



WORLD FOOD TRENDS AND FUTURE FOOD SECURITY

PER PINSTRUP-ANDERSEN

**FOOD POLICY REPORT
THE INTERNATIONAL FOOD
POLICY RESEARCH INSTITUTE**

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The International Food Policy Research Institute was established in 1975 to identify and analyze alternative national and international strategies and policies for meeting food needs of the developing world on a sustainable basis, with particular emphasis on low-income countries and on the poorer groups in those countries.

While the research effort is geared to the precise objective of contributing to the reduction of hunger and malnutrition, the factors involved are many and wide-ranging, requiring analysis of underlying processes and extending beyond a narrowly defined food sector. The Institute's research program reflects worldwide collaboration with governments and private and public institutions interested in increasing food production and improving the equity of its distribution. Research results are disseminated to policymakers, opinion formers, administrators, policy analysts, researchers, and others concerned with national and international food and agricultural policy.

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Washington, D.C.
March 1994

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PREFACE

At first glance, the world food situation has never been better. Enough food is being produced today that, if it were evenly distributed, no one should have to go hungry. World food production is increasing faster than population growth: per capita production increased by 5 percent during the 1980s. Real food prices are at historic lows and have been declining for some time now. Yields of major cereals have more than doubled in the past three decades. These trends have contributed to complacency in some quarters regarding the world food situation.

Yet, more than 700 million people in the developing world do not have access to sufficient food to lead healthy and productive lives. More than 180 million children are underweight. Diseases of hunger and malnutrition are widespread. The desire to satisfy food needs has, in combination with increasing population densities and inadequate agricultural intensification, led to much degradation of environmentally fragile lands, such as forests and steep hillsides.

Over the next 20-30 years, farmers and policymakers in developing countries will be challenged to provide food at affordable prices for almost 100 million more people every year—the largest annual population increase in history. Moreover, they will have to increase food production from more productive use of the land and without further degradation of natural resources: area expansion is no longer a feasible option in most of the world.

This report asks, What can we learn from current world food trends? Are the production trends of the last 30 years likely to continue or are we headed toward the fulfillment of Malthus' predictions? Are we likely to face a future

of global food surpluses or one of increasing food scarcity and widespread hunger? How will expected surpluses and scarcities be distributed across regions, countries, households, and individuals? Are we likely to face increasing inequality, poverty, malnutrition, and human misery or will the future be bright for all? Will future efforts to meet food needs be sustainable or will our natural resources be further degraded?

What future food security will look like depends not on exogenous factors over which we have no control but on the decisions and actions taken by the major players: households, private- and public-sector agencies, governments, and the international community. If we continue to act as we have in the 1980s and early 1990s, more people will suffer from food insecurity. If Malthus turns out to be right, it will be because some or all of these players failed to act in an appropriate and timely manner.

Much of the action needed has been delineated by a number of conferences and publications of the Food and Agriculture Organization of the United Nations (FAO), by the United Nations Conference on the Environment and Development and Agenda 21, the International Conference on Nutrition, and the World Summit for Children. The upcoming International Population Conference, FAO's Fiftieth Anniversary Conference, and IFPRI's new initiative for a 2020 Vision on Food, Agriculture, and the Environment will add more building blocks to the development of a common vision for food, agriculture, and the environment, and a consensus for action to bring about such a vision. This report identifies those actions that

the international community needs to take to facilitate desirable future food trends and to modify undesirable trends for the ultimate purpose of assisting developing countries to achieve improved and sustainable household food security in the future.

A version of this report was original-

ly presented at the International Centers' Week of the Consultative Group on International Agricultural Research (CGIAR) in Washington, D.C., on October 25, 1993. The assistance of Rajul Pandya-Lorch, special assistant, and Kene Ezemenari, research analyst at IFPRI, is gratefully acknowledged.

FEEDING THE WORLD: AVAILABILITY AND ACCESS TO FOOD

There is enough food in the world today to feed everyone, if it were evenly distributed. Availability of daily food energy per capita in the developing countries as a whole increased by 0.7 percent per year during the 1980s.¹ China (at 1.4 percent annually) and the Far East (excluding China) (at 1.2 percent annually) experienced the greatest increases in per capita food availability, while Latin America and Africa experienced the smallest increases.

Twenty-five developing countries, including about half of the African countries, were unable to assure sufficient food energy (2,200 calories per person per day) for their populations at the end of the 1980s even if available food energy were evenly distributed within each country.² This is down from 45 countries at the end of the 1970s.

However, available food is neither evenly distributed nor fully consumed. Availability of enough food at global, regional, or national levels does not necessarily mean that everyone is well fed. For people to be food secure—that is, to have access at all times to the food required for a healthy and productive life—there must be both availability of food *and* access to food. Access to food by households (and individuals) is conditioned by poverty: the poor usually lack adequate means to secure access to food.

Over 1.1 billion people in developing countries were living in poverty in 1990, more than 500 million in conditions of extreme poverty.³ South Asia is the home of about 50 percent of the developing world's poor—more than 500 million people. Another 15 percent

are found in East Asia, 19 percent in Sub-Saharan Africa, and 10 percent in Latin America and the Caribbean. The prevalence of poverty (the proportion of each region's population that is poor) is very high—about 50 percent—in South Asia as well as in Sub-Saharan Africa. World Bank projections indicate that significant reductions could occur in the magnitude and incidence of poverty if, for example, efforts were made to reduce poverty through engagement in efficient labor-intensive growth and provision of adequate social services.⁴ The most significant reductions are expected to occur in East Asia and South Asia. But in Sub-Saharan Africa, the numbers of the poor are expected to increase by almost 50 percent to 304 million by the year 2000. By the end of the decade, it is projected that almost one-third of the developing world's poor will be found in Sub-Saharan Africa, compared with about 19 percent currently.

Today, there are more than 700 million people who do not have access to sufficient food to meet their needs for a healthy and productive life; they often go hungry and do not know when they will have their next meal. Many of these hungry adults and children also suffer from diseases associated with hunger and poverty. For almost one-fifth of the total population of developing countries to be chronically hungry tarnishes the image of a world that is now considered food-secure because it produces enough food.

Great progress has been made in meeting food needs during the last 30 years. For instance, the number of underfed people⁵ declined from an

estimated 976 million in 1974-76 to 786 million in the late 1980s.⁶ But the problem is far from solved. Keeping up with increasing needs and demands due to population growth, income increases, and dietary changes is itself a formidable challenge.

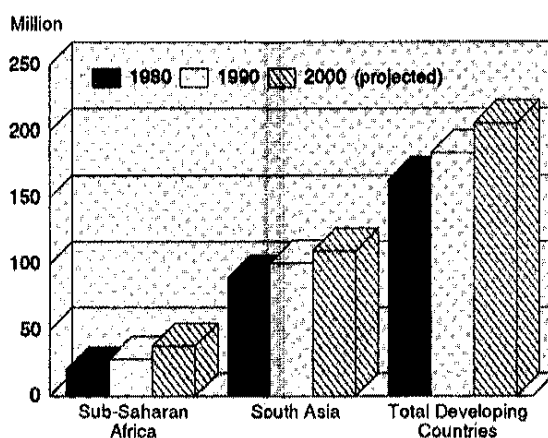
Hunger and food insecurity have a significant effect on health and nutrition of both adults and children. They can lead to growth failure in children. About 184 million preschool children in developing countries were underweight⁷ in 1990 (Figure 1). About 55 percent of these underweight children were found in South Asia and another 16 percent in Sub-Saharan Africa. The proportion of children that are underweight is higher in South Asia (almost 60 percent), but it is also significant in Sub-Saharan Africa (30 percent) and Southeast Asia (31 percent). It is worrisome that the number of underweight children has risen in recent years, up from 164 million in 1980. The increase in the number of underweight children in Sub-Saharan Africa during the 1980s from

20 million to 28 million is particularly striking. Projections by the United Nations Administrative Committee on Coordination/Sub-Committee on Nutrition (UN ACC/SCN) suggest that regardless of whether optimistic or pessimistic scenarios are employed,⁸ the number of underweight children in Sub-Saharan Africa will increase during the 1990s. The situation in South Asia is also rather precarious, with almost half of the children still projected to be underweight by the year 2000.

In addition to energy deficiencies, micronutrient deficiencies are also widespread in the developing world. About 14 million preschool children (under the age of five years) have eye damage as a result of vitamin A deficiency.⁹ Ten million of these children are found in Southeast Asia. Between 250,000 and 500,000 preschool children go blind each year due to vitamin A deficiency; two-thirds of these children die within months of going blind.¹⁰ Many more children are mildly affected. Recent research has shown that even mild deficiencies can increase mortality significantly. Vitamin A deficiencies are closely linked to diet, which can be influenced by agricultural research and policy.

