# 1st Report on the World Nutrition Situation

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A report compiled from information available to the United Nations agencies of the ACC/SCN

**UNITED NATIONS** **NATIONS UNIES**

ADMINISTRATIVE COMMITTEE ON COORDINATION − SUBCOMMITTEE ON NUTRITION

**November 1987**



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## UNITED NATIONS − ADMINISTRATIVE COMMITTEE ON COORDINATION − SUB COMMITTEE ON NUTRITION (ACC/SCN)

The ACC/SCN is the focal point for harmonizing the policies and activities in nutrition of the United Nations system. The Administrative Committee on Coordination (ACC), which is comprised of the heads of the UN Agencies, recommended the establishment of the Sub−Committee on Nutrition in 1977, following the World Food Conference (with particular reference to Resolution V on food and nutrition). This was approved by the Economic and Social Council of the UN (ECOSOC). The role of the SCN is to serve as a coordinating mechanism, for exchange of information and technical guidance, and to act dynamically to help the UN respond to nutritional problems.

The UN members of the SCN are: FAO, IBRD, IFAD, ILO, UN, UNDP, UNHCR, UNICEF, UNU, WFC, WFP and WHO. From the outset, representatives of bilateral donor agencies have participated actively in SCN activities. The SCN is assisted by the Advisory Group on Nutrition (AGN), with six to eight experienced individuals drawn from relevant disciplines and with wide geographical representation. The Secretariat is hosted by FAO in Rome.

The SCN undertakes a range of activities to meet its mandate. Annual meetings have representation from the concerned UN agencies, from some 10 to 20 donor agencies, the AGN, as well as invitees on specific topics; these meetings begin with symposia on topics of current importance for policy. The SCN brings certain such matters to the attention of the ACC. The SCN sponsors working groups on inter−sectoral and sector−specific topics. Ten−year programmes to address two major deficiencies, vitamin A and iodine, have been launched.

The SCN compiles and disseminates information on nutrition, reflecting the shared views of the agencies concerned. A regular Report on the World Nutrition Situation is being issued. State−of−the−Art papers are produced to summarize current knowledge on selected topics. Research priorities for solving nutrition problems are proposed in consultation with agencies and researchers in the field. As decided by the Sub−Committee, initiatives are taken to promote coordinated activities − inter−agency programmes, meetings, publications − aimed at reducing malnutrition, primarily in developing countries.

## ACKNOWLEDGEMENTS

The compilation, analysis, and presentation of the data contained in this report involved a large number of people, from the UN agencies, as consultants to the ACC/SCN, from the Advisory Group on Nutrition (AGN), and from the research community.

The first draft of this report was prepared for the 13th Session of the ACC/SCN in March 1987. For this, Ms. G. Rothe and Ms. K. Test (SCN consultants) compiled and analyzed data, in collaboration with staff of FAO and WHO. Ideas for this first draft were provided by D. Casley, B. Edmonston, G. Eele, and J. Haaga. Comments incorporated into the present version were made by members of the AGN, and representatives of FAO, UNICEF, and WHO.

This final version was put together by Ms. K. Test, with analytical advice from Dr. B. Edmonston. Staff of FAO Statistics Division contributed greatly throughout to the food–related statistical analysis and text. Dr. Chen Chung–Ming (AGN) contributed section 2.7 on China. Dr. M. Lotfi (SCN consultant) prepared much of section 3 on micronutrients. J. Gorstein (WHO consultant) supplied additional information on anthropometry. A. Kelly (SCN) did the analysis for the Appendix. G. Thomas gave editorial assistance, O. Bolbol did the graphics, Ms. N. Kelly helped with final presentation, and Ms. W. Idun–Mensah handled the word processing.

The AGN provided initial guidance on concepts, and support throughout.

This final document, as agreed at the SCN 13th Session, was reviewed by representatives from FAO, WHO, and UNICEF; members of the AGN; and Dr. R. Martorell (Stanford University) as consultant.

John B. Mason
Secretary, ACC/SCN

19 November 1987

## FOREWORD

One of the responsibilities assigned to the Sub–Committee on Nutrition of the United Nations Administrative Committee on Coordination (ACC/SCN), when established in 1977, was to regularly review the evolution of global nutrition problems. Responding to this mandate has now become feasible, due to improving availability of data, and to two developments in particular. First, FAO has for many years accumulated and issued the only comprehensive source of data on food availability, yearly for almost all countries, namely the "Food Balance Sheet" data; periodically these and other data are used to define the world food problem, through the series of World Food Surveys. Now the Fifth World Food Survey (FAO, 1987a) has been issued, giving a fundamental point of reference for assessing nutrition problems. Second, the conduct of national surveys of nutritional status, measured by anthropometry, has accelerated in the last decade: a WHO review in 1974 identified only 6 such surveys in the previous ten years; by 1982 more than 20 national surveys had been carried out – many with support from USAID – and by 1987 WHO was able to compile data from nearly 50 national surveys done since 1975, and to produce the results in consistent format (WHO, 1987). Together with the established work of the UN Population Division and the World Bank, the information thus available from member agencies of the SCN has now made it possible to assemble and integrate data describing the world nutrition situation, thereby meeting one of the key objectives originally set for the Sub–Committee on Nutrition.

The Advisory Group on Nutrition of the SCN, which had recommended that a Report on the World Nutrition Situation should be issued on a regular basis, proposed in 1986 indicators and methods relying on standard practice by the concerned UN Agencies. This was agreed by the SCN as a whole at its 12th Session in April 1985. The overall objectives of the report are to provide an agreed basis for raising awareness of malnutrition – its extent, severity and trends – to advocate that increased attention be given to preventing this extensive and serious human problem. The report, through the indicators and their interpretation, should demonstrate the inter–sectoral nature of the problem, and thus the need for concerted and coordinated efforts to tackle it. This should be regularly updated. Finally, this information should then be set against estimates of the flow of available resources for addressing nutrition problems, as a basis for assessing the adequacy and utilization of these.

This First Report on the World Nutrition Situation represents a shared concern of the UN member agencies of the ACC/SCN. It uses data and indicators from throughout the UN system to focus on prevalence of malnutrition and its trends. The document has been reviewed by representatives of FAO, WHO and UNICEF, by members of the Advisory Group on Nutrition, and by independent consultants, as agreed by the SCN 13th Session in March 1987 when a first draft of the report was made available.

Finally, this report should provide the basis for periodically updating our knowledge of trends in the world nutrition situation. At the same time, resource flows relevant to nutrition will now be assessed. Comments and suggestions for additional information in future issues would be welcome, in line with our priority to provide up–to–date information on the global picture of nutrition.

A. Horwitz
Chairman, ACC/SCN

## SUMMARY

This report provides information on trends in nutritional indicators from 1960 to the most recent year available, usually 1985. The data utilized for the estimates are taken from those available to different United Nations agencies (primarily UN Population Division, FAO, WHO, and the World Bank). The report is based on existing data, methods and definitions used by the UN agencies, and aims to provide information on prevalences and trends based primarily on indirect estimates. It is expected that in updating for future reports more emphasis will be given to causal and associated factors.

In most parts of the world, nutrition has improved over the last 25 years (see section 1). Infant and child mortality rates, which summarize many factors, reflect this. However, Sub–Saharan Africa has suffered long–term declining food availability and increased malnutrition; total numbers of infant and child deaths are thought to be still rising, in contrast to most other regions.

The estimates of child nutritional status demonstrate that improvements of the 1970's ceased, on average, in the 1980's. Economic stress, as well as severe drought, have contributed to the overall picture (see Figure 3) of deterioration in Africa, and no significant improvement in South America, the latter contrasting with previous progress. However, proportions of the population estimated as having marginal access to food, referred to for brevity here as "undernourished", are estimated to have fallen in South and South East Asia, Central America and the Near East.

Indicators by groups of countries are shown in panels in section 2. These give trends in population, food production, dietary energy supply, proportions of the population "undernourished" (i.e. estimated to have access to food equivalent to less than 1.2 times basal metabolic rate) and of children malnourished (i.e. of weight–for–age less than 2 standard deviations of reference standards), and infant and child mortality rates. Estimates are also shown in terms of numbers of people affected. The indicators may be contrasted across country groups, by comparing the panels. Selected results – showing for example prevalences of malnutrition reported from clinics in Africa, and changes in food purchasing power in certain Latin America countries – are included.

Trends in the nutrition situation with respect to three of the most common micronutrient deficiencies – vitamin A, iron and iodine – are described in section 3. Of the developing regions, Africa had the highest average availability per caput of vitamin A and iron, but this was falling alarmingly in recent years, and averages hide maldistribution. In contrast, supply of these nutrients has increased rapidly in the Near East. The prevalences and geographical distribution of clinical deficiencies in vitamin A, iron and iodine are summarized in section 3, noting that for all three micro–nutrients mild/moderate deficiencies are becoming recognized as problems with significant consequences for health and welfare. Prevalences of these deficiencies are substantial – for example, about 50% of women of child–bearing age in developing countries are estimated to be anaemic, for which iron deficiency is the commonest cause.

A summary of information on sources of the data used, methods, and definitions is given in the technical notes in section 4. A fuller description will be provided in the Supplement on Methods and Statistics, to be issued in early 1988.

# 1. INTRODUCTION AND OVERVIEW

Hunger and malnutrition[1] cause perhaps the most widespread human suffering in the world today. While hunger cannot be measured directly, the extent and severity of malnutrition are fairly well known in general terms. But changes in the world nutrition situation over time are not so obvious, except when brought to public attention because of famine. Information about trends are needed in order to adequately respond to the problems of hunger and malnutrition. For example, has the proportion of the population affected gone up or down over the last quarter century? Have the numbers of people with inadequate food increased as the population has expanded? How far have recent events, notably economic recession and the drought in Africa in 1983−85, changed underlying trends for the worse?

[1] Definitions are discussed in section 4 and in the Supplement on Methods and Statistics to the First Report on the World Nutrition Situation. A glossary of terms is given at the end of this report.

Firm answers to questions about the extent and trends of nutrition problems are sometimes incomplete and definitions problematic. This is discussed below. But by piecing together data from various sources on related factors, a plausible and consistent view emerges. This report − the first to bring together such data − aims to lay out the current state of knowledge about the nutrition situation in the developing world.

Food production and availability, population growth, economic development and health interact to substantially determine the present world nutrition situation and the direction in which it is heading. FAO's Fifth World Food Survey (1987a, p.v) concluded that while much starvation and malnutrition remained in the world, there is evidence of a turn in the tide. It continues: "...the proportion of the population suffering from undernutrition has declined, even though the absolute numbers of the undernourished have increased..."

Certain striking aspects of global trends in nutrition are illustrated in Figures 1 to 4. Figure 1 plots improvements over the past 20 years in infant mortality rates, which summarize many factors including food availability and health. The middle panel shows that these death rates have fallen rapidly throughout the developing world and by more than half in some countries. This falling incidence is encouraging. But during the same period, population nearly doubled in most regions, resulting in a drop in total numbers of annual infant and child deaths of only 20 percent (lower panel in Fig. 1). This is an average figure for the entire developing world; in fact, the number of infants and pre−school children dying each year in Africa has risen. In the short−term, increasing child survival contributes to population growth, but ultimately, falling infant and child death rates precede falling birth rates.

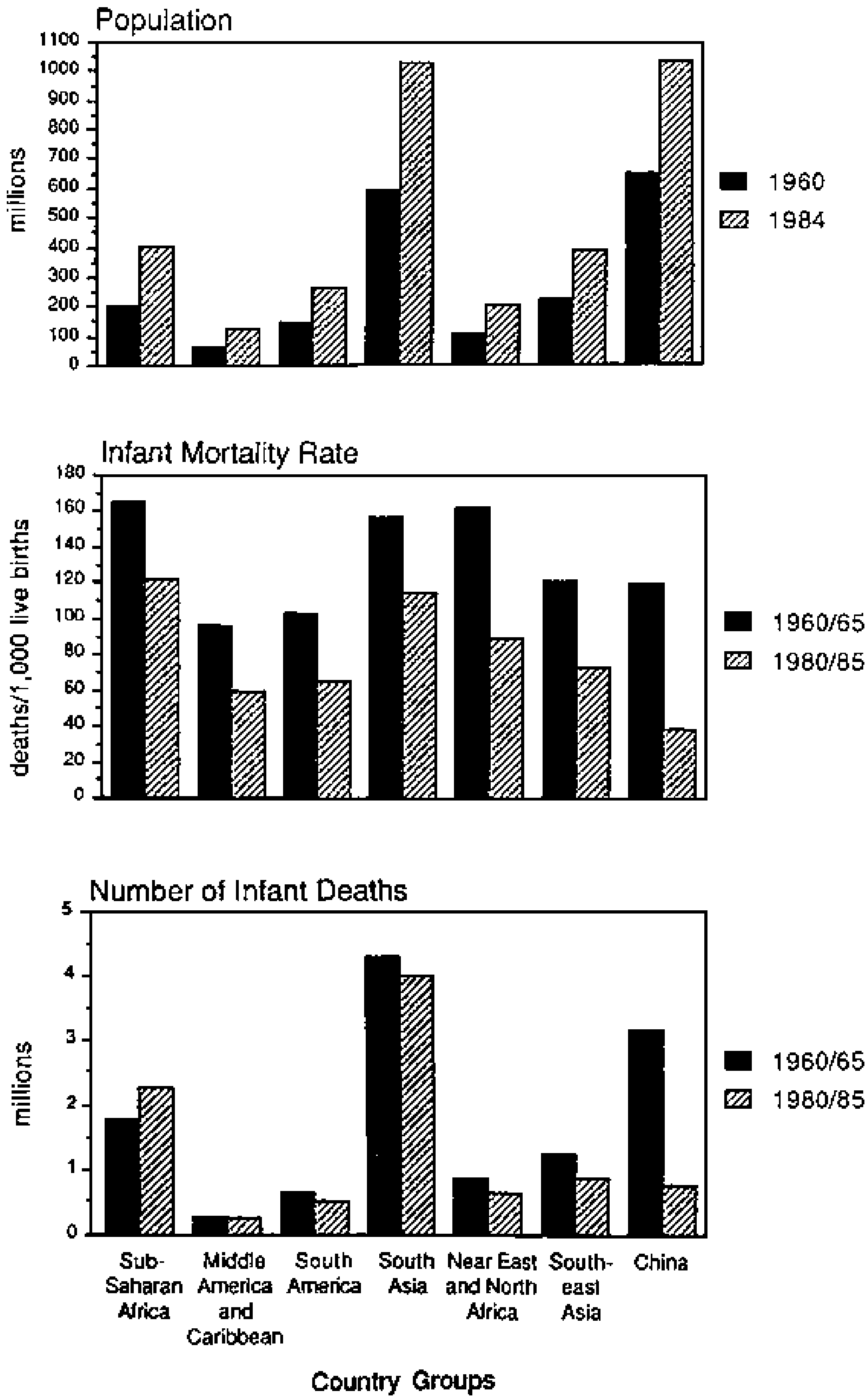



**FIGURE 1:** Changes in Total Population, Infant Mortality Rates, and Number of Infant Deaths Since 1960 by Country Groups.

Much more information on child nutritional status is available now than even 10 years ago. WHO (1987) has compiled results from more than 50 national surveys conducted from 1975, and re–analyzed many of these to give consistent indicators, as used in this report. Averaging these survey results over two to three year periods, and adjusting for regions, gives the results shown in Figure 2[2]. The indications are that prevalences of underweight children declined significantly between 1975/6 and 1979/80, and have been unchanged since then. Improvements in living conditions recorded in many countries during the 1970's have slowed or halted with the severe economic recession of the early 1980's, and this is affecting child nutrition.

[2] The method of calculation is referred to in section 4.3, and discussed in detail in the Supplement on Methods and Statistics. It allows for the fact that the availability of data is uneven for different regions over the different time periods.

Different regions of the world show different trends, and indeed there are variations between countries within regions. The data available generally do not allow reliable estimates of trends in nutritional indicators at country level, and this report focuses primarily on groups of countries, defined by similarity in nutritional situation and based on the regional groupings used by the UN. Groups of countries in which child nutrition is calculated to have improved significantly, deteriorated or remained unchanged, are shown in Figure 3. The method used is described in section 4.4. The map illustrates the overall impression of recent trends in nutrition. Generally, malnutrition has increased in much of Africa, remained stable in South America and decreased in Asia and Central America.

These analyses must be regarded as of a tentative nature because of the scarcity of data on child anthropometry which would provide the basis for a robust assessment of trends. However, when considered together with other information, including that on food availability and infant mortality rates, the general impression is probably sound, though the Latin American situation in reality may be less sanguine, and that in parts of Africa, subject to drought and civil unrest, more precarious.

Low birthweight, principally due to maternal malnutrition in the developing if not the developed world, is a recently collected indicator of nutritional status. Low birth weight is associated with impaired child performance, health and survival. The incidences of low birth weight by country for 1982 are presented in Figure 4. Since there are as yet insufficient data to follow trends, these incidences are not presented over time. This map complements the nutritional status data on regional trends to indicate the relative nutrition situation between countries.

The emphasis in this report is on estimating prevalences and trends in indicators of access to food and of nutritional deficiencies for groups of developing countries. The report does not review the causes of food and nutrition problems nor does it consider other diseases related to diet (e.g. obesity and hypertension) even when these are important concerns in some developing nations. The choice of indicators is constrained by the availability of data. While it is assumed that nutrient intakes of individuals and infections are the immediate factors which determine nutrient availability at the cellular level, and are therefore ultimately determinants of nutritional status, neither are discussed in this report. Future updates of this report will devote greater attention to infections, particularly diarrheal diseases, since their role in the etiology of nutrition problems is recognized as of substantial importance, and more data is now becoming available.

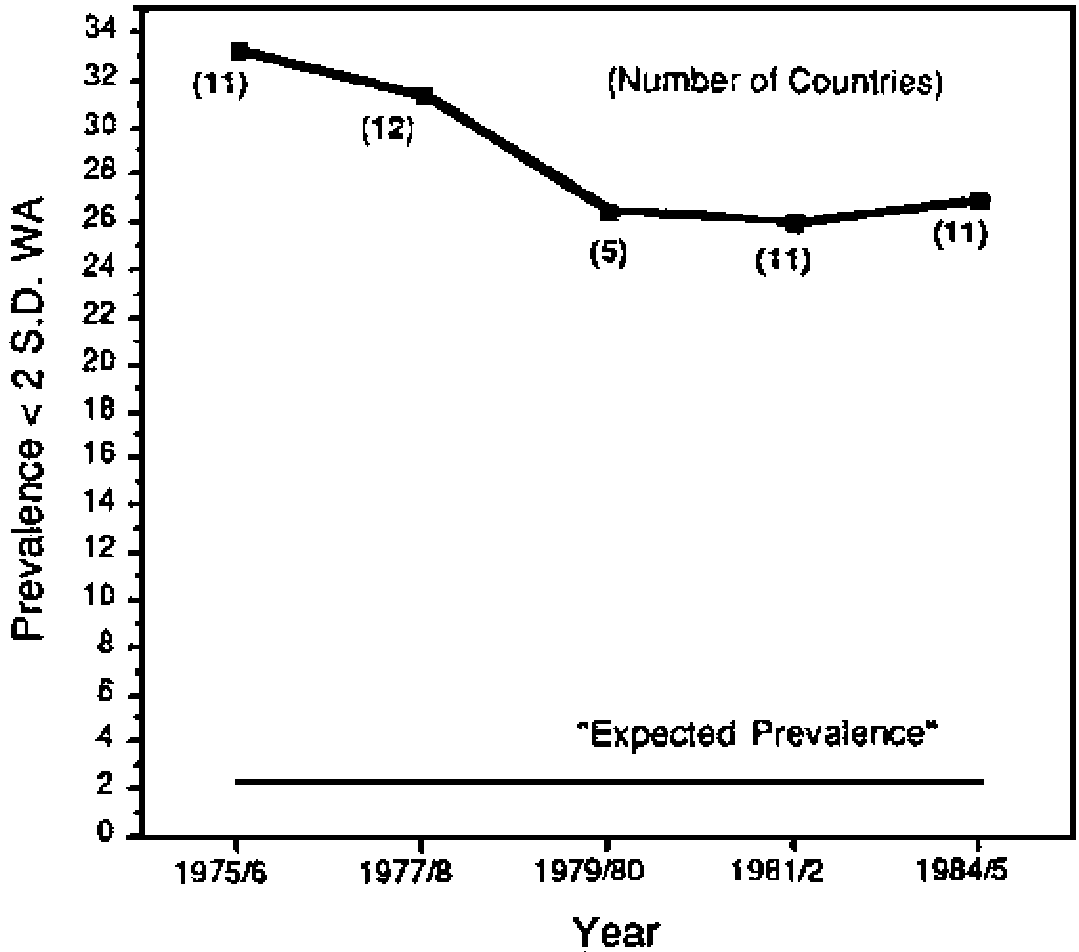



**FIGURE 2:** Global Prevalence of Low Weight−for−Age (WA) in Preschool Children, 1975−1985, Adjusting for Country Group.

Estimates are based on prevalences of underweight children from survey data, as described in section 4.3. Underweight is defined as below 2 standard deviations by NCHS/WHO standards. The improvement 1975/6 to 1979/80 is statistically significant. The "Expected Prevalence" is the percent of the NCHS reference that is below 2 SDs (i.e. 2.5%).

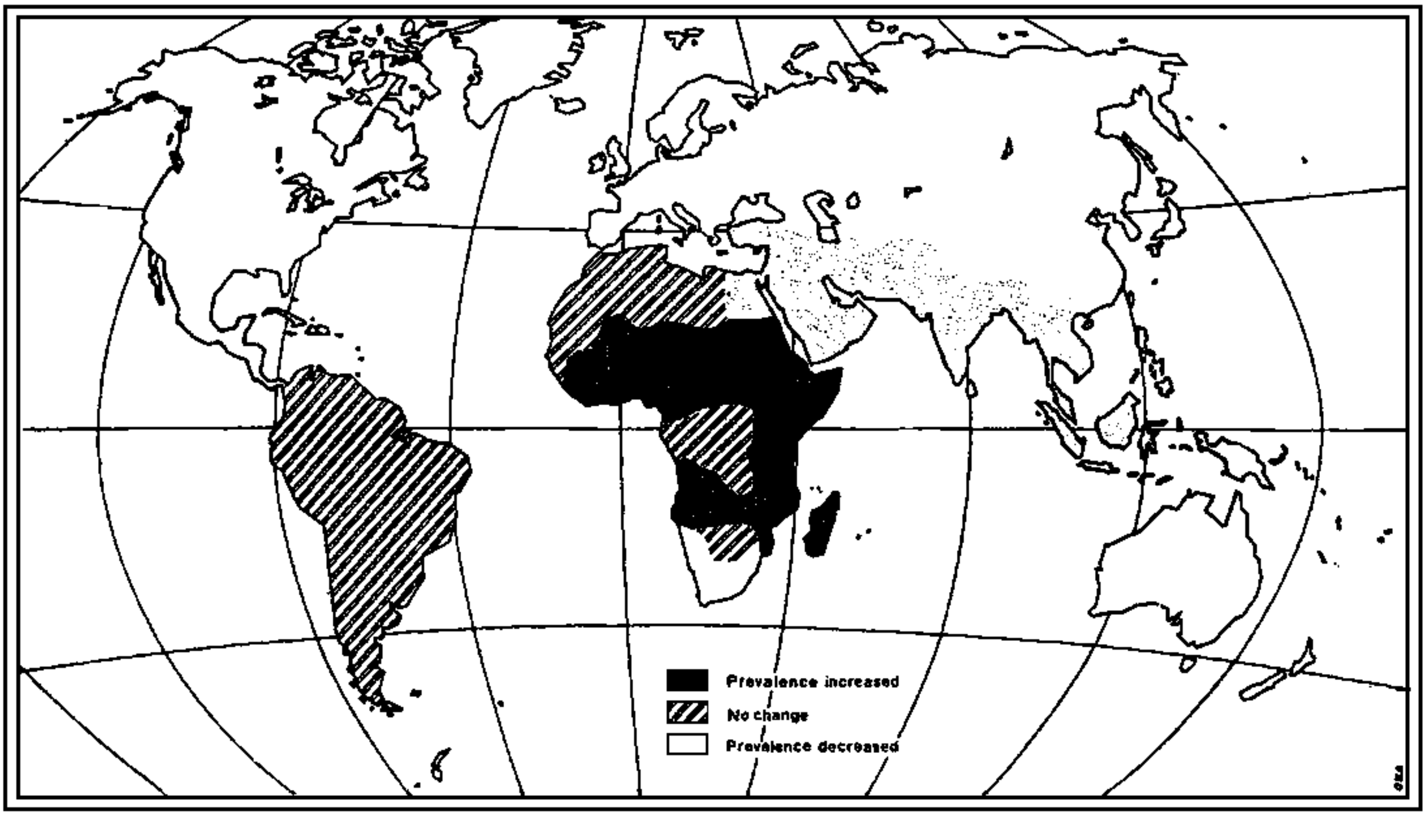



**FIGURE 3:** Changes in Prevalence of Underweight Children by Groups of Countries from 1980 to 1984.

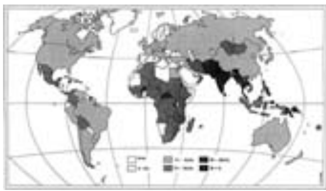


**FIGURE 4:** Incidence of Low Birthweight by Country, 1982

(Source: WHO, 1984)

Direct measures of dietary intake or consumption are rarely obtained from nationally representative samples. For this reason, possible trends in average food consumption are inferred from changes in "dietary energy supply" (DES, provided by FAO) which refer to the total food nationally available for human consumption, expressed on a per caput per day basis (kcals/caput/day), for each country and year. There are obvious limitations in the use of DES as an estimate of consumption since it does not allow for wastage, or losses through food preparation or at the food plate level.

A related indicator used in this report is the proportion of the population estimated to have access to less than an absolute minimum amount of food energy (based on 1.2 times the basic metabolic rate for adults). These estimates are calculated from DES and additional data on distribution. The methods (see section 4.1.4) are those used by FAO in the Fifth World Food Survey (FAO, 1987a, Appendix: "Methodology for Estimating the Incidence of Undernutrition"). The appropriate terminology for this indicator has been a matter for debate; formally, it was decided to refer to it as "marginal access to food", partly to emphasize that it is not based on direct measures of consumption. However, for brevity and in line with usage in the Fifth World Food Survey, it is also referred to here as "undernutrition". The above cautions should be borne in mind when interpreting this expression.

A variety of indicators including anthropometric, biochemical, and clinical data can be used as measures of nutritional status. Biochemical and clinical data from national samples are rare and for this reason this report relies primarily on anthropometric data on preschool children (1 through 4 years of age), compiled by WHO (1987), to monitor trends in nutritional status. Prevalences of underweight children (from their weight compared with the expected weight at that age for healthy children, known as weight−for−age) was chosen for this report, because of the greater availability of data. Finally, infant and child mortality rates are included as general indicators of nutrition and health. This report is descriptive, and immediate and causal factors are not analyzed, although such an analysis would be a useful next step.

Thus, the two major proxy indicators used refer to access to food, and weight–for–age in pre–school children. Data availability and quality are nonetheless uneven for these nutritional indicators, although they are considered the most suitable for the present purposes. DES data from food balance sheets, like mortality rates, are sometimes rough guesses at best for a number of countries, particularly for the poorer ones. Weight–for–age data are not available from nationally representative samples for the majority of countries and even when they are, results usually refer to only one point in time. Therefore, this report also relies on estimates of prevalences of underweight based on regression models, incorporating information from food balance sheets, infant mortality rates and other variables, to fill in the gaps. These estimation techniques are referred to in section 4.1.6.

In general, there is at the country level an association between growth retardation and per capita food availability. However, that association could be caused by growth retardation leading to low food consumption, or vice–versa. It is also important to note that at the family level it is rare that food availability in the market limits household food intake, which is almost always limited by economic factors such as income and land tenure.

The core of this report is contained in section 2, where estimates relating to food availability, underweight children, and infant and child mortality are given by country groups. Particular emphasis is given to Africa, the region showing trends of the most concern. Information on data sources, methods of calculating indicators, and their presentation, is given in section 4. Data have been compiled from United Nations sources, generally FAO, WHO and the UN Population Division. WHO data on anthropometry has been used, together with other variables, to estimate prevalences of underweight children to obtain broad dimensions and trends. Panels containing data on nutrition indicators by country groups allow comparisons between different indicators for each group, and for the same indicators across country groups. Most of the data points are either three year averages, or are derived from these except for mortality which are based on a five year period. However for dietary energy supply, food production indices, and population, annual estimates are also given for the period 1980/85.

Recent information on prevalences of deficiencies of three micro–nutrients – vitamin A, iron, and iodine – is given in section 3. Here again information is given on access to the nutrients in the diet, from Food Balance Sheets, and on the clinical effects of deficiencies usually derived from WHO compilations.

The report seeks to present a plausible picture of the world nutrition situation in sections 2 and 3. The relevant sections of the Technical Notes (section 4) indicate the limitations of the data, and where statistical methods have been used for hypothesis testing, the confidence limits of the results. Fuller details will be given in the Supplement on Methods and Statistics, to be issued in early 1988.

## 2. INDICATORS BY GROUPS OF COUNTRIES

### 2.1 SUB–SAHARAN AFRICA

#### Panel 1

Throughout the 1970s, population expanded more rapidly than food production in Sub–Saharan Africa. The consequent steady decline in per caput food production was offset by rising levels of food imports, so that dietary energy supply (DES) increased marginally between 1969/71 and 1979/81 (see panel 1C). The distribution of dietary energy supply by country for 1979/81 is illustrated in Figure 5A. The proportion of the population undernourished in terms of access to food[3] fell slightly, from 24 percent to 23 percent, during this period (panel ID). With population growth, estimated numbers of people undernourished increased from around 60 million in 1969/71 to nearly 80 million by the end of the decade. This was in contrast to trends in most other country groups, where the rate of decline in prevalence was enough to largely offset the rise in population (compare panel ID with sections D of other panels).

[3] As discussed in section 1, the population with marginal access to food, referred to also as undernourished, is estimated using FAO (1987a) methods as those with less than 1.2 times

basic metabolic rate (see section 4.1.5).

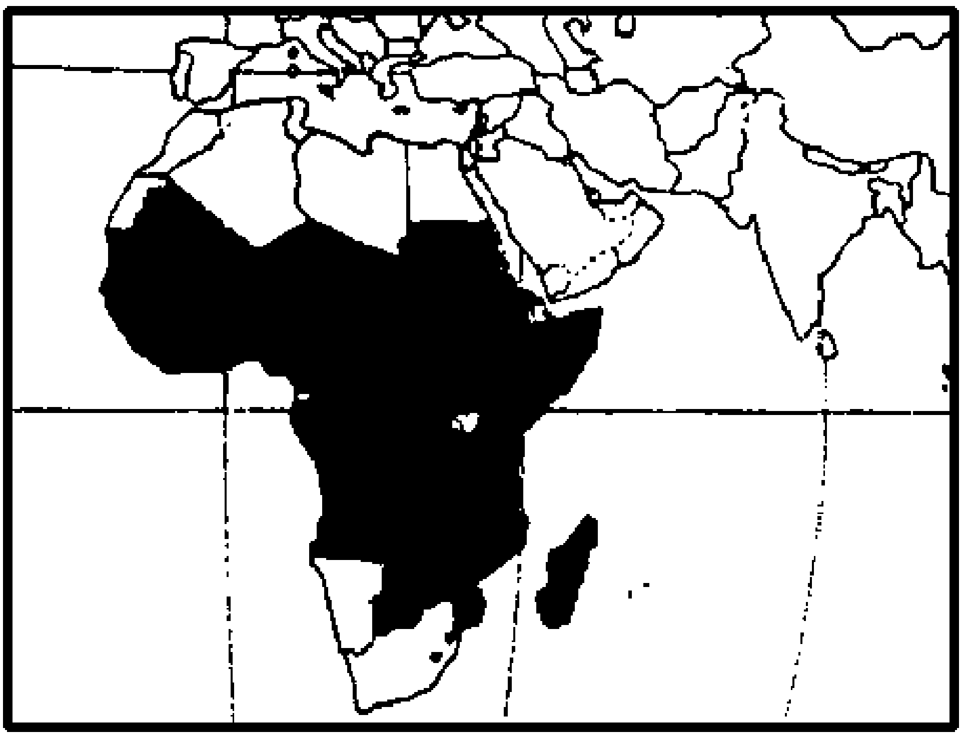
Malnutrition in pre−school children was extensive in many African countries during the 1970s, as indicated by the prevalence of underweight children (panel 1E). Eight nationally representative surveys show from 17 to 31 percent of the child population as being underweight between 1975 and 1980[4]. For the region as a whole, the average prevalence of underweight children has been calculated as 24 percent in 1980, similar to the proportion undernourished in the general population[5]. This indicates that some 16 million children were underweight around 1980. The highest prevalences − greater than one third of the child population according to the present estimates − were believed to be in Ethiopia and the Sahel countries. An estimate of the relative prevalences by country for 1980 is shown in Figure 5B.

[4] Survey results and other data quoted are summarized in the Supplement, with references of sources.

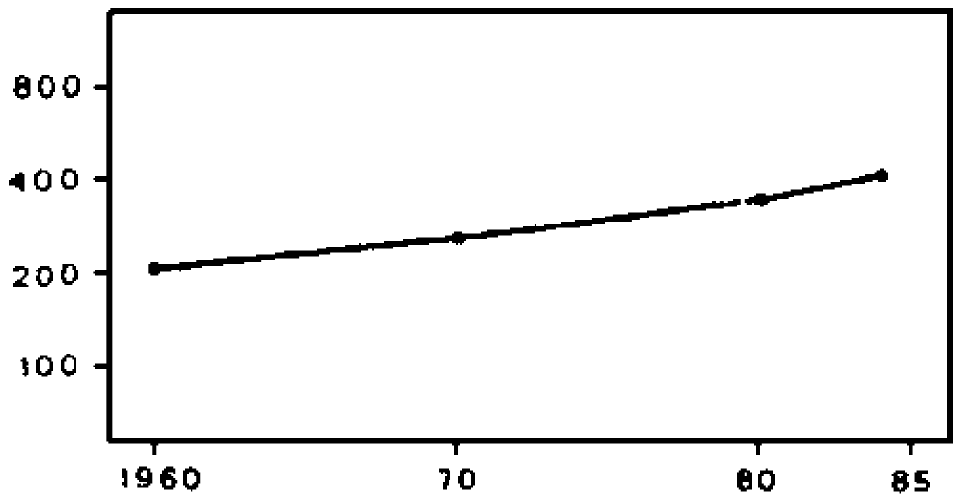
[5] Results calculated by the interpolation (regression) method given in section 4.1.6 and described in detail in the Supplement.

Calculations from demographic data indicate a consistent fall in the infant and child death rate during the 1960s and '70s, probably due to improvements in health services as well as to some increase in food availability. Nonetheless, actual numbers of infant and child deaths in Africa are believed to have risen throughout this period (panels IF & G), in contrast to tendencies in all other regions except South Asia. By 1980 annual death rates in mainland African countries were the highest in the world, with the infant mortality rate ranging from an estimated 75 to 180 per thousand live births and the child (1−4 year old) death rate running at 10 to 50 per thousand children per year. The average infant mortality rate was estimated as 122 deaths per thousand live births, and the child death rate as 26 per thousand children per year, equal to some 2.3 million infant deaths and 1.4 million child deaths annually. This is equivalent to the entire pre−school child population of a large European country, such as France, dying in one year. Many of these deaths were preventable, and malnutrition contributed to a substantial proportion of them.

