficiency. The protein deficiency may arise initially from eating staple foods lacking in protein, such as cassava, plantain and bananas, or indirectly during the recovery period after infectious diseases when much more protein is required. Uneven distribution of food in the

family or ignorance on the part of the parents may also cause malnutrition in the infants. The onset of kwashiorkor is rapid and in its more advanced stages is associated with malabsorption and copper in the blood is very low in these patients. The wasting body tissue is usually covered with edema.

Marasmus, which is due to an energy deficiency, is not only observed in chilren, but also in adults suffering from calorie-protein malnutrition. The body's own tissue has to be used in order to provide the energy requirements which are lacking in an inadequate diet. This leads to a severe form of growth retardation in children, as well as to the wasting of muscles and subcutaneous fat in children and adults. Generally, cases of marasmus are found more frequently than those of kwashiorkor. Marasmic kwashiorkor is the most common type of severe disease caused by malnutrition.

Adult malnutrition (marasmus) affects the elderly, pregnant and lactating women especially. Impaired maternal nutrition affects the size of the baby, its ability to survive, as well as maternal mortality. Fetal malnutrition, which may be caused by inadequate nutrients within the maternal circulation, can result in growth retardation of the fetus (a decreased number of total cells), in malformations, and in poor brain growth of the fetus. At a later stage, malnutrition in the mother can affect lactation, and consequently influence the nutritional status of the infant. These children tend to be too small in size for their age and can have retarded brain development. If malnutrition in the infant occurs before he is 8 months of age, the total number of brain cells will decrease; if nutritional deprivation takes place later, the cells will decrease in size. Both these effects are reflected in the behavior and the learning ability of the child and may result in a lower intelligence quotient. However, while the effects of malnutrition cannot be isolated from environmental influences, malnutrition very often coincides with ignorance on the part of the parents. The metabolism of the under-

nourished children may adapt to the deficiency of nutrients, they may suffer permanent brain retardation, and perhaps may later become as ignorant as their parents.

2.1.2 Infectious Diseases

Malnutrition and infection are linked because the malnourished (often marasmic) child cannot form antibodies as effectively as a well nourished child. Furthermore, a child suffering from an infection is much more susceptible to protein-calorie malnutrition than a child who is not, although they may both be on the same diet. The child suffering from an infection and when recouperating afterwards, requires a much higher level of nutrition.

The infectious diseases associated with malnutrition can be of bacterial origin, e.g. infective diarrhoea, whooping cough or tuberculosis, of viral origin, as for example measles or scarlet fever, or of parasitic origin, e.g. malaria, ascariases or hookworm infection. The incidence of infection is always associated with poor hygenic conditions which are prevalent in the low socio-economic classes struggling for food. The course which the disease takes is also much more severe in undernourished individuals and quite often leads then to death. If the food is impaired during the course of the disease (a very common practice) and in the recouperation phase, the body becomes even weaker and more susceptible to new infections, possibly associated with kwashiorkor.

2.1.3 Avitaminosis and Nutritional Anamias

Many diseases are due to vitamin deficiencies in the diet. One of the oldest ones known to be of dietary origin is scurvy. Even in the 16th century people were familiar with the idea that lemon juice or an extract of leaves can cure this disease and at the beginning of this century the cause was clearly identified as being a vitamin C deficiency. As early as the 18th century, pellagra was observed, mainly in poor peasants who lived chiefly on maize, but it was not identified as a deficiency in nicotinic acid until recently. Rickets was recognized as a disease pertaining to industrialization and was estimated to have originated

in England about the beginning of the 17th century. Later, the antirachitic factor was identified as vitamin D, present in certain oils and fats or produced by the action of ultraviolet light. Therefore children kept inside exclusively are very susceptible to this disease. Beriberi is a well-known disease in rice-eating countries and is caused by a vitamin B_1 (thiamine) deficiency. Xerophthalmia, the major cause of blindness in developing countries, is a sign of a vitamin A deficient diet.

The most common type of nutritional anemia in the world is caused by an iron deficiency; it is mostly observed among infants, adolescent girls and women. A balanced diet, rich in vegetables, cereal and egg yolks can be a preventive measure. There are several types of megaloblastic anemias, of which the most important are deficiencies in the vitamin folacin or the vitamin B_{12}. Pernicious anemia, or lack of vitamin B_{12}, is observed in vegetarians who live strictly without any milk, eggs, or other types of animal protein, as this "animal protein factor" is only found in foods of animal origin.

2.1.4 Endemic Goitre

This nutritional disease is related to an iodine deficiency and is found very often in countries which do not have access to the sea. Iodine is especially rich in sea food and in some vegetables, depending on the iodine content of the soil. However, the soils can be quite often deficient in iodine, and the total consumption of this mineral has become very low. Endemic goitre is associated with impaired intellectual development and performance, among other symptoms, and is closely related to endemic cretinism.

2.2 Diseases Initiated By Nutrient Affluence

2.2.1 Obesity

For a long time obesity was mistakenly considered as a sign of good health and, only recently, was the connection discovered between an excessive intake of calories (especially of fat and sugar) and cardiovascular and pulmonary diseases, hypertension, diabetes and many others. Obesity is not only a nutritional disorder, but is also associated with psychological, social and genetic malfunctions. A child's nutritional status in infancy influences his susceptibility to obesity in later years, as only an infant is able to form fat cells. Although, at a later stage in his development, the cells vary in size according to the caloric intake, they do not vary in number.

2.2.2 Coronary Heart Disease

Cardiovascular diseases are the most common causes of death in the developed countries. They are clearly related to the affluent diet which is rich in fat and empty calories* and linked to hypertension, obesity, smoking and alcoholism. The distribution of lipids in the body and the composition of the circulating lipids are influenced by the diet, especially by the amount of saturated fats from animal products and by the consumption of sugar.

2.2.3 Diabetes Mellitus

Due to the affluent diet consisting to a large extent of refined sugar and highly refined flour, the amount of insulin required to utilize the high amount of blood glucose is very high. This overproduction in the various tissues leads quite often to an exhaustion of the synthesis of insulin and, therefore, to a reduced carbohydrate tolerance.

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* empty calories: food which does not contain any nutrient other than energy, i.e. refined sugar and alcohol.

2.2.4 Cancer

Cancer is the second most important cause of death in the United States and it is very tempting to associate it with the affluent diet. But too little is still known to pin down the exact causes of this disease. At the present stage of investigations, it can be generalized that the mortality rate of all varieties of cancer in the body is independent of protein consumption; however, the development of intestinal and gastric cancer is positively related to high animal protein consumption. The degradation products of tyrosine and the tryptophan metablites formed during the digestion of animal protein are known to produce intestinal cancer. Further on, the microflora in the intestine, the metabolism of lipids and the high sugar consumption can be made responsible for the development of cancerous tissue.

