CHAPTER 2

Prevalence and intensity of food inadequacy in developing countries

- Methodological issues
- Reliability of data and models
- Results: magnitude and trends of food inadequacy in developing countries
- Intensity of food inadequacy

This chapter explores the implications that the levels and changes in per caput DES presented in Chapter 1 have for the extent of food inadequacy in the developing regions. To do so, it is necessary to look beyond the overall per caput food availability (which merely shows how the average person has fared in each country) and take into account the distribution of food within a population.

Based on the distribution of food intake, two measures of food inadequacy are presented which are analogous to the well-known head count and income gap measures of poverty. The first is called the *prevalence* of food inadequacy and shows the proportion and number of people in a given population whose food access is deemed to be inadequate; the second is called the *intensity* of food inadequacy, and it shows the amount of additional food that is needed to eliminate the prevalence of food inadequacy.

METHODOLOGICAL ISSUES

An accurate assessment of the number of people and proportion of a population with inadequate access to food requires data from national sample surveys designed to measure both the food consumption and the food requirements of individuals, i.e. specialized food consumption or dietary intake surveys. Unfortunately, however, national surveys of this kind are costly and time-consuming to implement and have been undertaken in very few countries. Therefore, to generate a distribution curve of access to food (expressed in dietary energy terms) for each country, FAO has developed a methodology that uses the per caput DES data from food balance sheets combined with an estimate of variations in food consumption derived from a variety of sources. By applying a cutoff point based on the concept of minimum energy requirements, the prevalence of food inadequacy is estimated.

The methodological framework for the present estimates is essentially the same as that adopted in *The Fifth World Food Survey*, although a number of improvements have been made. Appendix 3 provides a detailed and comprehensive account of this methodology, of which a brief account is given here.

Basic steps of the methodology

i) It is assumed that the pattern of the distribution of per caput dietary energy (calorie) consumption within each country is log-normal so that the levels of energy consumption throughout a population can be calculated simply from the mean and the standard deviation (SD) (see Appendix 3 for details). Thus, based on the per caput DES derived from the FAO food balance sheets and on an estimated value of the

coefficient of variation (CV), the distribution of per caput calorie consumption is generated for each country. The CV is kept constant throughout the three periods under study (1969-71, 1979-81 and 1990-92), so the extent of inequality in the distribution is assumed to have remained unchanged. This admittedly unsatisfactory assumption is necessary because, for most of the countries under study, little is known about any change in distribution that might have occurred during the last two decades.

ii) Based on nutritional considerations, an estimate is made of the minimum per caput dietary energy requirement (cutoff point) below which the average person's intake is considered to be inadequate – the average person being defined as the weighted average of one person from each of the age-sex groups adopted for estimating energy requirements.

iii) The next step is to calculate the proportion of the population that consumes less than the minimum requirement, using the distribution of per caput calorie consumption (obtained following step i above) and the minimum per caput energy requirement.

iv) Finally, the calculated proportion is multiplied by the size of the total population to obtain an estimate of the number of people who have inadequate access to food.

Details of specification and departures from *The Fifth World Food Survey*

It is clear from this basic account of the methodology that, given the per caput DES and population figures for a country, the prevalence estimates would be determined by the consumption distribution variability parameter, i.e. the CV, and the minimum per caput dietary energy requirement. The specification of both presents considerable problems owing to a lack of appropriate data as well as conceptual difficulties. These problems are discussed in depth in Appendix 3 but some of the salient points are mentioned below. In the light of new knowledge gained since *The Fifth World Food Survey*, a number of methodological improvements have been introduced; it should be emphasized that all were retroactively applied to the three periods under consideration in order to generate comparable results that warrant an analysis over time. These changes are indicated at the appropriate points and are also discussed in detail in Appendix 3.

The coefficient of variation. Wherever possible, this parameter, which refers to the ratio of the SD to the mean, is derived from the sample distribution of per caput calorie consumption as measured in national household surveys. These surveys are corrected to remove the component of variation resulting from short-term (weekly, monthly or seasonal)

fluctuations in consumption so as to allow a final estimate of variation in "habitual" dietary energy consumption that is consistent with the annual per caput average value based on food balance sheets. For countries where such direct estimates of variation are not available, recourse has to be made either to estimates derived from household income or expenditure surveys or, in the "worst cases" where no distributional data of any kind are available, to the use of the average CV for other countries in the same region.

The analysis of interhousehold variations in per caput calorie consumption has also led to the definition of a plausible range for the CV. The lower and upper limits of this range have been set at 0.20 and 0.35, respectively. Hence, if a CV calculated for a country (after adjustment) was found to be outside this range, it was replaced by either 0.20 or 0.35, depending on whether the figure was below the lower limit or above the upper limit. This is a departure from *The Fifth World Food Survey* approach in which no a priori limit was imposed on the CV value.

Minimum per caput dietary energy requirement. The concept of a minimum dietary energy requirement is explained at length in Appendix 3 so only a brief definition is given here: an individual can be considered to have a more or less fixed energy requirement whereas a group of people of the same age-sex type will have a range of requirements; and people whose intake falls within this range will tend to adjust it to meet their respective requirements (FAO/WHO/UNU, 1985). If such people were completely free to adjust their intake, then obviously none would suffer from food inadequacy. However, in reality there may not be such freedom of choice, so food inadequacy may still exist among certain people. But it is safe to assume that, if the intakes of a group of people are high enough to fall within the range of requirements, the constraints on their food access, if any, cannot be too severe and most of them are likely to have an intake that is fairly close to their requirements. This argument implies that a group of people whose intake falls within the range of requirements can be considered to be at a low or "acceptable" risk of food inadequacy. By implication, people whose intake falls below the range of requirements can be said to be at a high or "unacceptable" risk of food inadequacy. It is the latter group that the present methodology seeks to identify. In other words, the term "prevalence of food inadequacy" refers to those people who face a high risk of food inadequacy in the above sense. Accordingly, with the exception of children below the age of ten, the minimum energy requirement for individuals of an age-sex type is defined as the lower end of the range of requirements for that type. This is also called the cutoff point for the simple reason that this point is used to set apart people who are at an

unacceptable risk of food inadequacy from the rest. The aggregate minimum energy requirement, or the overall cutoff point, to be applied to the aggregated per caput intake distribution is derived as a weighted average of the age-sex specific minimum requirements.[5]

For estimating the energy requirements of different age-sex groups, the basic methodology recommended by the FAO/WHO/UNU Expert Consultation on Energy and Protein Requirements (FAO/WHO/UNU, 1985) has been followed. This methodology derives energy requirements by adding up components of energy expenditure: for each component, the level of energy expenditure that is consistent with good health and an active life is assumed. The main components are the basal metabolic rate (BMR) which essentially refers to the amount of energy needed to keep the body in a satisfactory condition while at rest, and the energy required for physical activity. In addition to these components, an allowance is made for additional energy demands occasioned by pregnancy and lactation among women and physical growth in children.

Within this overall framework, the practical procedure of estimating energy requirements differs slightly, as it does between children and adults. In both cases, the first step is to specify a set of reference body weights for each age-sex group. The difference is in the next step: for children up to the age of ten, energy requirements are obtained directly by applying to the reference body weight the set of energy requirements per kilogram of body weight given in FAO/WHO/UNU (1985); for adults and adolescents, first the age-sex specific BMR is estimated, using the appropriate equations linking BMR with weight, and then an allowance is added for physical activity, expressed as a multiple of the BMR.

