

RESEARCH REPORT

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# FOOD IN THE THIRD WORLD: PAST TRENDS AND PROJECTIONS TO 2000

Leonardo A. Paulino

June 1986

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**Leonardo A. Paulino**

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International Food Policy Research Institute  
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Headings for income categories:  
for \$500-\$1,249, read \$500-\$1,999;  
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## FOREWORD

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In 1977, IFPRI published Research Report 3, *Food Needs of Developing Countries: Projections of Production and Consumption to 1990*, which presented an assessment of the current and prospective food situation of developing market economies. The study covered major food crops (cereals, roots and tubers, pulses, and groundnuts) in 82 countries and used 1960-75 data on cereals from USDA and noncereals from the FAO. It made trend-based projections of food production and consumption into the future, which pointed to a possible gross deficit of 120-145 million metric tons by the end of the current decade. The report also called attention to the special food problem of the low-income countries in Asia and Sub-Saharan Africa "whose major option is to increase food production more rapidly while supplementing supplies as far as possible with food aid and commercial imports" (page 27).

This study expands the coverage of the 1977 food gap work to 105 developing countries, including the People's Republic of China and other Asian centrally planned countries, and it adds bananas and plantains to the list of major food crops. Although bananas and plantains contribute only about 1 percent of the output of major food crops in developing countries as a whole, these crops represent about 5 percent of the basic food staples produced in each of two regions: Sub-Saharan Africa and Latin America. The study builds on data from other international organizations, including FAO on food production and consumption, the United Nations Secretariat on population, and the World

Bank on national accounts. Agricultural statistics on the People's Republic of China are from the data sets organized by Bruce Stone of IFPRI from various government sources, both national and provincial.

Compared to previous work, the study investigates in more detail trends in the components of food production, consumption, and trade. It also extends the projection horizon to the end of the century. Appendix I compares the study projections with those in FAO's 1981 global study *Agriculture: Toward 2000*.

The food projections in this study are developed assuming that trends in developing-country production and per capita GNP will continue. These trend-oriented projections provide a "future" scenario from which needed departures may be effected through changes in food and food-related policies. However, because of rapidly changing economic factors, projecting true trends appears to be as difficult as predicting future situations. This should be kept in mind when looking at the projections in this study.

Because of its size and importance, we have included China in this food gap analysis to obtain a more comprehensive assessment of the future food situation in developing countries. Largely because of the lack of IFPRI data for the purpose, analysts who have closely followed the development of agriculture in the People's Republic of China were originally commissioned to collect data. Later developments on the international scene, however, led to a large flow of official data from the Chinese government. IFPRI

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therefore undertook a systematic collection and organization of agricultural statistics for China, coupled with continuing analysis of changes in China's food and agriculture situation.

In presenting these data, we implicitly accept that in matters as complex as the interaction of supply and demand a simple approach of measuring past changes may be more useful than complex attempts to analyze component parts or to perform large-scale

modeling exercises. What we present here is a base for further analysis, derived from past development. From this solid base, modifications can be made depending on changes in technological possibilities, income growth, and other factors.

John W. Mellor  
Washington, D.C.  
June 1986

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# 1

## SUMMARY

Domestic production shortfalls and rising food imports leading to widening trade imbalances in developing countries have given cause for concern since the 1960s. These changes have occurred despite the substantial growth in crop yields that has resulted from technological advances in agriculture, particularly in Asia. With food demand clearly outpacing food output in the Third World, how serious are food problems in developing countries and what is their likely food situation in the coming decades? This study examines the trends in production, consumption, and trade of the basic food staples in 105 developing countries and, through the use of projections based on past trends in output and income, attempts to determine the general size of future food problems in the Third World. The study also tries to identify the geographical areas and country groups that are most likely to face serious deficiencies. It considers data for the developing countries as a whole, for four regions, and for a dozen subregions.

The study finds that food production outpaced population growth in most countries during the period 1961-80. Production of major food crops (including cereals, roots and tubers, pulses, groundnuts, and bananas and plantains) in developing countries grew an average of 3.1 percent a year, compared to a 2.4 percent average growth rate of population. This relatively rapid growth of food production was strongly influenced by the trends in China, whose abnormally low agricultural output at the start of the reference period tended to exaggerate the country's production growth rate, which in turn greatly biased the food trends of developing countries as a whole. During the 1961-80 period in particular, China's food production data indicate an extremely rapid growth rate of 4.1 percent a year; trends for the longer 1952-80 period, however, show a more normal growth rate of 2.8 percent a

year. The 2.8 percent figure is used for the country's output projections. If China data are excluded, the average food production growth rate declines to 2.6 percent and the population growth rate rises to 2.5 percent. Because China's statistics can significantly alter the picture for Asia and for the Third World, the results of the study are given with and without China.

Although rice remained the largest Third World crop, wheat output expanded the fastest—5 percent a year. Wheat had replaced maize as the second principal crop of developing countries by the late 1970s. Maize also grew rapidly at 4 percent a year. Improvement in crop yields accounted for 75 percent of food production growth (60 percent excluding China). Output per hectare (yield) expanded nearly 2.5 percent a year, whereas harvested area grew less than 1.0 percent a year.

In a comparison of the two decades considered, production growth slowed in the 1970s for the developing countries, both including and excluding China. Its rate increased in Asia and in North Africa/Middle East but fell in Sub-Saharan Africa and Latin America. The contribution of crop yield to production growth increased in the developing regions, except in Asia where it was unchanged.

Although production growth has generally stayed abreast of or exceeded population growth, food demand has outstripped both in many countries. Estimates of total domestic consumption of major food crops during the trend consumption period 1966-80, for which a comprehensive set of commodity utilization data is available, show an increase of 3.3 percent a year. Average annual growth rates in the use of these commodities for direct consumption by humans were 3.2 percent (2.8 percent, excluding China) and for animal feed, 4.3 percent.

The reasons for this fast growth in de-

mand vary among regions and subregions. In regions where incomes grew rapidly, the demand for food increased accordingly. These countries also saw a shift in food consumption patterns: demand for livestock and poultry products increased sharply. As production of livestock rose to meet this demand, consumption of basic staple foods as feed for livestock also increased. This pattern has been evident in the regions of Latin America and North Africa/Middle East and in the East and Southeast Asia subregion of Asia: in relative terms, direct food use declined while feed use increased. In Sub-Saharan Africa and the other subregions of Asia, increases in the use of staples for animal feed have been much slower, and population growth is still the dominant factor in consumption growth.

Looking at the data on international trade of basic food staples during the two decades, the study shows that the food imports of developing countries expanded more than twice as fast as their food exports. Average yearly net imports increased from 12 million metric tons during 1966-70 to nearly 40 million metric tons during 1976-80. They more than tripled in North Africa/Middle East. There was a small increase in Asia, but if China is excluded, the region's net imports actually decreased about 45 percent as the result of major reductions in cereal imports in South Asia. Latin America and Sub-Saharan Africa both switched from being net exporters to net importers. In Latin America rapid consumption growth, spurred by rising incomes, slightly outpaced output growth. The picture for Sub-Saharan Africa is more discouraging: food production grew slowly, if at all; population grew rapidly; and the resulting food gap had to be filled with imports.

If the 1961-80 production trends and the 1966-80 per capita income trends continue, there could be an overall net deficit of about 70 million metric tons of food in the developing countries by the end of the century. This projected food gap would represent less than 5 percent of the projected demand for basic staples in 2000—slightly less than the percentage in 1980 and only 20 million metric tons more than the shortfall in that year.

The largest projected shortfall—60 million tons—would be in North Africa/Middle East, then Sub-Saharan Africa with close to 50 million tons, followed by Latin America with 10 million tons. Asia, in contrast, is projected to achieve a net surplus of slightly more than 50 million tons (about 45 million metric tons, excluding China).

The study alternatively groups developing countries by average income, income growth, and food and calorie sufficiency. A total deficit in 2000 of nearly 10 million metric tons of basic food staples is projected for the 19 countries that in 1980 formed the lowest income group (less than U.S. \$250 per year) and where growth of food output had lagged behind population increase. Shortfalls two to three times larger than those during 1980 are also projected for the middle- and high-income countries.

If country grouping is based on annual growth rates of per capita income, nearly 30 countries with rates of less than 1 percent have a projected food deficit of almost 30 million metric tons. The fast-growing developing countries, especially those with rates of 5 percent or more, are also projected to face large food deficits.

In the nutrition-based classification of countries, the 1980 output shortfall of 22 countries with the lowest calorie supplies is projected to increase fivefold. These countries had calorie sufficiency ratios in 1979-81 of less than 90 percent of the FAO/WHO recommended calorie requirements. This country group and the two others with sufficiency ratios of 100 percent or more have projected food deficits of about 25 million metric tons each.

Food prospects are brighter for the country group immediately above the lowest category in all three alternative typologies. Surpluses are projected for the groups of countries with per capita incomes of U.S. \$250-\$500, per capita income growth rates of 1-3 percent, and calorie sufficiency ratios of 90-99 percent.

The projections are based on the assumption that historical trends in production and per capita income will continue. But because of the long projection period, even slight changes in these and other related factors could cause the size of the projected

food gap to differ substantially. Production trends include the unusually rapid growth in the late 1960s and the 1970s that resulted from the effects of the "green revolution." Both the rate of area expansion and the increase in crop yields, which jointly form the trend rate of food output growth, will need to be maintained. If area expansion continues to slow, as shown by data for the 1960s and 1970s, future increments in output may depend much more on continued gains from agricultural technology—the spread of current technical know-how and an additional flow of improvements in output per hectare.

On the consumption side, maintaining 1966-80 growth rates of per capita income and, hence, of food demand also poses problems in view of changes in the world economy after this period. Unless offset by faster-than-trend increases in income in the years ahead, the slower income growth in Third World countries due to the recession in the industrialized economies during the early 1980s is bound to reduce the projected food demand. Although the effects on developing countries may be mixed, the more recent rapid decline in energy prices can also be expected to affect food demand trends. The effects of these slowdowns in production growth and income-induced demand growth could offset each other, but the resultant change in the projected food gap is difficult to determine because of the close relationship between agricultural production and incomes in developing countries.

Exclusive of changes in production and income trends, however, there is reason to believe that the projected food gap in the Third World may be larger than indicated. In this study the technical coefficients in the conversion of feed to livestock products are assumed to be constant. An alternative method of projecting the use of basic food staples for animal feed that could take into account the changing input-output relationship in livestock production in developing countries can increase their projected food demand by 4 percent and widen the projected food gap by 40 million metric tons.

The importance of China in assessing the Third World food situation has been shown before. Any changes of the country's output and demand projections could easily affect the size of the food deficit for the developing countries as a whole. Based on the country's 1952-80 production trends and a projected average growth rate of population of 1.1 percent a year during 1980-2000, China is projected to have a small food surplus by the end of the century. Assuming that the major decline in the population growth rate in China is achieved, the consequent change of population structure could, as the proportion of adults rises, result in increases of per capita food consumption above the level projected for the country. Even if China's fairly rapid growth of food production continues, the country could fall into the food deficit column.

Although study projections of the size of the food gaps cannot be precise, some general trends are evident. Unless Sub-Saharan Africa's production trends improve or its population growth decreases, this region faces serious food shortages: Sub-Saharan Africa has yet to benefit significantly from the seed-fertilizer technology of the 1960s, but constraints presented by the region's environment, especially in the Sahel, may stand in the way of substantial gains from this technology. Food aid has provided a major portion of the food imports of the region in the past, but the food aid trend has to improve significantly. Increasing technical and financial support to accelerate growth of the region's food output will be necessary to ease Sub-Saharan Africa's food problem.

In assessing the overall food situation of the Third World and identifying geographical areas and particular developing-country groups that could face serious food problems in the future, this study has relied on the relative stability of the trends drawn from aggregated data of countries and commodities. Complementary research would be needed to examine prospective situations of specific countries and commodities before policy recommendations at these levels could be addressed.

# 2

## INTRODUCTION

This study examines the trends in production, consumption, and trade of basic food staples in Third World countries during the two decades ending in 1980 and presents a trend-based scenario of the supply and demand situation in these commodities by the end of the century. Its aim is to define the world's food problems—its size, geographical composition, and dynamics—as a part of the International Food Policy Research Institute's efforts to identify and analyze alternative national and international strategies and policies for meeting food needs in the world, particularly in low-income countries and for the poor in these countries.

The study focuses on the major food crops, including cereals, roots and tubers, pulses, groundnuts, and bananas and plantains, which together represent the bulk of total calorie supply in developing countries.<sup>1</sup> For purposes of aggregation, the noncereal components are converted to cereal equivalents on the basis of their calorie content relative to that of wheat. Analysis of past trends makes use of 1961-80 data provided mostly by the Food and Agriculture Organization of the United Nations (FAO). Production trends are largely derived from annual estimates for the whole of this period, whereas trends in consumption and trade are obtained from the annual data for 1966-80 or the five-year averages at both ends of this period. The FAO series of estimates on consumption starts from 1966; trade data for the same period are used for the sake of consistency with consumption estimates. Projections of production to the year 2000 are in general simple extrapolations of country trends in aggregate output, whereas those of demand represent the sum of separate projections of each country's use of the basic food staples for direct consumption by humans, for animal feed, and for

other purposes such as seeds, nonfood uses, and allowances for waste. Demands for direct consumption by humans and for animal feed are each projected based on constant 1980 per capita use and on the trend growth rate of per capita incomes during 1966-80. These projections assume unchanged relative prices. Details of the assumptions, methodology, and data sources employed in this study are given in Appendix 1 of this report.

Results of the analyses are presented for the four major developing regions of Asia, North Africa/Middle East, Sub-Saharan Africa, and Latin America. In most cases, study results are also shown for 11 country groups or subregions: China, South Asia, East and Southeast Asia, Northern Africa, Western Asia, West Africa, Central Africa, Eastern and Southern Africa, Mexico and Central America (including the Caribbean), Upper South America, and Lower South America. Subregional trends are especially useful in helping identify the areas that have had the most influence on regional trends. Because of data problems encountered on food production and consumption in China during the study period, particularly in the People's Republic of China, results given for Asia and for the developing countries as a group both include and exclude China. The report also shows food trends and projections for other country typologies, using criteria such as income, food availability, and calorie supplies in each country. Appendix 2, Table 18, presents the system used to classify countries.

Chapter 3 discusses in detail the trends in major food crop production in developing countries from 1961 to 1980. It includes comparisons of the trends of population and food output. The relative importance of the major food crops in the output of the regions and subregions is examined, as are the con-

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<sup>1</sup> The terms major food crops and basic food staples are used here synonymously.

tributions of these commodities to the overall growth of food production, based on 1961-65 and 1976-80 averages. Analysis is also made of the trends in harvested area and output per hectare during 1961-80 and between halves of this period.

Chapter 4 looks at past trends in the consumption of basic food staples. Consumption here refers to the domestic use of these commodities for food, animal feed, and other domestic purposes. Trends in the growth of utilization in these three categories are analyzed for changes in the pattern of consumption of basic food staples among country groups and in the Third World as a whole. Trends in the use of cereals and non-cereals for food and for feed during the past two decades are examined briefly. The data used in analyzing consumption trends, particularly those of feed use, include not only the primary forms of the study commodities but also bran and cakes from cereals and groundnuts.

Trends in the growth of Third World exports and imports of basic food staples are examined in Chapter 5. The increases in food exports and imports shown here reflect the expanding role of international trade in adjusting supply-demand imbalances, as consumption outpaces the production of these commodities in Third World countries. The food trade positions of the developing regions and subregions are shown for the periods 1966-70 and 1976-80, the average annual estimates of which are used in deriving the trends in food trade.

Chapter 6 presents the food projections for developing countries to the year 2000. It should be emphasized at the outset that these projections are made under specific assumptions. Food projections are developed for each country under the assumption that the 1961-80 trends of food production and the 1966-80 trends of per capita income

will continue. The resultant gaps between projected production and demand for basic food staples suggest general orders of magnitude and the critical locations of the world food problem around the year 2000. The reliability of estimated gaps is increased at higher levels of aggregation because errors in country projections tend to be offset in the process. Absolute measures of individual country food gaps, the treatment of which requires caution, are not presented in this report. An important assumption in these projections is that relative prices are unchanged. Although there is no doubt that food prices are important, their inclusion would be more useful for clearing the market in either a total global approach or specific country studies. Globally, the responses to world food prices from the supply side largely come from the developed economies whose food exporters also hold most of the world's cereal stocks, the size of which has a major effect on price.<sup>2</sup> The food projections in Appendix 1 of this study are compared with those developed in FAO's 1981 global study, *Agriculture: Toward 2000*.

Food trends and projections based on classifications of countries other than by geographical location are discussed in Chapter 7. Countries are grouped according to per capita GNP in 1980, average annual growth rate of real per capita GNP during 1961-80, ratio of production to consumption of basic food staples in 1976-80, and calorie sufficiency during 1979-81.

Finally, the general implications of the results of the study for the food policies of Third World countries are considered. The possible roles of domestic food production and international food transfers in filling the projected food deficits of these countries are reviewed, and some areas of further research that could provide more insights on the world food problem are suggested.

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<sup>2</sup> Leonardo A. Paulino, "Global Trends in Cereal Supply, Demand, Trade and Stocks," International Food Policy Research Institute, Washington, D.C., 1985 (mimeographed).

# 3

## FOOD PRODUCTION

### Population and Food Production

In 1982 the average annual world output of major food crops reached an estimated 1,830 million metric tons (see Table 1).<sup>3</sup> The developed economies, with 26 percent of the world's population, produced 51 percent of these basic food staples in that year. Thus the world's distribution of population and food production was such that the developing countries, which had more than 3 billion people or about three-fourths of the world's population, accounted for less than half of its output of these commodities. The Third World's per capita food produc-

tion of 260 kilograms in 1982 was only one-third of that in the developed countries.

Food production in developing countries expanded by 3.1 percent a year during the period 1961-80—significantly faster than population, which grew 2.4 percent a year (see Table 2). This rate of increase in Third World output was, however, largely influenced by the rapid production growth in China, which accounts for about 30 percent of the population and 35 percent of the food production of developing countries.<sup>4</sup> With China excluded, production grew just slightly faster than the 2.5 percent annual increase in population in Third World countries. Increases in the output of major food crops outpaced population growth in Asia and Latin America but lagged behind population growth in North Africa/Middle East and especially in Sub-Saharan Africa. For the Third World as a whole, more than three-fourths of the population lived in countries where food production growth rates exceeded the population increase during 1961-80. Increases in food production outpaced population growth in large countries such as Brazil, China, India, and Indonesia. When China is excluded, the ratio is reduced to slightly less than 70 percent.

Asia accounted for about 70 percent of both population and food production in the Third World, largely because it contains two of the most populous countries, China and India. The outputs of major food crops in North Africa/Middle East and Sub-Saharan Africa were also closely proportionate to their shares of population. Only Latin America's 13 percent share of Third World production was higher than its relative share of population. Among subregions, however, output

**Table 1—World population and food production, 1982**

Country Group	Population (millions)	Major Food Crop Production	
		Total (million metric tons)	Per Capita (kilograms)
World	4,605	1,830	400
Developed economies	1,185	925	780
Developing economies	3,420	905	260

Sources: Food and Agriculture Organization of the United Nations, *FAO Production Yearbook, 1983* (Rome: FAO, 1984); and United Nations, Department of International Economic and Social Affairs, "World Population Prospects as Assessed in 1982," New York, 1983 (computer printout).

<sup>3</sup> All tons referred to in this report are metric tons. For purposes of aggregation, the rice figures are for rice in its husked form and the noncereal items have been converted to cereal equivalents.

<sup>4</sup> Food output in China during the early 1960s was far below normal because of major domestic problems, which led to a rapid production growth rate for the observation period used in this study; consequently, the output growth rates for Asia and the developing countries as a whole were raised.

**Table 2—Population and major food crop production, by region and subregion, 1980, and average annual growth rates, 1961-80**

Country Group	Population			Major Food Crop Production		
	1980		1961-80 Annual Growth Rate	1980		1961-80 Annual Growth Rate
	Number	Percent		Quantity	Percent	
	(millions)	(percent)	(million metri- tons)	(percent)		
Developing countries	3,273	100	2.4	841.9	100	3.1
(Excluding China)	(2,270)	(69)	(2.5)	(543.1)	(65)	(2.6)
Asia	2,325	71	2.3	593.8	70	3.4
(Excluding China)	(1,322)	(40)	(2.4)	(295.0)	(35)	(2.8)
China	1,003	31	2.1	298.9	35	4.1
South Asia	880	27	2.4	184.8	22	2.7
East and Southeast Asia	442	13	2.4	110.2	13	3.1
North Africa/Middle East	253	8	2.7	68.0	8	2.5
Northern Africa	108	3	2.6	21.1	2	2.3
Western Asia	145	5	2.8	46.9	6	2.6
Sub-Saharan Africa	338	10	2.8	72.4	9	1.7
West Africa	148	4	2.9	32.7	4	0.8
Central Africa	59	2	2.3	12.1	2	2.9
Eastern and Southern Africa	131	4	3.0	27.6	3	2.4
Latin America	357	11	2.6	107.7	13	2.8
Mexico and Central America <sup>a</sup>	117	4	2.9	29.7	3	3.4
Upper South America	198	6	2.7	55.6	7	2.8
Lower South America	42	1	1.6	22.4	3	2.3

Sources: Food and Agriculture Organization of the United Nations, "Production Yearbook Data Tape, 1975, 1979, 1981, and 1983," Rome, 1976, 1980, 1982, and 1984; People's Republic of China, State Statistical Bureau, *Statistical Yearbook of China*, various issues (Hong Kong: Economic Information Agency, various years); Republic of China, Executive Yuan, Directorate General of Budget, Accounting, and Statistics, *Statistical Yearbook of the Republic of China, 1982* (Taiwan: Republic of China, 1983); and United Nations, Department of International Economic and Social Affairs, "World Population Prospects as Assessed in 1982," New York, 1983 (computer printout).

Notes: The major food crops here include cereals, roots and tubers, pulses, groundnuts, and bananas and plantains; rice is in husked form, and the noncereal components are in cereal equivalents. Parts may not add to totals due to rounding.

<sup>a</sup> Mexico and Central America includes the Caribbean.

shares exceeded those of population in China, Western Asia, and both Upper and Lower South America.

In Asia, China's abnormally low food output in the early 1960s combined with a rapid increase in production during the late 1970s resulted in a very rapid annual growth rate of major food crop output in 1961-80 of 4.1 percent, a rate of expansion almost twice that of its population growth. (The country's growth rate of food production for the 1952-80 period was only 2.8 percent.) Increases in the production of basic food staples in all three Asian subregions significantly outstripped population growth. The effects of the "green revolution" in the re-

gion in the 1960s were reflected by the rapid increase of food output in East and Southeast Asia. Asia's 1961-80 production growth rate was the same as that for developing countries as a whole. When data on China were excluded, the average annual increase of food output dropped from 3.4 percent to 2.8 percent.

As in Asia, population increases lagged behind the growth of major food crop production in the three subregions of Latin America, although only slightly in Upper South America. Improvements in agricultural technology in Mexico and Central America must have greatly influenced its rapid 3.4 percent annual rate of increase in

food production. Although the growth rate of food output in Lower South America during 1961-80 was modest, it was much faster than the population growth rate.

The poorest production performance during the two-decade period occurred in Sub-Saharan Africa where the production of basic food staples grew only 1.7 percent a year, a rate way below growth of the region's population. This was due to the slow 0.8 percent annual rate of increase of output in West Africa, where population growth outstripped increases in food production by more than two full percentage points. Another food problem area was Eastern and Southern Africa, which, although its production performance was fair, had the most rapid population growth of all the subregions. Food production in Central Africa performed well, but the output of major food crops in this subregion is relatively small, and it could not reverse the poor production trend in much larger West Africa. Population growth in both subregions of North Africa/Middle East outpaced increases in food output; however, the differences between population and production growth rates were not wide.

These rates of increase in food output and population indicate that the most rapid growth of per capita production among the subregions during 1961-80 was in China, about 2 percent a year. East and Southeast Asia and Lower South America followed far behind; each achieved an annual growth rate of 0.7 percent. West Africa's per capita food production declined at an alarming rate of more than 2 percent annually. The rapid growth of food output in China pushed per capita production in developing countries as a group to 0.7 percent a year. With China excluded, however, the annual rate of increase falls to only 0.1 percent.