3. NUTRITIONAL REQUIREMENTS AND ALLOWANCES

The required food consumption of a person varies according to his age, sex, weight, physical activity, the environmental conditions prevailing, and other factors. Food consumption also depends upon the rate of digestion and metabolism of the body, and may differ from one individual to the other. The minimum requirement refers to "the least amount of a nutrient that will prevent clinical symptoms of deficiency or support a well-defined biochemical or physiological response".(8) On the other hand, the average requirement describes "the amount of a nutrient that will support health in most persons of a given population group and implies that the true requirement for individuals may be either above or below the average of the group".(8) As both definitions contain a considerable number of uncertainties, no absolute figures can be given to determine the required nutrients of an individual or a group of people. Therefore, food allowances (Recommended Dietary Allowances - RDA) (9), or safe level of intake (FAO, 1973) (10), were introduced, being above the estimated requirements both to cover the variations among individuals and the uncertainties of the estimated requirements

3.1 Energy Requirements

The amount of energy required can be determined quite accurately. It is dependent on the sex, age, size and activity of a person. Required energy is defined as: the level of intake of calories at which the body weight of an adult remains constant and neither gains nor loses weight, or at which the body weight of a child increases in accordance with pediatric norms. These criteria are simple to determine and therefore the allowances have not changed considerably since the first time they were stated (Table 1). In their latest recommendations in 1973, FAO and WHO (10), divided energy requirements not only into different age and sex groups, but also according to the degree of activity and related them to a reference man (Table 2). The reference man (woman) is clearly defined in respect to age, weight, physical state and activity and represents the group under investigation. However, in order to estimate the energy requirements of a country or a community more precisely, own group-specific reference men (women) should be established, characterized by the specific age distribution and anthropological measures of the population group, the main activities and adjustment to the climate. [For further detail, see (10)]. For further considerations in this paper dealing with whole countries where data are available only for the economical non-active and economical active (agricultural and non agricultural) population, the urban population will be defined as very active. As detailed data are not available for the age distribution in many of the developing countries, the caloric requirements have to be estimated by using a conglomeration of certain groups (Table 3). In addition, adjustments to the local reference men (women), as well as the effect of the climate cannot be considered, because these data are not available for all countries. Adjustment for pregnancies was made according to FAO recommendations (Table 2).

3.2 Protein Requirements

Ever since the first recommendations were published by Voit (11) and Atwater (12) (Table 1), the minimum amount of protein required has been quite strongly disputed. The first recommendations are based on the observations of a healthy European diet whereas the more recent ones refer to more sophisticated experiments to determine the minimum amount required. The quality of protein consumed is also of major importance in establishing the minimum level of protein which will meet the required amount of essential amino acids. Egg and milk proteins are the best with regard to the digestibility and amino-acid content. Therefore, egg protein was suggested as a standard protein in the last FAO/WHO recommendations (10), and all "crude protein" has to be converted into "high quality protein". This is done by considering the amino-acid score of the lowest essential amino-acid of the product.*

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* The amino acid score of a protein is based on its chemical distribution of essential amino acid and related to the amino acid pattern of egg as reference protein as given by the Export Group in its report, Protein Requirements (FAO/WHO, 1965). The amino acid showing the lowest percentage is called the limiting amino acid and this percentage is called the chemical score (this classical method was proposed by Mitchell and Block in 1946, J. Biol. Chem. 163: 599 - 620).

Problems are connected with this method in respect to the reference protein. The amino acid content of egg protein is reference protein. The amino acid content of egg protein is not well defined and depends upon the chemical analysis and the feeding of the animal. Furthermore, the protein content and the amino acid distribution of the item to be examined varies with the variety and the analysis. Thirdly, the amino acid scores are calculated only for one commodity. However, usually a variety of commodities are consumed at one time and even items with a very low protein content can raise remarkably the amino acid score of the whole diet just by contributing to the limited amino acid.

Regardless of these problems it is still one of the best methods available at the present time to calculate the amount of high quality protein in the food. It has to be kept in mind that this method may provide a slightly negative estimation of the content of high quality protein in a diet, but considering all the difficulties connected with the whole estimation, the overall picture of the protein intake may become quite realistic in this way.

In order to stay consistent with the estimations of the higher quality protein, the amino acid scores (A/T) listed in the FAO publication, Amino-Acid Content of Food, No. 24, 1970, were solely used throughout this work.

TABLE 1

ESTIMATES OF PROTEIN AND ENERGY REQUIREMENTS FOR A REFERENCE MAN

Year	Energy kcal/day	Protein g/day	% protein of the total energy	Source
1881	3,055	118	15.5	Voit (11)
1895	3,500	125	14.3	Atwater (12)
1918	3,000			Inter-Allied Scientific Commission (13)
1935	3,000			National Health Organization (14)
1943	3,000			National Research Council USA (15)
1957	3,000	46[a] - 59[b]	6.1 - 7.9	FAO (16)
1963	3,000	50[c]	6.7	FAO/WHO (17)
1969	2,900	73	10.1	UK standards (18)
1973	3,000	37[d]	4.9	FAO/WHO (10)
1974	2,700	56	8.3	RDA (9)
1974	3,000	56	7.5	Canadian Standards (19)

a) For a country with a high standard of living.

b) For a country where vegetable sources provide almost all of the dietary protein.

c) If 100% of the protein is utilized.

d) Of egg protein or "high quality protein".

TABLE 2

ENERGY REQUIREMENTS (KCAL) (PER PERSON PER DAY)

	Moderately Active (urban population)		Very Active (rural population)	
Age	Male	Female	Male	Female
< 1	1,090*	1,090*	1,090*	1,090*
1 - 4	1,460	1,430	1,460	1,430
5 - 9	2,130	2,000	2,130	2,000
10 - 14	2,700	2,400	2,700	2,400
15 - 19	3,050	2,350	3,200	2,500
20 - 29	3,000	2,200	3,500	2,600
30 - 39	3,000	2,200	3,500	2,600
40 - 49	2,850	2,090	3,330	2,470
50 - 59	2,700	1,980	3,150	2,340
60 - 69	2,400	1,760	2,800	2,080
> 70	2,100	1,540	2,450	1,820

Source: Energy and Protein Requirements - Report of a Joint FAO/WHO Ad Hoc Expert Committee. World Health Organization Technical Report Series No. 522 - FAO Nutrition Meetings, Report Series No. 52. Published by FAO and WHO, World Health Organization, Geneva, 1973.

* 1090 kcal per day for infants under the age of one year represents the energy allowances for infants and the supplementary needs for pregnant and lactating women.

TABLE 3

CALORIC REQUIREMENTS FOR THE ECONOMICALLY ACTIVE AND ECONOMICALLY NON-ACTIVE POPULATION

Economically active population[a] :	urban	2,420 kcal/caput/day
	rural	2,830 kcal/caput/day
Economically non-active population (0-14, > 65)[b] :		1,980 kcal/caput/day

a) Estimated from FAO-energy requirements (1973)(10) for the population of 15 - 65 years which comprises men and women (equal numbers) divided equally into the age groups 15 - 20, 20 - 29, 30 - 39, 40 - 49, 50 - 59 and 60 - 65. The urban population is moderately active and the rural population is very active in terms of their energy requirements.

b) Estimated from FAO-energy requirements (1973)(10) for the population of 0-14 and >65 years, which comprises boys and girls (equal numbers) divided equally into the age groups 0 - 4, 5 - 9 and 10 - 14 and half the number of people older than 66.