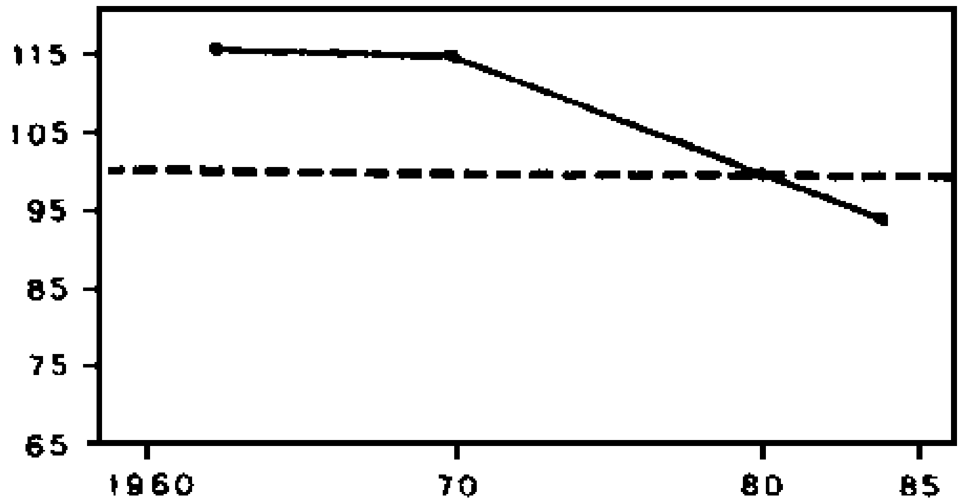
**Panel 1 Sub−Saharan Africa**



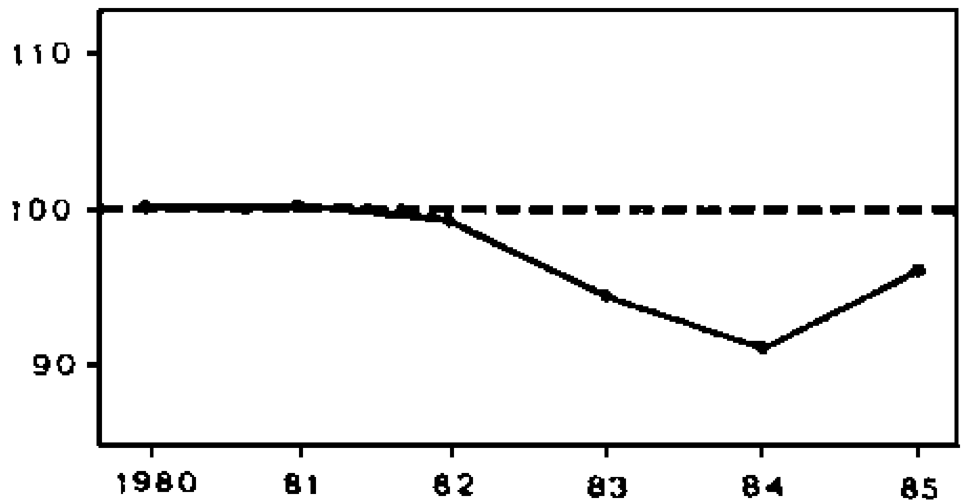
**A. Total population** *(millions − log scale)*




**B. Index numbers of per caput food production** *(1979/81 = 100)*

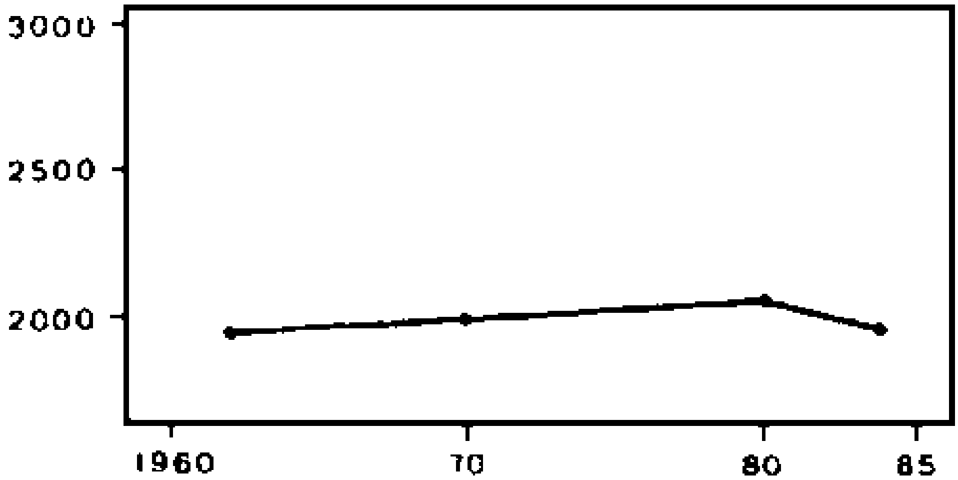



i. 1960–85 (3–year averages)

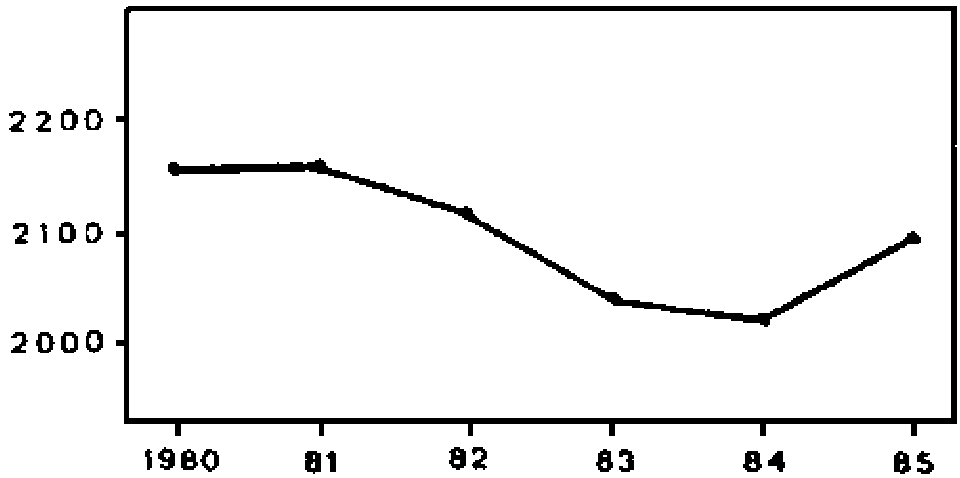



ii. 1980–85 (annual)

**C. Dietary energy supply** *(Kcals/caput/day)*

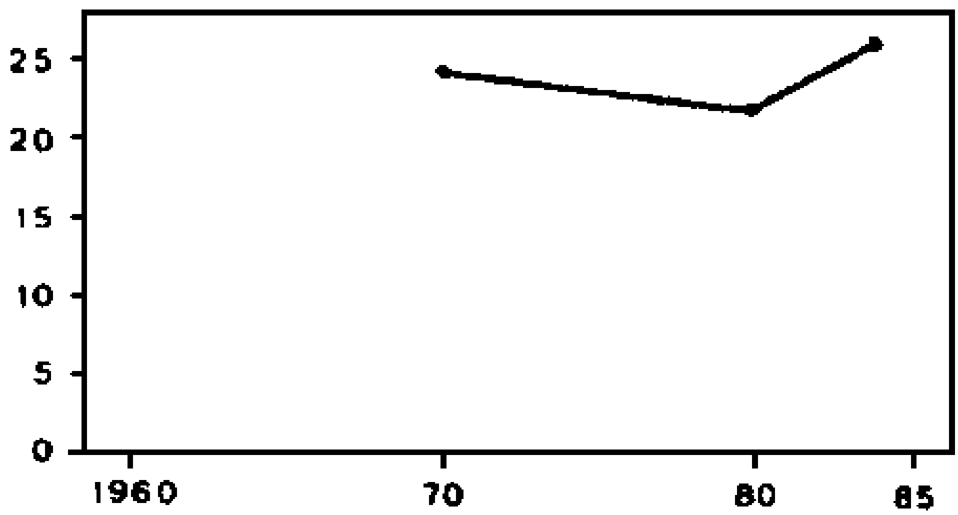


i. 1960–85 (3–year averages)

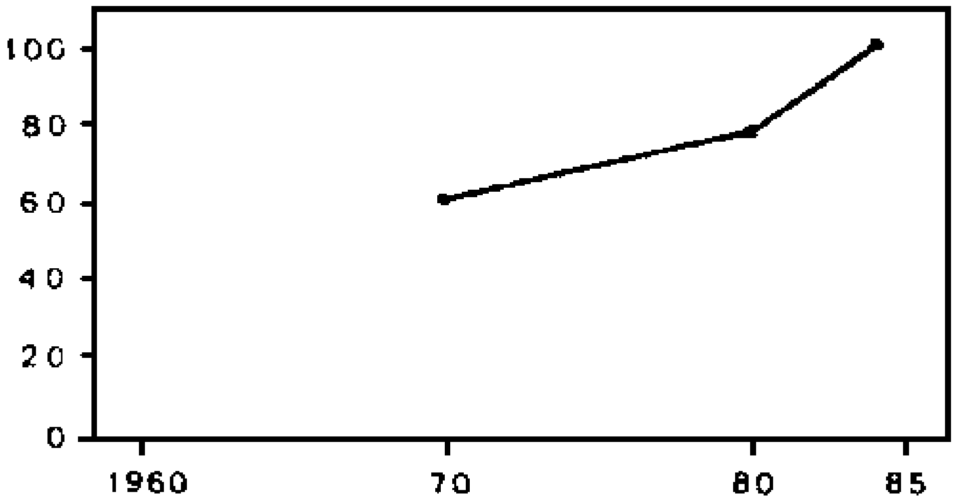


ii. 1980–85 (annual)

**D. Undernourished population** *(DES < 1.2 BMR)*

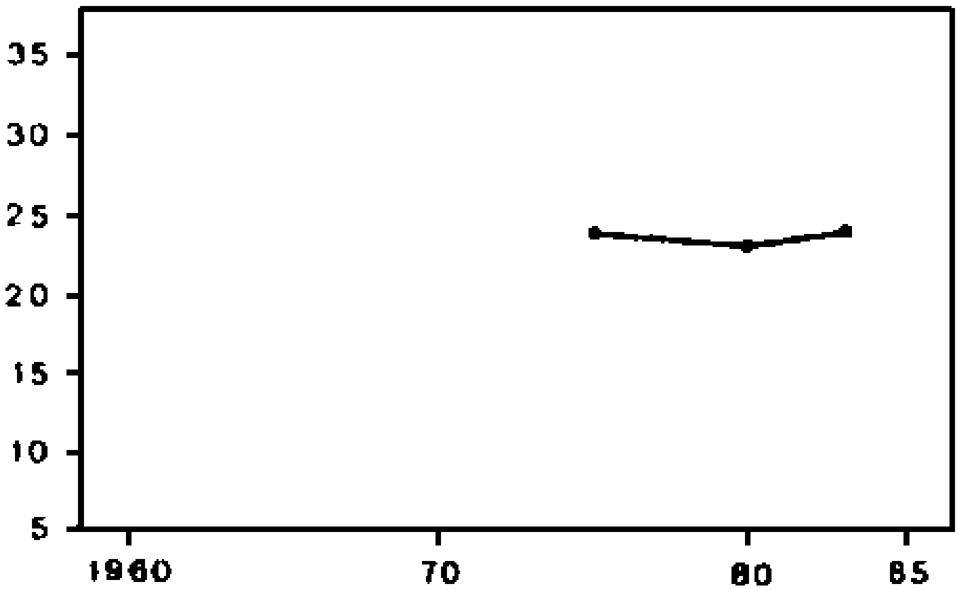


i. percent

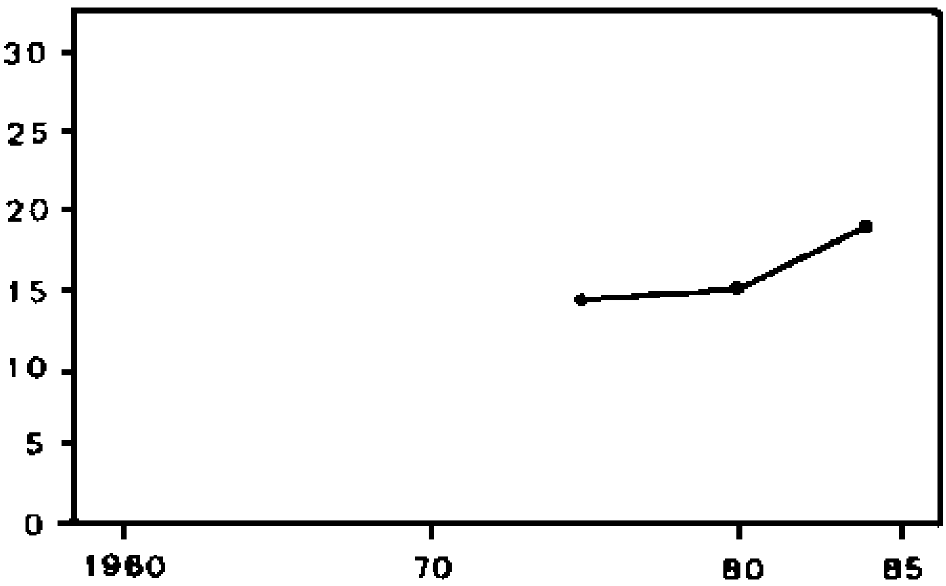


ii. numbers (millions)

**E. Underweight children** *(<2 SD weight−for−age)*



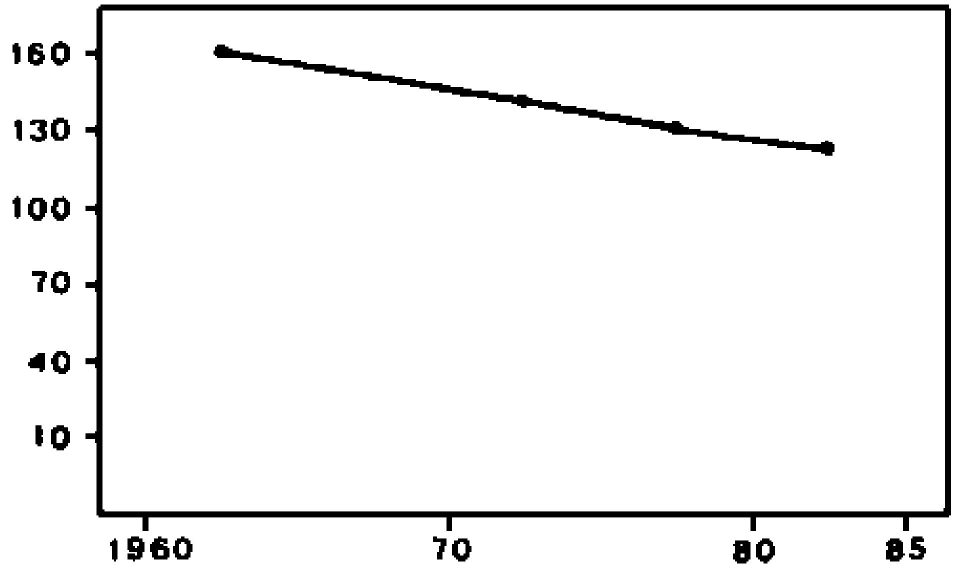
i. percent



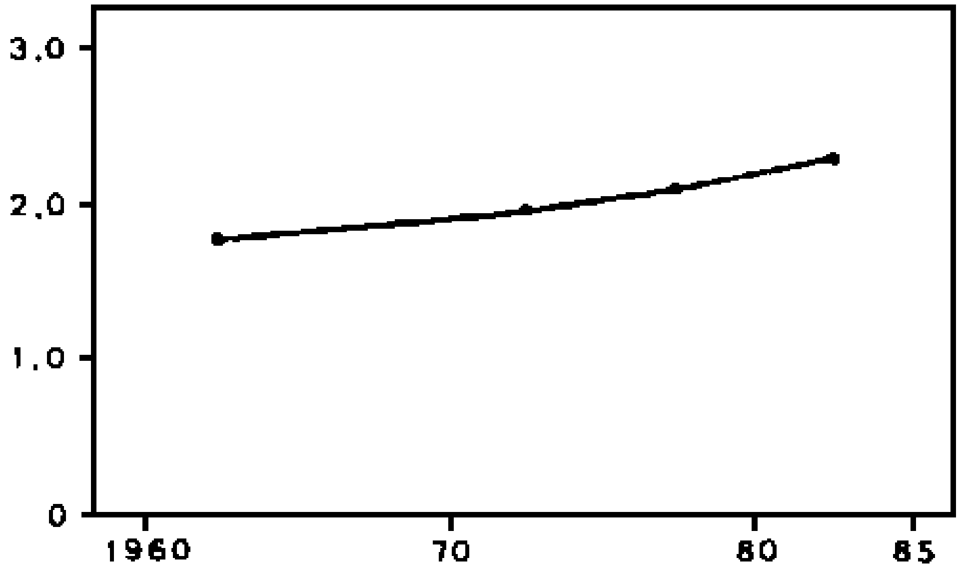
ii. numbers (millions)

**F Infant mortality***

* Infants 0–12 months



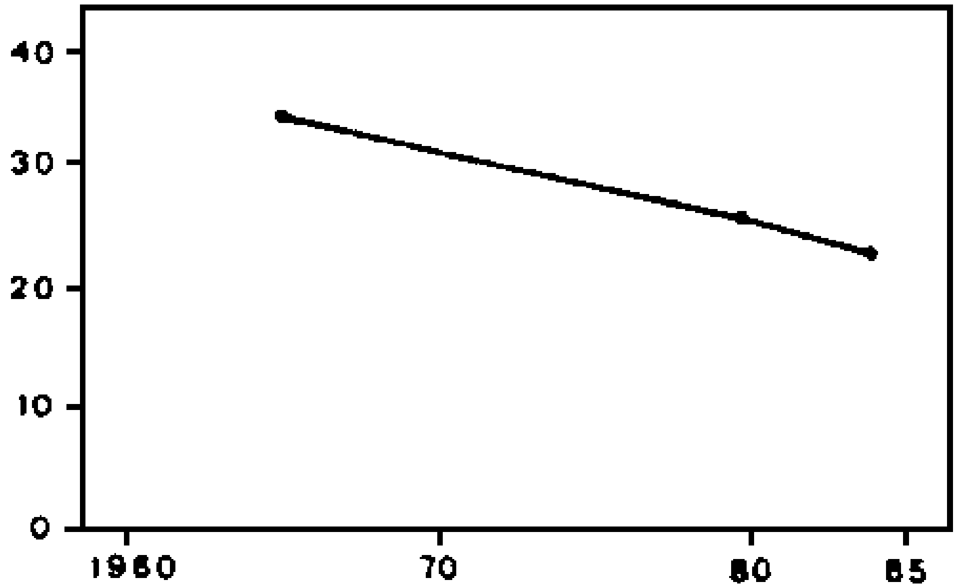

i. Number of deaths/1000 live births



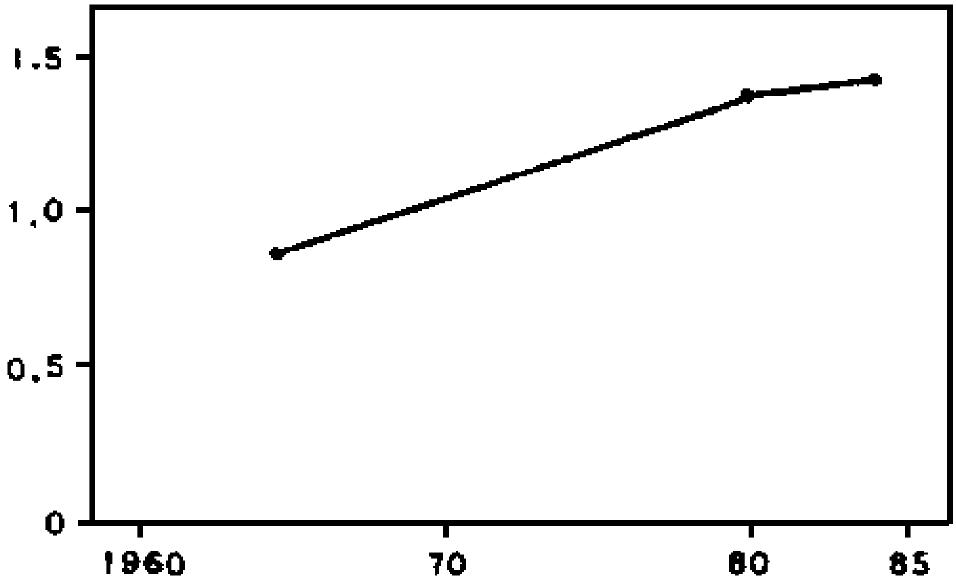

ii. Number of deaths/year (millions)

**G. Child deaths***

* Children 12–60 months




i. Number of deaths/1000 children/year




ii. Number of deaths/year (millions)

Africa's nutrition situation worsened during the early 1980's. The onset of severe drought reduced food production drastically across large areas of the region, particularly in countries of the Sahel and Eastern and Southern Africa (Figure 5C). By 1984, the per caput food production index had fallen by over 20 percentage points below that of 1970 (Panel 1B). This is an average for the country group; undoubtedly, the drop in production was far worse in many countries. Despite recourse to food imports and food aid, dietary energy supply fell from about 2150 kcals in 1979/81 to 2050 kcals in 1983/85. Thus the proportion of the population estimated to have marginal access to food[6] rose sharply from an estimated 22 percent of the population in 1979/81 to 26 percent in 1983/85. Since the breaking of the drought in 1985, levels of food availability have improved and recent estimates indicate that the situation may have been restored in 1986 to that of the pre–drought years.

[6] See footnote 3.

At the height of the food crisis, the proportion of the African population undernourished was higher than at any time in the previous 15 years. This represents an rise of nearly 30 million, to more than 100 million people so affected. This estimated increase is of a similar order to reports of numbers struck by famine at the height of the drought and may, in fact, be an underestimate because distributional effects cannot be calculated.

The widespread reduction in food availability and its likely effects on consumption during the 1980s is reflected in the increased prevalence and numbers of underweight children across the continent. Many of the countries most severely affected by the drought already had the region's lowest levels of food availability and highest prevalences of pre−school child malnutrition (compare Figures 5A to 5C). The impact of drought shows up clearly in monthly clinic data in countries such as Botswana (Figure 6A). Economic stress worsened the effects of drought in Lesotho, increasing child malnutrition (Figure 6B; see also the Appendix). In most cases where drought or economic difficulties were severe enough to alter estimated access to food (DES levels), and where independent assessments of malnutrition exist, the effect on child nutrition was clear. A striking example is Ghana during the period 1980−83 (Figure 6C), when severe economic recession reduced DES at the same time as clinics reported rising prevalences of malnutrition in children (UNICEF, 1985). The trend has been reversed since 1983 following policy reforms which strengthened the country's economy.

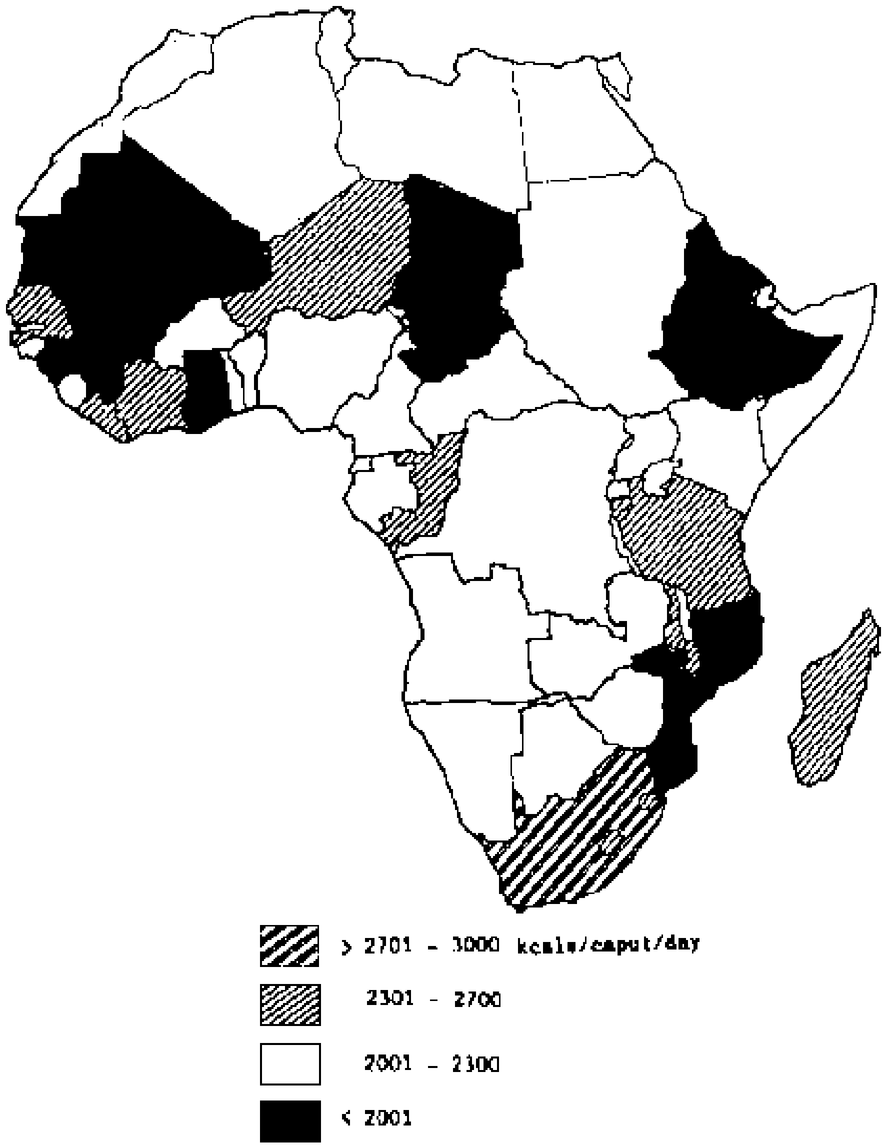



**FIGURE 5A:** Food Availability (Kcals/caput/day) in Subsaharan Africa, 1979/81.

(Source: FAO, 1985)

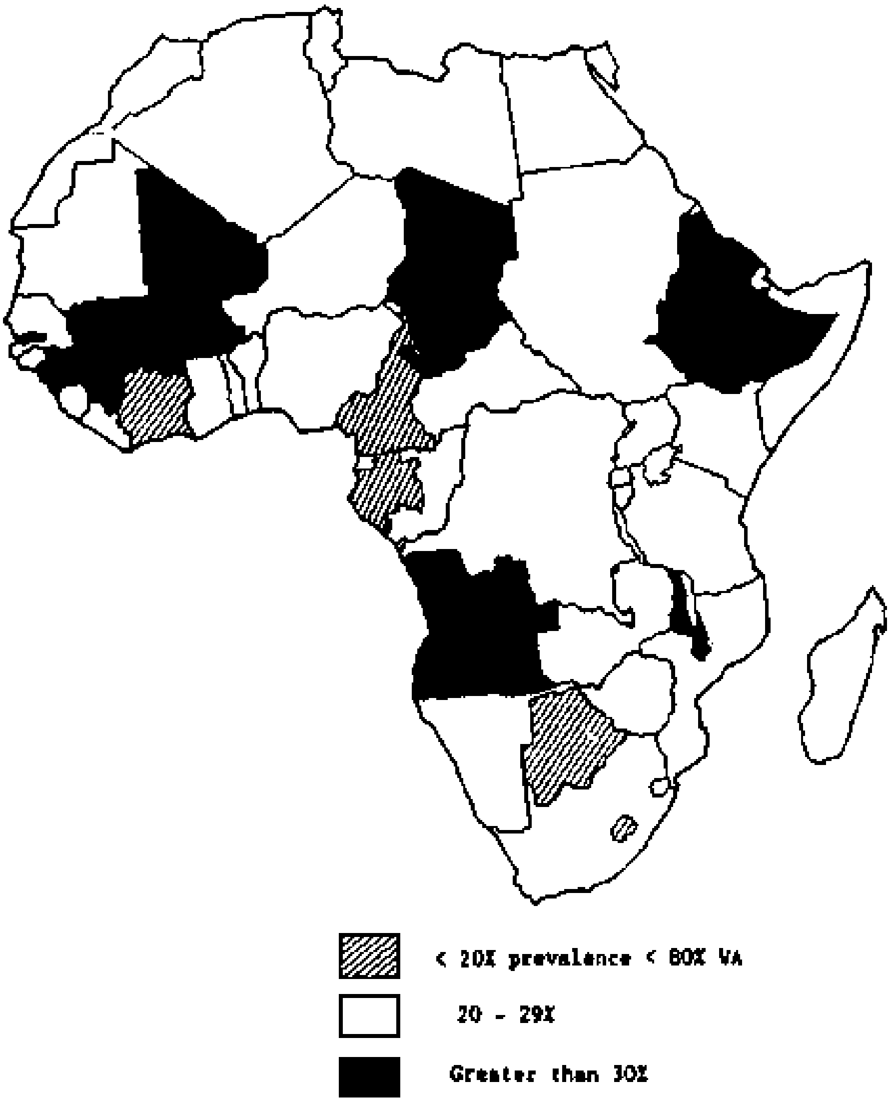



**FIGURE 5B:** Estimated Prevalences of Underweight Children in Subsaharan Africa, (1980). (Based on weight–for–age, WA).

(Source: UNICEF, 1985)

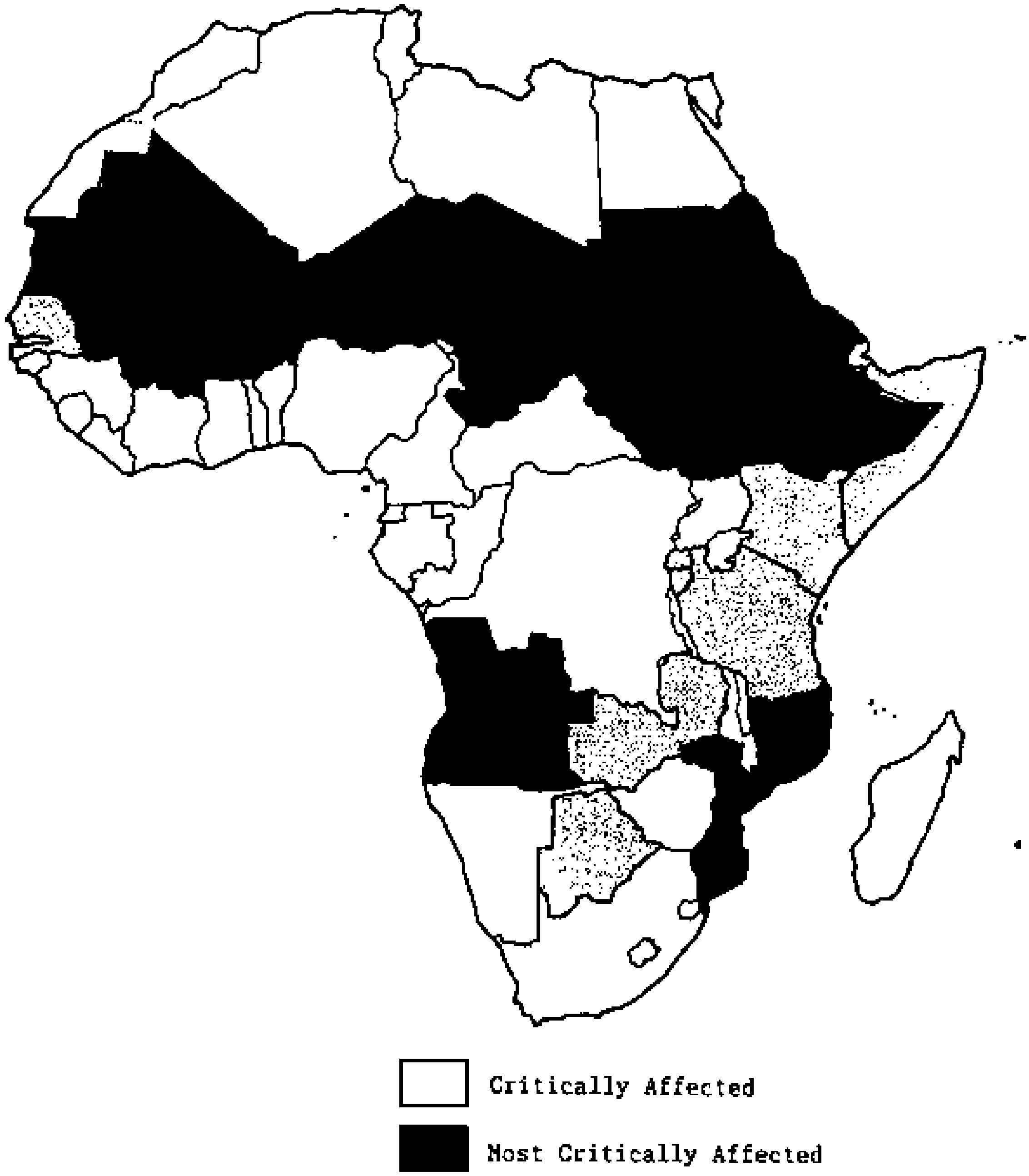



**FIGURE 5C:** Areas Most Critically Affected by Drought in Africa, 1980's (as of June, 1985).

(Source: Walker, 1985)

However, the overriding impression from monthly clinic data is of stability in seasonal patterns of malnutrition, except when disturbed by drought or economic recession. The mean yearly prevalence hides substantial seasonal variation, as shown in the examples of Burkino Faso and Madagascar in Figures 6D and 6E.

Estimates of prevalences of underweight children around 1980 (given by country in UNICEF, 1985, and reproduced in Figure 5B) have been updated to 1985 for this report (see section 4.1.6). The results illustrate the deterioration of the nutritional status of Africa's children in the last few years (panel 1E). The prevalence of underweight children in 1984 is estimated at 25 percent, slightly higher than the 1980 figure of 24 percent. Due to population growth, there was a more acute increase in estimated numbers of underweight children, from about 16 million to nearly 20 million. These estimates mirror underlying trends in Africa's food situation. In fact, they do not take into account fully the effects of drought, being based on three year averages,

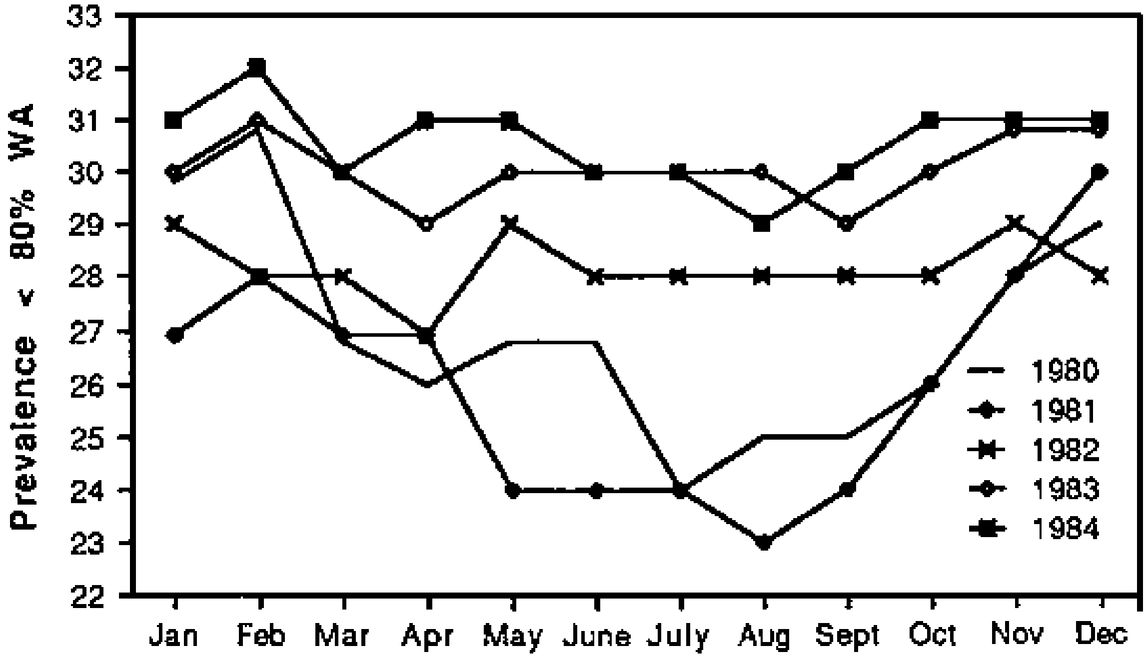



**FIGURE 6A:** Prevalence of Underweight Children in Botswana, 1980–84, from Clinic Data. Prevalence defined as Percent Below 80% of Harvard Standard Weight–for–Age.

(Source: UNICEF, 1985)

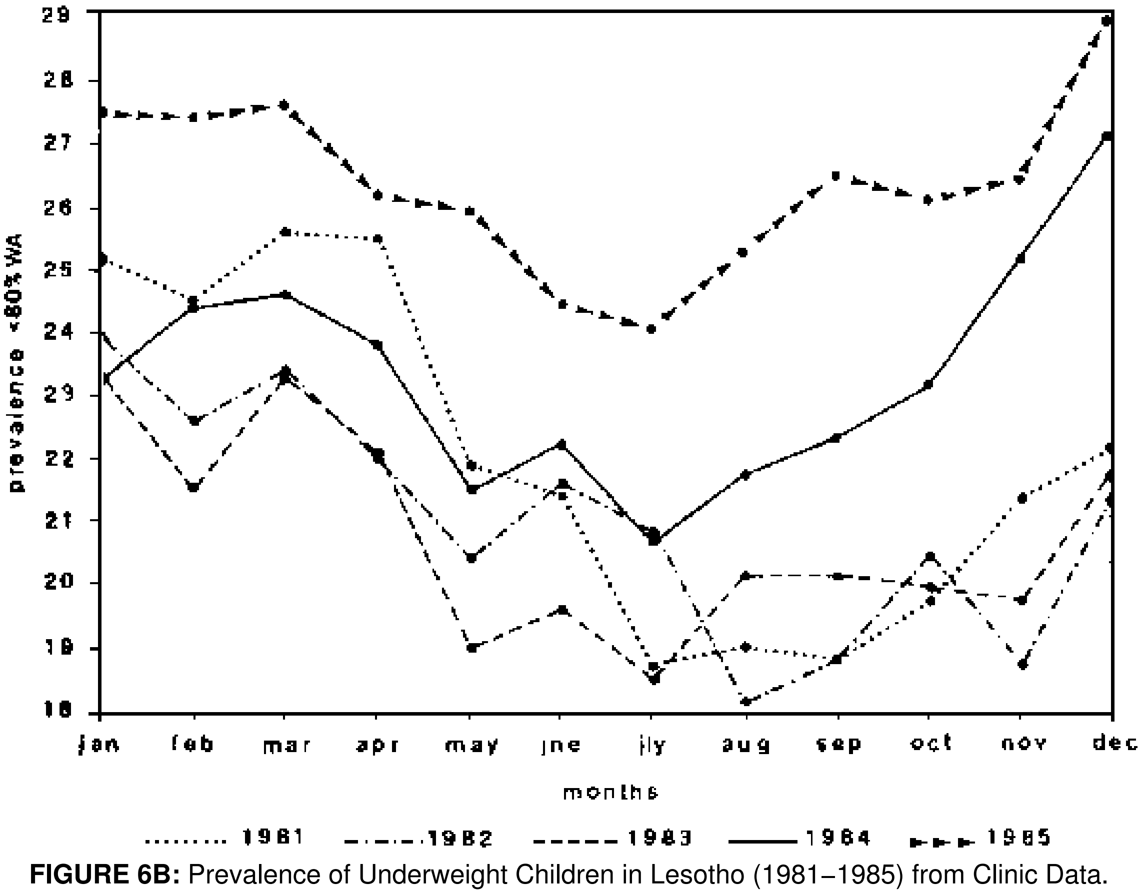



**FIGURE 6B:** Prevalence of Underweight Children in Lesotho (1981–1985) from Clinic Data.

(Source: Test et al, 1987; from Catholic Relief Services data)

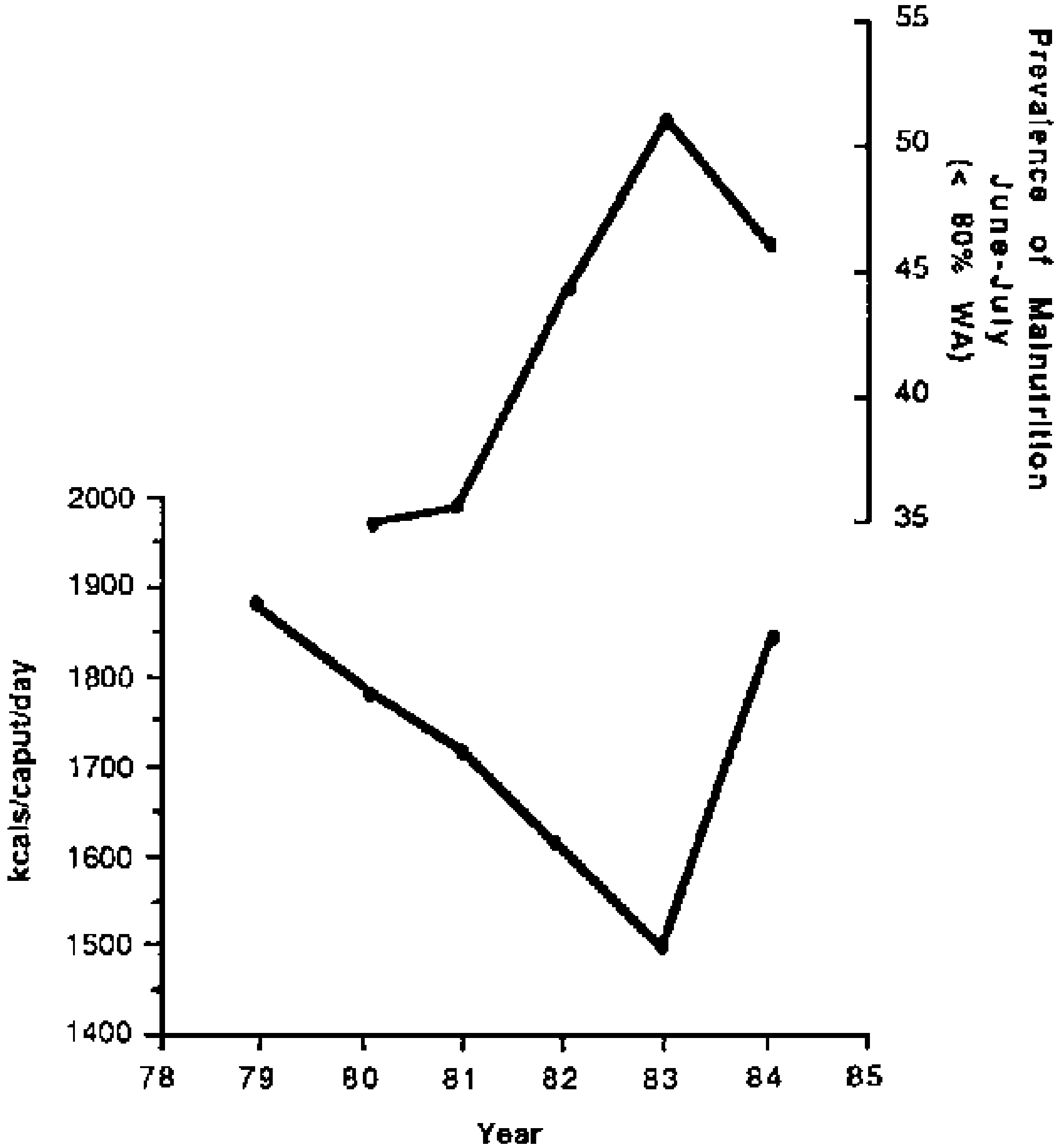



**FIGURE 6C:** Per Caput Dietary Energy Supply (kcals/caput/day) and Prevalence of Underweight Children in Ghana from 1979–1984.