Iron deficiency affects about 1 billion people in the world, particularly children and women of reproductive age.¹¹ Iron deficiency leads to anemia, which if not checked can diminish learning capacity and increase morbidity and mortality. In the developing countries, about 370 million women between 15 and 49 years of age—42 percent of this population group—were anemic in the 1980s. Almost one-half were in South Asia. And there are tentative indications from South Asia and Sub-Saharan Africa that the prevalence of anemia is rising in nonpregnant adult women of reproductive ages (Figure 2).

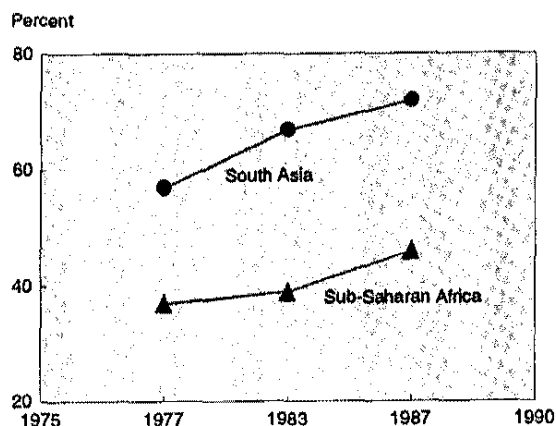
Figure 1—Malnutrition among preschool children



Source: UN ACC/SCN (United Nations Administrative Committee on Coordination/Sub-Committee on Nutrition), *Second Report on the World Nutrition Situation*, vol. 1 of *Global and Regional Results* (Geneva: UN ACC/SCN, 1992).

Note: The projections for 2000 are based on the pessimistic trend.

Figure 2—Trends in anemia in nonpregnant women, 1977-87



Source: UN ACC/SCN (United Nations Administrative Committee on Coordination/Sub-Committee on Nutrition), *Second Report on the World Nutrition Situation*, vol. 1 of *Global and Regional Results* (Geneva: UN ACC/SCN, 1992).

In Sub-Saharan Africa, this trend is undoubtedly associated with deterioration in general standards of living, including increased poverty and food

insecurity. Anemia partly arises from diets insufficient in iron, which again could be addressed through agricultural research and policy. For example, a possible reason why iron deficiency and anemia are going up in South Asia may lie in the decrease in production of iron-rich pulses during that same period,¹² which in part reflects the larger research input into competing crops such as wheat in South Asia. This emphasizes the importance of considering the effects on diet and thus on health and nutrition in setting research priorities for yield-increasing research.

In summary, South Asia is the home of about half of the developing world's hungry and food-insecure people, but this population group is growing rapidly in Sub-Saharan Africa. Much of the poverty and food insecurity is in rural areas, mainly in low-potential areas such as arid zones, but urban poverty is also growing rapidly.

CAN YIELD GAINS KEEP PACE WITH POPULATION GROWTH?

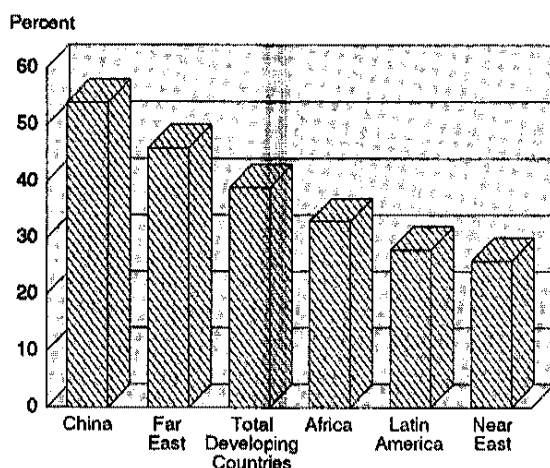
Cereal Crops

Food production increased by 39 percent in developing countries as a whole during the 1980s, with particularly impressive performances in China and the Far East (Figure 3). Even in Africa, where concerns regarding the future food situation are greatest, total food production increased by 33 percent during the 1980s. In fact, total food production rose in 101 developing countries, with 30 countries experiencing increases of 40 percent or more.

However, food production growth is not so impressive when compared with population growth. During the 1980s, per capita food production increased by

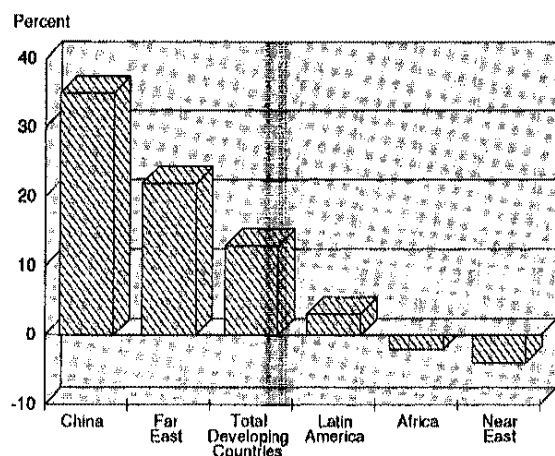
only 13 percent in the developing countries as a group, again with China and the Far East leading (Figure 4). In Africa and the Near East, per capita food production declined. In 75 countries, less food was produced per person at the end of the 1980s than at the beginning. Three-fourths of the African countries fell into that category, as did almost two-thirds of the Latin American countries and half of the Asian countries. Fifteen countries experienced reductions of 20 percent or more in per capita food production during the decade. Two-thirds of all developing countries recorded stagnant or reduced per capita food production

Figure 3—Change in total food production in developing countries, 1979-81 to 1989-91



Sources: FAO (Food and Agriculture Organization of the United Nations), *FAO Production Yearbook* (Rome: FAO, 1990 and 1991).

Figure 4—Change in per capita food production, 1979-81 to 1989-91



Sources: FAO (Food and Agriculture Organization of the United Nations), *FAO Production Yearbook* (Rome: FAO, 1990 and 1991).

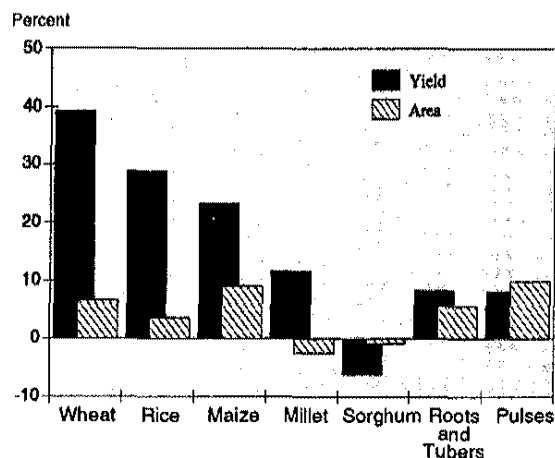
during 1991-92.¹³ Africa as a whole experienced a 6 percent fall in per capita agricultural production in 1992 alone.¹⁴ This reflects serious droughts in southern Africa.

Yield increases were the major source of food production growth in all developing regions except Africa¹⁵, contributing about 80 percent of increased cereal production in developing countries as a whole. Yield increases were the only source of China's spectacular food production performance during the 1980s. In cereals, the area cultivated actually declined in China as well as in Latin America. In Africa, by contrast, more than half of cereal production increases during the 1980s came from area expansion. While cultivated area is still increasing in developing countries, it is doing so at a low and declining rate, and increased food production in the future will have to come primarily from increased yields.

The most important cereal crops in developing countries are rice, wheat, and maize, which in 1992 accounted for 47, 23, and 19 percent, respectively, of all developing-country cereal production.¹⁶ In Africa, coarse grains are particularly important, with maize, sorghum, and millet accounting for 33, 18, and 14 percent of total cereal production. Yield increases have been a particularly important source of production growth in wheat and rice and, to a lesser extent, maize, while they have played a much smaller role in sorghum, roots and tubers, and pulses (Figure 5). Although opportunities for further yield increases are strong,¹⁷ yield-expanding technology is vital for enhancing the food production capacity of developing countries, including those in Africa.

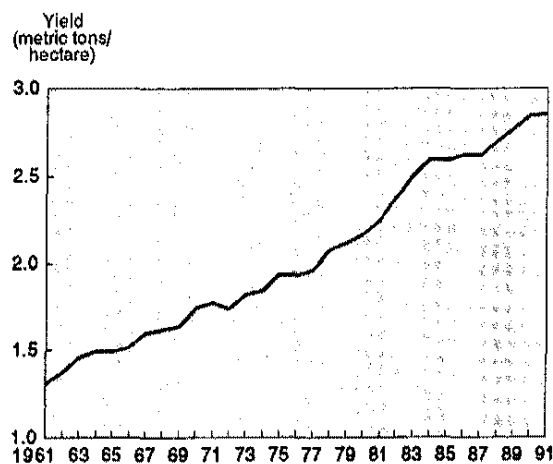
A steady upward movement of the yield trend is clear for all three major cereals. Mainly stimulated by the green revolution, yields of maize, rice, and wheat more than doubled between 1961 and 1991 in developing countries (Figure 6). Yield increases in Asia were notably high, especially for rice and

Figure 5—Change in area and yields for selected crops in developing countries, 1979-81 to 1989-91



Source: FAO (Food and Agriculture Organization of the United Nations), "FAO Agrost-PC, Population, Production, and Food Balance Sheets Domains," FAO, Rome, 1992 (computer disk).