The minimum amount of protein required is estimated as 23g of protein per day for a 70kg adult man, or 0.33g per kg per day (9, 10). This amount is sufficient to maintain the body protein; complete utilization is assumed. According to RDA, 0.8g of protein per kg per day are required, assuming 70% efficiency of the utilization of the protein (9); they do not consider the quality of the protein (9). On the other hand, the FAO/WHO Committee (10), suggests 0.57g standard protein (eggs, milk) per kg per day, or 37g per day for an adult average man (20 - 39 years, 65 kg, moderately active). This refers to the average requirements, with an addition of 30% for protein efficiency, and is calculated to maintain the health of nearly all people. If more protein is consumed than the required amount, it is used as energy which can be more cheaply provided by starch. The FAO/WHO standards were used exclusively in this report.

Even if there is no correlation between the energy and protein intake, it can be roughly assumed that slightly less than 5% of the required calories for a moderately active population should be derived from high quality protein. If all the protein is of low quality as, for example, maize protein with its amino acid score of 41*, the required amount increases to 12.0% of the calories. However, since usually not all of the consumed protein is of such a low quality it will be assumed for all African countries that the amino acid score is between 55 and 60 for the whole diet; therefore, an intake of 8.5% of the energy derived from crude protein will be regarded as sufficient further on. These approximations hold for children and may be a slightly conservative estimate for moderately active adults. A very active person does not need more protein than a moderately active man; he only requires more energy. On the other hand, however, adjustments for the recovery from infectious diseases, when actually a higher protein consumption is required, have also not been taken into account. Scrimshaw estimated an extra protein

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* See footnote, page 10.

requirement during the recovery period of 0.2 to 0.4 g of high quality protein per kg body weight in order to replace the protein losses during the acute infectious phase (20). Furthermore, protein supplementations are needed during the pregnancy and lactation period - 2,685 g of high quality protein per pregnancy and 6 month lactation (10). Therefore, it has to be borne in mind that when estimating the protein requirements with 5% of the caloric requirements, there may be a slight underestimation of the actual required amount, but no data are available for a better approximation of the protein requirements for a whole population.

3.3 Fat and Carbohydrate Requirements

No specific recommendations for either nutrient group are proposed. However, the intake of fat should not exceed 35% of total calories because of the close relationship between high fat intake and arteriosclerosis. The essential fatty acids, mainly obtained from vegetable fat, should be 1 - 2% of the daily caloric intake.

Carbohydrates are needed to avoid ketosis and loss of cations, especially of sodium. It is recommended to consume complex carbohydrates, but not refined sugar, because starchy food also provides minerals, vitamins and fibre, whereas sugar delivers only "empty calories". Starchy roots are a cheap and healthy source of energy. Besides the allowances for protein and the minimum amount of fat, these complex carbohydrates should provide the necessary calories.

3.4 Mineral and Vitamin Requirements

Mineral and vitamin requirements are listed in Table 4. Their area of activity, and the symptoms which appear because of specific deficiencies are excellently tabulated by Scrimshaw (21) and are described in more detail by Pike and Brown (8).

TABLE 4

MINERAL AND VITAMIN REQUIREMENTS

Mineral/Vitamin	Requirement	Used for approximation of requirements of a population
Calcium	800 mg	800 mg
Phosphorus	800 mg; for infants 540 mg	
Magnesium	300 mg for females 350 mg for males	
Iron	10 mg for males 18 mg for females	14 mg
Zinc	15 mg	
Iodine	0.1 mg for females 0.14 mg for males	
Vitamin A	4,000 I.U.* for females 4,500 I.U.* for males	4,500 I.U.
Vitamin D	400 I.U. for children	
Vitamin E	12 I.U. for females 15 I.U. for males	
Ascorbic Acid	45 mg	45 mg
Folacin	0.4 mg	
Niacin	6.6 mg/1000 Kcal	6.6 mg/1000 Kcal
Riboflavin	0.6 mg/1000 Kcal	0.6 mg/1000 Kcal
Thiamine	0.5 mg/1000 Kcal	0.5 mg/1000 Kcal
Vitamin B_6	2.0 mg	
Vitamin B_{12}	0.003 mg	

* Also expressed in retinol equivalent (RE) (1RE = 5 I.U. Vitamin A)

1 RE = 1 µg retinol

= 6 µg β-carotene

= 12 µg other provitamin A carotinoids

= 3.33 I.U. vitamin activity from retinol

= 10 I.U. vitamin activity from β-carotene

4. NUTRITIONAL STATUS IN AFRICA

The food and nutritional situation of a whole country can be estimated from the food balance sheets issued by FAO. It has to be stressed that they do not say much about the nutritional status of an individual in a country, because it is not known how much an individual really receives out of his whole basket, and how much an individual really needs. Therefore, the approximated amount of food required and consumed can only be estimated for a group of individuals* (as the larger the group, the more precise the estimation) and compared with other groups. It is also not known how much of the food eaten by an individual is digested and absorbed as well as how many of the nutrients are destroyed during preparation. Therefore, the whole study can only be an approximation outlining which country has so much food available to feed its population adequately and which is very susceptible to nutritional deficiencies. If there is already a nationwide deficit in the supplied food then it is much more likely that a larger group of the population is undernourished.

Since the distribution of the population and the exact definition of the reference man (woman) is very often not known for developing countries, the nutritional requirements can only be an approximation for these countries as was earlier suggested in Chapter 3 of this presentation. The nutritional status of Africa with regard to its requirements and supplies was elaborated using this kind of estimation and the per capita consumption data (22), leading to the general conclusion that Africa is a continent where hunger (= undernutrition in energy and protein) is still one of the greatest problems (Table 5). It appears from these estimations that at least 40% of the countries are deficient in supplies of either calories or protein, or both. The African countries have therefore been divided into 5 categories according to their food supplies in Table 5a and 5b:

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* Calculated as the mean caloric value plus two standard deviations and, therefore, valid for 97.5% of the individuals of the population. Only 2.5% of the healthy individuals are not covered by the energy allowances. This approach is generally used by international committees in estimating dietary allowances.

A) Countries with more than 110% of the required calories and with adequate protein supplies;

B) Countries with 90 - 110% of the required calories (adequate caloric supply; this large span was used because of variations in the statistics and its uncertainties) and adequate protein supplies;

C) Countries with less than 90% of the required calories but sufficient protein;

D) Countries with adequate caloric intake but deficiency in protein;

E) Countries deficient in protein and calories (less than 90%).

The graphical representation of the results of Table 5 is given in Figure 1 and 2.