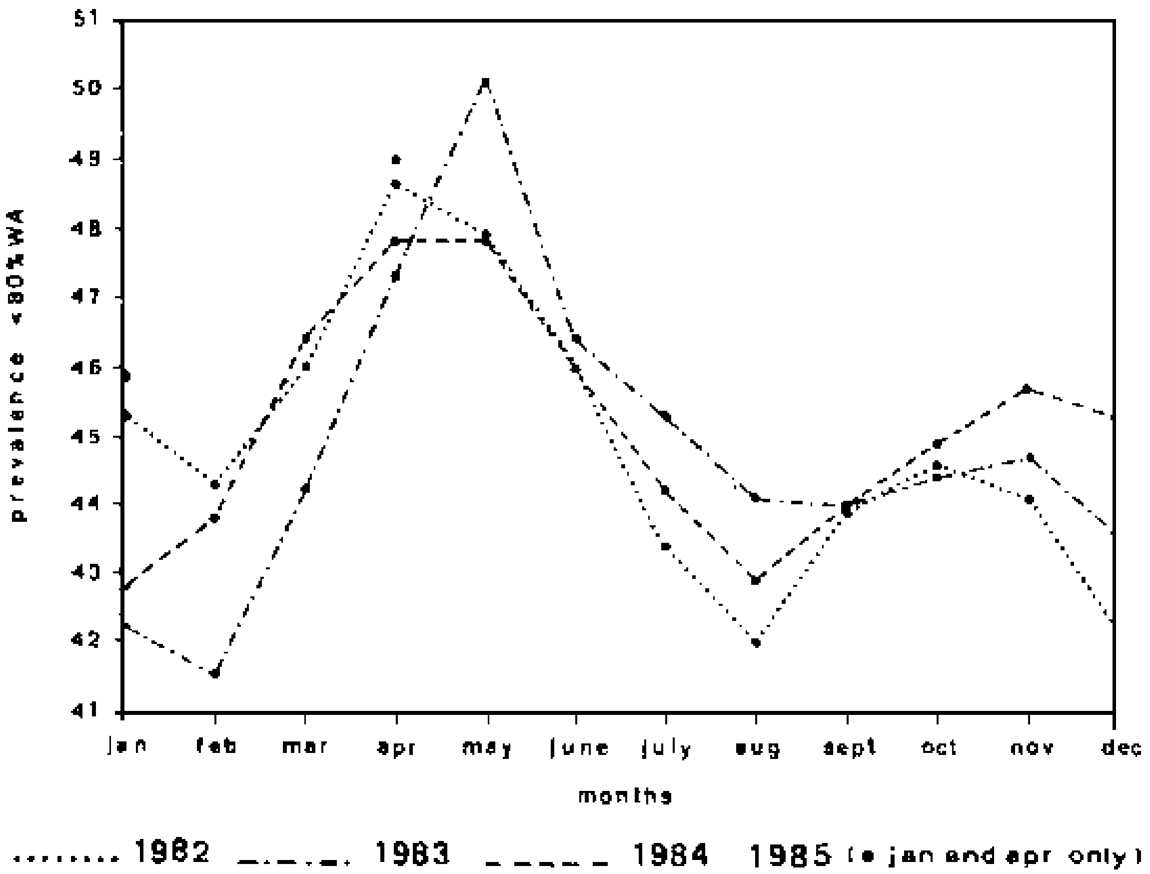



**FIGURE 6D:** Prevalence of Underweight Children in Burkina Faso (1982–1985) from Clinic Data.

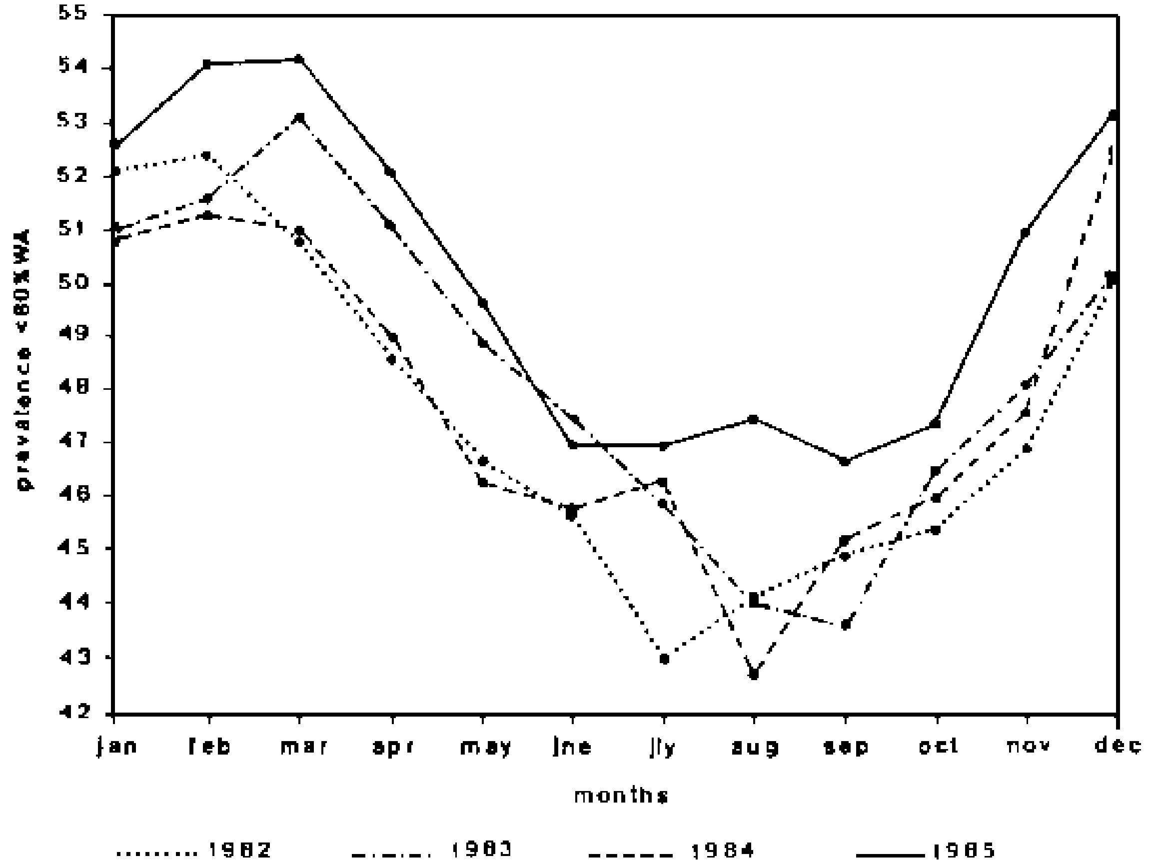



**FIGURE 6E:** Prevalence of Underweight Children in Madagascar (1982–1985) from Clinic Data.

(Source: Test et al, 1987; from Catholic Relief Services data).

Both infant and child death rates probably continued to fall slowly on average, during the 1980s. Estimates reported here also do not assess the effects of acute events, such as drought, which increase mortality. In any case, the decline in death rates has not been sufficient to reverse the trend of increasing numbers of deaths in a rapidly growing population. Sub−Saharan Africa is the only region in which the total number of infant and child deaths rose over the ten year period between 1970−75 and 1980−85.

Furthermore, there is cause for concern that in some areas death rates − let alone numbers − remain high and may no longer be falling. Prevalences of underweight pre−school children provide an early indicator of child welfare and prospects of survival. Evidence of an upturn in the prevalence of underweight pre−school children in the region as a whole in the 1980s may be a warning of a slow−down or reversal in the improving trends in infant and child mortality rates.

## 2.2 SOUTH ASIA

### Panel 2

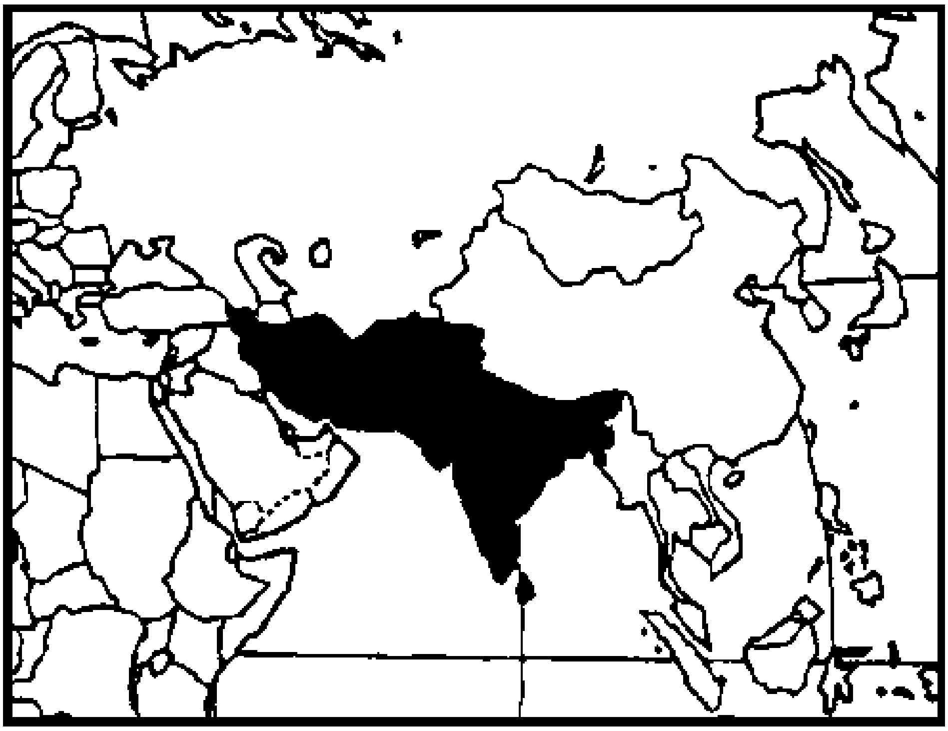
During the 1960's, food production expanded slightly faster than population in South Asia and per caput dietary energy supply (DES) remained almost constant (panels 2B and 2C). Per caput DES increased faster during the following decade. The estimated proportion of the population undernourished (with marginal access to food[7]) was 21 percent for 1969/71, falling to 18 percent for 1979/81. However, with population growth, the resulting numbers of people estimated to have inadequate food increased from about 155 million in 1969/71 to 170 million in 1979/81 (panel 2D).

[7] See footnote 3.

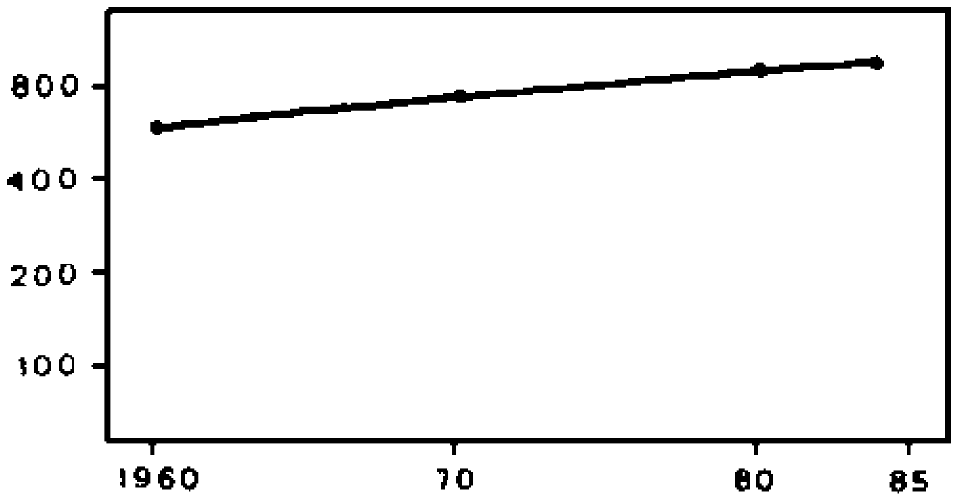
During the present decade, food production has accelerated and per caput DES levels have risen so that total numbers of people undernourished may have stopped increasing. The percentage decreased from 18 to 17 from 1979/81 to 1983/85, and the numbers remained constant at about 170 million. If correct, this estimate means that a corner has been turned in the last 10 years, and that the seemingly inexorable increase in numbers of people undernourished in South Asia is showing signs of reversal. Nevertheless, the magnitude of the problem in South Asia is staggering. Today, almost half of the world's undernourished population − or 170 million people − live in this group of countries., South Asia's food and nutrition problems must rank as one of the world's most serious issues of human welfare.

Estimates of child malnutrition in South Asia (panel 2E) need careful interpretation. Available data from which direct estimates can be made confirm that prevalences of underweight children declined somewhat in the late 1970s and early '80s. Updating of indirect estimates for 1979/81 gives similar results, indicating a change in prevalence from 70 percent in 1980 to 67 percent in 1983/85. Thus there are consistent signs of improvement − important if not dramatic −in nutrition indicators.

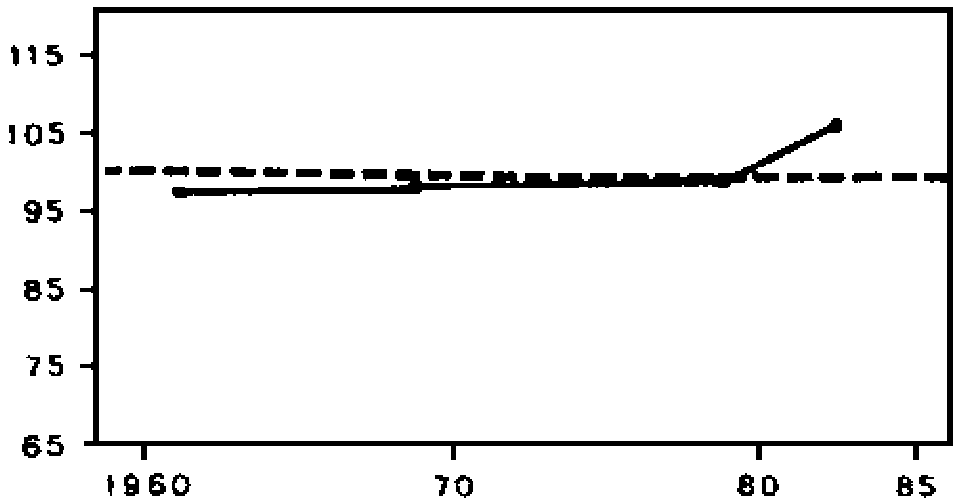
### Panel 2 South Asia



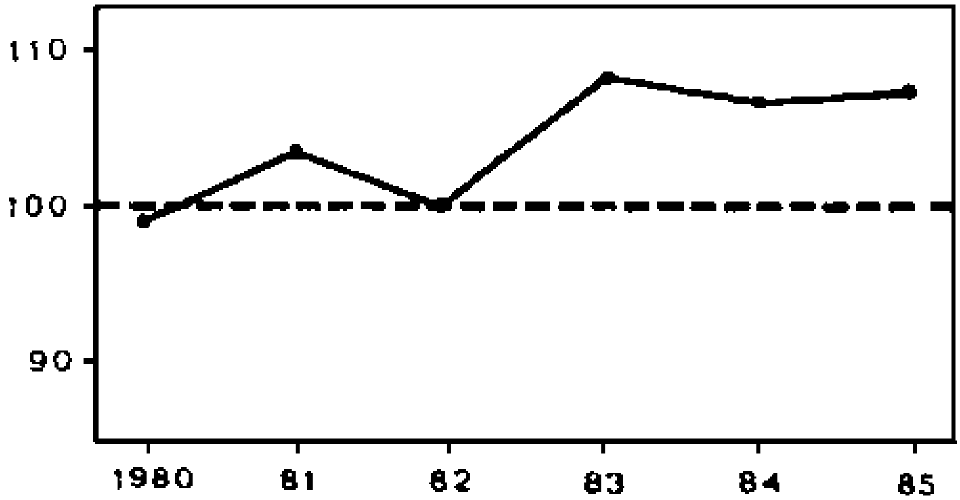
**A. Total population** *(millions – log scale)*




**B. Index numbers of per caput food production** *(1979/81 = 100)*

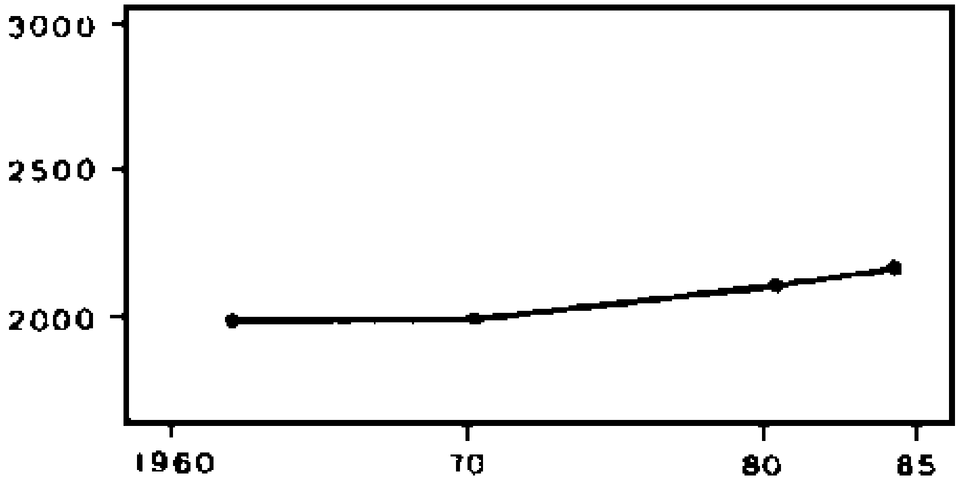



i. 1960–85 (3–year averages)

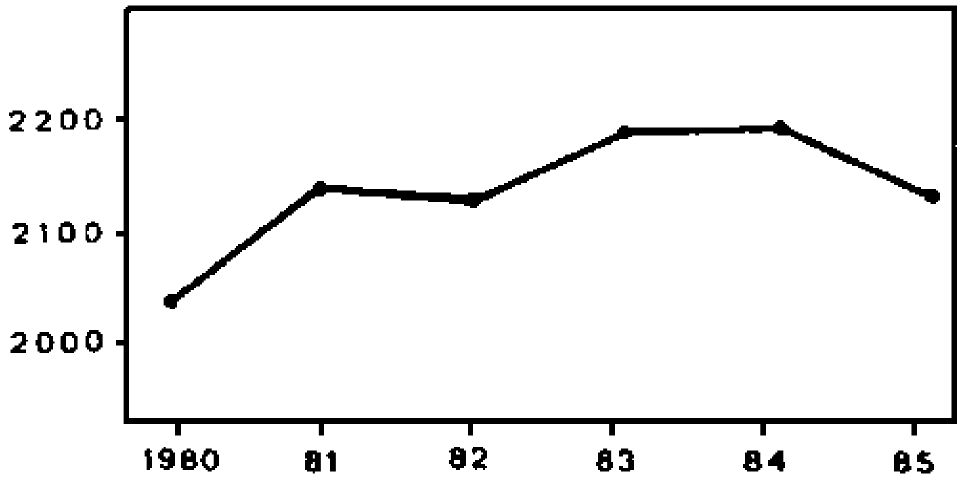



ii. 1980–85 (annual)

**C. Dietary energy supply** *(Kcals/caput/day)*

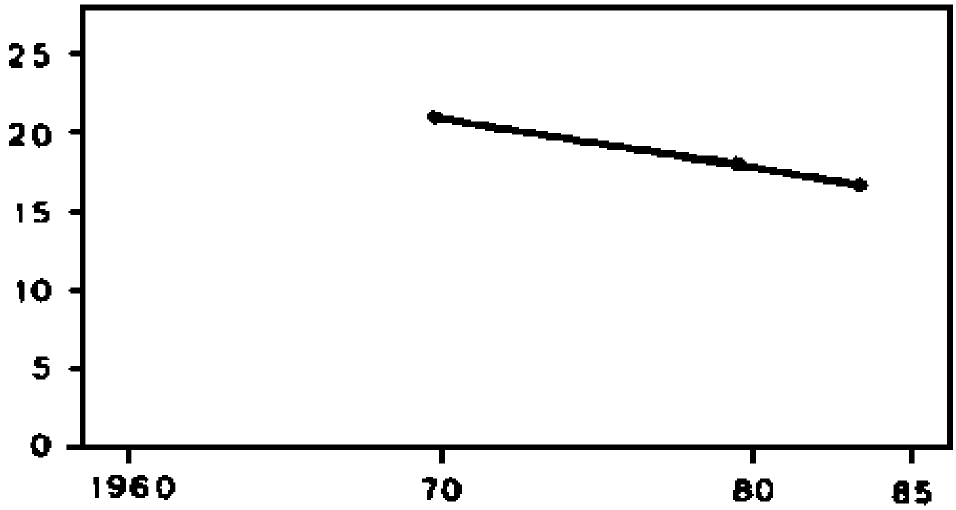



i. 1960–85 (3–year averages)

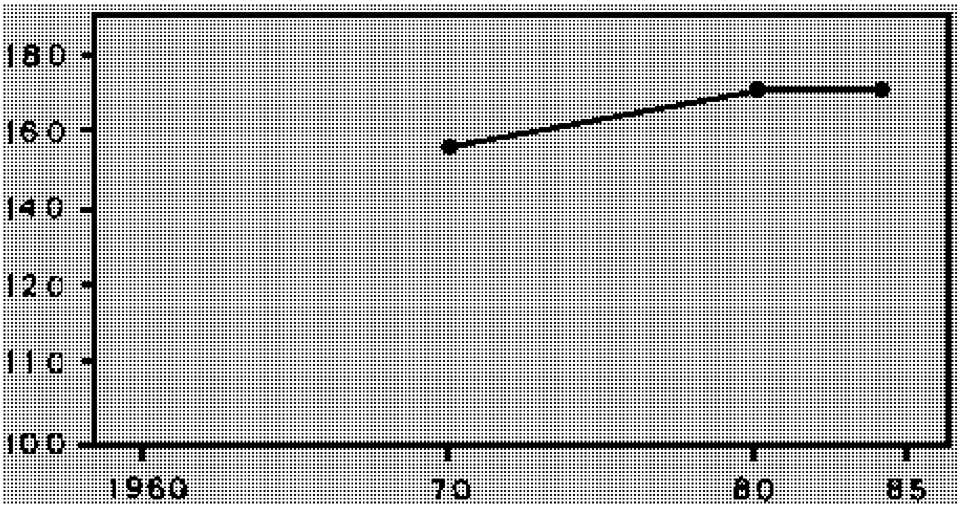



ii. 1980–85 (annual)

**D. Undernourished population** *(DES < 1.2 BMR)*

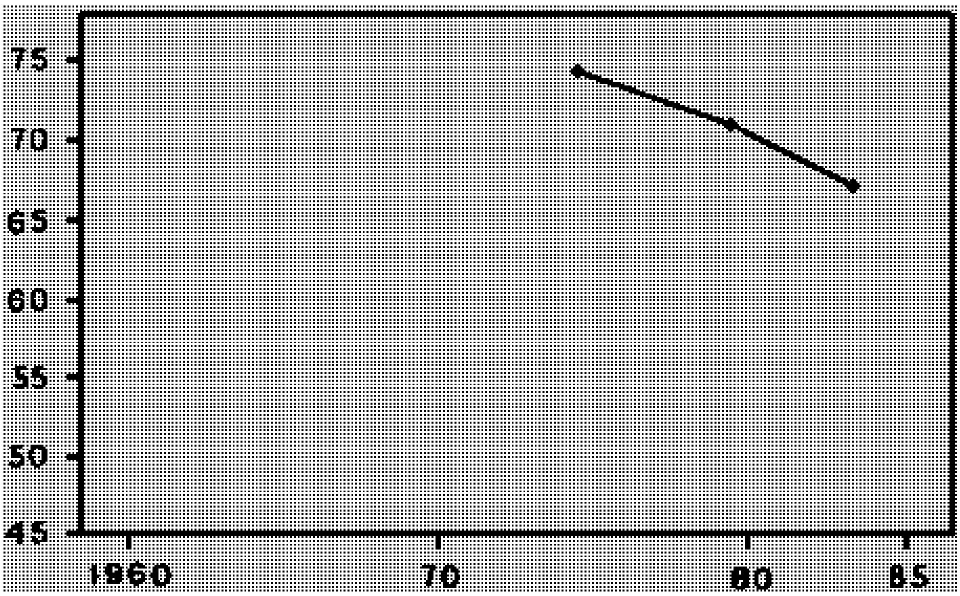


i. percent

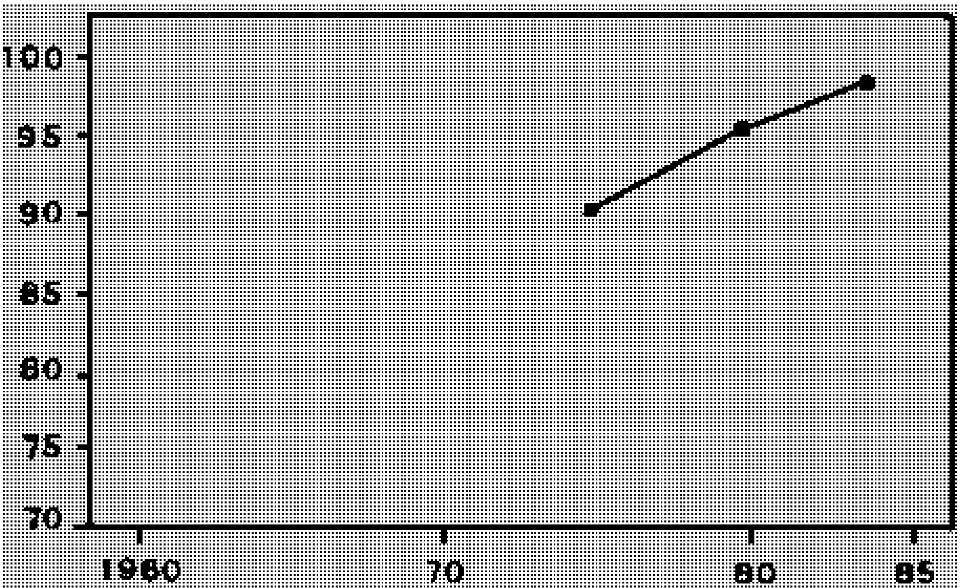


ii. numbers (millions)

**E. Underweight children** *(< 2 SD weight−for−age)*



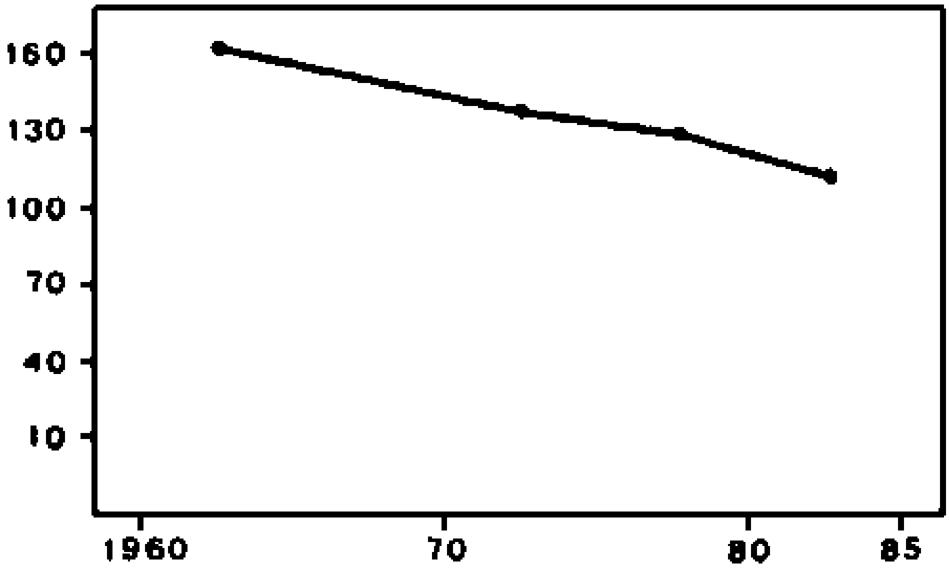
i. percent



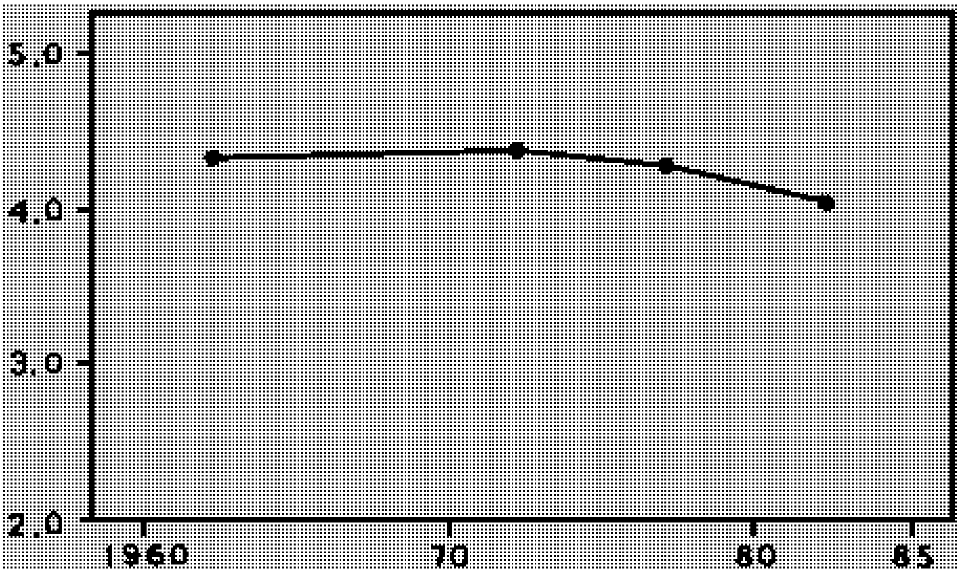

ii. numbers (millions)

**F Infant mortality***

* Infants 0−12 months



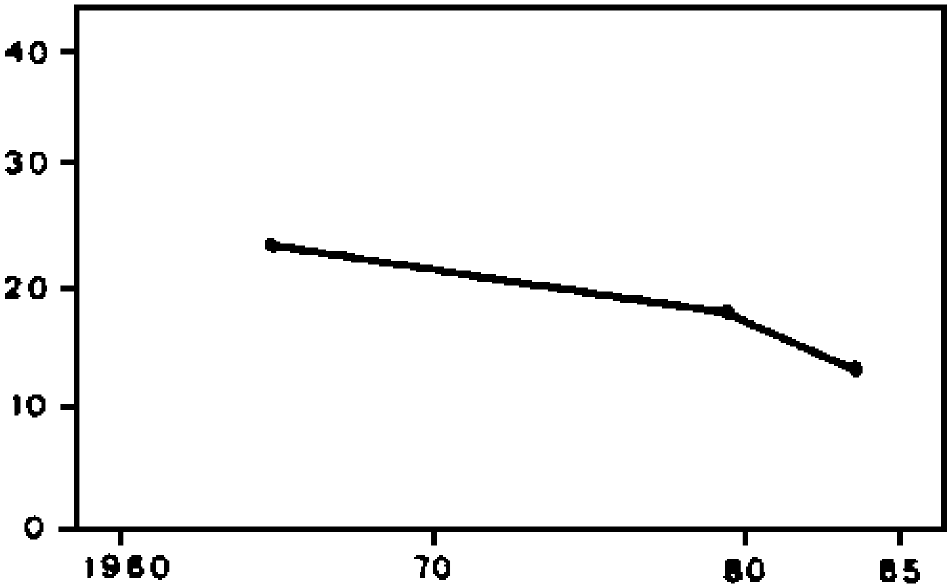

i. Number of deaths/1000 live births



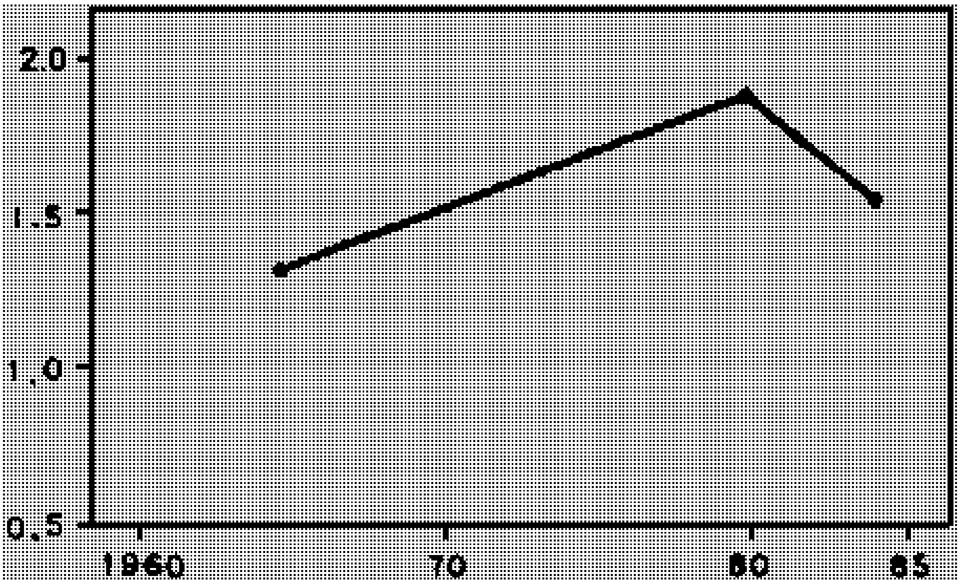
ii. Number of deaths/year (millions)

**G. Child deaths***

* Children 12–60 months



i. Number of deaths/1000 children/year



ii. Number of deaths/year (millions)

Vertical axes on shaded graphs are different from those in other country groupings.

In spite of some drop in the proportion of underweight children, the decline in prevalence has not matched the increase in South Asia's child population. As a result, estimated numbers of underweight children continue to mount, from about 94 million in 1979/81 to almost 98 million in 1983/85.

The proportion of underweight children in South Asia is more than twice that of any other region. In other regions underweight is mostly due to stunted growth in height. In South Asia underweight also results from a much higher degree of wasting − low weight for a given height − than elsewhere. Comparisons of underweight prevalences with other regions thus require caution (Haaga et al, 1985; FAO, 1987a, p.24). It would probably be incorrect to conclude, for example, that the proportion of malnourished children in South Asia is twice as high as that in Africa, as far as the causes and consequences of malnutrition are concerned. This is an area for further research.

Infant mortality rates and child death rates in South Asia have declined steadily since the 1960s (panels 2F and 2G). Because the rate of decline has been faster than that of growth in population in recent years, total annual deaths have also fallen since 1980. Infant deaths dropped from around 4.3 million per year in the early 1960s to an estimated four million in 1980−85. It appears that total child (1 through 4 year old) deaths peaked at 1.9 million a year around 1980 and are now decreasing. This may be another corner turned: if the improvement can be sustained − through a slowing rate of population growth as well as declining mortality rates − the annual death toll among infants and children in South Asia may never again exceed the total of nearly six million a year recorded in the late 1970s and early '80s.

## 2.3 SOUTHEAST ASIA

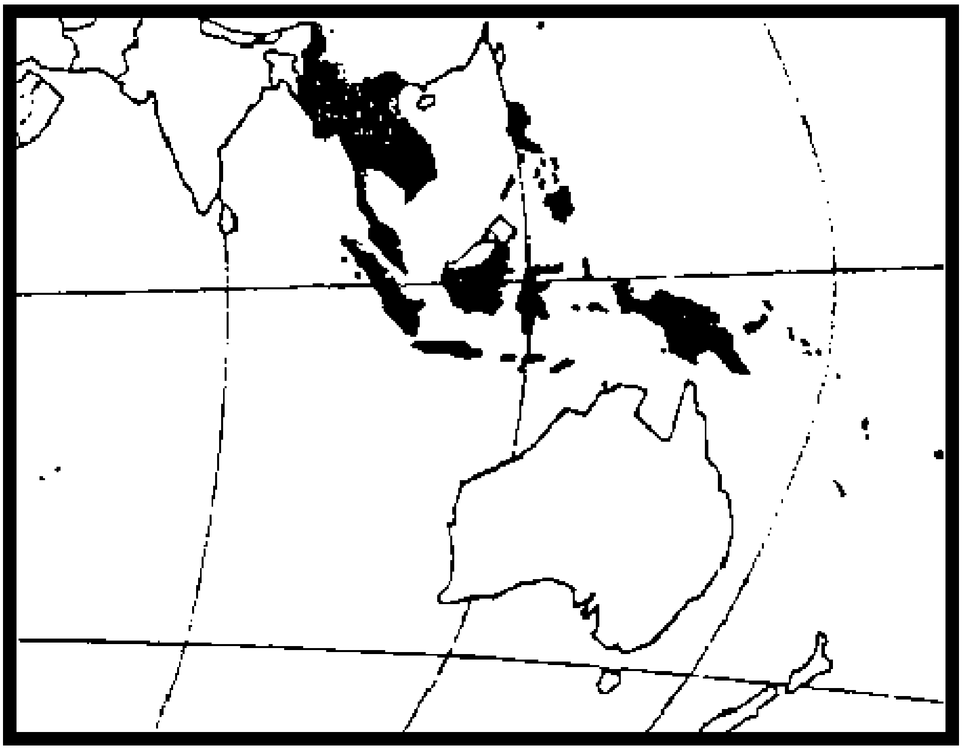
### Panel 3

Southeast Asia's population almost doubled between 1960 and 1985 but, thanks partly to the adoption of high−yielding cereals, food production expanded even faster. In fact, per caput food production increased more rapidly in Southeast Asia than in any other area except China. Dietary energy supply (DES) has increased substantially over the past 15 years, comparably to food production. The increase in DES slowed, however, during the early 1980s (see panels 3B and 3C).

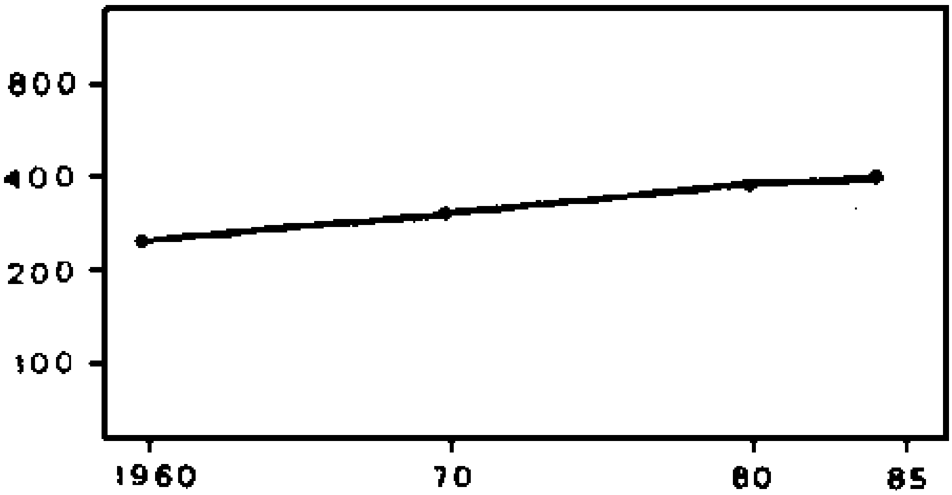
The proportion of the population undernourished (with marginal access to food[8]) fell from about 18 percent of the population in 1969/71 to about 8 percent in 1983/85 (panel 3D). This proportion is now similar to that in South America and about half that in South Asia. However, trends in the mid−1980s are not yet clear and more data are needed to determine whether the slow−down in the growth of food availability is an established trend. Available evidence suggests that total numbers of people undernourished in Southeast Asia have fallen significantly, from above 40 million in 1969/71 to about 27 million in 1979/81; but this improving trend has slowed or even stopped in the 1980's.

[8] See footnote 3.