## **Distribution of Production Among Crops and Regions**

During 1976-80 cereals accounted for more than four-fifths of the total output of

major food crops in the Third World (see Table 3). Rice led all major food crops with a 35 percent share of the total, while wheat and maize each held about half the share of rice. Millet and sorghum were also important, accounting for about 8 percent.<sup>5</sup> Of the noncereals, roots and tubers had the largest share, with 11 percent of major food crop production. Pulses, groundnuts, and bananas and plantains were relatively minor crops and together formed only 6 percent of Third World food output.

As seen earlier, Asia produced the bulk of Third World food production and thus strongly influenced its composition. Data show that the region's food output represented more than 70 percent of the cereals and nearly 60 percent of the major non-cereal food crops grown in developing countries. China alone accounted for about half of each of these shares. Of the principal cereals, Asia produced more than 90 percent of rice, more than 60 percent of wheat, and 55 percent of maize. Food production in North Africa/Middle East, which had the smallest share among the regions, contributed one-fourth of the wheat output in the Third World. Nearly a quarter of the Third World's output of the major noncereal food crops was contributed by Sub-Saharan Africa, where these commodities are nearly as important as cereals. Sub-Saharan Africa accounted for only 6 percent of the cereals produced in developing countries, but its production of millet and sorghum represented a quarter of the total output of these grains. Latin America led other regions in the production of bananas and plantains, with more than 40 percent of the Third World's total, and it ranked next to Asia in maize output.

Of course, the composition of food production of geographical areas generally reflects area consumption patterns and is largely dependent on natural endowments. Climatic factors strongly influence the kind of crops grown, and hence the production mix of the basic food staples among regions can be expected to vary widely. Rice, wheat, and maize composed three-fourths of the pro-

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<sup>5</sup> Millet and sorghum are combined in this report because many developing countries, especially in Africa, have pooled estimates for these crops.

**Table 3—Distribution of major food crop production, by region, 1976-80 averages**

Commodity	Developing Countries <sup>a</sup>		Asia <sup>a</sup>		North Africa/ Middle East		Sub-Saharan Africa		Latin America	
	Quantity	Share of Total Production	Quantity	Share of Total Production	Quantity	Share of Total Production	Quantity	Share of Total Production	Quantity	Share of Total Production
	(million metric tons)	(percent)	(million metric tons)	(percent)	(million metric tons)	(percent)	(million metric tons)	(percent)	(million metric tons)	(percent)
Cereals	670.0	83	486.8	86	66.7	93	39.5	55	83.0	79
Wheat	145.6	18	95.1	17	34.3	52	1.1	2	15.2	15
Rice (husked)	282.4	35	262.0	46	3.7	6	4.7	7	12.0	11
Maize	136.7	17	75.0	13	5.7	9	14.7	20	41.3	39
Millet and sorghum	68.9	8	36.0	7	4.3	7	16.6	23	11.9	11
Other <sup>b</sup>	36.6	5	18.7	3	12.6	19	2.4	3	2.7	3
Noncereals <sup>c</sup>	140.4	17	80.6	14	4.7	7	32.5	45	22.6	21
Roots and tubers	88.3	11	53.4	9	1.4	2	21.0	29	12.4	12
Pulses	95.0	3	13.9	2	2.2	3	4.5	6	4.4	4
Groundnuts	16.2	2	10.2	2	1.0	2	3.8	5	1.2	1
Bananas and plantains	11.0	1	3.2	1	0.1	...	3.2	5	4.6	4

Sources: Food and Agriculture Organization of the United Nations, "Production Yearbook Data Tape, 1975, 1979, 1981, and 1983," Rome, 1976, 1980, 1982, and 1984; People's Republic of China, State Statistical Bureau, *Statistical Yearbook of China*, various issues (Hong Kong: Economic Information Agency, various years); and Republic of China, Executive Yuan, Directorate General of Budget, Accounting, and Statistics, *Statistical Yearbook of the Republic of China, 1982* (Taiwan: Republic of China, 1983).

Notes: For production estimates, parts may not add to totals due to rounding. The ellipsis (. . .) indicates a negligible amount.

<sup>a</sup> Includes China.

<sup>b</sup> Data on other cereals for the People's Republic of China include pulses.

<sup>c</sup> The data for noncereals are converted to wheat equivalents based on calorie content.

duction of major food crops in Asia, with rice alone accounting for 46 percent of total output. In North Africa/Middle East, cereals represented 93 percent of production, and wheat output alone was more than half of the total. Barley, the major component of the "other cereals" category, formed a significant part of production in this region. Sub-Saharan Africa's production mix indicates that noncereal food crops were relatively more important than in other regions; 29 percent of food output in this region was roots and tubers. Maize and millet and sorghum comprised most of the cereal production in Sub-Saharan Africa. In Latin America, about four-fifths of the output of major food crops was cereals, half of which was maize. Although maize dominated food output in Latin America, the production mix was dispersed more evenly among other crops than in other regions. Wheat accounted for 15 percent of Latin American production, and about 35 percent was evenly shared among rice, millet and sorghum, and roots and tubers.

## **Production Increases Among Crops**

The output of major food crops in Third World countries expanded by 298 million tons from 1961-65 to 1976-80 (see Table 4). Of this increment, 87 percent was from the cereals group. With the increases in cereal production from 1961-65, the contribution of cereals to the total production of major food crops rose about three percentage points by 1976-80. As expected, most production increases from cereals came from the three principal grain crops—rice, wheat, and maize. Although rice contributed the most to the increase in production, its relative share in the total output of major food crops stayed about the same during the two decades. Maize and especially wheat gained significantly: their percentage shares of the total production increment were well above their relative production shares in 1961-65. The corresponding decline in percentage shares was absorbed by the rest of the cereals and the noncereal crops. Except for bananas and plantains, each of the non-

cereal crops dropped a percentage point in relative importance between the two periods.

In Asia, the combined increase in production of wheat and maize about equaled that of rice and accounted for 43 percent of the total increase in the output of major food crops in the region. Wheat and maize accounted for nearly equal shares of Asian food output in 1961-65, but with its faster growth, wheat gained seven percentage points by 1976-80 compared to three percentage points for maize. Two-thirds of the production increase in North Africa/Middle East came from wheat, the region's principal staple. With the relative share of cereals in food production almost unchanged, the large increment in wheat led to decreases in the output shares of millet and sorghum and especially other cereals, because of their absolute production declines.

Production gains made by Sub Saharan Africa since the early 1960s did not significantly change the relative contributions of cereals and noncereals to food output in that region. The relative shares of maize, rice, and roots and tubers slightly improved but the shares of the region's ranking crops, millet and sorghum and groundnuts, decreased. The output of groundnuts, an important foreign exchange earner for the region, declined considerably from 1961-65. The growth in output of millet and sorghum was very slow—only 1.4 million tons over the 1961-65 average output of 15.2 million tons. The cereals group accounted for 87 percent of the production increase in Latin America. Maize, as expected, had the largest output increase, contributing 39 percent to production growth in that region, but the relative share of the crop in total food output remained constant. The most rapid expansion in Latin America's food crop production was in millet and sorghum, the output of which increased almost five-fold and accounted for 26 percent of the increment in total output; the relative share of these grains in the region's production of major food crops increased by nearly eight percentage points. Increases in the output of feedgrains, that is, cereals other than wheat and rice, contributed about two-thirds to the growth of production of basic

**Table 4—Changes in the production of major food crops and their relative contributions to the total production increase, by region, 1961-65 to 1976-80**

Commodity	Developing Countries <sup>a</sup>		Asia <sup>a</sup>		North Africa/ Middle East		Sub-Saharan Africa		Latin America	
	Increase	Share of Total Increase	Increase	Share of Total Increase	Increase	Share of Total Increase	Increase	Share of Total Increase	Increase	Share of Total Increase
	(million metric tons)	(percent)	(million metric tons)	(percent)	(million metric tons)	(percent)	(million metric tons)	(percent)	(million metric tons)	(percent)
Major food crops	298.0	100	224.6	100	20.4	100	16.7	100	36.3	100
Cereals	260.0	87	200.3	89	18.8	92	9.2	55	31.7	87
Wheat	76.9	25	59.8	26	13.4	66	0.3	2	3.4	9
Rice (husked)	106.1	35	98.4	43	1.0	5	2.0	12	4.7	13
Maize	63.0	21	42.1	18	1.7	8	4.9	29	14.3	39
Millet and sorghum	17.1	6	5.7	2	0.6	3	1.4	9	9.5	26
Other <sup>b</sup>	-3.1	...	-5.7	...	2.1	10	0.6	3	-0.2	...
Noncereals <sup>c</sup>	38.0	13	24.3	11	1.6	8	7.5	45	4.6	13
Roots and tubers	29.7	10	20.5	9	0.6	3	6.3	32	2.2	6
Pulses	2.7	1	0.2	...	0.4	2	1.5	8	0.7	2
Groundnuts	1.5	1	2.1	1	0.6	3	-1.2	...	...	...
Bananas and plantains	4.1	1	1.5	1	...	...	0.9	5	1.7	5

Sources: Food and Agriculture Organization of the United Nations, "Production Yearbook Data Tape, 1975, 1979, 1981, and 1983," Rome, 1976, 1980, 1982, and 1984; People's Republic of China, State Statistical Bureau, *Statistical Yearbook of China*, various issues (Hong Kong: Economic Information Agency, various years); and China, Executive Yuan, Directorate General of Budget, Accounting, and Statistics, *Statistical Yearbook of the Republic of China, 1982* (Taiwan: Republic of China, 1983).

Notes: Where declines occurred, the contributions of commodities were adjusted to the relative share of the commodity group. The ellipses (...) indicate a negligible contribution.

<sup>a</sup> Includes China.

<sup>b</sup> Data on other cereals for the People's Republic of China include pulses.

<sup>c</sup> The data for noncereals are converted to wheat equivalents based on calorie content.

food staples in Latin America. Except for rice and bananas and plantains, whose positions relative to total production either improved slightly or remained unchanged, the percentage shares of the rest of the major food crops in the region decreased.

## **Trends in Production, Area Harvested, and Output Per Hectare<sup>6</sup>**

### **1961-80**

About 75 percent of the average annual growth rate of 3.1 percent in the production of basic food staples in Third World countries from 1961 to 1980 could be attributed to the increase in output per hectare (see Table 5).<sup>7</sup> The expansion in area harvested of the major food crops, which averaged 0.8 percent a year, contributed the other 25 percent. Excluding China, the contribution of output per hectare to the growth rate of food production in the rest of the developing countries, 2.6 percent a year, would be reduced to 62 percent. The growth in production that came from increases in area harvested would rise to 38 percent. These large differences arise because area expansion in China was extremely slow and growth of output per hectare was extremely rapid during this reference period.

The dominant role of crop yields in increasing food production among the developing regions is most pronounced in Asia, where increases in output per hectare at the average rate of 2.9 percent a year accounted for 85 percent of production growth during 1961-80. Growth of area harvested in the region averaged only 0.5 percent a year. Data on China indicate that its rapid 4.1 percent average annual growth rate of food production was almost wholly achieved through growth in crop yields (see Table 5). The depressed growth in output per hectare in China during the early 1960s accounted

for its abnormally low production during the period, which tends to exaggerate its output growth rate. But even excluding China, the contribution of output per hectare to food output growth in the rest of Asia was higher than in other developing regions. Without China, however, the production growth rate for Asia would be reduced to 2.8 percent a year—the same as the rate of increase in Latin America. Although the growth rates in output per hectare in South Asia and in East and Southeast Asia were the same, food output in the latter subregion expanded much faster because its rate of area expansion was nearly twice as fast as in South Asia.

The growth of output per hectare in North Africa/Middle East played the larger role in the region's 2.5 percent annual increase in production during 1961-80. However, the sources of food output growth in the two subregions of North Africa/Middle East were in contrast; the main contributions to food production growth were made by area expansion in Northern Africa and crop yields in Western Asia. But output per hectare was the dominant source of growth in the region because food production in Western Asia was more than twice that of Northern Africa.

Area expansion, on the other hand, was the main source of the production increases of Sub-Saharan Africa. A relatively large portion of food production in Sub-Saharan Africa is in noncereals, for which significant technological advances for increasing yields have yet to be achieved. Growth of area harvested provided four-fifths of the slow annual growth in food output, 1.7 percent a year, of the whole region. Area expansion alone sustained production growth in West Africa and Central Africa because the output per hectare of the major food crops declined. West Africa's 1 percent annual growth rate of area harvested combined with declines in crop yields was the main reason for the

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<sup>6</sup> The data used in this part of the analysis of production trends exclude bananas and plantains, for which estimates on harvested area are not available; thus some of the production growth rates cited here may differ slightly from those presented earlier.

<sup>7</sup> Output per hectare represents the weighted average of the individual crop yields for a country group; changes in crop composition over time can lead to changes in output per hectare even if individual crop yields are unchanged.

**Table 5—Average annual growth rates of production, area harvested, and output per hectare of major food crops, by region and subregion, 1961-80**

Country Group	Average Annual Growth Rate			Contribution to Production Increase	
	Production <sup>a</sup>	Area Harvested	Output Per Hectare	Area Harvested	Output Per Hectare
			(percent)		
Developing countries	3.1	0.8	2.3	25	75
(Excluding China)	(2.6)	(1.0)	(1.6)	(38)	(62)
Asia	3.4	0.5	2.9	15	85
(Excluding China)	(2.8)	(0.7)	(2.1)	(26)	(74)
China <sup>b</sup>	4.1	0.1	4.0	3	97
South Asia	2.7	0.6	2.0	23	77
East and Southeast Asia	3.1	1.1	2.0	35	65
North Africa/Middle East	2.5	1.0	1.5	40	60
Northern Africa	2.3	1.8	0.5	79	21
Western Asia	2.6	0.6	2.0	23	77
Sub-Saharan Africa	1.7	1.4	0.4	79	21
West Africa	0.8	1.1	-0.3	100	... <sup>d</sup>
Central Africa	2.9	3.3	-0.4	100	... <sup>d</sup>
Eastern and Southern Africa	2.5	1.2	1.3	47	53
Latin America	2.8	1.5	1.3	52	48
Mexico and Central America <sup>c</sup>	3.4	0.6	2.9	17	83
Upper South America	2.8	2.6	0.2	92	8
Lower South America	2.3	0.2	2.1	7	93

Sources: Food and Agriculture Organization of the United Nations, "Production Yearbook Data Tape, 1975, 1979, 1981, and 1983," Rome, 1976, 1980, 1982, and 1984; People's Republic of China, State Statistical Bureau, *Statistical Yearbook of China*, various issues (Hong Kong: Economic Information Agency, various years); Republic of China, Executive Yuan, Directorate General of Budget, Accounting, and Statistics, *Statistical Yearbook of the Republic of China, 1982* (Taiwan: Republic of China, 1983).

<sup>a</sup> Annual growth rates of production may differ slightly from those shown in Table 2 because data used here exclude the output of bananas and plantains, for which area estimates are not available.

<sup>b</sup> The data on area for China are for area planted.

<sup>c</sup> Mexico and Central America includes the Caribbean.

<sup>d</sup> Negative. The contribution to the production increase is assigned totally to area harvested because of declining output per hectare.

dismal food production performance of Sub-Saharan Africa. The area estimates reported for Central Africa show very rapid area expansion in 1961-80, which contributed to swift increases in food output despite decreases in output per hectare. Growth in output per hectare and area expansion contributed about equally to production growth in Eastern and Southern Africa.

Increases in area harvested and in output per hectare were also near equal contributors to the 2.8 percent yearly growth of production in Latin America. Overall regional output growth, however, came from the rapid increases of output per hectare in Mexico and Central America and Lower South America, on one hand, and the rapid

area expansion in Upper South America, on the other. It may be worth noting that the rate of increase of crop yields in Mexico and Central America, nearly 3 percent a year, was second only to China's 4 percent among the subregions.

#### 1961-70 and 1971-80

During 1961-70, the first half of the total period, the output of major food crops in developing countries increased rapidly, by 3.6 percent a year. About 70 percent of this production growth could be attributed to increases in output per hectare and 30 percent to expansion of crop area (see Table 6). Production growth decelerated by almost 20 percent in 1971-80 largely on account

**Table 6—Average annual growth rates of production, area harvested, and output per hectare of major food crops, by region and subregion, 1961-70 and 1971-80**

Country Group	Period	Average Annual Growth Rate			Contribution to Production Increase	
		Pro-duction <sup>a</sup>	Area Harvested	Output Per Hectare	Area Harvested	Output Per Hectare
				(percent)		
Developing countries	1961-70	3.6	1.1	2.5	30	70
	1971-80	2.9	0.6	2.3	20	80
(Excluding China)	1961-70	(2.9)	(1.5)	(1.4)	(51)	(49)
	1971-80	(2.6)	(0.8)	(1.8)	(32)	(68)
Asia	1961-70	3.8	0.5	3.4	13	87
	1971-80	3.3	0.5	2.8	16	84
(Excluding China)	1961-70	(2.7)	(0.8)	(1.8)	(31)	(69)
	1971-80	(3.1)	(0.9)	(2.2)	(30)	(70)
China <sup>b</sup>	1961-70	5.2	-0.1	5.4	... <sup>d</sup>	100
	1971-80	3.4	-0.2	3.6	... <sup>d</sup>	100
South Asia	1961-70	2.7	0.8	1.9	29	71
	1971-80	2.7	0.7	2.0	25	75
East and Southeast Asia	1961-70	2.7	1.1	1.6	40	60
	1971-80	3.9	1.7	2.2	44	56
North Africa/Middle East	1961-70	2.4	1.2	1.2	51	49
	1971-80	2.6	0.7	1.9	26	74
Northern Africa	1961-70	3.3	1.4	1.9	43	57
	1971-80	0.9	1.5	-0.6	100	... <sup>d</sup>
Western Asia	1961-70	2.0	1.1	0.9	57	43
	1971-80	3.5	0.3	3.2	8	92
Sub-Saharan Africa	1961-70	2.2	2.4	-0.2	100	... <sup>d</sup>
	1971-80	1.6	0.8	0.8	50	50
West Africa	1961-70	1.1	2.2	-1.1	100	... <sup>d</sup>
	1971-80	1.9	1.1	0.7	61	39
Central Africa	1961-70	4.4	4.8	-0.4	100	... <sup>d</sup>
	1971-80	1.8	2.3	-0.5	100	... <sup>d</sup>
Eastern and Southern Africa	1961-70	3.0	2.2	0.8	72	28
	1971-80	1.4	-0.3	1.6	... <sup>d</sup>	100
Latin America	1961-70	4.2	2.8	1.4	66	34
	1971-80	1.8	0.6	1.2	33	47
Mexico and Central America <sup>c</sup>	1961-70	5.7	2.2	3.5	39	61
	1971-80	3.0	-0.2	3.2	... <sup>d</sup>	100
Upper South America	1961-70	4.6	3.7	0.8	82	18
	1971-80	1.8	1.8	0.0	100	0
Lower South America	1961-70	2.5	1.6	0.9	63	37
	1971-80	0.6	-1.3	2.0	... <sup>d</sup>	100

Sources: Food and Agriculture Organization of the United Nations, "Production Yearbook Data Tape, 1975, 1979, 1981, and 1983," Rome, 1976, 1980, 1982, and 1984; People's Republic of China, State Statistical Bureau, *Statistical Yearbook of China*, various issues (Hong Kong: Economic Information Agency, various years); Republic of China, Executive Yuan, Directorate General of Budget, Accounting, and Statistics, *Statistical Yearbook of the Republic of China, 1982* (Taiwan: Republic of China, 1983).

Notes: Unlike in Table 5, negative rates also occurred for area during subperiods.

<sup>a</sup> The production data exclude bananas and plantains, for which area estimates are not available.

<sup>b</sup> The data on area for China are for area planted.

<sup>c</sup> Mexico and Central America includes the Caribbean.

<sup>d</sup> Negative. The contribution to the production increase is assigned totally to the other source of increase.

of the major slowdown in area expansion; increases in harvested area during the 1970s were only half as fast on average as in the 1960s. Although growth of output per hectare in the later period slowed slightly, its contribution to the production increase rose to 80 percent.

Food production in Third World countries excluding China had average annual rates of increase of 2.9 percent in the 1960s and 2.6 percent in the 1970s. Whereas area expansion and growth of output per hectare contributed about equally to production growth in these countries during the earlier decade, more than two-thirds of output increases in 1971-80 could be attributed to improvements in output per hectare. Their rate of growth in harvested area in the 1970s was only half as fast as in the 1960s; in contrast, their rate of increase in output per hectare accelerated between the two decades.

Among the four developing regions, the growth of food production accelerated between the 1960s and 1970s only in North Africa/Middle East. If China were excluded, however, food output growth in the rest of Asia would also have accelerated, and at a faster rate than in North Africa/Middle East. Production growth in Sub-Saharan Africa decreased about 30 percent between the 1960s and the 1970s. The decline of the food output growth rate between the two decades was more drastic in Latin America, where the increase in production slowed from a rapid 4.2 percent a year to 1.8 percent.

In Asia as a whole, area expansion was slow and growth rates remained the same during the two decades. Although the growth of output per hectare significantly declined, it provided most of the increases in production in both the 1960s and 1970s. China's data on food crop area show decreases in both the 1960s and 1970s, but the rates of decline were slow and crop area remained nearly constant. The rapid increase of food output in China, especially in the 1960s, can be attributed to the fast growth of output per hectare. Excluding China's output trends, the rest of Asia shows nearly the same rate of area expansion and an increased acceleration of growth in output per hectare

and, hence, total production between the two decades. The growth rates of production and its two components were virtually unchanged in South Asia, but in East and Southeast Asia all three accelerated. Food output growth in East and Southeast Asia rose to 3.9 percent a year during the second decade.

The slight acceleration of production growth in North Africa/Middle East between the 1960s and the 1970s resulted from a slowdown in growth of area harvested against a faster acceleration in growth of output per hectare. The slightly favorable trend could be traced to increases in the major food crop output of Western Asia, which more than offset the slowdown of food production growth in Northern Africa. More than 90 percent of Western Asia's rapid growth in food output in the later period came from improvements in crop yields. In contrast, Northern Africa in the 1970s experienced absolute declines in output per hectare of the major food crops; hence, area expansion alone sustained the growth of food production during that decade.

The growth rate of food production in Sub-Saharan Africa during the 1970s was less than two-thirds as large as it had been during the 1960s, as a result of a major decline in the growth of area harvested of food crops in the region. Increases in output per hectare in the 1970s, after crop yields declined during the 1960s, failed to offset the slowdown in the growth of harvested area. Area expansion wholly provided production increases in the earlier decade, whereas output growth during the later decade was shared equally between increases in harvested area and output per hectare.

Output growth accelerated in West Africa but slowed in the other Sub-Saharan subregions. In 1961-70, West Africa's production growth was the slowest among the 11 developing-country subregions, whereas Central Africa and Eastern and Southern Africa achieved fast output growth. Area expansion was the main source of production growth in all three subregions in that decade, especially in West Africa and Central Africa, where the output per hectare declined. The 1971-80 trends, however, show

that growth of food crop area slowed considerably in all three subregions and hence in Sub-Saharan Africa as a whole. Improvements in output per hectare during the 1970s more than offset the slowdown of area expansion in West Africa but not in Eastern and Southern Africa, where the rate of growth of production decreased by more than 50 percent from the 1960s. A marked deceleration of output growth in Central Africa occurred in the later decade, as crop yields in that subregion continued to decline.

Latin America's food production growth of 4.2 percent a year in the 1960s, which was more rapid than for any other region during that decade, decelerated to only 1.8 percent in the following decade. Increases in crop area were quite rapid in the 1960s and accounted for two-thirds of output growth in the region during that period. In the 1970s, however, the rate of area expansion in Latin America slowed drastically—by 80 percent. This time it was growth in output per hectare, which, despite a slight deceleration between decades, provided two-thirds of food output growth. The significant slowdown in area expansion and consequent deceleration of food output growth occurred in all three subregions of Latin America. In Upper South America, where increases in food crop area were most rapid in the 1960s, area expansion decelerated by 50 percent and output per hectare remained almost constant in the 1970s; the

result was a 60 percent decrease in the rate of production growth of the subregion between these decades. Both Mexico and Central America and Lower South America, where area expansion made positive contributions to production growth during the earlier decade, experienced absolute declines in food crop area in the 1970s; consequently, increases in output per hectare sustained production growth during the later decade. From the 1960s to the 1970s, food output growth rates decreased by almost 50 percent in Mexico and Central America and by 75 percent in Lower South America.

