

Winning the Food Race

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In many developing countries rapid population growth makes it difficult for food production to keep up with demand. Helping couples prevent unintended pregnancies by providing family planning would slow the growth in demand for food. This would buy time to increase food supplies and improve food production technologies while conserving natural resources.

While the global economy produces enough food to feed the world's 6 billion people, food could be better distributed and many people lack access to enough food for a healthy life. In particular, the UN Food and Agriculture Organization (FAO) has identified 82 poor countries that are at particular risk. These countries face rapid population growth, do not produce enough food domestically, confront serious constraints to producing more food, and cannot import enough to make up the deficit.

Hunger Widespread

In poor countries, especially where population is growing rapidly, hunger and malnutrition are often critical problems. An estimated two billion people suffer from malnutrition and dietary deficiencies. More than 840 million people—disproportionately women and girl children—suffer chronic malnourishment. Each year about 18 million people, mostly children, die from starvation, malnutrition, and related causes.

The World Food Summit in 1996 focused international attention on the concept of food security—access by all people to "safe and nutritious food to maintain a healthy and active life," according to FAO. Worrisome trends in agricultural production and current international trade policies raise questions about whether food production and distribution can improve fast enough to overtake population growth and reach the goal of food security.

Discouraging New Trends

From the 1960s until a few years ago, world food supply kept pace with population growth. New agricultural technologies, better seed varieties, and irrigation—the Green Revolution—expanded the food supply. At the same time, in many developing countries contraceptive use has risen substantially, and fertility has fallen rapidly, amounting to a reproductive revolution. Between 1985 and 1995, however, in 64 of 105 countries studied by FAO, food production lagged behind population growth. Africa now produces nearly 30% less food per person than in 1967.

Moreover, trying to meet the rising demand for food is leading people to overuse the world's finite resource base. Most developing countries are already cultivating virtually all arable land. In some areas fertile soils are being exploited faster than they can regenerate. Fresh water supplies are becoming degraded or exhausted. Yields from capture fisheries have fallen. Such trends make it increasingly difficult to meet the world's food needs.

Steps to Food Security

Winning the food race requires a coordinated approach to increase agricultural production, improve food distribution, manage resources, and provide family planning. Also providing education and health care is essential to improve people's well-being and thus promote productivity and sustainable resource use. Along with better food distribution, achieving food

security requires addressing the needs of small farmers and raising agricultural productivity while preserving soil and water resources.

The ultimate outcome of the race to achieve food security is likely to depend on answers to the following questions:

- Will a new Green Revolution dramatically increase crop yields and keep up with growth in demand?
- Will resource degradation, waste, and pollution be reduced, and by how much?
- How soon will the reproductive revolution lead to replacement-level fertility worldwide?

Recent fertility declines have raised the hope that world population can stabilize some time in the next century. The sooner the world reaches replacement-level fertility of about two children per couple, the sooner world attention could shift away from the need to increase food production continually and toward improving the quality of life for all.

Population Growth and Food Needs

In many developing countries rapid population growth makes it difficult for agricultural production to keep pace with the rising demand for food. Most developing countries are already cultivating virtually all arable land and are bringing ever more marginal land under cultivation.

"Unfortunately, population growth continues to out-strip food availability in many countries," reported Jacques Diouf, director-general of the United Nations Food and Agriculture Organization (FAO), at the 1996 World Food Summit in Rome. For example, between 1985 and 1995, food production lagged behind population growth in 64 of 105 developing countries studied by FAO. Among regions, Africa fared the worst. Food production per person fell in 31 of 46 African countries.

Concerns about lagging agricultural production and rapid population growth, as well as inadequate food distribution systems, have focused international attention on the concept of food security. FAO defines food security as a "state of affairs where all people at all times have access to safe and nutritious food to maintain a healthy and active life". By this definition about two billion people—one person in every three—lack food security. Either they cannot grow enough food themselves, or they cannot afford to purchase enough in the domestic marketplace. As a result, they suffer from micronutrient and protein energy deficiencies in their diets.