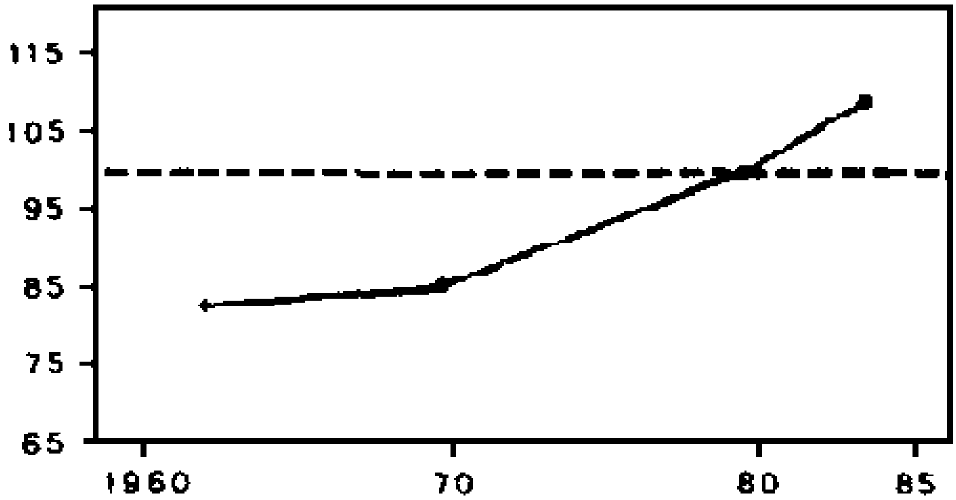
**Panel 3 Southeast Asia**



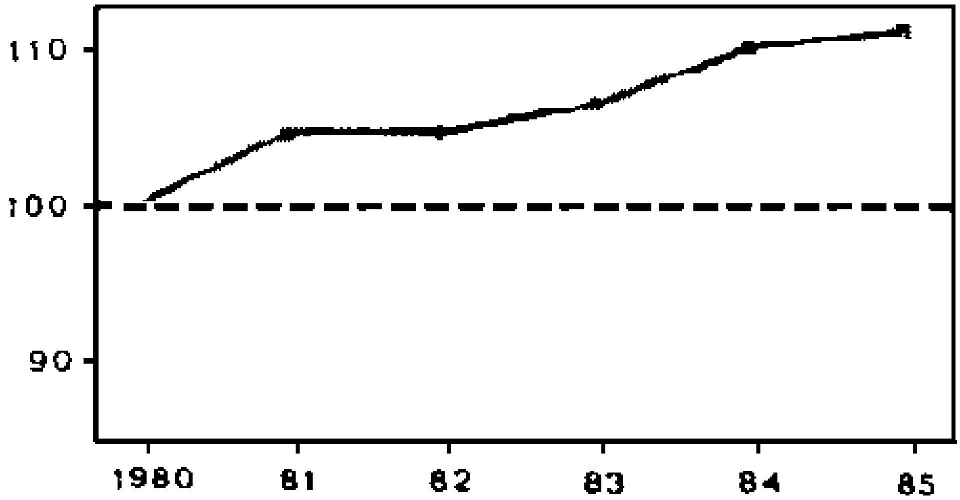
**A. Total population** *(millions – log scale)*




**B. Index numbers of per caput food production** *(1979/81 = 100)*

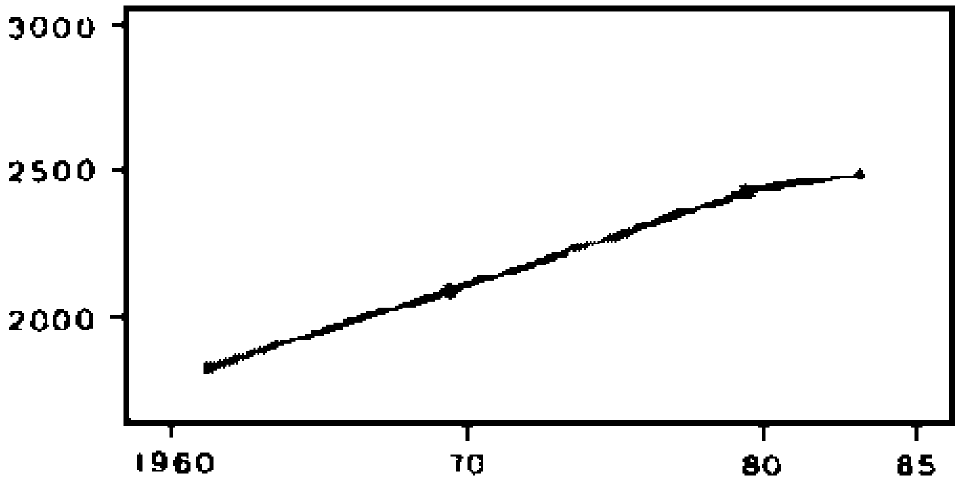


i. 1960–85 (3–year averages)

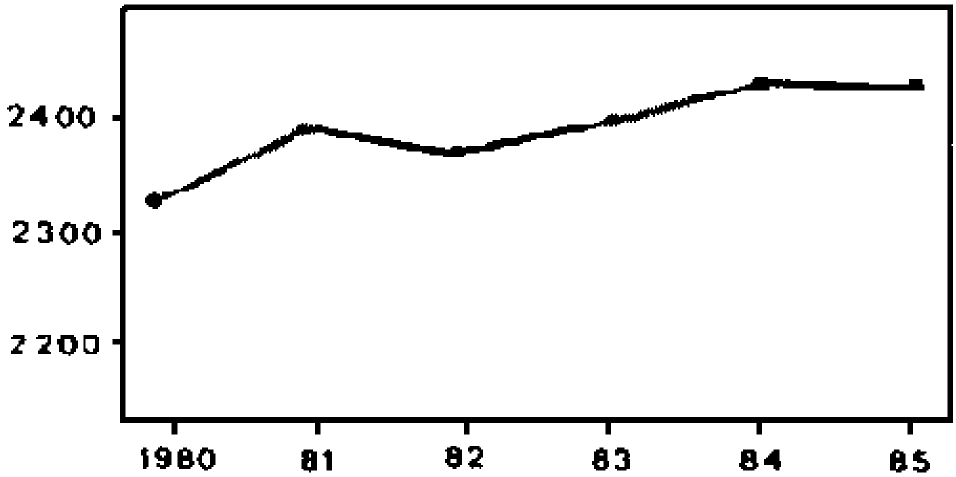


ii. 1980–85 (annual)

**C. Dietary energy supply** (*Kcals/caput/day)*

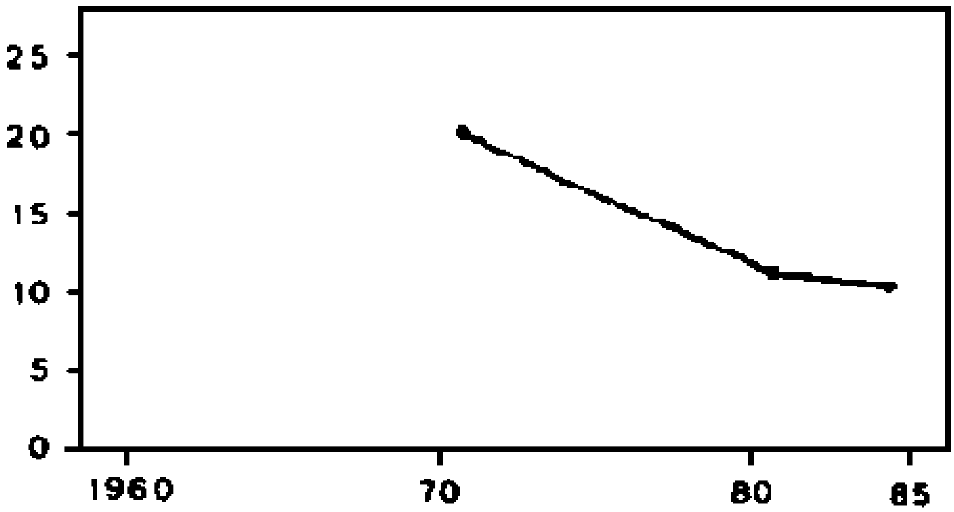


i. 1960–85 (3–year averages)

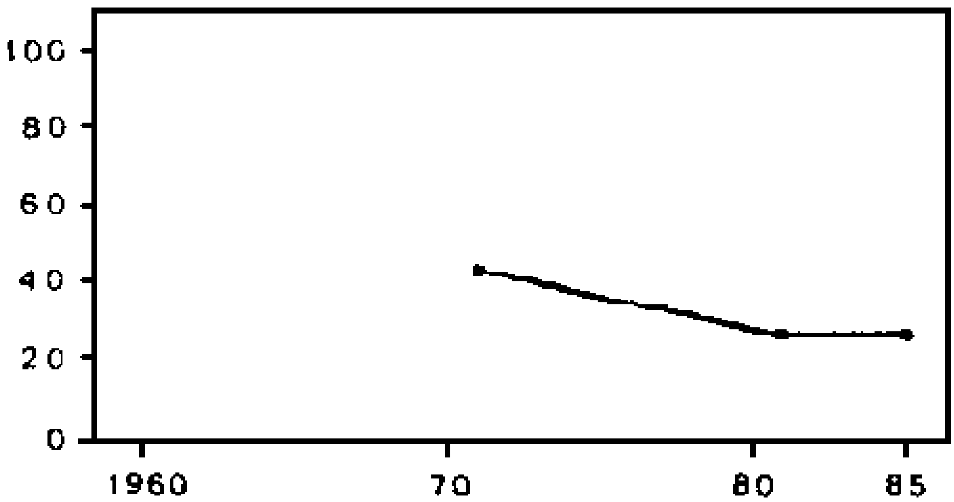



ii. 1980–85 (annual)

**D. Undernourished population** *(DES < 1.2 BMR)*

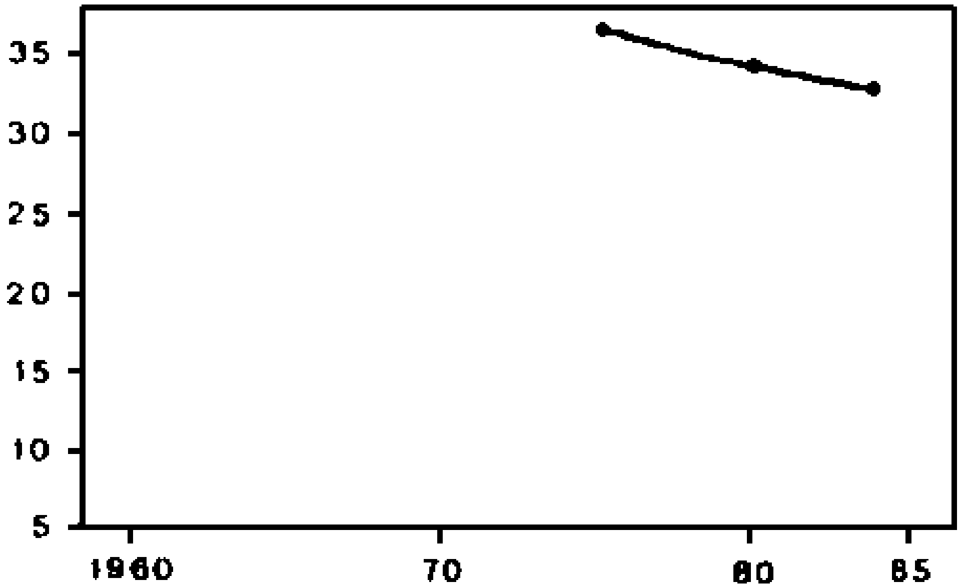



i. percent

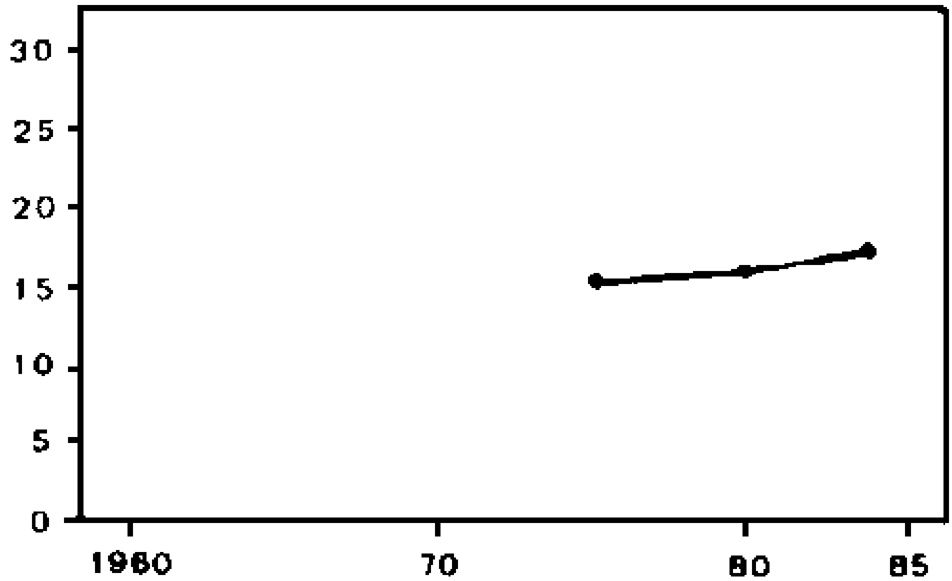



ii. numbers (millions)

**E. Underweight children** *(<2 SD weight–for–age)*



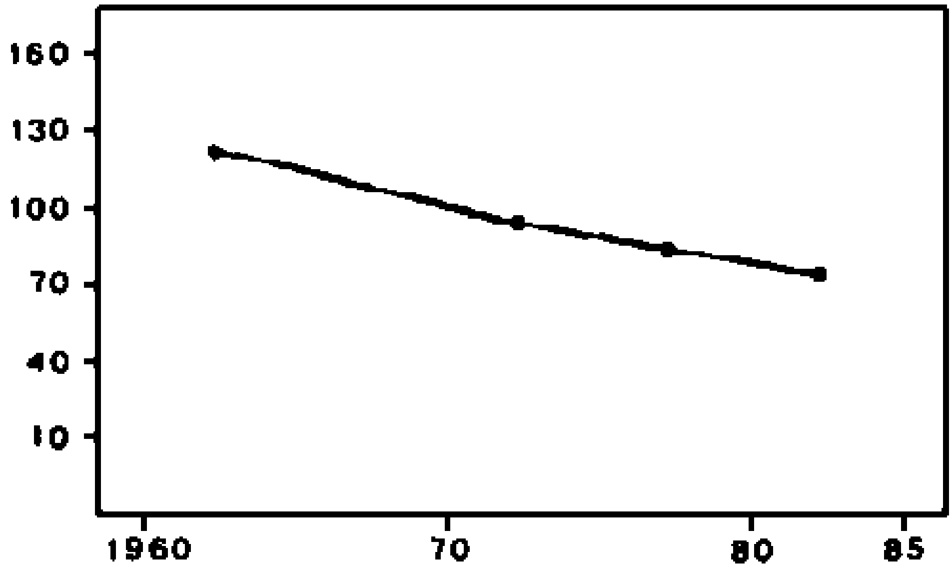
i. percent



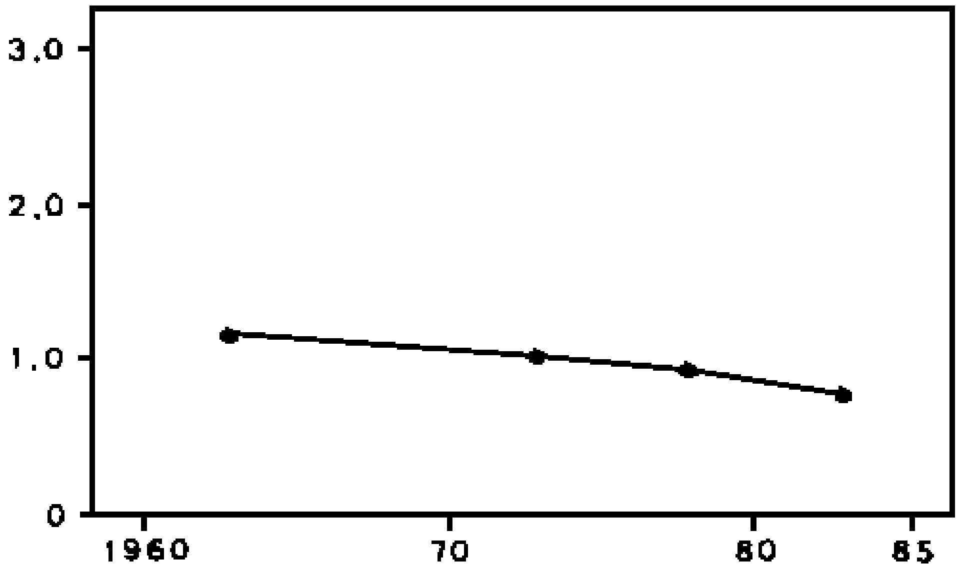
ii. numbers (millions)

**F Infant mortality***

* Infants 0–12 months



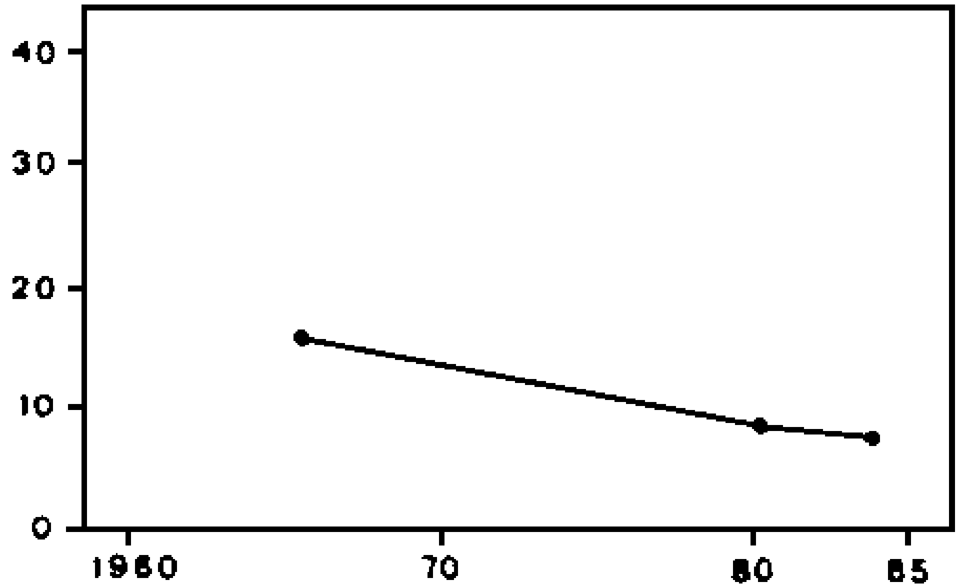
i. Number of deaths/1000 live births



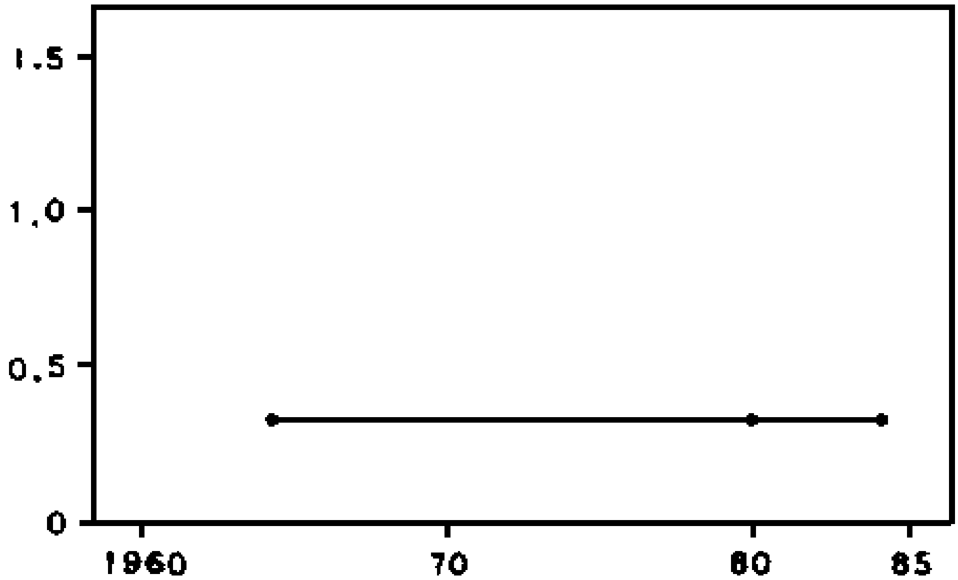
ii. Number of deaths/year (millions)

**G. Child deaths***

* Children 12–60 months



i. Number of deaths/1000 children/year



ii. Number of deaths/year (millions)

A positive trend is also seen in estimates of child malnutrition. Calculations show that average prevalences of underweight children have fallen slightly, from 34 percent in 1979/81 and 33 percent in 1983/85 (panel 3E). This change, slight but moving in the right direction, is shown in the results of child nutrition surveys in a few countries. However, in the Philippines representative surveys indicated a drop in malnutrition levels among children between 1978 and 1982, but an increase again in 1982 to 1985 (NFP, 1986). Moreover, the rate of increase in Southeast Asia's child population is such that numbers of underweight children are estimated to be increasing still and could now total nearly 18 million.

Infant and child death rates have fallen rapidly since 1960/65 (panels 3F and 3G), and are now considerably lower on average than in South Asia, but higher than in South America. The number of infant deaths has fallen, and child deaths have remained stable, but together they still total more than one million a year.

**2.4 MIDDLE AMERICA AND CARIBBEAN**

**Panel 4**

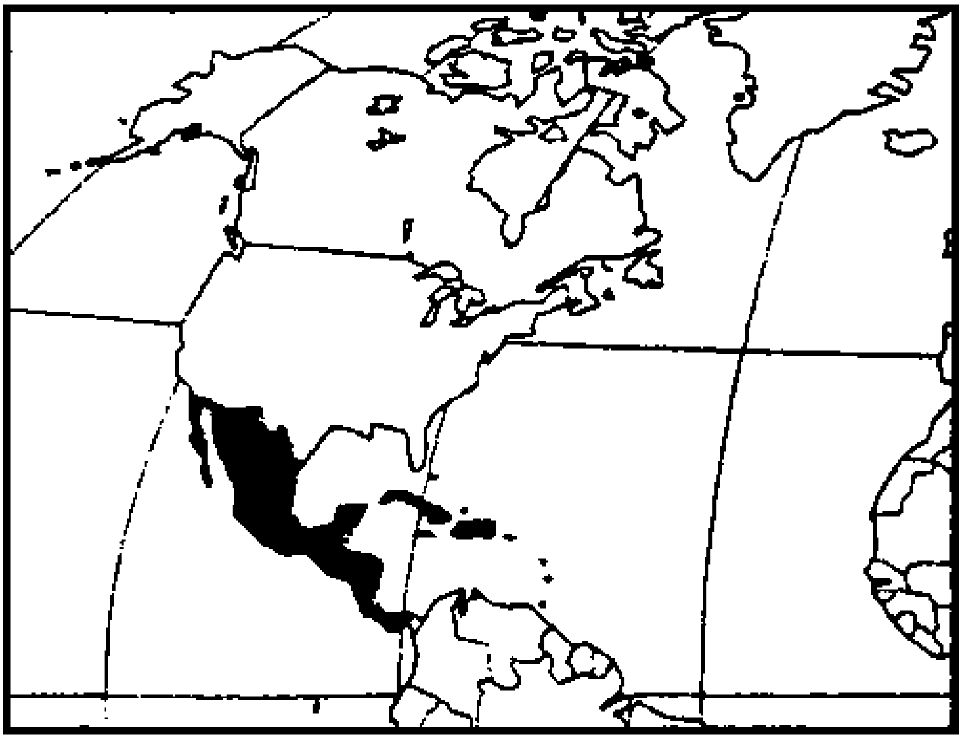
This grouping includes Mexico, Central America, and the countries of the Caribbean. Population sizes are diverse, and average indicators are substantially influenced by values for Mexico and Cuba. Averages, in any region or country, tend to hide the presence of groups of population where problems of undernutrition are still very serious. On the other hand, for many countries in this group, obesity and other diet−related health problems are becoming relevant.

Per caput food production underwent a noticeable expansion in Middle America and the Caribbean in the 1960s and '70s (panel 4B). In the early '80s, however, this was reversed, probably in response to economic recession and political instability. The average index of per caput food production fell from 1981, although there are broad differences between countries.

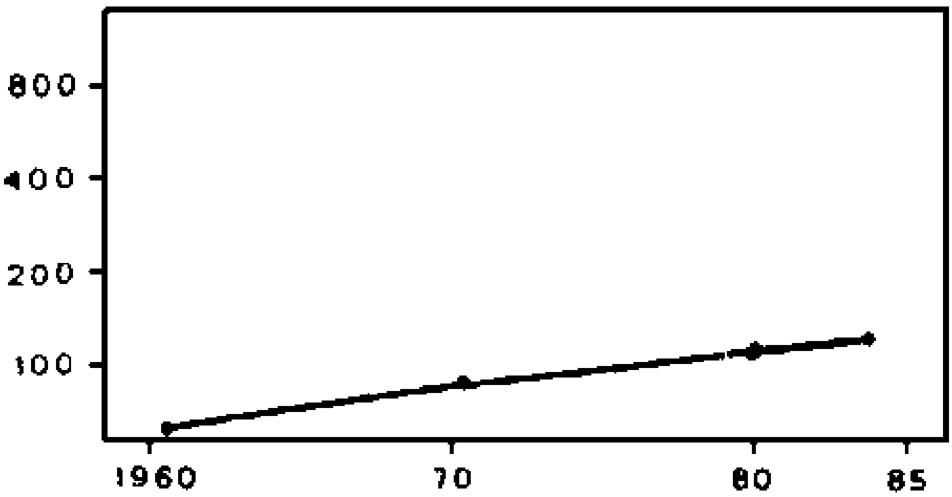
Despite these difficulties, per caput dietary energy supply (DES) continued to expand fairly rapidly, with increases in food imports, and by 1983/85 average DES in Middle America and the Caribbean was estimated at nearly 2900 kcals/caput/day (panel 4C), approaching the levels of industrialized countries. The proportion of the population undernourished (with marginal access to food[9]) is estimated to have fallen from around 20 to 15 percent between 1969/71 and 1979/81. This rate of improvement slowed, however, in the 1980s. It should be noted that a slowing in the decrease of already relatively low prevalences in this area is perhaps less serious a problem than in other regions. Total numbers undernourished remain around 12 million.

[9] See footnote 3.

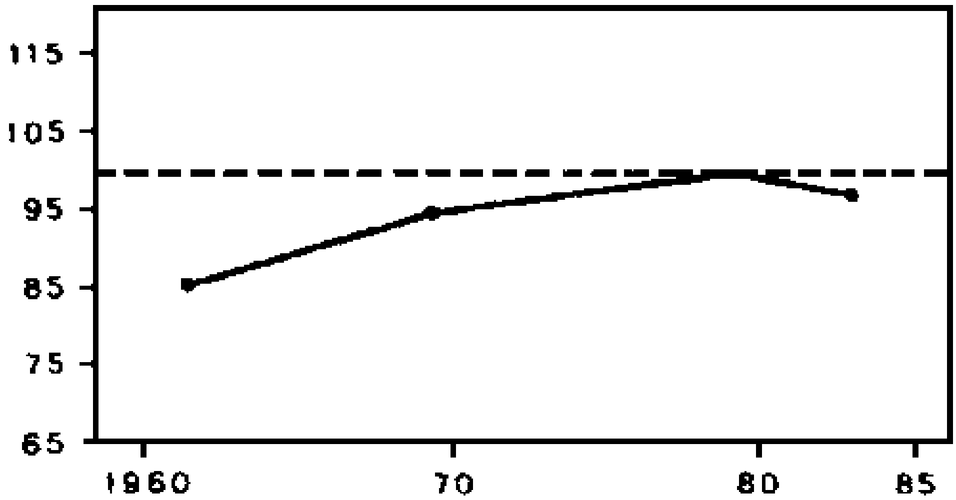
**Panel 4 Middle America/Caribbean**



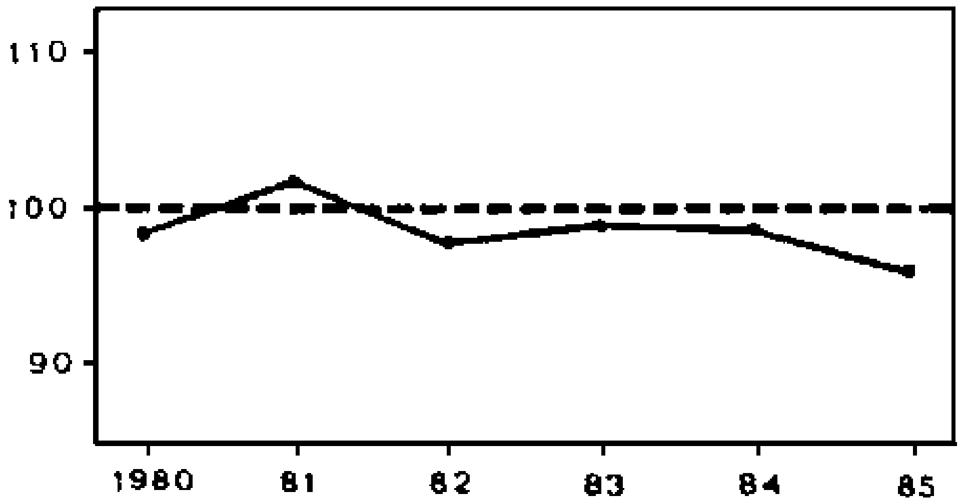
**A. Total population** *(millions – log scale)*



**B. Index numbers of per caput food production** *(1979/81 = 100)*

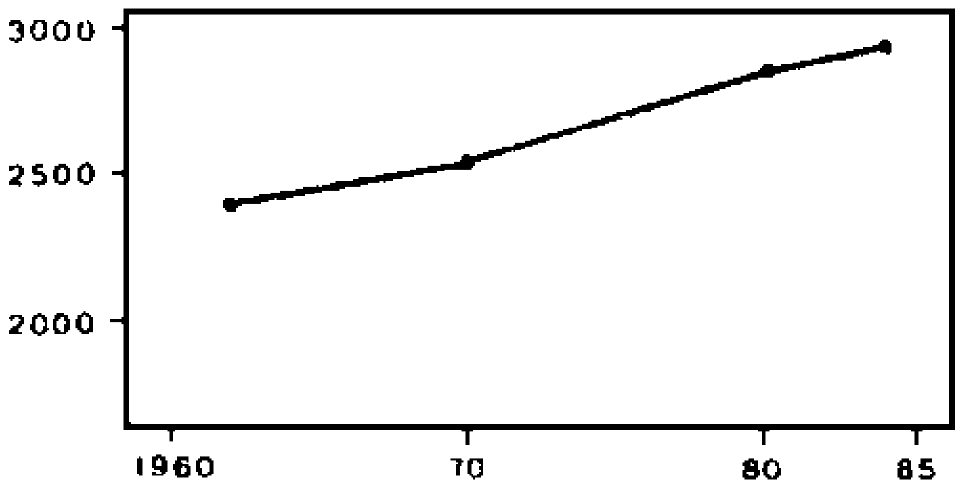


i. 1960–85 (3–year averages)

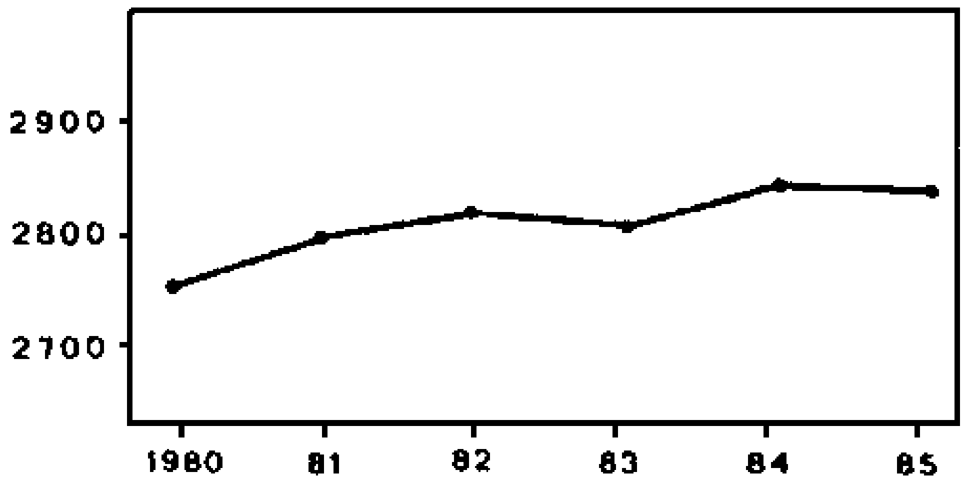


ii. 1980–85 (annual)

**C. Dietary energy supply** *(Kcals/caput/day)*

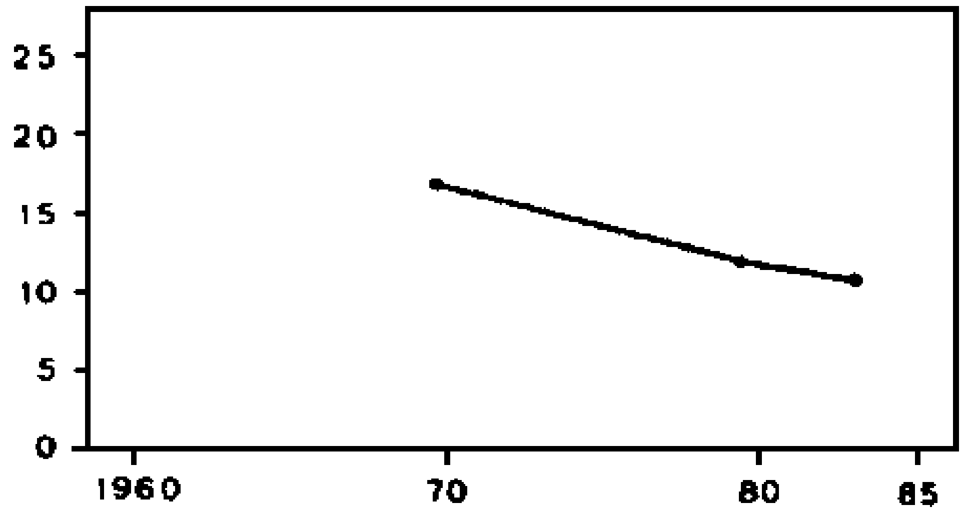


i. 1960–85 (3–year averages)

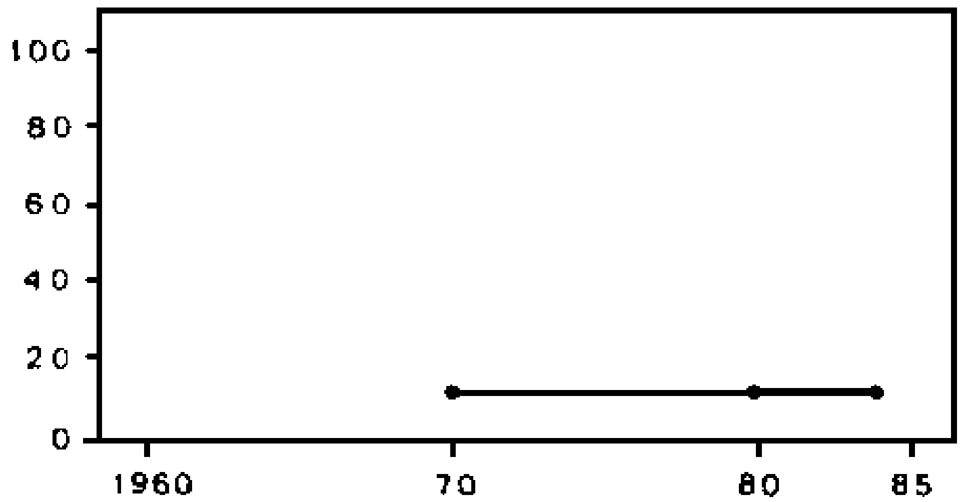


ii. 1980–85 (annual)

**D. Undernourished population** *(DES < 1.2 BMR)*

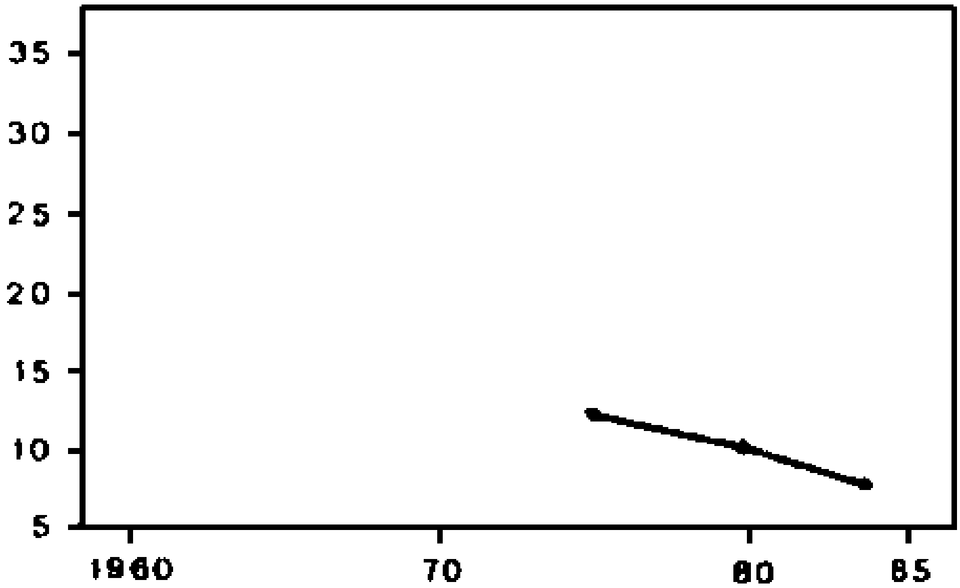


i. percent

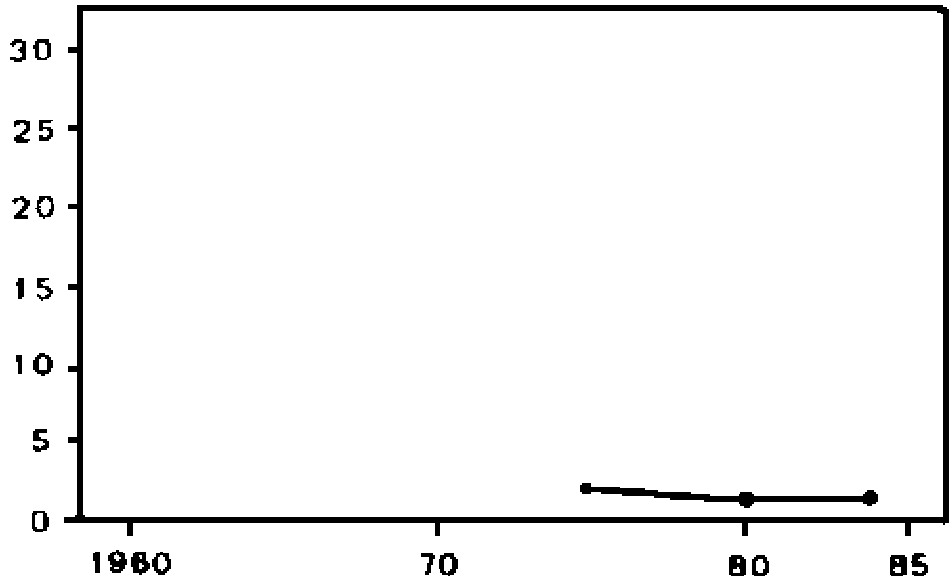


ii. numbers (millions)

**E. Underweight children** *(< 2 SD weight–for–age)*



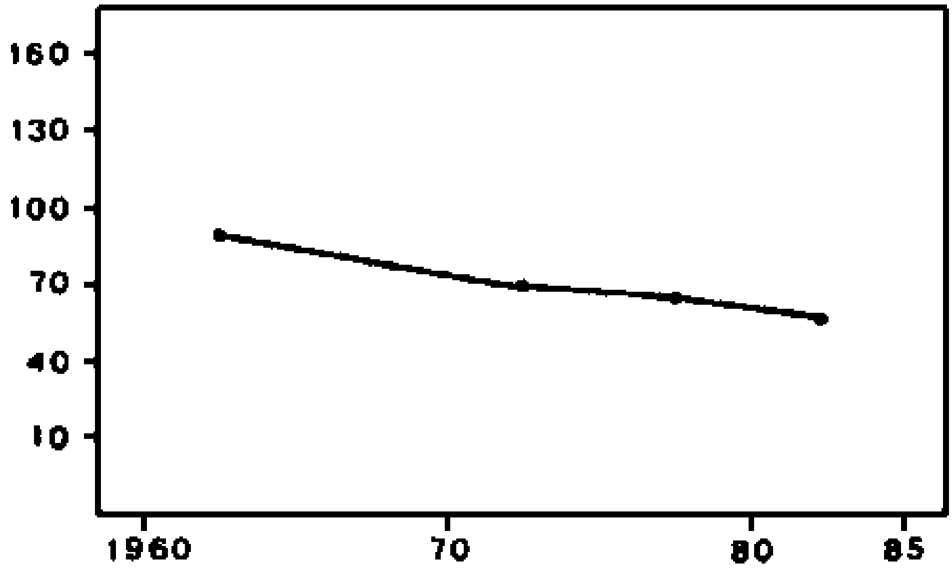
i. percent



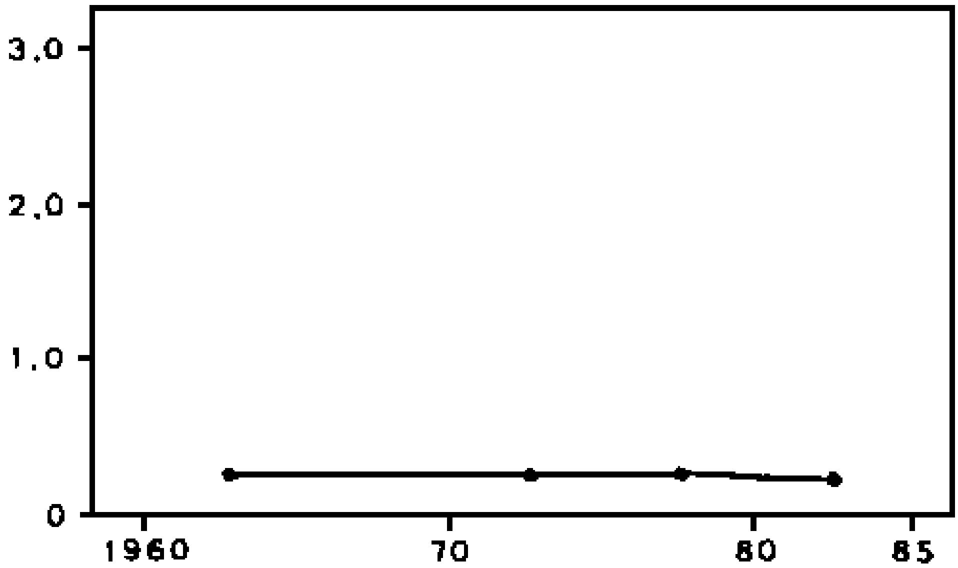
ii. numbers (millions)

**F Infant mortality***

* Infants 0–12 months



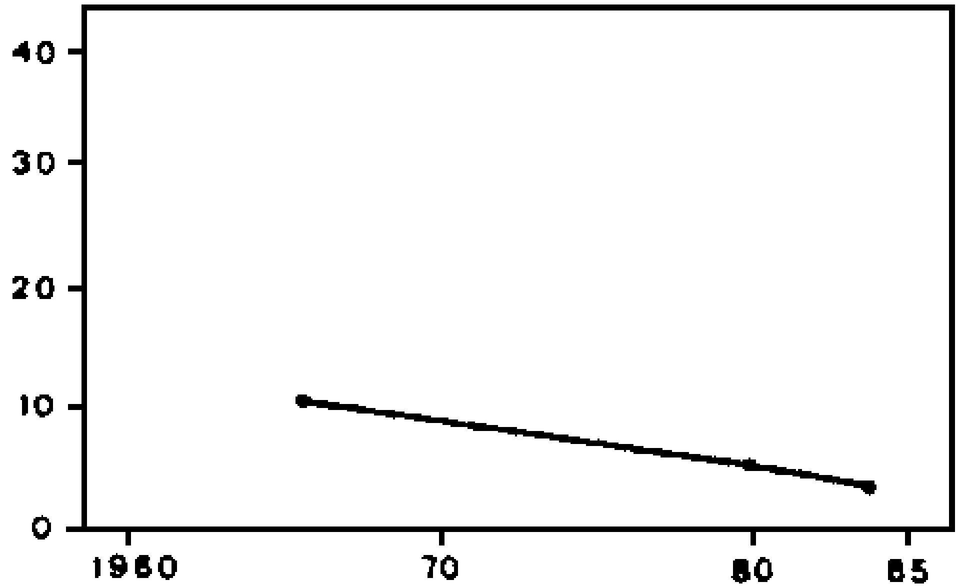

i. Number of deaths/1000 live births



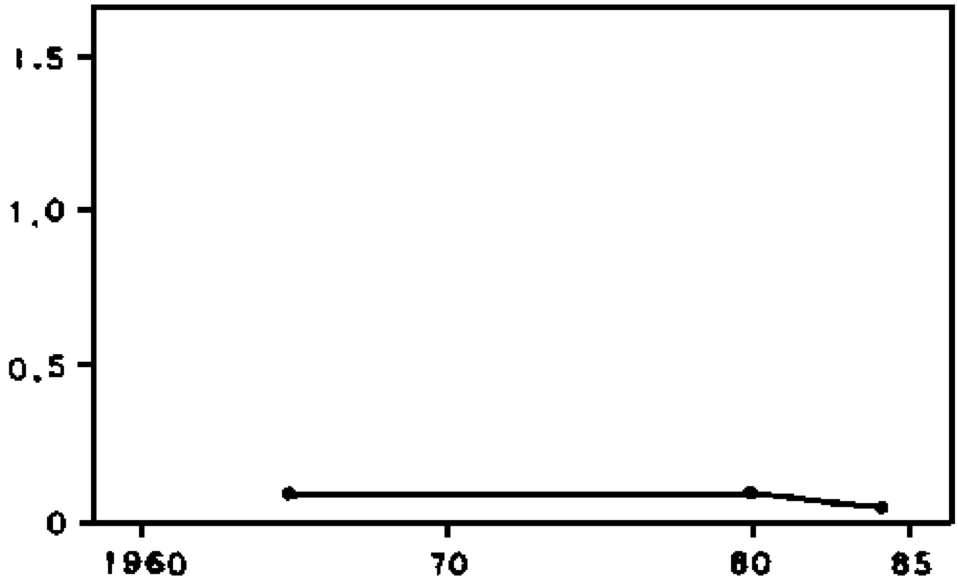

ii. Number of deaths/year (millions)

**G. Child deaths***

* Children 12–60 months



i. Number of deaths/1000 children/year



ii. Number of deaths/year (millions)

Economic recession has affected the poor in most parts of the region. That food consumption almost certainly fell during the early 1980's is indicated, for example, by the increase in the hours of labour at minimum wage necessary to feed a family in countries such as Costa Rica, illustrated in Figure 7, and Mexico (Arnauld, 1986). Results such as these indicate that access to food, especially for the urban population, may have been at its most difficult in 1982 in Costa Rica, and 1985 in Mexico.