Improvements in output per hectare were the main source of production growth in China, South Asia, East and Southeast Asia, and Mexico and Central America, whereas output increases relied more on area expansion in Upper South America, Central Africa, and West Africa during both the 1960s and 1970s. Growth of food production in the other four subregions during the past two decades was achieved from one of these two factors in the 1960s and from the other in the 1970s. Trend data suggest that the rapid growth of food production that was achieved through increases in output per hectare occurred in subregions that benefited from adoption of the seed-fertilizer technology that was pushed in the 1960s.

# 4

## FOOD CONSUMPTION

### Trends in Food Consumption

Total consumption of basic food staples in developing countries expanded at an average annual rate of 3.3 percent during 1966-80 (see Table 7).<sup>8</sup> The amount used directly for food, which increased at a slightly slower rate, accounted for about 70 percent of the total consumption of these commodities. But the growth in food use was much faster than the population increase, which suggests that overall average per capita food availability in the Third World improved during the period. The use of major food crops, especially coarse grains, for animal feed grew at an annual rate of 4.3 percent, raising the relative share of feed in total consumption in 1966-70 by two percentage points to about 16 percent in 1976-80. The basic food staples that went to other uses—seeds, wastes, and other nonfood purposes—grew by only 2.5 percent a year and, like direct food use, declined slightly in share because of the much faster growth of feed use. These other uses represented about 15 percent of total domestic utilization in developing countries during the late 1970s.

When China is excluded, developing countries showed a slower growth in direct food use but about as rapid an increase in feed use as the Third World as a whole. The relative share of feed use in the total consumption of basic food staples was higher with China excluded than for developing countries as a whole by two percentage points during both 1966-70 and 1976-80. With the relative share of other uses unchanged, the corresponding decline in share was absorbed solely by direct food use, which in 1976-80 represented about two-thirds of the total domestic utilization of major food crops.

The distribution of consumption among the major uses of basic food staples in Asia during 1966-70 stayed constant through 1976-80. Food use accounted for three-fourths of the total domestic use of these commodities in the region and, with such a large share, its 1966-80 growth rate of 3.3 percent a year mainly determined the pace of total consumption. The percentage of total consumption represented by food use in Asia, with or without China, was highest among the developing regions during both 1966-70 and 1976-80. For the Asian countries excluding China, the relative distribution of basic food staples among their domestic uses closely approximated that in Asia as a whole although the rate of increase of total consumption—3.0 percent a year—was slower. With this consumption growth rate, it is estimated that the 2.4 percent annual rate of increase in the population of these countries represented about four-fifths of the expansion in the domestic utilization of these commodities; the remaining 20 percent may be attributed to the growth of per capita income.

Direct food use accounted for more than 70 percent of the total consumption of the basic food staples in each of the subregions of Asia as late as 1976-80 (see Table 7 and Appendix 3, Table 19). China continued to use three-fourths of its basic food staples for food between 1966-70 and 1976-80. Although feed use in China grew 4.4 percent a year, the share of animal feed rose only slightly, from 11 percent in 1966-70 to 12 percent in 1976-80, while 12 percent went to other uses in the later period. In South Asia the yearly rates of growth of food, feed, and other uses during the 1966-80 period were almost equal and all 2.8 percent or less.

<sup>8</sup> Food consumption here refers to the total domestic use of the major food crops, which includes food, feed, seeds, allowances for waste, and other nonfood uses.

**Table 7—Trends in consumption of basic food staples, by region and subregion, 1966-80**

Country Group	Average Annual Growth Rate of Consumption				Distribution in Domestic Use					
	Total	Food	Feed <sup>a</sup>	Others <sup>b</sup>	1966-70			1976-80		
					Food	Feed <sup>a</sup>	Others <sup>b</sup>	Food	Feed <sup>a</sup>	Others <sup>b</sup>
	(percent)									
Developing Countries (Excluding China)	3.3 (3.0)	3.2 (2.8)	4.3 (4.3)	2.5 (2.4)	70 (67)	14 (16)	16 (17)	69 (65)	16 (18)	15 (17)
Asia (Excluding China)	3.3 (3.0)	3.3 (2.9)	4.2 (4.1)	2.8 (2.7)	75 (74)	11 (10)	14 (16)	75 (73)	11 (11)	14 (16)
China	3.8	3.7	4.4	2.9	76	11	13	76	12	12
South Asia	2.7	2.7	2.8	2.8	75	9	16	74	9	17
East and Southeast Asia	3.5	3.2	5.7	2.6	73	12	15	72	15	13
North Africa/Middle East	3.9	3.7	4.8	3.2	56	24	20	55	26	19
Northern Africa	4.3	3.9	6.9	3.1	66	17	17	64	21	15
Western Asia	3.6	3.5	4.1	3.3	51	27	22	50	29	21
Sub-Saharan Africa	2.2	2.5	3.1	1.3	71	6	23	73	6	21
West Africa	2.3	2.7	3.6	1.1	66	5	29	69	5	26
Central Africa	2.7	2.7	3.7	2.8	82	4	14	81	4	15
Eastern and Southern Africa	1.9	2.0	2.7	1.3	73	8	19	73	8	19
Latin America	3.1	2.4	4.4	2.0	50	34	16	47	39	14
Mexico and Central America <sup>c</sup>	4.3	3.0	7.5	2.8	62	26	12	55	34	11
Upper South America	3.0	2.3	4.3	2.0	48	34	18	45	38	17
Lower South America	1.4	1.3	1.6	0.8	34	49	17	34	50	16

Sources: Food and Agriculture Organization of the United Nations, "Agricultural Supply Utilization Accounts Tape, 1981," Rome, 1982; and Republic of China, Council for Agricultural Planning and Development, "Taiwan Food Balance Sheets, 1935-80," Taiwan, 1981 (computer printout). Consumption data for the People's Republic of China were provided by Bruce Stone of the International Food Policy Research Institute.

Notes: Consumption here refers to domestic use.

<sup>a</sup> Feed includes bran and cakes.

<sup>b</sup> Others includes seeds, waste, and other nonfood uses.

<sup>c</sup> Mexico and Central America includes the Caribbean.

The growth of food use in South Asia was faster than population increase, suggesting an improvement in the average per capita food availability in the subregion. Feed use in South Asia remained constant at 9 percent of total consumption between 1966-70 and 1976-80. The fastest growth of feed use in Asia was in East and Southeast Asia, at 5.7 percent a year, which appreciably increased the share of animal feed in the total domestic use of basic food staples from 12 percent in 1966-70 to 15 percent in 1976-80. Other uses grew an average of 2.6 percent a year in the subregion over the total period.

At 3.9 percent a year, the most rapid consumption growth among developing re-

gions during 1966-80 was in North Africa/Middle East. Feed use expanded by 4.8 percent a year and represented more than a quarter of total consumption in that region by 1976-80. Food use had a slower growth rate, its share declining slightly from 56 to 55 percent in the late 1970s. The rate of increase in the use of major food crops directly for food in North Africa/Middle East was a full percentage point above the 2.7 percent annual rate of population growth of the region.

Northern Africa was one of only two subregions with consumption growth of more than 4 percent a year during 1966-80. Growth of feed use by 6.9 percent a year in this subregion raised the 1966-70 relative share of animal feed by four percentage

points to slightly more than a fifth of total consumption during 1976-80. Food and feed uses both grew more slowly in Western Asia than in Northern Africa. Food use in Western Asia represented one-half of total consumption during 1976-80, a slight reduction of its share in 1966-70; feed use, on the other hand, rose by two percentage points to almost 30 percent in the late 1970s. Other domestic uses had an unusually large share of total consumption in 1976-80.

The slowest increases in consumption among the developing regions during 1966-80 were in Sub-Saharan Africa, where food and feed uses grew at average annual rates of 2.5 percent and 3.1 percent, respectively. With the very slow rate of increase in other domestic uses, which represented a fifth of the domestic utilization of basic food staples in 1976-80, total consumption had a growth rate of only 2.2 percent a year. Food use in Sub-Saharan Africa accounted for 71 percent of total consumption during 1966-70, and this share rose to 73 percent in 1976-80. This was in contrast with other developing regions where the percentage share of food use either declined or stayed unchanged between these periods. Feed use was still very low in Sub-Saharan Africa, accounting for only 6 percent of the total domestic utilization of basic food staples in the region; this share remained constant between 1966-70 and 1976-80.

The slow growth of food consumption in Sub-Saharan Africa largely reflected the 2 percent rate of yearly increase in the consumption of basic food staples in Eastern and Southern Africa. This subregion represented more than 35 percent of total food consumption in the entire region. The shares of food and feed uses in this subregion remained unchanged between 1966-70 and 1976-80. Although the relative share of feed use in total consumption was less than 10 percent, this was nearly twice the share of each of the other subregions in Sub-Saharan Africa. In Central Africa, the 1976-80 relative shares of domestic use were the highest in

food use (81 percent) and the lowest in feed use (4 percent) among the developing subregions. The percentage share of food use declined slightly during the 1970s, but that of feed use remained unchanged despite fairly rapid growth. Of the subregions in Sub-Saharan Africa, West Africa had the lowest share of food use in the total domestic use of basic food staples. In 1966-70, about two-thirds of total consumption in this subregion was accounted for by direct food use which, in contrast with the food trends of other subregions, increased after a decade. Such an increase was, as shown earlier, reflected by the region as a whole. Although in West Africa the growth of feed use was 3.6 percent a year during 1966-80, the 5 percent share of animal feed in total consumption stayed unchanged between the late 1960s and the late 1970s. Consumption data for West Africa indicate that a sizable portion of total domestic utilization is accounted for by other uses, which expanded just 1 percent a year in 1966-80 and hence significantly influenced the growth of total consumption in the subregion.<sup>9</sup> It should be noted that the annual rate of increase of total domestic use in West Africa was much lower than the growth rates of its food and feed uses.

Latin America had the slowest growth rate among the developing regions in the use of basic staples directly for food during 1966-80. Growth of the region's total consumption in that period reached 3.1 percent a year and was influenced strongly by the 4.4 percent annual growth rate of feed use. The relative share of animal feed in Latin America had risen to nearly two-fifths of total consumption by 1976-80; food use, on the other hand, had dropped below its 1966-70 share of 50 percent. These relative shares clearly indicate that growth in the use of basic food staples for feed in this region has become a major determinant of consumption growth; of all the developing regions, Latin America had the lowest percentage share of food use and the highest percentage share of feed use. Other domestic uses of

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<sup>9</sup> A major data problem is likely here; the reported amounts for other domestic uses are unusually large, representing 29 percent in 1966-70 and 26 percent in 1976-80.

the major food crops in Latin America expanded at a much slower annual rate of 2.0 percent and represented 14 percent of total consumption in 1976-80.

The fast growth of feed use in Latin America may be traced to Mexico and Central America, which had the most rapid growth in the use of basic staples for animal feed among the developing subregions. Its 7.5 percent annual growth rate of feed use during 1966-80 raised the share of feed in the total consumption of the region by eight percentage points to 34 percent in 1976-80. This rapid growth of feed use in Mexico and Central America also pushed the subregion's growth rate of total consumption during 1966-80 to 4.3 percent annually, which matched that of Northern Africa.

Upper South America accounts for more than one-half of the domestic utilization of the major food crops in Latin America, and thus consumption growth in this subregion greatly influences that of the region as a whole. The annual growth rates of the total consumption of basic food staples and its components in Upper South America closely resemble the averages for Latin America as a whole. The relative share of food use in total consumption in this subregion, which was 48 percent during the late 1960s, decreased to 45 percent during 1976-80; on the other hand, the portion accounted for by animal feed increased from 34 percent to 38 percent. Other uses of basic food staples in Upper South America represented about one-sixth of total consumption of the subregion in both periods.

Lower South America had the slowest rates of increase for all of the different uses of basic food staples among the developing subregions. The total consumption of these commodities in the subregion expanded by 1.4 percent a year, with rates of increase of 1.3 percent for food use and 1.6 percent for feed; other uses rose 0.8 percent annually. In contrast with other developing subregions, the percentage share of feed use in the total consumption of basic food staples in Lower

South America greatly exceeds that of food use. The relative distribution among items of domestic utilization, which remained almost unchanged between 1966-70 and 1976-80, shows that feed use accounted for about one-half of total consumption, compared to 34 percent in the use of basic staples directly for food. The growth of feed use in Lower South America has become the major determinant of the pace of consumption growth. These relative shares of food and feed uses also reflect the pattern of consumption in this subregion, where more of the basic food staples are converted to livestock and poultry products than are consumed directly for food. The slow growth of both food and feed uses in Lower South America is due in part to the slow growth of incomes in the subregion. Additionally, for food use in particular, the income elasticities of demand for the basic food staples are low and even negative for some items. A likely reason for the slow growth of feed use is that animal production in Lower South America is mainly composed of large livestock that are range-fed rather than fed with concentrates.

### **Trends in Consumption of Cereals and Major Noncereal Food Staples**

Data on Third World food consumption indicate a trend toward the increased use of cereals relative to the noncereal staples (see Appendix 3, Table 20). Of the total domestic utilization of major food crops in developing countries (excluding China)—about 550 million tons during the late 1970s—nearly 85 percent was cereals.<sup>10</sup> This represented an increase in the relative share of cereals of two percentage points from the decade before. The declining role of noncereals in Third World food consumption is examined by looking into the specific trends in the use of cereals and noncereals for direct human consumption and for animal feed.

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<sup>10</sup> This analysis deals with regional consumption data only. China has been excluded due to data problems regarding the quantities of cereals and noncereals for domestic utilization.

## Food Use

Cereals accounted for more than four-fifths of the major food crops consumed by humans in Third World countries in the 1970s. The use of cereals directly for food increased by 3.1 percent a year from 1966 to 1980 compared to a growth rate of 1.9 percent for noncereals (see Table 8).

Among the developing regions, cereal food use expanded faster than noncereal food use in Asia, Sub-Saharan Africa, and, especially, Latin America. The growth of noncereal food use significantly outpaced that of cereals in North Africa/Middle East; however, noncereals held only a 7 percent share of the region's consumption. The 1966-80 growth rates of cereal and noncereal food uses in Asia, which represented about three-fifths of Third World food consumption, were similar to the rates for the developing countries as a whole.

The largest share of noncereals in food use among the developing regions was in Sub-Saharan Africa, where these commodities accounted for 42 percent of the basic staples used for direct human consumption during 1976-80. However, even in this region the growth of noncereal food use in 1966-80 was outpaced by that of cereal food use, probably as a result of grain imports by the region. Consumption patterns may vary widely, as indicated by a relative share of

cereals in direct human consumption of 93 percent for North Africa/Middle East and 58 percent for Sub-Saharan Africa.

The widest difference in the growth rates of food use of these commodities during 1966-80 was in Latin America, where cereals used directly as food rose by nearly 40 percent while noncereal use increased by less than 3 percent. Consequently, the relative share of cereals in food use in the earlier period increased to 75 percent by 1976-80.

## Feed Use

Table 8 shows that cereals made up 91 percent of the basic food staples used for animal feed in developing countries in the late 1970s. Growth of cereal feed use during the period 1966-80 was 4.6 percent a year. Among the regions, the use of cereals for animal feed increased most rapidly in Latin America at 5.0 percent a year, whereas noncereal feed use hardly changed. The amount of cereals used for animal feed in this region rose by more than 60 percent, its share of total consumption rising to 90 percent in 1976-80. Cereal feed use in North Africa/Middle East increased nearly as fast as in Latin America. Use of noncereals for animal feed in North Africa/Middle East is relatively small. In Asia the share of cereals used for

**Table 8—Trends in the use of cereals and major noncereal food crops for food and feed, by region, 1966-80**

Country Group	Average Annual Growth Rate, 1966-80				Share in Total Use, 1976-80			
	Food Use		Feed Use		Food Use		Feed Use	
	Cereals	Non-cereals	Cereals <sup>a</sup>	Non-cereals	Cereals	Non-cereals	Cereals <sup>a</sup>	Non-cereals
	(percent)							
Developing countries	3.1	1.9	4.6	1.8	82	18	91	9
Asia	3.0	2.0	4.2	3.2	87	13	88	12
North Africa/Middle East	3.6	4.3	4.8	4.5	93	7	97	3
Sub-Saharan Africa	2.6	2.3	3.1	3.2	58	42	82	18
Latin America	3.3	0.2	5.0	0.1	75	25	90	10

Sources: Food and Agriculture Organization of the United Nations, "Agricultural Supply Utilization Accounts Tape, 1981," Rome, 1982.

Notes: Data for China are excluded from this table.

<sup>a</sup> Includes bran and cakes.

feed was about the same as that used for food, about 88 percent in the late 1970s. Even in Sub-Saharan Africa, where the domestic use of noncereals is relatively much larger than in other developing regions, more than four-fifths of the animal feed used in 1976-80 was cereals. Unlike other regions, however, in Sub-Saharan Africa, the use of cereals and noncereals for feed grew at about the same rate during the 1966-80 period.

These trends in the consumption of cereals and noncereals in the Third World suggest a shift toward more use of grains

both for direct human consumption and for animal feed. Some of the developing countries that have always depended on noncereals for direct food use are consuming more and more grain. And changes in feeding practices in Third World livestock and poultry production appear to be moving toward more cereal use. A comparison of the output and consumption patterns for basic food staples in Third World countries suggests that these shifts in cereal consumption have been partly brought about through grain trade.

# 5

## FOOD TRADE

### Trends in Food Trade

International trade in food, especially cereals, continues to play a major role in relieving the pressure of supply-demand imbalances in the Third World. Net imports of basic food staples by developing countries rose from a yearly average of 12 million tons during 1966-70 to 38 million tons during 1976-80, or more than a threefold increase in the total period (Table 9).<sup>11</sup> Food exports rose 30 percent and food imports 84 percent, increases that represented average annual growth rates of 2.7 percent in exports and 6.3 percent in imports.<sup>12</sup> When China is excluded, the developing countries' rate of growth of net food imports is slightly faster. In 1966-70, Asia and North Africa/Middle East were net food importers while Sub-Saharan Africa and Latin America were net food exporters.<sup>13</sup> In 1976-80, all four developing regions were net food importers, although by only a slight amount in the case of Latin America.

Although Asia ranked a close second to Latin America as a food exporter, its imports of basic food staples were about double its exports in the late 1970s. Asia's imports accounted for more than two-fifths of the total for Third World countries during 1976-80. Asia was the only developing region with a growth rate of exports faster than the growth rate of imports between the two periods. Food trade data for China alone, however, indicate a trend counter to the rest of the region. China's exports of basic food staples declined, the country's food imports increased, and net food imports nearly

tripled during that decade (see Table 9). Excluding China, food exports of the rest of Asia expanded almost twofold, and food imports increased by only 1.1 percent annually. If these rates continue, net imports of these countries as a group will disappear in less than seven years.

The slow growth of food imports in other Asian developing countries (excluding China) can be attributed to South Asia, the only developing subregion that recorded an absolute decline in imports of basic food staples from 1966-70 to 1976-80.<sup>14</sup> With imports declining about as fast as exports were expanding, South Asia's net food imports dropped by 70 percent—to about 2.5 million tons in the late 1970s. In East and Southeast Asia, exports of basic food staples grew by almost 7 percent a year but the rate of growth of imports was not far behind; net food imports in this subregion increased by about a million tons in a decade.

In the late 1970s, the 17 million tons of net food imports of North Africa/Middle East represented nearly half the net imports of all Third World countries. Average annual food imports in the region in that period were almost three times the level during 1966-70, a rate of increase of 11.1 percent a year. This fast growth was shared almost equally by Northern Africa and Western Asia. The food imports of Northern Africa were slightly larger but increased at a slightly slower rate than those of Western Asia. The small amount of food exports showed opposite trends in the two subregions: exports of basic food staples declined in Northern Africa but more than doubled in Western Asia.

<sup>11</sup> Food trade data in this chapter include bran and cakes from cereals and groundnuts.

<sup>12</sup> Unless otherwise qualified, exports and imports are in gross terms.

<sup>13</sup> The net food exports of Sub-Saharan Africa during the late 1960s were largely groundnut exports from Nigeria and Senegal.

<sup>14</sup> This decline of South Asian food imports can, in turn, be traced to the substantial reduction in grain imports by India starting in 1978.

**Table 9—Exports, imports, and net trade of major food staples, by region and subregion, 1966-70 and 1976-80 averages**

Country Group	Exports			Imports			Net Trade <sup>a</sup>		Average Annual Growth Rate, 1966-70 to 1976-80 <sup>b</sup>	
	1966-70	1976-80	Change	1966-70	1976-80	Change	1966-70	1976-80	Exports	Imports
	(million metric tons)	(million metric tons)	(percent)	(million metric tons)	(million metric tons)	(percent)	(million metric tons)	(million metric tons)	(percent)	(percent)
Developing countries (Excluding China)	28.83 (26.85)	37.47 (35.80)	30 (33)	40.99 (35.16)	75.36 (63.06)	84 (79)	-12.16 (-8.31)	-37.89 (-27.26)	2.7 (2.9)	6.3 (6.0)
Asia (Excluding China)	9.61 (7.63)	15.98 (14.31)	66 (88)	23.78 (17.95)	32.24 (19.94)	36 (11)	-14.17 (-10.32)	-16.26 (-5.63)	5.2 (6.5)	3.1 (1.1)
China	1.98	1.67	-16	5.83	12.30	111	-3.85	-10.63	-1.7	7.8
South Asia	1.88	3.18	69	10.07	5.73	-43	-8.19	-2.55	5.4	-5.5
East and Southeast Asia	5.75	11.13	94	7.88	14.21	80	-2.13	-3.08	6.8	6.1
North Africa/Middle East	1.95	2.22	14	6.74	19.28	186	-4.79	-17.06	1.3	11.1
Northern Africa	1.37	0.82	-40	3.98	10.76	170	-2.61	-9.94	-5.0	10.5
Western Asia	0.58	1.40	142	2.76	8.52	209	-2.18	-7.13	9.2	11.9
Sub-Saharan Africa	3.89	1.86	-52	2.60	6.25	140	1.29	-4.39	-7.1	9.2
West Africa	2.51	1.08	-57	1.11	3.37	203	1.40	-2.29	-8.1	11.7
Central Africa	0.26	0.06	-78	0.39	0.87	124	-0.13	-0.82	-13.9	8.4
Eastern and Southern Africa	1.13	0.72	-36	1.10	2.00	82	0.03	-1.28	-4.4	6.2
Latin America	13.38	17.41	30	7.87	17.59	123	5.51	-0.18	2.7	8.4
Mexico and Central America <sup>c</sup>	1.71	0.87	-49	2.34	6.65	184	-0.63	-5.78	-6.6	11.0
Upper South America	1.99	1.79	-10	4.82	9.69	101	-2.83	-7.90	-1.0	7.2
Lower South America	9.68	14.76	52	0.71	1.25	76	8.97	13.50	4.3	5.8

Sources: Food and Agriculture Organization of the United Nations, "Agricultural Supply Utilization Accounts Tape, 1981," Rome, 1982; People's Republic of China, State Statistical Bureau, *Statistical Yearbook of China*, various issues (Hong Kong: Economic Information Agency, various years); and Republic of China, Council for Agricultural Planning and Development, "Taiwan, Food Balance Sheets, 1935-80," Taiwan, 1981 (computer printout).

Notes: Trade in bran and cakes for feed use is included. Parts may not add to totals due to rounding.

<sup>a</sup> Net trade is exports minus imports.

<sup>b</sup> Calculations are based on the midpoints of the indicated periods.

<sup>c</sup> Mexico and Central America includes the Caribbean.

The shift in the food trade position of Sub-Saharan Africa between 1966-70 and 1976-80 resulted from a 52 percent decline in exports and a 140 percent increase in imports. On an average annual basis, these changes represent a decline in exports of 7.1 percent a year and an expansion in imports of 9.2 percent a year. Despite this rapid growth of food imports, however, Sub-Saharan Africa accounted for less than 10 percent of the total imports of basic food staples by Third World countries in the late 1970s. The region was a net exporter of food in the 1960s mostly because of West Africa's net exports of groundnuts. During 1966-70, food exports in West Africa were more than double food imports; Central Africa was a small net food importer; and Eastern and Southern Africa exported just a little more than it imported. With the poor production performance throughout the region during the second period, food exports declined and food imports increased rapidly in all three subregions, which were all net importers. Compared to 1966-70, imports of basic food staples rose threefold in West Africa, more than doubled in Central Africa, and expanded by 82 percent in Eastern and Southern Africa. It should be pointed out that although the relative changes in the amount of imports appear to be large, the absolute amounts were small compared to those in other developing subregions. Relative to the total for Third World countries, net imports of basic food staples by the Sub-Saharan subregions during 1976-80 were 2 percent in Central Africa, 3 percent in Eastern and Southern Africa, and 6 percent in West Africa.