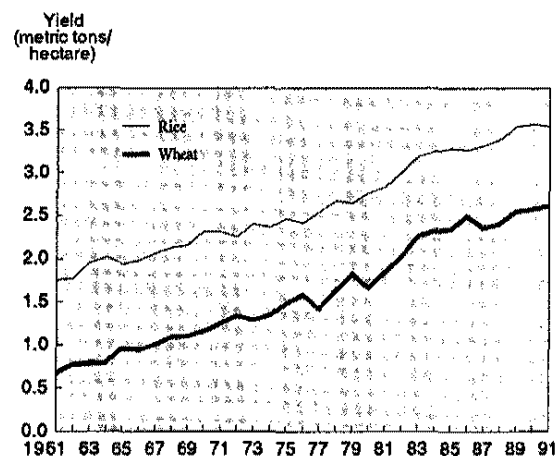
Figure 6—Trend in yields in rice, wheat, and maize for all developing countries, 1961-91 (weighted average)



Source: FAO (Food and Agriculture Organization of the United Nations), "FAO Agrost-PC, Population, Production, and Food Balance Sheets Domains," FAO, Rome, 1992 (computer disk).

wheat (Figure 7). Rising from 0.5 tons per hectare in 1961, wheat yields in Asia exceeded 2.5 tons per hectare by 1991. In China, between 1961 and 1991, maize yields increased from 1.2

Figure 7—Trends in yields of rice and wheat for Asia, 1961-91



Source: FAO (Food and Agriculture Organization of the United Nations), "FAO Agrost-PC, Population, Production, and Food Balance Sheets Domains," FAO, Rome, 1992 (computer disk).

tons per hectare to 4.6 tons; rice yields tripled from 2.0 to 6.0 tons per hectare; and wheat yields increased sixfold from 0.5 to 3.0 tons per hectare.¹⁸

Yield performances in Africa, however, were poor and variable for maize, rice, and wheat.¹⁹ While maize yields in Asia rose from 1.2 to 3.4 tons per hectare during 1961-91, maize yields in Africa rose from about 0.8 to 1.2 tons per hectare. In 1961 China and Africa had similar yields for wheat (0.5 tons per hectare), but by 1991 Chinese wheat yields were double those of Africa (1.6 tons). That Africa has a long way to go to catch up with Asia is painfully obvious. To expand production, African farmers have always relied on bringing new land into cultivation. But continued attempts to expand agricultural land will entail increasing financial and ecological costs. As has happened in most of Asia, Africa will have to rely on increased yields to expand future food production.

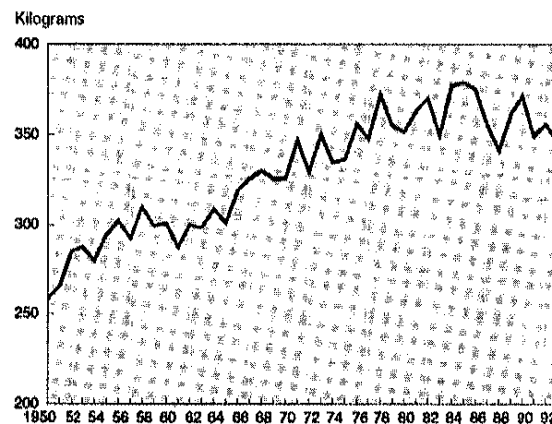
Even in Asia, however, there are some signs of trouble. The annual rate of yield increase for the two major

crops, wheat and rice, is slowing. Rice yields increased rapidly during the 1960s and 1970s, but since then the annual rate of increase has slowed. It is returning close to the rate prevailing in the early 1960s, declining from 3 percent a year between the mid-1970s and early 1980s to less than 2 percent in the late 1980s.²⁰ In Southeast Asia, rice yields have declined by half from an annual rate of 3.2 percent in the 1970s to 1.6 percent in recent years. Even in China, rice yield growth rates have slowed from more than 4 percent per year in the late 1970s to about 1.6 percent a year during the 1980s. Only in India have rice yield growth rates continued to grow. The situation is similar for wheat. Yield growth rates have slowed in Asia as a whole from 4.4 percent in the late 1970s to 2.7 percent in the 1980s.²¹ The exception to this trend is Southeast Asia, where yield growth rates increased from -0.8 percent in the late 1970s to 2.8 percent in the 1980s.

In addition to lower growth rates in yields, significant increases in variability in total world grain production are causing concern.²² This variability is partly explained by the increasing similarity of cereal varieties grown across wide areas so that large areas of crops prone to a certain pest, disease, or drought may be negatively affected at one time.

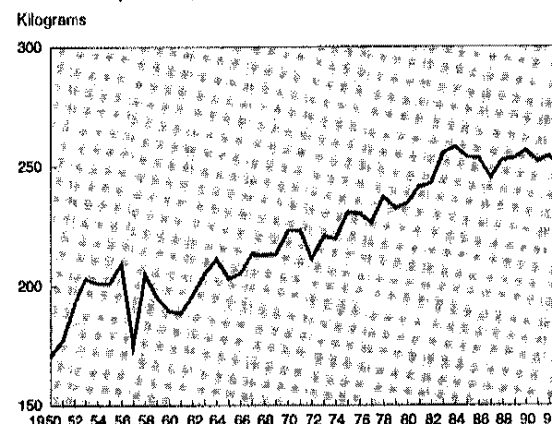
World grain production per person increased steadily during the 1950s, 1960s, and 1970s, but recent trends suggest that there has been a leveling off during the 1980s and early 1990s for the world as a whole (Figure 8) and for developing countries (Figure 9). Some argue that world grain production per person is now declining.²³ Based on statistical tests, the trend between 1980 and 1993 is best represented by a horizontal line for the world as a

Figure 8—World grain production per person, 1950-93



Source: FAO (Food and Agriculture Organization of the United Nations), "FAO Agrostat-PC, Population, Production, and Food Balance Sheets Domains," FAO, Rome, 1992 (computer disk); FAO, "The State of Food and Agriculture 1993," FAO, Rome, 1993 (mimeographed).

Figure 9—Developing-country grain production per person, 1950-93



Source: FAO (Food and Agriculture Organization of the United Nations), "FAO Agrostat-PC, Population, Production, and Food Balance Sheets Domains," FAO, Rome, 1992 (computer disk); FAO, "The State of Food and Agriculture 1993," FAO, Rome, 1993 (mimeographed).

whole and for developing countries—a constant rather than declining trend. However, there are indications that the trend in world food production will turn downward if corrective actions are not taken soon.

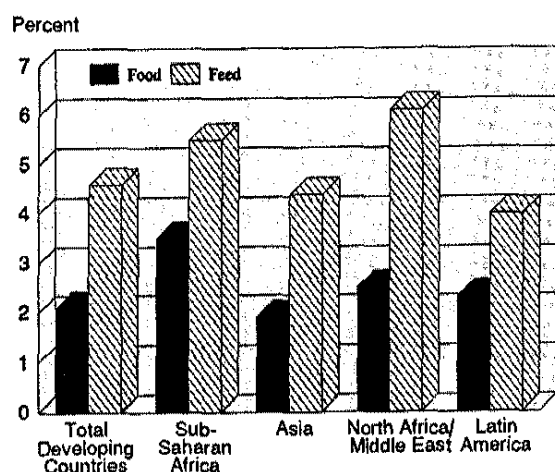
The recent stagnation and possible

fall in world grain production per person should be of serious concern because factors other than population growth will continue to push grain demand upward. For example, the demand for feedgrain increases rapidly once incomes increase beyond a certain level. Whereas projected growth in cereal consumption for food is very close to population growth (Figure 10), expected growth in feedgrain demand is more than twice the expected population growth. Once incomes have reached an even higher point, feedgrain demand levels off. This has happened in the Republic of Korea, for example.²⁴ Incomes in most developing countries either are still below the level where feedgrain use increases rapidly or they are now experiencing steep increases.

