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ABSTRACT

The predominant perception is that the world's food problems are now concentrated in Sub-Saharan Africa. Declining food production and recurrent famine in many African countries are the focal points of much recent work on food problems. This paper assesses the evidence on the prevalence of undernutrition on a more permanent basis. The overall conclusion is that there is no firm evidence corroborating the notion that chronic and severe undernutrition is widespread in most parts of Africa.

World Bank estimates, derived on the basis of aggregate data, suggest that almost half the population in Sub-Saharan Africa is undernourished and one-quarter severely so. FAO estimates purport that the amount of calories available for human consumption in the region corresponds to 80 percent of requirements even if distributed in proportion to needs. In the present paper, these estimates are shown to be biased, i.e., to exaggerate the non-transitory food consumption problems in Africa. Moreover, the aggregate estimates do not square up with the evidence from (i) dietary, (ii) anthropometric and (iii) food expenditure studies of sample populations.

Many infants and children in Africa are stunted by Western standards and they face an exceedingly high risk of dying. There is, however, practically no evidence vindicating the notion that lack of food at the household level is the main reason; it thus seems that other factors, such as disease and nutritional misallocation within the families, are the major culprits. Finally, it is shown that there is no bias against female children in Africa, something that has been found in South Asia and Latin America. On the contrary, in Africa, boys seem to be at a systematic disadvantage.

1. INTRODUCTION

While food production has kept abreast of population growth in all other major regions in the world, there has been a significant decline in Sub-Saharan Africa over the past twenty years. In Latin America and Asia, per-capita consumption of food calories has increased; in Sub-Saharan Africa at large, it has decreased. On the Indian sub-continent, there has been only one large-scale famine over the post-war period (in Bangladesh in 1974), while none in Latin America; in Africa, famine has ravaged many countries repeatedly.[1] Agriculture and food problems, permanent as well as transitory ones, are the most noticed and, it is widely thought, notable manifestations of the African economical and political crisis.

Faltering food production has been the focal point in most studies of the African food problem.[2] In this paper, the focus is on the consumption side.[3] The overall objective is to assess the prevalence, distribution, secular change and forms of chronic under- and malnutrition in the Sub-Saharan African countries[4]; the transitory problems related to severe acute starvation and famine are

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[1]. The most extensive famine in terms of victims during the post-war period seems to be the one in China during 1959-62 (see the paper by Riskin (1987) in this volume). The famine in Campuchea, related to civil war, may have claimed the lives of a larger share of the population, but little quantitative evidence seems to be available.

[2]. For recent contributions to this literature, see Mellor et al., 1987; FAO, 1986a; Lawrence et al., 1986; Low, 1986; Lele, 1986; and USDA, 1981.

[3]. The supply and demand side of the food market is of course heavily inter-related in countries where a large share of food production is for subsistence, as in most of Africa.

[4]. Sub-Saharan Africa, as defined in this paper, excludes Morocco, Algeria, West-Sahara, Tunisia, Libya, Egypt and the South-African Union, and includes the island republics of Mauritius, Comoros and the Malagasy Republic.

analyzed in two different papers (Svedberg, 1987b, 1987c). Among the more specific questions that we seek answers to are the following. What proportion of the African population suffers from under- and malnutrition and how severely so (using different yardsticks)? Is the nutritional situation in Africa in the 1980s more precarious than in India and Bangladesh, the two countries in which food and nutrition problems were thought to be the most serious in the 1960s and early 1970s? (Throughout the paper, comparisons will be made to these countries so as to put the African situation in perspective.) Are we witnessing a secular deterioration in food and nutrition standards in Africa at large or is the problem confined to a limited number of countries? If so, are there any common characteristics of these countries that can be isolated?[5] Can the population groups that do not fulfill their basic food requirements be identified? A further question is whether there is evidence of nutritional "discrimination" along gender or age lines.

The plan of the paper is as follows. In section 2, the problems associated with measuring the nutrition status of a population are discussed briefly. In the following five sections, different measures and indicators of nutrition standards in Africa and changes therein are presented and analyzed. In section 3, the evidence on per-capita calorie supplies is assessed. The available estimates of the overall prevalence of undernourished people in African countries are discussed in section 4. In section 5, food consumption and nutrition studies of village and sample populations are scrutinized. In section 6, what is thought to be one of the most tragic outcomes of

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5. This particular question will only be dealt with briefly in the present paper; a more thorough statistical analysis is conducted in a separate paper (Svedberg, 1987a).

undernutrition, excess infant mortality, is analyzed. The information that can be obtained from food expenditure studies is presented in section 7.[6] In section 8, an attempt is made to sum up and synthesize the main findings of the earlier sections and check whether they are consistent; and, when not, discuss the reasons therefore. Finally, in section 9, the major conclusions and some suggestions for future research and policy are presented.

A few preliminary remarks on the scope of the study are in order. What follows is mainly a survey of previously published material; almost all the data are from secondary sources. The intended contributions are fourfold. The first is to bring together the main existing information in one place (sections 3-7). The second and more important contribution is to provide new insights into nutrition standards in Africa through cross-comparisons of various measures and indicators. As section 3-7 show, no single measure or indicator permits firm conclusions about the nutritional status of African populations. As we shall see, they are all built on data that are rather crude and/or provide incomplete information. However, by combining aggregate data with that from sample studies, dietary with anthropometric evidence, economic (food expenditure) data with nutrition data, mortality figures with food consumption estimates, we hope to be able to find out more than is presently known about nutrition standards in Africa (section 8). The third contribution is

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6. "Food consumption surveys" are given different meaning in different standard references, which may cause some confusion. In the FAO (1986) Review of Food Consumption Surveys, what is actually covered are food expenditure surveys, i.e., data on the share of sample populations' monetary expenditures that is devoted to food. In IDRC (1981), food consumption surveys mean surveys of peoples' actual food intakes. In the following of this study, we use the IDRC terminology and what the FAO labels food consumption surveys, we will refer to as food expenditure studies.

related, i.e. to use the results that emerge from the comparison of different measures and indicators so as to assess their relative reliability and relevance and, thus, usefulness (section 9). The fourth hoped-for contribution is a summary statement of what we know about the permanent nutritional problems in Africa - and what we do not know - so as to pinpoint directions for further research and policy (section 9).

The paper makes no attempt to explore in any detail the political, economical, cultural, etc. reasons for the nutrition inadequacy documented in several African countries and recent developments (cf. footnote 5). Knowledge about the prevalence, severity, distribution and change in undernutrition is essential as a first step in coming to grips with several serious problems.

Sub-Saharan Africa has been ravaged repeatedly by famine, in historical as well as in more recent times (Svedberg, 1987b). Unless we can identify the population groups that suffer from permanent nutritional deficiency, which make them vulnerable to shocks in their food entitlements (cf. Svedberg, 1987c), there is little chance of identifying the reasons for their exigence and, thus, of designing policies that can effectively prevent or alleviate famine. If we are concerned with distribution in development, we must be able to identify the population groups that are under severe nutritional stress, which is, not a perfect, but a relatively reliable indicator of absolute poverty (Sen, 1983). Without knowledge about where the poorest and most destitute population segments are found, it will be very difficult to come up with long-term development strategies that do not leave them out, or, at least, do not inflict additional hardship upon them.[7]

2. UNDERNUTRITION: MEASUREMENT PROBLEMS

There are two main ways to go about in finding out whether, and to what extent, an individual is undernourished within a given time period. One is as follows: (i) estimate her/his food consumption, (ii) evaluate the nutritional content of the food intake and (iii) estimate what nutritional requirements the individual has in order to comply with the stated objective function. This is what is usually called the dietary approach. The other method is to measure health and other conditions of the individual that reflect the outcome of an imbalance between her/his nutritional intake and expenditure, as indicated by anthropometric, clinical, biochemical, mortality and other demographic evidence. Both approaches involve many measurement difficulties as well as normative evaluation problems. Additional difficulties arise when we attempt to derive estimates on the basis of aggregate data.

A related, but distinct, question is how the individual values nutritional adequacy in relation to other "basic needs". The study of the individual's revealed preferences (the behaviouristic approach) can, as we shall argue, provide indirect evidence on her/his nutritional status.

The following subsections discuss (i) the practical problems with assessing nutritional adequacy through food intakes in the African context, (ii) the equivalent problems with anthropometric and related measures and (iii) the scope for using economic expenditure

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[7]. See Sen, 1984, for a more thorough discussion of the implications of nutritional knowledge for economic theory, analysis and policy.

data to assess nutritional status. The analysis of perhaps the most difficult problem, i.e., the objectives to which the observed nutrition measures and indicators should be related is postponed to Section 8.

(1) The Dietary Approach. To measure the food intake of individuals is complicated and costly in the practical circumstances of underdeveloped countries in general and the African ones in particular. The most reliable procedure is to weigh all the different food items that the individual enjoys over a long period of time. However, even this method is far from flawless. For instance, the individual may change the level and composition of her/his food consumption while being observed by a nutritionist team. If the household members all eat from the same pot, which is common practice in many parts of Africa, there is little possibility of measuring the intra-family distribution. Between-meal snacks and away-from-home meals introduce further complications. The other methods (e.g. interviews or stock takings) are even more unreliable.

At a more aggregate level, average or per-capita food consumption is usually estimated from so-called food balance sheets. That is, the aggregate supply - domestic production, net imports and changes in stocks - of various food items are estimated, adjusted for wastage, feed and seed, and divided by the population (taking account of its composition) so as to derive estimates of per-capita "availabilities", which are then used as proxies for food consumption. The same type of estimates of food consumption has also been derived for households or other entities at the micro level.

In the African context, estimates of food consumption derived from supply-side data are apt to be rather crude. In almost all the Sub-Saharan countries, between 50 and 80 percent of the population is self-employed in the agricultural sector, most of them in shifting-cum-subsistence cultivation. It is well known that it is inherently difficult to obtain exact measures of the product of these peoples' labor. Only major crops, such as cereals, are usually sold at all outside the village or district; and of these crops, often only a small part (20-40 percent) is marketed (Eicher and Baker, 1982, p. 48) and officially (although imperfectly) measured. In the parts of rural Africa where minor local crops and various roots and tubers play an important role in the diet, the measurement problems are especially acute. What a (subsistence) peasant household grows and consumes can realy only be measured through direct observation, which is seldom done. Most aggregate estimates are based on rather crude approximations. Likewise, for most of the African countries, data on food trade and changes in food stocks, especially, are seldom reliable, either at the national or at the village/ household level.

A further problem is that the population and demographic data needed to derive per-capita estimates are as shaky as most other statistics on Africa.[8] This is a problem in studies at the aggregate level (e.g. the FAO estimates), but also in household surveys, as the number of people that eat from a common "kitchen" tend to vary.

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[8]. For most of the African countries, the size of the population is only approximately known. In many countries with a federal constitution, population census is a highly political issue. Not only do the population estimates from the various "states" determine their representation in federal political bodies; the population data are also important determinants for the intra-country allocation of resources and for taxation. This has been vividly demonstrated in the case of Nigeria, the most populous country in Africa. No reliable census has been carried out since 1963 and whether the population in 1984 was 90 millions (the UN estimate), or 100, or 80 millions, we simply do not know. For several African countries, the size of population should be set within a range rather than at a definitive number as is done by the UN.

Moreover, in order to relate the intakes to requirements (cf. below), the composition of the population along gender and age lines has to be known, which is seldom the case.

In surveys at the level of households or individuals, the most reliable estimates of the **nutritional content** of the (estimated) food intakes are obtained through decomposing the (equivalent) food by complex chemical and mechanical separation methods. At best, these methods provide very detailed information about the nutritional elements contained in the food. The methods are very costly, however, and in practice, standard conversion tables are used. This applies to the estimates derived at the aggregate level as well as most sample studies. But local varieties of various "raw" foods in Africa differ, sometimes considerably, in nutritional value and content because of soil characteristics, precipitation and the quality of the seeds used. The nutritional content of the food actually consumed, especially of vitamins, also varies as different storage, processing, preparation and cooking methods are used in different locations.[9] Moreover, the main staple foods in Africa contains varying degrees of "antinutritional elements", i.e., compounds that affect the digestibility of the food negatively (IDRC, 1981, pp. 11-12). The use of standard conversion tables inevitably means that an error and, possibly, a bias is introduced in the estimates.[10]

Yet another problem is that most dietary estimates consider one nutritional element only, viz. the energy (calorie) content in the

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9. See several contributions to FAO (1983), especially Eggum (1983).

10. There will be a bias in the estimated distribution of undernutrition if, for instance, the storage, preparation and cooking methods used by the poorest households differ from those applied by the better off ones and the nutritional quality of the food consumed are affected differently.

food. This is true of the aggregate estimates provided by the FAO and the IBRD and most "village" nutrition studies. There is nevertheless some justification for the focus on calories. Since the mid 1970's, many nutritionists seem to agree that lack of calories is a more widespread and serious problem than lack of protein and micro-nutrients, such as vitamins and minerals (e.g. Sukhatme, 1974; Mayer, 1976; Osmani, 1982). There are, of course, local exceptions in Africa and elsewhere (section 5 below). In most cases, however, it seems that where calories are adequate, protein and most micro-nutrients tend to be adequate too; when calories are insufficient, protein is often, but not always, lacking (the so-called protein-calorie deficiency)[11]. The use of the calorie intake as a one-dimensional measure of nutritional adequacy is thus acceptable for some, but not all, situations.

Quite obviously, in order to establish whether an individual is undernourished or not, her/his actual nutrition intake has to be related to a norm, usually termed **requirement**. There are, however, several **criterion** according to which one can relate nutritional "requirements", such as activity, subjective well-being, health, height or weight status, capabilities of various types, etc. Moreover, there is no unambiguous way in which one can establish what level of, say, physical activity that the "nutritional needs" should be related to, and different activities imply different food requirements.[12] Without passing **value judgments**, there is thus no possibility to decide that one criterion should be used rather than

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11. This is what we mean by undernutrition in the following. Malnutrition is related to inadequacy of one or more micro-nutrients, in combination with, or without, calorie-protein deficiency.

12. See Prizkova (1983) for a large number of studies of food energy expenditures under field conditions.

the next and what "level" is appropriate. As we shall see in Section 8, the use of different norms explains some of the discrepancies in the results reported in different studies.

The individual's nutritional requirement needed to fulfill a certain objective depends on **personal characteristics**, such as weight, age and sex. It also varies with the **environment** in which she/he lives (climate, seasonality, altitude, local incidence of disease, etc). Furthermore, there are, most likely, **inter-individual** (of the same weight, sex, age, etc.) differences in nutritional requirements, due to differences in metabolism. There is also the possibility that there are **intra-individual** variations in "requirements" over time, whether random, autocorrelated, related to some exogenous unidentified variable(s), or to actual food intakes over a certain range. While "personal characteristics" have been considered in most nutrition studies, the latter three complications are usually ignored. As we shall see in section 8, the inclusion of such factors will produce results quite different from the standard ones.

In summary, we cannot but conclude that to estimate what the individual and, especially, aggregates of people, actually eat in "normal" times is a difficult undertaking, not least in Sub-Saharan Africa. It is also problematic to obtain accurate estimates of the nutritional content in the food enjoyed. What an average person actually requires in terms of nutrition to fulfill specific objectives is not known with a great deal of accuracy and there may be large inter- and intra-individual variations. Finally, without passing value judgments, we cannot say what criterion "requirements" should be based on.

(2) Anthropometric and Related Approaches. The above-mentioned problems with measuring peoples' nutrition status through the dietary approach have lead nutritionists to supplement or substitute this method with others. The nutritional status of infants and small children, in particular, has proved almost impossible to estimate accurately through "intakes". For these age groups, but also for others, it is generally agreed that anthropometric, clinical and biochemical methods provide more reliable estimates; not least because "the doubtful concept of 'food requirement' does not have to be invoked" (Sen 1984, p. 354). Also the mortality rate has commonly been used as an indicator of the nutritional standard in a population. None of these methods provide full-proof estimates, however, for a number of reasons.

The most commonly used **anthropometric** measures are (i) weight for height (w/h), (ii) height for age (h/a) and (iii) weight for age (w/a). The w/h measure is mainly used as an indicator of **temporary**, acute, undernutrition; the h/a measure as one of **permanent**, chronic, dietary inadequacy in childhood (which affects also growth in height). The w/a measure cannot be used to discriminate between temporary and permanent undernutrition. Other anthropometric measures include skinfold thickness and circumference of the arm. The h/a measure is the least affected by temporary food deficiency and, thus, the most reliable indicator of chronic dietary inadequacy in childhood, but in childhood only. None of the above weight/height/age measures can be used to discriminate between acute and chronic undernutrition in adultery.

With modern equipment, unbiased weight and height measures are relatively easy to obtain. It has also been shown that random measurement errors in these entities give rise to relatively small biases in the results (Bairagi, 1986). One difficulty, however, with anthropometry in Africa is that age, needed for the commonly used height- and weight-for-age measures, is usually not recorded adequately, if at all. There is thus significant risk for data biases and also random measurement errors of age can produce notable biases in the results (ibid). The basic problems with the anthropometric approach in the African context are not the practical ones, but the choice of reference standards (to be discussed in section 8).

The clinical methods include the identification of diseases and medical symptoms that are known to be related to inadequate diets. There are a large number of such medical indicators of mal- and undernutrition[13], most of which have been found in Africa. Two of the most serious deficiency diseases are kwashiorkor and marasmus, related mainly to protein and calorie deficiency, respectively. There are two principal problems with the use of clinical evidence to assess nutritional status, however. One is that most of the symptoms show up only at very severe malnutrition (as conventionally defined), while milder forms that affect the well-being, general health status and activity of the individual, escape detection. The other problem is that many of the nutrition-related diseases also have other causes, which have proved difficult to isolate.

The most commonly used biochemical tests aim at measuring the content of vitamins and minerals (e.g. iron to detect anemia) in the blood. These methods nowadays provide very accurate measures of content. The problem, again, is that the exact requirements are not known, and they may vary across individuals and also interact in a

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[13]. See Ensminger et al., 1983, pp. 524-40 for a description of the symptoms of the most common deficiency diseases and their relation to deficiency of particular nutritional elements.

complicated way. Furthermore, not all deficiency diseases can be related to specific nutritional elements that can be identified through biochemical methods.

Increased **morbidity** is one serious consequence of inadequate diets; the ultimate outcome is that the individual dies prematurely from a nutrition-related disease, or from outright starvation (i.e., the energy needed to maintain basic metabolic functions is taken from body tissues). Infant and child **mortality** rates, especially, are commonly used as indicators of the nutrition status of a population. Again, the problem is that mortality is also affected by factors other than inadequate nutrition and in the context of underdeveloped countries, it is difficult to isolate the various causes.

(3) **Revealed Preferences**. The two preceding sub-sections have discussed the general problems encountered in trying to estimate the actual nutritional status of individuals or groups of people. A further, related, question is the individual's choice between fulfilling her/his nutritional requirements and other basic needs given the budget constraint. For instance, if it is found that individuals or households are undernourished when applying the standard dietary or anthropometric measures, while at the same time they spend a significant share of their incomes on non-food items and/or on a very cost-inefficient diet, the implications are not straightforward (cf. section 8).