Between the late 1960s and the late 1970s Latin American imports of basic food staples increased 123 percent, while the region's exports of these commodities rose only 30 percent. This shifted Latin America's food trade position from net food exporter to net food importer in 1976-80, though net imports were small, only 180,000 tons. Of its subregions, only Lower South America was a net food exporter in both periods. In

1976-80 Lower South America was the only net food exporting subregion in the Third World, but its net food exports failed to offset the food trade imbalance in the rest of Latin America. Food imports in Mexico and Central America grew very rapidly—11 percent a year—and nearly tripled from 1966-70 to 1976-80. This, together with the decline of its food exports to one-half the earlier level, led to a ninefold expansion of net food imports in that subregion. But the largest quantity of net food imports was in Upper South America, which accounted for more than half of Latin American food imports in 1976-80. As in Mexico and Central America but at much slower rates, food exports in Upper South America declined and food imports increased between 1966-70 and 1976-80.

## Trade in Cereals and Noncereal Food Staples

### Exports

In Third World countries the export trade in basic food staples is about three-fourths cereals and one-fourth roots and tubers, pulses, groundnuts, and bananas and plantains combined. The rates of expansion of cereal and noncereal exports between 1966-70 and 1976-80 were not far apart, and hence their relative shares of the total exports of these commodities have remained almost unchanged (see Table 10 and Appendix 3, Table 21).<sup>15</sup> When China data are excluded, the growth rates for cereal and noncereal exports in developing countries are the same. Cereal exports increased rapidly in Asia, slowly in North Africa/Middle East, and moderately in Latin America. They declined in Sub-Saharan Africa. Exports of noncereals more than doubled in Asia but decreased sharply in Sub-Saharan Africa.

Asia's noncereal exports grew 8.9 percent a year from 1966-70 to 1976-80; the export growth rate would have been even higher if trade data for China were excluded. The rapid growth of noncereal exports caused the relative share of noncereals in total food

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<sup>15</sup> Data analyses in this section are for regions only.

**Table 10—Trends in exports, imports, and net trade of cereals and major noncereal staples, by region, 1966-70 to 1976-80**

Country Group	Average Annual Growth Rate, 1966-70 to 1976-80				Net Trade			
	Exports		Imports		1966-70 Average		1976-80 Average	
	Cereals	Non-cereals	Cereals	Non-cereals	Cereals	Non-cereals	Cereals	Non-cereals
	(percent)				(million metric tons)			
Developing countries (Excluding China)	2.6 (2.9)	2.8 (2.9)	6.3 (6.1)	4.3 (4.3)	-18.6 (-14.6)	6.4 (6.3)	-46.2 (-35.5)	8.3 (8.2)
Asia (Excluding China)	3.5 (4.8)	8.9 (9.6)	3.1 (1.0)	3.3 (3.3)	-16.3 (-12.3)	2.1 (2.0)	-21.7 (-11.0)	5.4 (5.3)
North Africa/Middle East	0.5	3.0	11.2	7.7	-5.2	0.4	-17.4	0.4
Sub-Saharan Africa	-3.0	-9.2	9.5	-1.7	-1.4	2.7	-5.4	1.0
Latin America	2.7	2.6	8.5	4.7	4.3	1.2	-1.7	1.5

Sources: Food and Agriculture Organization of the United Nations, "Agricultural Supply Utilization Accounts Tape, 1981," Rome, 1982; People's Republic of China, State Statistical Bureau, *Statistical Yearbook of China*, various issues (Hong Kong: Economic Information Agency, various years); and Republic of China, Council for Agricultural Planning and Development, "Taiwan Food Balance Sheets, 1935-80," Taiwan, 1981 (computer printout).

Notes: Data include trade in bran and cakes for use as feed. Calculations are based on the midpoints of the indicated periods. Net trade is exports minus imports. Parts may not add to totals due to rounding. See also Appendix 3, Table 21.

exports of Asia to rise from 26 to 37 percent between 1966-70 and 1976-80; it can be attributed mainly to the large increase in cassava exports from East and Southeast Asia to Europe for livestock feed.<sup>10</sup> Cereal exports of Asia, which represented more than a third of the total cereal exports of Third World countries in 1976-80, also expanded fairly rapidly at 3.5 percent a year (4.8 percent, excluding China).

Nearly 90 percent of the exports of basic food staples in Latin America during 1976-80 was cereals (see Appendix 3, Table 21). As a major cereal producer and, until recently, a net food exporter, Latin America accounted for more than one-half of the cereal exports in developing countries. This share has remained almost unchanged since the 1960s, because cereal exports from the region have increased at about the same rate as those of the Third World as a whole. Cereals also form the bulk of the small amount

of exports of basic food staples in North Africa/Middle East; as seen earlier, more than 90 percent of its food production is accounted for by this food group. However, the cereal exports of this region increased very slowly, changing only slightly between the late 1960s and late 1970s.

Sub-Saharan Africa is the smallest food exporter among the developing regions. In the late 1970s the region accounted for just 5 percent of the food exports of the Third World as a whole. As a result of the slow growth of food production in Sub-Saharan Africa, exports of both cereals and noncereals declined between 1966-70 and 1976-80; noncereal exports decreased rapidly by 9.2 percent a year—three times faster than the rate of decline of cereal exports. The big decrease in noncereal exports can be traced to the drastic reduction of groundnut exports in West Africa. As mentioned earlier, the decline of groundnut exports in Sub-

<sup>10</sup>J. S. Sarma and Leonardo A. Paulino, "Trends in the Production and Utilization of Cassava and Other Selected Food Crops in Tropical Asia," a paper presented at the Workshop on the Future Potential of Cassava in Asia and Research Development Needs, Bangkok, June 1984 (mimeographed).

Saharan Africa caused the region's food trade position to shift from net exports in the 1960s to net imports in the 1970s.

### Imports

Because cereals accounted for almost all of the imports of basic food staples in the Third World, the annual rate of increase for cereals is the same as that for total food imports of developing countries: 6.3 percent (see Table 10). Imports of noncereal basic food staples expanded at a slower rate of 4.3 percent a year. These rates change only slightly if data on China are excluded.

As expected, Asia leads the developing regions in the volume of cereal imports; it accounted for more than two-fifths of Third World cereal imports during 1976-80 (Appendix 3, Table 21). North Africa/Middle East and Latin America had cereal import shares of about a quarter each and the remainder went to Sub-Saharan Africa. Non-cereals account for just a small portion of food imports by the Third World. In the late 1970s these commodities represented only 2-3 percent of imports of basic food staples by the developing countries.

Except for Asia, the developing regions experienced rapid rates of increase in cereal imports. The fastest import growth from 1966-70 to 1976-80 was in North Africa/Middle East, 11.2 percent a year. Sub-Saharan Africa and Latin America were not far behind; these three regions more than doubled their cereal imports. At 3.1 percent a year, Asia's cereal imports grew relatively slowly, and when China's trade data are excluded, the rate of increase drops to only 1.0 percent a year.

These trends partly reflect the improved performance of food production in Asia over the two decades and partly the failure of consumption to expand, commensurate with increases in production, particularly in South Asia. In contrast, the decline in cereal exports and the rapid increase in cereal imports in Sub-Saharan Africa reflect the poor performance of food production in that region. In both North Africa/Middle East and Latin America, where production of basic food staples since the 1960s can be viewed as

satisfactory, the pressures that led to increases in cereal imports appear to have come from the demand side. The rapid growth of incomes in these two regions generated a rapid growth in consumption, especially of cereals for feed use, as shown in the preceding chapter.

### Net Food Trade

Because cereal imports were growing faster than cereal exports, net cereal imports of Third World countries more than doubled from 1966-70 to 1976-80, rising from 18.6 million tons a year to 46.2 million tons (see Table 10). This expansion represented a growth rate of net cereal imports by developing countries of more than 9 percent a year. When the net trade of basic food staples is viewed as a whole, the unfavorable trade in cereals of Third World countries, relative to the developed economies, appears to be partly offset by their net exports of non-cereal basic food staples, which expanded by 30 percent between these periods. During 1976-80, net exports of noncereals in developing countries offset nearly a fifth of net cereal imports. Excluding China, which accounted for almost one-fourth of the total net imports of cereals of developing countries in the late 1970s, the overall trends of net food trade did not change much.

Between 1966-70 and 1976-80, net cereal imports expanded by a third in Asia, more than tripled in North Africa/Middle East, and rose nearly fourfold in Sub-Saharan Africa. Latin America shifted its cereal trade position from a net exporter of 4.3 million tons a year during the earlier period to a net importer of 1.7 million tons a year in the later period. The largest annual increase of net cereal imports, more than 12 million tons, occurred in North Africa/Middle East, but the fastest growth, although only a third of the absolute increase in North Africa/Middle East, was in Sub-Saharan Africa, where net cereal imports grew almost fourfold. The slowest increase of net cereal imports was in Asia, with an annual rate of increase of less than 3 percent. If China data are excluded, the net cereal trade trends

for Asia would show a decline in net imports.

In trade in noncereal basic food staples between 1966-70 and 1976-80, net exports increased two-and-a-half times in Asia and 25 percent in Latin America, stayed about the same in North Africa/Middle East, and decreased to 37 percent in Sub-Saharan Africa. Net noncereal exports in Asia averaged 5.4 million tons of cereal equivalent yearly during the later period and represented two-thirds of the total for developing countries. Growth of net exports in Asia was a rapid 10 percent a year and would have been even faster if China were excluded; China's net noncereal exports declined after the

1960s. Sub-Saharan Africa, where these commodities are more important than in other developing regions, accounted for the largest share of the net noncereal exports of developing countries in the 1960s. However, with the decline in the groundnut exports of the region, net exports of noncereal staples in Sub-Saharan Africa had dropped substantially by the late 1970s. Despite the limited demand for noncereal basic food staples by the developed countries, these commodities help significantly to ease the financial burden of developing countries in acquiring their food imports from the developed economies.

# 6

## LOOKING TO 2000

### Population Growth

Recent United Nations medium-variant population projections for developing countries show that the number of people in the Third World may increase from 3.3 billion in 1980 to 4.8 billion by the end of the century. This represents an annual growth rate of 1.9 percent or an average increase of about 75 million people a year during the two decades (see Table 11). The projected growth rate is significantly less than the 2.4 percent annual population increase during 1961-80. Excluding China, whose projected population growth—1.1 percent a year—is relatively low, the Third World countries are projected to have a population increase of 2.2 percent a year, bringing the total number of people in these countries to 3.5 billion in 2000. Despite the projected slow growth of population in China, the country would have an increase of 13 million people a year and account for about one-sixth of the total increase in Third World population during 1980-2000. It may be important to note that projections of population growth in developing countries have become more conservative over time. The assessment of population estimates and projections that was made in 1978 indicated that, under the medium-variant assumption, Third World population would probably increase at an annual rate of 2.1 percent (2.4 percent excluding China) until the year 2000.

Among the developing regions, population growth is projected to decelerate in Asia and Latin America, remain unchanged in North Africa/Middle East, and accelerate in Sub-Saharan Africa, compared to growth rates during the past two decades. The slowest population growth is projected for Asia, with an annual rate of 1.5 percent; this would bring its population to 3.2 billion in 2000 or about two-thirds of the projected total for developing countries. This rate of increase is a substantial decline from Asia's

annual growth rate of 2.3 percent during 1961-80. Population growth projections show a faster rate of expansion—1.8 percent—for the other countries in the region when China is excluded. About three-fourths of the 40 million average annual increase in Asia's population until 2000 would come from these countries. Even with the exclusion of data on China, the projected population growth in the rest of Asia shows a slowdown of 25 percent from the 1961-80 rate.

The projected population increase in Latin America, as in Asia, reflects a significant deceleration compared to population growth in the region in the trend period. Latin America's projected 1980-2000 growth rate of 2.1 percent a year would mean an average of more than 9 million people every year over the two decades; the region's projected population by the end of the century is about 540 million. The 2.7 percent average annual population growth of North Africa/Middle East is projected to continue. By the year 2000 projected population for this region would be 70 percent larger than its 1980 population of about a quarter of a million. The incremental growth of population in North Africa/Middle East would be about 9 million people annually, slightly less than in Latin America. Together these two regions are projected to account for about one-fourth of the total increase in Third World population between 1980 and 2000.

Sub-Saharan Africa's population is projected to expand from about 340 million in 1980 to 640 million in 2000, an average annual growth rate of 3.3 percent. This projected population increase, which represents the fastest growth rate among regions, clearly shows that population growth is still accelerating in most of Sub-Saharan Africa. The projected rate of population increase in this region means an average of 15 million additional people a year during 1980-2000, a fifth of the projected increase for the entire Third World population during this period.

**Table 11—Projected growth rates of population, production, and domestic use of major food crops, by region, 1980-2000**

Country Group	Projected Annual Growth Rate, 1980-2000					Share of Feed in Domestic Use	
	Population	Production	Domestic Use <sup>a</sup>			1980	2000
			Total	Food	Feed		
			(percent/year)			(percent)	
Developing countries (Excluding China)	1.9 (2.2)	2.9 (2.9)	2.7 (3.0)	2.1 (2.4)	4.6 (4.7)	16 (18)	23 (26)
Asia (Excluding China)	1.5 (1.8)	2.9 (3.0)	2.3 (2.4)	1.9 (2.0)	4.4 (4.4)	12 (11)	17 (17)
North Africa/Middle East	2.7	2.9	3.8	2.5	6.1	26	39
Sub-Saharan Africa	3.3	2.1	3.6	3.5	5.5	6	9
Latin America	2.1	3.0	3.2	2.3	4.0	40	47

Sources: Food and Agriculture Organization of the United Nations (FAO), "Agricultural Supply Utilization Accounts Tape, 1981," Rome, 1982; FAO, "Estimates of Income Elasticities for Various Commodities by Country," Rome, 1979 (computer printout); FAO, "Production Yearbook Data Tape, 1975, 1979, 1981, and 1983," Rome, 1976, 1980, 1982, and 1984; People's Republic of China, State Statistical Bureau, *Statistical Yearbook of China*, various issues (Hong Kong: Economic Information Agency, various years); Republic of China, Council for Agricultural Planning and Development, "Taiwan Food Balance Sheets, 1935-80," Taiwan, 1981 (computer printout); Republic of China, Executive Yuan, Directorate General of Budget, Accounting, and Statistics, *Statistical Yearbook of the Republic of China, 1982* (Taiwan: Republic of China, 1983); United Nations, Department of International Economic and Social Affairs, "World Population Prospects as Assessed in 1982," New York, 1983 (computer printout); and World Bank, "Gross National Product by Country Data Tape, 1961-80," Washington, D.C., 1981. Consumption data for the People's Republic of China were provided by Bruce Stone of the International Food Policy Research Institute.

Notes: See also Appendix 3, Table 22.

<sup>a</sup> The growth rate of domestic use is based on 1980 trend estimates and projections to 2000 a trend income growth.

## Growth of Food Production and Consumption

If the 1961-80 food production trends in developing countries continue into the future, the output of basic food staples is projected to increase at an average annual rate of 2.9 percent during 1980-2000.<sup>17</sup> At this rate, food production in developing countries as a whole would be expanding much faster than projected population growth (see Table 11). These output projections also suggest a yearly increase of per capita food production of nearly 1.0 percent during the period. Even excluding China, the projected growth rate of production in the rest of the Third World would remain essentially unchanged; however, the faster population growth projected for developing countries outside China would result in a slower growth

of per capita production of 0.7 percent annually.

Growth of food production among the developing regions is projected to outpace population increases in Asia, North Africa/Middle East, and Latin America, but to lag far behind population growth in Sub-Saharan Africa. The average yearly increase of major food crop production in Asia (2.9 percent) is projected to be nearly twice as fast as population growth, and its 1.4 percent projected annual growth rate of per capita output would be the highest among developing regions. Asian developing countries excluding China would have a slightly faster rate of increase in food output but, at 1.2 percent a year, a slightly slower growth in per capita production. The production of basic food staples in North Africa/Middle East is projected to expand at about the same rate as

<sup>17</sup> It is also assumed that for countries with negative trends in food production during 1961-80, there would be no further decline in output after 1980. In the case of China the projection of food production is based on the trend shown by output for the longer period 1952-80.

in Asia, but because population growth is projected to be so fast, per capita output is projected to increase by only 0.2 percent annually.

The most rapid growth of food production among the regions is projected for Latin America—3.0 percent a year. This rate would be about the same as that of Asia excluding China, but the region's yearly rate of increase in per capita production would be less than 1.0 percent. In contrast with other developing regions, Sub-Saharan Africa has a projected growth of food production considerably slower than its projected population increase; poor production performance and rapid population growth could lead to a decline of the region's per capita output exceeding 1.0 percent a year between 1980 and 2000.

On the consumption side, if the 1966-80 trends in the growth of per capita incomes in developing countries continue, demand for basic food staples in the Third World as a whole is projected to expand at an annual rate of 2.7 percent during the 1980-2000 period, or slightly slower than the rate of increase in food production. Food demand in the developing countries excluding China is projected to increase 3.0 percent a year, which is slightly faster than food output; the projected rate of increase of food demand in China is about 2.3 percent annually. However, it is likely that food demand would grow faster because the projected slow population growth can be expected to change the country's population structure and lead to increases in per capita food consumption above those induced by income growth.

Between 1980 and 2000, increases in food demand are projected to outstrip the growth of food output in all developing regions except Asia, either with or without China. The projected growth of demand for basic food staples in Asia (2.3 percent a year) is slowest among the regions and is significantly slower than the projected increases in the output of these commodities: For Asia excluding China, the projected growth rates of food production and demand nearly equal those for Asia with China. The rates of increase in the consumption of basic food staples

for the other developing regions are all projected to exceed 3.0 percent a year. With its rapid population growth, Sub-Saharan Africa's food demand is projected to expand by 3.6 percent a year, which would substantially outpace the projected growth of production of the major food crops.

Rapid income growth and a fairly rapid increase of population in North Africa/Middle East, if continued, could push the growth in demand for basic food staples to 3.8 percent annually between 1980 and the end of the century, the fastest growth rate of food consumption among the developing regions. The projected growth in demand for basic food staples in North Africa/Middle East would exceed the region's projected growth of food output by almost one percentage point a year. Although the projected rate of increase in the production of basic food staples for Latin America would be the most rapid among the regions, food demand has been expanding rapidly, and it is projected to increase slightly faster than food output growth.

## **Use of Basic Food Staples for Food and Feed**

The Third World's projected annual growth rates of the domestic use of basic food staples for direct consumption by humans of 2.1 percent and for animal feed of 4.6 percent may be expected as a result of projected changes in population and per capita incomes in the developing countries (see Table 11). Compared to the growth in the consumption of these commodities in the past two decades, the projected rates of increase during 1980-2000 would be slower for direct use as food but faster for use as animal feed. As per capita incomes in developing countries increase over time, it is likely that an increasing proportion of their total domestic utilization of basic food staples would be converted to livestock and poultry products.

By the year 2000, the projected level of basic staples directly used as food would be 62 percent of their total domestic utilization and that for animal feed would be 23 per-

cent (see Appendix 3, Table 22). This represents a ratio between feed use and food use of about 37 percent, compared to less than 25 percent in 1980. These projections also show that about 15 percent of the total consumption of basic food staples in developing countries in 2000 would go to uses other than food and feed. For Third World countries other than China, a faster growth rate is projected for food use; the annual rates of increase of these two principal uses would result in relative shares of 58 percent for direct food use and 26 percent for animal feed in 2000.

Although the projected rate of increase in the use of basic food staples for direct human consumption in Asia is less than half of the 4.4 percent annual rate of growth of their use for animal feed, food use would still dominate projected total domestic utilization in the region. With these rates of increase, the share of food use in total consumption by the year 2000 would be nearly 70 percent and feed use would be 17 percent; the projected share of feed use is relatively low partly because it started from a low base of only 12 percent of total domestic utilization in 1980. The projected consumption growth rates of Asian developing countries excluding China are close to those for Asia as a whole; these rates show the same percentage share of feed use.

The projected 3.5 percent annual increase in the use of basic staples directly for food in Sub-Saharan Africa during 1980-2000 largely reflects the rapid population increase that is projected for the region; food use would account for slightly more than 70 percent of projected food demand for these commodities by the end of the century. The rapid rate of increase in the use of basic food staples for animal feed that is projected for Sub-Saharan Africa is, as in Asia, partly due to its low base. Despite the rapid 5.5 percent annual growth of feed use in the region, its share of total consumption is pro-

jected to rise from 6 percent in 1980 to only 9 percent in 2000.

The fastest projected growth in the use of major food crops for animal feed among the developing regions is in North Africa/Middle East where rapid increases in income could push the rate of growth of feed use to 6.1 percent a year.<sup>18</sup> The use of basic staples directly for food in this region is projected to expand by 2.5 percent annually, a little less than projected population growth. As higher incomes are achieved in the region, per capita use of these commodities directly for human consumption may be expected to decline in favor of more livestock and poultry products. The shares of total consumption that are projected for food and feed are 43 percent and 39 percent, respectively. The projected ratio of feed use to food use of more than 90 percent by the year 2000 would be a considerable rise from less than 50 percent in 1980. Compared with those in Asia and Sub-Saharan Africa, the proportion of animal feed in the total domestic utilization of basic food staples in North Africa/Middle East appears to have reached a point where the growth of feed use can significantly influence food consumption growth in that region.

In Latin America, where per capita incomes are already growing rapidly and feed use is already high, the domestic use of basic food staples for animal feed is projected to expand at an average rate of 4 percent a year during 1980-2000. Feed use is projected to account for 47 percent of the total consumption of these commodities by the end of the century. The projected amount of major food crops for feed use would exceed that for direct use as food by more than 20 percent. Despite the rapid growth of per capita incomes in this region, the projected rate of increase in the use of basic food staples for animal feed is the lowest among the developing regions; feed use in Latin America has reached levels where

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<sup>18</sup> As shown in Appendix 1, the projected growth of feed use is similar to the projected increase in meat consumption, which is expected to expand quickly in this region because of the rapid growth of incomes. However, with the recent major decline in oil prices and the consequent deceleration of income growth in the region, feed use in North Africa/Middle East may not grow as fast as projected.

rapid rates of increase would be difficult to achieve. Furthermore, the large livestock that dominate animal production in the region are primarily grassfed.

## Food Projections to the Year 2000

Assuming that 1961-80 output trends continue, the Third World is projected to produce about 1,471 million tons of major food crops by the end of the century (see Table 12). Projected output would then be 75 percent higher than the production of these commodities in 1980. On the demand side, the expanded population of Third World countries in the year 2000 would require 1,315 million tons of these basic food staples if 1980 levels of per capita food consumption remain unchanged, that is, assuming there is no growth in income. An additional 225 million tons would be needed if per capita incomes expand following the 1966-80 trends.<sup>19</sup> The projected food demand at trend income growth would be slightly more than 70 percent larger than the estimated consumption of basic food staples in developing countries in 1980. These projections point to a net food deficit in the Third World of 69 million tons by the year 2000—more than 30 percent larger than the net production shortfall in 1980. Developing countries excluding China have a projected food output of 970 million tons or two-thirds of the total for the Third World as a whole. With trend growth of per capita incomes, the demand for basic food staples in these countries is projected to increase to 1,046 million, more than 85 percent of which would be required to feed the population in 2000 even if no growth in per capita incomes takes place. However, if per capita incomes grow at 1966-80 trend rates this group of countries could face a projected food gap of 76 million tons.<sup>20</sup>

Asia is the only region that is projected to attain a net surplus of basic food staples by the end of the century, with country output projections of 1,035 million tons and demand projections at trend income growth of 983 million tons. Asia's projected net surplus of 51 million tons represents a shift of the region's food position from a net deficit in major food crops of 18.9 million tons in 1980. If Asia's projected population were to maintain 1980 per capita consumption levels, the food requirements of the region would be 847 million tons in 2000. At least five-eighths of the projected increase in consumption from 1980 can be attributed to population growth. For countries in the region excluding China, the demand for basic food staples is projected to reach 489 million tons at trend income growth, 44 million tons below the projected production of these commodities.

The three Asian subregions, all of which had net food deficits in 1980, are projected to move to net surplus positions by the end of the century (see Table 12). At trend income growth, East and Southeast Asia, with the smallest net deficit in 1980, is projected to have a net surplus of 31 million tons; this represents 60 percent of the projected net surplus for the region as a whole in 2000. China is projected to have a net surplus of 7 million tons and South Asia of 13 million tons. Of the projected increase in food demand, population growth would account for about 70 percent in East and Southeast Asia and more than 75 percent in South Asia. With the slow rate of population increase projected for China between 1980 and 2000, population growth would represent only one-half of the projected growth of food demand in this country/subregion.