4.1 Countries with Excess Caloric Supplies

Only a few countries in Africa along the Mediterranean shore and the south of the continent have more food available than actually required for adequate nutrition of the population. The requirements in this group are relatively low, because only 45.6 ± 12.9 percent of the economically active population are working in the agricultural field and, therefore, are "very active" in the sense of their nutritional needs; the rest of the population is only "moderately active". Not only are the caloric supplies in this group of countries relatively high, but they also consume more protein, fat and sugar than the remaining countries in Africa. The agricultural conditions in these countries are also the best in the whole continent, producing mainly wheat and barley, as well as fruits and vegetables.

Nutritional problems occurring in these countries are not a matter of deficient supplies, but are more a matter of a wrong distribution of the foodstuff among the whole population, among regions in the country and among the family itself. A major problem in all African countries is still that the father very often

TABLE 5a

NUTRITIONAL SITUATION IN AFRICA (1972-1974)

IN ABSOLUTE TERMS PER CAPUT PER DAY

Country	energy[a] required (kcal)	energy[b] supplied (kcal)	Protein total[b] (g)	Protein vegetable[b] (g)	Protein animal[b] (g)	Fat total[b] (g)	Fat vegetable[b] (g)	Fat animal[b] (g)	Carbohydrates total[c] (g)	Carbohydrates starch[d] (g)	Carbohydrates sugar[b] (g)
A. Countries with excess caloric supplies											
Egypt	2,160	2,633	71.3	60.9	10.3	47.3	36.2	11.1	481	427	53.7
Libya	2,140	2,698	68.1	48.0	20.1	76.7	56.1	20.6	434	338	96.3
Mauritius	2,150	2,438	53.4	37.3	16.1	58.5	42.3	16.1	424	332	92.5
Morocco	2,160	2,592	69.9	59.2	10.7	46.4	33.8	12.6	475	405	70.3
Reunion	2,130	2,554	67.8	38.3	29.5	57.1	19.6	37.5	443	387	56.1
Rhodesia	2,230	2,477	72.2	54.7	17.5	51.2	33.8	17.4	432	384	47.8
South Africa	2,170	2,866	78.0	48.0	29.9	63.3	30.4	33.0	496	398	98.7
Tunisia	2,140	2,378	65.6	51.7	13.9	60.0	46.2	13.8	393	339	54.3
B. Countries with adequate caloric and protein supplies											
Algeria	2,140	2,039	54.9	44.4	10.5	39.1	25.5	13.6	373	325	48.0
Burundi	2,380	2,347	61.3	56.8	4.4	20.1	16.3	3.8	480	477	2.6
Cameroon	2,360	2,383	59.4	47.8	11.5	50.6	41.6	9.0	422	410	12.9
Gabon	2,340	2,274	49.3	22.5	26.8	34.1	21.7	12.4	443	428	15.1
Gambia	2,390	2,307	58.0	46.0	11.9	64.5	54.5	7.9	379	350	29.1
Ghana	2,240	2,303	52.2	36.5	15.7	43.4	37.3	6.1	425	401	23.8
Guinea-Bissau	2,230	2,327	48.5	38.2	10.3	49.4	37.1	12.3	422	408	14.1
Ivory Coast	2,390	2,626	63.1	43.3	19.8	34.3	23.8	10.6	516	483	32.5
Kenya	2,290	2,140	60.5	48.9	11.6	32.0	20.3	11.7	403	353	49.3
Lesotho	2,420	2,204	67.6	56.4	11.2	27.9	17.8	10.1	420	392	28.4
Madagascar	2,390	2,360	56.5	43.6	12.9	26.7	13.0	13.7	473	447	26.3
Malawi	2,340	2,414	68.4	62.3	6.2	44.4	37.5	6.9	435	416	18.8
Namibia	2,230	2,162	71.1	38.0	33.1	58.1	26.7	31.4	338	309	29.1
Nigeria	2,270	2,073	46.2	41.5	4.7	37.6	34.2	3.4	387	380	6.7
Senegal	2,310	2,181	61.7	43.9	17.8	53.3	43.5	9.9	363	321	42.5
Sierra Leone	2,280	2,254	50.5	39.7	10.8	53.8	49.8	4.0	392	372	19.6
Sudan	2,230	2,070	60.6	40.7	20.0	59.4	38.3	21.2	323	283	40.2
Swaziland	2,340	2,118	57.0	36.1	20.8	42.8	20.5	22.3	377	292	84.1
Togo	2,300	2,167	52.6	45.3	7.2	30.7	25.2	5.5	421	413	7.8
Uganda	2,330	2,141	54.6	42.0	12.6	32.0	24.2	7.9	408	385	22.9
C. Calorie-deficient countries											
Benin	2,350	2,040	51.0	41.6	9.3	45.9	40.8	51.7	355	348	7.5
Botswana	2,390	2,025	69.5	46.2	23.3	43.1	20.4	22.7	340	296	43.6
Chad	2,270	1,765	60.1	46.9	13.2	36.3	28.1	8.2	299	284	15.3
Ethiopia	2,340	2,051	63.4	53.4	10.0	33.7	23.6	10.1	274	366	7.9
Mali	2,440	1,759	52.7	42.6	10.1	32.9	25.6	7.3	312	296	16.3
Mauritania	2,230	1,867	63.2	31.1	32.0	44.7	15.5	29.2	303	255	47.6
Niger	2,240	1,857	63.6	54.3	9.4	30.7	22.2	8.5	332	323	9.0
Rwanda	2,420	2,102	54.0	51.2	2.8	12.5	10.1	2.5	443	442	1.0
Somalia	2,280	1,916	59.1	32.7	26.5	51.7	20.5	3.1	304	258	46.0
Tanzania	2,330	1,959	46.1	32.5	13.6	30.2	19.0	11.2	376	350	25.9
Zambia	2,260	2,016	58.1	43.9	14.2	34.9	25.0	9.9	365	329	38.4
Upper Volta	2,430	1,728	55.9	52.2	3.7	25.6	22.1	3.5	319	313	5.3
D. Protein-deficient countries											
Angola	2,180	1,997	41.8	30.1	11.7	34.2	25.1	9.2	378	341	37.3
Central Africa	2,430	2,320	44.6	35.5	9.1	46.0	38.4	7.6	432	421	10.2
Congo	2,210	2,274	41.7	28.6	13.2	32.3	27.1	5.3	454	438	16.0
Mozambique	2,190	1,989	37.3	32.3	5.0	31.5	25.9	5.5	389	353	36.3
E. Protein and calorie-deficient countries											
Guinea	2,350	1,994	43.3	39.2	4.0	36.6	33.5	3.1	372	365	7.5
Liberia	2,280	1,976	35.9	26.3	9.6	36.1	30.5	5.6	377	367	10.7
Zaire	2,330	1,848	31.2	23.4	7.7	29.5	25.7	3.9	364	356	7.8

a) calculated from the distribution of the population in 1970 (23) according to Table 3.
b) calculated from national consumption data (22).
c) calculated from the supplied energy minus the calories obtained from protein and fat.
d) calculated from the total amount of carbohydrate minus the amount of consumed sugar.