With the above comments and caveats, we shall not enter further into the **general** problems of measuring mal- and undernutrition, but merely present and assess the available evidence, based on the conventional definitions and measurements, and see what these estimates indicate about levels, distribution and changes in "undernutrition" in the African countries over the past two decades.

The more specific problems with representativeness and technical quality of the various nutrition-related studies that have been undertaken in Africa are discussed as we proceed. The normative problems involved in assessing this evidence are left to section 8.

3. PER-CAPITA CALORIE AVAILABILITY

The "per-capita calorie availability", provided by the FAO, is the most comprehensive estimate of "nutrition standards" in the African countries that we have. (How these measures are derived is described in detail in FAO, 1980, pp. 6-16.) The data (see appendix table 1), covering the 44 Sub-Saharan countries, suggest that in 1961/63, 40 of these nations had a per-capita calorie intake below the 'required' level. By the mid 1980s, the number had dropped to 31. Out of these, 16 countries had a per-capita intake below 90 percent of requirements, indicating a relatively serious average food deficiency; Chad, Ghana, Guinea, Mali, and Ethiopia were at the bottom of the list (below 80 percent).

Focusing on the developments over the last decade and a half (1970 to 1985), the estimated calorie availability has improved significantly in little more than a third of the Sub-Saharan countries. In some of these, the improvement is substantial, e.g. in Congo, Gabon, Lesotho, Mauritius, Niger and Tanzania (see table 1). There are, on the other hand, a dozen countries for which there has been a statistically significant deterioration; in a few cases by more than one percent annually over the 17 years: Chad, Ghana, and Mozambique. These countries had an average "availability" below requirements already in 1970/2. In 14 countries the year-to-year fluctuations have been very pronounced and/or there is no discernible trend.

TABLE 1

Per Capita Availability of Calories in Sub-Saharan Africa

Trendwise change 1970-1985	1983/85		
	High (>105)	Intermediate (95-105)	Low (<95)
Notable[b] Increase (>1 percent per year)	Congo (1.11;114)[a] Mauritius (1.15;120) Reunion (1.13;120)	Lesotho (1.44;103) Niger (1.40;96) Sao Tome (1.46;104) Tanzania (1.44;100)	
Moderate[b] Increase (<1 percent per year)	Cape Verde (0.23;111) Ivory Coast (0.56;106) Swaziland (0.89;110)	Gabon (0.24;104) Liberia (0.49;101) Senegal (0.24;98)	Botswana (0.15;93) Burk.Faso (0.38;83) Ethiopia (0.49;73) Guinea Biss. (0.50;86) Mauritania (0.96;90)
No statistically significant trend	Malagasy R (-0.04;109)	Malawi (0.15;105) Togo (0.28;96) Burundi (-0.07;95) Uganda (-0.02;98)	Benin (0.22;93) The Gambia (0.11;94) Mali (0.05;76) Nigeria (0.10;87) Rwanda (0.51;87) Angola (-0.09;83) S.Leone (-0.20;80) Somalia (-0.16;89) Sudan (-0.01;85)
Moderate[b] Decrease (>-1 percent per year)		Zaire (-0.55;97)	Cameroon (-0.60;89) Cent Afr. (-0.70;91) Comoros (-0.43;89) Guinea (-0.87;75) Kenya (-0.32;93) Namibia (-0.34;82) Zambia (-0.40;92) Zimbabwe (-0.35;88)
Notable[b] Decrease (<-1 percent per year)			Chad (-1.65;66) Ghana (-2.42;73) Mozamb. (-1.47;71)

[a]. The first figure inside the brackets shows the annual percentage change over the period 1970 to 1985; the second, the estimated per-capita availability of calories in relation to requirements in 1983/85.
[b]. Statistically significant at the 0.05 level.
Source: Derived from FAO (1987).

/Table 1/

The FAO data thus suggest a very varied experience across Africa over the past 17 years. In some countries, there has been a significant decline in the per-capita availability of calories, in others a pronounced improvement; in still others there is no trend. The most notable development over the 1980s is that the per-capita supply of calories has continued to fall in the countries where there has been a secular deterioration since the early 1970s: Chad, Ghana, Guinea and Sierra Leone. There is no single country in which there has been a notable increase over the first half of the 1980s.

For Sub-Saharan Africa as a whole, the FAO estimates show that there has been a slight deterioration. In fact, in an international comparisons (table 2), the Sub-Saharan region comes out the worst. The Near East has seen the per-capita availability of food calories increase drastically since the early 1960s; in the Far East and Latin America, there have been improvements. India has experienced a small increase, while for Bangladesh, the FAO estimates suggest a deterioration.

/Table 2/

One of the main problems with "per-capita calorie availability" as an indicator of nutrition standards (in addition to the more general measurement problems mentioned in section 2 above) has to do with **distribution**. It is not a measure of the incidence of undernutrition that is comparable across countries. The **inter-household** distribution of the "available calories" is apt to differ from country to country. First, **incomes** are not distributed in the same way. Second, the levels of income differ, and **calorie-expenditure elasticities** are usually inversely related to the income level. Third, the **relative price of food** calories cannot be assumed

TABLE 2

Per Capita Calorie Availability by Selected Countries and Regions and in Relation to Requirements (percent)

	Number of Calories				In Relation to Requirement				Req.[a]
	1961/ 1963	1970/ 1972	1980/ 1982	1983/ 1985	1961/ 1963	1970/ 1972	1980/ 1982	1983/ 1985	
Sub-Saharan Africa[b]	2014	1896	1982	1876	86	81	85	80	2340
India	2038	2054	2075	2161	93	93	94	98	2200
Bangladesh	1938	1953	1879	1859	84	84	81	80	2315
Developing Market Economies	2069	2187	2338	2363	..	..	..	..	..
Latin America	2381	2518	2692	2700	100	106	113	113	2380
Near East	2225	2415	2879	2947	101	110	131	134	2200
Far East	1962	2080	2186	2239	88	93	98	100	2230
Africa	2055	2103	2200	2129	88	90	94	91	2340

a. Requirements according to 1971 FAO/WHO standards (FAO, 1977, annex table 13).
b. The FAO (1987) tapes provide no separate data for Sub-Saharan Africa. The above estimates have been derived by correcting the average for Africa as a whole with the weighted averages of the North African countries (Algeria, Egypt, Libya, Morocco and Tunisia).
Source: Derived from FAO, 1987.

to be identical in each and every country (if for no other reason, food prices are generally influenced by country-specific trade policies). Furthermore, there is little a priori reason to expect the intra-household distribution of food should not differ across households with different characteristics.

4. ESTIMATED PREVALENCE OF UNDERNOURISHED PEOPLE

Both the IBRD and the FAO have made attempts to estimate the share of the population suffering from undernutrition in a large number of developing countries on the basis of estimates of (i) calorie requirements, (ii) per-capita calorie availability, (iii) income distribution and (iv) food expenditure elasticities (see Reutlinger and Selowsky, 1976; IBRD, 1986, appendix A; FAO, 1985, pp. 17-30 and appendix 3). The method, especially the IBRD version, has been criticized on theoretical grounds (e.g. Sukhatme, 1978; Srinivasan, 1981), the main argument being that inter- and intra-individual differences in "requirements" have not been allowed for in the IBRD estimates (cf. section 8 below).

When applied to Africa, additional problems of an empirical nature arise. Firstly, the two sets of estimates of the prevalence of undernutrition on the continent take the FAO data on "calorie availability" as the starting point. As was argued above (pp. 6-9), these data are not very reliable and, as we shall see, probably downward biased. Another problem is that little is known about the distribution of incomes in the African countries and, above all, changes therein. Moreover, calorie-income elasticities have only been estimated for a few small sub-sets of the African population (see section 7 below).[14] The available estimates of the number of 'undernourished' people in the various countries are thus subject to much uncertainty (and, as we shall argue in section 8 below, probably exaggerate the prevalence of undernutrition in Africa).

With the crudeness of the basic data and the estimation methods in mind, what do the IBRD and FAO estimates suggest? Two different yardsticks are used by the IBRD to derive the "prevalence of energy-deficient diets" in Africa (and elsewhere). These are the share of the population with a calorie intake below 90 and 80 percent, respectively, of FAO/WHO "requirements" as of 1971. By the first criterion, it is estimated that 44 percent of the population in Sub-Saharan Africa at large was undernourished in 1980; by this criterion, only South Asia has a higher estimated incidence of undernourished people (50 percent). With the second criterion, Sub-Saharan Africa, with 25 percent of the population severely undernourished, heads the list. In absolute numbers, the IBRD estimates that about 90 million people have "not enough calories to prevent stunted growth and serious health risks" (the below 80 percent criterion). The IBRD further finds the share of the population with inadequate calorie intakes to have increased, but only marginally, over the 1970-1980 period. In absolute terms the Bank estimates that the number of Africans suffering from undernutrition has increased by 30 or 35 millions, depending on which of the two criterion is used.

/Table 3 /

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14. For a discussion of the problems involved in estimating calorie-income elasticities, see Knudsen and Scandizzo, 1982; 1986; Podkaminer, 1986; and Silberger, 1985.

TABLE 3

Prevalence of Undernourished People in Developing Countries, by Major Regions, as Estimated by the IBRD and the FAO

IBRD								FAO							
Region		Number of People (mill) 1970	1980	Change	Percent of Population 1970	1980	Change	Region		Number of People (mill) 1970	1980	Change	Percent of Population 1970	1980	Change
Sub-Saharan	(H)[b]	115	150	+35	43	44	+1	Africa[a]	(H)	81	99	+18	29	26	-3
Africa	(L)	60	90	+30	21	25	+4		(L)	57	70	+13	20	19	-1
East Asia	(H)	93	40	-53	41	14	-27	Far East	(H)	303	313	+10	31	25	-6
& Pacific	(L)	47	20	-27	21	7	-14		(L)	208	210	+2	21	17	-4
South Asia	(H)	341	470	+129	47	50	+3								
	(L)	136	200	+64	19	21	+2								
Middle East	(H)	53	20	-33	35	10	-25	Near East	(H)	34	25	-9	22	12	-10
& North Afr.	(L)	31	10	-21	18	4	-14		(L)	23	16	-7	15	8	-7
Latin America	(H)	59	50	-9	20	13	-7	Latin	(H)	53	56	+3	19	16	-3
& Caribbean	(L)	25	20	-5	10	6	-4	America	(L)	36	38	+2	13	11	-2
Developing	(H)	664	730	+64	40	34	-6	Developing	(H)	472	494	+22	28	23	-5
Countries	(L)	298	340	+42	18	16	-2	Countries	(L)	325	335	+10	19	15	-4

[a]. Africa, excluding Egypt, Libya, Sudan and SAU. [b]. (H) = High Estimate; (L) = Low Estimate.
Sources: IBRD, 1986, tables 2-3 and 2-4; FAO, 1985, table 3-4.

As table 3 shows, the FAO estimates suggest a less precarious situation in Africa, both in the level of and recent changes in, the prevalence of undernutrition, but these estimates are not strictly comparable to the IBRD ones. The FAO definition of Africa includes Tunisia, Algeria and Morocco and excludes Sudan, countries excluded and included, respectively, in the IBRD (and our) definition of Sub-Saharan Africa. The estimated prevalence of undernutrition in the three North African countries is comparatively low, corresponding to some 2 to 4 millions (according the the IBRD estimates), which is about equal to the estimated number of undernourished people in Sudan. Knowing that the population of the three North African countries is about three times that of Sudan, the FAO estimate of the prevalence in "Africa" can be adjusted to cover Sub-Saharan Africa proper. The adjusted FAO (Low and High) estimates suggest that 20 and 28 percent of the population in Sub-Saharan Africa where undernourished in 1980.

The Low IBRD and and the High FAO estimates are thus quite similar. The Low FAO estimate is not strictly comparable to the IBRD estimates (to be discussed in section 8 below). It is further notable that both the FAO and the IBRD find the prevalence of severe undernutrition in Sub-Saharan Africa to be higher than in all other regions in 1980.

The background material used for the construction of the aggregate IBRD estimates suggests that the incidence of undernourished people varies considerably across the African nations. In 1980, there wre four countries in which more than half the population is estimated to have a daily calorie intake below 80 percent of requirements: Chad, Ethiopia, Mozambique and Zimbabwe. In an additional nine countries, more than one-fourth of the population falls below this line (see appendix table 1). There are 13 countries in which, it is suggested, the incidence of severely undernourished people exceeds that found in South Asia. There are nine African countries, in which less than 10 percent of the population is estimated to fall below 80 percent of requirements in 1979/81 and only in six of these, is the share of the population with this severely deficient calorie intake very small, or nil (Cape Verde, Gabon, Ivory Coast, Lesotho, Mauritania and The Malagasy Republic).

In some ten countries, the share of people falling below the 80 percent line is estimated to have **dropped by half or more** (Botswana, Cameroon, Gabon, Cape Verde, Lesotho, Liberia, Mauritania, Mauritius, Rwanda, Sudan and Swaziland). On the other hand, there are eight countries in which the estimated **share has doubled**, from initially high levels, between 1970 and 1980 (Chad, Ethiopia, Ghana, Kenya, Mozambique, Uganda, Zambia and Zimbabwe).

Data and methodological weaknesses apart (to be discussed at length in section 8), it has to be remembered that the "prevalence of undernutrition", as estimated by the IBRD and the FAO, is an **incomplete** indicator for several reasons. One is that it does not provide information on how much below the mark the undernourished share of the population is. Another is that calories is the only nutritional element considered. A third is that the estimates use broad income groups as the basic entities; no possibility for "discrimination" within these broad groups is allowed for, e.g. along gender and age lines. In order to get information on these counts, we have to rely on dietary and anthropometric studies of sample populations.

5. SAMPLE NUTRITION STUDIES

What may seem like a good number of nutritional studies exists at a relatively low level of aggregation for African countries, i.e., the village or random or selected population groups. Schofield's (1979) survey covers 92 nutrition studies of 247 villages in the rural sector in 18 African countries, conducted over the 1950-1973 period. In Dillon and Lajoie (1981), 51 nutrition studies carried out in the Sahel region between 1960 and 1979 are examined and compared. Only a few nutrition studies are included in both surveys, signifying that, together, they cover almost 300 population groups. Half of the 92 studies in Schofield are based on the dietary approach, one-fourth apply anthropometric, clinical and/or biochemical methods, and the rest combinations thereof. Ten of the 51 studies examined in Dillon and Lajoie are based on food intake estimates. Since 1979 a substantial number of additional studies, using mainly anthropometric approaches, have been conducted (also reported from in the following).

For a variety of reasons, however, many of the more than 300 nutrition studies are of limited value when it comes to assess the nutrition situation in the African countries and, especially, secular changes therein.

First, it has to be recalled that there are some 700-1000 ethnic groups in the 50 Sub-Saharan countries, many of which live in several "villages" spread over two or more (i) countries, (ii) national administrative regions, (iii) ecological and climatological zones and (iv) cropping systems.[15] In this perspective, 300 samples (obtained over a period of 30 years) constitute but a faction of the

[15]. See Oliver and Crowder (1983, pp. 78-86) for a description of the about 100 largest ethnic groups in Africa. Only a dozen of these comprise more than 2 million people, those not covered are usually very small.

total number of "villages" in Africa. The surveyed villages and populations are not sufficiently many, or large enough, to be representative for any individual country at any particular point in time.

Second, in most of the studies covered in Dillon and Lajoie (1981), the sample population is not selected by random methods. In a great majority of the studies, the focus is on population groups that have been identified to have nutritional problems prior to the examination (e.g. in relief camps) or who live in regions where the nutritional situation was known to be especially precarious at the time of examination. In fact, the sample population is unambiguously representative only in four out of the 51 studies examined (ibid, table 1). It is notable, however, that three of these four studies were conducted in the Sahel during the peak of the famine in 1972-74, perhaps not fully representative years. Moreover, the bulk of the studies covers rural areas only; urban and peri-urban areas, where a notable proportion of the African population dwell, are seldom studied. Schofield (1979, p. 11) does not discuss the representativeness of the samples in the 92 studies from Africa in her survey in any detail, but notes that, "in general....investigations are restricted to small, unrepresentative samples".

Third, most of the nutrition studies available for Africa are based on survey techniques that are questionable. More than half of the 68 studies using the dietary approach covered by Schofield (1979, table 4.1) are based on qualitative assessments rather than quantitative data. Less than half the studies are based on the food "weightment method", which is generally considered to be the most reliable, but also the most complicated and costly. In fact, comparisons of "recall" with weighting have shown that the former method tends to underestimate the food intake by large factions, especially in the not-so-recent studies (see Harriss, 1987, p. 24).

Furthermore, in none of the studies based on weighing has this been followed up by a "nutrition composition" examination (which is even more costly). Of the 10 food consumption and nutrition studies reported in Dillon and Lajoie (1981), seven relied on recall/interview methods. It is also notable that most of the studies covered in both surveys were carried out during a very short time span, 24 hours up to week, without due consideration of intra-year variations in local food supplies, income, employment, activity level, climate, incidence of diseases, etc. It is also notable that in the bulk of the studies, per-capita "requirement" has not been derived on basis of the particular demographical, activity and climatological characteristics of the particular village. Moreover, only in some of the more recent studies, has the variance in the sample been reported.

Fourth, the intra-village or intra-household distribution of the food consumed has been estimated in very few of the dietary studies. Quite obviously, the percentage of the inhabitants that is malnourished may be smaller in a village with a comparatively low average nutrition status than in the next village with a higher average, if the distribution of the food entitlements is more even in the first village.

Fifth, only six of the cases analyzed by Schofield was followed up by a resurvey. In Dillon and Lajoie, no resurvey is reported. The available studies are thus especially deficient when it comes to estimating secular changes over time or inter-year variability.[16]

The two main surveys of nutrition studies report their findings in different ways. Dillon and Lajoie provide a brief summary of results and a description of the various studies investigated. The regularities that emerge are reported without a claim to be statistically representative. Schofield has made several bivariate, cross-sectional, statistical tests, using the data from the studies included in her review. Cross-sectional tests, based on a relatively small number of observations (between 10 and 36), are bound to produce unreliable results as there is no possibility to allow for the fact that the data from the various studies have been obtained through different methods, refer to different years and seasons and cover populations which differ in a host of ways. The bivariate correlations must thus be interpreted with some caution.

With all these (and possibly other) reservations on the representativeness, comparability, reliability and usefulness of the "village" nutrition studies in Africa for the purpose of this paper, what do they suggest?

(1) Per-Capita Calorie Intake. The estimated daily per-capita intake lies in the 1800 to 2200 range in most of the samples, signifying notable inter-village differences and mild to modest "average" undernutrition according to FAO/WHO standards. In 36 village studies investigated in Schofield (1979, table 5.5), covering the period 1950-1973, the average per-capita calorie intake is 1,935. In the 51 studies from the roughly the same period listed in Hulse

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[16]. The studies covered in Dillon and Lajoie overlap to large extent with those surveyed in the other contributions to IDRC, 1981, i.e., Benefice et al., 1981 and Hulse and Pearson, 1981).

and Pearson (1981, table 5), the equivalent figure is 1,968. There are some instances of notably lower, as well as higher, observations, but since no information is given in most cases regarding the season (and sometimes even the year) these samples were obtained, there is no possibility of finding out the explanation of the most extreme observations.