Prevalences of underweight children differ between countries in Middle America and the Caribbean, reaching as much as 44 percent in Guatemala, according to a survey in 1977 (Valverde et al, 1981). Data compiled by WHO show some improvements over time (WHO, 1987). For example, the proportion of the child population underweight, assessed in two national surveys in Costa Rica, dropped from 16 percent in 1978 to 6 percent in 1982 (Costa Rica, 1980,1982). Overall, the average prevalence for the country group is calculated to have declined from about 13 percent in 1974/76 to nine percent in 1983/85 (due largely to Mexico which accounts for nearly 70 percent of the total child population of the country group), while total numbers of underweight children fell from about 1.9 million to 1.7 million in the same period (panel 4E). Again, these are averages in a diverse group, and it is likely that in some countries the extent of child malnutrition increased with the economic stress of recent years. In Caribbean countries there is evidence of a resurgence of child malnutrition in the late 1970s and early 1980s – for example, hospital admissions for severe malnutrition are reported to have doubled between 1975 and 1985 (Landman, 1986).

In the period 1980/85, Middle America and the Caribbean had the lowest rates of infant mortality and child deaths of all groups of developing countries except China, and the trend to further improvement has continued (panels 4G and 4F). Differences within the region can be illustrated from infant mortality data. For example, Cuba and Costa Rica had estimated infant mortality rates for 1980/85 of 17 and 20, respectively, not much higher than those of high–income countries. These low rates are probably due to a considerable extent to social and health programmes designed to reach the majority of the population. On the other hand, countries such as Haiti, Honduras, and Nicaragua, have substantially higher infant mortality rates for the same period, of 128, 82, and 76 respectively.

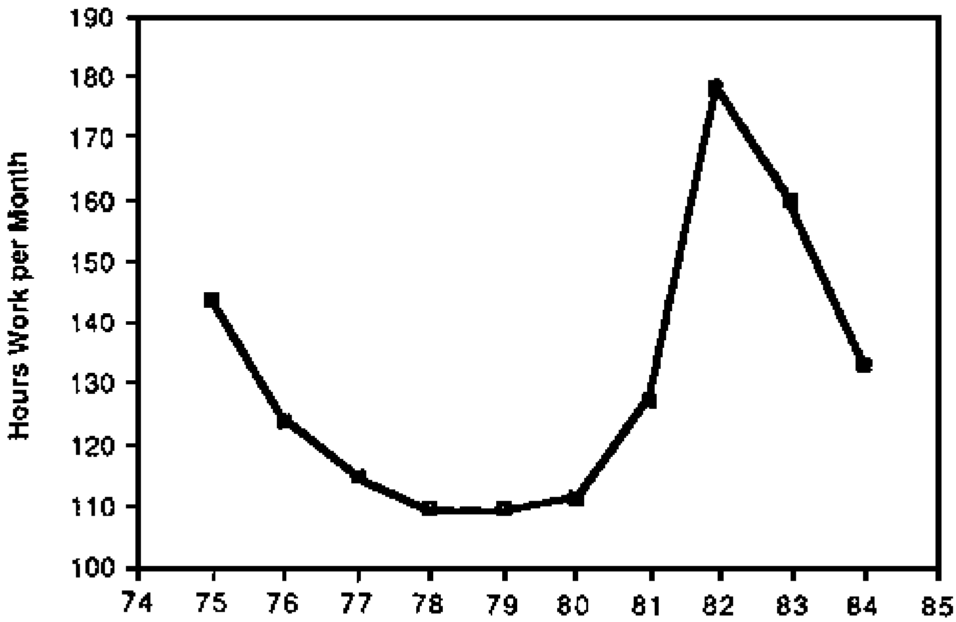


**FIGURE 7:** Hours Work per Month to Purchase Energy Requirement in Costa Rica, 1975–1984.

### 2.5 SOUTH AMERICA

#### Panel 5

The index of per caput food production in South America rose during the 1960s and '70s (panel 5B). There was also a gradual increase in dietary energy supply (DES), and a fall in the proportion of the population undernourished (with marginal access to food[10]) from an estimated nine percent around 1970 to eight percent, or some 18 million people, at the beginning of the 1980s (panel 5C and 5D).

[10] See footnote 3.

Since the onset of the economic recession in the early 1980s, however, there was no further improvement in the nutrition situation. The recession had severe effects on the level of food consumption, especially that of the poor. Unemployment increased and the cost of food in relation to minimum wages rose sharply (see the example of Peru in Figure 8). DES was static from 1980 onwards, at around 2600 kcals/caput/day, well below present levels in Middle America and the Caribbean, for example. The prevalence of undernutrition is calculated to have remained at eight percent since 1979/81 so that, with population growth, estimated numbers of undernourished are likely to have risen.

Progress in the nutritional status of children probably ceased in the 1980s (panel 5E). The proportion of underweight children is estimated to have declined from eight percent in 1974/76 to six percent in 1979/81 but not to have improved since. The number of underweight children remained steady at around 2.3 million. However, there are important differences within the region. Child malnutrition has virtually disappeared in Chile, although a temporary increase was recorded in 1983 (Valiente, 1985). In contrast, Bolivia has a prevalence of underweight children of about 14%, which remained essentially unchanged between 1976 to 1981 (Bolivia, 1977, 1981).

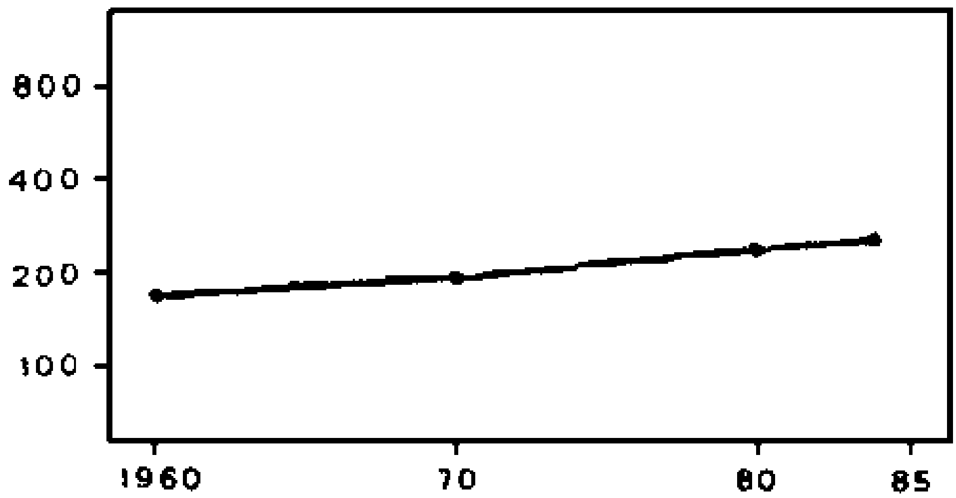
**FIGURE 8:** Hours Work per Month to Purchase Energy Requirement in Peru, 1975–1984.

Infant mortality rates fell fairly rapidly between 1960/65 and 1980/85, from about 103 to 65 per thousand live births. Birth rates also decreased (panel 5F). Numbers of infant deaths fell from an estimated 0.6 million in 1960/65 to 0.5 million in 1980/85, and child death rates and numbers have fallen similarly. Nevertheless, there is evidence in economically depressed areas such as Northeast Brazil that recently there has been an increase in the hours of labour needed to purchase an adequate food basket, a deterioration in nutritional indicators such as low birth weight and an upturn in child death rates (Figures 9A and 9B).

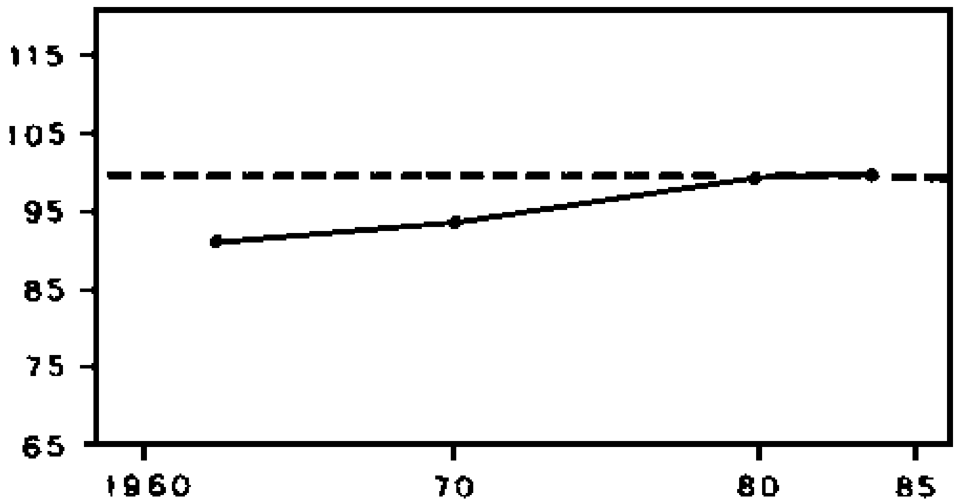
The underlying trend seems to be one of a long term improvement in the nutrition situation, halted during the current economic crisis. Improving trends may be re–established if the effects of the recession are contained.

**Panel 5 South America**

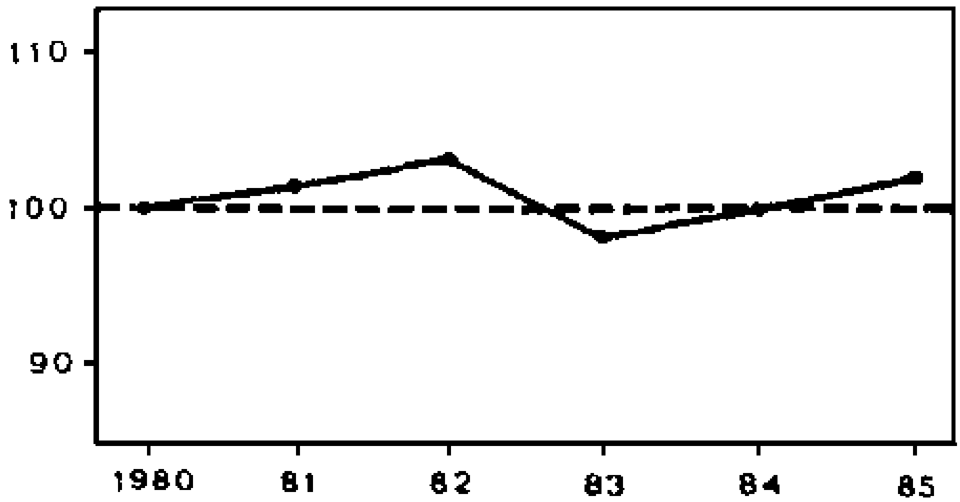
**A. Total population** *(millions – log scale)*




**B. Index numbers of per caput food production** *(1979/81 = 100)*

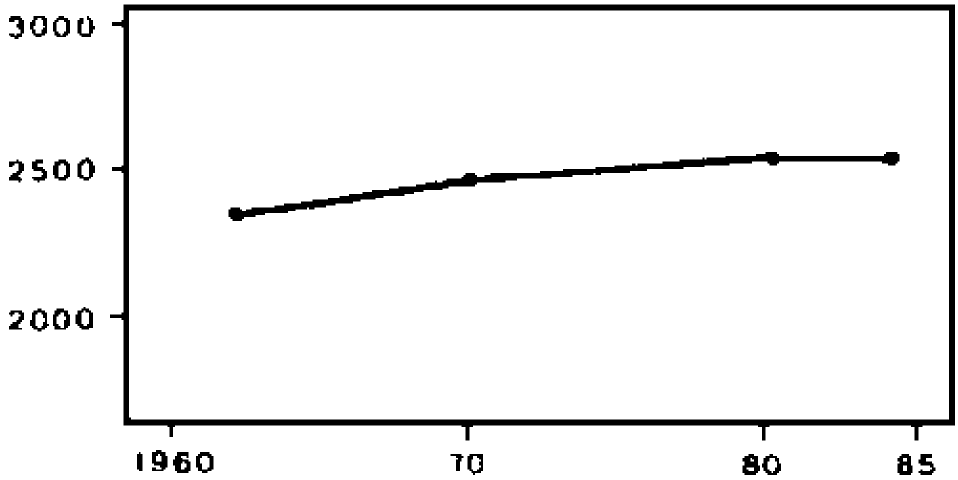



i. 1960–85 (3–year averages)

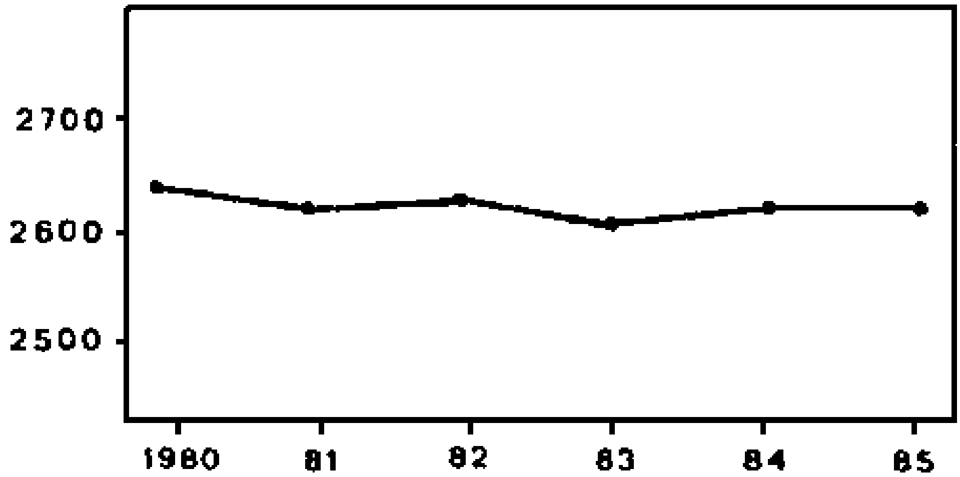



ii. 1980–85 (annual)

**C. Dietary energy supply** *(Kcals/caput/day)*

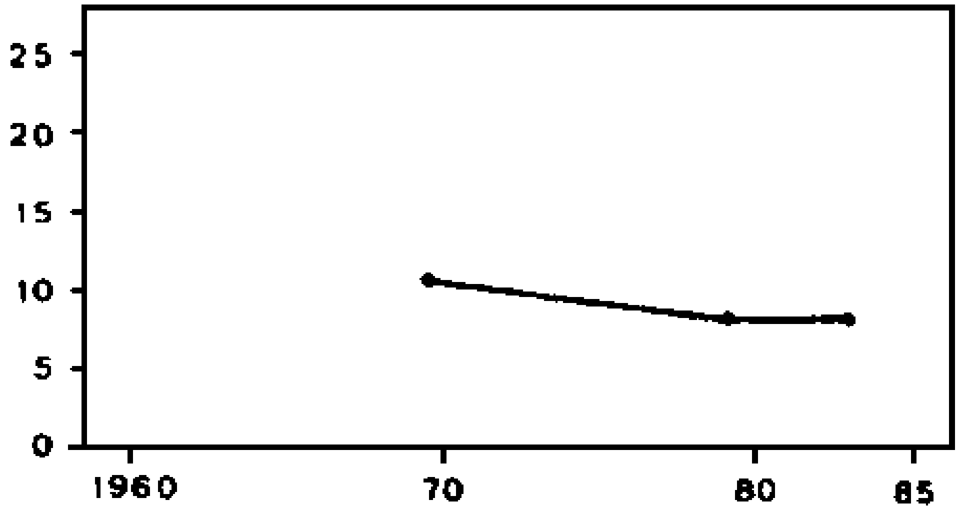


i. 1960–85 (3–year averages)

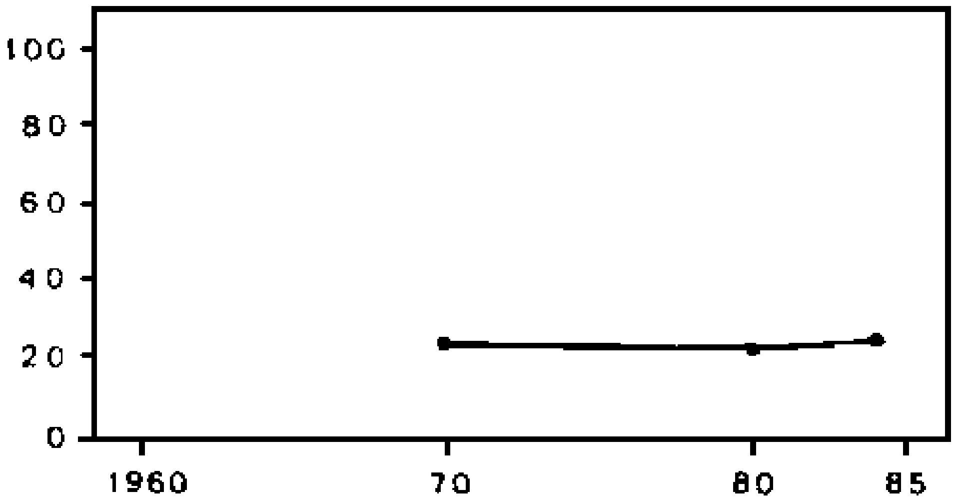


ii. 1980–85 (annual)

**D. Undernourished population** *(DES < 1.2 BMR)*

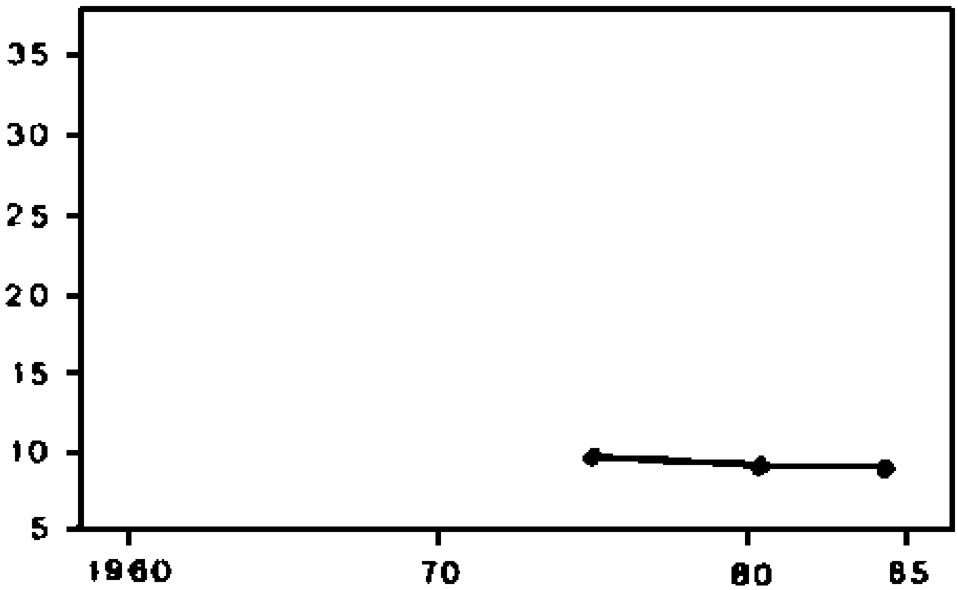


i. percent

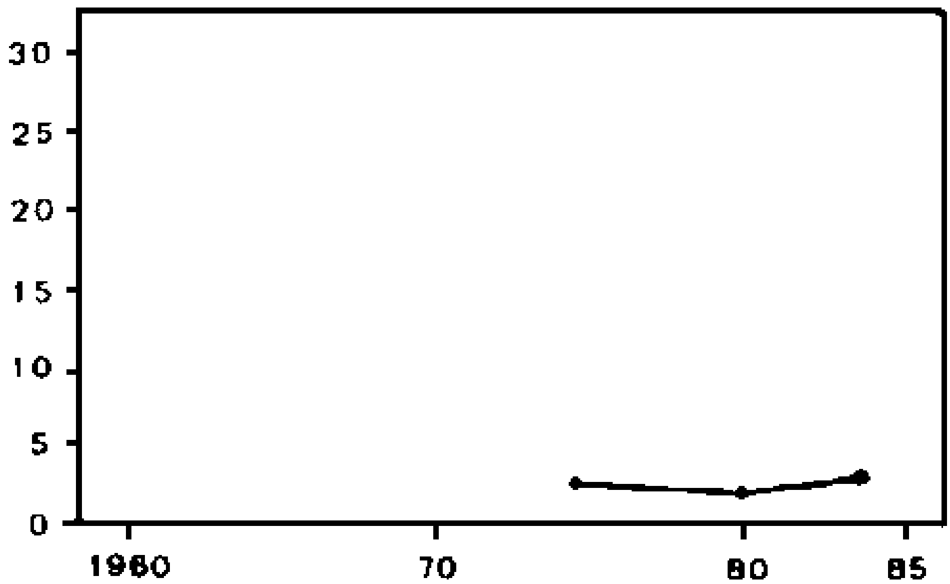



ii. numbers (millions)

**E. Underweight Children** *(< 2 SD weight–for–age)*



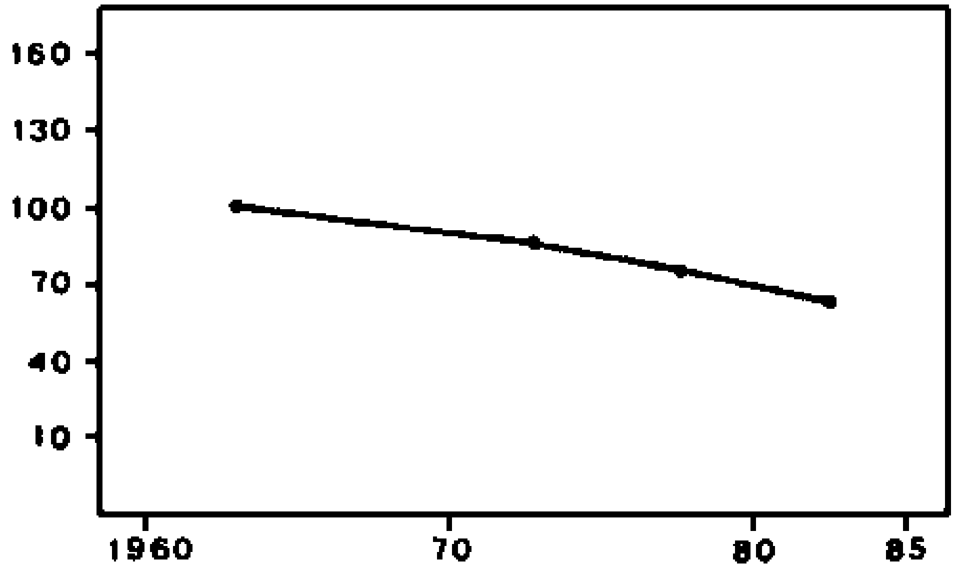

i. percent



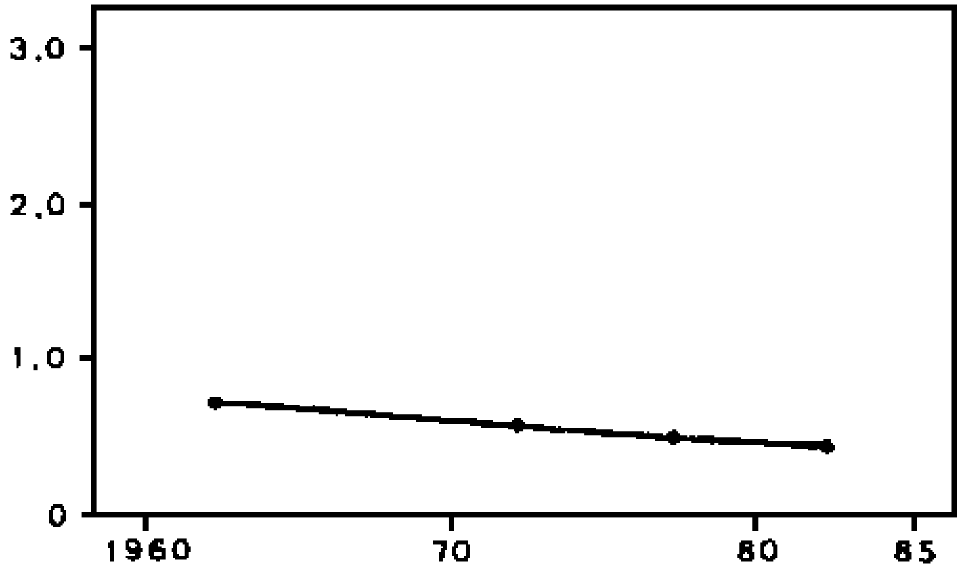

ii. numbers (millions)

**F Infant mortality***

* Infants 0–12 months



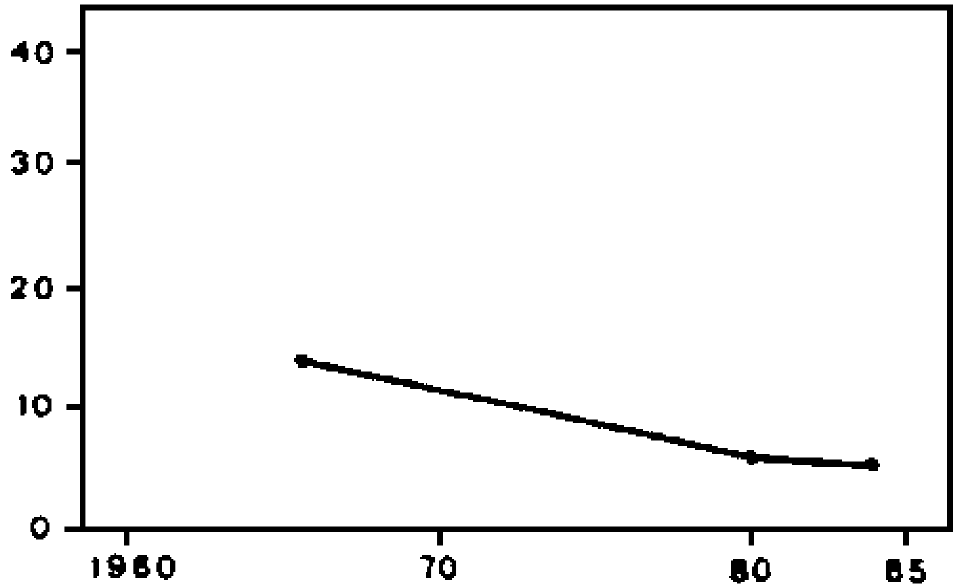

i. Number of deaths/1000 live births



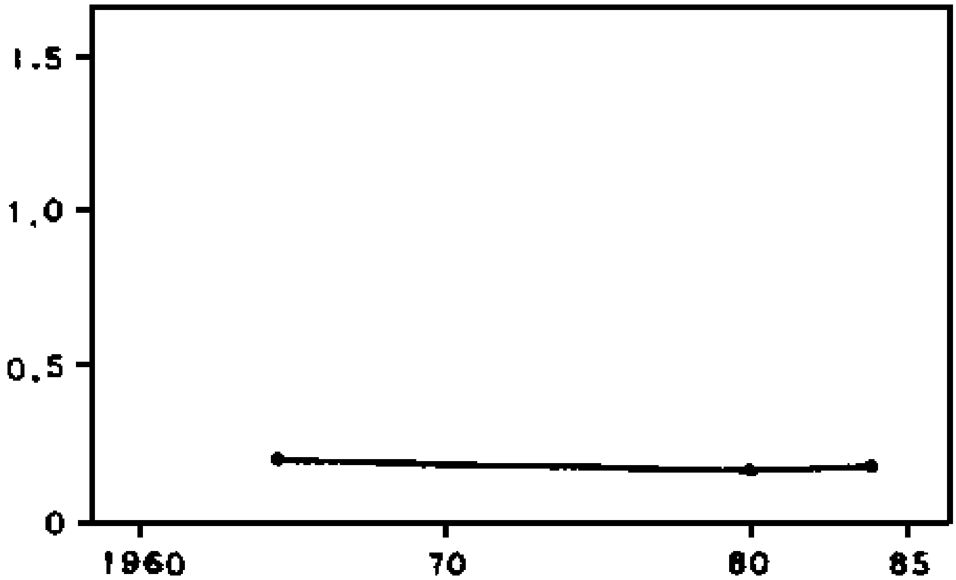

ii. Number of deaths/year (millions)

**G. Child deaths***

* Children 12–60 months



i. Number of deaths/1000 children/year



ii. Number of deaths/year (millions)

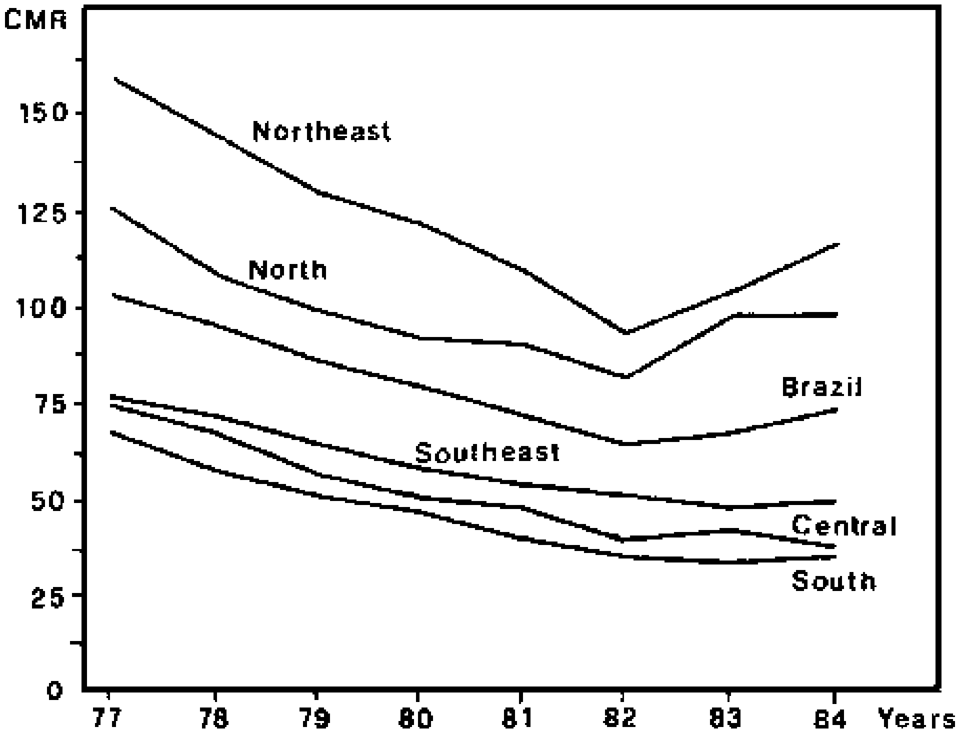


**FIGURE 9A:** Child Mortality Rates (CMR–child deaths/1000/year) in Brazil by Region, 1977–1984.

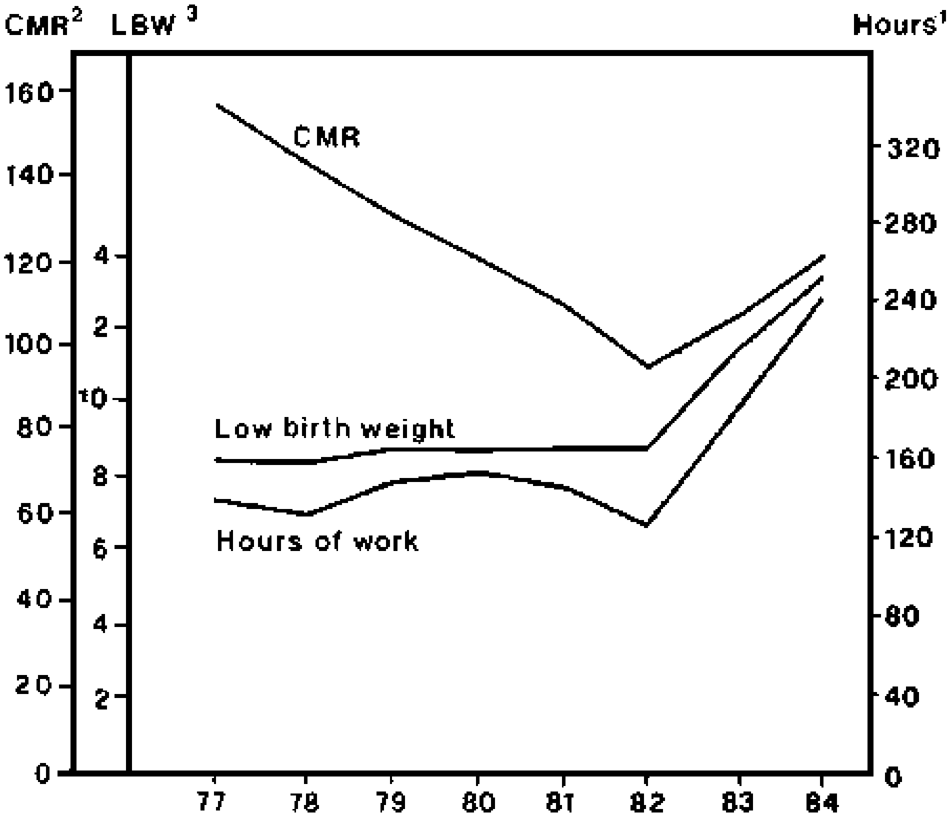


**FIGURE 9B:** Cost of Fixed Food Basket[1], Child Mortality Rate[2], and Low Birth Weight[3] in Northeast Brazil, 1977–1984.

[1] in working hours per month at minimum wages.
[2] CMR/l000/year
[3] LBW in percent of all newborn.

(Source: Becker and Lechtig, 1986)

## 2.6 NEAR EAST AND NORTH AFRICA

**Panel 6**

The level of food imports have increased in the Near East and North Africa over past two decades due to rapid population growth, urbanization, and increases in GNP helped by petroleum exports. Export revenues have lead to improvements in indicators of social veil−being and have been spread to varying degrees in poorer countries in the region, either through direct aid or through labour migration to the richer countries. Population growth, immigration, higher incomes and food policies have increased substantially the demand for food products, especially in the petroleum producing states.

Food production expanded at an accelerating rate in this region since 1960 (panel 6B). With the addition of increasing levels of food imports dietary energy supply (DES) rose even faster (panel 6C). Three groups of countries can be distinguished. The group with the highest income (GDP per caput greater than $ 2000 − including Cyprus, Kuwait, Libya, Saudi Arabia and United Arab Emirates) had a DES estimated at more than 3000 kcal/caput/day in 1979/81. An intermediate income group (GDP per caput of $1000−$2000 − with Algeria, Egypt, Iraq, Lebanon, Jordan, Morocco, Syria, Tunisia and Turkey) had DES from 2600−3200 kcal/caput/day in the same period. The two low−income countries (GDP per caput of less than $1000: Yemen Arab Republic and Yemen Peoples Democratic Republic) had DES of less than 2300 kcal/caput/day.

The prevalence of undernutrition (marginal access to food[11]) in the Near East and North Africa is estimated to have fallen from 15 percent to only 6 percent between 1969/71 and 1979/81, but declined more slowly in the following four years (panel 6D). Even with population growth, this led to a halving in the number of people suffering from under−nutrition, from an estimated 20 million to 10 million.

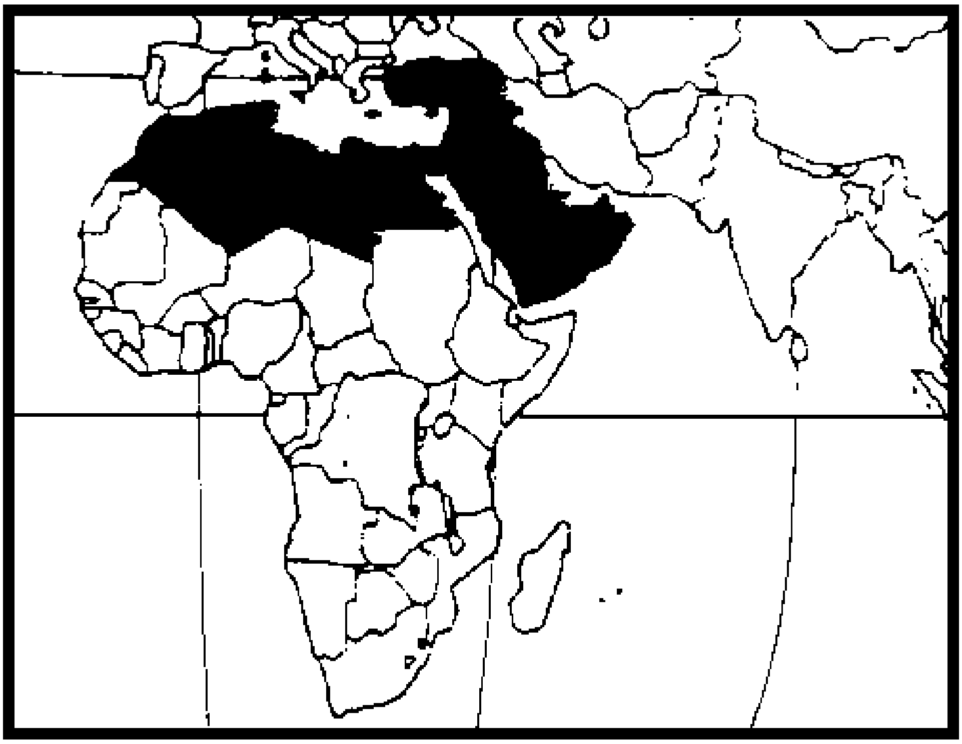
[11] See footnote 3.

The increased wealth of the region has caused far−reaching changes in diet. More roots and tubers, fruits and vegetables, sugar and animal products are now eaten. Consumption of maize and barley has declined in many countries, often accompanied by increased intake of wheat and rice. There has been a big increase in fat consumption, mostly from imported vegetable oils. Poultry production has become a growth industry, with the consumption of poultry replacing traditional meats such as goats and sheep. Average per caput meat consumption, which was around 10−20 kg a year in most countries 20 years ago, is now around 30 kg in many countries and exceeds 50 kg in the richest ones. Large increases have also been recorded in consumption of milk and sugar products. Although these changes in diet have so far contributed to rapidly improving nutrition (on average), diet−related health problems could now also emerge as issues of concern.