Noncereal Crops

Noncereal staples such as roots, tubers, and plantains not only contribute to total food availability but they play a major role in the diets and incomes of

Figure 10—Projected annual growth in cereal consumption for food and feed, 1980-2000



Source: L. Paulino, *Food in the Third World: Past Trends and Projections to 2000*, Research Report 52 (Washington, D.C.: International Food Policy Research Institute, 1986).

the poor in many regions. According to FAO, noncereals supply 40 percent of total food energy for the half of the Sub-Saharan African population with the highest risk of food insecurity.²⁵

The production performance of roots and tubers during the 1980s was disappointing. Although total production increased by 14 percent in developing countries as a whole, population increases were such that per capita production declined by 7.3 percent.²⁶ Only in Africa and the Near East did per capita production of roots and tubers increase; in Latin America, the Far East, and China per capita production declined about 13 percent. The production performance of bananas and plantains was also disappointing; per capita production of bananas barely increased during the 1980s, while per capita production of plantains declined by 7 percent.²⁷

Among the various roots and tubers, production varied considerably during the 1980s. Per capita production of yams in developing countries increased by 45 percent, but sweet potatoes declined by 25 percent.²⁸ Most of the increase in yam production occurred in Africa and the Far East. In Africa, total yam production increased by 86 percent, far exceeding production growth rates in other roots and tubers. In China, per capita production of potatoes increased, but production of cassava and sweet potatoes declined more than 15 percent. In the Near East, per capita cassava production declined from about 0.62 kilograms per person in 1979-81 to 0.03 kilograms in 1989-91.

Yield increases contributed about 60 percent of the growth in production of roots and tubers in developing regions, and area increases contributed the rest. Much of the increase in area was in Africa and to a lesser extent in the Near East; in Latin America, the Far East, and

China, area cultivated declined during the 1980s. In Africa, increases in area harvested were a much more important source of production increases than yield increases. Yields of roots and tubers were notably low in Africa, about 7 tons per hectare in 1989-91, half the level in Asia. Efforts to accelerate yields of noncereal crops in a sustainable manner should be an integral part of efforts to reduce food insecurity.

Livestock Products and Fish

Livestock production grew substantially during the 1980s. Between 1979-81 and 1989-91, livestock production increased by 53 percent in developing countries, which, after accounting for population increases, resulted in a 24 percent per capita increase.²⁹ Most of the increase in livestock production occurred in China (89 percent) and the Far East (53 percent). In Africa and the Near East, less livestock was produced per capita at the end of the 1980s than at the beginning, and in Latin America there was only a marginal increase. Livestock production is highly correlated with income growth. Production increased in regions where incomes grew rapidly, and production decreased where incomes stagnated or fell. Future demand for livestock products will increase rapidly in parts of Asia where strong income growth is expected, for example, in China and Thailand.

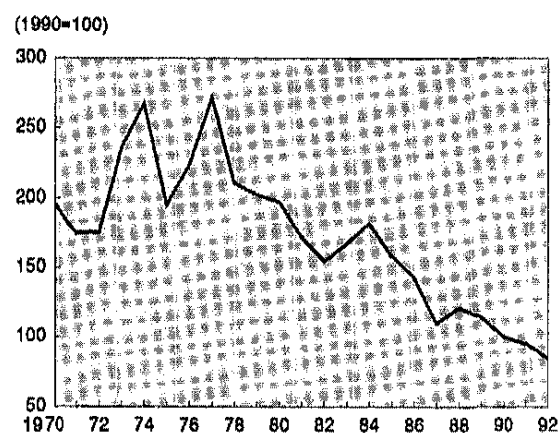
About 97 million tons of fish are caught or cultured in the world, 85 percent in marine waters and 15 percent in inland waters.³⁰ World inland fish production has increased in recent years (by about 5.9 percent in 1990, 3.8 percent in 1991, and 2.1 percent in 1992), while marine fish production has declined slightly.³¹ Developing countries produce about 56 million tons of fish a year. China, where fish produc-

tion is growing rapidly, is now the world's largest producer (12 million tons). African developing countries produce only about 4 million tons. Developing countries export about one-third of their catch, while developed countries export about two-fifths. The value of world exports of fish reached almost US\$40 billion in the early 1990s. Developing countries provide up to 40 percent of world exports, and they are net fish exporters;³² their positive trade balance in fish products reached US\$11.3 billion in 1991.³³

International Food Prices

Food prices have been on a downward trend for a long time (Figure 11). For almost 50 years—except for a few short periods such as the food crisis of the early 1970s—global food supplies have been sufficient to assure decreasing international food prices. Where are food prices headed now? Most recent projections conclude that it is unlikely that real food prices in the international market will increase significantly during the rest of the 1990s.³⁴

Figure 11—World food price index (in constant dollars), 1970-92



Source: World Bank, *World Development Report 1993* (New York: Oxford University Press, 1993).

Much depends on the implementation of the recently completed Uruguay Round of the General Agreement on Tariffs and Trade (GATT), and on developments in China, India, Eastern Europe, and the former Soviet Union. If the recently concluded GATT agreements are as successful as intended in significantly reducing agricultural subsidies and trade distortions in the European Union, the United States, and Japan, some expect food price increases in the world market. These price increases will vary among commodities and will depend on how much and how fast markets are liberalized. Available estimates suggest a 10-15 percent increase in real agricultural prices on the world market if the original goals of the Uruguay Round are achieved.

However, there are at least three reasons why price increases will be limited or will not occur at all. First, any reductions in agricultural trade distortions in the European Union, the United States, and Japan are likely to be small and spread out over a long period of time. Second, there are strong indications that enhanced supply management rather than freer markets may occur in these countries, which will keep domestic production at levels higher than free markets will justify. Third, it is likely that Eastern Europe and the former Soviet Union will increase agricultural production considerably faster than demand during the next 10 years.³⁵ Further reductions

in livestock production and consumption in those countries may release significant amounts of feedgrain to the world market. This, in turn, is likely to depress international prices. Furthermore, as the effects of structural adjustment take hold, the agricultural sectors of these countries are likely to become much more productive.

China and India produce about one-third of the world's cereals and more than half of the cereal production of the developing countries—about 2.5 times the amount traded internationally and about twice the current year-end world cereal stock. Thus, changes in cereal production or demand in these countries could have major effects on international prices and stocks.

Decreasing real world market prices for food are an outcome of both production performance and food demand. Food needs are represented in the world market only if they are matched by purchasing power. Thus, future food prices will be influenced by the extent to which the 1 billion people who currently earn 1 dollar a day or less (plus the 90-100 million people added every year through population growth) are able to convert their food needs into effective market demand. Low and decreasing real food prices in the world market are not incompatible with high and increasing poverty, food insecurity, hunger, and malnutrition. In fact, the former may be a result of the latter.

THE FUTURE OF FOOD TRADE AND AID

Developing countries are net food importers, importing about US\$5-10 billion more food than they exported during the mid- to late-1980s. However, during the 1980s, developing countries increased food exports more than they

increased food imports. Net food imports in all developing regions declined between 1979-81 and 1989-91. The decline was largest in the Near East (55 percent) and smallest in Africa (9 percent). Developing countries increased

food imports by 30 percent during the 1980s, while they increased food exports by 41 percent.³⁶ Large increases were recorded in both food imports and exports in the Near East, Far East, and China, with growth in exports outstripping growth in imports. In Africa, too, food exports grew faster than food imports, but since Africa and the Near East imported much more food than they exported, they remained net importers. Latin America was a net exporter of food.

Cereals form a major component of developing-country food trade. In 1989-91, developing countries imported about 120 million tons of cereals and exported about 32 million tons, resulting in net imports of about 88 million tons. The Near East and Far East are major net importers of cereals. During the 1980s, all developing regions except Latin America experienced a decline in net cereal imports, as cereal exports more than doubled in Africa and the Near East during the 1980s and almost quadrupled in China, while they declined in Latin America.³⁷ Net imports are a major source of total cereal availability in some developing regions,

especially Africa, where one-quarter of available cereals in the late 1980s were net imports. Developing countries' dependence on net imports decreased during the 1980s, except for Latin America where the share of net imports in total cereal availability doubled from 5 to 10 percent.

About 15 million tons of cereal food aid were shipped worldwide in 1992/93, up from 9 million tons a decade earlier.³⁸ According to the World Food Programme, Sub-Saharan Africa is the largest recipient of food aid, followed by North Africa and the Middle East. Food aid shipped to Eastern Europe and the former Soviet Union increased substantially from almost nothing in the mid-1980s to over a million tons in 1990/91.³⁹ The volume of food aid shipped to Latin America and the Caribbean almost tripled during the 1980s. Food aid for emergency relief peaked in the mid-1980s at the time of the great drought in Africa, declined slightly, and then increased sharply in 1990-91. As the Uruguay Round of the GATT is implemented successfully, food aid may be reduced as food surpluses in developed countries diminish.

FOUR KEY FACTORS WILL INFLUENCE FUTURE FOOD PRODUCTION AND CONSUMPTION

Global and regional food production and consumption during the next 10-20 years will be influenced by a large number of factors. Changes in the following four sets of factors are likely to be particularly important:

1. Economic growth and economic policies,
2. Population growth and urbanization,
3. Rural infrastructure, agricultural production technology, and access to modern inputs, and

4. Natural resource management and environmental considerations.

The expected impact of each of these factors on future food production and consumption is considerable.