It is clear from the preceding account that estimates of energy requirements depend crucially on the body weights and activity levels specified for different age-sex groups. A few comments are therefore in order regarding their specification as used in this report. Since the cutoff point has (in the case of adults and adolescents) been defined as the lower end of the range of requirements, it follows that, as determinants of requirements, body weight and activity levels should also be chosen at the *minimum* levels that are consistent with the good health and functioning of the specific age-sex groups. Accordingly, requirement estimates have been based on the lower end of the variation in body weights and physical activity that is generally observed among healthy people of the same group. The same principle was followed in *The Fifth World Food Survey*, but with some important differences.

[5] The weighting is according to the proportion of the population in the different age-sex groups.

In the previous survey, the minimum acceptable body weight for adults and adolescents was obtained by using data provided, respectively, by the New York Society of Actuaries and the Baldwin tables. The former gave a range of normal weights for height for different age-sex groups, and the minimum value of this range was applied to actual heights of age-sex groups in developing countries to obtain the minimum acceptable body weight. New data are used in the present survey because the old figures were based on mortality rates obtained many years ago in a selected United States population and because a considerable number of data on the weights and heights of people in developing countries have now become available. One particular measure of weight-height relationship that has been found to be a good indicator of health and nutrition in adults is the body mass index (BMI), defined as weight (in kilograms) divided by height (in metres) squared (see Appendix 4). It has also been found that there is a range of BMI which is consistent with good health, and the lower end of this range has been identified as 18.5 for both men and women (Shetty and James in FAO, 1994b). Accordingly, for the present assessment the minimum acceptable body weight for adults and adolescents has been calculated by applying the BMI value of 18.5 to the average height of different age-sex groups in different countries.

As regards adding an allowance for physical activity, *The Fifth World Food Survey* applied the multiplier 1.4 to the BMR as a provisional figure. Today, more definitive information is available (James and Schofield, 1990); it would now appear that the multipliers 1.55 and 1.56 are more appropriate for men and women, respectively, to allow for light activity, and these new multipliers are used in the present survey.

After calculating the energy requirements of different age-sex groups on the basis of minimum body weight and activity levels, *The Fifth World Food Survey* also allowed for the possibility of an individual's energy requirements being further reduced by an adaptive increase in the efficiency of energy utilization (intra-individual variation in requirements). This possibility was based on the hypothesis that, in response to low intakes, people could adapt up to a point by reducing their energy requirements through an automatic increase in the metabolic efficiency with which their body utilizes dietary energy. However, recent research has led to a growing consensus that, for a person with a given body weight and level of activity, the range of any possible variation in the metabolic efficiency of energy utilization is very small. Accordingly, no such allowance has been made in the present survey.

As stated earlier, with regard to children below the age of ten the procedure for arriving at the cutoff point differs from that adopted for adults and adolescents. *The Fifth World Food Survey* adopted the lower limit

of the range of normal body weight, as it did for adults and adolescents, but this procedure is now regarded as being unduly conservative and likely to result in a serious underestimation of the prevalence of food inadequacy among children. Therefore, in the current assessment the minimum has been replaced by the median value (see Appendix 3). On the other hand, the 5 percent allowance for additional desirable activity that was incorporated in the previous survey has been removed, while an allowance for the energy needed to recover from frequent rounds of infection is now included for children below the age of two.

It should also be noted that, in *The Fifth World Food Survey*, the population age-sex distribution that was used as a weight to aggregate the age-sex specific requirements and express them with regard to the average person (on a per caput basis) was assumed to be unchanged for each country between assessment periods. In the present assessment, the changes in age-sex distribution between the periods are taken into account.

Finally, in terms of geographical coverage, the present study goes beyond the previous survey by including estimates for the group of countries formerly classified as the Asian centrally planned economies for all three periods. As a result, the absolute number of people with inadequate access to food in the developing world turns out to be higher in this survey than in the preceding one.

RELIABILITY OF DATA AND MODELS

As indicated in the preceding methodological discussion and Appendix 3, the estimation of the prevalence of food inadequacy is based on two key elements: the distribution of dietary energy consumption or intake within a country and the cutoff point below which the intake of the average person is considered to be inadequate. The distribution of dietary energy consumption is derived by using the log-normal frequency distribution model and estimates of the per caput DES (obtained from FAO's food balance sheets) and the CV (which in many cases is estimated indirectly through the use of regression models). The cutoff point, on the other hand, is derived for each country on the basis of estimates of the average height of individuals by age-sex group. This in turn enables the derivation of the associated minimum (median in the case of children) of the acceptable range of body weight and the application of the energy requirement norms given in FAO/WHO/UNU (1985).

It is thus evident that the reliability of the resulting estimates of the prevalence of food inadequacy depends on the accuracy of all the above-mentioned estimates and models. This section discusses this issue in a very general manner and then attempts a sensitivity analysis to identify the most important determining factor for the food inadequacy level.

Of the two key estimation elements, the cutoff point is indeed a major factor because, given the distribution of intake, it has a direct effect on the proportion of the population estimated to be underfed or undernourished. However, the fixing of this element largely concerns matters relating to nutritional norms rather than food consumption data availability or reliability (see Appendix 3) and, consequently, the focus here is on the data and models used to derive the distribution of energy intakes only.

Data and models underlying the distribution of energy intakes

The derivation of the distribution of energy intakes involves the application of the two-parameter log-normal model as well as the use of estimates of the per caput DES and the CV of per caput energy intake to derive the two parameters (i.e. the mean and the SD). The caveats with respect to these parameters are discussed below:

The log-normal model. The log-normal model has been used because, in the few cases where it has been possible to obtain survey data on intake distribution, it has been found to give the best representation of empirical evidence (see Appendix 3). However, since the two-parameter log-normal distribution has no specific limits, the concern is that it is likely to result in a significant proportion of the population being assigned unrealistically low intakes and will thus overestimate the prevalence of inadequate intakes.

To address this issue, some indication of what could be considered "unrealistically low" is needed. The few available country data on the distribution of household per caput intake show that up to 2 percent of households may have an intake of less than 750 kcal per caput/day (with the intake averaged over different age-sex groups). Therefore, for practical purposes the figure of 800 kcal per caput/day may be taken as a rough indication of what is "unrealistically low".

The risk of a significant portion of the derived distribution being below this 800 kcal level can be expected only when a very low national per caput DES (representing the mean of the distribution) is combined with the highest CV value. As mentioned in the methodological discussion, the highest CV level applied is 0.35. Thus, the issue can be addressed by examining the proportion of the population with an intake below 800 kcal per caput/day resulting from combinations of the CV of 0.35 with very low per caput DES levels. The calculated proportion of the population below 800 kcal per caput/day at alternative low per caput DES levels is given in Table 12.

Thus, in the extreme situations characterized by a very low per caput DES, when the CV is set at the maximum level of 0.35, the percentage of

the population with unrealistically low intake levels is very low. Since the percentage of undernourished is more than 50 percent at such low per caput DES levels (see Table 13), the extent of overestimation is likely to be very small. The number of countries with a per caput DES of less than 1 700 kcal per caput/day is also very small. It may therefore be concluded that the absence of a lower-limit truncation in the log-normal distribution is not a matter of serious concern in the present context.

However, as the log-normal distribution is not fitted to actual data in the classical way, there is a risk that the pattern of the actual distribution may differ significantly. Therefore, its general application in all countries introduces an element of uncertainty or error in the shape of the distribution curve.

The per caput DES. This measure, which is taken as the mean of the intake distribution, is derived as a ratio of the total food supply to the population size. The total food supply includes food losses or wastage at the retail or household level so, at least conceptually, the per caput DES is likely to overstate the true mean energy intake level. However, the extent of overestimation is likely to be relatively small in most developing countries, where average intake levels are not high.[6] In the few countries where the per caput DES is close to or above 3 000 kcal per caput/day, the extent of overestimation can be significant. Nevertheless, even in this context the extent of exaggeration is likely to be greater in the upper rather than the lower tail of the derived distribution of intakes.