(2) **Inter-Village Differences**. There are a few regularities that come through in Schofield's (1979) examination of inter-village differences in the per-head calorie intake within and across countries in Africa. It is hardly surprising that the nutritional status is more unstable in villages in the unimodal, semi-arid zone, especially in places where irrigation is not used and storage facilities are inadequate, than in the other climatological zones (ibid, p. 54). There is no indication, however, whether the average is especially low in the semi-arid regions.

In a sample of 36 villages for which the relevant data were collected, the average per-capita calorie intake in the "cassava" and "millet" villages is higher than in the "maize" villages, but the difference is not statistically significant. As expected, the "cassava" villages are significantly below requirements in protein and riboflavin and the "millet" and "maize" villages in vitamin C and A, respectively. Counter to expectations, however, there is no systematic deficiency in nicain in the "maize" villages, while there is for calcium. On the whole, the evidence suggests, quite strongly, that energy (calorie) deficiency is a more serious problem than the lack of protein (IDRC, 1981, pp. 26 and 54; Schofield, 1979, table 5.5). The notable exception is the parts of Africa where cassava is the main staple (e.g. Central Africa). Furthermore, it seems that deficiency of calcium and zinc is a problem in many places, while deficiencies of other micronutrients are more localized.

Across the 29 villages covered by Schofield for which we have data on the degree of subsistence vs. cash-crop cultivation, there are notable differences. The per-capita nutrition status in the eight "pure" subsistence villages is significantly higher on all counts except for vitamins A and C (but at par with requirements) than in the seven semi-subsistence and the 14 semi-cash-crop villages (ibid, table 5.9). This result accords with earlier observations by Collis et al. (1962) and some later ones cited by Pinstrup-Andersen (1985), who also offers some explanations.

It is further noticeable that there is no systematic difference between villages with respect to access to transportation, infrastructure and market places. In this sample of some 30 villages, however, the variance is extremely high. The per-capita consumption of almost all foods in six villages in Tanzania, with "easy market access" is way above that in five villages with "difficult market access" in the same country. Evidence from other parts of Africa suggests no systematic difference, but the number (six) of "isolated" villages in this sample is far too small to permit generalizations.[17]

Regrettably, the data provided in the village nutrition surveys do not permit a cross-comparison with respect to differences in levels of income, income distribution, demographic composition, religion and ethnic traits, because very few of the studies provide such information. Furthermore, different studies report on different variables and the overlap is usually small. Therefore, the net influence of any one of the various different characteristics discussed above cannot be isolated through the use of more complex

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17. See Schofield 1979, chapter 5 for more details.

regression methods. For instance, it is not feasible to assess whether cash-crop villages differ from subsistence villages adjusted for levels of income, the main staple consumed, climatological zone, etc.

(3) **Inter-Household Differences.** The bulk of the nutrition studies available for Africa based on the dietary approach do not report on the distribution of food consumption across households. There is thus little information on the prevalence of under- or malnourished (as defined) households or individuals within the sample groups (also cf. Schofield, 1979, pp. 80-82). On a priori grounds, and from village studies in other parts of the world (ibid, pp. 89-95), one expects differences in the nutrition intake across households, related to occupation, level of income, land holdings, household size and composition, and the sex of the head of the household. On these relations, we have very few observations from Africa.

Studies of populations in the Ivory Coast, Senegal and Malawi suggest that the calorie intake per person declines with the size of the household, while not so in a Nigerian sample (Hulse and Pearson, 1981, p. 91; Schofield, 1979, pp. 92-93). The number of studies is far too small, however, to permit any conclusive assessments. The evidence we have on the relationship between nutrition standards and income is presented in section 7 below. On the other relations, occupation, education, etc., the little information there is relate to the nutritional status of children only (see point (5) below).

(4) **Intra-Household Disparities; Gender.** A few studies report on differences along gender lines. A sample of 11 studies using the dietary approach suggests that adult men fulfill their calorie and protein requirements on the average, while the average women is

slightly below her calorie needs, but the difference is not statistically significant (Schofield, 1979, p. 87). Other studies apply anthropometric methods to measure male-female differences in altogether 26 villages. The anthropometric measures do not indicate "discrimination" against women. "The mean percentage height/weight figures achieved by adult **non-pregnant** females (94 percent) are 5 percent[age points] higher than those achieved by adult males (89 percent) and the difference was found .... to be statistically significant at the 0.5 percent level" (ibid, p. 83; italics added).

The inclusion of pregnant women, one of the most commonly mentioned groups at a nutritional disadvantage, might have produced a different result. There are at least four studies indicating that lactating and pregnant women in Africa have an unduly low calorie intake (cited in Bleiberg et al., 1981, p. 513), but there is no information on whether these women were randomly selected, or whether they were at a disadvantage relatively to the population to which they belonged. Dillon and Lajoie (1981) provide no clue as to whether sex-bias among adults (or children) is reported in the 51 nutrition studies covered in their survey.

(5) Intra-Household Disparities; Age. According to many qualitative assessments, and also to quantitative investigations from various parts of the so-called third world, **infants** and small **children** are the most at risk when it comes to under- and malnutrition. This notion is corroborated by the evidence available for Africa.

Schofield (1979, pp. 87-88) found that over a cross-section of 10 African villages, **pre-school children** (age 4-6), obtained only between 55 and 90 percent of the fulfillment of calorie requirements that the entire population in respective village did. The difference between the fulfillment for these children and the total population was statistically significant at the 0.01 level. It should also be recalled, however, that since the practice in large parts of Africa is that all members of the family eat from the same pot, estimates based on nutritional intakes for children, especially, are not very reliable.

For younger (1-4) children and, especially, infants, estimates based on intakes are unreliable because of the difficulties involved in measuring the intake of breast milk. Estimates of the nutritional status of children in this age group usually rely on anthropometric assessments, most commonly height for age, weight for height, and weight for age.

The results of anthropometric examinations of 23 random samples of children in 17 Sub-Saharan countries over the 1973-1984 period are summarized in table 4. First the indications of chronic undernutrition, as measured by height for age. In the seven countries for which these data are available, an estimated 16 to 28 percent of all children (up to five or six years old) are stunted by US standards (below 90 percent of these standards). There are thus notable differences across these seven countries (Liberia, Sierra Leone, Togo, Cameroon, Kenya, Swaziland and Lesotho) from Western, Central, Eastern and Southern Africa. Unfortunately, there are little data on the prevalence of severe stunting, i.e., below 80 percent of standards, but the two indications there are, find it low.

/Table 4/

When it comes to acute undernutrition, as measured by weight for height, the picture looks unambiguously more favorable. As table 4 shows, in the seven countries just mentioned, the prevalence of modest (between 60 and 80 percent of reference standard) acute

TABLE 4

Percentage of Undernourished Children According to Selected Anthropometric Indicators, 1973-1982

Country (Age or Height Group)	Year (Season)[a]	Category	Size of sample	Anthropometric Measure: Height for Age: Below 90 % of Standards (Moderate)	Height for Age: Below 80 % of Standards (Severe)	Weight for Height: Below 80% of Standards (Moderate)	Weight for Height: Below 60% of Standards (Severe)	Weight for Age: Below 80% of Standards	Reference Standard Used[b]
Swaziland	1983-	Rural	3475	16.6	(< 2.0)	0.4	-	12.4	NCHS
(3-59 months)	1984	Peri-Urban	658	12.9	(< 1.5)	0.2	-	9.7	
	(BH)	Total	4133	16.0	(< 2.0)	0.4	-	12.0	
Cameroon	1978	Rural	3942	22.4	1.0	1.1	-	23.0	NAS
(3-59 months)	(Oct-	Urban	1733	15.4	-	0.7	-	12.2	
	April)	Total	5675	22.1	1.0	1.0	-	21.1	
		NRG[c]	505	4.2	-	-	-	3.6	
Liberia	1975-	Agr.	2502	20.2	..	1.6	-	25.5	NAS
(0-59 months)	1976	Non-agr.	977	13.8	..	1.5	-	20.1	
	(AH)	Total	3479	18.0	..	1.6	-	24.0	
		NRG	285	9.0	..	2.9	-	13.4	
Lesotho	1977	Rural	1421	23.7	..	4.3	-	24.9	NAS
(0-59 months)	(..)	Urban	285	17.2	..	3.0	-	17.3	
		Total	1706	22.7	..	4.3	-	22.5	
		NRG	293	11.3	..	4.8	-	5.8	
Sierra Leone	1978	Rural	..	26.2	..	3.2	..	32.4	..
(0-71 months)	(..)	Urban	..	17.4	..	3.2	..	24.3	
		Total	..	..	..	3.2	..	..	
		NRG	..	2.1	..	..	..	..	
Togo	1977	Rural	..	20.4	..	2.2	..	16.5	..
(6-71 months)	(..)	Urban	..	11.4	..	0.8	..	8.9	
		Total	..	19.1	..	2.0	..	15.3	
		NRG	..	..	..	..	..	..	
Kenya	1977	Rural	ca	24.0	..	..	..	..	NS
(12-47 months)	1979	by	3000	27.0	..	..	..	..	NS
	1982	Province		28.0	..	..	..	..	NS
Chad (65-115 cm)	1974 (BH)	Nation-wide	779	..	..	22.5	0.1	..	SM
Mali(1) (65-115 cm)	1974 (BH)	Nation-wide	625	..	..	10.7	0.3	..	SM
Mali(2) (0-71 months)	1978 (BH)	Rural	122	..	..	15.0	2.6	..	H
Mali(3) (0-71 months)	1979 (MH)	Rural	249	..	..	6.5	1.5	..	H

Mali(4) (0-59 months)	1976 (BH)	Migratory	208	..	..	9.4	5.0	..	H
Mauritania(1) (70-120 cm)	1973 (BH)	Sedentary	781	..	..	8.0	..	..	SM
		Migratory	410	..	..	17.0	..	..	
		Total	1191	..	..	14.0	..	..	
Mauritania(2) (65-115 cm)	1974 (BH)	Nation-wide	875	..	..	9.9	0.3	..	SM
Burkina F.(1) (0-9 years)	1973 (BH)	Sedentary	132	..	..	38.0	..	..	H
		Migratory	43	..	..	49.0	..	..	
		Total	175	..	..	41.0	..	..	
Burkina F.(2) (65-115 cm)	1974 (BH)	Nation-wide	875	..	..	9.1	-	..	SM
Burkina F.(3) (0-71 months)	1978 (BH)	Nation-wide	320	..	..	14.0	2.0	..	H
Niger (65-115 cm)	1974 (BH)	Nation-wide	774	..	..	11.4	0.3	..	SM
Benin (0-59 months)	1976 (BH)	Nation-wide	127	..	..	6.0	0.8	..	H
Senegal (0-71 months)	1979 (AH)	Rural	347	..	..	9.0	-	..	H
Gambia (6-35 months)	1981/2 (DS)	Urban	..	..	..	6.5	..	..	NCHS
Botswana (0-59 months)	1978-81 (MH)	Nation-wide	ca 50000	..	..	..	..	27.0	NS
Malawi (0-59 months)	1981 (DS)	Rural	..	..	..	..	..	32.0	NS

[a]. The following abbreviations for season have been used: BH (before harvest); AH (after harvest); MH (mid-harvest year); DS (average for different seasons).

[b]. The standards applied are: NAS: National Academy of Sciences; NCHS: National Centre for Health Statistics; SM: Stuart Meredith; H: Harvard; NS: Not stated.

[c]. National Reference Group.

Sources: USAID, 1978a, tables 21-24 (Cameroon); USAID, 1976, table 50 (Liberia); USAID, 1977, tables 36, 38 and 40 (Lesotho); USAID, 1986, tables 4.82-4.83 (Sierra Leone, Togo and Swaziland); Kloth et al., 1976, table 1 (Chad, Mali(1), Mauritania(2), Burkina Faso(2) and Niger); Greene, 1974, table on p. 1094 (Mauritania(1)); Benefice et.al., 1981, tables 5, 12 and 13 (Mali(2)-(4), Burkina Faso(3), Benin and Senegal); IDRC, 1981, p.22 (Burkina Faso(1)); Tomkins et al., 1986, p. 536 (Gambia); Maribe, 1982, Figure 1 and 2 (Botswana); Chiligo and Msukwe, p. 25 (Malawi); CNSP, 1984, table 1 (Kenya).

undernutrition among the children is but a few percent. Not surprisingly, the incidence was significantly higher in the Sahel countries during the famine years 1973 and 1974; in these years also severe acute undernutrition (below 60 percent of standard references) was found in a few percent of the children. The observations from Malawi and Botswana show relatively high prevalence of combined chronic and acute undernutrition as indicated by weight for age.

Table 4 further reveals that in all countries for which separate data exist on rural and urban children, the former are more frequently undernourished than the latter, both on a chronic and an acute basis. The two studies that report on differences between sedentary and migratory groups in the Sahel find the prevalence of acute undernutrition in children to be more widespread among the nomads (in 1973-74).

In eight of the studies reported from in table 4, the nutritional status of children of different ages are compared (the first seven plus Gambia). The picture is very similar across these eight countries. The prevalence of stunting, indicating chronic undernutrition, is relatively low for infants, but increases sharply thereafter until the children reach about 18 months of age; after that, the prevalence is rather stable (up to 59 months). When it comes to acute undernutrition, as indicated by weight for height, the prevalence is so low in all age groups that the difference with the reference population is not significant in most of the eight countries. The incidence of wasted children is the highest for the one-year-and-a-half age group and declines after that, but the change is hardly statistically significant in any of the cases. It seems that also in the Sahel countries, infants and very young children (two years and below), are slightly more acutely undernourished than their older siblings (Benefice et al., 1981, tables 12 and 13).

The question whether there is a sex bias in the nutritional status of children in the African populations can be answered firmly. We have observations from eight countries and in seven of these, the samples are very large and, as it seems, representative for the national populations. The picture that emerges is the same in all the eight cases (summary evidence from six of the studies is presented in table 5). There is no single indication that female children are at a disadvantage vis-a-vis male children. All indicators show that the prevalence of stunting and wasting is higher among boys than girls. The base data are not presented in a form that permit tests of statistical significance, but considering the size of the samples (1,500-4,800), there is strong reason to think that the difference in most cases is statistically ascertained. (The exception to this is probably in weight-for-height for which the prevalence of children of both sexes below the cut-off point is very low, a few percent at the most.)

/Table 5/

One of the two studies not reported from in table 5 covers two populations of Tanzanian school children, altogether 238 individuals (Carswell et al., 1981). Again, male children were found to be at a systematic disadvantage. In fact, the percentage of the male sample with severe signs of undernutrition (less than 70 percent of normal weight for age) was twice as high (51 percent) as that (26 percent) for the female sample. The remaining study covers two villages in the Machakos district in Kenya. The study finds a relatively large faction of children of all ages, and also adolescents, to be modestly undernourished on a chronic basis, as indicated by height and weight

TABLE 5

Prevalence of Undernutrition among Children in Selected Sub-Saharan African Countries, by Sex

Country Year and Age (months)	Sample Size	Sex	Chronic Under-nutrition: Height for age (<-2 SD or < 90% of Ref. Stand.)	Acute Under-nutrition: Weight for height (< 80% of Ref. Stand.)	Chronic/Acute Under-nutrition: Weight for age (< 80% of Ref. Stand.)
Swaziland	2,375	Male	31.1	1.1	10.6
1983	2,416	Female	27.5	0.6	8.2
(0-59)	4,791	Total	29.3	0.9	9.6
Liberia	1,703	Male	20.0	1.9	..
1976	1,776	Female	16.5	1.2	..
(0-59)	3,479	Total	18.2	1.6	..
Cameroon	1,669	Male	..	..	20.1
1978	1,656	Female	..	..	17.0
(24-59)	3,325	Total	..	..	18.5
Lesotho	690	Male	25.3	1.5	24.3
1976	812	Female	22.6	0.5	21.6
(0-59)	1,502	Total	23.9	1.0	22.9
Togo	..	Male	..	..	..
1977	..	Female	..	..	..
(0-59)	..	Total	..	..	..
Sierra Leone	..	Male	..	..	..
1978	..	Female	..	..	..
(0-59)	..	Total	..	..	..

Sources: USAID, 1986, tables 4.3, 4.4, 4.67, 4.68, 4.73, 4.74, (Swaziland); USAID, 1976, table 20 (Liberia); USAID, 1978a, table 102 (Cameroon); USAID, 1977, table 28 (Lesotho); USAID, 1977a, table xx (Togo); USAID, 1978, table xx (Sierra Leone).

for age, but to have a close to reference weight for height. In none of these measures, however, there is a statistically significant difference between girls and boys of any age; the minuscule difference in the average is to the advantage of girls (Stephenson et al., 1983, figures on pp. 25-26).

In recent years, empirical findings suggesting that female children in South Asia are more undernourished than male children have been reported (see Chen et al., 1981; Sen and Sengupta, 1983; Sen, 1984), although there are counterindications (Kakwani, 1986a; Harriss, 1987). Schofield's (1979, pp. 82-83) "analysis of data from 94 Latin American villages showed that females aged 0-4 years fulfilled 87 percent of their expected weight/age measurements compared with the 90 percent level achieved by boys of the same age. The differences (measured by the t-paired test) was found to be significant at the 0.5 percent level." The eight studies from Western, Central, Eastern, and Southern Africa, however, provide no support for the notion that female children are discriminated against in the intra-household distribution of food. On the contrary, boys seem to be disfavored.[18]

There are very few characteristics of the households to which the stunted children belong that have been identified; the little evidence there is come from the USAID studies (see the reference list).

First the demographic evidence. Perhaps to some surprise, there is no association between the prevalence of stunting and the size of the household in Cameroon, Lesotho and Swaziland. The number of

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18. This observation is consistent with the fact that longevity is higher for women than for men throughout Africa. It is also interesting to note that while the bride's parents usually pay the dowry in South Asia, bride price is the common practice in Africa.

children below five in the household has an impact only when exceeding four in Cameroon, but not at all in the two other countries. The birth order of the child seems to matter, but only when it is above nine (in Liberia, the only observation).

The evidence on the **socio-economic** characteristics of the stunted childrens' households is equally scarce. For the five countries for which there are data, the occupational status of the head of the household seems to matter little. The highest prevalence of stunted children is usually found in households where the main activity is farming and mining (or unemployment). The differences across households are not very large, however, and not statistically significant. It is, indeed, surprising that children of salaried government employees are little different from children of farmers in Swaziland and Liberia. One study, from Kenya, shows large inter-district variations in nutritional standards in small children related to the average size of the plots of land (CNSP, 1984). Also surprisingly, the level of education of the mother and/or father seems to have little impact. Only in households where one of them have collage/university education is the difference in the stature of the children significant.

The **dietary evidence** tentatively suggests that stunting among infants (3-11 months) is higher among those who receive breast milk only. The 12-23 months old are also more often stunted if they are still mainly breast feed. There are also some indications that children are shorter in households where the mother is absent and/or someone else is feeding the children. Finally, there is an interesting observation from Cameroon. Children in households where the practice is to eat from a common plate (pot) are less frequently stunted than children from households with other eating habits.