TABLE 5b

NUTRITIONAL SITUATION IN AFRICA (1972-1974)

IN RELATIVE TERMS PER CAPUT PER DAY*

Country	energy required* (kcal)	energy supplied (%)	Percent of Supplied Energy from: Protein total	Protein vegetable	Protein animal	fat total	fat vegetable	fat animal	carbohydrates total	carbohydrates starch	carbohydrates sugar
A. Countries with excess caloric supplies											
Egypt	2,160	122	13.2	11.3	1.9	19.7	15.1	4.6	89.0	79.1	9.9
Libya	2,140	126	12.7	9.0	3.8	32.3	23.6	8.6	81.1	63.1	18.0
Mauritius	2,150	113	9.9	6.9	3.0	24.5	17.7	6.8	78.9	61.7	17.2
Morocco	2,160	120	13.1	11.0	2.0	18.9	13.7	5.3	87.9	74.9	13.0
Reunion	2,130	120	12.7	7.2	5.5	24.1	8.3	15.9	83.2	72.7	10.5
Rhodesia	2,230	111	12.9	9.8	3.1	20.6	13.6	7.0	77.4	68.9	8.5
South Africa	2,170	132	14.4	8.8	5.5	26.2	12.6	13.7	91.4	73.2	18.2
Tunsia	2,140	111	12.3	9.7	2.6	25.3	19.4	5.8	73.6	63.5	10.1
			12.7±1.3		3.4±1.4	24.0±4.3					13.2±4.0
B. Countries with adequate caloric and protein supplies											
Algeria	2,140	95	9.1	7.4	1.7	16.5	10.7	5.7	69.6	60.6	9.0
Burundi	2,380	99	10.3	9.5	0.8	7.6	6.2	1.4	80.6	80.2	0.4
Cameroon	2,360	101	10.1	8.1	2.0	19.3	15.9	3.4	71.7	69.5	2.2
Gabon	2,340	97	8.4	3.9	4.6	13.1	8.3	4.8	75.7	73.1	2.6
Gambia	2,390	97	9.7	7.7	2.0	23.5	20.5	3.0	63.4	58.5	4.9
Ghana	2,240	103	9.5	6.5	2.9	17.5	15.0	2.5	76.0	71.8	4.2
Guinea-Bissau	2,230	104	8.7	6.8	1.8	19.9	14.9	5.0	75.6	73.1	2.5
Ivory Coast	2,390	110	10.6	7.2	3.3	12.9	9.0	4.0	86.2	80.8	5.4
Kenya	2,290	94	10.6	8.6	2.0	12.6	8.0	4.6	70.4	61.8	8.6
Lesotho	2,420	91	11.2	9.3	1.8	10.4	6.6	3.7	69.5	64.8	4.7
Madagascar	2,390	99	9.4	7.3	2.2	10.1	4.9	5.1	79.2	74.8	4.4
Malawi	2,340	103	11.7	10.6	1.1	17.1	14.4	2.6	74.3	71.1	3.2
Namibia	2,230	97	12.8	6.8	5.9	23.5	10.8	12.7	60.8	55.6	5.2
Nigeria	2,270	91	8.1	7.3	0.8	14.9	13.5	1.3	68.1	66.9	1.2
Senegal	2,310	94	10.7	7.6	3.1	20.8	16.9	3.9	62.8	55.4	7.4
Sierra Leone	2,280	99	8.9	7.0	1.9	21.3	19.7	1.6	68.9	65.5	3.4
Sudan	2,230	93	10.9	7.3	3.6	24.0	15.5	8.6	58.1	50.9	7.2
Swaziland	2,340	91	9.7	6.2	3.6	16.5	7.9	8.6	64.4	50.0	14.4
Togo	2,300	94	9.1	7.9	1.3	12.0	9.9	2.2	73.1	71.7	1.4
Uganda	2,330	92	9.4	7.2	2.2	12.4	9.4	3.0	70.1	66.2	3.9
			10.0±1.2		2.4±1.3	16.3±4.9					4.8±3.3
C. Calorie-deficient countries											
Benin	2,350	87	8.7	7.1	1.6	17.6	15.6	2.0	60.5	59.2	1.3
Botswana	2,390	85	11.6	7.7	3.9	16.2	7.7	8.5	56.8	49.5	7.3
Chad	2,270	78	10.6	8.3	2.3	14.4	11.2	3.3	52.8	50.1	2.7
Ethiopia	2,340	88	10.8	9.2	1.7	13.0	9.1	3.9	64.0	62.0	2.0
Mali	2,440	72	8.7	7.0	1.7	12.2	9.5	2.7	51.3	48.6	2.7
Mauritania	2,230	84	11.4	5.6	5.8	18.1	6.3	11.8	54.4	45.8	8.6
Niger	2,240	83	11.4	9.7	1.7	12.3	8.9	3.4	59.3	57.7	1.6
Rwanda	2,420	87	8.9	8.5	0.5	4.7	3.8	0.9	73.3	73.3	-
Somalia	2,280	84	10.4	5.7	4.6	20.4	8.1	12.3	53.2	45.1	8.1
Tanzania	2,330	84	7.9	5.9	2.3	11.7	7.3	4.3	64.5	60.1	4.4
Zambia	2,260	89	10.3	7.7	2.5	13.9	10.0	3.9	65.1	58.3	6.8
Upper Volta	2,430	71	9.2	8.6	0.6	9.5	8.2	1.3	52.5	51.6	0.9
			10.1±1.2		2.4±1.7	13.8±4.4					3.8±3.2
D. Protein-deficient countries											
Angola	2,180	91	7.7	5.5	2.1	14.1	10.4	3.8	69.3	63.0	6.3
Central Africa	2,430	96	7.4	5.9	1.5	17.1	14.2	2.8	71.2	69.5	1.2
Congo	2,210	103	7.6	5.2	2.4	13.2	11.1	2.1	82.3	79.4	2.9
Mozambique	2,190	91	6.8	5.9	0.9	12.9	10.7	2.2	71.0	64.4	6.6
			7.4±0.4		1.7±0.7	14.3±1.9					4.4±2.4
E. Protein and calorie-deficient countries											
Guinea	2,350	84	7.4	6.7	0.7	14.0	12.8	1.2	62.3	61.0	1.3
Liberia	2,280	87	6.3	4.6	1.7	14.2	12.0	2.2	66.1	64.2	1.9
Zaire	2,330	79	5.4	4.0	1.3	11.4	9.9	1.5	62.6	61.3	1.3
			6.8±1.1		1.5±0.8	12.8±1.5					2.2±1.5