The per caput DES is derived by FAO through the food balance sheet approach. The numerator, i.e. the total food supply, is based on information relating to food production, food products traded, wastage from the farm up to the retail level, stock changes and non-food uses of food products. While data on production and trade are available for most countries, it is well known that they are often subject to errors and that there are many gaps in the information reported by countries. As regards the information on stocks and non-food utilization, comprehensive and regular statistics are not normally available and there is therefore a need to rely on estimates based on fragmentary data or assumptions.

The population estimates used as the denominator of the ratio are based on the global series prepared and updated biannually by the UN Population Division. The basic data underlying these assessments are from the national population censuses and surveys. Although most of the developing countries have carried out censuses, these invariably suffer from errors of under- or overestimation. The UN Population Division

[6] See the section Statistical database, p. 128, Appendix 3.

undertakes a significant amount of evaluation and adjustment of the basic data in deriving the series of estimates. However, the revisions of estimates for the past periods, carried out by the UN as the series are updated, together with the differences that one notes when the estimates are compared with those reported by countries or other agencies, indicate that they are not necessarily accurate. Further, these global assessments often have to rely on data that reflect the *de jure* rather than the *de facto* situation.

TABLE 12

PERCENTAGE OF POPULATION WITH ENERGY INTAKE BELOW 800 KCAL PER CAPUT/DAY

Per caput DES (kcal/day)	Population below 800 kcal per caput/day (Percentage)
1 600	3.1
1 700	2.0
1 800	1.3

It is therefore evident that the per caput DES estimates resulting from the ratio of total food supply to population are likely to be subject to certain margins of error, particularly where data problems are severe, for example in Africa. Although FAO undertakes consistency checks within the supply utilization framework before arriving at the per caput DES figure, this ensures that the results are within a certain plausible range and does not necessarily guarantee that they reflect the true levels.

The CV of per caput dietary energy intakes. The CV reflects the inequality in the distribution of dietary energy availability or supply. The advantage of using the CV rather than the SD as the measure of inequality lies in the fact that it is not correlated with the mean. This means that it can be estimated independently of the per caput DES.

However, the appropriate data sets for estimating the CV for individuals are not available. The data available at best refer to the distribution of household per caput intakes which provide an approximation of the required measure. Even in this context, the relevant survey data are available for only 18 countries (although these include large countries such as China, India, Brazil, Pakistan and Bangladesh). In view of this, for many countries, it has been necessary to base the estimates on data referring to the distribution of household per caput income or expenditure. The estimation of the CV in these cases entails the use of regression equations, linking variables chosen according to data availability rather than economically meaningful criteria. As a result, their predictive capacity is poor, particularly outside the range of values of the variables used for deriving the equations. For another group of countries, not even income or expenditure distribution data are available, so the CV had to be imputed on the basis of the CV estimated for neighbouring countries with a similar socio-economic situation.

The problem of adopting an unrealistically high or low CV owing to the use of the regression equations has been avoided by keeping the CVs within the acceptable range of 0.20 and 0.35. However, this cannot ensure that the CVs adopted reflect the true levels in the different countries, particularly since the same CV has been applied to all the three periods under study.

The above remarks suggest that an analytically derived intake distribution runs the risk of inadequately reflecting the true distribution, thereby leading to errors of an unknown magnitude and direction in the estimate of the prevalence of food inadequacy for a given country. Needless to say, the greater the extent to which the available data have been extended by assumptions or models to arrive at the required parameters, the greater the likelihood of errors. In some countries the risk of error is likely to be particularly high, for example in Ethiopia, PDR, Somalia, Rwanda and Afghanistan, where civil strife has disrupted not only the normal food availability and distribution system but also the data collection system. These countries generally have a large refugee population living outside their borders, in which case serious problems are faced in arriving at plausible estimates of the total food supply and the size of the population partaking of it (and hence the per caput DES). Therefore, the very low per caput DES levels estimated for these countries need to be interpreted with extreme caution.

Sensitivity of prevalence of food inadequacy estimates to per caput DES and CV

On the assumption that the general application of the log-normal distribution is plausible and that the cutoff point can be taken as a given parameter, the proportion of the population with inadequate access to food is determined by the per caput DES and the CV. Therefore, as there

TABLE 13

PREVALANCE OF FOOD INADEQUACY AT DIFFERENT LEVELS OF PER CAPUT DES AND CV

Per caput DES	CV			
	0.20	0.24	0.29	0.35
(kcal/day)	(Percentage of undernourished)			
1 700[1]	65	64	63	63
2 040	30	34	38	42
2 450	7	12	17	23
2 940	1	2	6	10

[1] It should be noted that, at such low average levels, the percentage of undernourished rises rather than falls with a decline in the CV. This is because the implied aggregate food supply is so low that to achieve less inequality would mean increasing the proportion below the cutoff point.

is more likelihood of errors with the CV than with the per caput DES, it is useful to undertake a sensitivity analysis to assess which of the two is more important in determining the general food inadequacy level. This can be done by examining the extent of the change in the proportion of population with inadequate access to food, resulting from a proportional change in each of the two measures taken in turn.

The cutoff point is assumed to correspond to 1 800 kcal per caput/day and the per caput DES and CV are given initial values of 1 700 kcal per caput/day and 0.20, respectively. Both of these are then successively increased by 20 percent in three steps to arrive at the levels of 2 940 kcal per caput/day and 0.35. This produces 16 combinations of per caput DES and CV levels, according to which the resulting prevalence of food inadequacy is given in Table 13. The changes in the percentage of undernourished as the CV is successively increased by 20 percent are indicated in the rows moving towards the right, while the changes in the percentage of undernourished as the per caput DES is similarly increased are indicated downwards in the columns. Thus, the absolute change in percentage along the rows indicates the sensitivity to the CV at a given per caput DES level while the change down the columns indicates the sensitivity to the per caput DES at a given CV level.

It can be seen that, when the per caput DES is low and close to the cutoff point, the percentage is not only at its highest levels but it is also practically insensitive to changes in the CV. Sensitivity to the CV tends to increase gradually as the per caput DES moves above the cutoff point. In the present analysis, which assumes a cutoff point of 1 800 kcal per caput/day, it appears to reach a maximum when the per caput DES level of about 2 500 kcal per caput/day is reached. However, even at this maximum point, the absolute change in the percentage resulting from a change in the per caput DES is more than that resulting from a proportionate change in the CV. In other words, sensitivity to the per caput DES is greater than it is to the CV, even when the effect of the latter is at its maximum.

Given a cutoff point, therefore, the most important determining factor in the general level of food inadequacy is the per caput DES. This means that the expectation of greater errors in the CV compared with the per caput DES is not of great concern. Nevertheless, because of the caveats mentioned, the resulting estimates of the prevalence of food inadequacy need to be interpreted with caution, particularly at the country level. For this reason, the present survey focuses on broad levels and trends only. The basic intention is to provide indications of the broad magnitudes of the food inadequacy problem in different parts of the developing world by piecing together all the data available on food consumption at the country level, however incomplete or imprecise they may be.

RESULTS: MAGNITUDE AND TRENDS OF FOOD INADEQUACY IN DEVELOPING COUNTRIES

Interpretation of the estimates

When interpreting the estimates of food inadequacy presented below, two points should be borne in mind. First, for reasons discussed in the Introduction, the terms "inadequate food intake" and "inadequate access to food" cannot be equated with undernutrition as tends to be done in popular discussions. Even leaving aside the problem of measurement errors, for conceptual and methodological reasons alone the estimates of food inadequacy presented here must be seen as an approximation of the true extent of undernutrition. This caveat should be remembered if, by deferring to convention, the following estimates are used to refer to undernutrition. Second, as it is presented here, the prevalence of food inadequacy refers to the situation prevailing on the average over a relatively long period. This is because the estimates are based on "habitual" food intake defined as the average intake over a three-year period. Over shorter time spans (e.g. a month, a season, or even a year) the actual prevalence may well deviate from these estimates.