Regrettably, the various studies cited in tables 4 and 5 do not answer the question whether the observed children were more (or less) undernourished than the average for the population they belonged to. It is also notable that less than half the studies provide data on height for age, the most used indicator of chronic hunger. Random sampling methods were used to single out the individuals in all the studies cited in tables, but in some cases, only "accessible" locations in respective country were included.[19]

6. MORBIDITY AND MORTALITY

In the previous sections, the focus has been on measures of nutritional status based on (i) food intakes and (ii) imbalance between nutritional intakes and expenditures (anthropometric evidence). Under- and malnutrition, however, do not show up only in physical characteristics (e.g. stunting and wasting) and diseases that are directly and mainly caused by deficient diets (e.g. marasmus and kwashiorkor). It is relatively well known that health in a wider sense (morbidity) and nutrition are interrelated in a very complicated way. People, especially children, with deficient nutritional intakes are more susceptible to diarrhea and various other infections, most notably in the respiratory and gastro-intestinal tracts. Moreover, several diseases lead to a reduced intake of food (anorexia) and do impair the metabolism and absorptive

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[19]. In the Dillon and Lajoie (1981) review, a large number of studies are listed in which various aspects of child nutrition and health in the Sahelian countries over the 1947-79 period are reported. Only two of these studies (included in table 4 above) were based on representative samples, however; the others can thus not be used to distill information on the nutritional status of children in general in respective country.

capacity of the individual and/or increases her/his nutritional requirements (Chen, 1983).

In most developing countries, the nutrition-related diseases seem to account for a substantial share of the overall mortality, but these diseases have other causes as well and it has proved very difficult to isolate the effect of nutritional inadequacy. There is, however, some tentative evidence supporting the notion that the overall mortality is mainly a consequence of factors that are exogenous to a country's current state of income, nutrition standards and level of education (Preston, 1976, chapter 4).[20] If so, the overall mortality rate of a population would be a rather blunt indicator of the prevalence of under- and malnutrition.[21]

Infant and child mortality rates are frequently thought to provide better indications. It has been argued that "so common is the cycle of malnutrition, infection, severe malnutrition, recurrent

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20. Preston's evidence is based on cross-country, bivariate, correlations between mortality and real income. Such correlations have usually been shown to be statistically significant at a relatively high level (also see IBRD, 1986, and Svedberg, 1984). Preston finds, however, that the cross-country regression line has shifted downwards over time. That is, the regression line for data from the 1960's has a smaller intercept than the one obtained for the 1930's, etc. This he attributes to the influence of factors that are "external" to the individual country. The intercept, of course, captures all other influences than income, whether "internal" or "external" to respective country. It still has to be shown that most of these other influences are, in fact, "external". It also seems that much more intricate statistical methods are required to separate internal and external factors.

21. Simple correlations between, on the one hand, life expectancy at birth for males and females, respectively, and per-capita calorie availability, on the other hand, on a cross-country basis (31 observations) for both 1965 and 1983 carry the expected signs and some are statistically significant. Cross-country correlations between the changes in life expectancy and in per-capita availability of calories in the same 31 Sub-Saharan countries also show the expected signs, but are far from being statistically significant (cf. appendix table 3).

infection and eventual death at an early age that the death rate for children up to four years old in general and the infant mortality rate in particular, serve as one index of the nutritional status of a population as a whole" (Mayer, 1976, p. 41). In their survey of evidence on the nutritional status of the population in the semi-arid tropical countries, Hulse and Pearson (1981, p. 86) claim that "death of children under age 5 account for nearly 50 percent of total deaths, and careful examination shows that malnutrition is the major underlying factor". (Also see the evidence cited in Chen, 1983, pp. 3-4.)

The infant mortality rates for the African countries are not very reliable; in many areas, infants are not even named until they become a year old and deaths are incompletely registered, if at all. The available estimates nevertheless suggest that the African countries have, on the average, a much higher infant and, especially, child (1-4) mortality rate than India, and also Bangladesh, not to mention China. (The overall mortality rates in Africa are also higher than in India, but the difference for the 5+ population is not that large.) In fact, while the age group below five makes up 18.3 percent of the population in Africa (Chen, 1983, table 1), it accounts for almost half of total deaths (Oliver and Crowder, 1981, p. 309).

The evidence from food consumption and nutrition studies (section 5 above) suggests that there is nutritional discrimination against small children in the African countries. There is thus reason to expect that the lower the nutritional status of a population, the larger the incidence of undernourished children and, consequently, the higher the infant and child mortality rates. The presumed association between the prevalence of undernourished children and excess mortality can reflect several different underlying causes. One is that nutritional inadequacy impairs the children's immunocompetence system so that they become more susceptible to disease (producing a link between nutrition and the frequency and severity of disease). Another is that nutritional inadequacy means that the childrens' capacity to recover from illness is weakened (producing a link between nutrition and the time it takes to recover). It is also possible that children suffering from more frequent and severe disease have higher nutritional requirements and/or lower absorptive capacity. Furthermore, a low nutritional standard in a population may mean that pregnant women (usually alleged to be another discriminated group) give birth to unhealthier, prematurely born, and/or smaller, babies, with a higher risk of dying during infancy or early childhood. That is, whether there is a direct causal relationship, or an indirect association, we expect a negative correspondence between infant and child mortality and the nutritional status of the population to which they belong.[22]

In the following we shall investigate whether there is a correlation between the per-capita supply of calories, on the one hand, and the infant and child mortality rates, on the other, across the 32 African countries for which there are data. Cross-country observations for 19641/66 reveal a statistically significant correlation between each of the two mortality statistics and the

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[22]. There is only very limited evidence on the link between morbidity and nutrition in developing countries and hardly any from Africa. In their extensive survey of 200 "supplementary feeding programs for young children in developing countries", Beaton and Ghassemi (1982, p. 889) concludes that "food distribution programs that effectively reduce or eliminate severe malnutrition in a community have favorable impact upon morbidity and mortality in pre-school children. Unfortunately, there is no clear evidence about the effect of preventing "less-than-severe" malnutrition on morbidity and mortality" (italics added). Also see Martorell and Ho, 1984.

supply of calories with the expected signs (see appendix table 3). The equivalent correlations for the years 1982/84 carry the expected signs, but are statistically significant only at the 0.10 to 0.20 level. This is an indication that since the mid 1960s, other factors than the per-capita supply of calories have increasingly become more important in reducing infant and child mortality.

A more interesting correlation is therefore that between changes over the 1965-1983 period in the infant mortality rate and in the per-capita availability of calories across the 32 countries. This correlation does not even carry the expected sign (see appendix table 3). The same picture emergeswhen the changes in child mortality and per-capita calorie supply are correlated.

Varied experience across Africa thus suggests that an improved per-capita food supply has been neither a necessary nor a sufficient prerequisite for bringing down the infant (and child) mortality rate. The tentative conclusion must be that the declines in infant and child mortality are caused mainly by such factors as improved education, health facilities, medical care, sanitation and vaccination against measles and other endemic child diseases and also, perhaps, the introduction of oral rehydration salts. Reduced malnutrition at the household level may be a contributing factor in some countries, but of minor importance. The statistical results must be interpreted with some caution, however, since the data are very aggregate and probably not very reliable.[23]

What about Sub-Saharan Africa in an international comparison? The average infant mortality rate in this region has dropped significantly less than it has in India (from the same level in 1965) and, even more so, than in China. The drop in the infant mortality rate in Africa is at par with that in other low- and lower-middle-income countries, but larger than in, for instance, Bangladesh (see table 6).

/Table 6/

In India, the per-capita availability of calories has increased by a few percent over the past twenty years; in Sub-Saharan Africa, it has declined equally much. These changes thus seem too small to explain the difference in child mortality decline. It would certainly go beyond the scope of the present paper to attempt to explain why the infant mortality rate has declined so much less in Sub-Saharan Africa than in India. It will suffice to mention a few possible explanations and present some stylized facts.

One possible explanation is that while the distribution of incomes in India during the period has been largely unaltered, or deteriorated only slightly (see the survey by Bigsten, 1983, pp. 71-72), it seems to have deteriorated significantly in large parts of Africa (Svedberg, 1987a).

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[23]. The result presented here is not consistent with the only available study providing evidence from sample populations, in this case India (Taylor and Singh, 1975, cited in Beaton and Ghassemi, 1982, pp. 887-89). This study suggests that child (1-3 years) mortality was reduced through selective food supplementation, but "the effects cannot be generalized to the much less controlled, less targeted, community food distribution programs" (Beaton and Ghassemi, 1982, p. 888) and, one might add, improved food standards in general.

TABLE 6

Infant and Child Mortality in Developing Countries in 1965 and 1983

	Infant Mortality (aged under 1)			Child Death Rate (aged 1-4)		
	1965	1983	1965/1983	1965	1983	1965/1983
Sub-Saharan Africa						
Low Income	156	119	0.76	35	23	0.66
Lower-Middle Income	150	112	0.75	32	17	0.53
All Low-Income Countries	122	75	0.61	19	9	0.47
China	90	38	0.42	11	2	0.18
India	151	93	0.62	23	11	0.48
Bangladesh	153	132	0.86	24	19	0.79
All Lower-Middle Income Countries	127	87	0.69	22	11	0.50
All Upper-Middle Income Countries	92	59	0.64	13	5	0.39
Brazil	104	70	0.67	14	6	0.43

Source: IBRD, 1985, appendix table 23.

Another possible explanation is that the Indian system is more efficient when it comes to helping the most vulnerable people out in permanent as well as transitory distress situation. The most destitute households in the urban areas are selectively supported through subsidized rice and, in rural areas, through work-for-food schemes. In acute situations, such as impending famine, when children tend to fare the worst, the Indian system seems much more efficient in alleviating the crisis (see Svedberg, 1987c, and Dreze, 1987). In order to test the latter hypothesis, one would need reliable time-series data on mortality for extensive periods so that the variance could be calculated. Such data do not exist for Africa.

A third possibility is that the secular improvements in health-related facilities have been significantly larger in India than in most of Africa. Several health and demographic indicators are consistent with this hypothesis. The number of people to each physician in Sub-Saharan Africa has dropped by one-fourth only between 1965 and 1980 and is still way above that in India (by a factor of 7.6 and 3.2 in low- and lower-middle-income African countries, respectively). In fact, in low-income African countries, the number of people per physician in 1980 was five times higher than in India in 1965. When it comes to the number of people per "nursing person", the picture in Africa looks much brighter, both in absolute terms and when considering changes over time.

Another indication is that the improvement in life expectancy at birth for males as well as females between 1965 and 1983 is much smaller in Africa than in India. Moreover, at the beginning of the period, life expectancy was shorter in Africa, and the smaller the initial figure, the less it takes to achieve improvements through the provision of health facilities, etc. (see Sen, 1981b). Furthermore, the crude death rate has dropped less in Africa than in India (from roughly the same level). Finally, while the crude birth rate has remained largely unaltered since 1965 in Africa at an internationally unprecedented level, it has declined significantly in India (IBRD, 1985, appendix table 20). The commonly accepted notion is that the fewer the number of children in a family (cet. par.), the higher the chance for each individual child to survive (although the chance for the parents to have "many" surviving children may be positively related to the number of births).

7. FOOD EXPENDITURE SURVEYS

Poor, as well as rich, people demand food in order to satisfy several different needs and wants. The nutritional content of the food is only one of these needs; others are taste, bulk, texture, variety and the social stigma associated with different foods. The time and costs it take to prepare and eat the food also enter the consumers' preferences. Since different foods contain the various "characteristics" in different proportions, by varying the consumption mix, the consumer can usually satiate her/his demand for the various components in food with due regard to their (implicit) relative prices and the budget constraint. For instance, if the energy content in the food is the main concern for a poor household, it will demand cereals, pulses, roots and tubers, which usually have a much lower price per calorie than meat, fish, fruits and vegetables. The extent to which the various qualities of food can be demanded as separate goods, of course, depends on the variety of foods supplied locally. In places with strong monoculture, the joint-product property of the main staple may impose severe restrictions on the possibility to obtain a reasonably nutritionally balanced diet and satisfying the demand for other characteristics of food simultaneously.

On commonsense grounds, one would think that the energy-protein content of food is the most "basic" of all needs people have. From this presumption it follows that one expects to find that in severely undernourished populations, (i) the share of incomes spent on low-cost-per-calorie foods and (ii) the marginal calorie-income elasticity are both close to unity. One would also expect that as incomes goes up, this share and elasticity decrease quite rapidly and, in the case of the elasticity, approaches zero in the income bracket where calorie requirement are normally met. The study of poor peoples' economic behaviour can thus shed light on their nutritional status that supplement the information provided in nutrition and anthropometric studies.[24]

Empirical examinations have shown calorie-expenditure elasticities to range from 0.9 in very poor groups in underdeveloped countries to close to zero in the better off sections of the population (see Svedberg, 1985, footnote 2-4 and Behrman and Wolfe, 1984, pp. 106-08). Most of these observations, based on sample data, are from Asia and Latin America. For Africa, there are relatively few studies of the relation between "nutrition" and income.

One study, based on a relatively large sample of villages in Mali in 1977-79, suggests that there is no difference between "rich" and "poor" families in the level of food intake, even though nutritional requirements (FAO/WHO) were not met on the average (IDRC, 1981, pp. 25-26). Another study, from Sierra Leone, based on econometric methods, finds the constant calorie-income elasticity to

24. Different, but related, "revealed-preference indicators" have been suggested by Srinivasan (1981) and Lipton (1983); also see Osmani, 1984.

be very high, 0.9 (Strauss, unpublished, cited in Behrman and Wolfe, 1984). A third study of two villages in Nigeria also found calorie elasticities in this range (0.94), while only 0.30 and 0.34 in two sample populations from Sudan (Alderman, 1986, table 9). Yet another investigation of several districts in Kenya comes up with elasticities averaging 0.65 at the "poverty line" (Greer and Thorbecke, 1986, table 1). Estimates of calorie-income elasticities from other parts of the third world also differ significantly (cf. Behrman and Wolfe, 1984, and Svedberg, 1985). Considering the (largely unresolved) problems involved in estimating income elasticities for specific nutritional elements in food (see footnote 14 above), this causes little surprise.

Investigations based on aggregate data report much lower elasticities. The estimate derived on cross-country evidence in Africa by the IBRD, and used in their estimation of the prevalence of undernourished people in Africa (cf. section 4 above), is 0.15 at the level of satiated requirements and 0.55 in the lowest income group (Reutlinger and Selowsky, 1976, p. 19). The aggregate constant elasticity derived in Svedberg (1987a), 0.19, is downward biased, but its extent cannot be ascertained given the inadequacy of the data.

There is thus little evidence available on the degree to which various populations in Africa use incremental income increases for the satiation of caloric (or other nutrition) needs. We have, however, a set of food expenditure studies that provide supplementary information. At best, these studies provide data on (i) the share of incomes/expenditures spent on food and (ii) the share of food expenditures devoted to low-cost-per-calorie foods.

Almost 50 studies, from about half the African nations, are listed in the latest FAO (1986a) *Review of Food Consumption*

(Expenditure) Surveys. The surveys have been conducted primarily in order to construct weights for consumer price indices. They usually present data on expenditures on 10-20 food items. In most instances, they thus give a fairly detailed picture of the revealed preferences by the respondents given their budget (and other) constraint(s). For the main purpose of this study, however, the bulk of the available food expenditure surveys is of limited value. This is for several reasons.

First, most of the studies are based either on too broad aggregates or on non-representative population groups. For instance, in more than half the studies, no data are reported by income class, only for the entire sample. Moreover, in most of the studies, only urban areas are studied; some others cover both urban and rural areas without separate reporting. Most important, however, the studies consider cash expenditures only; the imputed incomes of subsistence farmers, the largest and often poorest population group in many an African country, are usually left out. These flaws make the studies of limited use for the purpose of assessing food standards of the poorest households in respective country.

Second, although the number of countries for which there are food expenditure studies is relatively large, no data are available for many of the poorest countries for which the aggregate dietary data suggest widespread undernutrition, e.g., Burkina Faso, the Central African Republic, Mauritania, Angola and Mozambique. Moreover, the information available for many other poor countries (in which per-capita income and food production are known to have declined over the past 10-15 years) is rather dated. These countries include Chad, Ghana, Ethiopia, Sierra Leone, Somalia, Tanzania, Uganda and Zaire.

Third, the expenditure studies available for Africa are methodologically and technically weak in most cases. The sample is rather small in many of the studies, especially those covering rural areas (while being very large in some of the others). Moreover, the representativeness of many of the studies, even with respect to the selected population covered, is open to questions. Some include only households that can be identified from official records, which tend to leave out many of the poorest and nutritionally most vulnerable households (e.g., the landless in the rural areas and newly arrived immigrants in the urban sector). Furthermore, in most of the studies, the size of the household is positively correlated to the level of income. Presumably, this means that the proportion of children is higher in the large households with higher incomes, but this is not allowed for. Some of the studies report on the the extent of non-responses, which in many instances is very large and not corrected for; in other studies, the problem is not even mentioned. It is well known that the poorest are usually overrepresented among the non-responses. Furthermore, in many of the studies, the average total expenditures of the poorest population groups grossly exceed their average incomes, a problem that is often left unexplained.

Finally, only for a handful of countries, Ghana, Kenya, Malawi, Nigeria, Sudan and Zambia, food expenditure surveys have been undertaken at two or more points in time. For none of these countries, however, are the surveys conducted in a way that permits strict intertemporal comparison. There is thus little possibility of estimating secular changes in food standards for different population segments in any of the countries.

Regrettably, we can only conclude that most of the available food expenditure surveys are not very relevant for the purpose of this study, mainly because of non-representative samples, the "urban bias", weak methodologies, the non-coverage of many of the most vulnerable countries, and the lack of re-surveys. For the last two decades, there are only about half a dozen studies that are of any use to us and, unfortunately, these studies are also in most cases beset by one or more of the flaws discussed above. The conclusions that follow from these studies are thus very tentative and must be interpreted with caution. The main findings are summarized in Table 7.

In all the countries, the data suggest that the share of total expenditures going to food purchases is inversely related to income (as one expects). Regrettably, the "poorest households" comprise different shares of the total sample in the various country studies available, which make strict inter-country comparisons unfeasible.

/Table 7/

The indicator of prime interest, however, is the share of total food expenditures that are used to buy low- respective high-cost-per-calorie food items by income class. Data are available for six countries in Sub-Saharan Africa. By low-cost-per-calorie foods we mean cereals, roots, tubers, pulses and sugar; by high-cost-per-calorie foods is meant meat, fish, vegetables and fruits; other foods are left as a residual.[25] The striking observation is the high share spent on high-cost-per-calorie foods by the families with the lowest incomes; ranging from 40 percent in Malawi to over 60 percent in Ghana (in both urban and rural areas). In all the six countries, the

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[25]. Chaudhri and Timmer (1986) show that the price per calorie contained in different foods normally varies by a factor ranging from 1 to 15. In all countries examined, the price of calories is the lowest when contained in cereals, roots and tubers; the highest when contained in meat, fish, vegetables and fruits.