Although the global economy probably produces enough food to feed the nearly 6 billion people in the world and even more, if it were distributed equitably, this food is not readily available to many millions of people. Natural resources, population, and agricultural production technologies are distributed unevenly around the world. Some countries produce more food than they need for domestic use, while others do not produce enough to assure access to adequate diets for all of their people. Thus better distribution of food is an essential component of any world strategy to improve food security.

While the way most people live and work has little impact on food distribution policies, people in their everyday lives do make a great difference in the demand for and supply of food, both as consumers and producers. While changes in food distribution policies are decided in national capitals and at international negotiations, communities and individuals can do much themselves to influence the demand for and supply of food. Therefore programmes and policies that enable people to improve agricultural productivity, manage natural resources, and plan their families are essential to improving food security.

Population: The Demand Side

Population growth, along with changes in people's living standards and dietary preferences, largely determine changes in the demand for food. Throughout history societies have raced to keep the food supply equal to or ahead of population growth. The race has not always been won, as the history of widespread malnutrition and famines attests.

Currently, world population is growing by over 80 million people a year—that is, by one billion people every 12 to 13 years. Such change is unprecedented. It was not until about 1800 that the world's total population reached 1 billion. It took approximately another century to reach 2 billion. In the past 50 years more people have been added to the world's population than during the previous 4 million years.

The world's population is expected to reach 6 billion in 1999. According to UN projections, by 2025 the world would contain over 8 billion people, of whom some 6.8 billion would live in developing countries.

Since the 1960s the rate of population growth has slowed. In what demographers have termed a reproductive revolution, fertility in developing countries has declined as contraceptive use has risen. Family planning programs have helped millions of couples avoid unintended pregnancies and thus have contributed importantly to reducing fertility rates. Because of family planning programmes in the past, the world now contains 400 million fewer people than it would otherwise.

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Many developing countries export one or two basic raw materials such as rubber or cacao, making them vulnerable to price changes.

World population is growing by 1.5% per year today compared with 2% per year in the 1960s. In some developing countries, however, primarily in sub-Saharan Africa, population is still growing at 2% to 3.5% per year, rates at which populations would double in 20 to 35 years. Even growth rates of 2% or less create a powerful momentum for future population increase, particularly as they are applied to ever larger numbers of people.

Changing diets. As living standards have risen in many parts of the world, more people have chosen to eat meat and dairy products regularly rather than to continue living almost entirely on grains such as rice, maize, and wheat. As people consume meat and dairy products instead of consuming grain directly, more grain must be produced to maintain the same calorific value. When used to feed livestock, grain provides humans with less than half as much food energy as when consumed by people directly.

Reflecting changing diets as well as population increases, the world's consumption of meat has nearly quadrupled in the second half of this century—from an estimated 44 million metric tons in 1950 to about 200 million metric tons in 1995. Today nearly 40% of the world's grain production goes to feed livestock. This trend makes it more difficult to feed the world's poor, who often cannot afford to eat meat at all.

Food Production: The Supply Side

For most of the past 50 years food production has outpaced rising demand. World population has doubled since World War II, but food production has tripled. In the developing world the calories available per person increased from an average of 1,925 calories in 1961 to 2,540 in 1992. World food production has expanded since the early 1960s due mainly to the Green Revolution—adoption of crop rotation, the mass production and use of petroleum-based fertilizers and chemical

pesticides, expanded irrigation, and the introduction of genetically superior, disease-resistant cultivars (cultivated crops).

The trend may now be changing for the worse, however. Since about 1990 global grain production has risen only slightly and, despite slower rates of population growth, grain supplies per capita have fallen. In the worst case, Africa now produces nearly 30% less food per person than it did in 1967. The reasons for the change in the trend include not only rapid population growth on the demand side, but also higher population densities in traditional agricultural areas, fragmentation of small farmsteads, poor land management, and inappropriate agricultural and economic policies, all of which suppress supply.