Developing countries as a whole and by region

During the two decades from 1969-71, the prevalence of food inadequacy declined in the developing countries as a whole: 20 percent of their total population had inadequate access to food in 1990-92 compared with 35 percent only two decades ago (Table 14). Even more remarkably, there was also an improvement in absolute terms, i.e. fewer people had inadequate access to food in 1990-92 compared with 20 years ago, notwithstanding the population increase of about 1.5 billion in the developing countries during this time. As shown in Table 14, the number of people with inadequate access to food declined from 918 million in 1969-71 to 906 million in 1979-81 and further to 841 million in 1990-92. Nevertheless, the number was still very high in 1990-92, as one out of five people in the developing countries had inadequate access to food.

A more disaggregated analysis shows that the overall improvement for the developing countries as a whole masks very different regional trends (Figure 4). During the last decade, the proportion of the population with inadequate food either remained unchanged or increased in sub-Saharan Africa, the Near East and North Africa and Latin America and the Caribbean. Of these regions, sub-Saharan Africa had the worst experience, as the proportion of the population as well as the absolute number of people with inadequate access to food increased over both decades. The proportion increased from 38 percent in 1969-71

TABLE 14

PREVALENCE OF FOOD INADEQUACY IN DEVELOPING REGIONS, 1969-71, 1979-81 AND 1990-92

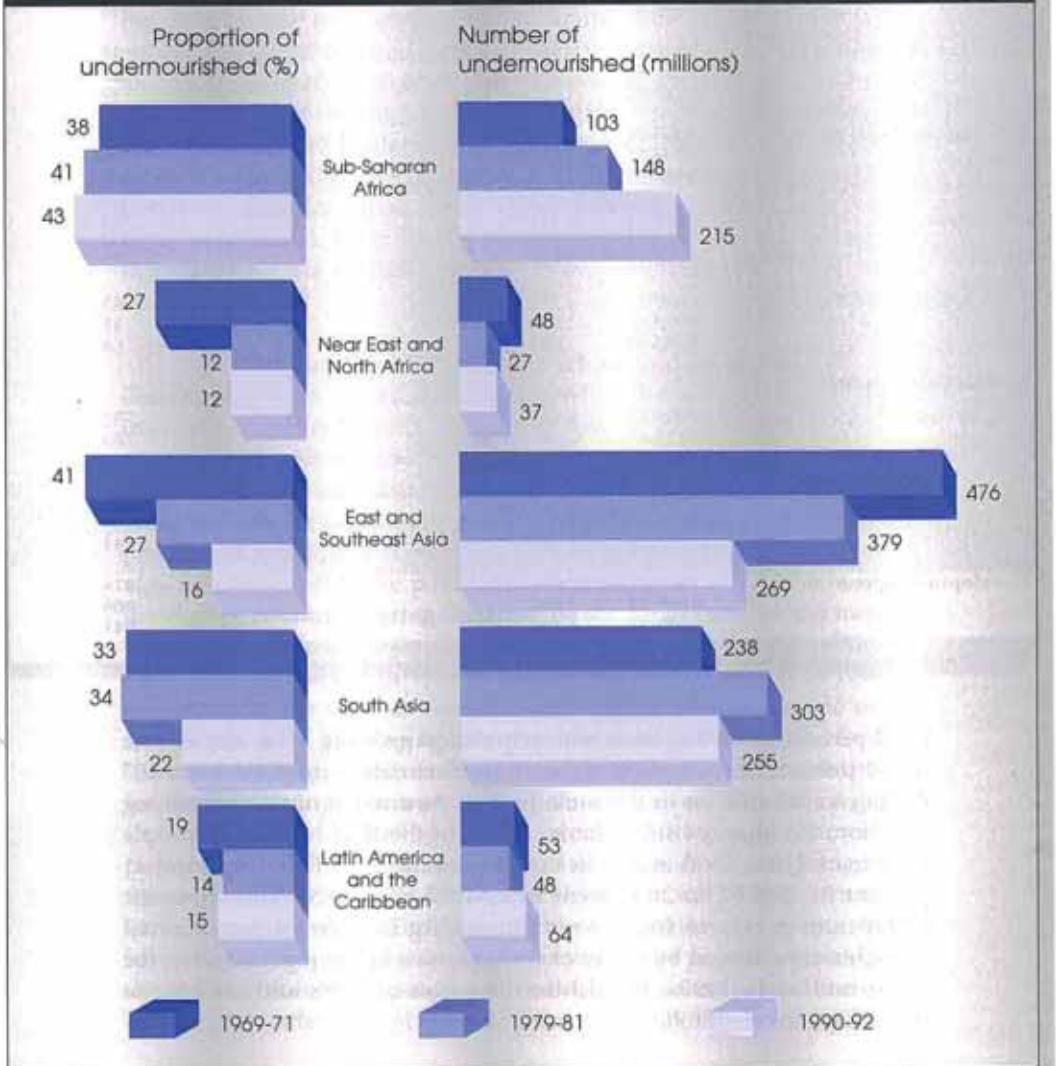
Region/economic group	Period	Total population	Proportion undernourished	Number undernourished
		(Millions)	*(Percentage)*	*(Millions)*
REGION				
Sub-Saharan Africa	1969-71	270	38	103
	1979-81	359	41	148
	1990-92	501	43	215
Near East and North Africa	1969-71	180	27	48
	1979-81	236	12	27
	1990-92	323	12	37
East and Southeast Asia	1969-71	1 166	41	476
	1979-81	1 417	27	379
	1990-92	1 694	16	269
South Asia	1969-71	711	33	238
	1979-81	892	34	303
	1990-92	1 138	22	255
Latin America and the Caribbean	1969-71	279	19	53
	1979-81	354	14	48
	1990-92	443	15	64
ECONOMIC GROUP				
Low-income	1969-71	1 934	39	752
	1979-81	2 397	33	783
	1990-92	3 000	23	696
Middle- to high-income	1969-71	674	25	166
	1979-81	863	14	123
	1990-92	1 104	13	144
Developing regions	**1969-71**	**2 608**	**35**	**918**
	1979-81	**3 260**	**28**	**906**
	1990-92	**4 104**	**20**	**841**

to 43 percent in 1990-92 and, with population growing at an annual rate of 2.9 percent, the absolute number approximately doubled from 103 million to 215 million in the same period. As a result of this worsening situation, the share of sub-Saharan Africa in the total number of people with inadequate food access in the developing world shot up from 11 percent in 1969-71 to 26 percent in 1990-92 (Figure 5). This dramatic collapse in access to food is not surprising in view of the unusual droughts experienced by many of the countries in the region during the 1980s and early 1990s. In addition, a series of wars and civil strife inevitably took their toll.