Economic Growth and Economic Policies

Economic growth must resume in the developing world, especially in Sub-Saharan Africa. To support such

growth, it is critical to

- complete structural adjustment and economic reforms;
- remove external barriers to growth such as trade distortions and subsidies in developed countries;
- liberalize trade and remove market distortions;
- enhance access by the poor to land, capital, and technology;
- expand investment in rural infrastructure, health, education, and agricultural research and technology;
- facilitate sustainability in agricultural production; and
- reverse the decline in international assistance to agriculture.

Growth in real per capita income during the 1980s was disappointing for developing countries as a whole (Table 1). However, the low average rate of growth covers large variations among regions. The high rates of economic growth in Asia are expected to continue through the 1990s, while incomes in Sub-Saharan Africa are expected to keep pace with population growth.

Future economic growth depends on internal policies as well as on the international environment. The extent to which current structural adjustment and

economic reforms in Latin America, Sub-Saharan Africa, the Commonwealth of Independent States (CIS), Eastern Europe, and selected countries in Asia and the Middle East are carried to a successful completion at an appropriate speed and sequence is of paramount importance for future economic growth in those countries.

Closely related to this issue is the question of the most appropriate role of the state in a market-oriented economy with inappropriate institutions, poor infrastructure, and insufficient experience by the private sector in dealing effectively in a competitive market environment. Overreaction to past failures such as excessive and inappropriate state intervention may cause governments to take on a passive role where intervention is needed to assure that the markets function effectively and to deal with outside influences on the economy.

Future economic growth will also depend on the international trade environment, including trade distortions by developed countries, and access to external aid. Import restrictions for agricultural and nonagricultural products in Japan, the European Union, and the United States, along with domestic agricultural subsidies and implicit and explicit export subsidies for agricultural products, are of particular concern. The World Bank⁴⁰ estimates that a 50 percent reduction of the current trade protection by Japan, the European Union, and the United States would result in an increase of US\$50 billion in export revenues to developing countries, which is roughly equivalent to the total official economic aid from Organization for Economic Cooperation and Development (OECD) countries to developing countries. The largest share of this economic gain (54 percent)⁴¹ would be captured by the Far East.⁴²

Table 1—Annual growth in real per capita income, by region, 1980-2000

Region	1980-89	1990-2000
	(percent)	
Sub-Saharan Africa	-0.9	0.3
East Asia	6.3	5.7
South Asia	3.1	3.1
Latin America	-0.5	2.2
Middle East/North Africa	-2.5	1.6
Developing countries	1.2	2.9

Source: World Bank, *Global Economic Prospects and the Developing Countries, 1992* (Washington, D.C.: World Bank, 1992).

Trade liberalization is an integral part of structural adjustment and economic reforms in most developing countries. Historical trends of extensive protection are being replaced by a large degree of trade liberalization in many Latin American countries, with expected positive effects on economic growth. However, the sustainability of Latin America's trade liberalization policies is in danger because they are not being matched by trade liberalization in the United States, Europe, and Japan. Failure to achieve sizable reductions in agricultural protection in OECD countries would make it difficult for Latin America to continue its elimination of nontariff barriers and large reductions in tariffs. The result will be reduced economic growth and increasing unemployment and poverty in the region.

During the 1980s, government policies in most developing countries were dominated by the need to deal with economic crises, including balance-of-payment problems. During the first half of the decade many countries attempted to correct balance-of-payment problems in an unrealistically short period of time. Stabilization policies aimed at freezing wages and reducing demand caused severe hardships for both the poor and the middle classes. It is hoped such stabilization policies are a thing of the past. More recently, emphasis has been on supply-enhancing structural adjustments and policy reforms. Unfortunately, insufficient attention has been paid to adjustments and reforms that improve the productivity of the human resource (health, education, and nutrition) and enhance access by the poor to productive resources such as land and capital. Furthermore, while policy reforms frequently aim to liberalize and privatize markets and to reduce inefficiencies caused by the public sector, much more attention should be

given to the removal of distortions in input and output markets, asset ownership, and a series of other institutional and market distortions that are adverse to the poor. Without such attention, existing institutions will continue to be adverse to the poor, and market liberalization and privatization are likely to result in rapid accumulations of wealth among a small number of people with only limited benefits to the poor.

Improved human resources and enhanced access by the poor to other productive resources will help reduce poverty and food insecurity and encourage higher economic growth. Policies that will expand investment in rural infrastructure, primary health care, education, agricultural research and improved production technology, technical assistance, and credit are urgently needed to enhance income earnings, food security, and nutritional status among the rural poor and to reduce unit costs of food production for the benefit of both the rural and urban poor.

Policies are needed to pursue the triple goal of poverty alleviation, increased productivity in food production, and sustainability. No attempts will be made to detail such policies here but such a list would include policies to improve water management, expand agricultural research, and deal effectively with externalities resulting in land degradation and deforestation. In addition, policies are needed to protect the rural and urban poor from both chronic and transitory food insecurity in the short run. Such policies would include targeted food and cash transfers of various types, labor-intensive public works programs, and emergency relief. International food aid may play an important role.

In the poorest of the developing countries, including virtually all of Sub-Saharan Africa, effective population

policies focused on family planning and reduced rural-urban migration are urgently needed. However, such policies will be fully successful only if accompanied by alleviation of poverty and improvements in education, primary health care, and nutrition. While investment in urban infrastructure, including social infrastructure, must be accelerated to accommodate the rapid urban population growth and avoid further expansions in urban slums and associated misery, rural development, including enhanced income-earning opportunities for the poor and access to primary health care, is critical to reduce migration of poor rural residents to urban areas. Provision of education in rural areas may accelerate migration but the migrants are less likely to end up in slums.

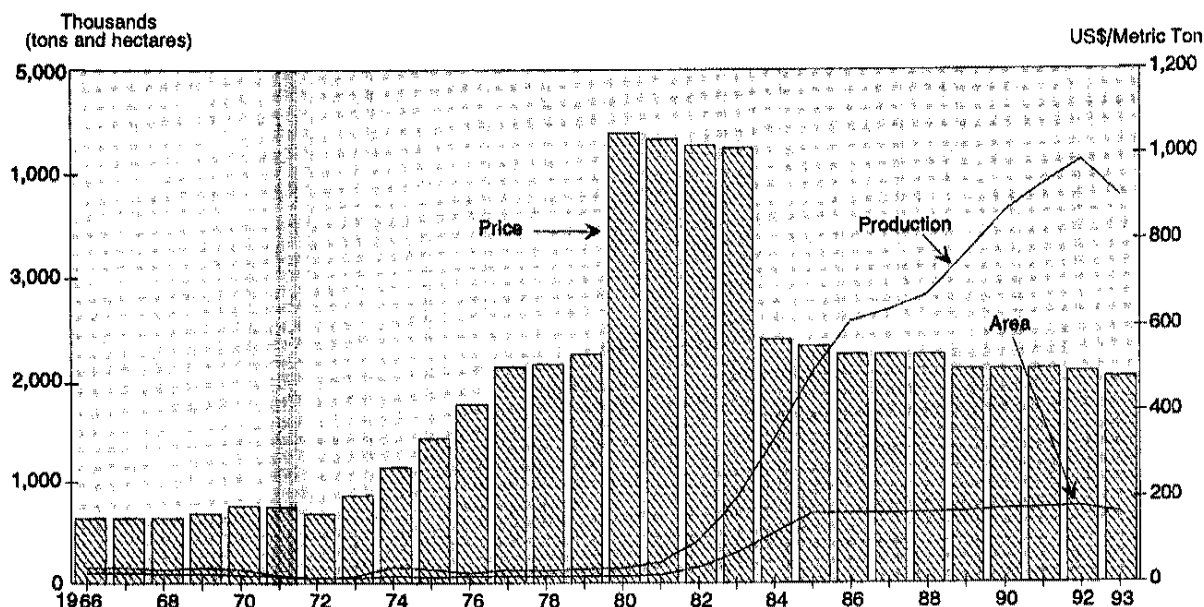
In low-income developing countries, agriculture is the most effective and frequently the only viable lead sector for overall economic growth. Agricultural growth stimulates economic growth in nonagricultural sectors, which, in turn, results in increased employment and reduced poverty. Unfortunately, international financial support to agricultural development has decreased sharply during the 1980s and early 1990s. A recent study shows that real external assistance to agriculture in low-income countries declined from US\$12 billion in 1980 to US\$10 billion in 1990, while the share of agriculture in development assistance declined from 20 percent in 1980 to 14 percent in 1990.⁴³ At the same time, no real advances have been made to reduce the negative effects on developing-country agriculture from the protection of OECD agriculture. A reversal of the downward trend in international support for developing-country agriculture is urgently needed not only to assure future food supplies and protect natural resources, but also to facili-

tate general economic growth in low-income developing countries. This is also critical for expanding export markets for both agricultural and nonagricultural commodities from OECD countries. Preliminary findings from on-going IFPRI research indicate that agricultural growth in low-income countries results in growth in agricultural imports that—in percentage terms—exceeds growth in the agricultural sector. Thus, rather than reducing export markets as feared by some farm groups in OECD countries, foreign assistance to developing-country agriculture expands these markets.