TABLE 7

Summary of Findings of Selected Food Expenditure Surveys from Sub-Saharan Africa and Selected Reference Countries

Country (urban/ rural)	Year(s)	Income Group	Share of Total House-holds	Share of Food in Total Expen-ditures	Share of High-Cost Per-Calorie Foods in Total Food Expenditures
Malawi[b] (urban)	1979-1980	LIG[a]	25-30	45-50	38-40
		HIG	8-10	17-22	46-59
Zambia (urban)	1974-1977	LIG	26	76	66
		HIG	8	35	56
Mauritius (nationwide)	1981	LIG	17	56	46
		HIG	21	38	45
Sudan (urban)	1978-1979	LIG	10	61	55
		HIG	7	39	63
Kenya (urban)	1968-1969	LIG	..	..	55
		HIG	..	..	53
Ghana (urban)	1967-1968	LIG	..	..	60
		HIG	..	..	63
Ghana (rural)	1967-1968	LIG	..	..	68
		HIG	..	..	66
India (urban)	1965-1966	LIG	20	..	28
		HIG	10	..	49
India (rural)	1965-1966	LIG	20	..	18
		HIG	10	..	36
Indonesia (nationwide)	1980	LIG	..	75	17
		HIG	..	45	46
Brazil (nationwide)	1974	LIG	12	63	37
		HIG	8	8	56

a. Lowest Income Group reported; Highest Income Group reported.
b. The figure for Malawi is an unweighted average for 4 urban centres.
Sources: FAO, 1986; Chaudhri and Timmer, 1986.

share of total food expenditures devoted to high-cost-per-calorie items by the poorest households only marginally falls below that of the households with the highest incomes; indeed, in Ghana, the estimated share is actually somewhat higher.[26]

Before we leave the food expenditure studies, a few comparisons with evidence from other parts of the so-called third world seem warranted. The data in table 7 suggest that the share of total food expenditures going to high-cost-per-calorie foods is consistently much higher in the African countries than in South Asia and Indonesia (and, also, in Brazil).

One possible interpretation of the observations that the poorest households in the African samples (i) spend less on food and (ii) have a less cost-efficient diet than their Indian and Indonesian counterparts, is that the African poor have higher real incomes (real food purchasing power). That is, as suggested by the national-account-based estimates provided by the international organisations, per-capita real incomes in the African countries for which there are food expenditure data, were notably higher than in India at the time when the estimates were obtained. A second interpretation is that the observations reflect differences in dietary traditions (demand) and/or comparative advantages (supply), which make relative price of the high-cost-per-calorie foods, lower in Africa. It is notable, however, that the price of meat/fish/ vegetables/fruits in relation to the price of cereals/roots/tubers is considerably higher in the

[26]. There is some scant evidence on intra-country differences (four urban centres) in the case of Malawi. These data suggest that the poorest in the two major cities, Lilongwe and Blantyre, spend a smaller share on food than their counterparts in two smaller urban locations. There are no notable differences when it comes to the share spent on low- and high-cost-per-calorie foods.

one African country for which data are available (Kenya) than in India (cf. Kravis et al., 1982, and Chaudhri and Timmer, 1986, table 12). It is further notable that the share of meat in the the Kenyan diet is not higher than in the average Sub-Saharan country (cf. appendix table 4).

It should be strongly emphasized, however, that the sample populations in the African food expenditure studies may not be representative. As indicated above, most of the samples are from urban areas, where average incomes presumably are higher than the national average.

8. SUMMARY AND SYNTHESIS

The objective in this section is to assess, on the basis of the previously analyzed evidence, what is known about the prevalence of undernutrition in Sub-Saharan Africa, its severity, and the developments over time. Doubtless, the reader has already noted that the various indicators presented above do not integrate into a picture that can be neatly summarized by a few numbers or statements. One observation is, however, reasonably well underscored: the basic problem is calorie-protein deficiency, i.e. not enogh food rather than unbalanced diet. The lack of micro-nutrients is a smaller and more localized problem. This is why we shall thus confine the subsequent analysis to undernutrition.

At face value, the various pieces of information on the extent of undernutrition do not seem consistent. On the one hand, there are the IBRD aggregate estimates, suggesting that 44 percent of the entire population in Sub-Saharan Africa is undernourished, and 25 percent severely so. The equivalent FAO estimates are lower, but they also suggest widespread nutritional deficiency. We also have the FAO "availability" estimates, suggesting that even on a per-capita basis (disregarding distribution altogether), the calorie intake in Sub-Saharan Africa in recent years (1983/85) corresponds to only 80 percent of "requirements". In many countries, the estimated percentage is much lower.

On the other hand, we have anthropometric evidence which tells us that the prevalence of moderate and severe undernutrition is considerably smaller, especially among adults, but also among children in many instances.

It is reasonably well established that infants and small children are at a nutritional disadvantage in Africa (as elsewhere).

Yet several national nutrition surveys (cf. table 4 above) of representative samples (from Cameroon, Liberia, Sierra Leone, Togo, Kenya, Lesotho and Swaziland) find "only" 16-28 percent of the children (0-5 years) to be **modestly** stunted (height for age), the most commonly used indicator of **permanent dietary deficiency.**

The IBRD estimate of the prevalence of **moderate to severe** undernutrition in the **entire population** in the same seven countries is notably higher in the three cases (Sirra Leone, Togo and Kenya). They are roughly at par with the national nutrition survey results for three countries (Cameroon, Swaziland and Liberia). Only for the remaining country, Lesotho, the IBRD estimate suggests a significantly lower prevalence of overall undernutrition than among small children, the result one would expect.

The relative ranking of the reported prevalence of undernutrition in the entire population (IBRD) and among children (the national surveys) across the seven countries is not consistent. Swaziland and Liberia have relatively favorable scores and Kenya is at the bottom of the list according to both sets of estimates. But the ordering of Lesotho, Togo, Cameroon and Sierra Leone is quite different. The ranking is equally inconsistent if one considers the incidence of **combined** chronic and acute undernutrition (as indicated by weight for age) in the eight countries for which such data are reported (now including Botswana and Malawi but excluding Kenya). It is further noticeable that the IBRD estimates suggest a much higher **inter-country** spread than the national surveys.

Taking the numbers at face value, it is even more difficult to reconcile the IBRD estimates with the anthropometric evidence on **acute** undernutrition. In the six countries listed first in table 4, only between 1 and 4 percent of the **children** were found to to have a weight-for-height below 80 percent of the reference standard, indicating modest to severe acute undernutrition. For the (five) Sahel countries, the estimates are higher, between 7 and 41 percent. Even during 1973-74, famine years, "only" between 0 and 5 percent of the children below 5 in the Sahel countries are reported to be **severely** undernourished (60 percent below the standard w/h) on thee measures. By contrast, the IBRD estimates suggest that 20 to 55 percent of the **entire** population of the same five Sahelian countries were **severely** undernourished on a **permanent** basis throughout the 1970s. Such widespread, and severe, **chronic** undernutrition does not seem consistent with the observation that a much lower percentage of the children show signs of **acute** undernutrition, in some instances even during famine years.

In principle, there are two main possible (sets of) explanations for the the incongruity between the IBRD/FAO aggregate estimates, based on the dietary approach, and those found in anthropometric studies. The first is that different things are measured; that a **different norm**, or requirement, is used to delineate the "undernourished" and the "wellnourished". The second is that one set of estimates (or both) is based on data, and/or estimation methods, that are **biased**. In the following of this sub-section we shall analyze the two explanations in some detail.

8.1 Requirement, The Five W's: For What, Who, When, Where and Why ?

The individual needs the energy (and the other nutrients) contained in food to sustain different processes and activities. The most basic is the **internal** work that is needed to maintain bodily functions (basic metabolism). In addition, the individual needs energy in order to be able to pursue external activities, such as work. Energy is also required for maintaining health and various physical and psychological capabilities. Children need extra energy for growth in stature.

The most commonly used estimates of dietary "requirement", provided by the FAO/WHO, and more recently together with the UNU, take most of the "needs" into consideration: "The energy requirement of an individual is that level of energy intake from food which will balance energy expenditure when the individual has a bodysize and composition and level of physical activity, consistent with long-term good health and which allow for the maintenance of economically necessary and socially desirable physical activity" (FAO, 1985, p. 19).

It has been claimed that the FAO/WHO requirements are "too high" (e.g. Poleman, 1975, p. 511). If so, this may explain at least some of the incongruity between the IBRD/FAO aggregate estimates of the prevalence of undernutrition, which use FAO/WHO "requirements" to establish the cut-off points, and the anthropometric evidence. However, the notion that requirements (not only FAO/WHO) are "too high" (or too low) can have at least eight different meanings.

(1) Irrelevant Objectives. One line of argument is that a "requirement" is related to objectives that have no welfare underpinning. For instance, it has been questioned whether the achievement of the full genetic potential for growth in stature is a relevant requirement. Children in developing countries who are modestly stunted according to Caucasian standards, have not been shown to be more susceptible to disease, to face a higher risk of dying or to have more severe cognitive handicaps than children of normal height (cet. par.). In adultery, they have not been proven to be less productive or to have a reduced reproductive capacity. (For a review of the evidence and a discussion, see Osmani, 1987, pp. 35-57.) "Small but healthy" is the slogan (Seckler, 1982). In the absence of evidence of impaired health and functional capabilities due to moderate stunting, it can thus be argued that caloric requirements should not allow for the full potential for growth in children.

It should be noted, however, that the extra calories needed to sustain normal growth in stature (and concomitant gain in weight) is relatively high for **infants** only. For this age group, the extra calories needed for growth account for an estimated one-fourth of total calorie requirements during the first three months, but the share declines rapidly, to about 6 percent at the age of ten months. For **children** between 1 and 10 years, the calories needed for growth correspond to a mere 2-3 percent of their total requirements (appendix table 6).

We also have to face the intricate value judgement whether or not (moderate) stunting **per** se, related to an insufficient food intake in childhood, affects a person's welfare. The answer to this question makes a whole lot of difference. If moderate stunting (conventionally defined as 80-90 percent of some standard derived from U.S. or European populations) is accepted as a relevant criterion, up to 28 percent of the children in the African countries are chronically undernourished. If, on the other hand, moderate stunting is **not** considered to reduce welfare, the estimated incidence of undernourished children is drastically reduced. By weight for height, for instance, only 1-5 percent of the same children are undernourished (below 80 percent of the reference). In summary, many children are small, but not seriously underweight and, as far as we know, not more handicapped than other children (cet. par.).

(2) Incomplete Objectives. There is also the problem that some of the methods used to estimate nutritional adequacy cannot capture the degree of fulfillment of an objective that may seem important. For instance, the anthropometric measures just discussed cannot be used to identify individuals who show no nutrition-related physical defects, but who have not enough calories to achieve "economically necessary and social desirable activities", which would classify them as undernourished by FAO/WHO/UNU standards.

(3) Misplaced Norms. A third possibility why a "requirement is too high" (or too low) is that the underlying norm is not valid in the special context to which it is applied. All the anthropometric evidence there is on **chronic** undernutrition in Sub-Saharan Africa is based on the height-for-age indicator. We have already discussed whether moderate stunting is a relevant criterion for classifying an individual chronically undernourished. We must also ask: stunted, **in relation to what?** Almost all the evidence on stunting in Africa is based on references obtained from populations in the developed countries, especially the U.S., mainly of Caucasian stock. The implied theory is that people of all ethnic origins have exactly the same genetic potential for growth in stature.

Recent empirical research indicates that children from well-to-do families in several developing countries have about the same height for age as the Western reference populations. For Africa, the evidence is rather limited considering the enormous ethnic diversity. For East Africa there are three studies from Kenya and one from Uganda. They all "indicate that Bantu children have as large a growth potential as European (Caucasian) children of similar socio-economic status" (Stephenson et al., 1983, pp. 6-9; italics added). From West Africa there is one study of Yoruba children, which also corroborates the notion of the same "genetical potential for growth" (Janes, 1974).

In five of the national nutrition surveys reported from in Tables 4 and 5, a National Reference Group (NRG) has been examined. These groups were not based on samples from well-to-do households, but on sub-populations from relatively rich areas or occupation groups. In two of the countries (Cameroon and Sierra Leone), the height-for-age distribution of the children in the NRG is very similar to that of the reference population. The incidence of moderate stunting is notably higher in the other three NRGs, but only about half that of the random-sample group in respective country (table 4).

It has to be recalled, again, that there are about 1,000 ethnic groups in Africa; only a dozen are large (above 12 million) and there are several hundreds in the 200,000 to 2 million range. The limited and varying empirical evidence at hand does thus not infer that standard Western reference heights can be applied indiscriminately Africa. Moreover, evidence from the Far East suggests that there are "tribal" groups which do not comply with standard references (Roberts, 1985).

Casual observation makes it difficult to accept that "international" standards are applicable throughout Africa. The average Dinka, Maasai and Tutsie, for instance, seems to be much taller than the average American or European. The Kalahari bushmen are much shorter and so are the various Pygmy populations. These ethnic groups may represent the extremes of a spectrum with an average that complies well with Caucasian/Western standards, and the variance in the ethnic distribution may be small, but this is yet to find out.

Again, a lowering of the reference standard would have a large impact on the estimated prevalence of chronic undernutrition. A standard, only 5 percent below the ones presently in use, would reduce the estimated "prevalence" of chronic undernutrition in children by one-third or more.

There are, however, also indications that some of the norms used are set too low considering the special characteristics of contemporary Africa. For instance, the FAO/WHO/UNU estimates of "requirement" do not allow for health hazards due to poor sanitation, high prevalence of disease and lack of health care, prevalent features in most parts of Africa. The estimates are derived on the presumption of a "standard" environment. Since there is plenty of evidence showing that an unhealthy environment increases the nutritional requirements and/or reduces the intake and the absorption of the nutrients, "requirements" for Africa should ideally be set higher (cet. par.). The main problems are that (i) the environmental hazards are too location-specific to be possible to take into account in standardized requirements and that (ii) the exact extra needs are not known.

Moreover, the pre-1985 FAO/WHO estimated requirement for adult women in Africa allows about 100 calories for household and home-based work only (Chen et al., 1981, p. 63). Recognising that women are estimated to undertake about 70 percent of the food-production work and that much of this work is heavy (cf. Koopman-Henn, 1983, and Trenchard, 1984), one would be inclined to raise the requirement for adult women by several hundred calories above those suggested by

FAO/WHO. Whether this has been done in the 1985 revisions of the old tables, is not clear (cf. FAO/WHO/UNU, 1985).

(4) Level of Ambition. A fourth interpretation of the notion that a requirement is "too high" is that the level of fulfillment of the underlying objectives is too ambitious. The standard FAO "requirements" are based on "complete" fulfillment of most of the various objectives. One may argue that in the context of Africa, such high standards are not relevant. It may well be that the FAO/WHO/UNU norms are perfectly appropriate for the total fulfillment of human well-being, but not for delineating undernutrition that is relevant for food policy in Africa. As most people here do not fulfill any of their basic needs completely, why should we have a norm that allows for full satiation of nutritional needs? There seems to be a certain range below the FAO/WHO/UNU requirements over which health, productivity, activity, weight and growth in stature are only marginally impaired (which is not to say that there is completely cost-less adaptation to low intakes; cf. below). Would it then not be more relevant to set requirements at a lower level? This is, in fact, what has been done in many instances, but there is little consistency in the "levels" chosen.

In the annual FAO publications reporting on per-capita calorie availability (e.g. *the State of Food and Agriculture*), these estimates are related to "full" requirements. When estimating the prevalence of undernutrition, however, the FAO and IBRD set the cut-off points at 90 percent of these requirements at the most (the High IBRD estimate). The High FAO estimate is based on 1.4 times the BMR for adults, which corresponds to about 80 percent of full per-capita requirement.[27]

The IBRD (1986, table 2-3) claims that below 80 percent of "full" requirement, people do "not have enough calories to prevent stunted growth and serious health risks". The equivalent (in terms of calories) FAO cut-off point, 1.4 times BMR, only allows for modest activity, below what is needed for medium heavy work (FAO/WHO/UNU, 1985, pp. 73-75). The implication is thus that below the 80-percent cut-off point, either people's growth and health are seriously impaired, or they cannot perform economically necessary work. The energy is simply not enough to sustain health/growth and full work activity simultaneously. If this is correct (see point 5 below), one may argue that the cut-off point is too low. That is, requirements should be set higher, at a level where peoples' health is not at serious risk when the energy needs for normal work activity are met.

The choice of cut-off point certainly has a strong impact on the estimated "prevalence of undernutrition". As shown by the IBRD estimates, raising the cut-off point by a mere 10 percent (cet. par.) means that the estimated prevalence of undernutrition in the African population is increased from 25 to 44 percent, not a doubling, but close to it. With 100 percent of FAO/WHO/UNU requirement as the cut-off point, almost two-thirds of the population would be classified as undernourished; in some individual countries more than 90 percent. The fact that the FAO and the World Bank estimates of the prevalence of undernutrition in developing countries are **not** based on a 100

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27. The Low FAO estimate is based on 1.2 times the BMR, but this low requirement is not related to a lower fulfillment of objectives than the higher estimate; the 1.2 BMR cut-off point is based on the assumption of intra-individual adaptation, a related, but different notion (cf. below).

percent of FAO/WHO/UNU "full" requirement indicates that these have little relevance.

(5) Biased Estimation of Individual Average Requirement. The above discussion raises the question whether the standard dietary requirement (for given levels of fulfillment of the various objectives for the average, reference, person) in Africa is biased. In the latest, quite ambitious, re-examination of the requirement tables (FAO/WHO/UNU, 1985), involving leading nutritionists, downward revisions were recommended, based on new knowledge on the relations between the average person's calorie intake and her/his physical status and various activities. Recommended calorie intakes for children, for instance, were lowered by 5-10 percent and those for adolescents by 8-10 percent (ibid, tables 23, 28 and annex 7). The downward revision in 1985 of the 1971 FAO/WHO "requirements" is one of many since the early 1950s (Poleman, 1975, p. 511). The IBRD (1986) estimations of the prevalence of undernutrition were based on the requirements established in 1971. Using the new ones would lower these estimates by a few percentage points.

(6) Inter-Individual Differences. The "requirement" concept used by the FAO/WHO/UNU does not allow for inter-individual (of the same sex, weight, etc.) differences in requirements. There is a fair amount of empirical evidence showing that such differences are, in fact, relatively large (see Osmani, 1987). This means that there are errors in the IBRD/FAO estimates of the prevalence of undernutrition. Some people with intakes at, or above, the standard requirements are actually undernourished due to higher individual needs (type I error). Other people with an intake below the standard requirements actually have lower requirements and are thus not undernourished (type II error). The two errors tend to cancel out, but the net effect is a slight bias towards overestimating the prevalence of undernutrition (see Kakwani, 1986, for a theoretical proof and some empirical illustrations from India). On balance, however, there is no reason to believe that the **order of magnitude** of the IBRD and FAO estimates for Africa has been tilted upwards by assuming no inter-individual differences in requirements.