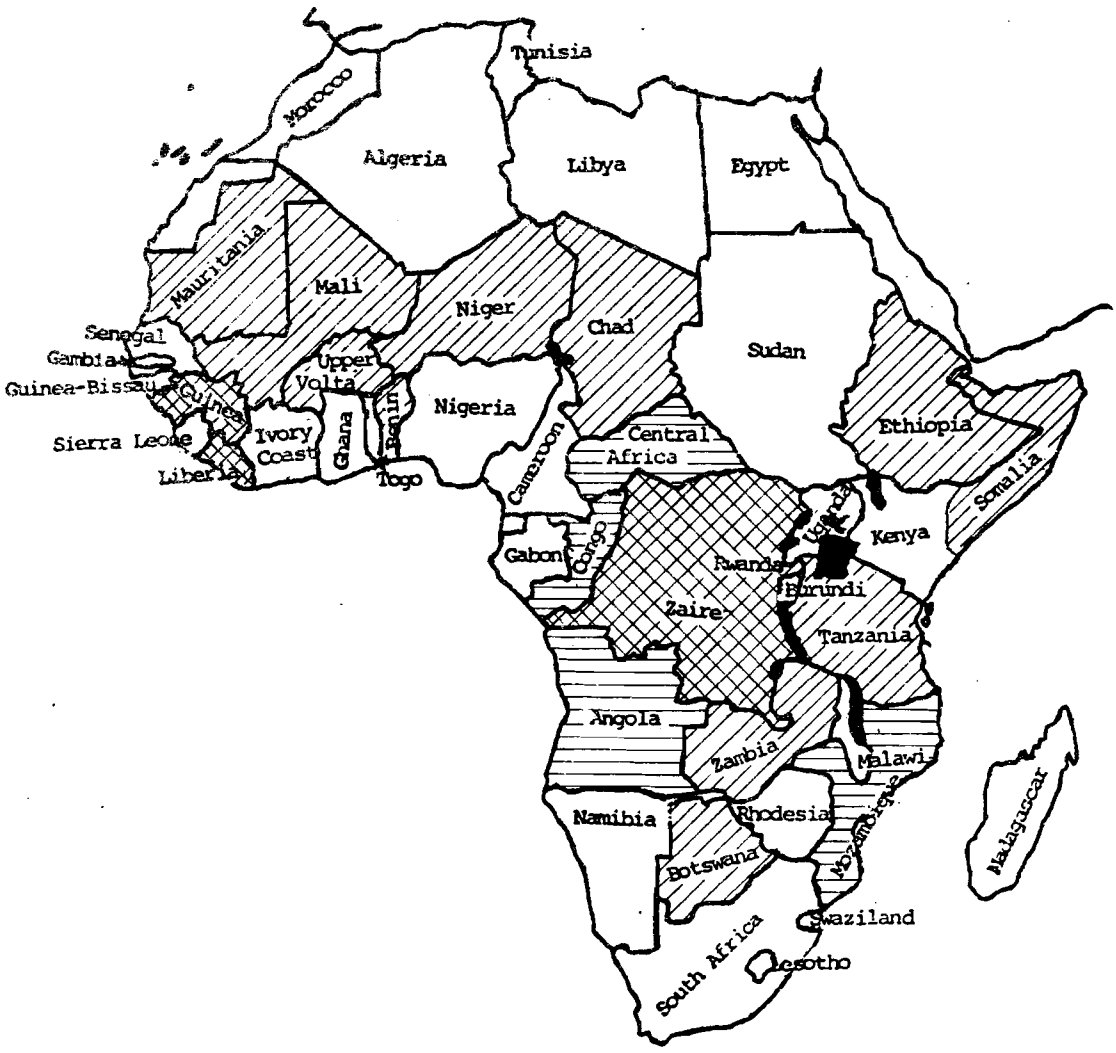
*Calculated from Table 5a

FIGURE 1

countries high in calories and protein = Group A

countries adequate in calories and protein = Group B

FIGURE 2



countries low in calories = Group C

countries low in protein = Group D

countries low in protein and calories = Group E

eats first as much as he wants and the rest is distributed among the women and children. The staple diet is also quite often deficient in the major nutrients, such as proteins and, as a result, the children are malnourished although they may have full stomachs.

Even if the caloric supplies are in excess in these countries, this does not imply that the vitamin and mineral supplies are also adequate or even in excess. Deficiencies in vitamin A, riboflavin and niacin still occur in the Egyptian diet* which is one of the richest countries in Africa in respect of the food available (Table 6). Calcium is also relatively low in that diet, but it is not known how much of this and other minerals is consumed through drinking water. Cereals supply almost 70% of the daily calories in Egypt, therefore the daily thiamine content is relatively high. Improving the nation's diet with small amounts of additional vegetables, milk products and nuts or beans would increase the vitamin A, riboflavin and niacin content, respectively, to achieve an optimal diet (Table 7).

The diseases associated with an affluent diet, such as cardiovascular diseases, diabetes mellitus or cancer are relatively common in this group of countries (Table 8**). On the other hand the infant mortalities in these countries are also quite high, which, among other factors, is a good indicator of malnutrition because children are especially susceptible to this. The incidence of diseases related to both an affluent diet and to malnutrition, reflects the unequal distribution of nutrients among the whole population.

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* The intake of nutrients in the diet was calculated with the FAO publication, Food Composition Tables - Minerals and Vitamins - for International Use, by C. Chatfield, No. 11, 1954. The daily diet patterns in a country were obtained from the Provisional Food Balance Sheets, 1972 - 74, FAO, 1977.

** Unfortunately, statistics related to morbidity and mortality rates as shown in Tables 8, 9 and 10 are not widely available for all the countries and the same time periods. The available statistics are also not absolutely reliable for developing countries, since the figures given are very often just estimates or counts of a small portion of the nation. Therefore, these values just give a general idea of the situation in a country. They should not be considered as absolute values.

TABLE 6

CONSUMPTION PER DAY AND PER CAPUT IN PERCENT OF THE DAILY ALLOWANCES

Country	Calories (without alcohol)	Protein		Fat*	Calcium	Iron	Vit.A	Thiamine	Riboflavin	Niacin	Vit.C	Alcohol**
		crude	high quality									
Egypt	122	269	166	16	64	155	91	178	62	85	203	-
Cameroon	96	198	125	19	49	119	80	158	52	101	336	5
Mali	72	173	119	17	26	105	26	111	40	62	46	1
Congo	101	145	99	13	43	77	51	96	39	87	578	2
Zaire	78	106	71	15	26	59	35	68	24	57	275	2

*Percent of total calories consumed.
**Percent of additional calories consumed as alcohol.

Source: Provisional Food Balance Sheets, 1972-1974 Average, FAO Rome 1977 (24)
Food Composition Tables-Minerals and Vitamins: for international use, by C. Chatfield, FAO Nutritional Studies No. 11, Rome, March 1954, (25).