Although an economically healthy agricultural sector is usually a necessary condition for the alleviation of rural poverty, it is not sufficient. In most developing countries, the rural poor derive a large share of their income from sources other than agriculture, although some of these income sources depend on agriculture directly or indirectly.⁴⁴ Furthermore, many of the rural poor are net buyers of food. Thus, while policies to stimulate expanded agricultural production will be beneficial to some of the rural poor, others will be either unaffected or negatively affected. Policies that increase food prices for the net-food-buying rural poor are an example of the latter.

The emphasis should be on low-cost rather than high-cost agriculture. Technological change and improved rural infrastructure are among the most effective ways to facilitate production expansions at reduced unit costs. Large production expansions can be obtained even under very adverse conditions if costs are of little concern. As a result of high prices and heavy investments, Saudi Arabia increased wheat production from virtually nothing prior to 1980 to more than 4 million tons by 1992 (Figure 12). Net imports of more than

Figure 12—Wheat production, area, and prices in Saudi Arabia, 1966-93



Source: Ministry of Agriculture and Water, Agricultural Trade Office, Riyadh, Saudi Arabia.

0.5 million tons in 1982 were converted to net exports of almost 2 million tons in 1991. In low-income developing countries, high-cost agriculture conflicts with the need to assure that low-income consumers have access to sufficient food.

Population Growth and Urbanization

If progress in economic growth is not to be undermined by rapid population growth and excessive urbanization, effective population and migration policies are necessary to complement growth-oriented policies. Such policies must focus on

- universal access to family planning information and technology; and
- incentives to reduce rural-urban migration, such as provision of employment in rural areas and stimulation of agricultural and nonagricultural growth in rural areas.

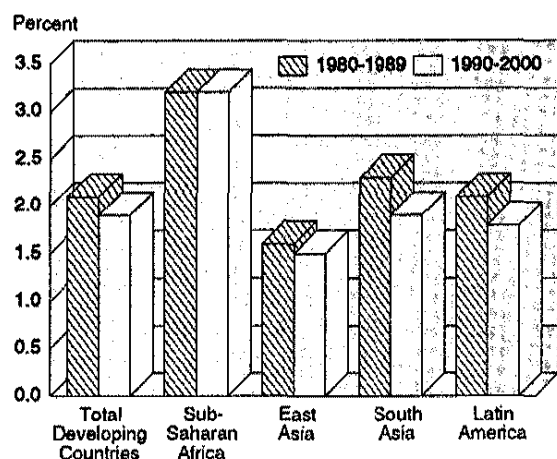
According to the United Nations, the current world population of 5.5 billion

will increase to approximately 10 billion by 2050. Although the annual growth rate is falling for the world as a whole, the population increase during the next 20-30 years, of slightly less than 100 million people a year, will be the largest ever. Approximately 97 percent of this increase is projected to occur in the Third World, with Africa alone accounting for 34 percent of the growth. Thus, although reductions in annual population growth rates have begun to occur in Asia and Latin America, they are insufficient to counter the absolute increases (Figure 13).

The rate of growth is particularly strong in urban areas (Figure 14), and it is projected that approximately 44 percent of the population of developing countries will reside in urban areas by 2000, up from 22 percent in 1960 and 31 percent in 1980 (Figure 15).

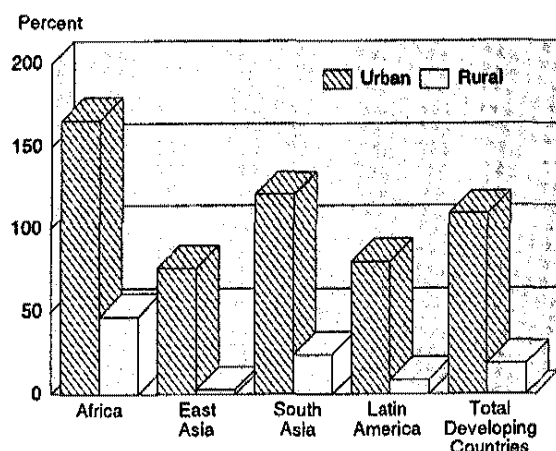
Population growth rates of these magnitudes will greatly increase the need for food and other basic necessities, severely constraining efforts to improve per capita income and well-

Figure 13—Annual population growth, 1980-2000



Source: World Bank, "World Development Indicators 1992," World Bank, Washington, D.C., 1992 (computer disk).

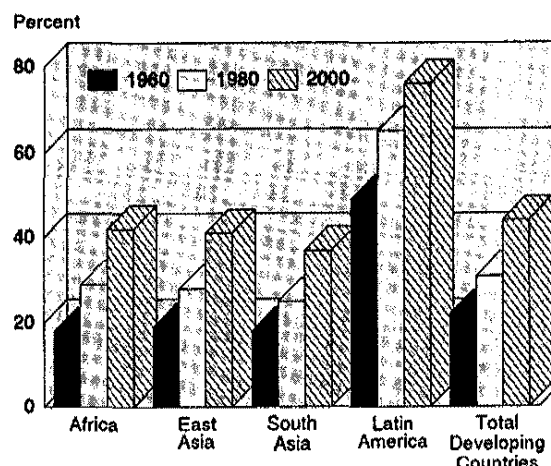
Figure 14—Projected increase in urban and rural populations, 1980-2000



Source: United Nations, *World Economic Survey 1993: Current Trends and Policies in the World Economy* (New York: UN Department of Economic and Social Information and Policy Analysis, 1993).

being in developing countries. It is unlikely that Sub-Saharan Africa will be able to cope with such large population growth without significant increases in poverty and decreases in the overall standard of living. Although past and current famines in the region have been blamed on droughts, wars, and adverse agricultural policies, they are largely an

Figure 15—Percent of population living in urban areas



Source: United Nations, *World Economic Survey 1993: Current Trends and Policies in the World Economy* (New York: UN Department of Economic and Social Information and Policy Analysis, 1993).

outcome of already high rates of population growth and widespread poverty. Failure to significantly reduce population growth within the next 20 years will render all other development efforts insufficient to avoid much greater human misery in the future than has been seen in the region so far.

Rapidly growing urban populations in the Third World will place severe pressures on the food marketing systems, including transportation, storage, processing, grading, and market information. In many developing countries, particularly in Sub-Saharan Africa, massive investments in physical infrastructure in both rural and urban areas will be needed to support the feeding of the urban population. Current efforts undertaken as part of economic reforms in many African countries to strengthen efficiency and competition in agricultural marketing through the private sector must be enhanced and the appropriate role of government must be identified.

Urbanization will accelerate the dietary transition associated with in-

creasing incomes. Increasing opportunity cost of women's time; changes in food preferences caused by promotions, advertising, and changing lifestyles; and changes in relative prices associated with rural to urban migration will change food demand from basic staples such as sorghum, millet, maize, and root crops to cereals such as wheat and rice (which require less preparation time), fruits, foods of animal origin, sugar, and processed foods. Rapid increases in the demand for livestock products will have severe repercussions for the demand for cereals as already discussed.

Rural Infrastructure, Agricultural Production Technology, and Access to Modern Inputs

Continued progress in all three of these areas is critical to future food security.

- Resources must be committed to infrastructure construction and maintenance. Labor-intensive public works programs are a viable mechanism for building roads, reforesting areas, and engaging in soil conservation projects, while creating employment and income in rural areas.
- International and national agricultural research must continue to develop yield-enhancing production technology, especially in maize, millet, and other crops, as well as build tolerance or resistance in crops to pests and adverse climatic conditions.
- Farmer access to modern inputs must be facilitated through provision of credit and technical assistance. Inputs must be made available to all farmers on time and in required amounts.

The importance of investments in rural infrastructure within the context of rapid urbanization has already been

established. Even without rapid urban growth, however, such investments are needed in many developing countries, particularly the poorest ones, to facilitate agricultural and rural development. Improved rural infrastructure enhances access to export markets, modern production inputs, and consumer goods. It reduces marketing costs, promotes exchange between intracountry markets, reduces spatial and temporal price distortions, and, in general, increases efficiency in production and marketing.

However, while essential, effective rural infrastructure alone is not enough to assure agricultural and rural development and rapid increases in food production in developing countries. Yield-enhancing production technology is of critical importance. Although opportunities for expansion of agricultural production into lands not currently under cultivation still exist in some countries, such opportunities are so limited that they would probably not be able to counter losses of current agricultural lands to alternative uses on a global level. Furthermore, attempts to expand agricultural production into new lands would, in most cases, require large investments in technology, tools, and materials and would increase the risk of land degradation and deforestation. Thus, future increases in food production must come primarily from higher yields per unit of land rather than from land expansion.