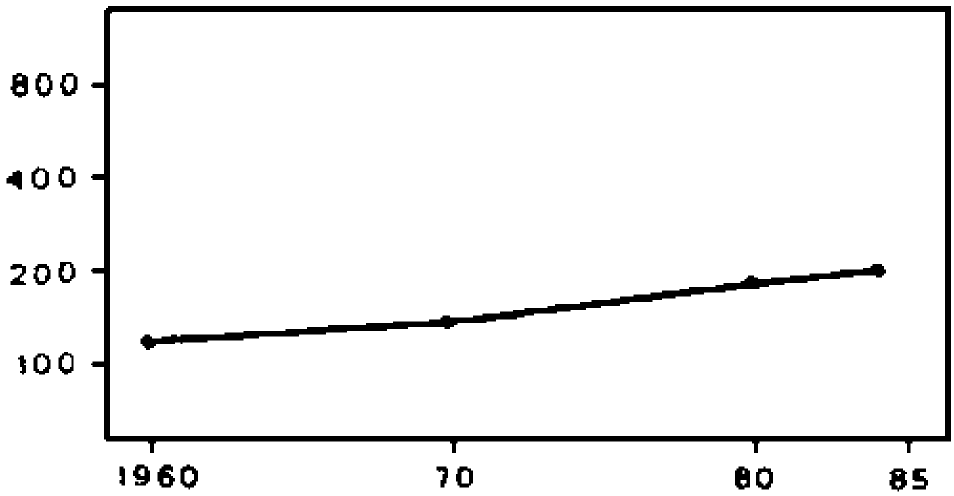
Nutrition indicators point to a marked improvement over the past 25 years (panel 6E). Survey data on child nutrition are very limited and their vide range makes generalization difficult. For example, survey results compiled by WHO (1987) shoved prevalences of underweight children of nine percent in Kuwait in 1984 and up to 60 percent in Yemen Arab Republic in 1979. The estimated prevalences for the region given in panel 6E − 12 percent around 1980 and 10 percent around 1985 −are therefore averages of a particularly vide range. This is in line with the vide variation in socio−economic conditions in the region. Even in the richest countries, there are extreme differences in living conditions among the population. Overall numbers of underweight children are declining, despite population increases, a positive trend seen elsewhere only in Middle America and the Caribbean and China.

The extent of the reduction in infant and child death rates − once among the highest in the world − has been greater than in any other group of countries (panels 6F and 6G; compare with other panels F and G). For example, infant mortality rates in 1960/65 were about 160 per thousand live births, the same as in Africa and South Asia; by 1980/85 they were substantially lover, less than 90 deaths per thousand live births. Numbers of infant and child deaths also fell rapidly, similar to trends in numbers of underweight children.

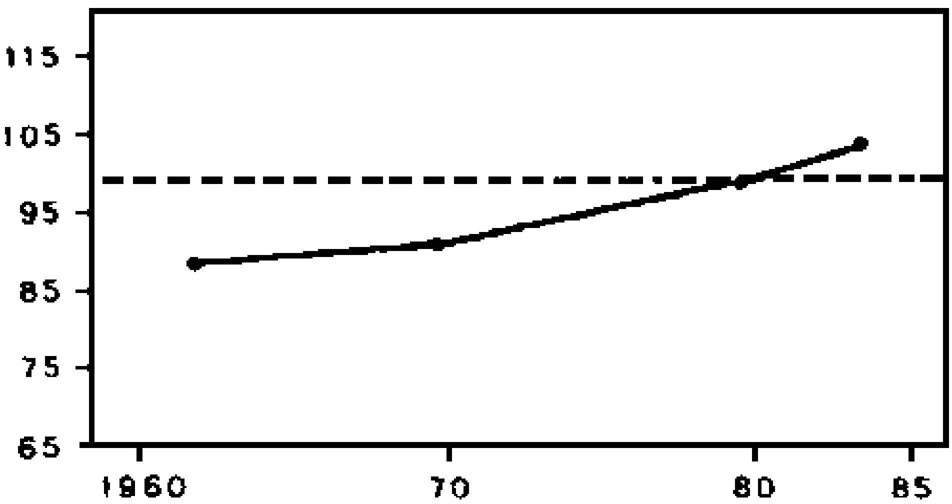
**Panel 6 Near East/North Africa**



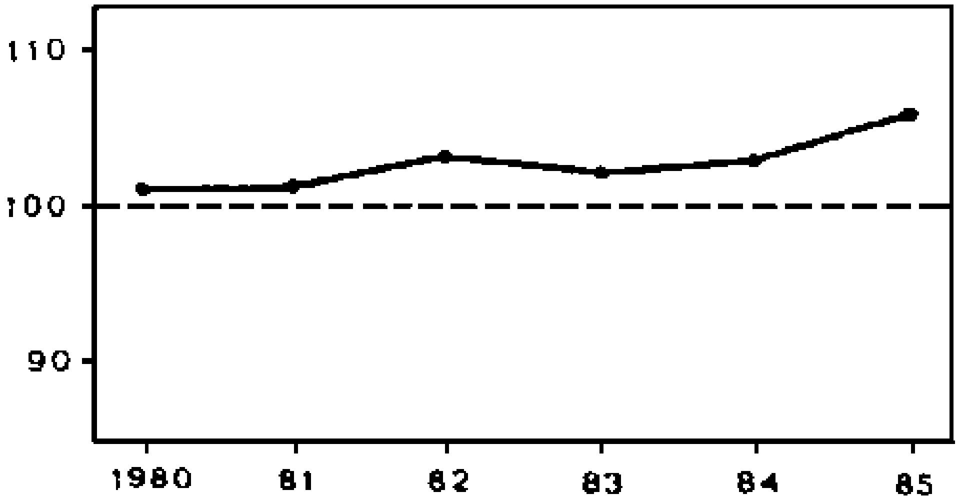
**A. Total population** *(millions – log scale)*




**B. Index numbers of per caput food production** *(1979/81 = 100)*

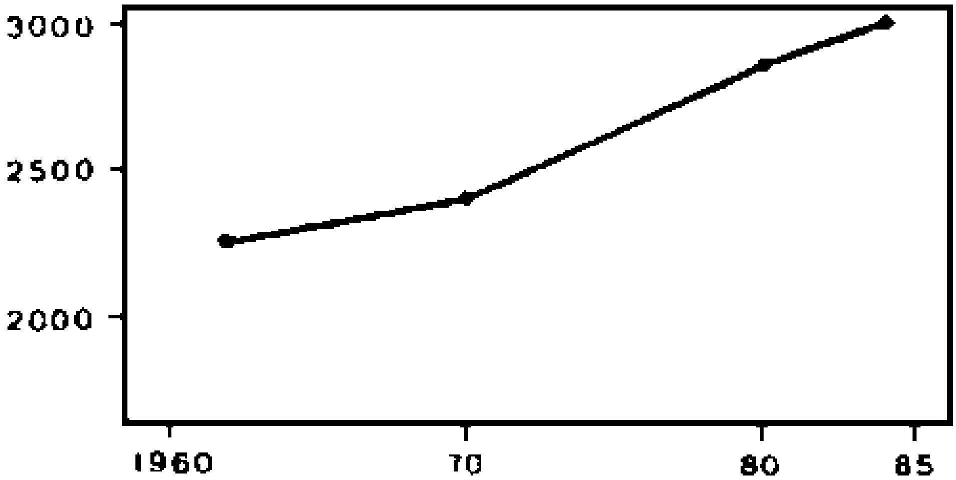



i. 1960–85 (3–year averages)

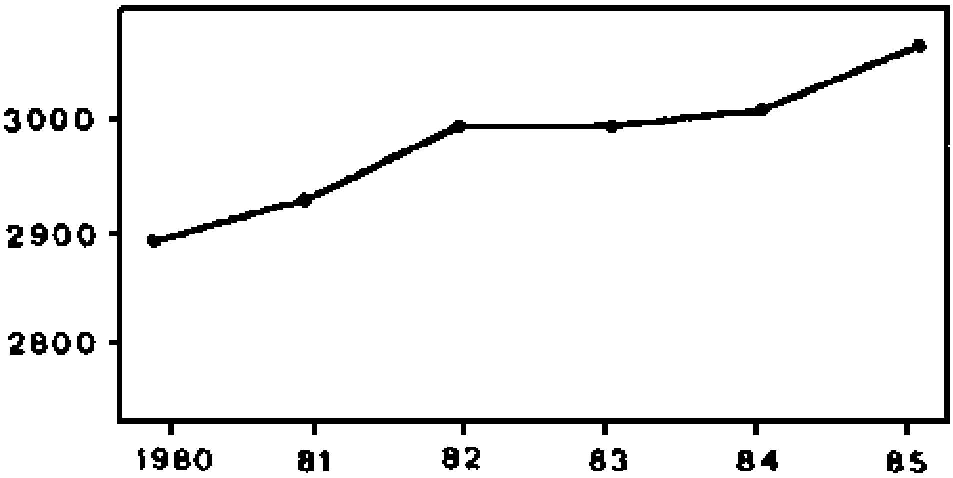



ii. 1980–85 (annual)

**C. Dietary energy supply** *(Kcals/caput/day)*

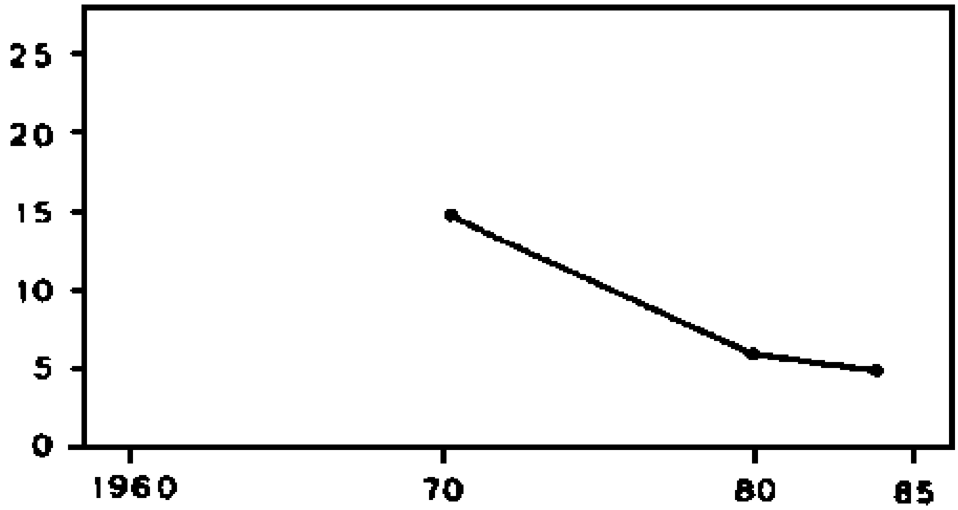



i. 1960–85 (3–year averages)

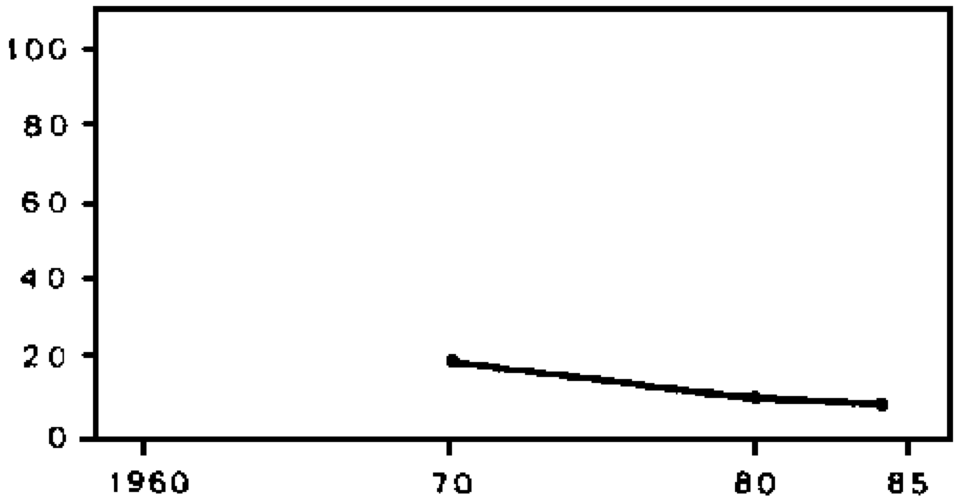



ii. 1980–85 (annual)

**D. Undernourished population** *(DES < 1.2 BMR)*

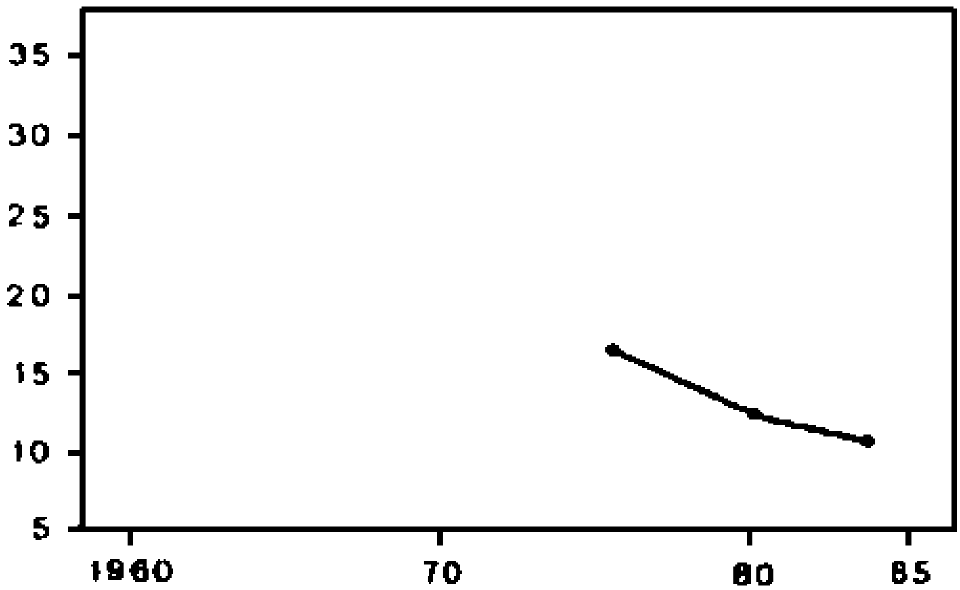


i. percent

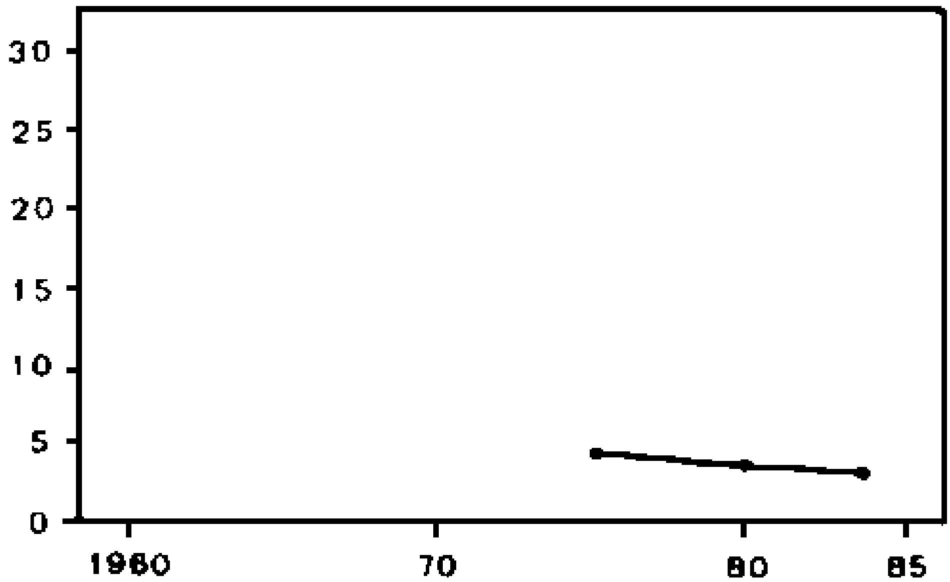


ii. numbers (millions)

**E. Underweight children** *(<2 SD weight–for–age)*



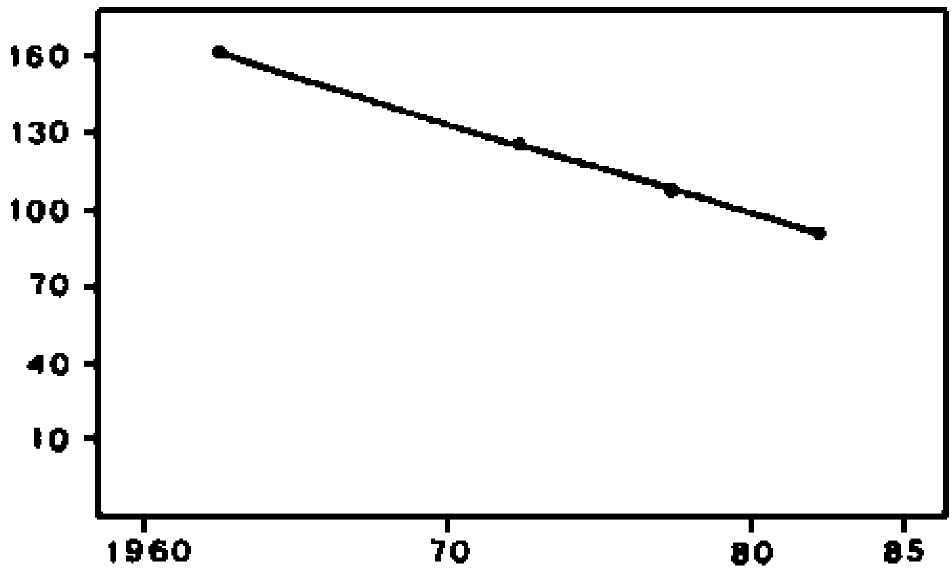
i. percent



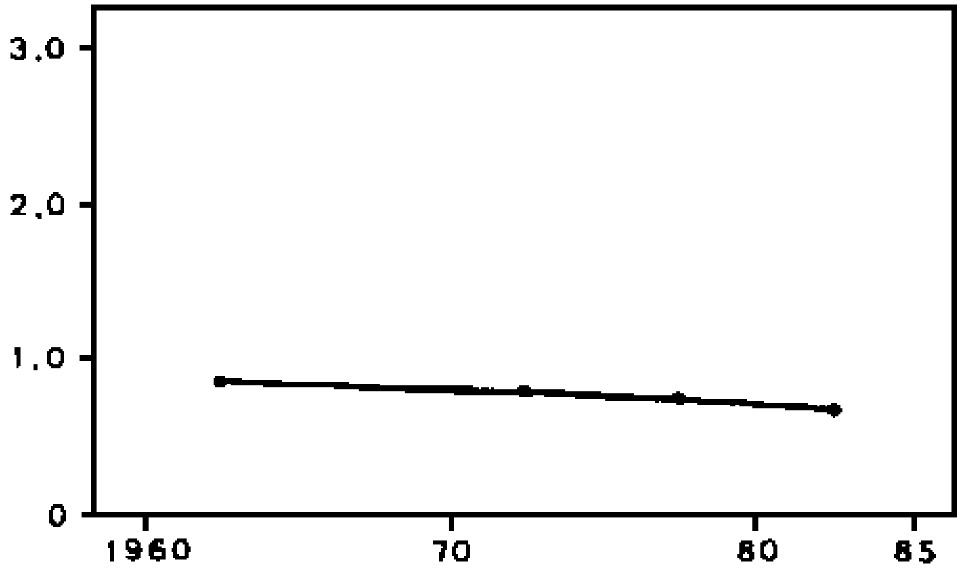
ii. numbers (millions)

**F. Infant mortality***

* Infants 0–12 months



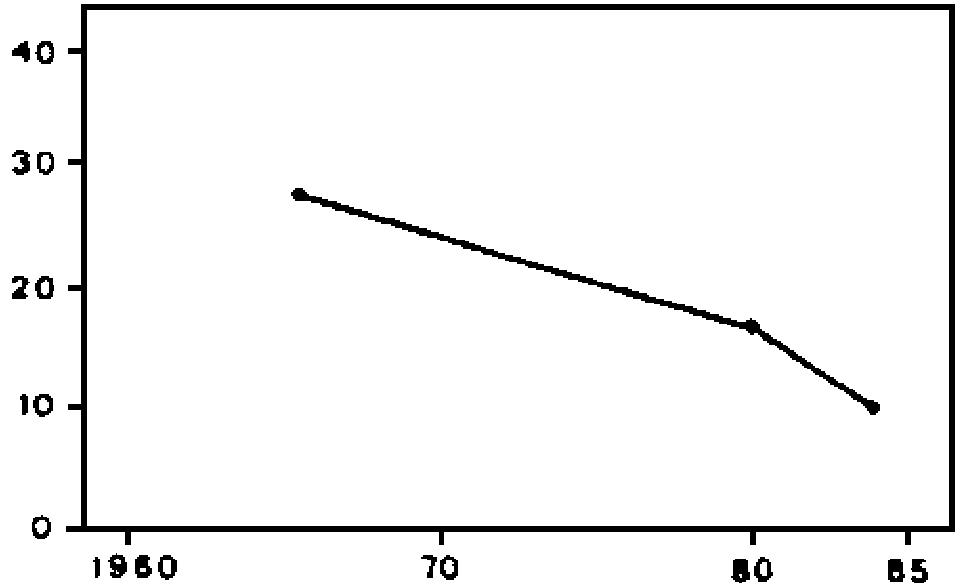
i. Number of deaths/1000 live births



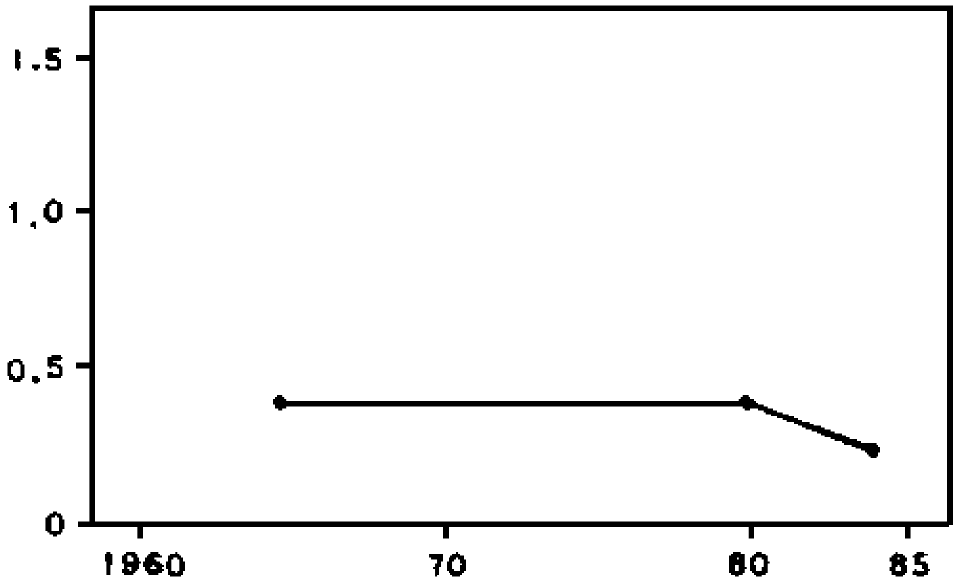

ii. Number of deaths/year (millions)

**G. Child deaths***

* Children 12–60 months




i. Number of deaths/1000 children/year



ii. Number of deaths/year (millions)

**2.7 CHINA**

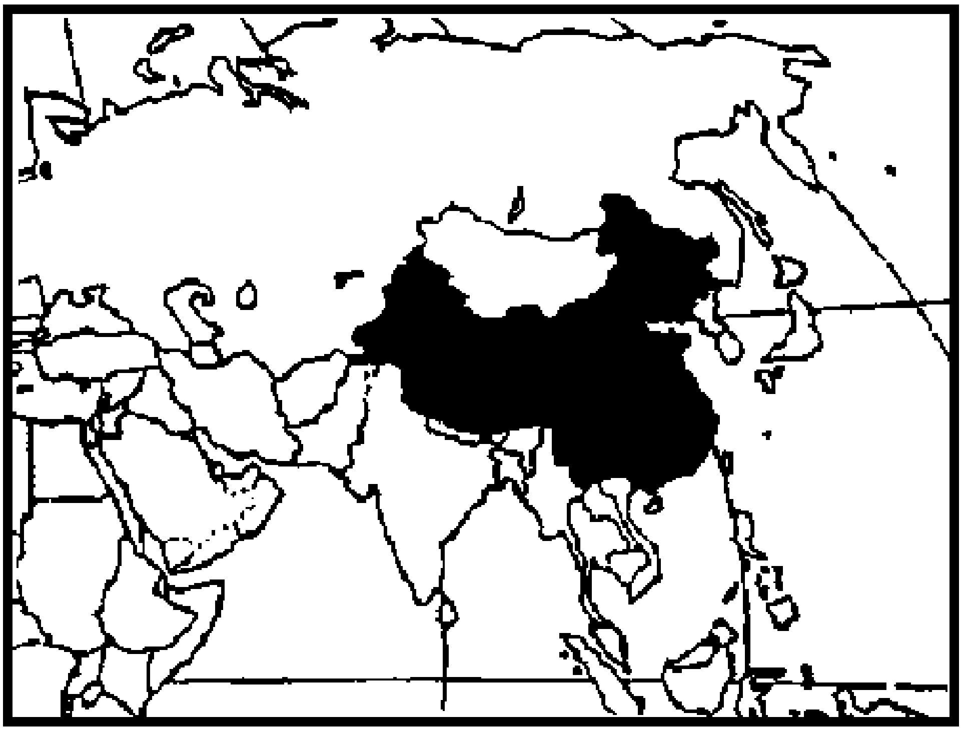
[12] Much information for this section was contributed by the SCN's Advisory Group on Nutrition.

**Panel 7**

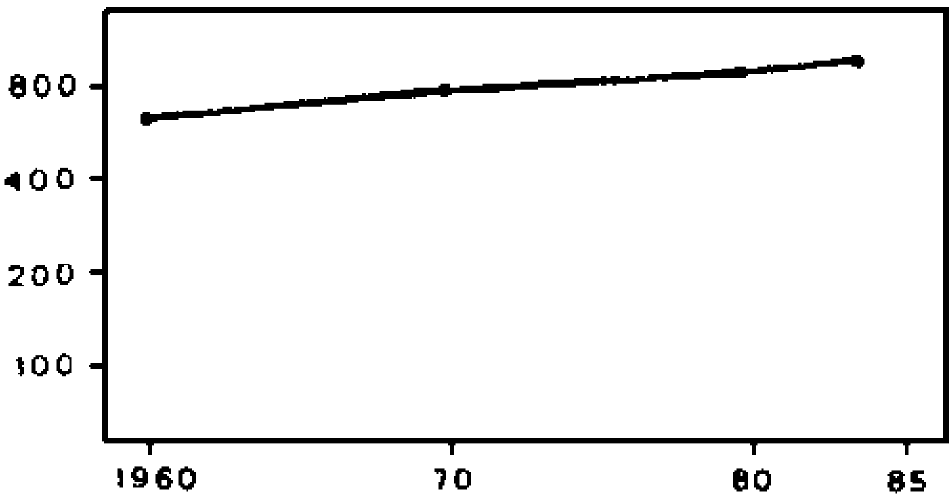
Over the past 25 years, China's per caput food production has increased 75 percent and its population by around 60 percent. In the period 1978–85, cereal production increased by 16 percent and the income of the rural population doubled. According FAO data, dietary energy supply (DES) increased from less than 1800 kcals/caput/day in 1961/63 to 2560 kcals/caput/day in 1983/85. This trend is borne out by the results of national nutrition surveys. The first, in 1959, reported a DES level of 2060 kcals/caput/day and protein intake of 57 gm/caput/day; a second survey in 1982, which covered 27 provinces and 240,000 people, shoved that average DES was 2485 kcals/caput/day, and protein 67 gm/caput/day.

Average birth weights in 1975 were 3.3 kg for boys and 3.2 kg for girls, slightly higher than birth weights in other Asian countries in the same period. The results of large scale anthropometric studies in 1975, 1979 and 1985 indicate that growth rates of both urban and rural school children had increased over time, and that the gap between urban and rural populations was narrowed. Estimates of prevalences of underweight children, calculated as for the other countries (see section 4.1.6) are displayed in panel 7E. China's infant mortality rate fell from 200 per thousand live births before 1949, to around 40 per thousand in 1980 and, according to census data, 35 per thousand in 1982.

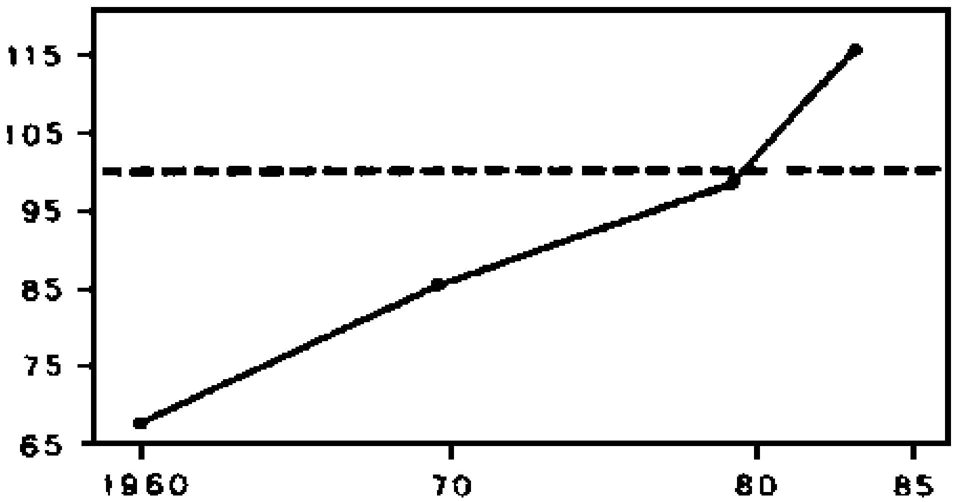
**Panel 7 China**



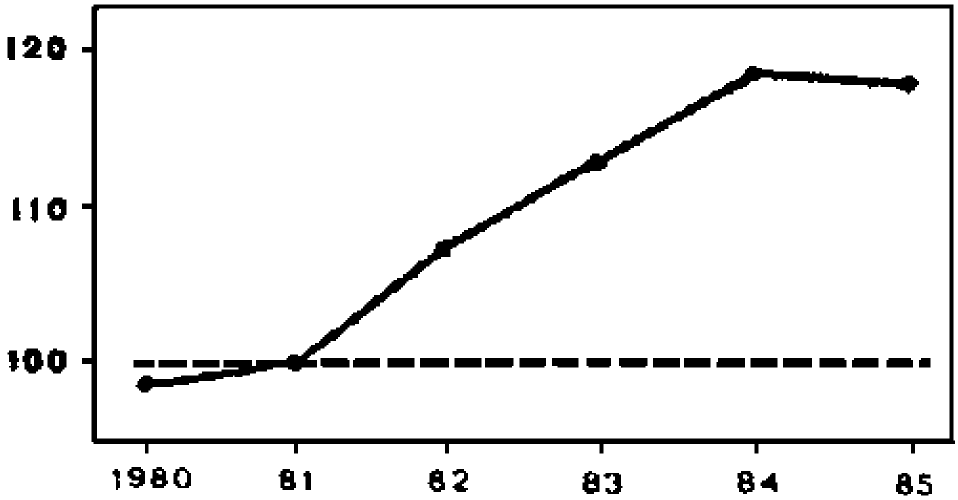
**A. Total population** *(millions – log scale)*




**B. Index numbers of per caput food production** *(1979/81 = 100)*

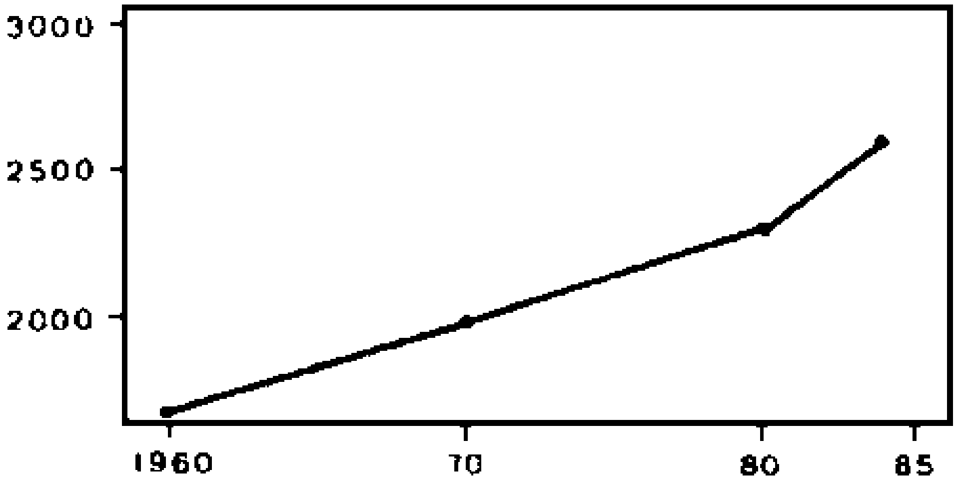



i. 1960–85 (3–year averages)

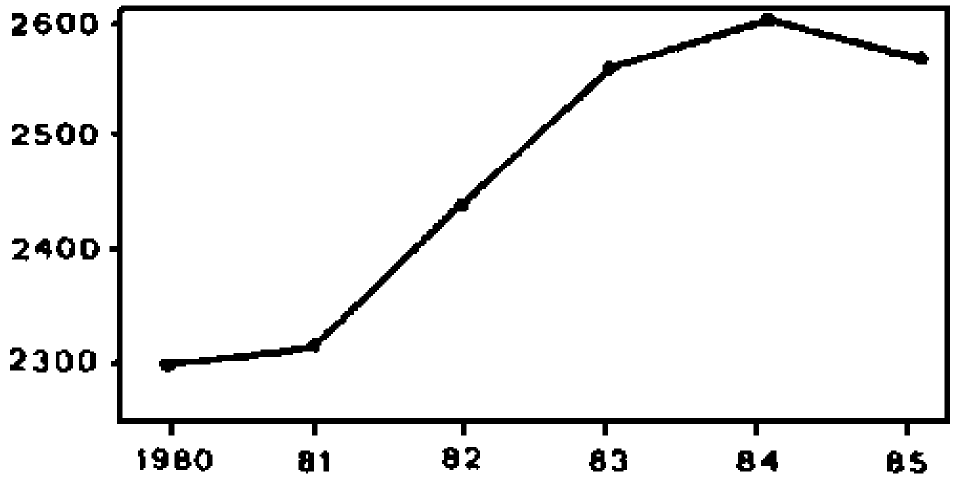


ii. 1980–85 (annual)

**C. Dietary energy supply** *(Kcals/caput/day)*



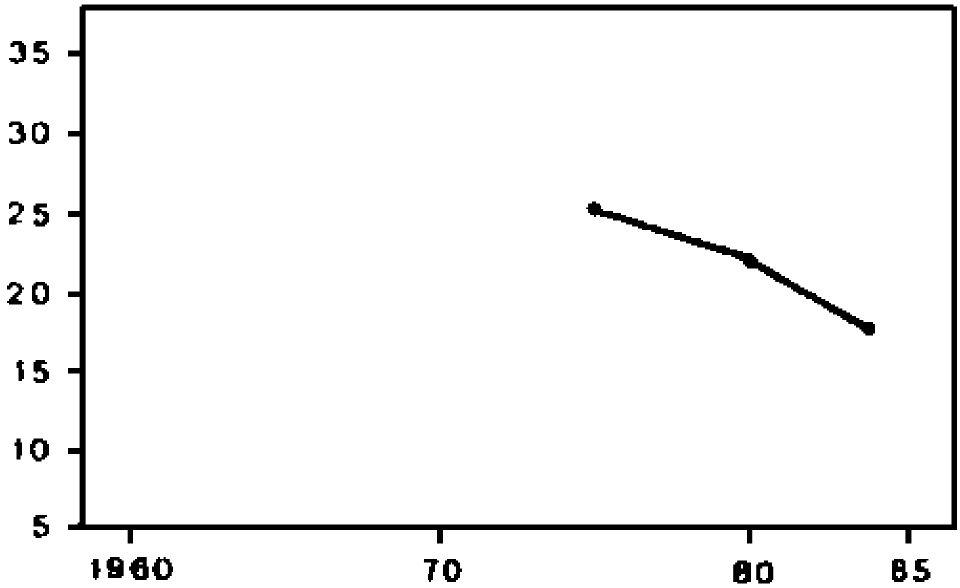
i. 1960–85 (3–year averages)



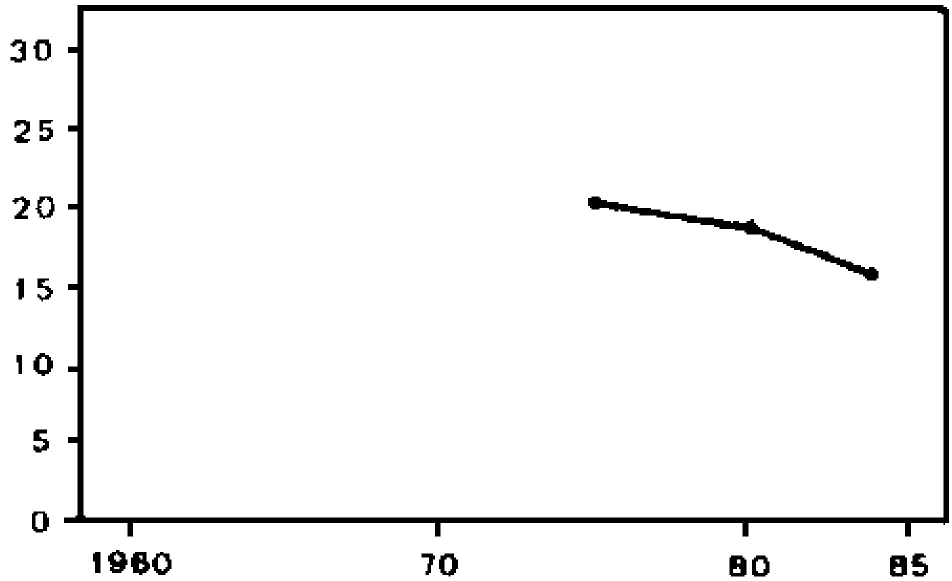
ii. 1980–85 (annual)

[Data on undernourished population not available for China]

**E. Underweight children** *(<2 SD weight–for–age)*



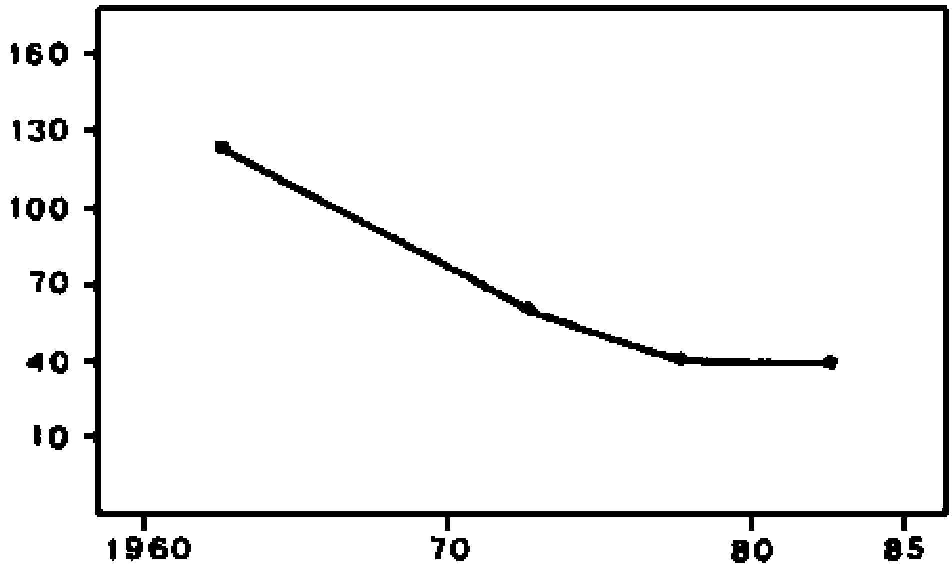
i. percent



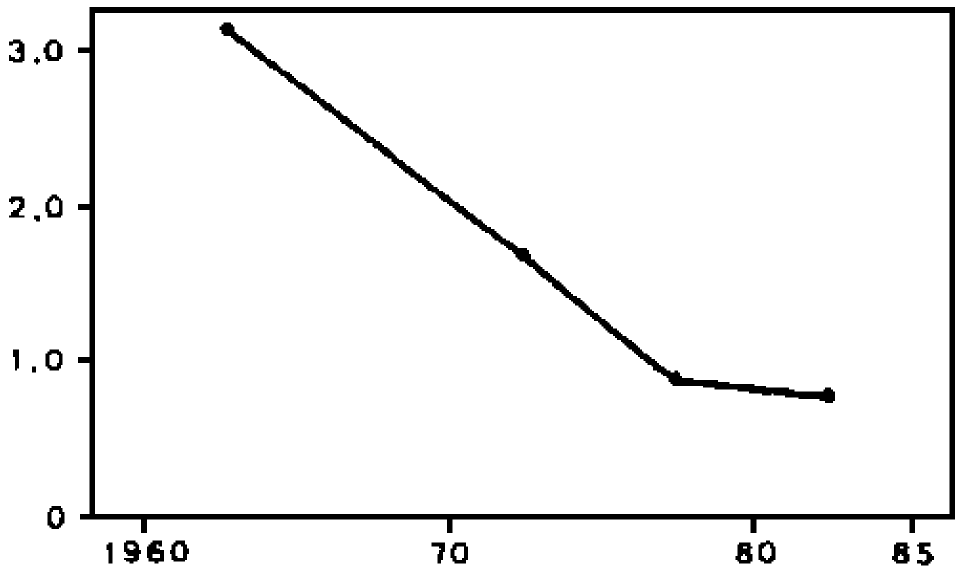
ii. numbers (millions)

**F Infant mortality***

* Infants 0–12 months



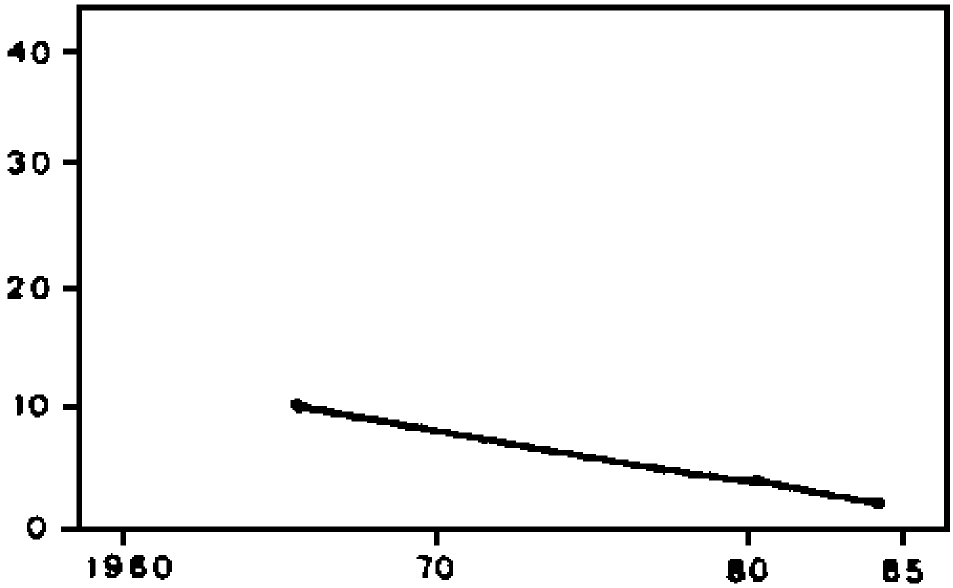

i. Number of deaths/1000 live births



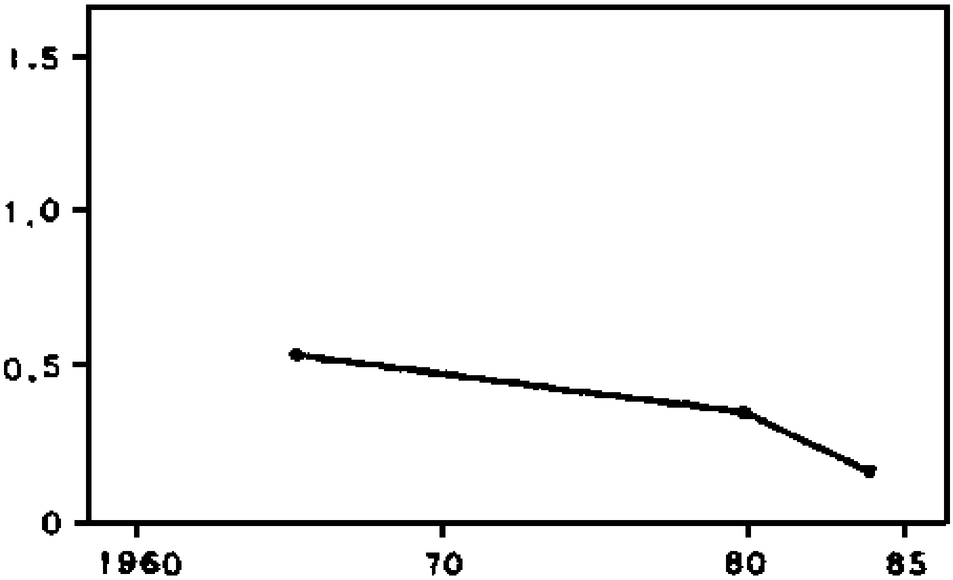

ii. Number of deaths/year (millions)

**G. Child deaths***

* Children 12–60 months




i. Number of deaths/1000 children/year




ii. Number of deaths/year (millions)

Vertical axes on shaded graphs are different from those in other country groupings.