In the Near East and North Africa and in the Latin American and Caribbean countries, the proportion of people with inadequate access to food remained fairly stable but the absolute number increased, from 27 million in 1979-81 to 37 million in 1990-92 in the Near East and North Africa and from 48 million to 64 million in Latin America and the

FIGURE 4

TRENDS IN NUMBER AND PROPORTION OF UNDERNOURISHED BY DEVELOPING REGION



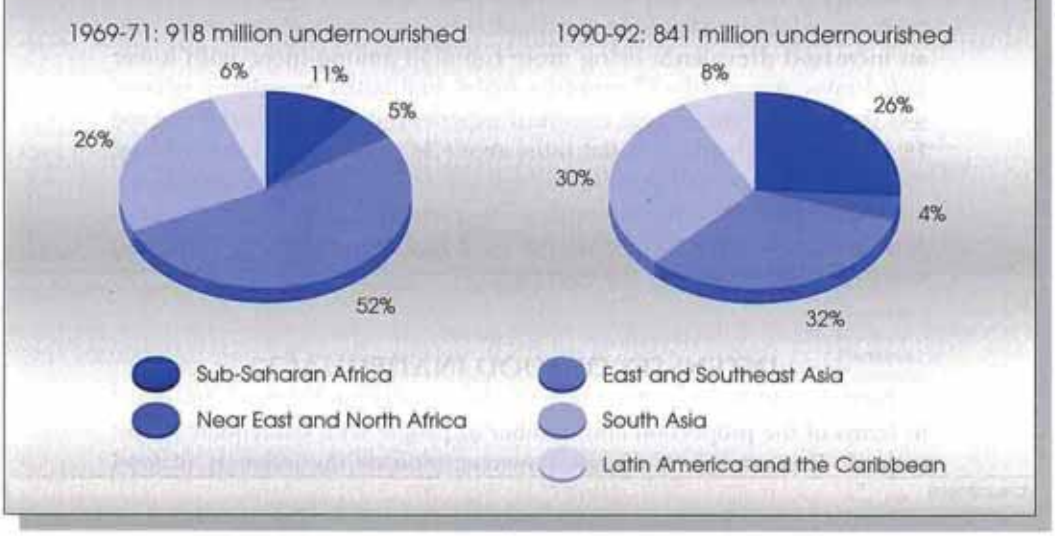
Caribbean. In South Asia, the proportion remained more or less constant in the 1970s and then declined in the 1980s but, because of the region's large population and high rate of population growth, the absolute number of people with inadequate food did not decline significantly after 1969-71.

In sharp contrast with all other regions, East and Southeast Asia experienced a continued improvement over the 20-year period. The proportion of the population with inadequate access to food dropped from 41 percent in 1969-71 to 27 percent in 1979-81 and further to only 16 percent in 1990-92. Even more remarkably, despite continued population growth, the absolute number of people with inadequate access to food also declined from 476 million in 1969-71 to 269 million in 1990-92. However, because of its large population, this region still accounts for the highest share of people facing food inadequacy in the developing world, although its share has declined over time from just over half in 1969-71 to about one-third in 1990-92.

Among the economic groups of countries, the proportion of the population with inadequate food access declined for all groups but was still as high as 23 percent in low-income countries in 1990-92 compared with 13 percent in middle- to high-income countries. The low-income countries account for about 83 percent of all people with inadequate access to food in the developing countries.

FIGURE 5

DISTRIBUTION OF UNDERNOURISHED BY DEVELOPING REGION, 1969-71 AND 1990-92



An overview of country trends

While regional trends are informative, it is necessary to disaggregate further since substantial differences often exist even among countries within the same region. An overview of country-level experience is presented in Table 15, in which the countries are classified by three different criteria: there is the usual division between low-income and middle- to high-income countries and, within each of these two broad groups, countries are then classified according to the prevalence of food inadequacy (as measured by the proportion of undernourished population) in 1969-71. Countries in each inadequacy group are then classified according to whether the prevalence of inadequacy declined, remained stable or increased over the two decades from 1969-71 to 1990-92.

As may be seen from Table 15, among the 98 developing countries covered by the present survey, between 1969-71 and 1990-92 the prevalence of food inadequacy increased in 39 countries (28 low-income and 11 middle- to high-income countries). Thus, beneath the overall improvement in access to food in the developing world there remains the disconcerting fact that the situation actually worsened in 40 percent of the countries; in the low-income group the situation worsened in well over half the countries. Since this deterioration would be of less significance if a country had a low prevalence of food inadequacy to begin with, it is necessary to distinguish between countries with different initial levels of food inadequacy.

Considering the low-income countries first, during the two decades starting from 1969-71, the increased prevalence of food inadequacy was somewhat more evident among those countries which had a relatively low prevalence to begin with. Thus, the prevalence rates increased in two-thirds of the countries which had initial rates of less than 45 percent and in one-third of the countries which had rates above 45 percent. A similar tendency is observed among the middle- to high-income countries, with an increased prevalence being more common among those with lower initial rates. Among the 32 countries which had initial prevalence rates of less than 30 percent, almost one-third experienced increases while, of the 18 countries which had initial rates above 45 percent, only one did so. Thus, in both low- and middle- to high-income countries, the prevalence of food inadequacy increased more among countries with low initial rates and declined more among countries with higher initial rates, indicating some convergence among the countries.

INTENSITY OF FOOD INADEQUACY

So far the problem of food inadequacy in a population has been discussed in terms of the proportion and number of people with inadequate access to food. These numbers do not, however, indicate the intensity of food

TABLE 15

LEVEL AND APPARENT TREND IN PREVALENCE OF FOOD INADEQUACY[1] IN 98 DEVELOPING COUNTRIES, 1969-71 TO 1990-92

Prevalence of food inadequacy in 1969-71 (Percentage)	Trend in prevalence of food inadequacy, 1969-71 to 1990-92		
	Declined	Stable	Increased
Low-income countries (48)			
Less than 15 (1)	–	–	(1) Cambodia
15-30 (16)	(5) Côte d'Ivoire Egypt Honduras Laos Pakistan	–	(11) Bangladesh Central African Rep. Guyana Madagascar Malawi Mongolia Nicaragua Nigeria Sri Lanka Uganda Viet Nam
30-45 (20)	(7) Benin Gambia Guinea India Mali Myanmar Nepal	(1) Togo	(12) Afghanistan Burundi Chad Ghana Kenya Liberia Rwanda Sierra Leone Sudan Zaire Zambia Zimbabwe
45-55 (6)	(5) China Lesotho Mauritania Niger Yemen	–	(1) Mozambique
More than 55 (5)	(2) Burkina Faso United Rep. of Tanzania	–	(3) Ethiopia, PDR Haiti Somalia
Middle- to high-income countries (50)			
Less than 15 (13)	(7) Brazil Hong Kong Jordan Korea, Rep. Malaysia Trinidad and Tobago Turkey	(1) United Arab Emirates	(5) Argentina Kuwait Panama Paraguay Uruguay

(continued)

(continued)

TABLE 15

LEVEL AND APPARENT TREND IN PREVALENCE OF FOOD INADEQUACY[1] IN 98 DEVELOPING COUNTRIES, 1969-71 TO 1990-92

Prevalence of food inadequacy in 1969-71	Trend in prevalence of food inadequacy, 1969-71 to 1990-92		
(Percentage)	**Declined**	**Stable**	**Increased**
15-30 (19)	(13) Costa Rica Cuba Korea, Dem. People's Rep. Lebanon Libyan Arab Jam. Mexico Morocco Papua New Guinea Swaziland Syrian Arab Rep. Thailand Tunisia Venezuela	(1) Iraq	(5) Cameroon Chile Jamaica Peru Senegal
30-45 (14)	(13) Bolivia Botswana Colombia Congo Dominican Rep. Ecuador Gabon Guatemala Indonesia Iran, Islamic Rep. Mauritius Namibia Suriname	–	(1) Angola
45-55 (4)	(4) Algeria El Salvador Philippines Saudi Arabia	–	–
More than 55 (0)	–	–	–

[1] Proportion of population with inadequate access to food.
Note: Figures in parentheses refer to the number of countries.

inadequacy, i.e. they do not indicate to what degree the food available is inadequate. In order to capture this aspect, it is necessary to consider the gap or the distance between actual food availability and a required or target level. There are several ways in which this gap can be conceptualized: one is to consider the gap in relation to the underfed,

comparing the actual per caput food consumption of the underfed people with a normative level. Another approach is to consider the gap in relation to the population as a whole and thus compare the actual per caput food supply of a country with the per caput supply level that would ensure a minimum prevalence of food inadequacy in the population.