Latin America is projected to produce 204 million tons of basic food staples in 2000, which would amount to one-seventh

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<sup>19</sup> Based on the country growth rates of real GNP per capita that are used in the demand projections for food and feed, annual growth rates are constrained to a minimum of 0.5 percent and a maximum of 6.0 percent. Details on data and methodology are given in Appendix I.

<sup>20</sup> Earlier projections, which used 1961-77 trends in production and 1966-77 trends in per capita incomes, showed net shortfalls of basic food staples in 2000 of 74 million tons for the Third World as a whole and 80 million tons for developing countries excluding China.

**Table 12—Production and consumption of major food crops, by region and subregion, 1980 and projections to 2000**

Country Group	1980			Projections to 2000				
	Pro- duction	Con- sumption	Net Surplus/ Deficit	At 1980 Per Capita Consumption			With Trend Income Growth <sup>a</sup>	
				Pro- duction	Con- sumption	Net Surplus/ Deficit	Con- sumption	Net Surplus/ Deficit
	(million metric tons)							
Developing countries (Excluding China)	841.9 (543.1)	893.7 (579.8)	-51.8 (-36.8)	1,471 (970)	1,315 (910)	156 (60)	1,540 (1,046)	-69 (-76)
Asia (Excluding China)	593.8 (295.0)	612.7 (298.8)	-18.9 (-3.8)	1,035 (534)	847 (442)	187 (91)	983 (489)	51 (44)
China	298.9	313.9	-15.0	501	405	96	494	7
South Asia	184.8	188.0	-3.3	323	282	41	310	13
East and Southeast Asia	110.2	110.8	-0.5	211	160	51	180	31
North Africa/Middle East	68.0	86.9	-18.9	119	145	-26	183	-64
Northern Africa	21.1	31.7	-10.6	35	55	-20	68	-33
Western Asia	46.9	55.2	-8.3	83	90	-7	114	-31
Sub-Saharan Africa	72.4	78.3	-5.9	114	149	-35	160	-47
West Africa	32.7	37.3	-4.7	39	69	-30	76	-36
Central Africa	12.1	13.0	-0.9	25	24	1	25	...
Eastern and Southern Africa	27.6	27.9	-0.3	49	56	-7	60	-10
Latin America	107.7	115.9	-8.2	204	174	30	214	-9
Mexico and Cen- tral America <sup>b</sup>	29.7	34.1	-4.4	57	55	2	65	-7
Upper South America	55.6	67.0	-11.5	100	97	3	126	-26
Lower South America	22.4	14.8	7.7	47	22	25	22	24

Sources: Food and Agriculture Organization of the United Nations (FAO), "Agricultural Supply Utilization Accounts Tape, 1981," Rome, 1982; FAO, "Estimates of Income Elasticities for Various Commodities by Country," Rome, 1979 (computer printout); FAO, "Production Yearbook Data Tape, 1975, 1979, 1981, and 1983," Rome, 1976, 1980, 1982, and 1984; People's Republic of China, State Statistical Bureau, *Statistical Yearbook of China*, various issues (Hong Kong: Economic Information Agency, various years); Republic of China, Council for Agricultural Planning and Development, "Taiwan Food Balance Sheets, 1935-80," Taiwan, 1981 (computer printout); Republic of China, Executive Yuan, Directorate General of Budget, Accounting, and Statistics, *Statistical Yearbook of the Republic of China, 1982* (Taiwan: Republic of China, 1983); United Nations, Department of International Economic and Social Affairs, "World Population Prospects as Assessed in 1982," New York, 1983 (computer printout); and World Bank, "Gross National Product by Country Data Tape, 1961-80," Washington, D.C., 1981. Consumption data for the People's Republic of China were provided by Bruce Stone of the International Food Policy Research Institute.

Notes: The ellipsis indicates a negligible amount. For aggregation purposes, rice is in husked form and the noncereal components are in wheat equivalents. Parts may not add to totals due to rounding; see also Appendix 3, Table 23.

<sup>a</sup> Based on the 1966-80 average annual growth rate of real GNP per capita.

<sup>b</sup> Mexico and Central America includes the Caribbean.

of the total for the Third World as a whole. The region's food demand is projected to expand abreast of production between 1980 and 2000, resulting in a net deficit at the end of the period about the same as that in 1980. On the basis of constant 1980 per capita consumption, the region's food output in 2000 would exceed the food needs

of the expanded population by 30 million tons. This suggests that approximately 60 percent of the projected increase in food demand would be needed for population growth and 40 percent for income growth during the 1980-2000 period.

Upper South America is projected to account for about one-half of Latin America's

output of major food crops in 2000; the other half would be shared about equally by Mexico and Central America and Lower South America. Food output in Upper South America is projected to expand by 80 percent, but its food demand at trend income growth is projected to rise faster. Thus the subregion's 1980 net production shortfall could more than double to 26 million tons in 2000. The increase in consumption that could be attributed to the projected growth of population in Upper South America represents about one-half of the projected increase in food demand.

Although food production is projected to expand at a fairly rapid pace in Mexico and Central America, the subregion could still face a net production shortfall of 7 million tons—2.6 million tons larger than its 1980 net food deficit. Food output and food demand at trend income growth in Mexico and Central America are projected to expand at about the same rate between 1980 and 2000. If incomes remain constant during this period, total consumption of basic food staples in the subregion in 2000 would be just slightly less than the projected production of these commodities; about two-thirds of the projected increase in food demand in Mexico and Central America would stem from population growth.

Lower South America is projected to continue as a net surplus subregion; by 2000 its projected net surplus is 24 million tons or more than three times its net surplus in 1980. This large net surplus would arise from a twofold expansion of projected food production, and a 50 percent increase in food demand as the result of slow growth of both population and income. The projected net surplus of basic food staples in Lower South America, however, would just about fill the net deficit projected for Upper South America. Thus with Mexico and Central America in deficit, Latin America as a region could continue to have a food deficit.

North Africa/Middle East and Sub-Saharan Africa are each projected to account for about 8 percent of Third World food production by the end of the century, but food output in North Africa/Middle East is projected to slightly exceed that of Sub-Saharan Africa in 2000, which would reverse their relative positions in 1980. The projected production of basic food staples in North Africa/Middle East would be three-fourths higher than the region's estimated output in 1980. If the rapid growth of incomes in this region continues, food demand would expand much faster and increase to more than twice the 1980 consumption level.<sup>21</sup> The projected net deficit of 64 million tons is more than three times the region's 1980 net deficit, and it would be the largest projected production shortfall among the developing regions by the end of the century. Even if the region's 1980 per capita consumption were to remain constant, the resulting food requirements of North Africa/Middle East in 2000 would exceed projected production by 26 million tons. At least 60 percent of the projected increase in food demand could result from population growth and the rest from the growth of per capita income.

Both subregions of North Africa/Middle East are projected to face sizable net food deficits by the end of the century. Relative to 1980, the projected production of basic food staples in 2000 would be larger by two-thirds in Northern Africa and by three-fourths in Western Asia. On the consumption side, projected demand based on the 1966-80 trend growth in incomes would be more than double the amounts of these commodities consumed in 1980 in both subregions. These output and demand projections to 2000 could result in net production shortfalls of 33 million tons in Northern Africa and 31 million tons in Western Asia. Food requirements in 2000 calculated on the basis of 1980 per capita consumption

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<sup>21</sup> As seen in Appendix 1 on methodology, per capita income growth is constrained to a maximum of 6 percent a year for projection purposes. Relative to actual per capita income growth rates in 1966-80, this constraint is equivalent to a slowdown of 27 percent in the growth of the oil exporting countries in North Africa/Middle East as a group.

would exceed projected production in both subregions but more so in Northern Africa. Of the projected increase of food demand at trend income growth, population growth alone would account for at least 65 percent in Northern Africa and 60 percent in Western Asia.

If the slow growth of food production in Sub-Saharan Africa continues, its output of basic food staples is projected to expand to only 114 million tons by the year 2000. This would represent an increase of less than 60 percent of the 1980 production of these commodities. The demand for basic food staples at trend income growth in Sub-Saharan Africa, on the other hand, is projected to rise to twice the estimated consumption in 1980. The net food deficit in this region is projected to increase to 47 million tons in 2000, nearly eight times the 1980 production shortfall. A combination of slow production growth and rapid population increase could cause Sub-Saharan Africa's projected food deficit to rise steeply. As in North Africa/Middle East, food production would fall short of requirements even if 1980 per capita consumption were to remain constant until 2000. Population growth would represent more than 85 percent of the increase in food demand in this region between 1980 and the end of the century. The role of income growth in the projected expansion of food demand in Sub-Saharan Africa would probably be smaller than in the other developing regions.

West Africa would account for about three-fourths of the net production shortfall projected for Sub-Saharan Africa. The production of basic food staples in this subregion is projected to grow by only 20 percent between 1980 and 2000, compared to a projected doubling of food demand during the period. As a result, West Africa's net food deficit of 4.7 million tons in 1980 could increase sevenfold by 2000. Even assuming that incomes do not increase, the food requirements of the population of West Africa would exceed the projected output of basic food staples in the subregion by 30 million tons. Eastern and Southern Africa's net production shortfall of less than half a million tons of major food crops in 1980 is projected

to expand to 10 million tons by the end of the century. Food demand in Eastern and Southern Africa is projected to grow just slightly faster than in West Africa, but its food output is projected to increase more than three times faster. Population growth alone represents nearly 90 percent of the projected growth in demand for basic food staples in Eastern and Southern Africa. In the case of Central Africa, the projected production of basic food staples would almost equal its projected demand for these commodities. This subregion, which had a net food deficit of about 1 million tons in 1980, is expected to be almost self-sufficient by the end of the century. Food production in Central Africa is projected to more than double between 1980 and 2000, growing faster than food demand. If the per capita consumption of the countries in Central Africa is held constant at 1980 levels, the increase of food requirements due to population growth between 1980 and 2000 would be more than 90 percent of the projected expansion in food demand during this period.

Based on the 1961-80 trends in production and the 1966-80 trends in per capita incomes, output and demand projections show that Lower South America and all three subregions of Asia would have net surpluses of the basic food staples in 2000. Central Africa would be close to self-sufficiency, but the rest of the developing subregions are projected to face net deficits ranging from 7 million tons in Mexico and Central America to 36 million tons in West Africa.

## **Gross Food Surpluses and Deficits**

Projections of country surpluses and of country deficits cancel each other out when presented in net terms for country groups. From the viewpoint of food trade, it is more meaningful to examine food surpluses and deficits in gross terms, or their aggregates for regions and subregions. It must be pointed out, however, that the disposition of potential surpluses by self-sufficient developing countries would depend on their national policies; there is no assurance that such

surpluses would actually flow to developing countries with food production shortfalls.

For the Third World as a whole, the projected gross surplus of basic food staples in countries that are projected to be self-sufficient in 2000 could reach 118 million tons (see Appendix 3, Table 23). That would be almost five times the gross surplus of 25 million tons of these commodities in 1980, a rate of increase of about 8 percent a year between 1980 and the end of the century. These projected surpluses would come from 22 countries of the four developing-country regions.

Asia is projected to contribute more than two-thirds of the aggregate surplus, with the East and Southeast Asia subregion alone contributing more than 40 percent. China is projected to shift from a significant deficit in 1980 to a surplus in 2000, whereas South Asia is projected to have a gross surplus of more than 20 million tons. Latin America's projected gross surplus, mostly from Lower South America, would be about one-fourth of the Third World total. About 6 percent would be contributed by Sub-Saharan Africa, with nearly equal shares coming from Central Africa and Eastern and Southern Africa. No surplus is projected for any country in West Africa. The smallest regional contribution to the total gross surplus—less than 1 percent—is projected for North Africa/Middle East. No country in Western Asia is projected to be in a food surplus position by the end of the century.

Considering the food transfers needed to fill the country gaps between output and demand, the size of the Third World food problem projected for the end of the century is immense. The projected gross deficit is

about 185 million tons of basic food staples in 83 developing countries. That is almost two-and-a-half times the projected gross deficit of all the countries with shortfalls in 1980. More than one-third of the Third World gross deficit would be in North Africa/Middle East, where the projected gross shortfall would be more than three times that of 1980. Nearly 30 percent of the total gross deficit of basic food staples is projected for Sub-Saharan Africa, while about one-fifth is indicated for Latin America. Compared to their gross food deficits in 1980, the projected aggregate shortfall in Sub-Saharan Africa is sixfold and in Latin America, twofold. In Asia, the gross deficit of basic food staples by the year 2000 is projected to be about the same as in 1980.

As may be expected, the largest projected gross food deficit among the developing subregions is in West Africa (36 million tons), where the projected slow growth of production and the rapid population increase could result in an annual rate of increase in its gross food deficit exceeding 10 percent. Following close behind West Africa are Northern Africa and Western Asia, where the projected fast growth in food demand can be brought about by rapid increases in income. The gross production shortfalls projected for these two subregions each exceed 30 million tons. Upper South America and East and Southeast Asia are projected to have gross deficits of 15 percent and 11 percent of the Third World total, respectively. It may be important to note that the projected annual growth rates of gross food deficits of the subregions of North Africa/Middle East and Sub-Saharan Africa for the 1980-2000 period all exceed 5 percent.

# 7

## FOOD TRENDS AND PROJECTIONS FOR DEVELOPING COUNTRIES GROUPED BY INCOMES AND SUFFICIENCY RATIOS

### Classification of Countries

For the purpose of identifying food problems that are shared by countries with common characteristics, the 105 developing countries covered in this study have been categorized by income levels and growth rates and on the basis of food and calorie sufficiency ratios (see Appendix 2, Table 18). Group ranges are essentially arbitrary because they are largely set by the spread of the countries in each classification.<sup>22</sup>

#### Income Levels

In grouping the developing countries by income levels, the 1980 trend estimate of average annual per capita GNP in U.S. dollars for each country was calculated from the 1961-80 annual estimates of real GNP (1979-81 = 100). Each country was then assigned to one of these categories: less than \$250, the very-low-income countries; \$250-\$499, the low-income group; \$500-\$1,999, the middle-income category; and \$2,000 and over, the high-income countries. The very-low-income and low-income categories have 39 countries and account for nearly three-fourths of the Third World population; the low-income group alone (which includes China) accounts for more than 40 percent. Forty-six countries, containing 17 percent of the population, form the middle-income group. Lastly, some 19 relatively small developing countries constitute the high-income category, which contains only 10 percent of the developing-country population. Three-fifths of the countries in Sub-Saharan Africa belong to the very-low- and low-income groups, whereas all but three of the countries in North Africa/Middle East and all but one

of those in Latin America are in the middle- or high-income categories. In Asia, the very-low- and low-income groups include about 55 percent of the countries in the region.

#### Income Growth Rates

This typology of Third World countries uses the average annual rate of growth of real per capita GNP during the 1961-80 period. Countries are classified according to annual growth rates: less than 1.0 percent, the very-slow-growth group; 1.0-2.9 percent, the slow-growth countries; 3.0-4.9 percent, the medium-growth category; and 5.0 percent and over, the rapid-growth countries. Twenty-seven countries, containing about 11 percent of the Third World population, form the very-slow-growth group, and 36 others, representing a third of the population, fall in the slow-growth category. For the countries in these two groups, the growth rate of real GNP at best just slightly exceeds population growth. The largest category in this typology is the 24 medium-growth countries, which includes China and thus contains almost half of the Third World population. The 18 fast-growing countries that form the rapid-growth group represent only 8 percent of the population.

#### Food Sufficiency

The indicator used in this typology is the ratio of production to consumption of major food crops during the five-year period 1976-80. With this ratio, the country classifications are: less than 75 percent, the heavy food importers; 75-94 percent, the light food importers; 95-104 percent, the marginally

<sup>22</sup> The countries under each typology are presented in Appendix 2.

self-sufficient countries; and 105 percent and over, the self-sufficient category. Although the category of heavy food importers—that relied on trade to provide more than 25 percent of their consumption requirements of basic food staples during 1976-80—has the largest number of countries, 35, these are relatively small economies whose combined population composed only 8 percent of the Third World total in 1980. Another group of almost the same number is formed by the light food-importing countries, which also relied on trade for part of their food needs though not as heavily. These economies account for about one-fourth of the developing-country population. Twenty developing countries (including China) that were marginally sufficient in food during the late 1970s contain more than 60 percent of the Third World population. These countries imported a relatively small portion of their food needs or probably turned to imports only during years of crop production failures. Sixteen countries, which are classified as self-sufficient and represent the remaining 6 percent of the population, show food supplies exceeding food requirements by 5 percent or more of their estimated consumption during 1976-80. This group includes net food-exporting countries such as Argentina and Thailand.

### **Calorie Sufficiency**

For this typology, countries are grouped according to the ratio of the average daily per capita supply of calories in 1979-81 to the FAO-WHO recommended levels. The countries are broken down into those with ratios of: less than 90 percent (22 countries); 90-99 percent (28 countries); 100-109 percent (19 countries, including China); and 110 percent and over (36 countries). The two groups of countries whose average calorie supply fell below the WHO-FAO recommended levels during the base period accounted for nearly 40 percent of the Third World population in 1980. The largest group in terms of number of people is the 100-109 percent category, which includes China and contained more than two-fifths of the 1980 population in developing countries.

## **Trends in the Growth of Population and Food Production**

### **Income Level**

Growth trends during the 1961-80 period show that food production growth lagged slightly behind population increases in very-low-income countries, widely outpaced population growth in the low-income group, and just kept abreast of population expansion in both the middle- and high-income categories (see Table 13). The very-low-income group accounted for about one-fourth of the 1980 production of major food crops in developing countries; as can be expected, this output share was much less than proportionate to the population share of these countries. Food production in the low-income countries expanded by 3.9 percent annually during the two decades, which was a much faster rate of increase than their 2.2 percent average yearly growth of population. The rapid growth of production in the low-income countries was largely biased by China, which accounts for almost 80 percent of the output of basic food staples of the group, and which, as seen earlier, had a very rapid rate of increase in food output during 1961-80. However, even if China is excluded, this group of countries would still show a fairly rapid growth in food production of 3.3 percent a year. In this typology, per capita production growth was positive only in the low-income countries, with or without China. The middle- and high-income country groups represented about 30 percent of the 1980 production of major food crops in the developing countries. Growth of food production in each of these two categories tended to keep abreast of population increases during the last two decades.

### **Income Growth Rate**

When the developing countries are grouped on the basis of their per capita income growth rates during 1961-80, the data show that the rate of population increase in the very-slow-growth countries was almost one percentage point faster than their 1.6

**Table 13—Population and major food crop production, by income, food self-sufficiency, and calorie sufficiency country groups, 1980, and average annual growth rates, 1961-80**

Country Group	Population			Major Food Crop Production		
	1980	Share of Total for Developing Countries	1961-80	1980	Share of Total for Developing Countries	1961-80
	Number		Average Annual Growth Rate	Quantity		Average Annual Growth Rate
	(million)	(percent)	(percent)	(million metric tons)	(percent)	(percent)
Developing countries Grouped by 1980 per capita income <sup>a</sup>	3,273	100	2.4	841.9	100	3.1
Less than \$250	1,005	31	2.4	215.4	26	2.3
\$250 - \$499	1,368	42	2.2	376.8	45	3.9
(Excluding China)	(366)	(11)	(2.5)	(78.0)	(9)	(3.3)
\$500 - \$1,999	555	17	2.7	145.3	17	2.7
\$2,000 and over	345	10	2.8	104.4	12	2.8
Grouped by 1961-80 income growth <sup>b</sup>						
Less than 1.0 percent	355	11	2.5	72.9	9	1.6
1.0 - 2.9 percent	1,102	33	2.5	245.5	29	2.7
3.0 - 4.9 percent	1,564	48	2.3	460.4	55	3.7
(Excluding China)	(561)	(17)	(2.6)	(161.5)	(19)	(3.1)
5.0 percent and over	253	8	2.7	63.1	7	2.5
Grouped by food self-sufficiency in 1976-80 <sup>c</sup>						
Less than 75 percent	273	8	2.6	38.4	4	1.7
75 - 94 percent	788	24	2.6	190.9	23	2.5
95 - 104 percent	2,016	62	2.3	518.8	62	3.5
(Excluding China)	(1,013)	(31)	(2.5)	(219.9)	(26)	(2.8)
105 percent and over	197	6	2.4	93.7	11	3.0
Grouped by calorie sufficiency in 1979-81 <sup>d</sup>						
Less than 90 percent	253	8	2.6	51.6	6	1.5
90 - 99 percent	1,015	31	2.4	208.6	25	2.7
100 - 109 percent	1,421	43	2.2	416.1	49	3.7
(Excluding China)	(418)	(13)	(2.8)	(117.2)	(14)	(2.6)
110 percent and over	584	18	2.5	165.7	20	3.2

Sources: Food and Agriculture Organization of the United Nations (FAO), "Agricultural Supply Utilization Accounts Tape, 1981," Rome, 1982; FAO, "Estimates of Income Elasticities for Various Commodities by Country," Rome, 1979 (computer printout); FAO, "Production Yearbook Data Tape, 1975, 1979, 1981, and 1983," Rome, 1976, 1980, 1982, and 1984; People's Republic of China, State Statistical Bureau, *Statistical Yearbook of China*, various issues (Hong Kong: Economic Information Agency, various years); Republic of China, Council for Agricultural Planning and Development, "Taiwan Food Balance Sheets, 1935-80," Taiwan, 1981 (computer printout); Republic of China, Executive Yuan, Directorate General of Budget, Accounting, and Statistics, *Statistical Yearbook of the Republic of China, 1982* (Taipei: Republic of China, 1983); United Nations, Department of International Economic and Social Affairs, "World Population Prospects as Assessed in 1982," New York, 1983 (computer printout); and World Bank "Gross National Product by Country Data Tape, 1961-80," Washington, D.C., 1981.

Note: Parts may not add to totals due to rounding.

<sup>a</sup> In U.S. dollars per capita, using 1980 trend values of real GNP (based on 1961-80 data, 1979-81 = 100) and population estimates.

<sup>b</sup> Average annual growth rate of real GNP per capita during 1961-80.

<sup>c</sup> Ratio of domestic production to total consumption of major food crops during 1976-80.

<sup>d</sup> Average per capita calorie supply during 1979-81 relative to the FAO-WHO recommended levels.

percent annual growth of food production. The very-slow-growth countries, which accounted for 9 percent of the Third World production of basic food staples in 1980, include the countries of the Sahel and Indochina, where growth of food output was extremely slow during the period. Similarly, food production growth lagged behind population increases, although but slightly, in the rapid-growth countries. But production growth outpaced population increases in the slow-growth countries and, especially, in the medium-growth category. The rate of growth of food output in the slow-growth countries was faster than the rate of population increase. The fastest growth of food output among the four income growth categories was in the medium-growth countries, where production in 1961-80 expanded by 3.7 percent annually, compared to a population increase of 2.3 percent. The relatively fast production growth in this group again shows the influence of the rapid growth of food output in China, which accounted for nearly two-thirds of food production in this category.

### **Food Sufficiency Ratio**

Data based on this typology indicate that production of basic food staples in the heavy-food-importers group expanded by only 1.7 percent annually during 1961-80, compared to a 2.6 percent growth in population. Countries in this group accounted for only 4 percent of Third World food production in 1980, but they held an 8 percent share of Third World population. The growth of food output was almost the same as the population increase in the light-food-importers category, but it was well ahead of population growth in both the marginally sufficient group (which includes China) and the self-sufficient category. The 16 countries belonging to the self-sufficient category accounted for 6 percent of the population and 11 percent of food production of developing countries in 1980. Except for the biased effect of the rapid growth of food production in China on the output trends of the marginally sufficient group during the 1961-80 period, food sufficiency ratios and food production growth rates clearly show a direct relationship.

### **Calorie Sufficiency Ratio**

Data suggest that, like food sufficiency ratios, calorie sufficiency ratios tend to be associated directly with the growth rate of food production. In 1961-80 the increase in the production of basic food staples in developing countries where average calorie supplies were less than 90 percent of the FAO-WHO recommendations lagged far behind their population growth. This country group contained 8 percent of the Third World population and accounted for 6 percent of food production in developing countries in 1980. Growth of food output outpaced population increases in the three other categories of this typology. The widest difference in growth rates—1.5 percent a year—was in the 100-109 percent group, which includes China. Although food production in the 90-99 percent calorie sufficiency category increased faster than population, its 1980 share of food production was still significantly less than proportionate to its population share. This typology of developing countries shows that food production increased much faster than population in the two groups of countries whose average per capita calorie supplies were equal to or greater than the FAO-WHO recommendations. Food production in these country groups expanded more than 3 percent a year during 1961-80, compared to 2.5 percent or less for population. Countries in these two categories, which together contain 61 percent of Third World population, accounted for 69 percent of its food output in 1980.