Agricultural research has successfully developed yield-enhancing technology for the majority of crops grown in temperate zones and for several crops grown in tropical zones. The dramatic impact of agricultural research and modern technology on wheat and rice yields in Asia and Latin America since the mid-1960s is well known. Less dramatic but significant yield gains have been obtained from research and tech-

nological change in other crops, particularly maize. Large yield gains currently being obtained in many crops at the experimental level offer great promise for future yield and production increases at the farm level. In addition to affecting yield levels, research resulting in tolerance or resistance to adverse production factors such as pests and drought and research on new varieties and hybrids better suited for various ecological conditions reduce risks and uncertainty and enhance sustainability in production through better management of natural resources and reduced environmental risks (through reduced use of chemical pesticides and avoidance of irreversible land degradation).

Even if the positive impact on sustainability and natural resource management is ignored, investment in national and international agricultural research has been shown to produce large economic gains relative to costs (Tables 2 and 3). The distribution of economic gains among groups in society varies among countries and over time, depending on a number of issues

Table 2—Annual rates of return (RR) to agricultural research, by region

Region	Less Than 10 Percent RR	More Than 50 Percent RR
(percent of programs analyzed)		
Africa	20	40
Asia	3	63
Latin America	7	46

Source: R. E. Evenson and M. W. Rosegrant, "Determinants of Productivity Growth in Asian Agriculture: Past and Future," Paper presented at the 1993 American Agricultural Economics Association International Pre-Conference on Post-Green Revolution Agricultural Development Strategies in the Third World: What Next? Orlando, Florida, August 1993.

Table 3—Annual rates of return (RR) to agricultural research, by commodity

Region	Less Than 10 Percent RR	More Than 50 Percent RR
(percent of programs analyzed)		
Wheat	7	43
Rice	0	68
Maize	0	31
Other commodity programs	12	53
Aggregate research programs	1	62

Source: R. E. Evenson and M. W. Rosegrant, "Determinants of Productivity Growth in Asian Agriculture: Past and Future," Paper presented at the 1993 American Agricultural Economics Association International Pre-Conference on Post-Green Revolution Agricultural Development Strategies in the Third World: What Next? Orlando, Florida, August 1993.

related to markets, institutions, and policies. Gains captured by producers and agricultural workers contribute to employment, growth, and investment in agriculture and rural areas both directly and indirectly through growth linkages, while gains captured by consumers enhance purchasing power and facilitate employment and economic growth through lower wages and increased demand for goods and services. Depending on the structure of the economy, poverty would be alleviated in both rural and urban areas.

Accelerated investment in agricultural research and technological improvements is not only necessary and urgent, it is the only viable option to assure sufficient food to meet future needs and demands at reasonable prices without irreversible degradation of natural resources. While the large past and current economic benefits from agricultural research reflect traditional re-

search methods, the recent development of biotechnological methods is likely to accelerate the research process, that is, reduce the time needed between initiation of research and expected impact, and greatly enhance the opportunities for improved and higher-yielding plants and animals.

In addition to land, water is another natural resource becoming increasingly scarce in many production environments. Efforts to meet future food needs and demands while promoting sustainable economic growth and poverty alleviation, including agricultural research and government policy, must pay increasing attention to the efficiency of water use, sustainability of water management practices, and investment in establishing and maintaining irrigation facilities.

Last but not least, farmers must have access to modern inputs such as improved livestock, crop varieties and hybrids, fertilizers, and pest control measures, as well as to credit, technical assistance, and improved farm management practices. These are essential components of a successful strategy to meet food production and development goals. Efforts to enhance farmers' access to modern inputs must recognize the role of women in farming and marketing and design the programs accordingly.

Natural Resource Management and Environmental Considerations

Research, technology development, incentives, and regulations are needed to prevent environmental degradation. These measures include appropriate water management policies, reduction of subsidies that encourage wasteful

use of inputs, better definition of ownership and user rights to resources including land, education of farmers to encourage appropriate use of technology and resource conservation, and the provision of alternatives to resource-degrading inputs and techniques. Since poverty is a major source of degradation, poverty eradication is justified also on environmental grounds.

The recent surge in public and private concerns about negative environmental effects of economic growth and development may, if sustained, have important implications for agricultural development and future food production and consumption. Of particular concern is the need to avoid degradation of natural resources such as land and water, as well as deforestation, water contamination, and health risks associated with the use of chemicals. Since most of the current and potential resource degradation and environmental contamination result from situations in which those who cause and possibly benefit from degradation do not pay the costs, neither the market nor the individual producers and consumers are likely to incorporate preventive measures into their behavior. Only when sufficient damage has been done to influence significantly current or future production costs will market and producer behavior change. The state is more likely to undertake preventive measures either through publicly funded research and technology development or through incentive policies and regulations. Extensive waterlogging, salination, and associated land degradation and productivity losses resulting from inappropriate water management are of particular concern in large parts of Asia.

In developing countries, poverty, rapid population growth, low agricultural productivity, and poorly defined ownership of and user rights to resources are the major risk factors associated with the degradation of natural resources.

Attempts to meet basic needs for survival in the short run take priority over longer-term sustainability. Rural poverty combined with low yield capacity of crops and livestock and poorly defined land ownership lead to unsustainable exploitation of fragile lands, including those where rainfall is low. Where land is scarce and population pressures are strong, deforestation is an appealing solution for poor rural households to mitigate short-run food and income shortfalls. However, the ultimate consequences are likely to be reduced forest land, soil erosion, changing rainfall patterns, and general reductions in the productive capacity of the land.

Yield-enhancing agricultural technology is the most promising avenue to sustainable agricultural production. Higher yields on land with high production potential will reduce the pressure on fragile land and, together with better definition and distribution of land ownership and user rights, will reduce deforestation and desertification. Agricultural research and technology can develop production methods that will help maintain land quality and productivity over time. And appropriate agricultural technology and production practices for drought-prone areas may buffer the negative effects of low and variable rainfall on food security in addition to reversing current trends of land degradation.

Agricultural research has already made great progress in developing plants that are tolerant or resistant to

various pests and in biological pest control, thus reducing the need for chemicals. The efficiency of chemical pest control methods has been greatly increased and contamination and personal safety risks have been reduced. Accelerated research could further reduce the dependence on chemical pest control and the risk of contamination.

As population, poverty, and food demand continue to grow, failure to develop and implement appropriate technology in production and marketing will lead either to more food insecurity and hunger, for which the current generation of poor people will pay, or to further degradation of natural resources, for which future generations will pay. Future food demands can be met and production capacity can be sustained only if (1) investment in appropriate research and technology is accelerated; (2) decisions on problems such as resource ownership and user rights and the needs of future generations are either incorporated into production and consumption decisions or effectively dealt with by government policy; and (3) poverty is significantly reduced or eradicated.

In view of the large risk of irreversible degradation of our natural resources and the urgent need to assure sustainable agricultural production to meet future food demands, it is difficult to understand why investment in the most promising solution, agricultural research and technology, is decreasing. While government policy and regulations are essential to assure compatibility between production and environmental goals, they will have only limited success unless accompanied by appropriate technology.