A word of caution is in order regarding the interpretation of the estimates. Whether considering the food deficit on the basis of the underfed only or on that of the population as a whole, the elimination of these deficits will not necessarily suffice to ensure adequate access to food for everyone at some point in the *future*. Following are the main reasons why:

- The assessment of food inadequacy is based on estimates of energy requirements that refer to the prevailing age-sex distribution of the population concerned. As these distributions change over time, aggregate requirements will also change and so will the magnitude of food deficit to be eliminated.
- As the world adopts measures to improve conditions of health care and hygiene, future populations are likely to have higher statures and correspondingly higher body weights compared with present populations. Therefore, as the energy requirements used in the prevalence estimates are based on ideal body weights corresponding to the heights of the present population, the food deficits, as measured here, may not reflect future deficits.
- The deficits are expressed on a per caput basis, so the expected growth in population is not taken into account.

Consequently, the estimates of food deficit, or the implied "required" per caput food supply level presented here cannot be taken to indicate the full magnitude of the task that confronts the world if it is to solve the problem of inadequate access to food. Rather, they should be seen as an indicator of the task that remains on the food front under the *ceteris paribus* assumption that all other factors, including population and its age-sex distribution and the conditions of health care and hygiene, remain unchanged.

Intensity of food inadequacy expressed as food deficit of the undernourished

When setting a normative level for calculating the food deficit in terms of the population with inadequate food access, the following points should be taken into consideration. It has been argued in this report that, for identifying individuals who have inadequate access to food, the cutoff point should be set at the lower end of the range of food requirements.

However, when choosing a normative level at which an individual's intake ought to be, this minimum requirement standard does not apply. Once people are free from the problem of food inadequacy, they are likely to choose different intake levels according to their needs within the whole range of variation in requirements. In this case, the average intake of these people will be roughly equal to the average requirement. (Some may of course decide to have an intake level above their own requirements, thus allowing themselves to become obese, but this cannot be a valid consideration while choosing a normative target.) Thus, the concept of freedom from food inadequacy points to the fact that the normative level should be set equal to the average requirement level.

Accordingly, the intensity of food inadequacy is based here on the difference between the actual per caput intake of the underfed and the average per caput requirement of the population. The average per caput energy requirements calculated for this purpose are based on body weights for adults and adolescents corresponding to a BMI of 22.0 (which is the average level of BMI observed among healthy, active people) and on activity allowances corresponding to the moderate activity norms of 1.78 x BMR (1.78 BMR) for males and 1.64 BMR for females. As regards children, the 5 percent extra allowance for desirable activity, which was previously excluded to calculate a minimum requirement, has been included for the present purpose.

The difference between the average requirement and the average intake of people with inadequate access to food is called quite simply the average food deficit of the undernourished. This difference multiplied by the number of people with inadequate food gives an estimate of the total food deficit. The total deficit expressed as a percentage of the DES is referred to as the *relative inadequacy* of the current food supply.

The average per caput energy consumption level of inadequately fed people and the calculated average per caput energy requirement for the different developing regions are given in Table 16.

The relative food inadequacy of the 98 developing countries considered in this study (see Table 17) declined by almost one-half in the 20 years since 1969-71. This is clearly a sign of progress, but the experience was not uniformly positive in all regions. In 1969-71, East and Southeast Asia had the largest relative food inadequacy level among all developing regions, followed by sub-Saharan Africa and South Asia. By 1990, the ranking had changed among these three regions, with sub-Saharan Africa not only emerging with the largest relative food inadequacy level but actually witnessing a rise contrary to the overall declining trend. There was also a slight increase in the 1980s in Latin America and the Caribbean although the relative inadequacy of food in this region was much lower than in sub-Saharan Africa.

TABLE 16

AVERAGE PER CAPUT ENERGY CONSUMPTION OF UNDERNOURISHED POPULATION COMPARED WITH MINIMUM AND AVERAGE PER CAPUT ENERGY REQUIREMENTS

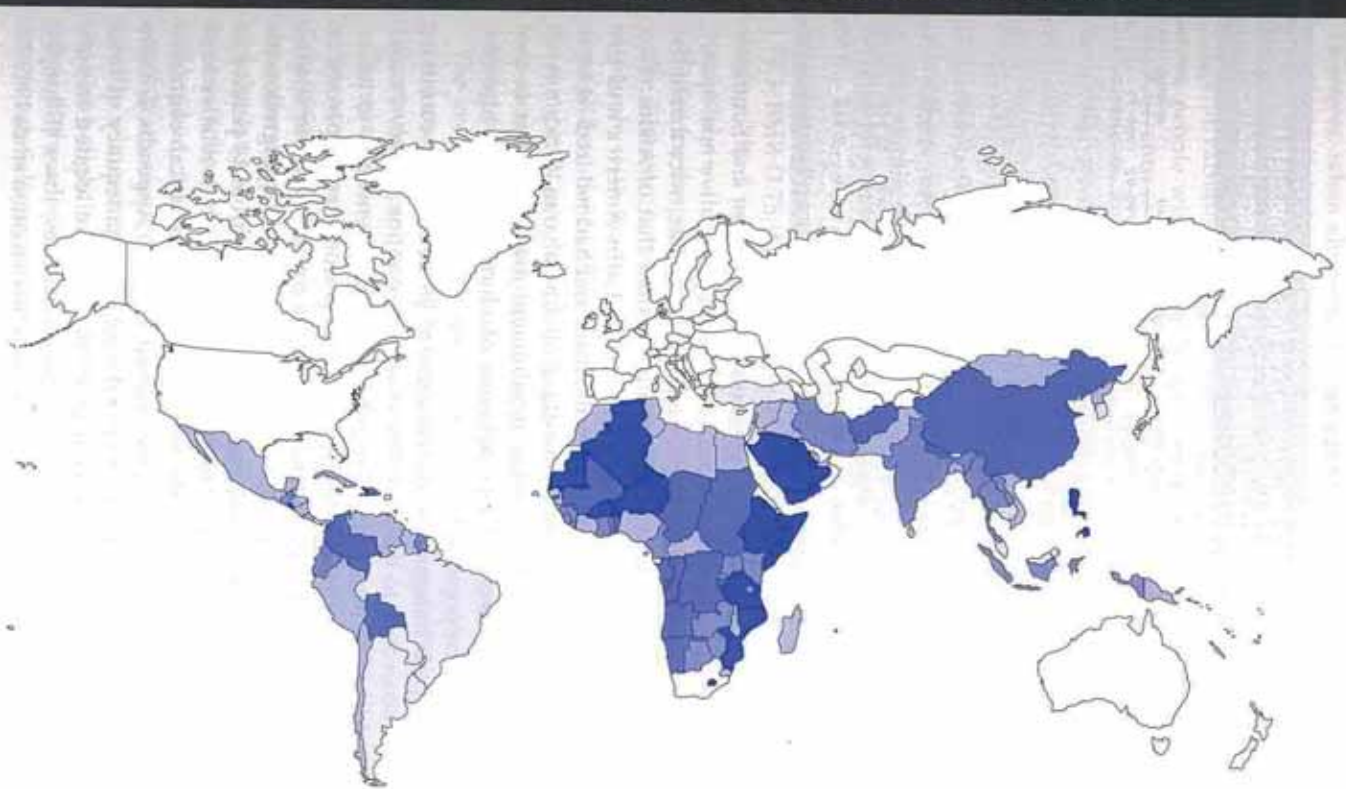
Region	Average per caput energy consumption of undernourished population			Minimum per caput energy requirement			Average per caput energy requirement		
	1969-71	1979-81	1990-92	1969-71	1979-81	1990-92	1969-71	1979-81	1990-92
	(kcal/day)								
Sub-Saharan Africa	1 490	1 480	1 470	1 810	1 810	1 800	2 110	2 100	2 100
Near East and North Africa	1 570	1 630	1 640	1 830	1 840	1 840	2 130	2 150	2 150
East and Southeast Asia	1 520	1 610	1 660	1 820	1 870	1 880	2 130	2 200	2 220
South Asia	1 530	1 540	1 580	1 770	1 780	1 790	2 070	2 090	2 110
Latin America and the Caribbean	1 610	1 650	1 660	1 830	1 850	1 870	2 140	2 170	2 200
Developing regions	**1 530**	**1 580**	**1 610**	**1 810**	**1 830**	**1 840**	**2 110**	**2 150**	**2 170**