### **Food Projections to the Year 2000**

This section presents the same projections of food production, consumption, and surpluses and deficits of Third World countries that were discussed in Chapter 6, but here they are aggregated on the basis of the typologies using income and sufficiency ratios (see Table 14).

#### **Income Level**

The very-low-income countries and the low-income countries would contribute 68 percent of the projected production of 1,471

**Table 14—Production and consumption of major food crops, by income, food self-sufficiency, and calorie sufficiency country groups, 1980 and projections to 2000**

Country Group	1980		Projections to 2000					
	Production	Consumption	Net Surplus/ Deficit	At 1980 Per Capita Consumption			With Trend Income Growth	
				Production	Consumption	Net Surplus/ Deficit	Consumption	Net Surplus/ Deficit
	(million metric tons)							
Developing countries	842	894	-52	1,471	1,315	156	1,540	-69
Grouped by 1980 per capita income <sup>a</sup>								
Less than \$250	215	216	-1	348	328	19	357	-9
\$250 - \$499	377	394	-17	656	536	120	634	22
\$500 - \$1,999	145	165	-19	271	269	3	324	-52
\$2,000 and over	104	119	-15	197	183	14	226	-29
Grouped by 1961-80 income growth <sup>b</sup>								
Less than 1.0 percent	73	82	-9	111	136	-25	140	-29
1.0 - 2.9 percent	246	242	4	448	381	67	422	26
3.0 - 4.9 percent	460	484	-24	798	672	127	812	-14
5.0 percent and over	63	66	-23	114	126	-12	165	-51
Grouped by food self-sufficiency in 1976-80 <sup>c</sup>								
Less than 75 percent	38	75	-37	63	117	-55	144	-82
75 - 94 percent	191	212	-21	327	334	-7	384	-57
95 - 104 percent	519	535	-16	903	752	150	881	22
105 percent and over	94	72	22	179	112	67	131	49
Grouped by calorie sufficiency in 1979-81 <sup>d</sup>								
Less than 90 percent	52	56	-5	77	98	-21	102	-25
90 - 99 percent	209	213	-4	371	332	39	364	6
100 - 109 percent	416	440	-24	711	603	109	738	-27
110 percent and over	166	185	-20	313	283	30	335	-23

Sources: Food and Agriculture Organization of the United Nations (FAO), "Agricultural Supply Utilization Accounts Tape, 1981," Rome, 1982; FAO, "Estimates of Income Elasticities for Various Commodities by Country," Rome, 1979 (computer printout); FAO, "Production Yearbook Data Tape, 1975, 1979, 1981, and 1983," Rome, 1976, 1980, 1982, and 1984; People's Republic of China, State Statistical Bureau, *Statistical Yearbook of China*, various issues (Hong Kong: Economic Information Agency, various years); Republic of China, Council for Agricultural Planning and Development, "Taiwan Food Balance Sheets, 1935-80," Taiwan, 1981 (computer printout); Republic of China, Executive Yuan, Directorate General of Budget, Accounting, and Statistics, *Statistical Yearbook of the Republic of China, 1982* (Taipei: Republic of China, 1983); United Nations, Department of International Economic and Social Affairs, "World Population Prospects as Assessed in 1982," New York, 1983 (computer printout); and World Bank, "Gross National Product by Country Data Tape, 1961-80," Washington, D.C., 1981. Consumption data for the People's Republic of China were provided by Bruce Stone of the International Food Policy Research Institute.

Note: Parts may not add to totals due to rounding.

<sup>a</sup> In U.S. dollars per capita, using 1980 trend values of real GNP based on 1961-80 data (1979-81 = 100) and population estimates.

<sup>b</sup> Average annual growth rate of real GNP per capita during 1961-80.

<sup>c</sup> Ratio of domestic production to total consumption of major food crops during 1976-80.

<sup>d</sup> Average per capita calorie supply during 1979-81 relative to the FAO-WHO recommended levels.

million tons of basic food staples in the Third World in 2000, with the low-income countries alone projected to account for 45 percent of this amount. The projected total output of these two country categories represents a slight decline from their 1980 share because their production is projected to grow more slowly than that of the higher-income groups. The two upper-income categories accounted for 30 percent of the total output of major food crops in developing countries in 1980.

On the consumption side, the low-income countries have a projected demand of 634 million tons of basic food staples at trend income growth or about two-fifths of the total for the Third World. China would account for nearly 80 percent of the food demand of this group. Projected demand for basic food staples by countries in the very-low-income category could reach 357 million tons or nearly one-fourth of the total for developing countries. This represents an increase of two-thirds over 1980 consumption, of which at least 80 percent would stem from population growth. The projected food consumption of the middle- and high-income groups would be almost double their consumption in 1980. For the middle-income countries in particular, the expanded food requirements in 2000 due to population growth alone would almost equal the projected food output of the group. Population growth would account for at least 65 and 60 percent of the projected increase in food demand in the middle- and high-income growth countries, respectively.

Projections of output and demand for the countries grouped according to income point to a net production shortfall of 9 million tons in the very-low-income category, a ninefold increase over its 1980 food deficit. The low-income group, however, is projected to have a net surplus of 22 million tons, a dramatic shift from its 1980 net food deficit of 17 million tons. Such a shift would occur even without the projections for China. Projections show that both the middle-income and high-income groups of Third World countries could face sizable deficits in basic food staples. Compared to the 1980 shortfalls, the projected deficits would be nearly

threefold for the middle-income group and almost twofold for the high-income countries.

### **Income Growth**

The very-slow-growth and the rapid-growth groups are projected to account for about 8 percent each of the total production of major food crops of Third World countries in the year 2000. Relative to the production distribution in 1980, these projected shares represent a reduction for the very-slow-growth countries and a slight increase for the rapid-growth category. About 30 percent of projected production would come from the slow-growth group and more than half from the medium-growth group, which includes China.

Among the four income-growth groups, food demand at trend income growth is projected to increase fastest in the rapid-growth countries; food consumption in the three other categories is projected to expand 2.6-2.8 percent a year. Even assuming that per capita consumption is held constant at 1980 levels, the very-slow-growth and the rapid-growth categories would experience output shortfalls in 2000, but the slow-growth and especially the medium-growth countries would have surpluses.

Projections to 2000 based on the 1966-80 trend growth in GNP per capita, show that food demand would exceed output in the very-slow-growth, medium-growth, and rapid-growth categories. The largest food deficit in 2000 is projected for the rapid-growth countries (51 million tons). The only group projected to have a food surplus is the slow-growth group, whose projected production by the end of the century would exceed projected demand by 26 million tons. No income-growth group is projected to reverse its 1980 food position. Compared to the 1980 levels, food deficits are projected to more than triple in the very-slow-growth category and more than double in the rapid-growth group. Projections show substantial improvement of the food situation in the two middle categories: the food deficit of the medium-growth countries is projected to decrease by about 40 percent and the surplus of the slow-growth group is projected to increase more than sixfold.

The projected production shortfall of the rapid-growth category in 2000 almost equals the estimated food deficit of all the developing countries in 1980.

### **Food Sufficiency Ratio**

More than three-fifths of the projected production of basic food staples in the Third World in 2000 would come from the marginally sufficient countries, which include China. Less than 5 percent of the total projected output would be contributed by the heavy food importers. Output projections for both the heavy and light food importers would fall short of their expanded requirements in 2000 as the result of population growth alone. With demand projected at trend income growth, the marginally sufficient group and the self-sufficient category would have potential surpluses of 22 million tons and 49 million tons, respectively. These would represent a doubling of the surplus of the self-sufficient countries and a shift in the food position of the marginally sufficient category compared to their 1980 food situations. Food deficits would expand to two-to-three times 1980 levels for the heavy and light food importers. The projected food production shortfall for the heavy importers is 82 million tons and for the light importers 57 million tons.

### **Calorie Sufficiency Ratio**

The 1980 estimates of production and consumption of major food crops for this

typology indicate food deficits in all four categories. Food production in the less-than-90 percent calorie sufficiency group is projected to expand between 1980 and 2000 by 48 percent compared to 71 percent or more in the three other groups. Projected output of the less-than-90 percent category in 2000 would account for just 5 percent of the total, while nearly half of the projected total production of developing countries would come from the 100-109 percent calorie sufficiency category, which includes China. The 90-99 percent group would contribute about one-fourth of the total and the 110 percent-and-over group about one-fifth. Even if per capita consumption were to remain constant at 1980 levels, the food needs of the expanded population in 2000 would exceed projected food production in the less-than-90 percent calorie sufficiency category.

If production projections are matched with demand projections at trend income growth, the 4 million ton deficit of the 90-99 percent calorie sufficiency group in 1980 would change to a 6 million ton surplus by 2000. The other three categories of this typology are projected to face food deficits of about 25 million tons each. Compared to 1980, the projected deficits of these groups in 2000 show a five-fold increase for the less-than-90 percent calorie sufficiency category and small increases of about 3 million tons each for the 100-109 percent and 110 percent-and-over groups.

# 8

## GENERAL POLICY IMPLICATIONS

Past trends indicate that much of the increase in food production of developing countries during the 1960s and 1970s was achieved through the growth of crop yields. Area expansion, which was a major contributor to the growth of food output in the 1960s, slowed considerably in the 1970s. A comparison of 10-year trends shows that major slowdowns in the growth of area under food crops occurred in Latin America and Sub-Saharan Africa, particularly in Brazil and Nigeria, countries that greatly influence food production growth rates in their respective regions. These trends suggest that future increments in Third World food output may depend more on continued improvements in agricultural technology in areas of yield-oriented production growth and on the spread of new technology to areas that still have not benefited from it. The boundary of areas amenable to seed-fertilizer technology is being extended through public expenditures on irrigation, but complementary investments are also needed in support services such as agricultural credit, extension, and research. Increased attention is needed for research to increase the productivity of rainfed areas, which represent the bulk of land that is used for food production in the Third World. Developing economies that have the resources can exploit these opportunities themselves, but many low-income countries will need assistance.

Time-series data on the use of basic food staples show that the increase in population is still the major determinant of food consumption growth in developing countries. But data also point to the quickly growing importance of income growth in several countries. As incomes rise, the demand for better quality food also increases, causing the composition of food consumption to change.

Among these changes, the growing demand for livestock and poultry products is most important because of the derived demand for basic food staples to be used as feed.<sup>23</sup> Growth in the derived demand for animal feed can increase rapidly in countries where incomes are growing rapidly and where feed use has reached a significant proportion of total consumption, as in Latin America and North Africa/Middle East. In Sub-Saharan Africa and Asia, increases in the use of basic food staples for animal feed have been relatively slow, and population growth still accounts for most of the growth of food consumption. If the expansion of livestock and poultry production accelerates in developing countries, there may be a need to examine the balance in the use of agricultural resources for the production of basic food staples for direct consumption by humans and for animal feed.

Net food imports of the Third World expanded rapidly between the late 1960s and the late 1970s as increases in food consumption outran increases in food production. Net imports of basic food staples rose about threefold. With shifts in the food trade positions of both Latin America and Sub-Saharan Africa by the later period, all of the developing regions became net food importers. While food imports grew rapidly in North Africa/Middle East, Sub-Saharan Africa, and Latin America, food exports grew faster than imports in Asia. Increases in food imports in North Africa/Middle East and Latin America can be attributed to income-induced expansion in food consumption, whereas in Sub-Saharan Africa they resulted from the region's poor production performance. The change in Asian food trends may be traced to a combination of the rapid growth of noncereal exports in East and

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<sup>23</sup> John W. Meller, "Third World Development: Food, Employment and Growth Interactions," *American Journal of Agricultural Economics* 64 (May 1982): 307.

Southeast Asia and the major reduction in cereal imports by South Asia in the late 1970s.

Changes in the growth rates of food production and consumption in the Third World also led to changes in the relative volumes of food trade flows among the developing regions. During 1976-80 Asia's food exports nearly matched those of Latin America, and North Africa/Middle East replaced Latin America as second to Asia in food imports. These trends may signal that Latin America's role as the leading Third World food exporter is declining whereas Asia's is emerging. Although Sub-Saharan Africa's food imports in the late 1970s were relatively small compared to those of other regions, the region's food trade trends show ample cause for worry.

The output and demand projections of basic food staples for Third World countries point to a net production shortfall of about 70 million tons (76 million tons if China is excluded) by the close of the century. Such a food gap may not be alarming considering that it would be only a third larger than the estimated net food deficit in 1980, or an average increment of less than 1 million tons a year between 1980 and 2000. These projections suggest, however, that more than 90 percent of the expansion in food demand by the developing countries would be filled by increases in production, especially from Asia, where production is projected to greatly exceed demand. The projected increases in food production and consumption in Latin America nearly balance each other, while output growth in both North Africa/Middle East and Sub-Saharan Africa is projected to fill only about half of the projected increase in food demand. If growth of food output in developing countries slows, the overall net production shortfall may increase depending on the consequent changes in Third World food demand.

Food projections strongly suggest a rapid worsening of the food problem in Sub-Saharan Africa, especially in West Africa. Unless pro-

duction trends greatly improve, growth of the region's food demand, arising from rapid population growth and expanding incomes in a number of countries, could result in a sizable production shortfall by the end of the century. Crop yields in Sub-Saharan Africa have remained low; their growth has been extremely slow and in several countries has even declined. The seed-fertilizer technology of the 1960s, which greatly benefited other developing areas, has yet to make an impact on Sub-Saharan food production. The harsh environmental conditions of soil and climate in parts of Sub-Saharan Africa, especially the severe Sahelian droughts, have constrained output growth in the region.<sup>24</sup> A major portion of production increases may still have to rely on expansion of crop area, which was the principal source of production growth in the 1960s but slowed dramatically in the 1970s. The current focus on the food problems of Sub-Saharan Africa by the donor community is encouraging, but coordinated action in these assistance efforts is needed to help foster agricultural production growth and improve the food situation of the poor in the region.

A major concern is the ability of the poorest countries to pay the costs of projected food imports. This group would include about a fifth of the developing countries—many in Sub-Saharan Africa. Their estimated GNP per capita in 1980 was less than U.S. \$250 and their projected net food deficit as a group in 2000 would represent about 12 percent of the total for the Third World. For food aid to play an important role in filling the potential food gaps in these countries, a reversal of the trend in the level of food aid for developing countries would be required. Huddleston reports that total cereal food aid decreased from an average of 12 million tons annually during 1961-63 to less than 8 million tons in 1981 or, in relation to yearly cereal imports, from 40 percent to less than 10 percent.<sup>25</sup> As international pres-

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<sup>24</sup> A comprehensive discussion of the food problem in Sub-Saharan Africa may be found in: John W. Mellor, Christopher Delgado, and Malcolm Blackie, eds. *Accelerating Food Production in Sub-Saharan Africa* (Baltimore, Md.: Johns Hopkins University Press for the International Food Policy Research Institute, forthcoming).

<sup>25</sup> Barbara Huddleston, *Closing the Cereals Gap with Trade and Food Aid*, Research Report 43 (Washington, D.C.: International Food Policy Research Institute, 1984).

sure to alleviate poverty and hunger in the Third World increases, food exports from the developed to the developing economies would include more foreign assistance to poor food-deficit countries, but the much bigger portion will still be through commercial trade.

Typologies of Third World countries based on income and calorie sufficiency indicators can identify 19 countries that may need to receive the highest priority for assistance to ease their future food problems (see Appendix 2). Seven of these had average GNP per capita income levels of less than U.S. \$250 in 1980, GNP per capita growth rates of less than 1 percent a year during 1961-80, and calorie sufficiency ratios of less than 90 percent of the FAO/WHO recommended requirements during 1979-81. These three criteria are met separately by at least one-half of these needy countries, which include Bangladesh, Kampuchea, Nepal, and Vietnam in Asia; Afghanistan in North Africa/Middle East; Burkina Faso, Central African Republic, Chad, Guinea, Guinea-Bissau, Kenya, Madagascar, Mali, Mauritania, Mozambique, Niger, Senegal, and Somalia in Sub-Saharan Africa; and Haiti in Latin America. Based on previously cited assumptions regarding growth of food output and per capita incomes in food projections, all of these 19 countries are projected to have food shortages in 2000, their aggregate food deficit amounting to about 31 million tons. This represents about 17 percent of the projected gross shortfall of the Third World. In six of these countries where food production trends indicate declines in 1961-80, it is assumed that food output will not increase during 1980-2000 (see Appendix 1 on data and methodology).

The projections made in this study are based on a continuation of the trends of food production and of per capita income in each developing country. Technological gains in crop yields during the past two decades largely influenced the production trends of Third World countries that were able to take advantage of the seed-fertilizer technology; in others, output trends were determined more by production increases that relied on the expansion of area under food

crops. For many of these countries an eventual slowdown in the spread of this technology or the existence of land constraints could pose problems in sustaining the production trends of the past two decades.

On the demand side, however, changes occurred that tended to narrow the projected food gap. Developments in the world economy at the close of the 1970s and the beginning of the 1980s caused incomes and consequently consumption in the Third World to grow more slowly. In view of the economic interdependence between the developed and developing countries, the slow growth experienced by the industrialized economies during that period was passed on to Third World economies. This slowdown, which started near the end of the observation period of this study, would depress the long-term demand projections unless offset by faster-than-trend income increases in the future. Alternative income-growth scenarios show that if the 1961-80 trends for each country were used, the overall slightly slower growth rate of GNP per capita would result in a total food demand projection for the Third World of only 0.5 percent (1.3 percent, if China is excluded) below that projected by this study (see Appendix 1). A substantial deceleration of income growth in developing countries of 25 percent less than their 1966-80 trends would lead to a much larger decrease in the projected food demand of 3.1 percent (excluding China, 3.5 percent). The effect of changes in income growth on the projected food gap of Third World countries would be difficult to quantify because of the close relationship of agricultural output to income in most of these economies. A major slowdown of income growth in developing countries would be caused in part by a slowdown in agricultural production.

Another important element of Third World projections of food demand relates to the future use of basic food staples for animal feed. The feed demand projections for developing countries used here assume constant input-output relationships in livestock and poultry production. However, the rapid growth of grain use for animal feed, which suggests a decline in the relative im-

portance of wastes and by-products in Third World animal production, would tend to change input-output ratios over time. Although the changes may not be large in the production of grazing livestock, which can be expected to continue to rely heavily on grasslands, these could be significant in the production of hogs and poultry. Pigmeat and poultry together account for more than half of the total meat production in developing countries.<sup>26</sup> Alternative projections of feed demand based on trends of animal feed use by country, which can incorporate changes in input-output relationships, show an increase in the total projected demand for basic food staples of almost 4 percent by developing countries excluding China (see Appendix 1). Although a 25-percent slowdown in income growth could bring about a significant decrease in the food demand projection for Third World countries in 2000, the use of the trends approach in projecting feed consumption to include possible changes in animal feeding practices could more than offset such a decrease.

A major component of the food projections to 2000 for the Third World as a whole is the projected food situation in China. Food data of the late 1970s indicate that China accounts for more than a third of both production and consumption of developing countries and thus could easily alter the overall food projections. Based on China's production trend over three decades, food output is projected to expand 2.8 percent annually during 1980-2000; the assumed per capita income growth rate for the country of 3.7 percent a year would lead to a projected average annual growth rate of 2.1 percent in food demand for the same period.<sup>27</sup> Thus the country is projected to achieve a production surplus of about 7 million tons of basic food staples by the year 2000. Whereas China's projected growth of food output is about the same as that of the rest of the developing countries, its projected

growth of food demand is considerably slower, largely because population growth for China is projected to average only 1.1 percent annually during 1980-2000, compared to 2.1 percent during 1960-80.

It is estimated that, if the assumed growth rate of incomes and consequent increase in per capita demand for China do not change, an average population growth rate during 1980-2000 of even 1.3 percent a year could easily erase China's projected surplus in 2000 and consequently increase the net production shortfall projected for developing countries as a whole. Assuming that the projected decline of population growth in China is achieved, the consequent change in population structure could result in increases of per capita consumption above the level projected for the country. Although China is projected to be in slight surplus, it could easily be a food-deficit country in 2000.

The projected Third World food gap obtained in this study, which represents the difference between the aggregates of the trend-oriented projections of country production and consumption, essentially provides a bench-mark of the size of the future food problem so that policy measures can be chosen to alleviate it. The potential food gap can ultimately be closed by accelerating output growth in developing countries where possible and by transferring food from the developed to the developing economies through commercial food trade and food aid; in the event of a shortage in world food supplies, there will be reduced consumption because of increased food prices. Efforts would largely be addressed toward expanding domestic production and trade, and possibly avoiding high food prices, which would be detrimental to the low-income countries. Appropriate national and international policies relating to food are needed to reduce the Third World food gap to be filled by imports to an optimum size, one

<sup>26</sup> Food and Agriculture Organization of the United Nations, *Production Yearbook, 1983* (Rome: FAO, 1984).

<sup>27</sup> As explained in the notes on data and methodology (Appendix 1), major disruptions of agriculture in China during the early 1960s strongly bias food data for the general reference period (1961-80) of this study; hence, the available estimates for the longer period 1952-80 are used as the basis of the trend projections of output. The data used to obtain the per capita consumption base level and income trends in projecting food demand start from 1966, as for the other countries.

that would not entail a heavy financial burden in developing countries and, more importantly, prevent the decline of food consumption in poor countries.

In assessing the prospective food situation of developing countries and identifying the critical areas of the future food problem in the Third World, this study has relied on the relative stability of the trends from aggregated data of commodities and countries. In view of the need to make production decisions in response to changing consumption patterns in those countries, additional macro studies using disaggregated data are required for analyzing the trends of specific commodities or of smaller commodity groups. There is need for a closer look into the production and consumption prospects for rice, which accounts for the largest share of the output of major food crops in developing countries, and of wheat, which has responded to increases in urban demand with rapidly expanding production. The inferred trends in the shift of food consumption toward more livestock products in the Third World also suggest more detailed analysis of the production and consumption of coarse grains, the combined output of which was only 15 percent less than rice production during 1976-80. Related to this, more studies need to be pursued regarding changes in the production of livestock and poultry products in relation to changes in feed use in Third World countries. Further research on the noncereals, which represent close to a fifth of total output of major food crops, could provide insights into the possibility of an increased role in filling future food needs.

Finally, a word of caution is in order regarding the use of the Third World food trends and projections presented in this report. The statistical problems posed by production fluctuations and the inevitability of errors in the food data base of developing countries are well recognized. Weather-related and other short-term variations in

food output may be viewed as random occurrences, which tend to average out over a long enough trend period. And because annual changes in data collection methods among countries are usually small, there is reason to believe that data biases from this source are generally consistent over the years. Also, overall improvement of the data system in developing countries is a slow process; revisions are usually implemented gradually and any statistical refinement made in a few countries would not result in major departures from the calculated trends for the Third World as a whole. As mentioned before, this study depended on the stability of trend estimates drawn from data aggregates. However, care is needed in using the absolute levels of food projections to the year 2000, which are subject to specific assumptions and are only indicative of general orders of magnitude. This is especially so for the less-aggregated results, particularly the projections for individual countries. For this reason, estimates of country trends and projections are not presented in this report.

As indicated earlier, most of the basic information used in deriving the food trends and projections in this report are from the FAO international data system, which relies mainly on the official statistical systems of its member countries. Because the quality of official data from the Third World depends on the stage of a country's development, an attempt to portray the global food picture of developing countries necessarily uses estimates of varying degrees of reliability. Nevertheless, these data are still useful in providing approximations for assessing the overall Third World food situation. As national data systems improve, more refined country analyses and global assessments can be made. And more importantly, with reliable data the developing countries themselves can evolve better plans for meeting their future food problems.

# APPENDIX 1: DATA AND METHODOLOGY

## Data

This study largely uses FAO's international data base for estimates on the production, consumption, and trade of the basic food staples in developing countries. FAO also provided the five-year-interval estimates of income elasticities by commodity for each country that are used in demand projections. Population estimates and projections, as assessed in 1982, are from the Department of International Economic and Social Affairs of the United Nations Secretariat. Data on the annual GNP of each country, which were used to derive estimates of the 1980 trend levels and growth rates of per capita income, are from the World Bank. Production, consumption, and trade statistics for the People's Republic of China are from data assembled by Bruce Stone of the International Food Policy Research Institute, and those for Taiwan are from the government yearbook on statistics. Like those for the other countries in the study, estimates of income elasticities for China are from FAO, and GNP data are from the World Bank. The estimates of the growth rates of GNP per capita and of income elasticities of demand used in the projections are shown in Appendix 3, Table 24.