## 3. MICRONUTRIENTS

Dietary deficiencies of micronutrients exist in many parts of the world. Of these, vitamin A, iodine, and iron deficiencies are the most important, in terms of their consequences and the numbers of people affected. This section covers these problems. Other deficiencies persist, notably scurvy from vitamin C deficiency, rickets related to vitamin D, and anaemias caused by lack of vitamin B12 and folic acid; these will be reviewed in future as data becomes available.

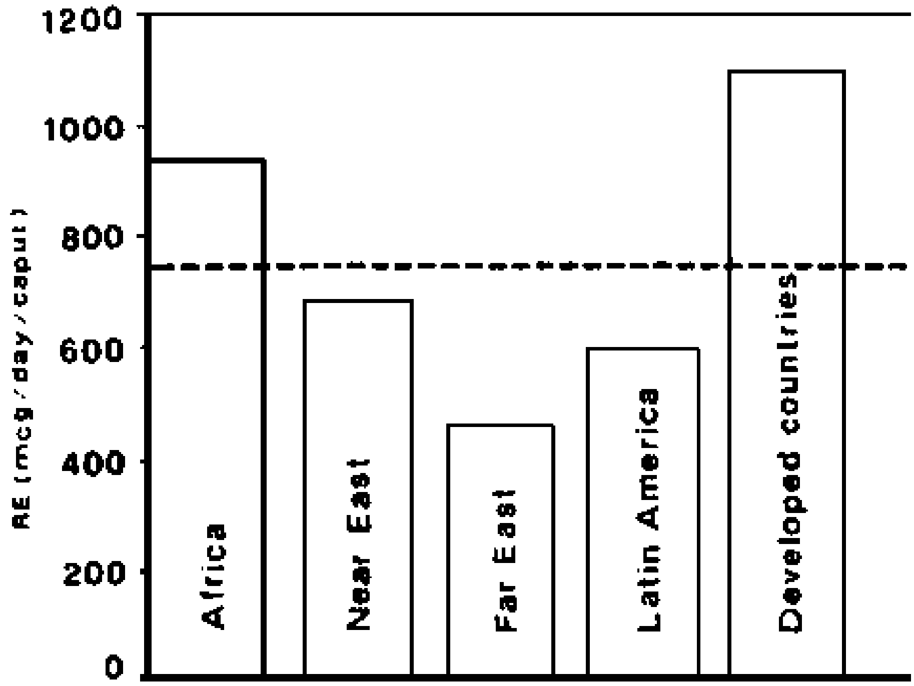
### 3.1 VITAMIN A DEFICIENCY

Vitamin A deficiency, when severe, causes blindness usually starting in childhood, and has far−reaching effects on maintenance of health. Recent evidence has indicated a direct effect of vitamin A supplementation on reducing child mortality in deficient populations (Sommer et al, 1986). Blindness and mortality associated with vitamin A deficiency are heavy burdens in the developing parts of the world. The major cause of this deficiency in most developing countries is habitually inadequate dietary intake of vitamin A to meet the requirements of this nutrient in the body, sometimes worsened by low absorption.

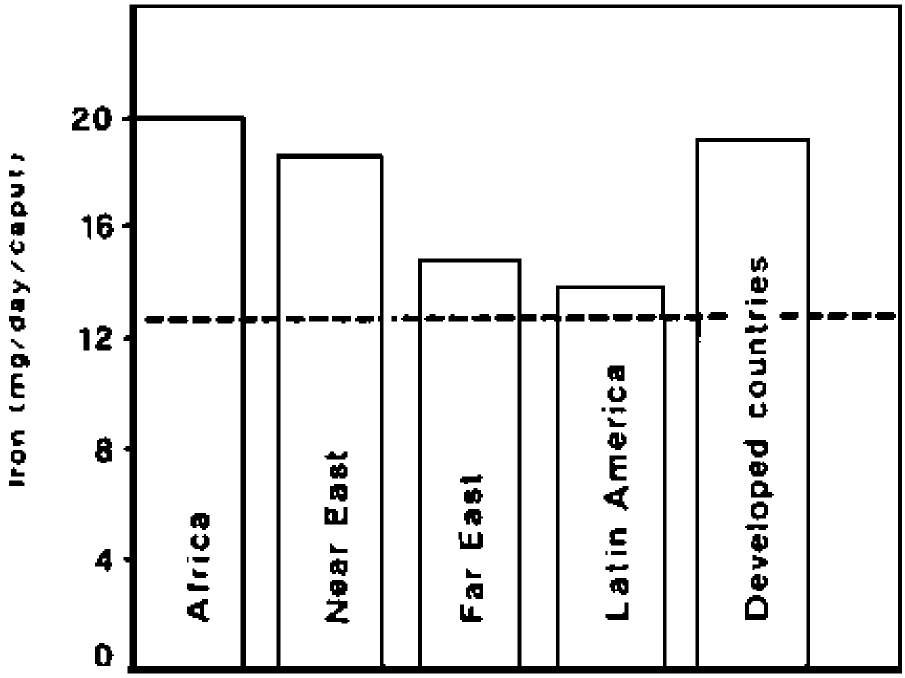
Food balance sheet data (FAO, 1980) show that the average availability of vitamin A (including that available from carotenes) varies between 100 and 1700 mcg retinol equivalents (RE)/caput/day, with a value of below 600 mcg RE/caput/day for the majority of the most seriously affected developing countries. For developed countries the range is 800 to 1700 mcg RE/caput/day. Compared to a requirement of 250−575 mcg RE/caput/day for children and 750 mcg RE/caput/day for adults (IVACG, 1981, p.8), it is not surprising to find high prevalences of vitamin A deficiency in many countries.

Dietary availability of vitamin A differs substantially between regions (see Figure 10A). Africa apparently has an adequate availability on average. However, there are significant differences among countries and there is evidence of clinical vitamin A deficiency in some. In Asia the overall average availability (estimated for 1977) was less than requirement. Trends in vitamin A availability can be seen for 1963 to 1976, as shown in Figure 11A drawn from FAO data. Dietary energy supply (DES) is also plotted to indicate when the micronutrient trends differ from those in total food intake. The upward trend in Asia, if continued, would take many decades to reach average adequacy. The slight downward trend in Africa may indicate a deteriorating vitamin A content of the diet, and should be of concern, particularly given the uneven distribution. The Latin America and Near East regions were still low on vitamin A in 1977, and more recent trends will be of interest.

WHO (DeMaeyer, 1986) has mapped the geographical distribution of clinical signs of vitamin A deficiency (xerophthalmia), as shown in Figure 12. The major problem in terms of numbers affected is in South and East Asia (notably Bangladesh, India and Indonesia), while many countries in Africa, and some in the Near East and the Americas also report vitamin A deficiency. On the basis of WHO data, thirty−four countries have been identified (ACC/SCN 1985a) as having serious vitamin A deficiency problems.



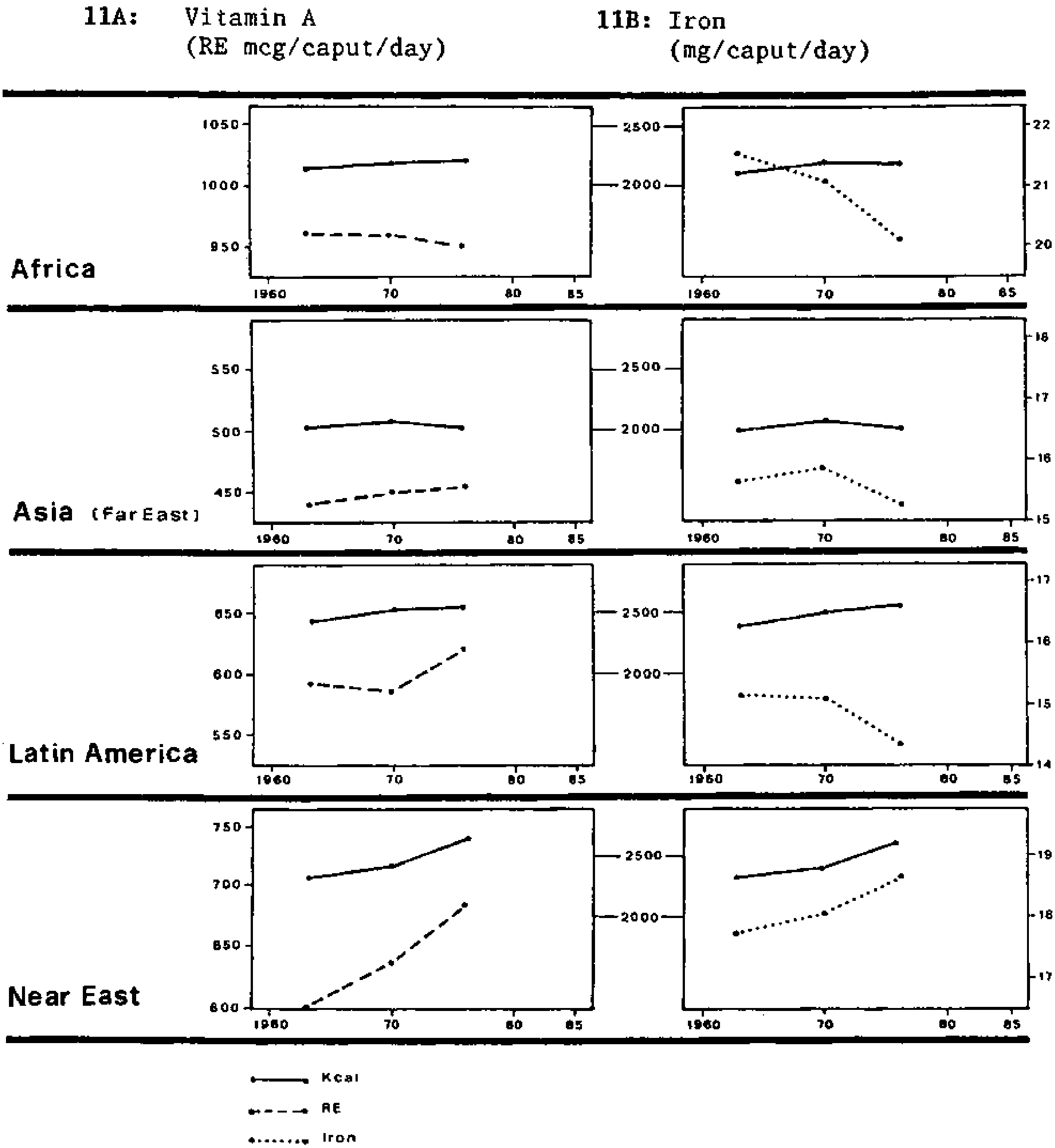

**FIGURES 10A and 10B:** Availabilities of Vitamin A and Iron in the Diet by FAO Regions, 1975/77. (A)




**FIGURES 10A and 10B:** Availabilities of Vitamin A and Iron in the Diet by FAO Regions, 1975/77. (B)

Dotted lines represent adult recommended intake of RE and for iron, level of intake for basic requirement of adult women on intermediate bioavailability diet (IVACG, 1981; and FAO/WHO, 1987, p.63).

The rate of appearance of new cases (incidence) of severe vitamin A deficiency, measured as eye damage (of which about 25% result in partial or total blindness) was estimated in Indonesia at around 2.7 cases per 1000 pre-school children per year (Sommer, 1982). This led to an estimate of up to 500,000 new cases of eye damage per year for Asia (WHO, 1985a). Applying this rate to all countries with known vitamin A deficiency gives world-wide estimates of some 700,000 new cases per year, among pre-school children.




**FIGURES 11A and 11B:** Changes in Availability of Vitamin A, Iron and Kcals by FAO Region from 1960/65 to 1975/77.

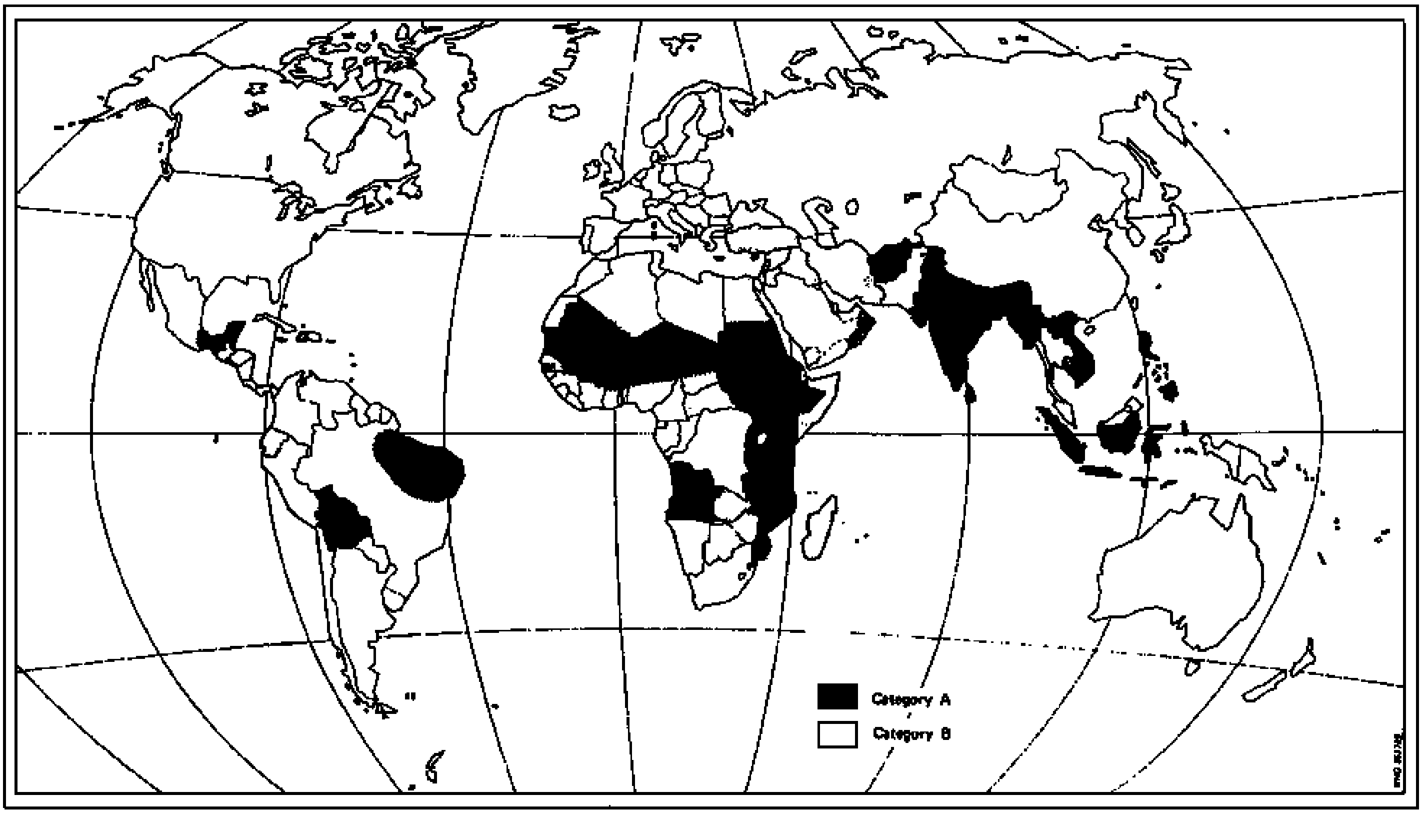



**FIGURE 12:** The Geographical Distribution of Xeropthalmia in 1986.

(Source: DeMaeyer, 1986)

What happens to children with eye damage? It is estimated that some 60% die, and of the survivors 25%. remain totally blind, and 50–60% partially blind (IVACG, 1981, p.8). This amounts to some 250,000 children going blind or partially blind each year. As a result, some 3 million children under 10 years of age are blind from this cause, over a million of whom are in India. Vitamin A deficiency is the largest single cause of an estimated 40 million people world–wide being blind (Kupfer, 1980, 1987).

Similar calculations give an incidence estimate of 6–7 million new cases per year of children with mild deficiency, and some 20 to 40 million suffering from at least mild deficiency at any one time, of which nearly half are in India.

Intervention programmes to prevent vitamin A deficiency are in operation nationally in at least 8 of the 34 countries with known vitamin A deficiency. Coverage of the population at risk in some of these – e.g. Bangladesh, India, Indonesia – is reaching high enough levels that a significant impact is expected. But in other countries coverage is still much too low, usually considerably less than 10 percent of the population at risk. The UN system has adopted a ten–year programme to combat vitamin A deficiency (ACC/SCN, 1985a), with components from FAO, WHO and UNICEF. A number of bilateral donors are supporting the development of national programmes. There are no longer technical barriers to accelerating these efforts, using well–established and cost–effective methods (ACC/SCN, 1987a). If these are energetically implemented, vitamin A deficiency could soon be curbed, and finally reduced to the point that it no longer constitutes a public health problem. Literally millions of children's sight could be saved, and very possibly a large number of lives.

### 3.2 IRON DEFICIENCY

Iron deficiency is widespread, particularly but not exclusively in developing countries, and is the most common cause of nutritional anaemia in women of reproductive age and in young children (DeMaeyer & Adiels–Tegman, 1985). Anaemia is defined as haemoglobin concentrations in blood below certain levels proposed by WHO (1968). Anaemia is not synonymous with dietary iron deficiency. A number of other causes of anaemia are important – malaria and intestinal parasites for example. Nonetheless, it is clear that deficient intakes of iron (here, both iron content of the diet and its absorption are particularly important) is the most common cause of anaemia (WHO, 1975), moreover one which is open to effective intervention. The effects of severe anaemia are well−established, as compromising work performance and health; others are suggested, such as links with immune competence and resistance to infection (ACC/SCN, 1986). Mild anaemia may also have far−reaching effects, on psychological function and cognitive development. If this is established (ACC/SCN, 1987b), then anaemia and iron deficiency will become recognized as one of the most extensive nutritional and public health problems now faced.

The extent and trends of iron deficiency can be described approximately from somewhat fragmentary data, and better documentation of the problem is important. Information on prevalences around 1980 has been assembled by WHO (DeMaeyer & Adiels−Tegman, 1985), and FAO data from food balance sheets (FAO, 1980) indicate dietary intakes, and trends in these from 1961/65 to 1975/77.

As for vitamin A, dietary intakes of iron (estimated from FAO food balance sheet data) vary considerably by region (Figure 10B). Africa had the highest calculated intake (for 1977), with Latin America and Asia the lowest. For comparison, around 13 mg dietary iron per day is recommended for adult women (whose requirement is higher than men's) (FAO/WHO, 1987). Trends in dietary iron supplies, estimated up to 1976, give some cause for concern (Figure 11B). In Africa, Asia and South America the trend was downward during 1963 to 1976, and this was against the direction of change in total food intake as measured by kcals. Dietary patterns seemed to be altering to the detriment of iron nutrition, unless other changes in dietary composition were improving absorption. Hence, the prevalences of anaemia discussed below may if anything have worsened, except in the Near East, if the trends shown in Figure 11B have continued.

WHO have compiled available information from over 500 studies on prevalences of anaemia (DeMaeyer & Adiels−Tegman, 1985). From these, estimates were made of prevalences and numbers of people affected, by WHO region, as summarized in Table 1.

Anaemia prevalences are remarkably high − nearly 50% of women of reproductive age in developing countries are at least mildly anaemic. Africa and South Asia have by far the highest prevalences. While average iron supply is apparently greater than the requirement level for women, iron deficiency persists as a massive public health problem throughout the world. Poor iron absorption in the diet or the presence of parasites are examples of factors which might contribute to this situation, as well as uneven distribution of dietary iron between population groups. In very general terms, estimates of such high prevalences of anaemia are credible in relation to the data on dietary iron supplies, taking account of the important effect of the availability of iron in the diet. This estimate that nearly half of the reproductive−age women in developing countries have inadequate haemoglobin levels by WHO criteria, amounting to almost 290 million women, illustrates the magnitude of the problem.

In sum, iron deficiency is clearly very widespread, and indeed may be worsening. It clearly has an extensive effect on health when causing severe anaemia, and may have other far−reaching effects through mild deficiency. Prevalences, trends, and consequences of iron deficiency are subjects of current research, and future assessments of the world nutrition situation should be able to be more specific. But, given that effective methods for prevention are available, through iron

TABLE 1

ESTIMATED PREVALENCE OF ANAEMIA BY GEOGRAPHIC REGION AND AGE/SEX CATEGORY, AROUND 1980 (POPULATION DATA IN MILLIONS)

| REGION | CHILDREN | | | | MEN | | WOMEN | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0−4 years | | 5−12 years | | 15−59 years | | 15−49 years | | | |
| | | | | | | | Pregnant | | | |
| | % | Number | % | Number | % | Number | % | Number | % | All Number |
| Africa | 56 | 48.0 | 49 | 47.3 | 20 | 23.4 | 63 | 11.3 | 44 | 46.8 |
| Latin America | 26 | 13.7 | 26 | 18.1 | 13 | 12.8 | 30 | 3.0 | 17 | 14.7 |
| East Asia* | 20 | 3.2 | 22 | 5.6 | 11 | 6.1 | 20 | 0.5 | 18 | 8.4 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| South Asia | 56 | 118.7 | 50 | 139.2 | 32 | 123.6 | 65 | 27.1 | 58 | 191.0 |
| World* | 43 | 193.5 | 37 | 217.4 | 18 | 174.2 | 51 | 43.9 | 35 | 288.4 |
| Developed regions | 12 | 10.3 | 7 | 9.1 | 3 | 12.0 | 14 | 2.0 | 11 | 32.7 |
| Developing regions | 51 | 183.2 | 46 | 208.3 | 26 | 162.2 | 59 | 41.9 | 47 | 255.7 |

NOTES: * Excluding China. All calculations were made before rounding, figures may thus not add to totals.

Anaemia is defined as a haemoglobin concentration below WHO reference values for age, sex, pregnancy status.

Regions are drawn according to United Nations regions; more developed regions include Northern America, Japan, Europe, Australia, New Zealand, and the Union of Soviet Socialist Republics.

Prevalence rates are estimated from the various studies.

SOURCE: DeMaeyer & Adiels−Tegman, 1985. fortification and supplementation, more priority could now be given to prevention of this very common deficiency.

### 3.3 IODINE DEFICIENCY

Iodine, which is a component of thyroid hormones, is essential for normal growth and development of the foetus, infant and child, and for the normal physical and mental activity of adults. Iodine−deficient populations suffer a variety of consequences that include goitre, reduced mental function, widespread lethargy, and increased rates of stillbirths and infant mortality. Irreversible forms of severe mental and neurological impairment, commonly known as cretinism, occur in the babies of severely iodine deficient mothers (ACC/SCN, 1987c).

Iodine deficiency, generally recognized from goitre in the population, occurs in areas with low iodine in the soil and water. The best known iodine deficient areas are mountainous, especially the Andes and Himalayas. However, coastal areas and plains and areas where repeated flooding occurs, may also be deficient in iodine. Large proportions of the populations in these areas may be affected by inadequacy of dietary iodine, because the foods grown in these area are deficient in iodine. Excessive intakes of goitrogens (toxins causing goitre, for example with high intakes of cassava in Central Africa, or with water−borne goitrogens in parts of Latin America) are another important cause of iodine deficiency.

The occurrence of clinically obvious and easily recognizable effects of iodine deficiency (goitre and cretinism) may have in the past diverted attention from other far−reaching pathological conditions produced by this deficiency. Although the association of goitre and cretinism with iodine deficiency has been known for a long time, the more pervasive effects of milder iodine deficiency on mental development and intellectual ability is only now becoming recognized. This has similarities with vitamin A deficiency and blindness. The term "iodine deficiency disorders "(IDD; Hetzel, 1983) is now preferred, which include a spectrum of effects from slight enlargement of the thyroid, to the severest form of iodine deficiency disorders namely neurological cretinism, with a range of various manifestations in between. Grades of intellectual development, ranging from normality through mild to profoundly retarded, have been observed in populations in iodine−deficient areas (Stanbury, 1985; Delange, 1986). Effects of the deficiency are most serious during early foetal development and the first two years of life. Thus women of child−bearing age, infants and young children are given priority in control programmes.

The localization of iodine−deficiency disorders has been established from many surveys, illustrated in the map in Figure 13. New pockets of the deficiency continue to be uncovered, partly because the deficiency occurs primarily in more remote places. In Africa, for example, surveys continue to document the occurrence of goitre in new areas (Kavishe, 1985).

Iodine deficiency is also present in industrialized parts of the world. A recent publication (European Thyroid Association, 1985) identifies a number of European countries where low concentrations of iodine are added to salt and decreased salt consumption has lead to an increase in goitre prevalences. In some areas cretinism is described.

Prevalences and numbers affected by goitre, and at risk of iodine deficiency disorders in that they live in iodine−deficient areas, are shown by WHO region in Table 2. Nearly 200 million people world−wide are thought to have goitre and over 3 million suffer from overt cretinism due to iodine deficiency. More than 50% of those affected by goitre and cretinism live in South−East Asia, or 80% in Asia taken as a whole (ACC/SCN, 1985b). At least 40 million people in South−East Asia are estimated to suffer mental and physical impairment due to iodine deficiency disorders (Clugston and Bagchi, 1986). Some 800 million people are at risk of iodine deficiency world−wide. Again, the majority of these are in Asia, including 300 million in China and 200 million in India. More details by country are given in ACC/SCN (1987c) and Dunn et al, (1986).

**TABLE 2**

**IODINE DEFICIENCY DISORDERS IN DEVELOPING COUNTRIES BY WHO REGION**

| Regions | Total Population | Number at Risk | Number with Goitre | Goitre Prevalence | Number with overt cretinism |
|---|---|---|---|---|---|
| | (millions) | | (millions) | (millions) | (millions) |
| Africa | 360 | 60 | 30 | 8% | 0.5 |
| South East Asia | 1050 | 280 | 100 | 10% | 1.5 |
| Asia (other countries) | 1070 | 400 | 30 | 3% | 0.9 |
| Latin America | 360 | 60 | 30 | 8% | 0.25 |
| Total | | 800 | 190 | | 3.15 |

**(Source:** ACC/SCN 1987c)

The very high prevalences observed in iodine deficient areas are striking (WHO, 1985b; ACC/SCN, 1987c). Often goitre may affect over *50%* of the population in such areas, and cretinism occur in 1−5%. An additional *20%* may suffer measurable impairment of mental and/or motor function. In some remote mountainous regions in Himalayas and Andes, where the soil is deficient in iodine, only foods of local origin are consumed, and control measures are difficult, over 30% prevalence of the full cretinism syndrome has been recorded. A national prevalence survey in Bangladesh found iodine deficiency disorders in almost all regions of the country, and the mean value for prevalence of endemic goitre was *11%* of the total national population (WHO, 1985d). Extensive pockets of iodine−deficiency occur in Africa (WHO/UNICEF/ICCIDD, 1987). Some surveys have reported prevalences as high as *60%* in parts of Bolivia (Pretell and Dunn, 1987).

Iodine deficiency, causing retardation of intellectual development and lethargy, thus may have crucial effects on productivity and human welfare in some of the poorest regions of the world. The deficiency can be prevented by established control methods, notably using iodized salt, or, where that is not feasible, by injecting iodized oil. The UN system, as for vitamin A deficiency, has proposed a ten−year programme for prevention and control of iodine deficiency disorders (ACC/SCN, 1987c). Impressive results are known in areas where such measures have been adopted, for example in China; and goitre has been greatly reduced in the previously endemic areas (Alps & Pyrenees) in Europe. Giving priority to controlling iodine deficiency could be of particular value to catalyze the development of many remote areas; indeed, this could be a notably cost−effective investment in places otherwise difficult to reach.

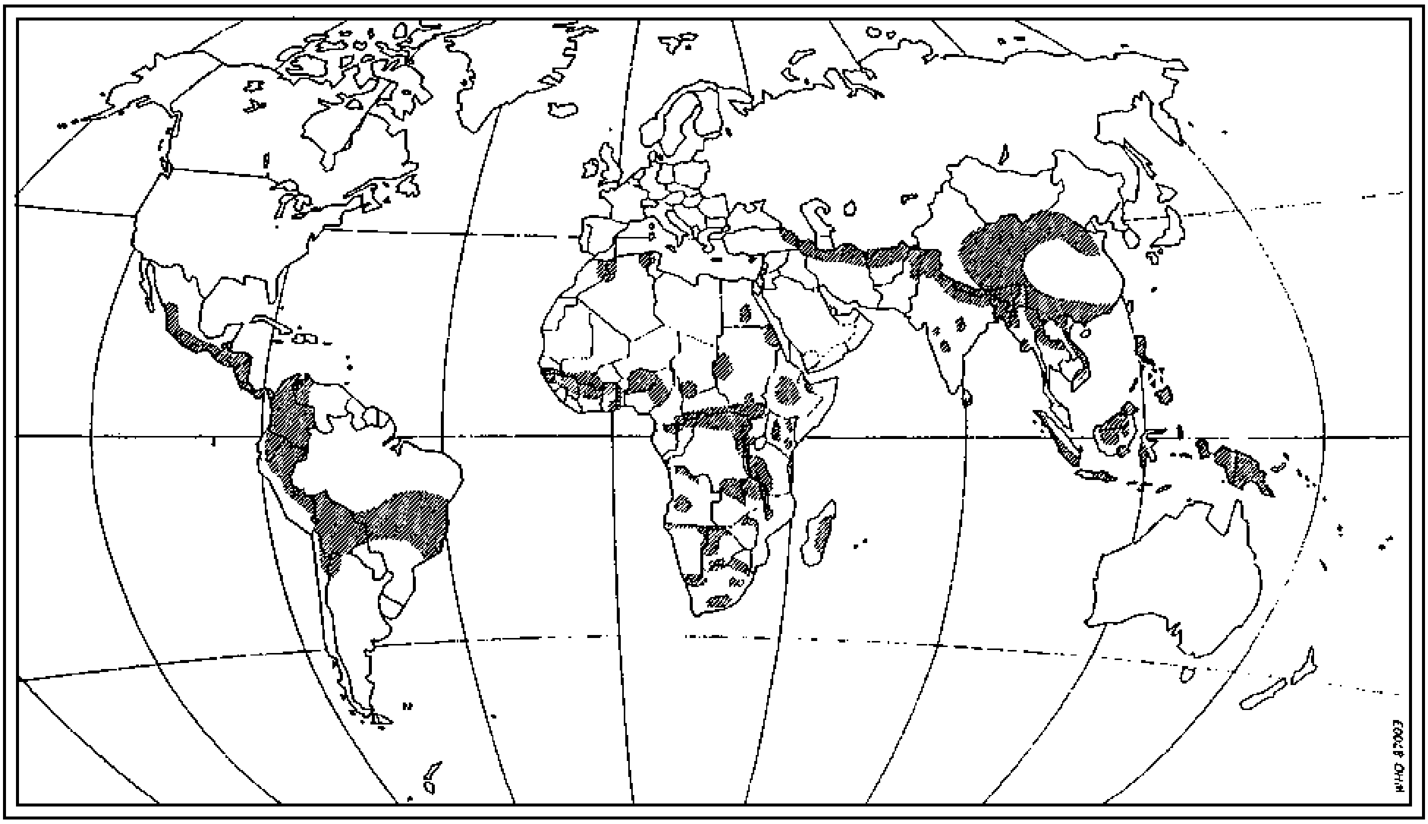


**FIGURE 13:** Distribution of Iodine Deficient Areas in Developing Countries.

(Source: ACC/SCN, 1987c)

## 4. TECHNICAL NOTES

These notes aim to give adequate information for the data presented in the previous sections to be understood, in terms of sources, principles of estimation methods, and limitations. They are not intended to give a comprehensive description of methods used, or of the data base. A Supplement on Methods and Statistics will be issued in early 1988. This will give fuller details and discussion of the methods, and will include tables of all the data used. Publication in two sections – main report and supplement – was recommended as an option by the SCN's Advisory Group on Nutrition at its September 1987 meeting, first so that the main report would be balanced in favour of the essential results for wider distribution; and second so that a more detailed document primarily of interest to technical people, with more limited distribution, could be completed without delaying the main report.

The technical notes below are structured to refer to the panels, figures and tables in which the data are presented. They give data sources, estimation methods, and brief results of statistical tests where relevant.

### 4.1 Panels 1–7

**4.1.1 General.** Section 4.1 describes the data presented in panels 1–7. Both definitions and sources are given, and calculations described where needed. Distinctions are made between actual data and estimated values. Population and food data were retrieved from the FAO Information System of Food and Agriculture (AGROSTAT), which contains published information from FAO, and from other UN organizations. A comprehensive list of data sources is given in the AGROSTAT Codebook (FAO, 1987b). Demographic and mortality data originated from the UN Population Division, production and dietary energy supply (DES) from FAO. Anthropometric data from national surveys were compiled and where necessary re–analyzed by WHO (WHO, 1987 – source references given in this document). Most estimates from AGROSTAT were provided by the FAO Statistics Division. Where different sources were needed to obtain estimates (e.g. population), the source was kept consistent for that particular country. For example, if the major source for population did not have estimates for one country, then population for this country for all years necessary was obtained from a second source.

All estimates are reported for 1960, 1970, 1980, and 1984 or 1985. When available annual trends are given from 1980 to 1985. In most cases the periodic data were calculated as three year averages (e.g. the point plotted at 1970, usually called 1969/71, is the mean of 1969, 1970, and 1971), in order to smooth out short term variation due to inaccuracies in estimation. All estimates were calculated at the country level and then aggregated to the country group level, weighted by population.

A list of countries and the country groupings is given in Table 3. Countries included in the weighted averages may vary depending on the availability of estimates; however, any deletion did not in itself bias estimates of the trend, because most countries with missing data had missing values for all years. Further, major countries in each country group, i.e. those with the bulk of the population and therefore with the major weight in the overall calculation, were never missing.

Panels 1−7 give indicators by country group for comparisons within the group; the same indicators are in the same position in each panel to facilitate comparisons across country groups, and as far as possible the scales are kept the same. Shaded areas in the panels for South Asia and China indicate a different scale on the vertical axis, shifted up or down. Annual data on DES (sections C (ii) of the panels) also shifts across country groups in a similar way, but is not shaded.

A list of all country group data contained in the panels will be given in the Supplement.

**4.1.2 Population (sections A of panels).** Population data come from the United Nations Population Division (UN, 1986), retrieved here from AGROSTAT. Child populations 0 through 4 years (i.e. 0−4 inclusive), and 1 through 4 years (i.e. 1−4 inclusive) were calculated by applying the known population proportions of these age groups to the total population by country and year. Details of derivations of both 0−4 and 1−4 year old child populations are given in sections 4.1.6 and 4.1.8, respectively.

Population data in the panels are point estimates for 1960, 1970, 1980, and 1984, graphed on a log scale; this transformation means that growth rates are comparable (by slope) irrespective of population size. It also allows plotting on the same scale across country groups. The magnitude of each region's population can also be seen in Figure 1.

**4.1.3 Per caput food production indices (sections B of panels).** These indices show the relative level of food production in a year compared to the average for the base period 1979/81. (Thus, the 1979/81 value is always 100 on the graphs, marked with a dotted line). "They are based on the sum of price−weighted quantities of different agricultural commodities produced after deductions of quantities used as seed and feed weighted in a similar manner" (FAO, 1984, 1987c, p.5). Food production includes all commodities considered edible and containing nutrients (e.g. this excludes coffee and tea). Food production information is obtained annually by FAO from member countries.

Indices graphed in sections of the panels designated B (i) are three year averages for 1961/63, 1969/71, 1979/81, and 1983/85. Sections B (ii) of the panels are annual values from 1980 to 1985. The vertical scales are increased between (i) and (ii) by a factor of 2 to better display these more recent trends.

## TABLE 3

### LIST OF DEVELOPING COUNTRIES BY COUNTRY GROUP COVERED IN THIS REPORT*

* The countries not listed in this report have been omitted mainly because of small populations and/or missing data.