With one-third of world population lacking food security now, FAO estimates that world food production would have to double to provide food security for the 8 billion people projected for 2025. By 2050, when world population is projected to be over 9 billion, the situation would be even more challenging. At current levels of consumption, without allowing for additional imports of food, Africa would have to increase food production by 300% to provide minimally adequate diets for the 2 billion people projected in 2050; Latin America would have to increase food production by 80% to feed a projected 810 million people; and Asia's food production would have to grow by 70% to feed the 5.4 billion people projected. Even North America would have to increase food production by 30% to feed a projected 384 million people in 2050.

Rapid population growth not only pushes up demand for food but may also be starting to diminish supply as well. As people try to obtain higher yields from heavily used natural resources, soil loss worsens, fresh water becomes scarcer, and pollution increases. As a result the developing world's capacity to expand food production may well be shrinking, not expanding.

Food Distribution

Food security could be improved for millions of people if food from countries with a surplus were better distributed to countries where there are food deficits—that is, countries that do not produce enough food to meet domestic needs. The international trade system, however, works against the ability of poor countries to meet their food needs with imports.

Most rich countries produce enough food for themselves and for export as well. Affluent manufacturing countries that are not self-sufficient in food production can afford to import as much food as they need, and more. Also, developed countries protect their agricultural sectors with various economic incentives and trade barriers—including price supports for key commodities, such as wheat and corn, and tariffs to shield domestic growers from cheaper imports.

In contrast, the poorest countries, particularly those with food deficits, usually export only one or two raw commodities, such as rubber or cacao. When prices of export commodities decline on the world market, or when prices of vital imported supplies rise, they are hit hard. During the 1980s raw commodities exported by developing countries lost 40% of their value in relation to the manufactured goods that these countries imported. Between 1982 and 1992 the real value of cacao fell by 60%, cotton by 40%, and natural rubber by 45%. In 1991—just one year—Africa lost an estimated US\$5.6 billion because of declines in commodity prices. Recently, however, some raw commodity prices have risen, providing relief to developing-country trade balances.

Declining commodity prices usually are good for consumers in wealthy countries, but in poor countries small-scale farmers suffer. In the 1970s and 1980s, for example, while real farm incomes increased substantially in most developed countries, real income from agriculture dropped for the average farmer in the developing world. To maintain their purchasing power, these poor farmers often try to bring more marginal land into production, even though this land yields less per hectare. Farmers may be pushed off their land altogether to make room for export driven agriculture, as governments try to make up the shortfall in international trade revenues.

National governments and international organizations can help to improve food distribution systems and can adopt new policies that make food more available and affordable. Over the long run, FAO argues, increased regional trade and cooperation are important to raising living standards in poor countries and to providing more affordable food. In addition, better world markets for developing country agricultural produce could help provide more jobs in these nations, raise incomes, reduce hunger, and minimize pressures from subsistence farming on the resource base.

At the same time, however, FAO contends that international trade alone "cannot solve the problems of poverty and access [to food] which are the keys to food security". Given current population growth trends and land degradation patterns, FAO has warned that "future nutritional requirements challenge....both food production and environmental capabilities".

Conflicting Predictions

For the past two decades food prices generally have fallen. Between 1981 and 1990, for example, the price of staple foods fell by close to 40% on world markets. Because this figure is an average, however, it masks price increases that have occurred in a number of developing countries in recent years.

In 1995 world grain prices soared by roughly half as world grain reserves fell to just 231 million metric tons, only enough to meet needs for 48 days and well below the minimum food cushion of 60 days advised by FAO. The shortfall in grain production and the rise in prices appear to have been temporary, largely the result of three years of poor harvests, stockpiling, a shift to production of other crops as price subsidies were cut in Europe and North America, and substantial declines in food production in the former Soviet Union.

Expert opinion is divided on the long-term outlook for food prices, reflecting differences of opinion about production capacities and environmental limits. FAO, the World Bank, and the International Food Policy Research Institute expect food prices to decline, following the basic trend of the past two decades. According to the Worldwatch Institute, however, food prices could rise over the next two decades in response to falling production per capita and rapid growth in food demand in developing countries.