TABLE 7

CONTENT OF NUTRIENTS OF SOME MAJOR COMMODITIES IN PERCENT OF THE DAILY ALLOWANCES*

For all African Countries

Commodity, 100g	Calcium	Iron	Vitamin A	Thiamin	Riboflavin	Niacin	Vit. C	Calories	Protein High Quality	Fat**
whole wheat flour	5	29	-	34-38	7-8	29-32	-	14-15	28-31	1
millet	4	29	-	25-28	7-8	6-7	-	14-16	22-25	1
maize	1	16	10	37-42	8-9	12-14	-	15-16	18-20	2
cassava, fresh	3	4	-	3-4	1-2	2-3	60	5	3	-
cassava, meal & flour	2	7	-	-	-	6-7	-	14-16	4-5	-
groundnuts, shelled	7	16	1	69-78	8-9	99-112	-	22-25	59-67	16-18
sesame	150	64	-	66-74	15-17	28-32	-	24-27	38-43	19-21
beans, dry	17	48	1	44-51	12-14	13-15	7	14-16	35-39	1
vegetable***	6	8	42	5-6	5-6	3-4	67	1	2-3	-
cassava leaves	22	12	2	11-13	18-20	9-11	500	2	2	-
cheese hard whole milk	88	71	31	1	31-35	6-7	-	16-18	51-58	11-13
skim milk, dried	154	64	1	29-32	123-138	6-7	13	15-17	80-90	-
eggs (hens, in shell)	6	16	20	7-8	18-21	1	-	6-7	37-42	4
meat (beef, med. carcasses)	1	13	-	9-10	14-15	31-35	-	6-7	40-46	3-4

*Calculated for the country with the lowest and the highest caloric requirements in Africa and with the help of Table 3 and 4.
**Percent of required calories.
***Especially dark green leaved vegetables.

Source: Food Composition Tables - Minerals and Vitamins for International Use, by C. Chatfield, FAO Nutritional Studies No.11, March 1954, (25).

TABLE 8

CAUSES OF DEATH (PER 1,000 POPULATION OF THE SAME AGE RESIDENCE)

	Year	Infant Mortalities 0-4 Years	Infectious Diseases	Diarrhoea	Avitaminosis	Heart Diseases Diabetes Mellitus	Cancer
A. Countries with excess caloric supplies							
Egypt	1973	201.1	31.5	6.5	3.2	127.6	21.6
Mauritius	1974	59.3	79.9	66.9	9.0	120.7	44.9
Reunion	1969	90.4	77.4	30.1	2.1	131.7	57.4
South Africa	1971						
Black pop.		224.7	295.6	212.5	8.7	141.8	75.7
white pop.		25.4	15.7	6.8	0.6	257.9	135.7
B. Countries with adequate caloric and protein supplies							
Cameroon	1964-65	184.5					
Kenya	1970		165.4	41.3	8.3	5.9	6.2
Madagascar	1972	135.4					
Togo	1961	183.9					
C. Caloric-deficient countries							
Benin	1961	155.6					
D. Protein-deficient countries							
Angola	1972		65.7	38.0	3.7	9.9	8.5
E. Protein and calorie deficient countries							
Liberia	1970	159.7					

Source: Demographic Yearbook, 1975, 27th Issue, UN, New York, 1976

TABLE 9

CAUSES OF DEATH FROM INFECTIOUS DISEASES AFFECTING MAINLY CHILDREN (PER 1,000 POPULATION)

COUNTRY	MEASLES	WHOOPING COUGH
Egypt	4.0	0.1
Cameroon	0.4	0.1
Mali	10.2	0.9
Congo	24.7	1.6
Zaire	4.6	0.4
Canada	0.1	0.0
Austria	0.1	0.0
Bulgaria	0.0	0.0
Federal Republic of Germany	0.1	0.0
France	0.1	0.1
Switzerland	0.1	0.0

Source: World Health Statistics Annual, 1971 - Volume I and II

South Africa is a very good example of the relationship between nutrition, health, income and education. The white population, having a higher income, a better education and living under more hygenic conditions than the black population, has a much lower incidence of infant mortalities, deaths from infectious diseases and diarrhoea (Table 8). The cases of deaths resulting from vitamin deficiencies are also remarkably lower in the white population. On the other hand, diseases related to an affluent diet such as cardiovascular diseases, diabetes mellitus and cancer are found more often among the white population.

4.2 Countries with Adequate Caloric and Protein Supplies

Adequate supplies of nutrients are also produced in the areas of the lowland rain forests as well as in the savannas where cereals, starchy roots and beans are the main staple diet (millet, sorghum, maize, rice, cassava, yam, sweet potatoes and plantain) (Table 5). The caloric requirements of these countries are in general higher than in the countries with mediterranean vegetation, because more people are working in agriculture (76.8 ± 11.0% of the economically active population) and, therefore, need more energy than urban populations. Not only is their total food consumption lower, but also their intake of protein, fat and sugar is remarkably lower than in the countries with excess supply of calories (Table 5).

In Cameroon, a country representative of this group of countries in Africa, 38% of the daily calories are obtained from cereals and 33% from starchy staples such as roots, tubers, plantains and bananas. This particular diet is low in vitamin A and riboflavin; the low intake of calcium can again not be evaluated because the water consumption and its mineral content is not known (Table 6). The diet could be improved by consuming additional low amounts of vegetables, milk products or red palm oil (Table 7). The consumption of nuts and beans is high enough in order to have an adequate intake of niacin.

TABLE 10

PERCENT OF PROTEIN-CALORIE MALNUTRITION IN CHILDREN UNDER 5 YEARS

Country	Year	Kwashiorkor	Marasmus	Total
A. Countries with excess calorie supplies				
-				
B. Countries with adequate calorie and protein supplies				
Cameroon	1973	3.0	1.4	4.4
Malawi	1969-70	0.2-0.5	0.7-2.7	0.9-3.2
Nigeria	1965	1.6	3.2	4.8
Sierra Leone	1964	1.2	2.3	5.5
Sudan	1972			1-4
Uganda	1961-67	0.0-0.7	0.4-1.5	0.4-2.2
C. Calorie deficient countries				
Botswana	1971			5
Mali	1964			1.5-5.4
Rwanda	1970			9.8
Zambia	1971-72	0.1	0.20	0.21
Tanzania	1968-69	0.2-0.8	0.3-6.8	0.5-7.6
D. Protein deficient countries				
Central Africa	1971			9.0
E. Protein and calorie deficient countries				
Guinea	1964	11.8	11.8	23.6

Source: Joint FAO/WHO/OAU Regional Food and Nutrition Commission for Africa, Brazzaville 1974

Malnutrition in this group of countries is caused by faulty distribution of the foodstuffs as in the group of countries with excess caloric supplies. An additional factor contributing to inadequate nutrition can certainly also be found in the relatively high percentage of dietary energy derived from alcohol which delivers merely empty calories. The incidence of marasmus in children of this group of countries is only slightly elevated compared to kwashiorkor (Table 10), indicating that children suffer from both caloric and protein deficiencies.

4.3 Caloric Deficient Countries

More susceptible to hunger and starvation are inhabitants of countries with huge fruitless areas where farming takes place only under extreme difficulties and not very effectively, as in the Sahara and the Central Highlands. Tubers and cereals are the main staple diet in these countries and vegetables and fruits do not receive very much attention. These countries are very often not able to produce or import enough food to supply at least the required per capita amount for its population.