(7) Intra-Individual Differences. There is perhaps more of a problem with the assumption underlying the IBRD estimates that there are no intra-individual differences in requirements, or, more specifically, that there is no **costless** adaptation of requirement to a low intake over a certain range. If such adaptation exists, "requirement" should be set, not at the average (as in the IBRD calculations), but at the lower end of the range over which adaptation takes place. In the *Fifth World Food Survey* (FAO, 1985), the Low estimate of the prevalence of undernutrition (cited in table 3 above) is derived on the assumptions that (i) intra-individual adaptation exists and that (ii) the adaptation range is minus two standard deviations from 1.4 times the BMR (the norm underlying the High FAO estimate). It is striking that assuming intra-individual adaptation in this range (cet. par.) reduces the estimated prevalence of undernourished people in Africa by eight percentage points.

The problem is that no independent empirical evidence of adaptive adjustment of requirements exists. Observations of random or auto-correlated variations in requirements cannot be taken to imply adaptation to intake (Osmani, 1987; also see Beaton, 1983, and Dasgupta and Ray, 1987). Until this problem has been empirically resolved (if at all possible), the derivation of estimates of the prevalence of undernutrition, based on the assumption of intra-individual adaptation, is premature.

(8) Requirement and Revealed Preferences. Finally, there seems to be an incompatibility between the IBRD and FAO estimates of the prevalence of undernutrition, on the one hand, and the sample food expenditure data for individual African countries, on the other. This is most dramatically illustrated in the case of Ghana.[28] In 1967/68, the poorest section of the population in this country devoted an estimated 65 percent of their food expenditures to the purchase of "high-cost-per-calorie" foods (cf. table 7 above). This study further suggests that there is little differences between the lowest and the highest income groups and between rural and urban populations. For the same years, the FAO reports that only 89 percent of per-capita calorie requirement in Ghana was met (FAO, 1987). The IBRD estimates tells us that 31 percent of the entire population of Ghana was undernourished in 1969/71, and 15 percent (the poorest) severely so.

One may find it somewhat difficult to understand why people, who because of inadequate income, have "not enough calories to prevent stunted growth and serious health risks" (IBRD, 1986, p. 17), spend almost two-thirds of their food expenditures on meat, fish, fruit and vegetables. This is, knowing that the price per calorie contained in these foods is way above the price of calories in the form of cereals, pulses, tubers, etc. The implication is that even a very small alteration in the food consumption basket, towards foods with a lower price per calorie, would enable the poor to satisfy

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28. The same pattern is revealed for all the Sub-Saharan countries for which there are data (cf. table 7). Ghana, however, is the only country for which extensive separate data are available for urban and rural households.

their basic calorie (as well as the other nutritional) requirements with the same total outlays for food.[29] Why don't they?

One possible explanation is that their basic calorie needs are already satisfied, either because they have a lower requirement than recommended by the FAO/WHO, or they consume considerably more calories than the FAO estimates purport. This, in turn, would imply biases in either the conventional requirement, or in the intake, estimates (or both).

The alternative explanation is that poor people in Ghana (and perhaps elsewhere in Africa) choose to starve themselves in order to attain higher fulfillment of other objectives. That is, for these people, the wellbeing obtained at the margin from being more "adequately" nourished is less than that derived from consuming non-food and "luxurious" food. The implication is straightforward; if poor people have the possibility to attain what is considered to be a "required" calorie intake by outsiders through a rather small shift towards less costly calories, but do not, they must value being nourished at this level very low. Is it then meaningful to impose calorie requirements that are considerably higher then conveyed by revealed preferences?

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[29]. A recent study of food consumption in Kerala (Shah, 1983), suggests that also the poorest, with an average intake of about 1,730 calories per day, have a (realized) demand for "luxurious" food (i.e., for taste, variety, texture etc.). According to Shah's simulations, these people could have a daily, nutritionally fully adequate, calorie intake of about 2,800 with the same expenditure if they choose a less varied and tasty diet. Considering that the poor in Kerala spend considerably (i) more of their incomes on food and (ii) less on high-cost-per-calorie foods than those in Ghana, and that (iii) the relative price difference between high- and low-cost-per-calorie foods seems to be much larger in Africa than in India, the scope for the poor in Ghana to raise their calorie intake at, or above, "requirements" is many times greater than for the poor in Kerala.

The answer may be yes; that is, if we postulate that the individuals concerned make decisions that are sub-optimal in some social welfare meaning. It could be presumed that poor individuals are (i) not concerned with their health, (ii) do not recognize the links between calorie intake and health, or (iii) are not capable of making rational decisions given their constraints. If one or more of these three assumptions is accepted, it may seem reasonable to have norms that do not comply with these peoples' revealed preferences. The policy implications, quite obviously, will be different depending on which of the three assumptions that is not met.

In summary, we have discussed eight arguments for not accepting at face value the "requirements" and norms that underlie the available estimates of prevalence of undernutrition. Can we now conclude, **either** (i) that the discrepancy between the dietary, aggregate, estimates and the anthropometric ones is largely explained by the use of "too high requirements" by IBRD/FAO, **or** (ii) that the norms underlying the anthropometric evidence are too low?

The "requirement" concept used by IBRD is "too high" for two, possibly three, reasons. The first is that 1971 rather than 1985 requirement was used. The second is that no allowance for inter-individual differences in requirement was made. A third reason may be that no intra-individual adaptation to intake was incorporated, but whether this is warranted or not is yet too early to say. The equivalent FAO "requirement" is too high for the second reason only. On the other hand, however, both the IBRD and the FAO requirements are "too low" for three other reasons. One is that the cut-off points are set below what most nutritionists recommend as safe (the FAO/WHO/UNU "full" requirement). The other is that no allowance is made for the fact that extra calories are needed in especially health impairing environments. The third is the miniscule allowance for women work activity. On balance, we can thus not say that the IBRD/FAO estimates of the prevalence of undernutrition have been inflated due to the use of unduly high calorie requirements. There are (up to six) off-setting "errors" of unknown sizes and the net effect is indeterminate.

The same applies to the norms used to estimate undernutrition through the anthropometric approach. On the one hand, the anthropometric indices tend to underestimate the prevalence of undernutrition since people whose activity is unduly low are not detected. On the other hand, it is possible that the reference standards for height and weight are too high.

The overall conclusion is thus that we cannot claim that the discrepancy between the prevalence of undernutrition reported by IBRD/FAO and the various anthropometric studies is explained by the fact that different norms and "requirement" are used to delineate the undernourished. It may be so, but no conclusive evidence exists. Some of the controversies involved in establishing norms and "requirements" can be resolved in the sense that they lead to hypotheses that are testable, at least in principle, e.g. whether intra-individual adaptation of requirement to actual intake does exist. Some other controversies involve normative judgement which cannot be settled by science, or at least, not by science only, e.g. what activity level a requirement should be related to.

8.2. Data and Methodology Biases

A major problem with dietary-based estimates is that information on such a variety of variables is needed: individual intakes, the nutritional content of the food and on requirements that vary across individuals in relation to a large number of factors (as discussed above). The anthropometric estimates, on the other hand, rely upon less information. To obtain such estimates, data on nutritional intakes or individual-specific requirements are not needed. The "only" problems are to identify (i) relevant norms and to (ii) establish the links between these and nutrition, normalized for other influences.

In the above sub-section we found that it is not possible to argue, on the basis of our present knowledge, that different norms, or "requirement", is a major reason for the incompatibility between the various estimates of the prevalence of undernutrition in Africa. The other main possible explanation is that the data on nutrition intakes in the aggregate dietary estimates are downward biased. In the following we shall first discuss the estimates of the per-capita "availability" of calories in the perspective of our previous findings. We then proceed to discuss the distribution of the calories (i) across and (ii) within households.

(1) **Calorie Availability**. From the ways in which the FAO estimates of the per-capita availability of calories in the African countries are derived, there is reason to suspect that they are not very accurate (pp. 6-9 above). Fortunately, there is some scope for "checking" these estimates, derived from the supply side, by comparing them with sample estimates from the demand side.

The information we have on per-capita calorie consumption is based on 85 sample studies from about half the African nations, most of them from the years 1960-1979; a few ones are from the 1950s. The estimated average per-capita calorie consumption in these populations is 1,950. In comparison, the aggregate FAO data suggest that over the period 1960 to 1979, the average per-capita availability of calories for Sub-Saharan Africa as a whole is 1,964. There is thus hardly any discrepancy between the estimates based on supply-side, aggregate, data and those derived from demand-side, disaggregate, data. At first sight, one might be inclined to take this almost unbelievable congruity between estimates obtained in completely different ways as a proof of the robustness of the estimation methods. Such an interpretation would lead to the wrong conclusions however.

As noted in section 5 above, most of the dietary sample studies are not representative for the entire population in respective country. On the whole, they tend to underestimate the national averages for a number of reasons.

First, the great majority of the sample dietary studies have been carried out on nutritionally disadvantaged sub-populations. This means that the estimates derived for these groups must be be lower than the national average for the respective country. How much lower cannot be ascertained, but if a population group is at a nutritional disadvantage, one would presume that for this to be detected in the first instance, the "disadvantage" must correspond to more than a few percent.

Second, more than half the dietary studies are based on the "recall" method (cf. p. 27 above), rather than the more precise weighing method. For India, it has been shown that the recall method is not only unreliable, but that it also give raise to estimates of calorie intakes that are downward biased. Cross-checking of results obtained by interviews with those obtained through weighing of the same populations suggests that the downward bias ranges from 10 to 40 percent; only in some recent studies has the underestimation been considerably less (cf. Harriss, 1987, p. 24).

Third, from the 51 studies of the Sahel countries, surveyed in Dillon and Lajoie (1981), it is evident that most of these were carried out in the preharvest, lean, season (soudure). There is plenty of evidence showing large intra-year variations in the the per-capita calorie consumption in countries with marked seasonality in agriculture (the majority of the countries in Sub-Saharan Africa). The difference between the pre- and post-harvest months amounts to several hundred calories according to observations from West Africa (cf. Hulse and Pearson, 1981, tables 6 and 7; Schofield, 1979, pp. 53-54; Chambers et al., 1981, pp. 45-50).

Fourth, almost all the dietary observations are from rural areas. From what we know from the anthropometric evidence (reported in table 4 above), food standards in urban areas are significantly higher than in the rural ones. The sample dietary estimates from rural populations, thus probably underestimate national averages, as between 15 and 50 percent of the population in the various African countries dwell in urban and peri-urban areas.[30]

Finally, it has been claimed that there is a systematic bias towards underestimating food consumption with the dietary approach, whether using the weighment or other methods, as not all food consumed is observed (Meyer, 1976). That is, the sample dietary studies are not only non-representative; they are downward biased as well.

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[30] Comparative sample dietary studies of urban and rural populations in Africa are very few; three studies suggest that the per-capita calorie in take is lower in the urban than in the rural areas (FAO, 1985, p. 40). It should be recalled, however, that dietary estimates of urban populations are notoriously unreliable as away-from-home meals/drinks and in-between-meal snacks are usually incompletely covered.

There are thus at least three, andd possibly five, reasons to believe that many of the about 85 studies of per-capita calorie consumption show figures that are downward biased and/or not representative for the entire population of the respective country. If so, the perfectly matching FAO aggregate estimate cannot be unbiased. There is thus a strong indication that the FAO per-capita estimates for Sub-Saharan Africa are too low in general, something that has often been claimed, but not substantiated in the African context.[31]

The number of sample nutrition studies for any individual African country and year is far too small to permit a consistency check with the aggregate FAO estimates; or to make feasible a comparison of estimated changes in aggregate calorie supply over time. There is thus no possibility to "check" whether the rather drastic changes over the past twenty years in the per-capita calorie availabilities as estimated by the FAO, in some countries to the better, in others to the worse, comply with sample data. Moreover, we have very little information at the disaggregate level for the 1980s, when FAO data suggest that nutritional standards have declined in many an African country and on the average.

(2) The Inter-household Distribution. In order to obtain estimates of the distribution of the "available" calories (and thus the prevalence of undernutrition), the IBRD/FAO take the perceived

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[31] Through a renewed, detailed check of the 85 sample dietary studies it would probably be possible to find out more about the extent to which these are non-representative in the ways discussed above, and thus, what the order of magnitude of the downward bias in the FAO aggregate per-capita estimates is likely to be. Unfortunately, time has not permitted such a check in this paper. Investigations of food-balance sheets for Malaysia and Sri Lanka have suggested that they underestimate food consumption by about 15 percent (Poleman, 1975, footnote 3).

distribution of incomes as the starting point. The IBRD rely on estimates of the income distribution in eight Sub-Saharan countries (Jain, 1975), derived at different times and with different methods and covering different samples of the national populations. The link between the distribution of incomes and of calories is established through (estimated) calorie-expenditure elasticities for the different income groups.

The share of total incomes ascribed the 30 percent of the poorest individuals or households range from 3.8 to 12 percent in the eight countries. There is reason to suspect that the incomes of the poorest are systematically underestimated. Large sections of these people earn their living from semi- or subsistence farming in most African countries. In some of the estimates of income distribution in Africa, subsistence farmers are excluded; in others, little effort has been undertaken to obtain accurate estimates of these peoples' imputed incomes. Since some time, it has been recognized that the conventional national-account-based estimates of per-capita real incomes in developing countries are systematically underrated in international comparisons (Kravis et al., 1982). Many of the biases towards underestimating the incomes of poor nations apply equally well to poor households and individuals. A re-examination of the "old" studies of income distribution in Africa (on which the IBRD/FAO estimates of the prevalence of undernutrition rest), has shown that these (i) underestimate the incomes of the poorest groups and (ii) overestimate the maldistribution of incomes (van Ginneken and Park, 1984).

(3) Changes in Inter-household Income Distribution. The IBRD estimates of the change in the prevalence of undernutrition are built on the explicit assumptions that in every country in African, the distribution of incomes was the same in 1970 and 1980. There are, however, indications of rather notable changes in income distribution over this period.[32] These estimates relate to the distribution of incomes between the agricultural and the non-agricultural population (Svedberg, 1987a). Across Sub-Saharan Africa, it is quite clear that in the (high-growth) countries where the per-capita availability of calories has increased most, the distribution of incomes has usually deteriorated during the 1970s. On the other hand, in most of the countries where per-capita calorie supply has decreased, the share of total incomes accruing to the agricultural population has remained stagnant or increased.

The assumption of no changes in income distribution has thus not only produced an error in the IBRD (possibly also FAO) estimated change in the prevalence of undernutrition, but a bias towards overestimating the increase over time. (Since the increase in the relative prevalence of undernutrition, as estimated by the IBRD, is very small, it may well be that taking changes in income distribution into account would show a decline, as suggested by the equivalent FAO estimates.)

(4) Calorie-Income Expenditure Elasticities. The IBRD estimates of the prevalence of undernutrition are derived on the assumption that the calorie-income elasticity for all African countries is 0.15 at the level of fulfilled requirements. For the lowest income groups, the elasticity is set at 0.55. This figure corresponds roughly to the average of the elasticities estimated for poor populations in Africa

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[32] No estimates of changes in the functional distribution of incomes are available for any of the African countries. The distribution between agricultural and non-agricultural incomes is a useful indicator in Africa where the majority of the population is self-employed in agriculture, where "capital" and "labor" are not separable entities.

and also other parts of the third world (section 7 above). It thus seems that the choice of parametric value for the calorie-income elasticity does not tend to **overestimate** the prevalence of undernutrition (cet. par.) in Africa.

(5) Intra-household Distribution. The IBRD and FAO estimates of prevalence of undernutrition are built on the assumption that the distribution of the available calories is a one-to-one transformation of the distribution of incomes across households, or rather, large sets of households that are lumped together in very broad income groups. It is further assumed that the distribution of the food within each household is proportional to individual requirements. The latter assumption raises two questions. The first is whether it complies with the empirical evidence at hand; if not, the next question is whether the assumption has induced a bias in the estimates of prevalence of undernutrition.

The assumption of no intra-household maldistribution is not corroborated by the empirical evidence presented in section 5 above. For what we know, there is little difference, if any, in the degree to which adult males and females fulfill their nutritional requirements (as conventionally defined). There seems to be a systematic, but not very large, discrimination of male children. There are, however, several indications that infants and small children of both sexes are at a nutritional disadvantage vis-a-vis adults.

The question is then whether child "discrimination" means that the IBRD/FAO assumption of no intra-household "inequalities" has induced a bias in the estimated overall prevalence of undernutrition. The answer is probably yes, but we cannot be sure in what direction, or the what the magnitude of the bias is.

Assume for the moment that children in Africa are discriminated in households at all levels of per-capita fulfillment of calorie requirements (however little). Ignoring child discrimination then means that some individuals (adults) in the "undernourished" households are classified as undernourished while they are not (type I error). On the other hand, some individuals (children) in the households classified as wellnourished will, in fact, be undernourished (type II error). There is little reason to expect that the two errors cancel out. The relative size of the two errors depends on several things, including (i) the intra-family distribution of calories in both the households which do not have enough calories to meet their requirements (even when distributed equitably) and in those who have; (ii) the degree to which these two sets of households fall below and exceed, respectively, the cut-off points; (iii) the relative size of the two household groups and (iv) adult vs. child requirements.

First, the relative degree of child discrimination within the households below and above the per-capita cut-off point, respectively, is important. The less severe the child discrimination is in the households above the cut-off point, the smaller the number of individuals (children) who are misclassified as wellnourished. The more severe the child discrimination in the households below the cut-off point, the larger the number of individuals (adults) who are erroneously classified as undernourished. Consequently, the overall prevalence of undernutrition will tend to be overestimated when child discrimination takes place mostly in food deficient households (cet. par.). It would also mean, however, that the severity of undernutrition in the children is underestimated.

Second, the more above per-capita requirements the better-to-do households are, the smaller the share of individuals that is mistakingly classified as wellnourished. In a parallel way, the more below the cut-off point the "undernourished" households are, the smaller the number of people who are erroneously taken to be undernourished. This means that the errors induced in the estimated overall prevalence by assuming no intra-household discrimination will be smaller the more uneven the overall inter-household distribution of food entitlements is. The relative size of the two errors will depend on the inter-household distribution within the group of households below and above the cut-off point, respectively.

Third, the relative size of the two errors depends on the share of the households below the cut-off point in the total population. If these households make up a small share, the absolute number of individuals mistakingly classified as undernourished will be small in relation to those erroneously labeled wellnourished in the other households. The overall prevalence of undernutrition will thus tend to be more underestimated the smaller the share of all households that are found below the cut-off point.

One would be inclined to expect that the discrimination against children is especially acute in households where food entitlements are insufficient to satisfy everyone's requirements. But what empirical evidence is there? There are the few observations from Schofield (1979, p. 87), which suggest that child maldistribution was not (relatively) less in two villages where per-capita requirements were met (by a wide margin) than in three villages where per-capita consumption was below requirements. The children in the two well-to-do villages did, however, meet their absolute calorie requirements. There is also the indication that Bantu children from well-to-do social groups in Kenya and Uganda, and also Yoruba children in West Africa (Ibadan), have a height and weight for age that comply well with children from wellnourished Caucasian populations (pp. 51-52 above). The problem is that the children from these well-to-do families represent the extreme upper end of a wide spectra. Whether there is nutritional discrimination against children in more normal households above the threshold, is largely open to question. What we have are the observations from the National Reference Groups in the some of the countries listed in table 4. These suggest that the incidence of child undernutrition within the NRGs is significantly smaller than in the national sample in two out of five countries.