As discussed in Chapter 2 of this report, the analysis of past production trends makes use of 1961-80 data. Estimates of the production of major food crops for the years 1961 through 1965 are from the FAO "Production Yearbook Tape, 1975." These estimates were adjusted to agree with the averages for this period shown in the 1979 data tape. Estimates for 1966 and 1967 are from the 1981 tape and those for 1968 to 1980 are from the 1983 tape.<sup>28</sup> In examining produc-

tion trends, output data are aggregated for cereals, for noncereals, and for major food crops as a whole. For this purpose, rice is given in husked form and the noncereal components are converted to cereal equivalents based on calorie content relative to that of wheat.<sup>29</sup> Production projections, which are extrapolations of 1961-80 country output trends, are developed only for the major food crops as a whole.

Trends of food consumption and trade are drawn from data in the FAO "Agricultural Supply Utilization Accounts Tape, 1981" which provides estimates starting from 1966. To better reflect the role of animal feed in the total domestic utilization and trade of the basic food staples, bran and cakes of cereals and groundnuts have been included in analyzing these trends. Analysis of consumption trends makes use of either the annual data from 1966-80 or the averages of the five years at both ends of this period, whereas that of trends in the trade of basic food staples is mostly based on the five-year averages. As in the analysis of trends and projections of production, the noncereals are given in terms of cereal equivalents. Because the estimates of the income elasticity of demand are mostly commodity specific, the demand projections are developed by commodity; per capita demand for these commodities is projected from the trend estimates of per capita consumption in 1980 as derived from 1966-80 annual data. The average annual growth rates of per capita income that are used in the projections for a country are obtained from the 1966-80 annual estimates of GNP in constant dollars (1980 = 100).

<sup>28</sup> Annual data for 1961-65 were last published in 1975 but averages for these five years, which included revisions, were made available until 1979. The 1983 data tape starts with estimates for 1968.

<sup>29</sup> Husked rice is estimated at 80 percent of paddy and the conversion factors used for the noncereals are: potatoes, 0.20; cassava, 0.303; sweet potatoes and other roots and tubers, 0.25; pulses, 1.00; groundnuts (in the shell), 1.05; and bananas and plantains, 0.20.

## Methodology

Basic calculations in the analysis of food trends in this study are made from the aggregates of country estimates to obtain growth rates for country groups and for the Third World countries as a whole. The data on China are presented for the country as a subregion of Asia. For projections to the year 2000, calculations are made for each country and then aggregated for country groups. Because errors at the country level tend to balance each other in country aggregates, it can be expected that the projections for country groups are more reliable than those for individual countries.

### Production and Consumption Trends

In general, the analyses of trends in production (including area harvested and output per hectare) for country groups make use of the time-series data formed by aggregates of country estimates. Following the approach of previous IFPRI studies of the food situation in developing countries, a semilogarithmic trend equation is fitted to the annual production data of 1961-80 to obtain the growth rates of the variables. This same procedure is used to examine the trends in consumption and its components (direct food use, animal feed, and other uses), except that the available data series span the shorter period 1966-80. The general equation fitted to each data set is:

$$Y_t = e^{a + bt}, \quad (1)$$

where

$Y_t$  = the estimate of the variable in year  $t$ ,

$a$  = the constant term (the logarithm of the variable's estimate for  $t=0$ , the base year),

$b$  = the slope of the fitted equation (also equal to the logarithm of the value one plus the annual rate of change of the variable), and

$t$  = the period in years, starting from the base year.

In addition to providing growth indicators, the resulting measures of the annual rate of

change are also used to estimate the relative contributions of area harvested and output per hectare to output growth.

### Trade Trends

The 1966-70 and 1976-80 averages of data on imports and exports of these basic food staples by country group are used in equation (2) below to obtain estimates of their average yearly rates of growth. The time span of total change in the variable is measured between the mid-years of the two periods.

$$Y_t = Y_0 (1 + r)^t, \quad (2)$$

where

$Y_0$  = estimate of imports or exports in year 0, the base year,

$Y_t$  = estimate of imports or exports in year  $t$ , and

$r$  = annual rate of growth of imports or exports.

### Production Projections

It is assumed that historical country trends in production will continue; thus output projections are essentially trend extrapolations with equation (1) fitted to data sets for each country. The projected production of major food crops (as a group) in each country represents its trend estimate of food output in 2000, as derived from data for the years 1961-80 (or, for China, 1952-80). It is further assumed that no country's food output will decline after 1980; hence for developing countries with negative growth rates in production during 1961-80, the trend estimate of food output for 1980 is used as the projected production for 2000.

### Consumption Projections

The projected consumption of major food crops in each country in 2000 is the sum of the projected demands for these commodities for direct consumption by humans and animal feed, plus the requirements for seeds, and the amounts for nonfood uses and allowances for waste.

*Direct Consumption by Humans.* The trend estimate of the 1980 per capita use of basic food staples directly as food is obtained from 1966-80 data with equation (1) for each commodity or commodity group. These estimates serve as starting points for the individual commodity projections to 2000, making use of income elasticity estimates and the 1966-80 trend growth rates of real per capita GNP in the equation

$$c_{2000} = c_{1980} (1 + r_y \eta)^{20}, \quad (3)$$

where

$c$  = per capita consumption of the commodity during the indicated years,

$r_y$  = annual trend rate of growth of per capita GNP, and

$\eta$  = income elasticity of demand for the commodity.

If the five-year-interval estimates of  $\eta$  are not constant, stepwise calculations are made. Projections of the total demand for direct consumption by humans to 2000 are then obtained using the medium-variant population projections of the United Nations Secretariat.

*Animal Feed.* As in direct consumption by humans, trend estimates of the per capita use of major food crops for animal feed in 1980 are obtained from equation (1) and, except for China, projected to the year 2000 using equation (3). In this case, however, the income elasticity of demand for meat is used as a proxy for the income elasticity of demand for animal feed. Meat, which accounts for the bulk of the production of animal products in developing countries, is assumed to represent the livestock and poultry products group. This approach to projecting the derived demand for animal feed essentially assumes that growth of feed use in a country would be as fast as the growth of their demand for meat. It is recognized that such an assumption may lead to underestimates

of feed use; besides changes in production technology that will be discussed later in this appendix, the composition of animal production is changing toward more hogs and poultry, which will accelerate increases in the amount of grain fed to livestock. In the case of China, the projection for feed use is based on an extrapolation of its trend drawn from the available 1966-80 data.<sup>30</sup>

*Seeds, Waste, and Other Nonfood Uses.*

The projected requirements for seeds, amounts for other nonfood uses, and allowances for waste are based on indications from 1976-80 data. Quantities for seed use are projected using the proportion of seeds to production during these years. The amounts for nonfood uses, which are relatively small, and allowances for waste are projected jointly using their percentage of the total amount that went to food and feed in 1976-80.

## Prices

An important assumption of the projections of production and consumption of basic food staples from 1980 to the year 2000 is that relative prices are unchanged.

## Alternative Income Growth Rates for Demand Projections

Food demand projections in this study use FAO estimates of the income elasticities of demand for basic food staples and assume a continuation of the 1966-80 trend growth rates of real GNP per capita in developing countries. The trend growth of income is calculated based on this period to match the time span of the available historical data series on food consumption in these countries. In order to determine the changes in the projected level of demand for basic food staples in 2000 resulting from changes in the assumed growth rates of per capita income in Third World countries, two scenarios

<sup>30</sup> Available consumption data for China would give a projected growth rate of feed use that is less than in South Asia where utilization of basic food staples for animal feed is still low and growing slowly. Recent developments in China suggest applying the alternative procedure of extrapolating the 1966-80 trend of feed utilization in the country. With this approach, the projected growth of feed use in China would be faster than in South Asia but slower than in East and Southeast Asia.

are tried in recalculating their demand projections. Scenario 1 uses income data for the longer period 1961-80 in determining the average annual growth rate of real GNP per capita of each country, and scenario 2 applies 75 percent of the 1966-80 trend growth rates of each country's GNP per capita. Table 25 of Appendix 3 shows the Third World country aggregates by region and subregion of the resulting projections of demand for basic food staples to 2000 under these scenarios, together with their relative deviations from the trend income growth demand projections given in Chapter 6.

The overall projected food demand of Third World countries in scenario 1 amounts to 1,533 million tons, or just half a percent less than the total projected demand based on the 1966-80 trend income growth rates. The scenario's projections for regions show about the same amount for Asia, slightly more than 0.5 percent less in Sub-Saharan Africa, and about 1.5 percent less in both North Africa/Middle East and Latin America. Results are more mixed among subregions. China, Eastern and Southern Africa, and Mexico and Central America show higher demand projections in this scenario, whereas the projected demand for Western Asia and Lower South America is essentially unchanged; those of the remaining subregions reflect decreases in the projections ranging from slightly less than 1 percent in Central Africa to nearly 4 percent in Northern Africa.

Although the results indicate that on the whole the growth of per capita income in developing countries during 1961-80 was slower than in 1966-80, the reverse occurred in some subregions and several of the developing countries. The increase or decrease in demand projections for Third World countries depends not only on the change in the rate of income growth but also on the direction of change of per capita demand as determined by the sign of their income elasticity of demand for the basic food staples; estimates of demand elasticities are already negative in a number of these countries.

Scenario 2 projections portray the results of a substantial slowdown of income growth in all countries. Overall projected

demand for the basic food staples under this scenario is more than 3 percent below the total demand projection in this study. Aggregate projections for regions and subregions are all below the corresponding projections given in Chapter 6. Deviations from the regional aggregates range from nearly 2 percent in Sub-Saharan Africa to almost 6 percent in North Africa/Middle East, whereas those of subregions range from 0.5 percent in Lower South America to more than 6 percent in Northern Africa. The size of the decreases in demand projections among regions and subregions under this scenario appears to reflect the relative importance of income growth to projected food demand among different country groups. Unlike in the first scenario, increases in demand projections could occur in scenario 2 only in countries where the overall income elasticity of demand for basic food staples is negative.

## Alternative Feed Projections

As stated earlier, the demand projections for animal feed by Third World countries other than China essentially follow the projected growth rates of country demand for meat. This approach assumes a constant technical relationship between feed use and meat (livestock and poultry) production. Input-output coefficients of animal production in many developing countries are, however, expected to change as their feeding practices change. Shifts from largely pastoral feeding methods to the wider use of grains and mixed feeds could lead to significant changes in these technical coefficients. An alternative way of projecting the demand for animal feed that might take into account this changing relationship would be a direct extrapolation of past trends in the use of basic staples for feed.

Table 15 shows the projections of total demand for basic food staples by developing-country groups, excluding China. These projections retain the figures on demand for direct food use and the requirements for seeds given in this report, but the projections for animal feed are based on 1966-80

**Table 15—Projected demand for basic food staples to 2000 using feed projections based on 1966-80 trends**

Country Group	Projected Demand	Change <sup>a</sup>
	(million metric tons)	
Developing countries	1,087	41
Asia	501	11
North Africa/Middle East	179	-3
Sub-Saharan Africa	156	-5
Latin America	251	37

Sources: Food and Agriculture Organization of the United Nations (FAO), "Agricultural Supply Utilization Accounts Tape, 1981," Rome, 1982; FAO, "Estimates of Income Elasticities for Various Commodities by Country," Rome, 1979 (computer printout); Republic of China, Council for Agricultural Planning and Development, "Taiwan Food Balance Sheets, 1935-80," Taiwan, 1981 (computer printout); United Nations, Department of International Economic and Social Affairs, "World Population Prospects as Assessed in 1982," New York, 1983 (computer printout); World Bank, "Gross National Product by Country Data Tape, 1961-80," Washington, D.C., 1981.

Notes: China is excluded. The change indicates the difference from earlier demand projections at trend income growth.

<sup>a</sup> Relative to projected consumption with trend income growth (see Table 12).

trends, with feed use growth rates constrained to 10 percent a year. Because the projections of nonfood use and allowance for waste are partly dependent on feed use, their levels also change.

The application of trend growth rates to animal feed use in projecting its demand to 2000 would result in a projected total demand for basic food staples in these countries that is 41 million tons higher than the demand projection of the main scenario of the study. Major contributors to the increase are Latin America and Asia; differences for North Africa/Middle East and Sub-Saharan Africa are comparatively smaller and negative. In Asia, much of the increase in the projected feed demand can be traced to the Republic of Korea, where the trend growth rate in feed use exceeded 10

percent a year. In other regions, significant contributors to the increase of projected feed demand are Mexico, Venezuela, and Colombia in Latin America and Sudan and Saudi Arabia in North Africa/Middle East. Most of Sub-Saharan Africa's decline in feed projections can be attributed to Nigeria, where rapid income growth results in a projected growth of meat consumption (or feed demand) of 8.3 percent a year, compared to a trend growth of feed use only half as fast.

The trend growth rates of feed use shown by time-series estimates are quite high for a number of developing countries; most of these arise from data problems, especially in Africa. Thirteen countries show growth rates exceeding 10 percent a year (see Table 16). With the trends approach, feed use projections would increase by 28 million tons more if the constraint is relaxed from 10.0 percent to 12.5 percent, and by another 10 million tons if it is allowed to rise to 15.0 percent.

Table 16 shows that the trend growth rates of feed use in developing countries are more widely dispersed than those obtained when the income elasticity of demand for meat is used as a proxy for that of animal feed. With the latter, which are equivalent to meat consumption growth rates, more than 80 percent of the developing countries have annual rates of growth in feed use ranging from 2.5 to 7.5 percent. But with the 1966-80 trends of feed use, only about half of the Third World countries would have growth rates in this range. About 28 percent of trend growth rates of these countries exceed 7.5 percent a year, compared to 10 percent of their meat consumption growth rates. The average annual growth rates for developing countries excluding China are 4.7 percent based on the projected meat consumption growth and 5.3 percent on the basis of trends in animal feed use.

Although the employment of feed use trends in demand projections has the advantage of possibly taking into account changes of input-output relationships in livestock production, the apparent sensitivity to data quality and the relatively short period for this approach. The relative weakness of feed data for the purpose results in unrealistically

**Table 16—Distribution of developing countries based on their annual growth rates of feed consumption for two methods of projecting feed use**

Method of Feed Projection	Annual Growth Rates				
	Less than 2.5 Percent	2.5–4.9 Percent	5.0–7.4 Percent	7.5–9.9 Percent	10.0 Percent and Greater
	(number of countries)				
Following meat consumption growth <sup>a</sup>	5	67	22	9	1
Trended 1966-80 data on feed use <sup>b</sup>	22	38	15	16	13

Sources: Food and Agriculture Organization of the United Nations (FAO), "Agricultural Supply Utilization Accounts Tape, 1981," Rome, 1982; FAO, "Estimates of Income Elasticities for Various Commodities by Country," Rome, 1979 (computer printout); Republic of China, Council for Agricultural Planning and Development, "Taiwan Food Balance Sheets, 1935-80," Taiwan, 1981 (computer printout); United Nations, Department of International Economic and Social Affairs, "World Population Prospects as Assessed in 1982," New York, 1983 (computer printout); and World Bank, "Gross National Product by Country Data Tape, 1961-80," Washington, D.C., 1981.

Notes: China is excluded.

<sup>a</sup> This approach is used in projecting feed use in this study.

<sup>b</sup> The rate of growth of feed use was constrained to a maximum of 10 percent a year.

high projections of feed demand for several developing countries and thus favors the use of the more conservative approach, which essentially follows the projected growth rates of meat consumption by country. Feed use trends are used in the projection for China, for other reasons, as cited earlier. It is important to note, however, that feed demand projections based on the conservative approach of keeping technical coefficients in production unchanged are likely to cause underestimation.

## Comparisons with FAO's Projections to 2000

In 1981, FAO completed a comprehensive global study, *Agriculture: Toward 2000 (AT 2000)*, which looked at agricultural perspectives and policy issues, especially for Third World countries, up to the end of the century. The study projected the production and consumption of various agricultural commodities for 90 developing countries, accounting for most of the developing-country population outside China. For the commodities covered by the IFPRI study, the *AT 2000* report presents projections for each cereal and noncereal except groundnuts. FAO's

projections for groundnuts form part of the total projections for vegetable oil and oilseeds.

The *AT 2000* projections for Third World countries are given for three scenarios: first, an optimistic scenario A, which assumes that the developing countries will achieve the economic growth targets set by the United Nations' International Development Strategy and, at the same time, improve agricultural output substantially; second, a medium-growth scenario B, which assumes that these countries will achieve more modest growth in agriculture and the whole economy; and a trend scenario, which is based on an extrapolation of past trends in the production and consumption of agricultural products in these countries. Economic growth rates for each country are specified for scenarios A and B but not for the trend scenario. Output and demand projections in the trend scenario are constrained at both upper and lower levels. For lower limits, no further decreases are assumed in the production of countries with declining output and in the per capita food demand of those with declining consumption. Upper bounds for production are also set for countries whose trend output projection exceeds that in scenario A, and for consumption, for countries with rapidly rising per capita calorie intake.

Both *AT 2000* and IFPRI projections are developed from country data and apply similar lower bounds in production. However, they differ in other aspects, including a slight difference in the span of the observation period, the FAO study using data for the years 1961 to 1977. The *AT 2000* production projections use scenario A levels as upper bounds, whereas projections in this study are made strictly on the basis of historical output trends, assuming that area harvested and yield per hectare would jointly contribute to their achievement. On the consumption side, the *AT 2000* report indicates that per capita food consumption levels in 1980 serve as lower limits of trend projections for countries that have declining consumption trends. This study does not set lower bounds directly but instead uses a minimum of 0.5 percent annual growth in per capita income for the consumption projections of these countries. The *AT 2000* trend projections also apply upper limits to per capita consumption in countries with rapidly rising average calorie intake, whereas this study uses a maximum annual income growth rate of 6 percent in its consumption projections.

The output projections of this study are for major food crops as a whole, with rice in husked form and the noncereal components in cereal equivalents. Projections of production in *AT 2000* are on a commodity basis, with rice in milled form and the noncereals covered by IFPRI expressed in their natural weights. In matching the results of the two studies, some adjustments had to be applied to both projections in order to obtain approximate comparability. For consistency with its overall results, the approximate projection of cereal production in this study is based on the ratio of the trend cereal projections of the 90 developing countries to the sum of their separate trend projections of cereals and noncereals, applied to the projected output of major food crops as a whole. The consumption projections of this study are additive among commodities, and hence the projection of cereal demand is drawn directly from the study results. In the *AT 2000* study, the cereal output projection is adjusted to include rice in husked form, and the cereal demand projection is

adjusted to include cereal bran. In addition, the noncereal components are converted to cereal equivalents and projections of groundnut production and consumption are based on 1976-80 indications.

Table 17 shows that the cereal projections for both production and consumption in this study fall between the corresponding *AT 2000* projections for the rapid-growth scenario A and the modest-growth scenario B. Unlike those in the *AT 2000* study, the trend-based country projections of cereal output in this study have no upper constraints; hence their aggregate is substantially larger than the production projection of FAO's trend scenario. For the cereal de-

**Table 17—Comparison with FAO projections to 2000 of production and consumption of cereals and major food crops**

Production or Consumption	AT 2000 Scenarios			IFPRI Study
	A	B	Trend	
(million metric tons)				
Cereals				
Production	838	744	679	787
Consumption	901	851	815	867
Food	592	575	...	488
Others	309	276	...	379
Net balance	-63	-107	-136	-80
Major food crops				
Production	1,032	927	...	967
Consumption	1,084	1,027	...	1,037
Net balance	-52	-100	...	-70

Sources: Food and Agriculture Organization of the United Nations, *Agriculture: Toward 2000* (Rome: FAO, 1981).

Notes: FAO's *AT 2000* projections are for 90 developing countries covered by the study. The "A" projections assume that those countries will reach the targets for economic growth of the U.N. International Development Strategy and that agricultural output will increase substantially. The "B" projections assume more modest growth in both agriculture and the whole economy. The trend scenario extrapolates from past trends, but with upper and lower bounds.

mand projections, the difference in the results of the two studies may be traced to the methods used in projecting the items of utilization, especially animal feed. As shown by the table, the *AT 2000* projections of cereal demand under the two scenarios average about 585 million tons for food and about 290 million tons for feed and other uses. It is notable that the IFPRI cereal projections for direct use as food are even less than those for scenario B of the *AT 2000* study and may be more in line with FAO's unreported trend scenario projection. The major difference between the projections of cereal consumption of the two studies is in the uses other than food (largely for animal feed), for which the approximate IFPRI figure exceeds that of the rapid-growth scenario A by 70 million tons. The specific approach used in *AT 2000* for projecting feed use is not presented in the report on this study. It has been shown that, depending on the procedure followed, feed projections can drastically change the picture of the future food situation in the Third World. Feed use now accounts for a significant share of total consumption in several developing countries that have experienced rapid increases in income.

On the projections for the whole major food crops group, including noncereals, this study's projected production in 2000 again falls between those of scenarios A and B of the *AT 2000* study. On the demand side, however, IFPRI's projected consumption of these basic food staples exceeds that of the

rapid-growth scenario by about 10 million tons.

The *AT 2000* projections of the net cereal deficit in the 90 developing countries range from about 65 million tons in scenario A to more than twice that amount in the trend scenario. The approximate IFPRI projection of the net cereals gap for these countries is about 80 million tons. For basic food staples as a whole, the net production shortfall projected by IFPRI is about 70 million tons compared to 55 million tons in scenario A and 100 million tons in scenario B. The reduced deficits shown for the major food crops reflect the projected net surpluses in noncereal food crops, which in cereal equivalents, are 10 million tons in this study and 7.11 million tons in the two *AT 2000* scenarios.

In summary, after making adjustments to obtain approximate comparability between the food projections of FAO's *AT 2000* and this study by IFPRI, differences in the trend projections in the year 2000 appear to be as follows: first, the trend projections of country production in this study tend to be higher than those in *AT 2000* due to the constraints imposed by the FAO study on the trend growth rates of food output; and second, the IFPRI projections of consumption also tend to be larger, which may be traced to the substantial differences in the country projections of feed use. The IFPRI projections of net deficits in cereals and major food crops are between the corresponding *AT 2000* projections for the rapid-growth scenario A and the modest-growth scenario B.