It is remarkable how much progress was made by East and Southeast Asia. At the beginning of the two-decade period, its relative inadequacy was three times that of Latin America and the Caribbean, twice that of the Near East and North Africa and even more than that of Africa. Two decades later, it had almost caught up with Latin America and the Caribbean and the Near East and North Africa and had reduced its level of relative inadequacy to about one-third of sub-Saharan Africa's level – despite the fact that the average requirement rose the fastest in this region over the two decades because of changes in the age-sex composition of the population.

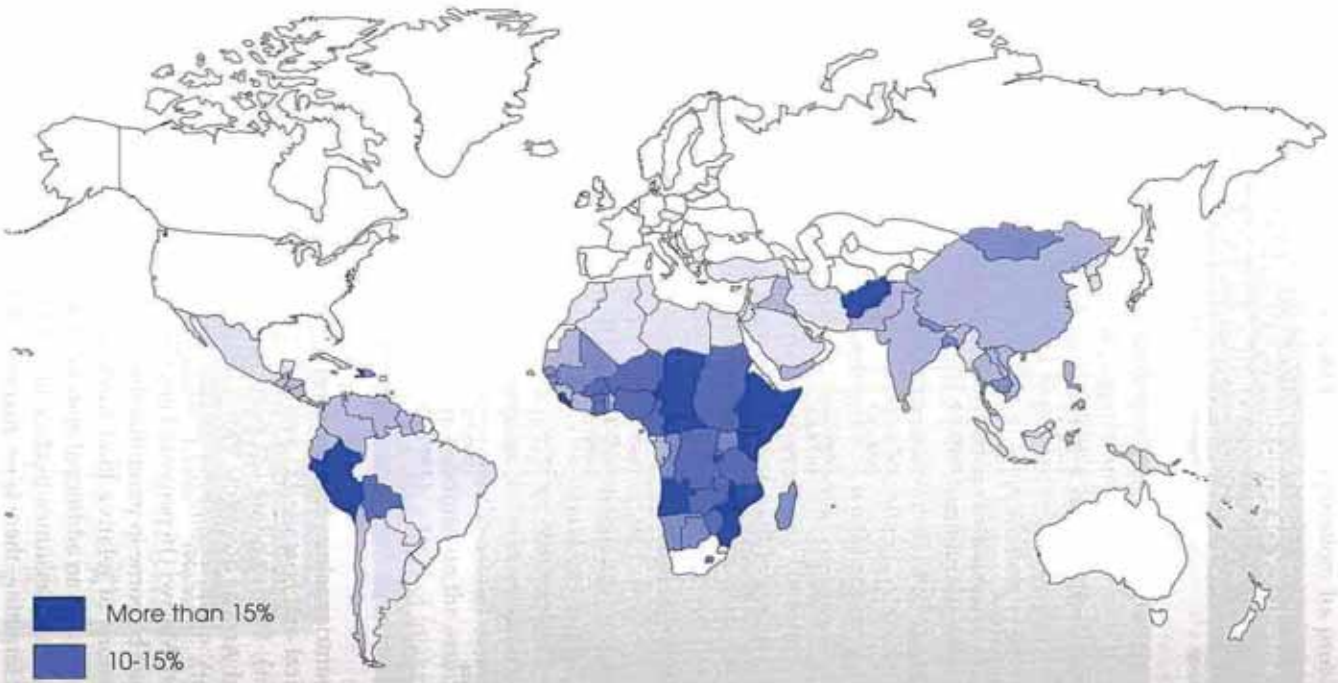
Table 18 (p. 57) shows the distribution of 98 developing countries classified according to their relative inadequacy ratios in 1969-71 and 1990-92. Although a number of countries shifted downwards to lower percentages, the number of countries with high percentages (10 percent or more) remained almost unchanged. Among the countries whose relative food deficit had been declining, China made considerable progress, with a reduction in the relative inadequacy of food supply from 14 percent in 1969-71 to about 4 percent in 1990-92. India also cut down its relative food inadequacy by almost half. In the Near East and North African countries, the relative inadequacy level almost reached zero (see Appendix 2, Table 7). Among the 14 countries in which the relative inadequacy of food supply was more than 15 percent in 1990-92, 11 are located in sub-Saharan Africa. Furthermore, among these countries, three (Ethiopia, PDR, Mozambique and Somalia) have been in this situation since 1969-71.

FIGURE 6

RELATIVE INADEQUACY OF FOOD SUPPLY IN 98 DEVELOPING COUNTRIES, 1969-71 AND 1990-92



1990-92



The food deficit situation has improved over the last 20 years, with particularly rapid declines in parts of Asia and the Near East and North Africa. However, critical food deficit persists in many parts of sub-Saharan Africa.

TABLE 17

RELATIVE INADEQUACY OF FOOD SUPPLY BY DEVELOPING REGION, 1969-71, 1979-81 AND 1990-92

Region/economic group	Period	Per caput DES (kcal/day)	Relative inadequacy of food supply (Percentage)
REGION			
Sub-Saharan Africa	1969-71	2 140	11
	1979-81	2 080	13
	1990-92	2 040	14
Near East and North Africa	1969-71	2 380	6
	1979-81	2 850	2
	1990-92	2 950	2
East and Southeast Asia	1969-71	2 060	12
	1979-81	2 370	7
	1990-92	2 680	3
South Asia	1969-71	2 060	9
	1979-81	2 070	9
	1990-92	2 290	5
Latin America and the Caribbean	1969-71	2 510	4
	1979-81	2 720	3
	1990-92	2 740	5
ECONOMIC GROUP			
Low-income	1969-71	2 060	11
	1979-81	2 210	9
	1990-92	2 430	6
Middle- to high-income	1969-71	2 360	6
	1979-81	2 670	3
	1990-92	2 760	3
Developing regions	**1969-71**	**2 140**	**10**
	1979-81	**2 330**	**7**
	1990-92	**2 520**	**5**

The countries where food inadequacy in 1990-92 could be characterized as critical are: Somalia (35 percent), Afghanistan (34 percent), Haiti (32 percent), Mozambique (29 percent), Ethiopia, PDR (28 percent), the Central African Republic (26 percent), Chad (25 percent), Liberia (23 percent), Sierra Leone (20 percent), Angola (20 percent), Burundi (18 percent), Malawi (16 percent), Peru (16 percent) and Kenya (15 percent).

It must be borne in mind that the absolute deficit underlying the above calculations of relative food inadequacy assumes that each underfed person obtains an additional amount of food equivalent to his or her own deficit, i.e. it assumes perfect targeting. However, in the absence of perfect targeting, there is no guarantee that the extra amount of food will

be obtained by the underfed segment of the population. Its problem of food access is rooted in poverty and unequal distribution which would not be solved simply by making available on the market the amount of extra food calculated by this approach. In view of this, the following approach is considered.