In summary, ignoring intra-household maldistribution of food calories certainly means that errors have been introduced in the estimates of overall incidence of undernutrition. Whether there will be a net bias, and if so, in what direction, we cannot say. Under the plausible assumption that intra-household maldistribution is more pronounced in families below the cut-off point, the net effect depends mainly on the relative share of these households in the total population. For countries/regions where more than half the households are above the cut-off point (however defined), the two errors will go in the same directions and the net result will be an overestimation of the overall prevalence of undernutrition. When these households make up less then half the population, the two errors will go in different directions and the bias can either be towards over- or underestimation.

The bottom line is that because of the assumption that there is no intra-household maldistribution of food, the prevalence of overall undernutrition will be overestimated in countries where it is rampant and underestimated in countries where it is more limited.

Consequently, the inter-country differences in the prevalence of overall undernutrition in Sub-Saharan Africa, as estimated by the IBRD, is probably overstated. This conclusion squares up with the earlier finding (p. 48 above) that the inter-country difference in the prevalence of chronic child undernutrition is much smaller than that indicated by the IBRD estimates for the same seven countries.

9. CONCLUSIONS, POLICY IMPLICATIONS AND SUGGESTIONS FOR FUTURE RESEARCH

In conclusion of a recent survey of nutritional studies from West Africa the question whether we have an "*adequate knowledge* of the nutrition state of the populations" was posed and answered by a "qualified yes" (IDRC, 1981, p. 15). In the present study, we find a more appropriate answer to be a "qualified no".

9.1. Conclusion 1: The Overall Prevalence of Undernutrition.

The basic questions concerning the prevalence and severity of chronic undernutrition in Sub-Saharan Africa cannot be answered firmly on basis of the data available today. The methodological framework and the estimates provided by the IBRD and FAO on the basis of aggregate data comprise an important starting point for assessing the overall nutrition situation in broad terms. The underlying data and the methods used are still much too crude to provide reliable estimates, however. In conclusion of the analysis in the preceding sections, one is inclined to think that these estimates tend to be upward biased (cet. par.) for at least three, and possibly four, reasons.

The first is that both sets of estimates of the prevalence of undernutrition are based on the FAO estimates of per-capita-calorie-availability. As was argued above (pp. 62-64), there are strong indications that these are too low in general. The second reason is that the distribution of incomes in the African countries have been shown to be less uneven (van Ginneken and Park, 1984) than the parametrical values underlying at least the IBRD estimates presume. The third reason is that inter-individual differences in requirements have not been allowed for. Fourth, the relative high estimates provided by the IBRD (as compared to FAO), may be upward biased as no allowance is made for intra-individual adaptation of requirement to intake (over a certain range). However, as there is no independent empirical evidence of such adaptation, it would be premature to claim that there actually is a bias on the latter account.

On the other hand, it is possible, our analysis suggests, that at least one of the parametric values used in the IBRD estimation, or to be more correct, simulation model, may have tilted the results downwards. The calorie-expenditure elasticity ascribed the lowest income households in Africa (0.55) looks somewhat small in comparison with some of the estimates found elsewhere in the literature (cf. table 7 above). What elasticities that have been used by the FAO (1985) is not reported.

Furthermore, there is the question whether the IBRD and FAO estimates of the prevalence of undernutrition are based on "requirements" that are relevant. As we have discussed at great length, there is no way in which requirements can be defined without invoking value judgement. In the opinion of the present author, however, the two cut-off points used by the IBRD and the higher one applied by the FAO are reasonable. They correspond to between 1.6 to 1.8 the BMR during non-sleeping hours, which allows for moderately heavy work and other normal activities, but are still some 10 to 20 percent below what the FAO/WHO/UNU recommend as safe for complete fulfillment of nutritional needs.

The fact is, however, that when it comes to estimating the overall prevalence of undernutrition on the basis of aggregate data, the question of relevant requirements is of little practical significance. The uncertainty regarding all the other parameters in the models used by the IBRD and the FAO is so large that the exact "requirement" makes little difference to the results. That is, the robustness of the estimates will be very low in any case.

For given "requirements" we can choose combinations of parametric values of the other variables in the model, which will produce estimates of the prevalence of undernutrition in Sub-Saharan Africa ranging from 10 to 75 percent of the entire population. These are parametric values that are not less corroborated by independent empirical evidence than those actually used in the IBRD/FAO estimations. Say, for instance, that the **availability of calories**, on the average, is 10 percent higher than indicated by the FAO data, a highly probable presumption in the light of our previous findings. Plugging that value into the IBRD simulation model reduces (cet. par.) the estimated prevalence of undernourished people in Sub-Saharan Africa from 44 to 25 percent in one stroke. Say further that the **population** in Sub-Saharan Africa at large is five percent smaller than the UN estimates suggest. This would mean that the **per-capita** availability of calories is an additional five percent higher than purported by the FAO estimates and - consequently - that the prevalence of undernutrition is lower. Raise also the incomes of the poorest households by a third or so (cf. van Ginneken and Park, 1984), recalculate **income distribution**, and plug the new parameters into the model, and we are down to 10-15 percent. Add an allowance for inter-individual differences in requirements and intra-individual adaptation to intakes and we are below 10 percent undernourished.

We can also derive estimates of the overall prevalence of undernutrition above 75 percent for Sub-Saharan Africa without using (a combination of) parametric values outside the ranges that find support in the independent empirical literature. In an early version of the IBRD simulation exercise, a calorie-expenditure elasticity of 0.30 at the level of fulfilled requirement, and a correspondingly higher one for the lowest income group, well in line with some of the estimates cited in section 7 above, was used. This version was scrapped, however, as it "would imply that large low-income segments of the population could subsist on consumption levels too low to sustain life" (Reutlinger and Selowski, 1976, pp. 18-19).

A simulation model that is so lacking in robustness that slight changes in the combination of values of the main exogenous parameters, all well within a plausible range, produces estimates of the prevalence of undernutrition ranging from below 10 to 75 percent of the population in Africa is of little practical use. This is not to say, however, that we should abandon attempts to estimate the overall prevalence of undernutrition once and for all. The conclusion is that before such estimates can be used for policy purposes (cf. below), the models have to be refined and, above all, we must have a better knowledge of size of the exogenous parameters inserted into the model. That is, we need more research on how to obtain more accurate estimates of per-capita availabilities of food, on nutrition-expenditure elasticities, on inter-household income distribution and on intra-household distribution of food. We also have to know more about non-African-specific issues, such as the existence of intra-individual adaptation of requirement to actual intake. There is thus a long way to go before we can produce aggregate estimates of the prevalence of undernutrition that are robust enough to help direct policy. One may, of course, doubt that we ever will be able to produce such estimates? Indeed, do we need such estimates?

I think it is important that we have reliable estimates of the order of magnitude of the overall incidence of undernutrition as a supplement to more detailed information from dietary and anthropometric sample studies (cf. below). A government concerned with nutrition will certainly pursue different policies if it believes that one-third or more of the population suffers from severe undernutrition (as is common according to the IBRD estimates) than if only five or ten percent is suffering. In the first case, it will be almost impossible to come to grips with the problem in the short and medium term through income redistribution or supplementary income/feeding programs. The expenditures needed for such extensive programs would, little doubt, be far beyond the resources that most governments in Africa can, or would be willing to, muster.

It would also be problematic to identify long-term development policies that provide special benefits to the nutritionally disadvantaged if these comprise a very large share of the population. Taking a general equilibrium perspective on how economies function, it is difficult to see what sustainable policies could efficiently improve the situation for these households if they account for one-third of the population. The problem will be especially severe if the target household are not very homogeneous in terms of occupation, geographical locations, etc., as seems to be the case. The only solution then may be policies that boost real incomes rapidly without inducing maldistribution. On the other hand, if severe undernutrition is limited to a small share of the population, the scope for targeted policies, short-term as well as long-term, is more promising.

9.2. Conclusion 2: Distribution of Undernutrition

Detailed dietary and anthropometric studies are, and will continue to be, our main source of information on the prevalence, severity and, most important, the distribution of undernutrition in Africa.

The clearest observation emerging from dietary and anthropometric evidence is that a large share of the small children in Sub-Saharan Africa are stunted by Western standards, but only moderately so. This type of measures provide no evidence of widespread and severe under- or malnutrition among adults, although the number of studies is too small to permit broad generalisations over time and countries. Neither have we found anything that corroborates the notion that adult, non-pregnant, women are at a nutritional disadvantage vis-a-vis men. There are a few observations suggesting that pregnant and lactating women have an unduly low calorie intake, but this evidence is too scant to be conclusive. Finally, we have found that male children unambiguously have lower scores on all anthropometric indicators than female children.

The only indication of widespread chronic undernutrition in Africa, howeer, is the relatively high prevalence of "stunted" children. It is thus of utmost importance that this observation is closely examined so as to establish its validity. Three questions arise.

The first question we have already discussed at length, viz. whether moderate stunting is a relevant criterion for assessing chronic undernutrition. There is no evidence showing that moderately stunted children are at a health, cognitive or capability disadvantage as compared to children of "normal" height living under the same conditions. Stunting as such can, nevertheless, be judged to impair welfare.

A second question is: are the children actually stunted? Some observations from well-to-do households in Africa show these children to have the same potential for growth in stature as children from Western/Caucasian populations; but there are other studies indicating that African children from well-to-do social classes are shorter. In order to settle the question whether Western growth standards apply in the ethnically diverse Africa once and for all, we must have more research on height-for-age in African population groups for which nutrition is not a problem. Such studies are relatively uncomplicated and not very expensive to carry out. Some 10 studies of the largest ethnic groups, and a few on randomly selected (smaller) groups, are needed before we can claim that the anthropometric evidence at hand on height-for-age indicates stunting.

If one accepts (i) that stunting impairs welfare and that (ii) many children in Africa are stunted, the third question is whether one can be sure that this is a consequence of nutritional inadequacy rather than poor health. Almost every contemporary nutritionist claims that both undernutrition and health hazards are to blame, not only for stunting, but more important, for the high infant and child mortality in Africa and other developing regions. This may very well be true, but we have to know more about what factor is at the bottom of the problem and what the marginal returns (and costs) from "lifting" the various constraints are. On these issues, massive research is required.

What do we know so far? In their survey of reports from some 200 "supplementary feeding programs for young children in developing countries", Beaton and Ghassemi (1982) found only one study that addresses the questions just posed and carries out the investigation in a rigorous manner. The study, from Narangwal in India, showed that (i) in the group for which "supplementary feeding" and "infectious disease control" were introduced simultaneously, the mortality rate for infants and children of all ages (up to five) declined notably as compared to the control group. The study further showed that (ii) in the sample groups for which either "supplementary feeding" or "infectious disease control" was introduced, the mortality rate also declined more than in the control group, but less so than in the sample where the two programs were applied synergistically. There was (iii) no systematic difference between the "feeding" and the "disease-control" groups; for some age groups, the former program showed better results; for others, the latter. On all three counts, however, there is no indication whether the observed differences were statistically significant.

After assessing the evidence from other, less controlled, supplementary feeding programs, including one study from Africa, Beaton and Ghassemi (1982, p. 889) note: "From the available data it may be concluded that food distribution programs that effectively reduce or eliminate severe malnutrition in a community have favorable impact upon morbidity and mortality. Unfortunately, there is no clear evidence about the effect of preventing 'less-than-severe' malnutrition" (italics added). Moreover, on the basis of all the supplementary feeding schemes covered in their survey, they conclude that "anthropometric improvement was surprisingly small" and the programs were "rather expensive for the measured benefit" (ibid, pp. 909-10).

Some of the evidence presented in this study also casts doubt on the notion that the lack of food at the household level is the basic explanation of stunting and high morbidity and mortality among children.

As shown by appendix table 6, the extra energy a child (above one year) needs to attain normal growth in stature (and concomitant weight gain) corresponds to 2-3 percent of her/his total calorie requirement only. Is it then possible that children, who are **stunted**, but have **normal weight-for-height** (in but a few percent of the cases during non-famine years; cf. table 4 above), do not have the extra 2-3 percent calories needed to achieve normal growth in stature? It is, of course, far beyond the competence of an economist to have a definitive opinion on how the body adjusts to mild to moderate undernutrition in childhood. On commonsense grounds, however, I am inclined to think that the level of activity is reduced as a first line of defense. It is difficult to believe, however, that retarded growth is the second adaptation mechanism and that wasting sets in only subsequently. Is **stunting without wasting** a possible consequence of nutritional inadequacy and, if so, under what circumstances?

The second indicator casts doubt on the notion that small childrens' poor health and excess risk of dying in Africa is first and foremost a consequence of chronic malnutrition: the lack of correlation between nutrition status and infant and child mortality. Over the past twenty years, the infant and child mortality rates have not dropped more in the African countries where aggregate food supplies have increased, in some instances rapidly, than in the countries where food supplies have declined (section 6 above).

An alternative explanation of the relatively high incidence of stunted (as presently defined) children in Africa and high mortality is that disease rather than the lack of food at the household level is the main culprit. The sanitation conditions under which most African children live are very poor and the prevalence of diseases like malaria and diaherra is high. It is well known that high morbidity often leads to child undernutrition, because of lower efficient intakes due to (i) anorexia, (ii) lower retainment in the body of the food eaten and (iii) impaired absorption of the nutrients and higher energy requirement due to (i) an increased basic metabolic rate (in connection with fever) and (ii) increased thermostatic losses.

The vicious circle of disease and undernutrition is, no doubt, the main cause of the exceedingly high infant and child mortality rates observed throughout Sub-Saharan Africa and possibly also for stunting. But agreement on this notion does not take us very far. We have to know what comes first and what is the most binding constraint in different locations where child mortality is abnormally high. There are, as we have seen, several indicators suggesting that factors other than inadequate food at the level of households is at the fundamental cause of excessive mortality. However, before a firm conclusion can be reached, many studies of African populations of the type conducted in the Narangwal district in India are needed. It may also be possible to learn more through cross-sectional comparisons of villages/populations located in more and less health-impairing environments and where the per-capita nutrition status differ considerably.

It is interesting to note, however, that the only evidence of widespread chronic undernutrition in Africa is that showing 16-28 percent of children below five to be stunted. If it can be shown (more definitively) that (i) standard reference heights do not apply in most African contexts, or that (ii) moderate stunting does not impair the child's capabilities or that (iii) stunting is not basically caused by nutritional inadequacy, we are left with no firm evidence whatsoever of widespread chronic undernutrition on the African continent.

What about the fact that famine has ravaged Sub-Saharan Africa repeatedly over the post-war period? It this not a solid sign of general food scarcities? Not necessarily; as has been pursuasively argued by Sen (e.g. 1981a), people with an adequate nutritional status in normal times can become victims of famine in situations where external shocks deprive them of their productive means, or incomes, which determine their entitlements to food. The recent famines in Africa have, in most instances, been triggered off by drought and military strife that have reduced food production in the inflicted areas. But the core problem is the concomitant loss of income at the level of households or individuals, not that aggregate food supplies in the country or even region have declined. Without income, a household cannot exert demand for the food available. That is, when there are no other means to assure its food entitlements, e.g., by redistribution on the local or national level. A secondary reason is that the redistribution of food (or money) towards the deprived people in Africa has not been expedient and extensive enough to prevent impending famine from becoming reality (Svedberg, 1987c), in sharp contrast with India (Dreze, 1987).

Even if chronic undernutrition among children is widespread, the reason is not necessarily lack of food at the household level. There are other possible explanations. One is that outright discrimination takes place. That is, the adults deprive the small children of food, either consciously or sub-consciously. The rationale for conscious discrimination could be that the productive members of the household need the energy so as to keep family earnings up, which, in the long term, benefits the (surviving) children as well.

This explanation is not very pursuasive, however. Children below 60 months of age make up an estimated 18.6 percent of the average household (population) in Africa. The per-capita calorie requirement in this age group is (on the average) less than half of that for the above five-year population, signifying that the small the child's total calorie requirement corresponds to less than 10 percent of that for the entire population. Say that the below-5 children are consciously deprived of food corresponding to 20 percent of their calorie requirements, possibly enough to cause stunting. The calories thus "freed" are enough to raise the per-capita calorie intake of the above-5 population by 2 percent only. In the absence of evidence of widespread and severe calorie deficiency among adolescents and adults, it is not very plausible to suppose that deliberate intra-household discrimination of small children is at the bottom of problem.

A more likely explanation is that children are discriminated against - if at all - due to ignorance. One frequently made observation is that the weaning foods in Africa are bulky and not very nutritious. Another is that mothers (and fathers) are away from home working long hours during which children are inadequately feed. Yet another explanation is that cultural taboos deprive the children of meat and other nutritious foods, especially during sickness. The empirical evidence on all these issues is mainly anecdotical. In order to be able to come to grips with the high mortality rates, however, we have to know more about what lies behind the undernutrition of children where it exists, whether widespread or not. Three different explanations have been offered: (i) food shortage at the level of households; (ii) high incidence of disease; (iii) inadequate maternal/paternal knowledge about the nutritional needs of infants and small children. The policy implications are, quite obviously, very different depending on what the underlying cause is.

We also need data that can help explain the reasons for the undernutrition there is at the level of households or "villages". We have more than 300 hundred dietary and anthropometric studies of populations in Africa. Still, there are few generalisations (cf. section 5 above) that can be drawn from a cross-examination of these. There is the rather surprising result that nutritional standards are lower in villages producing mainly cash crops than in subsistence villages. We have the unexpected result that there is no difference between villages depending on access to markets and transportation. But there is not enough supplementary economic data to find out the underlying reasons. More studies are welcome, but above all, what is needed are studies that collect a much wider range of standardized data. Not only traditional dietary and anthropometric data, but also supplementary information on a long list of economic and social variables: income, food expenditure, occupation, health, etc.

Until recently, few nutrition studies contained information on socio-economic variables. In the 1980s, promising work along the lines suggested here has been initiated. The National Nutrition Studies in six African countries, carried out by the USAID (see reference list) in collaboration with the national governments and the UCLA, contain data on a large number of economic and social variables (especially the more recent surveys). The same applies to the studies conducted within the Cornell Nutritional Surveillance Program (CNSP) in Eastern and Southern Africa. It also seems that the IFPRI (1986) Food Consumption and Nutrition Policy Research Program aims at going beyond the traditional bounderies. Also ORANA in Senegal seems to devote mounting effort to integrate socio-economic perspectives in its extensive nutritional monitoring of the countries in the Sahel region.

So far, however, not many results have been published from the programs mentioned. The mimeographed USAID reports available on request (at a high cost) are not properly prepared and it is difficult to wash out interesting results in the maze of poorly organised data presented (some of the reports are hardly readable because of poor technical quality). These studies nevertheless provide much valuable data that need further structuring and analysis before new extensive data collections are undertaken. The CNSP has resulted in a large number of publications (CNSP, 1986), but not many on the African countries aside from Kenya (Stephenson et al., 1983; CNSP, 1984). What is urgently needed in coming years is an assessment of the data at hand and, subsequently, of the type of standardized demographic, economic and social data that should be collected on a routine basis in future nutrition studies. From the UDAID surveys, it seems that much data that provide little insights are collected, while data on some variables that are urgently required are missing. Unless the appropriate supplementary data are collected, there is no way in which one can explain the reasons for the nutritional problems observed in Africa.