## APPENDIX 2:

## CLASSIFICATION OF COUNTRIES SELECTED FOR THE STUDY

Table 18—Classification of developing countries by per capita income, income growth, food self-sufficiency, and calorie sufficiency

Region, Subregion, and Country	GNP Per Capita, 1980 <sup>a</sup>				Growth of GNP Per Capita, 1961-80				Self-Sufficiency in Major Food Crops, 1976-80 <sup>b</sup>				Calorie Sufficiency, 1979-81 <sup>c</sup>			
	Less Than \$250	\$250-\$499	\$500-\$1,249	\$1,250 or More	Less Than 1 Per-cent	1.0-2.9 Per-cent	3.0-4.9 Per-cent	5 Per-cent or More	Less Than 75 Per-cent	75-94 Per-cent	95-104 Per-cent	105 Per-cent or More	Less Than 90 Per-cent	90-99 Per-cent	100-109 Per-cent	110 Per-cent or More
Asia																
China		x														
South Asia							x				x				x	
Bangladesh	x				x											
Bhutan	x				x					x			x			
India	x									x			x			
Nepal	x					x					x			x		
Pakistan		x					x				x		x			
Sri Lanka		x				x					x			x		
East and Southeast Asia									x						x	
Burma	x						x									
Fiji			x									x				x
Hong Kong				x					x							x
Indonesia		x						x	x							x
Kampuchea	x				x					x						x
Korea, Democratic People's Republic of										x			x			
Korea, Republic of			x								x					x
Laos	x		x				x		x							x
Malaysia			x							x			x			
Mongolia			x						x							x
Papua New Guinea			x							x						x
Philippines			x			x				x				x		
Singapore				x							x				x	
Thailand			x					x	x							x
Vietnam	x				x							x			x	

North Africa/Middle East														
Northern Africa														
Algeria				x			x						x	
Egypt			x				x							x
Libya				x			x							x
Morocco			x			x								x
Sudan		x			x								x	
Tunisia			x				x							x
Western Asia														
Afghanistan	x				x								x	
Cyprus								x						x
Iran								x						x
Iraq								x						x
Jordan			x					x						x
Kuwait					x			x						x
Lebanon			x					x						x
Oman								x						x
Saudi Arabia								x						x
Syria			x					x						x
Turkey			x					x						x
Yemen Arab Republic			x											x
Yemen People's Democratic Republic		x						x						x
Sub-Saharan Africa														
West Africa														
Benin		x												x
Burkina Faso	x													x
Chad	x				x									x
Gambia		x												x
Ghana			x											x
Guinea		x												x
Guinea-Bissau	x				x									x
Ivory Coast			x											x
Liberia			x											x
Mali	x													x
Mauritania		x												x
Niger		x			x									x
Nigeria			x											x
Senegal		x			x									x
Sierra Leone		x												x
Togo		x												x

Table 18—Continued

Region, Subregion, and Country	GNP Per Capita, 1980 <sup>a</sup>				Growth of GNP Per Capita, 1961-80				Self-Sufficiency in Major Food Crops, 1976-80 <sup>b</sup>				Calorie Sufficiency, 1979-81 <sup>c</sup>			
	Less Than \$250	\$250- \$499	\$500- \$1,249	\$1,250 or More	Less Than 1 Per-cent	1.0- 2.9 Per-cent	3.0- 4.9 Per-cent	5 Per-cent or More	Less Than 75 Per-cent	75- 94 Per-cent	95- 104 Per-cent	105 Per-cent or More	Less Than 90 Per-cent	90- 109 Per-cent	100- 109 Per-cent	110 Per-cent or More
Central Africa																
Angola			x		x					x				x		
Burundi	x					x										
Cameroon			x			x					x					
Central African Republic		x			x	x				x				x	x	
Congo			x			x					x			x		
Gabon				x						x						x
Rwanda	x						x		x							x
Zaire	x				x	x						x				x
Eastern and Southern Africa																
Botswana			x							x				x		
Ethiopia	x						x		x						x	
Kenya		x				x					x			x		
Lesotho			x			x					x					
Madagascar		x			x				x						x	
Malawi		x														
Mauritius			x								x					x
Mozambique		x			x	x			x							x
Namibia			x		x					x			x			
Réunion				x					x					x		
Somalia						x			x							
Swaziland	x				x				x							x
Tanzania		x					x									x
Uganda			x		x						x					
Zambia			x		x						x					
Zimbabwe			x		x					x				x		
Latin America																
Mexico and Central America																
Costa Rica			x													
Cuba			x				x				x					x
Dominican Republic			x					x								x
El Salvador			x					x								
Guatemala			x			x							x			
Haiti	x					x				x				x		

Honduras			x			x						x				
Jamaica			x			x			x					x		x
Mexico				x		x										
Nicaragua			x		x		x			x						x
Panama			x						x	x						x
Trinidad and Tobago				x			x					x			x	
Upper South America									x							x
Bolivia			x			x							x			
Brazil				x				x								
Colombia			x				x			x					x	
Ecuador			x					x							x	
Guyana			x			x					x			x		
Paraguay			x									x			x	
Peru			x		x						x					x
Surinam									x					x		
Venezuela				x		x		x								x
Lower South America									x						x	
Argentina				x		x										x
Chile				x	x				x							x
Uruguay				x		x										x
Total (105)	19	20	46	20	27	30	24	18	35	34	20	16	22	28	19	36

Notes: Mexico and Central America includes the Caribbean countries.

<sup>a</sup> GNP per capita is in U.S. dollars, based on the 1961-80 trend of real GNP (1979-81 = 100).

<sup>b</sup> Food crop self-sufficiency is the ratio of the production of major food crops to their total domestic use.

<sup>c</sup> Calorie sufficiency is the ratio of average annual calorie consumption to the WHO-FAO recommended levels.

## APPENDIX 3: SUPPLEMENTARY TABLES

**Table 19—Domestic use of basic food staples, by region and subregion, 1966-70 and 1976-80 averages**

Country Group	1966-70 Average				1976-80 Average			
	Total	Food	Feed <sup>a</sup>	Other Uses <sup>b</sup>	Total	Food	Feed <sup>a</sup>	Other Uses <sup>b</sup>
	(million metric tons)							
Developing countries	615.0	429.3	87.0	98.7	846.5	586.4	133.3	126.8
Asia	420.9	316.5	43.8	60.6	583.9	437.8	66.3	79.7
China <sup>c</sup>	206.2	157.3	22.4	26.5	296.9	227.1	34.4	35.4
South Asia	140.7	104.9	12.5	23.3	183.6	136.7	16.4	30.5
East and Southeast Asia	73.9	54.3	8.9	10.7	103.3	74.1	15.4	13.8
North Africa/Middle East	54.9	30.8	12.9	11.2	80.9	44.3	21.1	15.6
Northern Africa	19.3	12.8	3.2	3.3	29.5	18.8	6.2	4.4
Western Asia	35.6	18.0	9.7	7.9	51.4	25.5	14.9	11.1
Sub-Saharan Africa	60.2	42.8	3.4	14.0	74.9	54.6	4.6	15.8
West Africa	28.2	18.6	1.3	8.3	35.3	24.4	1.8	9.1
Central Africa	9.6	7.9	0.3	1.4	12.6	10.2	0.5	1.8
Eastern and Southern Africa	22.4	16.3	1.7	4.3	27.1	19.9	2.3	4.9
Latin America	79.1	39.2	27.0	12.9	106.8	49.7	41.3	15.7
Mexico and Central America <sup>d</sup>	20.9	12.9	5.3	2.6	31.3	17.3	10.6	3.5
Upper South America	44.7	21.7	15.0	8.0	59.9	27.2	23.0	9.7
Lower South America	13.5	4.6	6.6	2.3	15.5	5.3	7.7	2.5

Sources: Food and Agriculture Organization of the United Nations, "Agricultural Supply Utilization Accounts Tape, 1981," Rome, 1982; and Republic of China, Council for Agricultural Planning and Development, "Taiwan Food Balance Sheets, 1935-80," Taiwan, 1981 (computer printout). Consumption data for the People's Republic of China were provided by Bruce Stone of the International Food Policy Research Institute.

Note: Parts may not add to totals due to rounding.

<sup>a</sup> Feed includes bran and cakes.

<sup>b</sup> Other uses include seeds, waste, and other nonfood uses.

<sup>c</sup> Averages for China are from data for 1965 and 1970 for the first period and 1977-80 for the second period.

<sup>d</sup> Mexico and Central America includes the Caribbean.

**Table 20—Domestic use of cereals and major noncereal food crops, by region, 1966-70 and 1976-80 averages**

Period/Country Group	Total <sup>a</sup>		Food		Feed <sup>b</sup>	
	Cereals	Noncereals	Cereals	Noncereals	Cereals	Noncereals
	(million metric tons)					
1966-70 average						
Developing countries	329.3	79.4	217.7	54.3	56.9	7.8
Asia	185.0	29.6	137.4	21.7	18.6	2.9
North Africa/Middle East	51.9	2.9	28.7	2.1	12.6	0.3
Sub-Saharan Africa	34.2	25.9	24.6	18.3	2.7	0.6
Latin America	58.2	21.0	27.0	12.2	23.0	4.0
1976-80 average						
Developing countries	455.2	94.4	294.0	65.3	84.6	9.3
Asia	250.1	36.8	184.0	26.8	27.9	3.9
North Africa/Middle East	76.3	4.6	41.0	3.2	20.6	0.5
Sub-Saharan Africa	43.1	31.9	31.7	22.9	3.7	0.8
Latin America	85.6	21.2	37.3	12.5	37.3	4.0

Source: Food and Agriculture Organization of the United Nations, "Agricultural Supply Utilization Accounts Tape, 1981," Rome, 1982.

Notes: China is excluded from this table. Parts may not add to totals due to rounding.

<sup>a</sup> Total includes seeds, waste, and other nonfood uses. <sup>b</sup> Feed includes bran and cakes.

**Table 21—Exports and imports of basic food staples, by region, 1966-70 and 1976-80 averages**

Country Group	Exports			Imports		
	Total	Cereals	Noncereals	Total	Cereals	Noncereals
(million metric tons)						
1966-70 average						
Developing countries (Excluding China)	28.83 (26.85)	21.35 (19.51)	7.48 (7.34)	40.99 (35.16)	39.96 (34.15)	1.04 (1.01)
Asia (Excluding China)	9.61 (7.63)	7.14 (5.30)	2.47 (2.33)	23.78 (17.95)	23.41 (17.60)	0.37 (0.34)
North Africa/Middle East	1.95	1.36	0.59	6.74	6.53	0.21
Sub-Saharan Africa	3.89	1.03	2.86	2.60	2.47	0.13
Latin America	13.38	11.81	1.57	7.87	7.54	0.33
1976-80 average						
Developing countries (Excluding China)	37.47 (35.80)	27.63 (26.07)	9.84 (9.73)	75.36 (63.06)	73.78 (61.52)	1.58 (1.54)
Asia (Excluding China)	15.98 (14.31)	10.06 (8.50)	5.92 (5.81)	32.24 (19.94)	31.73 (19.47)	0.51 (0.47)
North Africa/Middle East	2.22	1.43	0.79	19.28	18.84	0.44
Sub-Saharan Africa	1.86	0.76	1.09	6.25	6.14	0.11
Latin America	17.41	15.39	2.03	17.59	17.07	0.52

Sources: Food and Agriculture Organization of the United Nations, "Agricultural Supply Utilization Accounts Tape, 1981," Rome, 1982; People's Republic of China, State Statistical Bureau, *Statistical Yearbook of China*, various issues (Hong Kong: Economic Information Agency, various years); and Republic of China, Council for Agricultural Planning and Development, "Taiwan Food Balance Sheets, 1935-80," Taiwan, 1981 (computer printout).

Notes: Trade in bran and cakes for feed use is included. The noncereal components of trade are converted to wheat equivalents based on calorie content. Parts may not add up to totals due to rounding.

**Table 22—Total domestic use of major food crops, by region, trend estimates for 1980, and projections to 2000**

Country Group	Trend Estimates for 1980				Projections to 2000 <sup>a</sup>			
	Total	Food	Feed	Others	Total	Food	Feed	Others
(million metric tons)								
Developing countries (Excluding China)	901.0 (583.3)	624.2 (380.1)	144.6 (107.3)	132.2 (95.9)	1,539.7 (1,045.9)	951.1 (605.7)	356.8 (268.1)	231.7 (172.1)
Asia (Excluding China)	622.0 (304.2)	467.2 (223.1)	71.9 (34.5)	82.9 (46.6)	983.1 (489.3)	677.3 (331.8)	169.8 (81.1)	136.0 (76.4)
North Africa/Middle East	85.9	47.5	22.2	16.2	182.6	77.8	72.0	32.9
Sub-Saharan Africa	78.8	57.3	4.9	16.6	160.5	113.9	14.4	32.2
Latin America	114.3	52.2	45.7	16.5	213.5	82.2	100.7	30.7

Sources: Food and Agriculture Organization of the United Nations (FAO), "Agricultural Supply Utilization Accounts Tape, 1981," Rome, 1982; FAO, "Estimates of Income Elasticities for Various Commodities by Country," Rome, 1979 (computer printout); Republic of China, Council for Agricultural Planning and Development, "Taiwan Food Balance Sheets, 1935-80," Taiwan, 1981 (computer printout); United Nations, Department of International Economic and Social Affairs, "World Population Prospects as Assessed in 1982," New York, 1983 (computer printout); and World Bank, "Gross National Product by Country Data Tape, 1961-80," Washington, D.C., 1981. Consumption data for the People's Republic of China were provided by Bruce Stone of the International Food Policy Research Institute.

Note: Parts may not add to totals due to rounding.

<sup>a</sup> Projections for food and feed are based on 1966-80 trend income growth.

**Table 23—Gross surpluses and deficits of major food crops, by region and subregion, 1980 and projections to 2000**

Country Group	1980			Projections to 2000 <sup>a</sup>		
	Surplus	Deficit	Net Balance <sup>b</sup>	Surplus	Deficit	Net Balance <sup>b</sup>
	(million metric tons)					
Developing countries	24.8	76.6	-51.8	117.7	186.2	-68.6
Asia	11.4	30.3	-18.9	81.0	29.5	51.4
China	...	15.0	-15.0	7.0	...	7.0
South Asia	0.4	3.7	-3.3	22.3	8.8	13.5
East and Southeast Asia	11.0	11.6	-0.6	51.6	20.7	30.9
North Africa/Middle East	1.0	19.9	-18.9	0.8	64.7	-63.9
Northern Africa	...	10.6	-10.6	0.8	33.7	-32.9
Western Asia	1.0	9.3	-8.3	...	31.0	-31.0
Sub-Saharan Africa	3.2	9.0	-5.9	6.9	53.7	-46.8
West Africa	0.2	4.9	-4.7	...	36.3	-36.3
Central Africa	0.3	1.2	-0.9	3.6	3.7	-0.1
Eastern and Southern Africa	2.7	2.9	-0.3	3.3	13.7	-10.4
Latin America	9.2	17.4	-8.2	29.0	38.2	-9.3
Mexico and Central America <sup>c</sup>	0.1	4.5	-4.4	0.8	8.3	-7.5
Upper South America	0.1	11.6	-11.5	1.8	28.0	-26.2
Lower South America	9.0	1.4	7.7	26.4	2.0	24.5

Sources: Food and Agriculture Organization of the United Nations (FAO), "Agricultural Supply Utilization Accounts Tape, 1981," Rome, 1982; FAO, "Estimates of Income Elasticities for Various Commodities by Country," Rome, 1979 (computer printout); FAO, "Production Yearbook Data Tape, 1975, 1979, 1981, and 1983," Rome, 1976, 1980, 1982, and 1984; FAO, *Production Yearbook, 1983* (Rome, FAO, 1984); People's Republic of China, State Statistical Bureau, *Statistical Yearbook of China*, various issues (Hong Kong: Economic Information Agency, various years); Republic of China, Council for Agricultural Planning and Development, "Taiwan Food Balance Sheets, 1935-80," Taiwan, 1981 (computer printout); Republic of China, Executive Yuan, Directorate General of Budget, Accounting, and Statistics, *Statistical Yearbook of the Republic of China, 1982* (Taipei: Republic of China, 1983); United Nations, Department of International Economic and Social Affairs, "World Population Prospects as Assessed in 1982," New York, 1983 (computer printout); and World Bank, "Gross National Product by Country Data Tape, 1961-80," Washington, D.C., 1981.

Note: Parts may not add to totals due to rounding.

<sup>a</sup> These are differences between country output projections based on 1961-80 trends and demand projections based on 1966-80 trend income growth.

<sup>b</sup> Net balance is surpluses minus deficits.

**Table 24—Projected average income elasticities of demand for basic food staples and annual growth rates of GNP per capita, by country, 1980-2000**

Country	Annual Growth Rate of GNP Per Capita <sup>a</sup>	Income Elasticity of Demand for Basic Food Staples <sup>b</sup>	
		Food Use	Feed Use
	(percent)		
Afghanistan	0.50 <sup>c</sup>		
Algeria	4.20	0.04	1.08
Angola	0.50 <sup>c</sup>	0.05	1.01
Argentina	1.71	0.32	0.91
Bangladesh	0.50 <sup>c</sup>	-0.08	0.09
Benin	0.86	0.09	1.03
Bhutan	0.50 <sup>c</sup>	0.15	1.12
Bolivia	1.84	0.18	1.23
Botswana	6.00 <sup>c</sup>	0.15	0.89
Brazil	6.00 <sup>c</sup>	0.17	0.78
		0.05	0.43

**Table 24—Continued**

Country	Annual Growth Rate of GNP Per Capita <sup>a</sup>	Income Elasticity of Demand for Basic Food Staples <sup>b</sup>	
		Food Use	Feed Use
	(percent)		
Burkina Faso	1.24	0.30	1.24
Burma	1.77	0.02	1.12
Burundi	3.06	0.16	1.11
Cameroon	2.74	0.04	1.00
Central African Republic	0.63	0.10	0.88
Chad	0.50 <sup>c</sup>	0.33	0.91
Chile	0.50 <sup>c</sup>	-0.13	0.52
China	3.66	0.17	0.89
Colombia	3.67	0.20	0.57
Congo	1.33	0.14	0.89
Costa Rica	3.09	0.24	0.60
Cuba	4.40	-0.14	0.44
Cyprus	6.00 <sup>c</sup>	-0.10	0.32
Dominican Republic	4.49	0.23	0.93
Ecuador	5.27	0.22	0.91
Egypt	3.87	0.05	0.89
El Salvador	1.08	0.27	0.69
Ethiopia	0.88	0.33	0.87
Fiji	4.03	0.23	0.41
Gabon	5.56	0.12	0.21
Gambia	2.86	0.07	0.93
Ghana	0.50 <sup>c</sup>	0.17	1.02
Guatemala	2.86	0.02	0.75
Guinea	1.14	0.27	1.20
Guinea-Bissau	0.50	0.04	0.93
Guyana	1.33	0.13	1.05
Haiti	0.71	0.44	1.05
Honduras	0.78	0.16	0.69
Hong Kong	6.00 <sup>c</sup>	-0.17	0.12
India	1.51	0.27	1.13
Indonesia	5.14	-0.14	1.27
Iran	6.00 <sup>c</sup>	-0.05	0.47
Iraq	6.00 <sup>c</sup>	0.04	0.90
Ivory Coast	2.62	-0.11	0.96
Jamaica	0.50 <sup>c</sup>	-0.13	0.39
Jordan	5.81	0.16	1.25
Kampuchea	0.50 <sup>c</sup>	0.32	1.25
Kenya	2.68	0.16	0.89
Korea, Democratic People's Republic of	3.50	-0.13	1.15
Korea, Republic of	6.00 <sup>c</sup>	0.00	0.47
Kuwait	0.50 <sup>c</sup>	-0.08	0.39
Laos	1.80	0.22	0.98
Lebanon	3.10	-0.13	0.62
Lesotho	6.00 <sup>c</sup>	0.34	1.13
Liberia	1.53	0.31	1.03
Libya	0.50 <sup>c</sup>	-0.19	0.67
Madagascar	0.50 <sup>c</sup>	0.24	0.99
Malawi	2.89	-0.13	1.00
Malaysia	4.61	-0.07	0.64
Mali	2.12	0.21	0.94
Mauritania	0.50 <sup>c</sup>	0.46	0.90
Mauritius	4.23	0.07	1.10
Mexico	3.60	-0.07	0.57
Mongolia	3.00	0.20	0.30
Morocco	3.41	-0.12	1.08
Mozambique	0.50 <sup>c</sup>	0.24	1.13

(continued)

**Table 24—Continued**

Country	Annual Growth Rate of GNP Per Capita <sup>a</sup>	Income Elasticity of Demand for Basic Food Staples <sup>b</sup>	
		Food Use	Feed Use
	(percent)		
Namibia	0.50 <sup>c</sup>	-0.09	0.94
Nepal	0.50 <sup>c</sup>	0.17	1.23
Nicaragua	0.50 <sup>c</sup>	0.16	0.52
Niger	0.50 <sup>c</sup>	0.09	1.02
Nigeria	4.55	0.08	1.01
Oman	5.99	-0.06	0.39
Pakistan	2.34	0.09	0.93
Panama	2.16	-0.22	0.53
Papua New Guinea	1.01	0.04	0.41
Paraguay	4.23	0.15	0.12
Peru	6.51	0.13	0.75
Philippines	3.38	0.18	0.71
Réunion	1.43	0.30	0.99
Rwanda	2.30	0.11	1.09
Saudi Arabia	6.00 <sup>c</sup>	-0.09	0.39
Senegal	0.50 <sup>c</sup>	0.20	0.92
Sierra Leone	1.27	0.20	1.17
Singapore	6.00 <sup>c</sup>	-0.20	0.32
Somalia	0.50 <sup>c</sup>	0.38	0.84
Sri Lanka	2.45	0.10	1.37
Sudan	0.50 <sup>c</sup>	0.30	0.77
Surinam	5.17	0.13	0.71
Swaziland	5.22	0.14	0.78
Syria	5.55	-0.16	0.62
Tanzania	1.82	0.05	1.03
Thailand	4.35	-0.05	0.41
Togo	0.50 <sup>c</sup>	0.13	1.06
Trinidad and Tobago	4.25	0.09	0.52
Tunisia	5.68	-0.28	0.91
Turkey	3.52	-0.30	0.96
Uganda	0.50 <sup>c</sup>	0.28	1.05
Uruguay	2.39	0.09	0.05
Venezuela	2.33	0.13	0.43
Vietnam	0.50 <sup>c</sup>	0.25	1.30
Yemen Arab Republic	6.00 <sup>c</sup>	0.23	0.88
Yemen People's Democratic Republic	6.00 <sup>c</sup>	0.38	0.91
Zaire	0.50 <sup>c</sup>	0.19	0.88
Zambia	0.50 <sup>c</sup>	0.14	0.78
Zimbabwe	0.50 <sup>c</sup>	-0.18	0.94

Sources: Food and Agriculture Organization of the United Nations (FAO), "Agricultural Supply Utilization Accounts Tape, 1981," Rome, 1982; FAO, "Estimates of Income Elasticities for Various Commodities by Country," Rome, 1979 (computer printout); Republic of China, Council for Agricultural Planning and Development, "Taiwan Food Balance Sheets, 1935-80," Taiwan, 1981 (computer printout); United Nations, Department of International Economic and Social Affairs, "World Population Prospects as Assessed in 1982," New York, 1983 (computer printout); and World Bank, "Gross National Product by Country Data Tape, 1961-80," Washington, D.C., 1981. Consumption data for the People's Republic of China were provided by Bruce Stone of the International Food Policy Research Institute.

<sup>a</sup> The average annual growth rate of real GNP per capita during 1966-80 was used. Growth rates for Kampuchea and Vietnam are assumed to be at the minimum.

<sup>b</sup> Estimates for feed use are those of meat as proxies. For Botswana, Bhutan, Central African Republic, Guinea-Bissau, Kuwait, Lesotho, Namibia, Oman, Réunion, and Swaziland, estimates of neighboring countries were used; those for Fiji and Oceania are of developing Oceania as a whole.

<sup>c</sup> A minimum constraint of 0.5 percent or a maximum constraint of 6.0 percent was applied.

**Table 25—Projections of demand for major food crops to 2000 based on alternative income growth rates, by region and subregion**

Region/Subregion	Projected Demand in 2000		Relative Change <sup>a</sup>	
	Scenario I	Scenario II	Scenario I	Scenario II
	(million metric tons)		(percent)	
Developing countries	1,532.8	1,491.3	-0.5	-3.1
Asia	983.5	958.6	0.0	-2.5
China	500.6	482.5	1.4	-2.3
South Asia	305.8	302.4	-1.2	-2.3
East and Southeast Asia	177.0	173.7	-1.5	-3.3
North Africa/Middle East	180.0	172.0	-1.5	-5.9
Northern Africa	65.7	64.0	-3.7	-6.2
Western Asia	114.4	108.0	-0.1	-5.7
Sub-Saharan Africa	159.3	157.6	-0.7	-1.8
West Africa	73.9	73.8	-2.2	-2.4
Central Africa	25.1	25.0	-0.8	-1.2
Eastern and Southern Africa	60.2	58.9	1.2	-1.2
Latin America	210.0	203.1	-1.6	-4.9
Mexico and Central America <sup>b</sup>	65.1	61.7	0.6	-4.6
Upper South America	122.5	119.0	-3.2	-5.9
Lower South America	22.4	22.3	0.0	-0.4

Sources: Food and Agriculture Organization of the United Nations (FAO), "Agricultural Supply Utilization Accounts Tape, 1981," Rome, 1982; FAO, "Estimates of Income Elasticities for Various Commodities by Country," Rome, 1979 (computer printout); Republic of China, Council for Agricultural Planning and Development, "Taiwan Food Balance Sheets, 1935-80," Taiwan, 1981 (computer printout); United Nations, Department of International Economic and Social Affairs, "World Population Prospects as Assessed in 1982," New York, 1983 (computer printout); and World Bank, "Gross National Product by Country Data Tape, 1961-80," Washington, D.C., 1981.

Notes: Projected income growth rates are presented under two scenarios: Scenario I uses the 1961-80 trend growth rate of GNP per capita in each country, and Scenario II uses a rate of income growth that is 25 percent slower than the 1966-80 trend of GNP per capita.

<sup>a</sup> The relative change is the difference between the projected demand based on the 1966-80 trend growth rate of GNP per capita and Scenario I or II.

<sup>b</sup> Mexico and Central America includes the Caribbean.

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