**SUB−SAHARAN AFRICA**

Angola
Benin
Botswana
Burkina Faso
Burundi
Cameroon
Central African Republic

Chad
Congo
Cote d'Ivoire
Ethiopia
Gabon
Gambia
Ghana
Guinea
Kenya
Lesotho
Liberia
Madagascar
Malawi
Mali
Mauritius
Mauritania
Mozambique
Niger
Nigeria
Rwanda
Senegal
Sierra Leone
Somalia
Sudan
Swaziland
Tanzania
Togo
Uganda
Zaire
Zambia
Zimbabwe

**MIDDLE AMERICA AND CARIBBEAN**

Costa Rica
Cuba
Dominican Republic
El Salvador
Guatemala
Haiti
Honduras
Jamaica
Mexico
Nicaragua
Panama
Trinidad & Tobago

**SOUTH AMERICA**

Argentina
Bolivia
Brazil
Chile
Colombia
Ecuador
Guyana
Paraguay
Peru
Uruguay
Venezuela

**SOUTH ASIA**

Afghanistan
Bangladesh
India
Iran, Islamic Republic
Nepal
Pakistan
Sri Lanka

**NEAR EAST AND NORTH AFRICA**

Algeria
Cyprus
Egypt
Iraq
Jordan
Kuwait
Lebanon
Libyan Arab
Jamahiriya
Morocco
Saudi Arabia
Kingdom of
Syrian Arab Republic
Tunisia
Turkey
United Arab Emirates
Yemen, Democratic
Yemen, Arab Republic

**SOUTHEAST ASIA**

Burma
Indonesia
Kampuchea, Democratic
Laos
Malaysia
Papua New Guinea
Philippines
Thailand
Vietnam

**CHINA**

China

**4.1.4 Dietary Energy Supply (DES: kcals/caput/day – sections C of panels).** DES is derived from food production data, adjusted for: imports and exports, amounts used for seed and feed, changes in stocks, and other non–food uses. This is the food balance sheet procedure calculated using a supply utilization account (FAO, 1984 p. viii). DES, expressed as kcals per caput per day, refers to the amount of food "reaching the consumer, but not necessarily to the amounts of food actually consumed" (FAO, 1987b). The data are by country and calendar year. Three year averages around the mid–point years 1962, 1970, 1980, and 1984 were calculated for the long–term trends (as for food production indices) in panel sections C (i), on the same scale for all panels. Annual data are given for 1980 to 1985 in panel sections C (ii), in which scales vary across country groups.

**4.1.5 Proportions and numbers of population undernourished (sections D of panels).** The proportions and numbers of population undernourished are defined as those with marginal access to food (see discussion in section 1 and footnote 3), that is with less than a minimum level of food availability. The estimates use the approximate methodology of FAO that attempts to utilize all pertinent data available. The methodology and other considerations related to these estimates, including the required caution in using them, are discussed fully in the Fifth World Food Survey (FAO, 1987a).

The method involves the specification of the distribution of households in a population according to per caput dietary energy intake levels, and then the application of a cut−off point designating low intakes. The proportion of households with intakes below this cut−off point is taken as a measure of the prevalence of undernutrition. Multiplying this proportion by population yields an estimate of absolute number undernourished.

(a) Cut−off points. The cut−off point, as in the case of intakes, is expressed on a per caput basis. It is obtained by aggregating some estimate of "minimum energy requirements" by age−sex groups, using the age−sex composition of the population as weights. Different concepts of energy requirement have been adopted for children as compared to the adolescents and adults.

For children below age 10 the minimum energy requirements are based on the actual energy intakes of healthy children as recommended by the FAO/WHO/UNU Expert Consultation (WHO, 1985c). For adolescents and adults the concept of maintenance requirement is used to designate low intakes.

It is accepted that there is a variation in the maintenance requirement for an individual of given age, sex and body−weight, and the FAO/WHO/UNU Expert Consultation has tentatively set the average maintenance requirement as corresponding to 1.4 times the Basal Metabolic Rate (BMR). This average can be used for the purpose of the cut−off point if the variation is considered to be of an inter−individual nature. On the other hand, if the variation is mainly of an intra−individual nature it is suggested that the minimum level, estimated as corresponding to 1.2 BMR, should be used. Since there is great uncertainty regarding which type of variation is more important both 1.2 BMR and 1.4 BMR have been used to estimate low intake levels for adolescents and adults in the FAO Fifth World Food Survey. As a result, two alternative per caput requirements (cut−off points) that differ with respect to the minimum requirement levels for adolescents and adults were applied in the Fifth World Food Survey.

The application of two alternative cut−off points obviously leads to two alternative estimates of the undernourished − (Alternative A and Alternative B). The cut−off point incorporating 1.2 BMR (Alternative A) as the requirement level for adolescents and adults, being lover than that with 1.4 BMR (Alternative B), clearly gives lover prevalence estimates. The choice between them depends on which of the two underlying hypotheses regarding the variation in requirements is used. Since the focus of the present report is on trends over time rather than the actual size of the undernutrition problem, the choice of cutoff is not crucial − either would give a similar picture of trends, but with different absolute levels. However, the lower and more conservative estimate (Alternative A) based on the cut−off point incorporating 1.2 BMR as the minimum requirement level for adults and adolescents has been chosen for presentation in this report. This should not be taken to imply acceptance of the hypothesis of intra−individual variation in requirement.

(b) Means and Standard Deviation of the Distribution of Per Caput Energy Intake or Availability. The estimate of per caput dietary energy supply (DES) from food balance sheets is taken as the mean of the distribution. Calculation of these mean values, as shown for country groups in the panels, is described in Section 4.1.4. The standard deviation is obtained through the coefficient of variation (CV) that is estimated directly or indirectly on the basis of distributional data pertaining to food consumption or related variables, e.g. food expenditure, income or total expenditure obtained from household surveys. For countries where such direct or indirect estimation was not possible because of the absence of any distributional data, the CV was set to be equal to the average for the country group where the country belongs.

(c) Estimates for 1969/71, 1979/81 and 1983/85. The FAO Fifth World Food Survey provides estimates for 1969/71 and 1979/81 (FAO, 1987a). Whereas the means of the underlying energy intake distribution for these periods are based on the corresponding per caput DES data, the coefficient of variation needed for deriving the standard deviation is assumed to remain constant. In other words, the estimates for the two periods are based on an assumption of no change in distribution as measured by the CV. The Fifth World Food Survey estimates have been recently brought forward to 1983/85 by FAO on the basis of the per caput DES data now available for this period. These recent estimates are used here. This updating has necessarily led to slight adjustments in the estimates for the previous periods reported in the Fifth World Food Survey due to revisions that have taken place in the underlying per caput DES and population figures.

The data in the panels − proportions and numbers undernourished for country groups − are calculated from the country assessments as follows: numbers less than 1.2 BMR are calculated from the proportion and the total population, summed for their country group (giving total numbers undernourished), then divided by total population for the group to give the proportion or prevalence.

**4.1.6 Prevalence and numbers of children underweight (below 2 standard deviations weight−for−age − sections E of panels).** Here is a brief description of the methods used. Estimates of the prevalence (proportion) and numbers of underweight children were calculated using, as a first step, data from surveys considered to be nationally representative, as given by WHO (1987), and from a previous compilation reported by Haaga et al (1985). Underweight is defined as less than 2 standard deviations (SDs) of weight−for−age, using NCHS standards, as adopted by WHO (WHO, 1983). The age range was generally 0−60 months, but in a few cases the range reported started at 3 or 6 months; estimates refer to the 0−60 month old population. An equation for interpolation by country and year was calculated by regressing these estimates on other selected independent factors. The model thus developed was then applied to the complete set of countries covered in this report (see table 3) to estimate their prevalence of less than 2 SDs weight−for−age. These values were then aggregated to give estimates by country groups. This was done for three time points, 1975, 1980, and 1984. The regression method was necessary because representative prevalence estimates of malnutrition were not available for most countries, nor for more than one or two different years in any one country. Each country's predicted prevalence was weighted by the 0 through 4 year old child populations, for the three years of interest, and then aggregated to the country group level. This gave the number of children 0−4 years who were underweight in a country group; dividing this by the total child population for that country group gave estimates of prevalences underweight by country group.

(a) Sources of data for interpolation model. Anthropometric data were compiled on 40 countries from several different sources, (WHO, 1987), and Haaga et al (1985). Nine countries had estimates from two different survey years during the period 1975/1986. Only the results of those surveys which were known to be nationally representative, and which included children 0 (or 6 months) through 4 years of age, were used.

Prevalence of less than 2 standard deviations for weight−for−age (WA) was used as a measure of malnutrition. Weight−for−age was chosen because it is the most commonly reported measure in most surveys. The cutoff of −2.0 SDs is recommended by WHO because it approximates the traditionally used 80% median cutoff point, but unlike % median, it is comparable across age groups, and has comparable meanings for different indicators (Waterlow, 1977; Keller and Fillmore, 1983). Prevalences below 2 SDs have an expected value (of 2.5%) in reference populations. The data available will be listed in the Supplement.

In a few cases, where only the proportion of less than 80% median weight−for−age was available, the proportion less than 2 SDs was estimated graphically from the relationship of % median and 2 standard deviations based on the NCHS reference standards, given in WHO (1983).

Other variables were compiled for these 40 countries for calculating an equation with which to predict the prevalence of less than 2 SDs weight−for−age in each country. These included per caput gross national product (GNP), kcals/caput/day, infant mortality rate (IMR), child death rate, and total population. For the purposes of consistency and availability of information, all independent factors, except for kcals, were obtained from the World Development Report (World Bank, 1978 − 86). Kcals was obtained from AGROSTAT (see above). These independent factors were chosen for the same year of the survey from which weight−for−age was collected. The choice of indicators and approach was based on the reasoning given by Haaga et al (1985).

(b) Relationship of independent factors with prevalences of malnutrition. It was determined that three major factors related to nutritional status were GNP, kcals, and IMR, as evidenced by plots against the prevalence of low weight−for−age, by country group (see Supplement).

(c) Interpolation model. Regression (OLS) was used to derive a predictive model for nutritional status. Because the purpose is only to select factors which best estimate the prevalence of weight−for−age where data are missing, the model has no reference to causality.

The "best" regression equation was chosen based on the values of the adjusted R square, T value for the independent factors, and the spread of the residuals. The model which showed the best fit is as follows:

KCAL model; R square == 93.6; N == 45; F (p value) = 80.7 (0.0000)

PREDWA = 59.29 − (0.161*KCALSY) − (0.00788*IMRSY) − (1.856*DSAMER) + (13.631*DSEASIA) + (17.307*DASIA) − (4.198*DCAMCA) + (0.235*IMRSY*DASIA).

Where: PREDWA = predicted prevalence of weight−for−age;

KCALSY = average kcals for survey year;

IMRSY = infant mortality rate for survey year;

DSAMER = dummy variable for South America (1 = yes, 0 = no);

DASIA = dummy variable for Asia (1 = yes, 0 = no);

DSEASIA = dummy variable for Southeast Asia (1 = yes, 0 = no);

DCAMCA = dummy variable for Middle America and Caribbean (1 = yes, 0 = no).

Of the 49 country/years in the dataset, 45 had complete information on both kcals and IMR.

The logarithm of per caput GNP shoved a very similar relationship to prevalence as kcals, but was slightly less predictive based on $R^2$ and residual fit. This equation was not used further except to check trends in two cases. Although IMR did not contribute much towards explaining the variability in low weight−for−age, it was included because of its significant interaction with Asia. Dummy variables for Middle America and the Caribbean, and for South America, were included to improve the fit for these country groups. Other details will be in the Supplement.

(d) Calculation of country group estimates of malnutrition. The prediction equation based on kcal and IMR, shown above, was applied to a sample of 94 developing countries, for 1975, 1980 and 1984. A predicted prevalence was calculated by country for all three years, by inserting values for all factors in the equation. DES values (kcals/caput/day) required for this calculation were three year averages around the mid−point years of 1975, 1980, and 1984. IMR's were available by five year intervals only; thus values for the three years of interest were interpolated. The resulting prevalences were then weighted by child population in each country, and aggregated to the country group level. Estimates of child population 0 through 4 years of age were calculated by applying a known proportion of this age group of the total population from 1985 population statistics (AGROSTAT), to the total population for the years 1975, 1980, and 1984. The population estimates used were three year averages around the midpoints, 1975, 1980, and 1984, in order to be comparable to the three year averages for kcals used in the model.

**4.1.7 Infant Mortality (sections F of panels).** Infant mortality rates were obtained for each country from the UN Population Division (retrieved from AGROSTAT). Estimates are reported by five year intervals. Crude birth rates, the number of annual births, and the number of annual infant deaths were also available for all countries directly from UN Population Division (accessed from AGROSTAT). All annual infant deaths were summed across all countries in a country group, and divided by the total number of annual live births to get country group IMR's. Sections F of the panels show the mid−points of the five year intervals for IMR (i.e. mid−point of 1960/65 is midyear between 1962 and 1963).

**4.1.8 Child Deaths (sections G of panels).** Child death rates were obtained from the World Bank and for a few missing values from UNICEF (1986 − UNICEF estimates of infant and child deaths originally from UN Population Division). Country group estimates were derived using child population 1−4 years of age for the calculation of numbers of deaths. Because child populations were not available from the same source as child death rates, it was necessary to calculate this by the procedure discussed below. As a result, the number of child deaths is perhaps the least accurate of the basic data used in this report because it is based on several assumptions both in the original figures from which it was derived, and in the algorithm used to calculate the child population. The details of calculation of 1−4 year old child populations are as follows.

Of the 94 developing countries in the sample, only 38 had population data on 0−1, and 1−4 year olds, and 38 had only 0−4 year populations; the rest were missing (UN, 1987). From those which had both figures, a proportion of the 0−4 years of age which are 1−4 years was calculated by country, and averaged for each country group. Proportions were fairly consistent, with values clustered around 78 − 80 %. These varied somewhat by region. The average proportion of 1−4 year olds by country group was then applied to all 0−4 year old child populations by country in that country group, to obtain an estimate of the 1−4 year child population. These figures on the child population were multiplied by the child death rates to calculate the number of child deaths by country.

Child death rates calculated by the world Bank are themselves "..based on the data on infant mortality and on the relationship between the infant mortality rate and the child death rate implicit in the appropriate Coale−Demeny Model life tables" (World Bank, 1986 p.254). Thus they will be highly correlated with IMR's, being calculated from them, but do include some information additional to IMR as they take into account regional variations in the age patterns of early childhood mortality.

### 4.2 Figure 1: Infant Mortality Statistics

Figure 1 gives infant mortality statistics by country groups. Total population data are point estimates for 1960 and 1984. Infant mortality rates are five year interval estimates for 1960/65 and 1980/85. The number of infant deaths also correspond to the five year IMR intervals. Population and IMR estimates are the same as graphed in the panels. Although the number of infant deaths in China in 1984 appears surprisingly low given its rise in population from 1960 to 1984, the crude birth rate in China halved over this period compared to a usual decrease of 16–23% in the other country groups.

### 4.3 Figure 2: Trends in Global Prevalences of Underweight Children

Global estimates of the prevalence of less than 2 SDs of weight–forage based on the sample of 40 countries with actual survey data on nutritional status. The points represent means for the combined years (as labelled on the horizontal axis), adjusted for the effect of the country group. This was necessary since yearly estimates were confounded by group, which had by far the most effect on prevalences. To calculate adjusted means, an analysis of variance (ANOVA) was done using prevalences as the dependent factor and including both year (but grouped as indicated on the horizontal axis) and country group as independent factors. The ANOVA procedure in SPSSPC was used, and the Multiple Classification Analysis routine (MCA) gave the adjusted means.

To more accurately test differences over time while adjusting for country group, the analysis was repeated keeping the survey year as a continuous (i.e. not grouped) variable, as an analysis of covariance. In the calculations, survey year was tested after the effects of country group were removed. Results shoved the downward trend over time to be significant ($p<0.05$; statistics in Supplement).

### 4.4 Figure 3: Geographical Distribution of Trends in Child Malnutrition, 1979/81 to 1983/5

This figure summarizes changes in estimated prevalences of underweight children by groups of countries, from 1979/81 to 1983/5. Prevalences were estimated by country for the two time periods as described above. Two additional steps were taken in order to show regional trends. Both of these steps involve "smoothing" the data in order to avoid displaying change in malnutrition when in fact there may have been no change; and to avoid giving country–specific change estimates for which the data were not strong enough. The purpose of this analysis is to err on the side of reporting no change.

First, it was calculated that if two nutritional surveys were taken with about 5,000 children in each survey, it would require about a two percentage point difference in the prevalence to be statistically significant. With this rough approximation in mind, the initial analysis identified countries where malnutrition levels were estimated to increase or decrease by at least two percentage points. Second, a form of spatial moving averages for the calculation of the grouped data shown in Figure 3 was adopted. The formal rule was to calculate the nutritional change in each country (either improving, no change, or deteriorating) based on estimate for the particular country and the adjoining countries. Thus any country categorized differently from two or more adjoining countries was treated as an outlier, and shown in the same category as the adjoining group. In practice only seven countries, all small, were treated thus. As a result, this moving average approach blends to the average level any singular country with a deviant trend in malnutrition. The result is to give an impression which summarizes the results by groups of countries.

### 4.5 Figure 4: Incidences of Low Birth Weight by Country

This map is taken directly from WHO (1984).

### 4.6 Figures 5A to 5C: African Maps

Figure 5A on DES in Africa was extracted and redrawn from FAO (1985, p.8). Figure 5B came from UNICEF (1985 p.11) and Mason et al, (1984a), and Figure 5C came from Walker (1985).

### 4.7 Figures 6A to 6E: Clinic Data

Time series data on malnutrition in Botswana are quoted from UNICEF (1985 p.15). Yearly and monthly trends in Lesotho, Burkina Faso, and Madagascar were compiled from country level clinic data collected by the Catholic Relief Services Growth and Surveillance System in Eastern Africa. Each prevalence point represents a weighted average for all clinics and regions in that particular month. These countries were chosen for lack of selection of children into the programme which could seriously bias estimates, especially if selection by nutritional status was practiced. After considering this and other potential sources of bias, it was concluded that trends observed were likely to be real. Details of methods are reported in Test, et al, (1987). Data from Ghana was calculated from information obtained from AGROSTAT, and from UNICEF (1985, p.15).

### 4.8 Figures 7 and 8: Hours Work to Maintain Diet

The indicator representing Hours Work to Maintain Diet (WHO, 1976 pp. 32−33; and Mason et al, 1984b, pp. 111) for Costa Rica (Figure 7) and Peru (Figure 8) is an index derived to approximate the changing purchasing power of hourly workers in these countries. Assuming that in 1980 70% of the wage income − and therefore 70% of the 160 hours worked per month − bought an adequate diet, the hours required per month for each year to maintain that diet was calculated as follows.

Number hours worked in Year X (yrX) = $(160 *0.7) (FPI_{yrX}) (wage_{80}/wage_{yrX})$

FPI is the Food Price Index using 1980 as the base year; wage is the wage for non−agricultural workers. Source was ILO (1985).

### 4.9 Figures 9A and 9B: Data on Northeast Brazil

Source for Figures 9A and 9B was Becker and Lechtig (1986).

### 4.10 Figures 10−13 and Tables 1 and 2: Micronutrient Deficiencies

Availabilities of vitamin A and iron in the diet were taken from Food Balance Sheet data published by FAO (1980). Averages were calculated for 1961−65 and 1975−77. Regions in Figures 10 and 11 are as defined by FAO. Retinol equivalents are the sum of preformed retinol (animal sources) and the equivalent value from carotenes (plant sources). Iron data are total iron and do not allow for bioavailability. In Figure 10, the dotted lines give an indication of requirements from FAO/WHO recommendations for adults for retinol equivalents (IVACG, 1981) and for an intermediate bioavailability diet for iron, from draft recommendations (FAO/WHO 1987, p.63); they are for guidance only in interpreting the figures. In Figure 11, DES is also plotted to indicate where vitamin A and iron intakes change differently from total food intake (i.e. where micronutrient/kcal ratios are changing).

The map showing geographical distribution of vitamin A deficiency (Figure 12) is taken from DeMaeyer (1986), itself assembled from various sources available to WHO. This map indicates current knowledge of distribution of the deficiency, and can be compared with a similar one in ACC/SCN (1986) which superimposes programme activities.

Prevalences of anaemia given in Table 1 are taken directly from WHO data (DeMaeyer & Adiels−Tegman, 1985, Table 5). The cut−off haemoglobin levels for defining anaemia are established by WHO (given in the reference) ranging from 110 g/l (young children and pregnant adults) to 130 g/l (adult males). Regions are as defined by WHO.

Table 2 showing distribution of goitre and cretinism by WHO region is derived from ACC/SCN (1987c), with population data calculated by WHO region. Figure 13, the map showing geographical distribution of iodine deficiency, is also taken from ACC/SCN (1987c), based on WHO sources.

## GLOSSARY

This section gives definitions of certain terms used in the text. for quick reference. Detailed definitions are given in section 4.

**Child death rate:** the number of deaths of children aged 1 through 4 years per 1000 child population of this age per year.

**Dietary energy supply (DES):** expressed as kcals/caput/day. The amount of food available to, not necessarily consumed by, the household; calculated from national food production and utilization data by the FAO Food Balance Sheet procedure (FAO, 1984), gives average per caput food availability for human consumption per year (see section 4.1.4).

**Food production indices per caput:** measure of changes in the total amount of edible food produced by a country per total population per year; calculated from price−weighted quantities of agricultural commodities (FAO, 1986). Reference period is 1979/81 = 100.

**Goitre and cretinism:** results of deficiency of iodine, an essential component of thyroid hormones. These and other effects are now referred to as "iodine deficiency disorders" (IDD's). Goitre means enlarged thyroid gland in the neck. Cretinism is a severe form of mental retardation.

**Haemoglobin, anaemia:** iron is an essential component of haemoglobin. Anaemia is lowered haemoglobin concentration in the blood, commonly due to iron deficiency, and is measured by haemoglobin levels, with cut−offs established by WHO (see section 4.10).

**Incidence:** number of new cases of a condition (e.g. cases of low birth weight per population per year) over a specified period of time, or as a percent of a rate (e.g. percent of births below 2.5 kg).

**Infant mortality rate (IMR):** the number of infant (below 1 year) deaths per 1,000 live births, usually presented for a given year.

**Malnutrition (malnourished):** used here to refer to physical effects in humans of dietary inadequacy, often exacerbated by infections, usually resulting from low total food (protein − energy) intake, resulting in inadequate growth in children and thinness in adults. The indicator used here is proportion or prevalence of 0−60 month old children underweight.

**Micronutrients:** vitamins and minerals − here Vitamin A, iron, iodine are discussed, being the most common deficiencies.

**Prevalence:** the proportion of population at one point in time, with a condition.

**Retinol equivalent (RE), Vitamin A:** pre−formed vitamin A from animal sources are retinol compounds; carotenes from vegetable sources are metabolized to retinol, usually 6 carotene units forming one retinol unit. Dietary vitamin A is therefore expressed as retinol equivalents, in order to sum all sources. Vitamin A is essential for the integrity of many tissues, notably for membrane function.

**Undernutrition (undernourished):** used here as shorthand, for ease of reading, to refer to inadequate access to food. The proportion or prevalence of undernutrition is calculated from a cut−off point (based on 1.2 BMR for adults here), DES, and an estimate of the distribution. Those estimated to have less than this cut−off are also referred to as having "marginal access to food". Details are in section 4.1.5.

**Underweight (or child malnutrition):** the percent of children 0 through 4 years who are below 2 standard deviations weight−for−age by NCHS/WHO standards is the prevalence of child malnutrition.

**Xerophthalmia ("xeros", dry: "ophthalmia", eye):** refers to the eye diseases specifically caused by vitamin A deficiency, often leading to blindness.

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## APPENDIX

### A PRELIMINARY EXAMINATION OF THE ASSOCIATION BETWEEN MALNUTRITION AND SELECTED ECONOMIC INDICATORS: LESOTHO (1981–1985)

**Introduction**

The prevalence of malnutrition data (clinic–based) for a number of countries has already been discussed in the main body of the report. The availability of these data for several years offers an opportunity to look in greater depth at the changing prevalence in terms of trend and seasonal components. In addition, it is clearly of interest–having regard to the human implications of economic adjustment – to investigate the association between prevalence and one or more economic indicators. In this appendix we report on one approach to these issues which appears to hold some promise. Data from Lesotho (see Sections 2.1 and 4.6) has been chosen for this study, as it has been established that variation in clinic–coverage has had no statistically discernible effect on prevalence estimates.[13]

[13] Test, K., J. Mason, P. Bertolin and R. Sarnoff (1987). Trends in Prevalences of Malnutrition in Five African Countries from Clinic Data: 1982–1985. Submitted for publication.

It is important to stress that this is a preliminary note, and that further work will be needed to develop the technique and to extend the analysis to other countries.

**Data and Methods**

A cursory examination of the original series (fig. A1) indicates a strong seasonal component, coupled with trend and irregular effects. An initial decomposition based on the assumption that trend and seasonal components remain constant over the span of the Series proved unsatisfactory. Inspection of the latter model shoved that the magnitude of the seasonal effects differed substantially from year to year, and the overall fit was poor. An alternative approach based on an adaptive model – one which allows both components to change with time, i.e. a model which is locally constant only – proved adequate. Specifically, the method adopted is discussed by Abraham and Ledolter[14], and is based on a discounted least squares technique. The model is expressed as:

$$Z_n = T_n X S_n + e_n$$

where $Z_n$ is the original series; $T_n$ is the trend estimate; $S_n$ is the seasonal effect; and $e_n$ represents the residual or irregular component. The trend component is linear and may be further decomposed into:–

$$T_n = (mu_n + b)$$

i.e. the level of the series mu, and the slope b. These components are re–estimated as each new observation becomes available.

[14] Abraham, B. and J. Ledolter (1983). Statistical Methods for Forecasting (Chpt. 4). Wiley, New York.

**Results**

Estimation requires the application of three smoothing constants $a_i$ (i=1,3), associated with the level, slope and seasonal effects, respectively. Each lies between 0 and 1. For these data the overall sums of squared errors (SSE) was minimized with $a_i$ (for all i) = 0.18, producing an SSE = 70.7. The 1−step ahead forecasts are shown superimposed on the original series in figure A1. The estimated seasonal factors and the fluctuating level of prevalence (adjusted for seasonality) are depicted in figures A2 and A3. For comparison purposes the latter figure is repeated on the following page. In addition, the estimated slope is shown in figure A4, while the two selected economic indicators[15] (Rate of Exchange and Consumer Price Index) are plotted in figure A5. Forecasts for the first half of 1986, are:

[15] IMF, 1987. International Financial Statistics: Bureau of Statistics of the International Monetary Fund, Vol XL, No. 3. Washington D.C.

| **Month (1986):** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** |
|---|---|---|---|---|---|---|
| % Prevalence: | 31.5 | 30.9 | 32.3 | 31.5 | 28.8 | 29.4 |

**Discussion**

In spite of the apparent complexity of the raw series, the above model provides a readily interpretable decomposition. The fit to the original series is evidently very good (fig. A1). The seasonal factors are pronounced and regular over the span of the series, with a slight tapering in amplitude towards 1985. The annual average is 1.0. Peaks reaching 110% occur in January through March of each year − which is immediately prior to the annual harvest (April/May), and troughs of around 90% follow the harvest in June/July. The level of prevalence (figure A3), corrected for seasonality and trend, was apparently falling slightly between 1981 and mid 1983. This is followed by a sharp upturn which continues for the remaining years. From figure A4 it will be observed that the slope also shows this pronounced increase from mid 1983. (It should be noted that during 1983/84, Lesotho suffered a drought and a national emergency was declared.) Of the two economic series chosen, the exchange rate suffers a much sharper decline after mid 1983, and, slightly later in the year, the rate of increase in CPI also rises somewhat. Regression analysis (results not included here) indicates that the prevalence level is strongly dependent on the exchange rate in particular. Naturally, this is not to imply that the relationship between these series is necessarily causal. Nevertheless, this exploratory exercise is clearly encouraging, and is certainly suggestive. It remains to extend the analysis by looking at other countries and additional economic indicators.

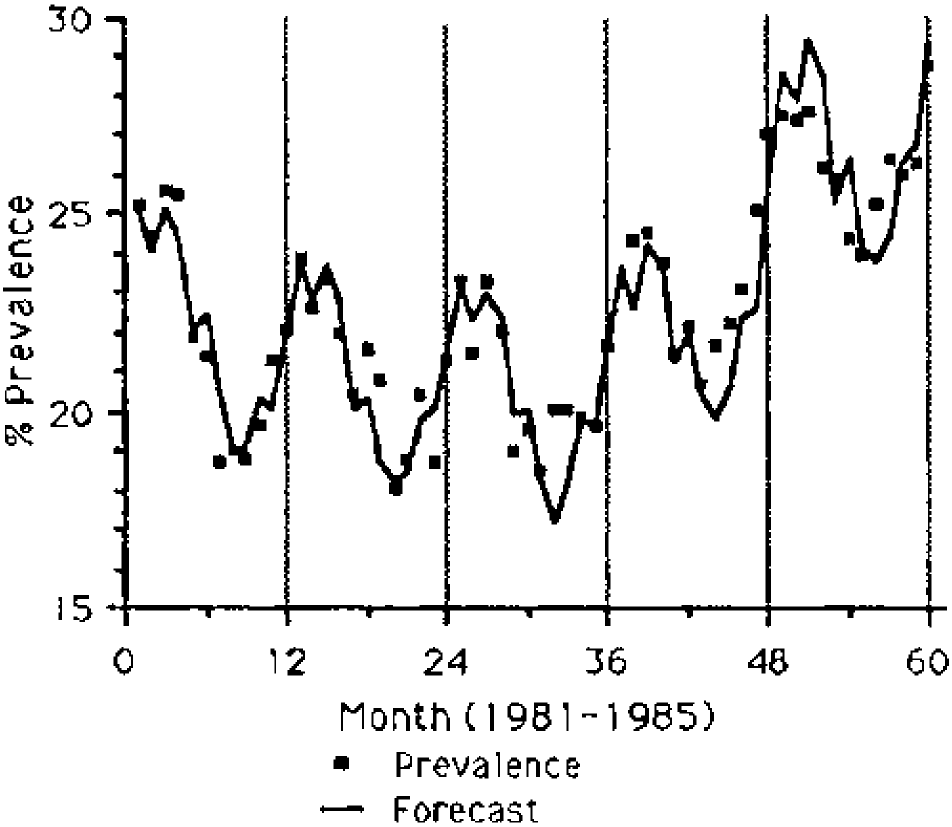

Figure A1 − Observed and Predicted % Prevalence

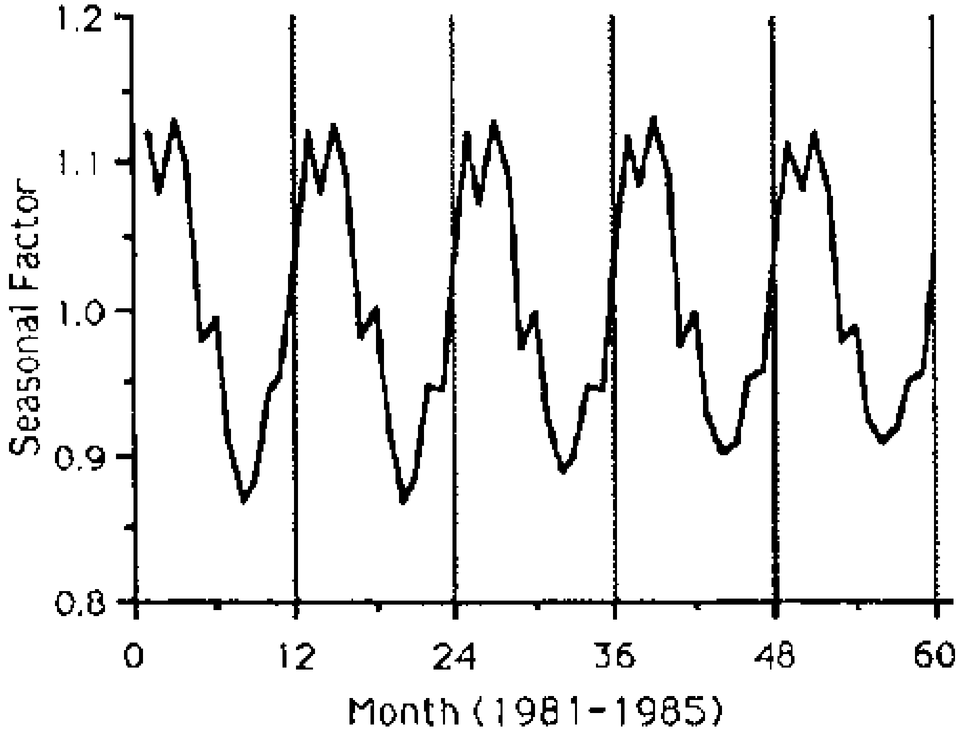

Figure A2 –Multiplicative Seasonal Factor

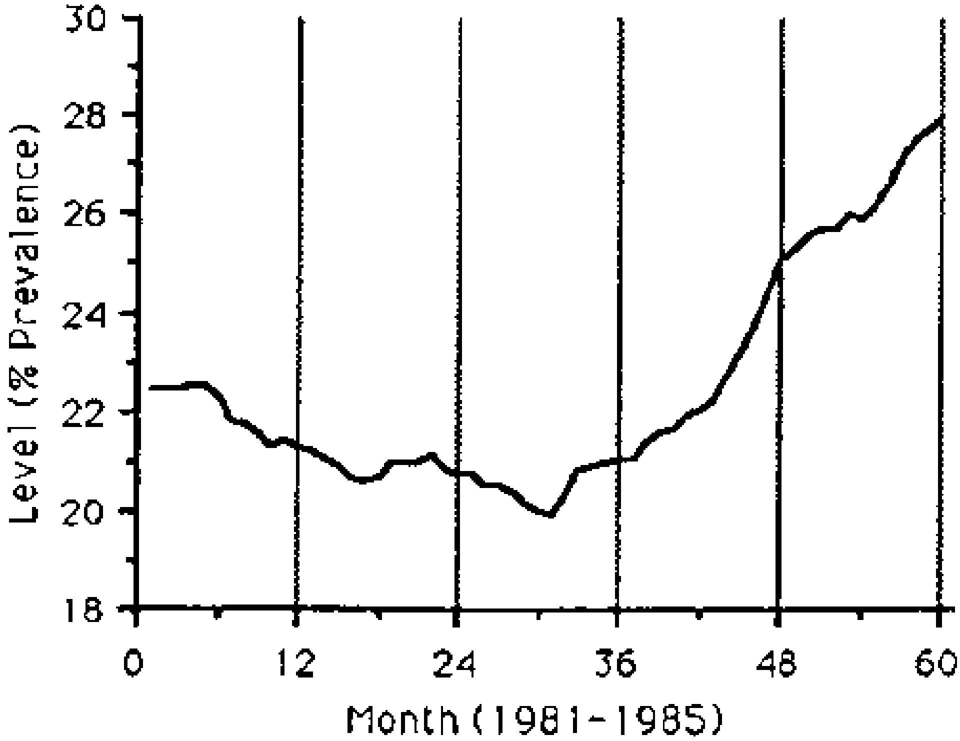

Figure A3 – Estimated Prevalence Level

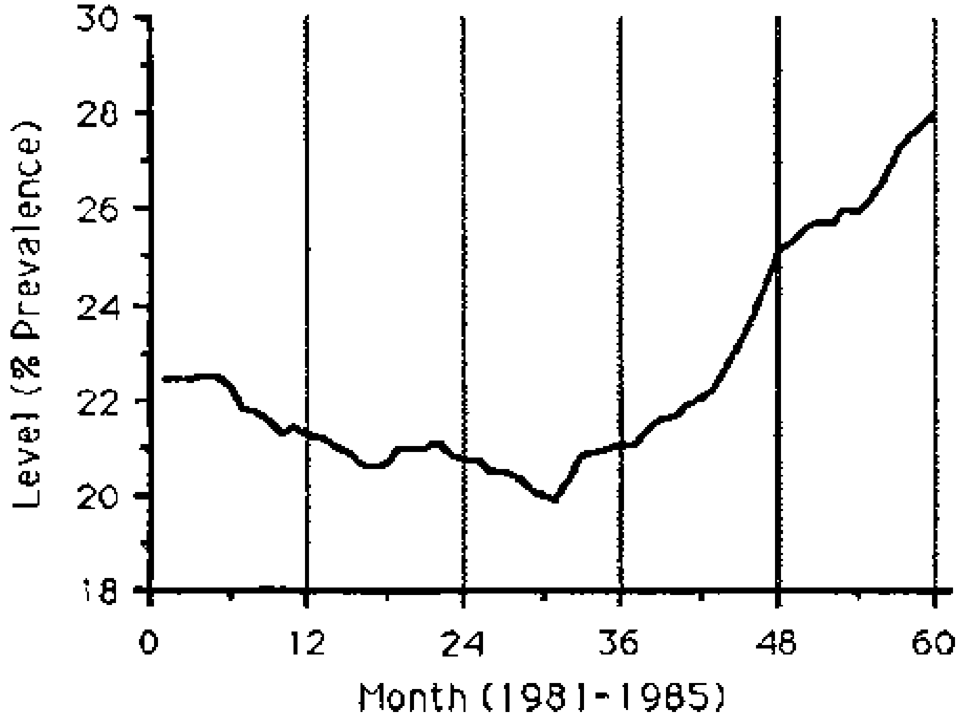

Figure A3 (repeated) – Estimated Prevalence Level

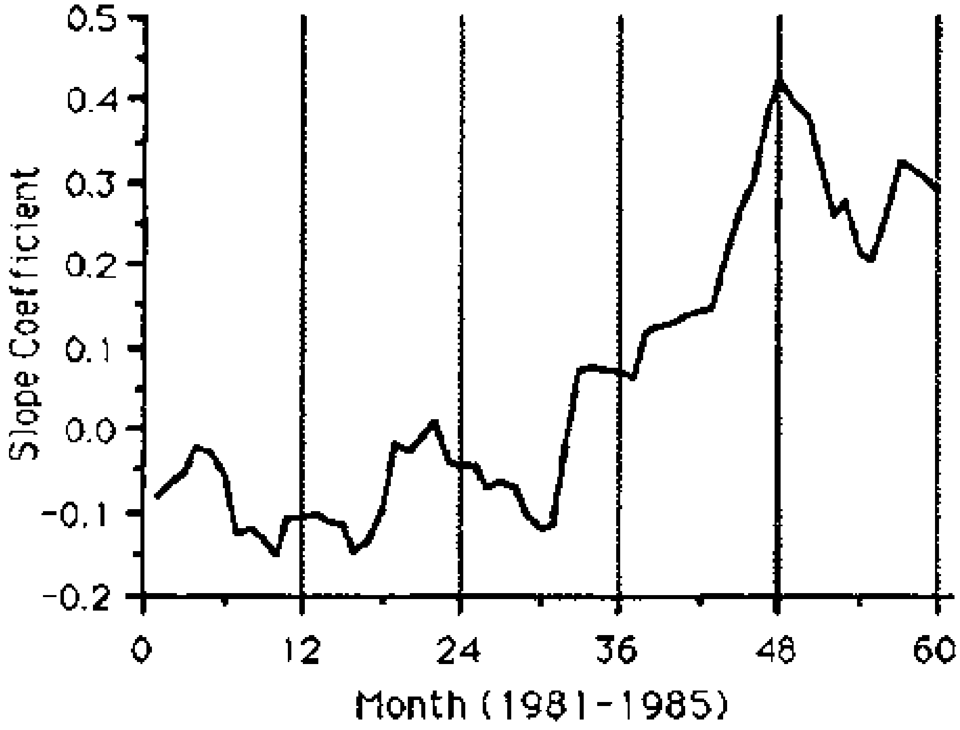

Figure A4 – Estimated Slope of Prevalence Series

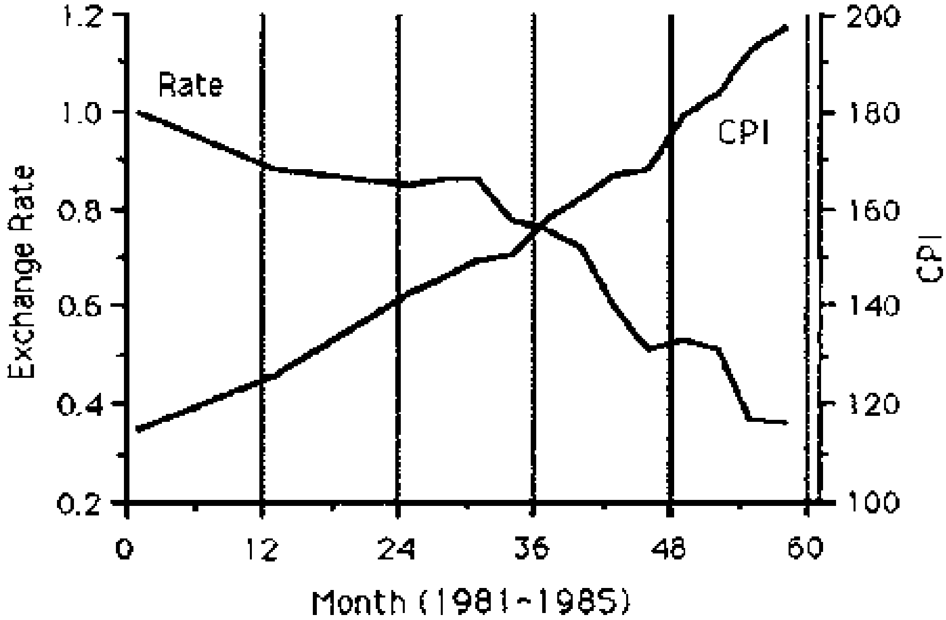

Figure A5 – Economic Series