9.3. Research Priorities: A Summary

We cannot but conclude that the evidence on the prevalence and severity of chronic undernutrition in Africa, not only among children, but also in general, is inadequate, but that it has been overestimated by the World Bank and the FAO. More research is thus needed so as to provide us with more reliable and accurate information on the extent and severity of undernutrition in Africa. In summary, the following research priorities seem to be among the most urgent: (1) Studies aimed at testing the hypothesis that Western height- and weight-for-age reference standards are generally applicable in Africa. (2) Investigations that make stern effort to delineate the adverse effects of inadequate nutrition and disease, respectively, on child mortality. (3) Studies applying dietary and anthropometric methods in examining the same populations so as to enable us to establish "requirements" and "norms" that are consistent. (4) Food expenditure surveys of representative populations by income class are urgently needed as a supplement to traditional nutrition studies. (5) Future nutrition surveys must collect also data on a number of demographic, social and economic variables. At a more general level, we also need (6) empirical research on the existence of intra-individual adaptation of requirement to actual intake. Economic studies of (7) income distribution in the Africa countries and, especially, changes therein, is an additional priority issue.

9.4. Policy Implications.

We have concluded that there is no firm evidence of widespread and severe undernutrition in the African populations at large. We can thus not recommend that food-consumption-oriented policies should be given top priority in development policies - at the expense of, say, policies that emphasise health, education and general productivity increases, in the agricultural as well as in other sectors. It is tempting to say that development programs and strategies ought to be such that the poorest sections of the population are not left behind, or at worst, pushed further back. This, however, is what is stressed from all quarters; the problem is that recent experience from Africa shows that to accomplish growth without increased maldistribution of income is difficult indeed (Svedberg, 1987a).

Many young children in Africa are stunted by Western standards but it has not been proven that (i) this constitutes a serious problem or that (ii) the reason is chronic depravation of food at the household level. In fact, we would be very hesitant to recommend "supplementary feeding programs" as a general way to enhance growth in stature and reduce child morbidity and mortality. Such programs have been shown to have limited effect at best and they have a high opportunity cost and we still do not know much about the relative importance of disease and nutrition in explaining the exuberant infant and child mortality rates in Africa and, most important, what comes first and why.

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APPENDIX TABLE 1

Selected Nutrition-Related Indicators for the African Countries

Country	Per caput Dietary Energy Supplies in Relation to Nutritional Requirements (percent)			Infant Mortality Rate (permille)		Child Death Rate (permille)		Estimated Share of Population with Daily Calorie Intake Below 90% of Requirements (percent)		Estimated Share of Population with Daily Calorie Intake Below 80% of Requirements (percent)	
	1961/1963	1970/1972	1983/1985	1965	1983	1965	1983	1970	1980	1970	1980
Angola	77	87	83	..	..	52	31	..	..	..	..
Benin	86	92	93	193	148	52	31	33	22	16	12
Botswana	88	92	93	..	..	..	..	60	29	31	14
Burkina Faso	79	81	83	193	148	52	31	70	42	37	21
Burundi	98	99	95	169	123	38	25	47	40	24	23
Cameroon	88	96	89	155	116	34	19	44	15	22	7
Cape Verde	76	83	111	..	..	..	..	65	10	34	3
Centr.Afr.Rep.	91	98	91	184	142	47	29	36	42	18	24
Chad	96	87	66	184	142	47	29	53	90	27	55
Comoros	84	95	89	..	..	..	..	..	..	..	..
Congo	100	100	114	1'6	82	19	8	41	27	20	15
Ethiopia	77	71	73	166	..	37	..	59	90	31	62
Gabon	84	80	104	..	..	..	..	22	2	11	1
Gambia	90	94	94	..	..	..	..	36	34	18	20
Ghana	88	96	73	132	97	25	12	31	61	15	30
Guinea	78	82	75	197	158	53	26	..	..	..	..
Guinea Bissau	75	82	86	..	..	..	..	..	..	..	..
Ivory Coast	93	103	106	160	121	37	20	1	1	0	0
Kenya	97	97	93	124	81	25	14	37	67	19	41
Lesotho	88	88	103	138	109	20	14	51	11	26	4
Liberia	91	96	101	149	111	32	17	32	12	15	7
Madagascar	106	110	109	99	66	18	10	12	9	4	3
Malawi	89	102	105	201	164	55	38	33	52	17	27
Mali	78	76	76	184	148	47	31	58	43	30	24
Mauritania	86	82	90	171	136	41	16	64	31	33	14
Mauritius	106	104	120	..	..	..	..	11	3	4	2
Mozambique	86	86	71	148	109	31	16	53	87	27	55
Namibia	82	87	82	..	..	..	..	..	..	..	..
Niger	88	85	96	181	139	46	28	56	30	29	16
Nigeria	93	90	87	152	113	33	17	41	23	21	13
Reunion	107	111	129	..	..	..	..	..	..	..	..
Rwanda	75	84	87	159	125	35	26	56	27	29	14
Sao Tome	93	91	104	..	..	..	..	..	..	..	..
Senegal	97	97	98	172	140	42	28	34	22	15	11
Sierra Leone	70	85	80	230	198	69	54	36	43	18	25
Somalia	85	94	89	166	142	37	30	36	46	18	27
Sudan	76	91	85	161	117	37	19	57	19	26	10
Swaziland	91	97	110	..	..	..	..	39	11	19	6
Tanzania	83	84	100	138	97	29	18	63	61	35	34
Togo	96	94	96	158	112	36	17	38	49	19	28
Uganda	99	98	98	139	120	26	21	35	69	17	34
Zaire	97	102	97	150	106	30	20	26	37	12	19
Zambia	91	96	92	164	105	29	19	39	65	11	33
Zimbabwe	89	92	88	100	83	15	7	58	90	30	61

Sources: Per caput dietary energy supplies in relation to nutritional requirements: FAO, 1987 and FAO, 1984. Infant mortality rate and child death rate: IBRD, 1985. Estimated share of population with daily calorie intake below 90 respectively 80 percent of requirements: unpublished estimates, World Bank.

APPENDIX TABLE 2

Selected Demographic Data for Developing Countries 1965 and 1983

	Life Expectancy at Birth						Crude Birth Rate			Crude Death Rate		
	Male			Female								
	1965	1983	1983/ 1965	1965	1983	1983/ 1965	1965	1983	1983/ 1965	1965	1983	1983/ 1965
Sub-Saharan Africa												
Low Income	42	46	1.09	45	49	1.09	48	47	0.98	22	18	0.82
Lower-Middle Income	41	48	1.17	44	51	1.16	50	49	0.98	22	16	0.73
All Low-Income Countries	49	58	1.18	51	60	1.18	43	30	0.70	17	11	0.65
China	55	65	1.18	59	69	1.17	39	19	0.49	13	7	0.54
India	46	56	1.22	44	54	1.23	45	34	0.76	21	13	0.62
Bangladesh	45	49	1.09	44	50	1.14	47	42	0.89	22	16	0.73
All Lower-Middle Income Countries	47	55	1.17	50	59	1.18	45	36	0.80	18	12	0.67
All Upper-Middle Income Countries	57	63	1.11	60	68	1.13	38	31	0.82	12	8	0.67
Brazil	55	61	1.11	59	66	1.12	39	30	0.77	12	8	0.67

Source: IBRD, 1985, tables 20 and 23.

APPENDIX TABLE 3

Correlations Between Mortality and Nutrition Data for Sub-Saharan Africa, 1964/66 and 1982/84

Dependent Variable	Independent Variable	Statistical Coefficients: Correl. coeff.	t-stat	$\bar{R}^2$
Infant Mortality 1965	PCCA[a] 1964/66	-1.47	-2.52	0.15
Child Death Rate 1965	PCCA 1964/66	-0.57	-2.30	0.12
Infant Mortality 1983	PCCA 1982/84	-0.83	-1.96	0.08
Child Death Rate 1983	PCCA 1982/84	-0.25	-1.69	0.06
Change in Infant Mortality 1965-1983	Change in PCCA 1965-1983[b]	0.00	0.17	0.00
Change in Child Death Rate 1965-1983	Change in PCCA 1965-1983[b]	0.00	0.52	0.00
Life Expectancy Male 1965	PCCA 1964/66	0.16	1.59	0.05
Life Expectancy Female 1965	PCCA 1964/66	0.16	1.39	0.03
Life Expectancy Male 1983	PCCA 1982/84	0.18	2.41	0.14
Life Expectancy Female 1983	PCCA 1982/84	0.17	2.01	0.09
Change in Life Exp. Male 1965-1983	Change in PCCA 1965-1983[b]	0.00	0.47	0.00
Change in Life Exp. Female 1965-1983	Change in PCCA 1965-1983[b]	0.00	0.01	0.00

[a]. PCCA: Per capita calorie availability in relation to nutritional requirements.
[b]. Trendwise change.
Sources: Demographic data from IBRD, 1985; PCCA data from FAO, 1987.

APPENDIX TABLE 4

Share of Low-cost Calories and High-cost Calories in Total Calorie Consumption

Country	LCC[a] 1961/65	HCC[b] 1961/65	LCC 1969/71	HCC 1969/71	LCC 1979/81	HCC 1979/81
Angola	77.6	8.2	77.0	11.8	..	..
Benin	82.9	2.9	79.3	5.8	75.3	6.4
Botswana	75.7	8.1	75.1	16.5	71.5	16.8
Burkina Faso	85.6	2.2	86.3	4.7	84.2	4.6
Burundi	84.3	7.0	82.0	8.2	77.7	9.0
Cameroon	62.0	13.0	59.2	16.1	61.1	15.3
Cape Verde	80.2	7.8	79.0	8.7	78.9	9.3
Centr.Afr.Rep.	76.1	6.2	72.4	10.1	70.5	10.3
Chad	77.5	5.4	77.8	8.6	..	..
Comoros	66.6	17.7	68.4	18.2	76.5	11.7
Congo	78.7	8.7	78.3	10.9	70.5	13.2
Ethiopia	83.5	3.5	83.6	8.3	..	..
Gabon	62.8	22.6	59.2	28.8	..	..
Gambia	73.7	1.8	73.1	5.4	70.8	7.4
Ghana	71.9	14.1	69.8	16.3	72.2	14.9
Guinea	81.0	8.5	78.8	9.2	66.9	16.0
Guinea-Bissau	68.5	8.7	65.9	13.9	..	..
Ivory Coast	69.3	15.1	69.1	17.0	69.4	16.0
Kenya	81.9	8.8	81.8	12.5	77.2	13.5
Lesotho	89.2	3.0	89.6	7.2	88.2	7.8
Liberia	75.5	8.4	75.2	10.9	74.1	10.2
Madagascar	84.3	4.9	85.0	10.8	83.8	10.8
Malawi	83.0	3.7	84.0	5.8	83.3	5.7
Mali	84.4	4.1	82.4	7.9	81.0	8.1
Mauritania	65.3	24.5	63.5	31.8	65.7	25.8
Mauritius	76.0	6.7	74.3	8.8	69.0	11.8
Mozambique	86.9	3.4	84.3	5.7	82.0	5.2
Namibia	69.1	6.3	69.8	19.7	..	..
Niger	86.3	5.2	86.5	8.5	85.1	8.1
Nigeria	77.1	4.8	77.6	7.0	75.0	7.7
Reunion	72.6	7.8	68.9	17.5	63.6	18.2
Rwanda	61.4	32.9	65.4	30.5	70.2	12.8
Sao Tome & P.	59.8	9.9	62.9	7.8	61.9	8.6
Senegal	73.8	6.1	72.8	9.4	73.4	8.2
Sierra Leone	67.5	4.5	70.3	5.4	67.3	7.8
Somalia	54.1	23.9	53.0	38.5	59.3	30.7
Sudan	67.8	12.6	68.4	16.5	65.7	14.7
Swaziland	75.4	7.1	78.3	14.9	76.3	14.0
Tanzania	73.4	14.4	71.8	18.2	72.8	15.8
Togo	85.4	2.2	85.6	4.6	81.9	4.9
Uganda	53.4	25.7	58.1	22.9	61.4	27.5
Zaire	75.9	9.1	75.3	11.5	75.8	10.2
Zambia	83.5	4.1	79.9	9.0	83.7	6.9
Zimbabwe	81.2	4.2	80.2	10.7	75.3	6.5
India	85.4	6.8	85.4	6.5	83.5	7.2
Bangladesh	90.1	5.3	90.3	5.2	92.1	4.4
Brazil	73.5	16.2	71.9	17.1	72.2	17.2

[a]. LCC - Low-cost calories: cereals, roots, sugar and pulses.
[b]. HCC - High-cost calories: vegetables, fruits, meat, eggs, fish and milk.
Source: FAO, 1980; 1984.

APPENDIX TABLE 5

Estimated Change in per Capita Calorie Availability in Sub-Saharan Africa

Country	1961-1985				1970-1985			
	Inter-cept	Corr. coeff.	t-stat.	$\bar{R}^2$	Inter-cept	Corr. coeff.	t-stat.	$\bar{R}^2$
Angola	7.5	0.46	3.79	0.36	7.6	-0.09	-0.37	0.00
Benin	7.6	0.30	2.99	0.25	7.6	0.22	0.99	0.00
Botswana	7.6	0.28	6.42	0.63	7.6	0.15	1.90	0.15
Burkina Faso	7.6	0.22	2.17	0.13	7.5	0.38	2.07	0.18
Burundi	7.8	-0.12	-0.96	0.00	7.8	-0.07	-0.25	0.00
Cameroon	7.6	0.20	1.69	0.07	7.8	-0.60	-4.49	0.56
Cape Verde	7.4	1.96	7.01	0.67	7.3	0.23	3.71	0.46
Centr.Afr.Rep.	7.7	0.06	0.54	0.00	7.8	-0.70	-5.35	0.65
Chad	7.8	-1.91	-10.20	0.81	7.7	-1.65	-4.21	0.53
Comoros	7.7	-0.06	-0.43	0.00	7.7	-0.43	-2.40	0.24
Congo	7.7	0.63	8.02	0.73	7.6	1.11	12.51	0.92
Ethiopia	7.5	-0.22	-1.54	0.06	7.3	0.49	1.79	0.13
Gabon	7.5	0.93	2.27	0.15	7.2	0.24	2.58	0.27
The Gambia	7.7	0.15	2.23	0.14	7.7	0.11	0.81	0.00
Ghana	7.7	-0.93	-3.85	0.37	8.0	-2.42	-7.69	0.80
Guinea	7.6	-0.25	-2.01	0.11	7.7	-0.87	-5.15	0.63
Guinea Bissau	7.5	0.35	3.20	0.28	7.5	0.50	2.21	0.21
Ivory Coast	7.7	0.55	4.73	0.47	7.7	0.56	2.54	0.27
Kenya	7.7	-0.18	-4.77	0.48	7.8	-0.32	-4.01	0.50
Lesotho	7.6	0.85	6.64	0.64	7.4	1.44	5.85	0.69
Liberia	7.7	0.57	11.18	0.84	7.7	0.49	4.32	0.54
Malagasy R.	7.8	0.14	3.30	0.29	7.8	-0.04	-0.53	0.00
Malawi	7.6	0.92	8.07	0.73	7.8	0.15	1.16	0.02
Mali	7.5	-0.20	-2.91	0.24	7.5	0.05	0.45	0.00
Mauritania	7.6	0.01	0.06	0.00	7.4	0.96	3.65	0.45
Mauritius	7.7	0.84	7.77	0.71	7.7	1.15	7.73	0.80
Mozambique	7.7	-0.87	-8.48	0.75	7.8	-1.47	-18.14	0.96
Namibia	7.6	0.07	1.01	0.00	7.6	-0.34	-4.38	0.55
Niger	7.6	0.67	4.46	0.44	7.4	1.40	5.13	0.63
Nigeria	7.7	-0.04	-0.51	0.00	7.7	0.10	0.50	0.00
Reunion	7.8	0.92	16 46	0.92	7.7	1.13	10.17	0.87
Rwanda	7.5	0.83	5.76	0.57	7.5	0.51	1.72	0.12
Sao Tome	7.6	0.52	2.99	0.25	7.5	1.46	4.70	0.58
Senegal	7.8	-0.11	-1.14	0.01	7.7	0.24	1.97	0.16
Sierra Leone	7.5	0.60	3.54	0.33	7.6	-0.20	-0.92	0.00
Somalia	7.6	-0.06	-0.56	0.00	7.7	-0.16	-0.75	0.00
Sudan	7.5	0.80	3.97	0.38	7.7	-0.01	-0.02	0.00
Swaziland	7.6	1.08	13.36	0.88	7.7	0.89	8.43	0.82
Tanzania	7.5	1.13	7.69	0.71	7.5	1.44	4.25	0.53
Togo	7.7	-0.16	-1.55	0.06	7.6	0.28	1.61	0.10
Uganda	7.7	-0.06	-0.58	0.00	7.7	-0.02	-0.10	0.00
Zaire	7.7	-0.05	-0.65	0.00	7.8	-0.55	-5.09	0.62
Zambia	7.7	0.17	1.62	0.06	7.8	-0.40	-2.16	0.20
Zimbabwe	7.7	0.04	0.48	0.00	7.7	-0.35	-2.79	0.31

Source: Derived from FAO, 1987.

APPENDIX TABLE 6

Estimated Daily Average Energy Requirement for Sustaining Growth in Children as a Percentage of Total Energy Requirement, by Age and Sex

Age Group (months/ years)	Normal Gain in Weight (grams) (1)	Calories Required for Gain (5 cal/ gram) (2)	Calories Required for Gain in Weight per Day (3)	Total Daily Calorie Requirement (4)	Calories Required for Growth Percent of Total Requirement (5)
Girls					
0-3	2,200	11,000	122	465	26.2
3-6	1,800	9,000	100	630	15.8
6-9	1,400	7,000	78	757	10.3
9-12	900	4,500	50	915	5.5
1-2	2,400	12,000	33	1,140	2.9
2-3	2,200	11,000	30	1,310	2.3
3-4	1,900	9,500	26	1,440	1.8
4-5	1,700	8,500	23	1,540	1.5
5-6	1,800	9,000	25	1,630	1.5
6-7	2,300	11,500	32	1,700	1.9
7-8	3,000	15,000	41	1,770	2.3
8-9	3,700	18,500	51	1,830	2.8
9-10	4,000	20,000	55	1,880	2.9
Boys					
0-3	2,700	13,500	150	543	27.6
3-6	1,800	9,000	100	693	14.4
6-9	1,400	7,000	78	810	9.6
9-12	1,000	5,000	56	981	5.7
1-2	2,400	12,000	33	1,200	2.8
2-3	2,000	10,000	27	1,410	1.9
3-4	1,900	9,500	26	1,560	1.7
4-5	2,000	10,000	27	1,690	1.6
5-6	2,000	10,000	27	1,810	1.5
6-7	2,200	11,000	30	1,900	1.6
7-8	2,400	12,000	33	1,990	1.7
8-9	2,800	14,000	38	2,070	1.8
9-10	3,300	16,500	45	2,150	2.1

Source: Derived from FAO/WHO/UNU, 1985, Annex 2, p. 180 (column 1); p. 95 (5 cal/gram) and tables 22 and 23 (column 4).

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