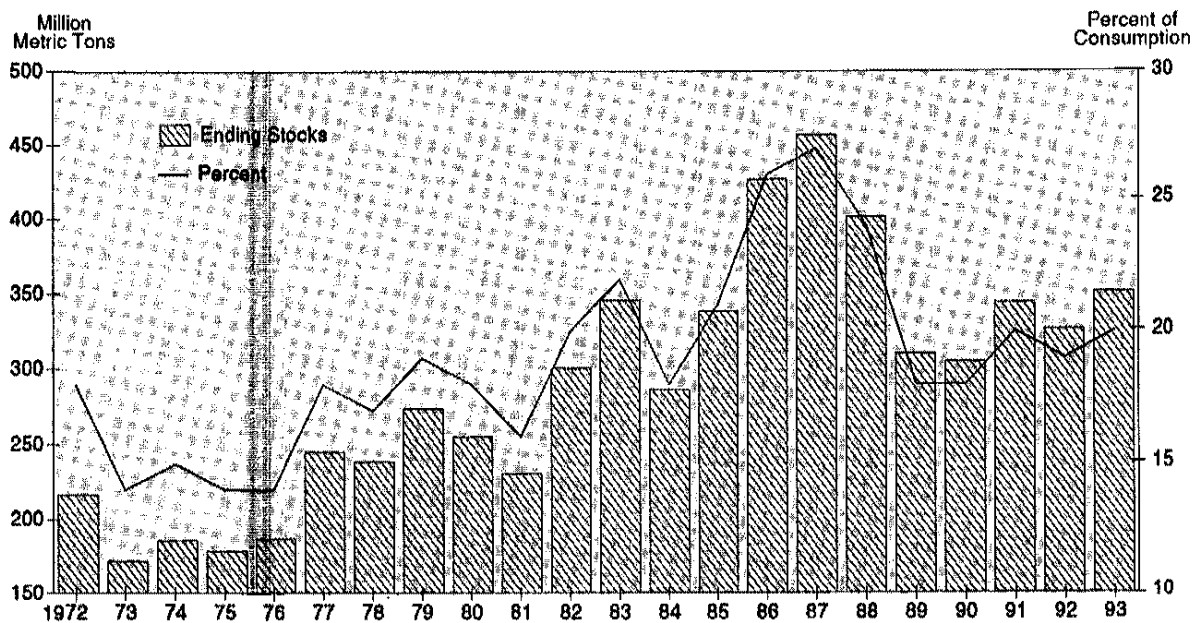
NO TIME FOR COMPLACENCY

International real food prices continue to decline, large food surpluses continue to exist in the European Union and the United States, and there is reason to believe that the former Soviet Union and Eastern Europe will expand food production and possibly reduce consumption during the next 10 years and perhaps beyond. Yields of wheat, rice, and maize are increasing in Asia and parts of Latin America, and a few African countries have shown an ability to rapidly expand food production in response to favorable policies and technologies. World stocks of cereals are about 350 million tons or 19 percent of annual consumption. Although lower than in the mid-1980s, this is considerably higher than the levels immediately prior to the food crisis of the early 1970s (Figure 16). Taken together,

these facts indicate there is no serious problem. And in response, support from developed nations for developing-country agriculture, including research and technology, is declining. The developed countries have become complacent.

But population growth will outstrip growth in food production in Sub-Saharan Africa for a long time to come unless more is done to accelerate agricultural growth. Between now and 2000, the population will grow at more than 3 percent a year, while food production is likely to grow at 2 percent or less a year. By the year 2000, the production shortfall is estimated to increase to about 50 million tons of grain equivalent, up from the current level of about 14 million tons.⁴⁶ The region will not have the necessary foreign exchange to import such large amounts of food. And

Figure 16—World stocks of grain, 1972-93



Sources: FAO (Food and Agriculture Organization of the United Nations), "FAO Agrostat-PC, Population, Production, and Food Balance Sheets Domains," FAO, Rome, 1992 (computer disk); FAO, "The State of Food and Agriculture 1993," FAO, Rome, 1993 (mimeographed).

African governments will not be able to count on enough food aid to make up the difference. If current trends continue, the World Bank estimates that by the year 2020, Africa will have a food shortage of 250 million tons, which is more than 20 times the current food gap.⁴⁶

Poverty is expected to increase rapidly in the coming years. Sub-Saharan Africa's share of the world's poor is expected to increase from the current 19 percent to about 28 percent in 2000. Furthermore, the number of underweight children is expected to increase in the 1990s in Sub-Saharan Africa even under the most optimistic assumptions made by the United Nations.

Asian demand for cereals is estimated to grow at an annual rate of 2.1 percent between now and the year 2000, whereas food production is expected to grow at 1.9 percent per year.⁴⁷ Much of the production shortfall is likely to be dealt with through expanded imports and perhaps through expanded regional production in response to price increases.

In Latin America, by contrast, growth in food production is anticipated to exceed food demand growth: food production is estimated to grow by 3 percent annually between 1990 and 2000, while food demand is estimated to grow by 2.5 percent per year.

Large areas of land are rapidly being degraded and deforested. And the principal reasons for environmental degradation—poverty, high population

growth, and limited access to appropriate agricultural technology—are not being dealt with effectively.

About 700 million people are food insecure; for them the food crisis has arrived. For the 10-12 million preschool children who died last year from hunger and diseases related to malnutrition, the food crisis came and went. One-third of the preschool children of the Third World are unable to grow to their full potential and face increased risk of death and disease.

Complacency is not in order. Clearly, Malthus underestimated the power of science to expand food production. The mass starvation that was predicted for Asia in the 1970s and 1980s did not occur because science was effectively put to work to expand crop yields. However, past yield increases came about because people with foresight made appropriate decisions. The failure to expand investments in agricultural research and technology development during the 1980s and early 1990s indicates that such foresight no longer prevails. Given the long lag time between investment in agricultural research and the resulting production increases, failure to invest today will show up in production shortfalls 10 to 20 years from now. The problems associated with environmental degradation will present themselves sooner. We must not wait until a global food crisis is upon us or until the last tree has fallen to make these investments.

NOTES

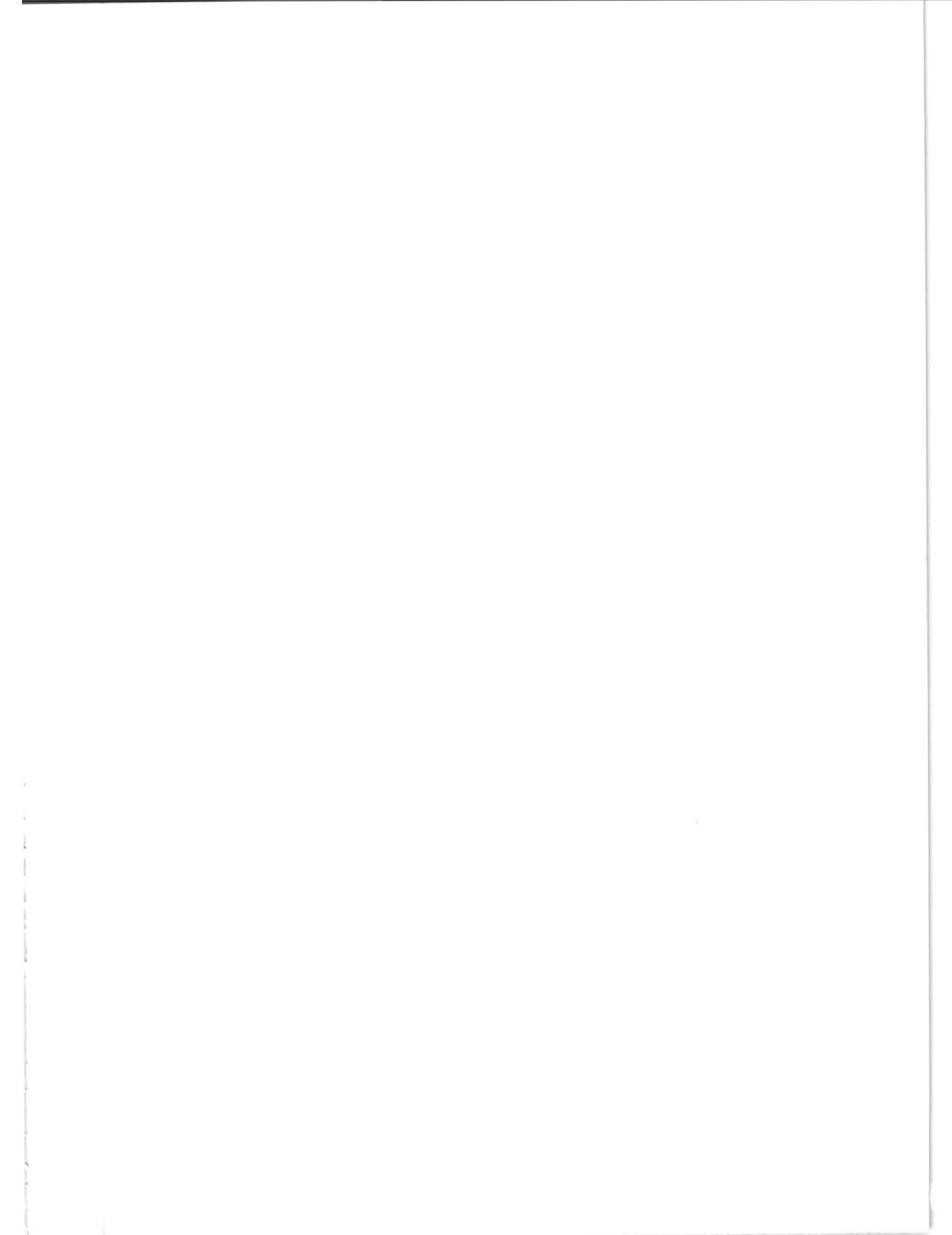
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5. This includes population of all ages with energy intake, on average, below 1.54 Basal Metabolic Rate (BMR) over one year.
6. United Nations Administrative Committee on Coordination/Sub-Committee on Nutrition (UN ACC/SCN), *Second Report on the World Nutrition Situation, Volume 1, Global and Regional Results* (Geneva: UN ACC/SCN, 1992).
7. Weight less than -2 standard deviations of a normal population.
8. The optimistic scenario applies the best observed rate of change over a five-year period during 1975-90 to the regional grouping of countries, whereas the pessimistic scenario applies the worst five-year rate.
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