Intensity of food inadequacy expressed as food deficit of the total population

The food deficit of the population is defined here as the amount of additional food that would be needed in the aggregate to ensure that the present prevalence of food inadequacy in a population is practically eliminated (once again, under the *ceteris paribus* assumption). This total deficit would coincide with the relative food inadequacy only if it is assumed that all people with inadequate food access obtain extra food according to their respective requirement levels while the consumption of the rest of the population remains unchanged. It would not be realistic to expect such perfect targeting and the consequential compression of the intake distribution that this assumption implies. Therefore, when considering the elimination of the prevalence of food inadequacy in the population, it is necessary to make explicit assumptions about the intake distribution. To the extent that the assumption made about the intake distribution is deemed realistic, this procedure provides a better measure of the intensity of food inadequacy.

One extreme assumption could be that the inequality in the intake distribution is the same as the present one. This would be consistent with the *ceteris paribus* assumption but there is a serious obstacle to overcome in adopting this procedure. In many countries, the average consumption of the inadequately fed population is so low and the overall distribution so unequal that, if the required food supply is defined on the assumption of unchanged inequality, it would imply too high a level of intake at the

TABLE 18

DISTRIBUTION OF 98 DEVELOPING COUNTRIES CLASSIFIED ACCORDING TO THEIR RELATIVE INADEQUACY RATIOS, 1969-71 AND 1990-92

Relative inadequacy of food supply	1969-71	1990-92
(Percentage)	*(Number of countries)*	
Less than 3	14	28
3-7	31	29
7-10	22	14
10-15	17	13
More than 15	14	14
	98	98

upper end of the distribution (too high in the sense that it may be physiologically impossible to consume that amount of food, implying socially undesirable wastage, and that there would be a widespread problem of obesity if the more privileged were indeed to consume so much). A purely economic problem may also arise where there is no feasible price at which the more privileged, who are already close to the saturation point, will be induced to consume so much food. This means that, for the incremental food supply to be demanded at a feasible price, the distribution must be more even so the less privileged can gain additional purchasing power to generate the necessary demand. All these considerations suggest that, unless the average intake of a country is already quite high and the prevalence of food inadequacy relatively mild, it will not make sense to assume an unchanged distribution pattern.

To assess the per caput DES required to eliminate the prevalence of food inadequacy, it has to be assumed in general that the distribution contains less inequality than is actually the case. The degree of inequality in the distribution has been set at the minimum feasible level with a view to providing a lower limit estimate of the required food supply. If a higher degree of inequality is assumed, the required per caput food supply will be correspondingly higher.

Recent studies suggest that the CV of food consumption within a given population does not usually fall below 0.20, so this has been taken as the minimum feasible degree of inequality. Furthermore, elimination of the prevalence of food inadequacy has been taken to mean, in practical terms, a reduction of the prevalence of food inadequacy to 2.5 percent of the total population. The exact procedure of calculating the per caput DES on the basis of these assumptions is given in Appendix 3. The first step is to estimate the required per caput DES level for each country; that is, the per caput food supply level that would eliminate the prevalence of food inadequacy under the assumptions explained above. The difference between this required level and the actual per caput DES level gives the food deficit of the population.

Apart from calculating the required per caput DES level, an attempt was made in this survey to assess how far redistribution alone can tackle food inadequacy. A calculation was made of the prevalence of food inadequacy that would result from keeping the per caput DES at the present level while assuming a reduction of the CV to the level of 0.20. Depending on the scope for reducing the prevalence of food inadequacy through purely redistributive measures, countries are classified into four categories (Table 19) and the required per caput DES levels are then presented separately for each category (Table 20). This categorization allows cases in which redistribution can play a major role in eliminating

food inadequacy to be distinguished from those in which an increase in the per caput DES must play a predominant role, and these cases, in turn, to be distinguished from those where there must be both an increase in per caput DES and redistribution. This point becomes clear from the following description of the four categories.

Category 1. The calculated prevalence of food inadequacy shows a rise rather than a decline from the currently assessed level. This indicates that the actual per caput DES levels in these countries are so low that some further growth is essential before redistribution measures can have a positive effect.

Category 2. The calculated prevalence of food inadequacy shows a decrease but this is less than half the currently assessed level. This indicates that the actual per caput DES levels in these countries are sufficiently high for redistribution to have a positive effect but not sufficiently high for redistribution to play a primary role.

Category 3. The calculated prevalence of food inadequacy shows a decrease by an amount equal to more than half the currently assessed level. This indicates that the actual per caput DES levels in these countries are sufficiently high to warrant a primary focus on redistribution measures.

Category 4. The decrease in the prevalence of food inadequacy is such that the new estimate is close to or lower than the target level of 2.5 percent of the total population. This indicates that the actual per caput DES levels are sufficiently high for redistribution to have a positive effect in eliminating the prevalence of food inadequacy without necessarily requiring further growth in the average consumption level.

The following salient points emerge from Table 20:

- The per caput DES levels required to eliminate the prevalence of food inadequacy are fairly close for all four country categories and average about 2 770 kcal/day. The small variations are explained by the differences in the stature and age-sex composition of the population adopted for calculating the minimum per caput energy requirement for the different countries.
- Moving from Category 1 to Category 4, the ratio of the required to the actual per caput DES levels declines consistently. This demonstrates the increasing role that redistribution can play as the per caput DES reaches higher levels.

TABLE 19

CLASSIFICATION OF 98 DEVELOPING COUNTRIES INTO FOUR CATEGORIES BASED ON ROLES OF PER CAPUT DES GROWTH AND REDISTRIBUTION IN ELIMINATING FOOD INADEQUACY

Category 1

Afghanistan
Central African Rep.
Chad
Ethiopia, PDR
Haiti
Mozambique
Somalia

Category 2

Angola
Bangladesh
Bolivia
Burkina Faso
Burundi
Cambodia
Cameroon
Congo
Dominican Rep.
Ghana
Guyana
India
Iraq
Kenya
Kuwait
Laos
Lesotho
Liberia
Madagascar
Malawi
Mali
Mongolia
Namibia
Nepal
Nicaragua
Niger
Nigeria
Pakistan
Panama
Peru
Philippines
Rwanda
Sierra Leone
Sri Lanka
Sudan
Trinidad and Tobago
United Rep. of Tanzania
Uruguay
Viet Nam
Zaire
Zambia
Zimbabwe

Category 3

Benin
Botswana
Brazil
Chile
China
Colombia
Côte d'Ivoire
Ecuador
El Salvador
Gabon
Gambia
Guatemala
Guinea
Honduras
Jamaica
Mauritania
Mauritius
Myanmar
Papua New Guinea
Senegal
Suriname
Swaziland
Thailand
Togo
Uganda
Venezuela
Yemen

Category 4

Algeria
Argentina
Costa Rica
Cuba
Egypt
Hong Kong
Indonesia
Iran, Islamic Rep.
Jordan
Korea, Dem. People's Rep.
Korea, Rep.
Lebanon
Libyan Arab Jam.
Malaysia
Mexico
Morocco
Paraguay
Saudi Arabia
Syrian Arab Rep.
Tunisia
Turkey
United Arab Emirates

TABLE 20

COMPARISON OF ACTUAL AND REQUIRED LEVELS OF PER CAPUT DES, 1990-92

Country category	No. of countries in category	Actual per caput DES (kcal/day)	Required per caput DES (kcal/day)	Ratio of required to actual per caput DES
1	7	1 660	2 730	1.6
2	42	2 240	2 700	1.2
3	27	2 680	2 860	1.1
4	22	3 000	2 780	0.9

- There are 22 countries (Category 4) where the present per caput DES levels are nearly as high or higher than the required levels, meaning their prevalence of food inadequacy could practically be eliminated through redistribution measures without any further increase in the per caput DES. However, for the large majority of countries (Categories 1, 2 and 3), an increase in per caput food supply will be needed in combination with redistribution measures. For the seven countries in Category 1, an increase in per caput DES levels is essential before redistribution can be effective.