In Mali, a typical country in this group, 77% of the consumed daily calories are obtained from cereals (millet, rice and maize). But not enough of it is available to feed everyone adequately. Because of this high consumption of cereals, the protein and vitamin intakes are above the recommended minimal amounts. However, all the other nutrients are in deficit. The vitamin A and C deficits result from the neglect of vegetables. Only a slightly higher consumption of this commodity group would improve the diet remarkably. The diet could be improved further by taking some of the groundnuts for home consumption instead of as a cash crop. To become adequate in caloric supplies, the cereal and tuber consumption should be increased by approximately 50%.

As a result of the undernutrition in this group of countries, marasmus among children is much more common than kwashiorkor and contributes most to the fairly high infant mortality rate. (Table 10).

4.4 Protein Deficient Countries

On the other hand, if roots and tubers are the main staple diet, protein deficiency is very likely, even with adequate caloric supplies.

In the Congo, for example, approximately 65% of the calories are obtained from cassava and sweet potatoes making the diet deficient in proteins and all essential nutrients. To improve the diet of these people it would be best to increase the meat consumption, especially of those animals which are resistant to the tsetsefly or to introduce new protein rich varieties of cereals and to shift then the diet more towards the consumption of these cereals. Also more vegetables, pulses and milk products should be consumed to ensure an adequate diet.

Children in these countries are especially susceptible to infectious diseases, which are much more severe and lead more often to death than in developed countries (Table 9).

It has to be pointed out according to this study that the number of countries in Africa being deficient in protein, but having enough calories per capita, is only very small (about 8% of all African countries).

4.5 Protein and Caloric Deficient Countries

The countries being worst off in respect to their nutritional status are deficient in proteins and calories. There are countries where farming is extremely difficult and only a small percentage of the whole land can be used for agriculture, either because of unpenetrable rainforests or fruitless highlands.

The main staple diet is derived from roots and tubers and only partially from cereals. Zaire is the country with the poorest per capita diet (Table 5), consequently its inhabitants are deficient in all nutrients (Table 6). Its main problem is based on the fact that not enough food can be produced to feed the population adequately and that the national income is too low to buy imported food.

As can be expected kwashiorkor and marasmus are widely spread in these countries. Infectious diseases such as malaria, sleeping sickness, filariasis, bilharziasis and ankylostomiasis are also very common because of the tropical climate and poor sanitary conditions. To be more resistant to these germs a diet adequate in all nutrients would be extremely important because an already weakened body cannot form antibodies as fast and not in the same quantity as a well nourished one.

4.6 General Conclusions

As has been shown in this analysis of the nutritional status in Africa, protein deficiency alone is not the major problem of the African continent. The problem has to be seen more as one of having an insufficient amount of energy available associated with the total number of essential nutrients. In general, sufficient protein is consumed when the main staple diet consists of cereals; only those few countries which consume mainly roots and tubers are relatively low in their protein supplies. Most of the protein is obtained from vegetable sources in all African countries. The amount of animal protein consumed in Africa is generally very low. Only two countries, Gabon and Mauritania have an equal amount of vegetables and animal protein in their diet. Therefore, the major problem of the African diet is related to energy and vitamin deficiencies which are much more serious than the protein deficiencies throughout the whole continent. According to FAO's Fourth World Food Survey, in 1977, some of these countries would have to be reclassified (Table 11) based upon different assumptions for the distribution of the population. However the general outline of the poor nutritional situation in Africa is the same in both studies.

It has to be kept in mind that the evaluation of the nutritional situation of a country in this work was based on national food balance sheets, which are established on weights at the retail level rather than on the food as consumed. The losses of

TABLE 11

According to the latest FAO estimates (28), the following countries would have to be reclassified.

Country to be added	Energy supply as percent of requirement FAO	present study	Country to be omitted	Energy supply as percent of requirement FAO	present study
A. Countries with excess calories					
Ivory Coast	114	110	Egypt	105	112
			Mauritius	107	113
			Morocco	107	120
			Rhodesia	104	111
B. Countries with adequate caloric and protein supplies					
Egypt	105	122	Algeria	86	95
Mauritius	107	113	Ivory Coast	114	110
Morocco	107	120	Nigeria	88	91
Rwanda	91	87	Sudan	88	93
C. Caloric-deficient countries					
Algeria	86	95	Rwanda	91	87
Nigeria	88	91			
Sudan	88	93			
D. Protein-deficient countries					
			Angola	85	91
			Mozambique	85	91
E. Protein and calorie-deficient countries					
Angola	85	91			
Mozambique	85	91			

edible material are difficult to define but up to now it is generally agreed that approximately 10% of the food at retail level is wasted (10). Applying this fact to the African countries would imply that most of the countries are actually in energy deficit, and the whole picture becomes even worse.

Only a very general picture is obtained when the nutritional situation of a country is evaluated solely on the basis of the food balance sheets, because they presume an equal distribution of the food among all individuals. However, it is a general fact that food is not spread equally among the total population. The food available to an individual is highly dependent upon his income and how much of it he is willing to spend on food. The unequal distribution of food among the population is also due to inadequate transport facilities for food between different areas resulting in empty stores or food of poor quality available in stores. Therefore, people are very often dependent solely on local farming practices. In addition, there may be marked seasonal variations in the diet. Times with adequate nutrition may alternate with times of starvation. This may be especially pronounced before the harvest season, as observed in Malawi and the Gambia (29). Food may also be spared because of social habits. Malnutrition can also be caused by traditional food preparation and faulty storage where great amounts of essential nutrients are lost. In addition, the habit of eating and feeding infants can contribute to the problems of malnutrition. Children are the ones suffering the most from malnutrition due to wrong feeding practices and their susceptibility to infectious diseases. Infants may be inadequately breastfed because of insufficient lactation of the mother (perhaps due to malnutrition) or fed with artificial milk, which in general is too diluted, too little and too contaminated (3). The traditional weaning food is very often a portion of the adults diet without substituting it with the main nutrients, and consequently children can be malnourished even although they may have a full stomach. These nutritional malpractices lead to poor recovery from infectious diseases, marasmus, kwashiorkor and other diet-related disfunctions.

Not only is the amount of food available in a country important, but also its distribution among the different income groups. It is a generally known fact that the low income groups have a much lower consumption level and a more stereotyped, poor diet than the higher income groups as they are unable to buy additional food to supplement their homegrown diet. This factor becomes especially serious if not enough food is available for the population as a whole, causing the already limited food intake of the poor to decrease further and making them even more susceptible to malnutrition. However, even in countries with adequate energy supplies, this still leads to malnutrition in the lowest income groups. In order to illustrate these statements, food consumption in relation to income distribution will be evaluated separately for Kenya (30), a country with adequate caloric and protein supplies, as shown in Table 5. To improve the nutritional status in Africa, not only has more and better food to be made available, especially to the poor, but also their lack of concern regarding malnutrition and even starvation has to be eliminated. They require to become better educated with respect to improved eating habits and more hygienic methods when preparing their own and their children's food.

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