The Japanese Ministry of Agriculture has forecast a doubling of world grain prices by 2010 and more than doubling of prices for wheat and rice (using 1992 as the base year). Unlike other forecasts, this one takes into account such factors as decreasing availability of arable land and fresh water and the mounting environmental costs of using more and more fertilizers and pesticides. Soil erosion and degradation already have reduced agricultural productivity on about one-third of the world's cropland.

Carrying Capacity

Logically, population growth must stop at some point, or the earth would become overcrowded and its resources eventually would be depleted. The term "carrying capacity" refers to the number of people that the earth can support on a sustained basis—that is, support indefinitely at a constant standard of living without destroying the natural resource base. There is no way to predict how large the population could become, however, before it overwhelmed the planet. Nor is there any way to predict the quality of life in the future under the almost infinite variety of scenarios for population growth, consumption patterns, food production, technological change, natural resource use, air and water pollution, land degradation, and many other factors.

The question of carrying capacity has been debated for 200 years, since 1798, when the English economist Thomas Malthus published his *Essay on the Principle of Population as It Affects the Future Improvement of Society*. Malthus reasoned that, since productive land and potable water

are finite resources, population growth inevitably would outstrip the food and water supply at some point. Mass starvation and anarchy would follow.

The Middle Ages in Europe provided many tragic examples for Malthus. Europe's population had risen from about 36 million in the year 1000 to 80 million in 1300, while new technology or innovations of any kind, were unknown. By 1300 good farmland was virtually exhausted. As more people tried to live from the same amount of cropland, food prices rose beyond the reach of the poor (that is, beyond the reach of nearly everyone except the clergy and nobility). Devastating famines ravaged the land in 1316 and 1317. Then in 1346 the Black Plague struck. By the end of the century it had killed one-third of the entire population of Europe.

Malthus failed to anticipate the subsequent leaps in agricultural technology and economies of scale that have enabled world population to rise to nearly six billion. Today, however, scientists warn that the planet may be increasingly at risk in the future. As biologists Peter Vitousek and colleagues argue, at current levels of population and technology, human activities cause "rapid, novel, and substantial changes" to the earth's ecosystems. These include degrading soil and water supplies; altering nature's cycles, largely by releasing enormous amounts of carbon dioxide into the atmosphere; and destroying or altering biological resources, even driving some plant and animal species into extinction. Reducing the pace of human impact on the earth's natural systems might give natural systems more time to adjust. The two basic ways of slowing the growth in human effects on the Earth, they advise, are to slow population growth and to use resources more efficiently.

While no one can accurately predict the distant future, the final outcome of the race between population growth and food supply is likely to hinge on the answers to several questions:

- Will a new Green Revolution dramatically increase crop yields and keep up with growth in demand?
- How soon will the reproductive revolution lead to replacement-level fertility worldwide?
- Will resource degradation, waste, and environmental pollution be reduced, and by how much?
- Can poor countries help small-scale and subsistence farmers (including women) become more productive and better off without overexploiting non-renewable natural resources?
- Will international trade policies be reformed to improve the flow of food across national borders?

Hunger in the Midst of Plenty

While food is abundant in many areas, many millions of people in developing countries are undernourished. Each year about 18 million people, mostly children, die from starvation, malnutrition, and related causes. An estimated two billion people suffer from malnutrition and dietary deficiencies; some 840 million of them are chronically malnourished. In sub-Saharan Africa as many as 70% of all women are anaemic.

About 200 million children under age five—40% of all children of this age in the developing world—lack sufficient nutrition to lead fully active lives. One indicator of chronic malnutrition among children is the percentage who are stunted—that is, short for their age compared with international standards set by the World Health Organization (WHO). Stunting among children ages 3 months to 3 years varies widely among countries, but at least one child in every three was stunted in over 40% of countries surveyed by the Demographic and Health Surveys between 1987 and 1996.

Recent projections by the International Food Policy Research Institute (IFPRI) indicate that child hunger and malnutrition are not likely to be reduced much over the course of the next several decades. According to IFPRI, 150 million children under the age of six will still be malnourished in

2020, just 20% fewer than in 1993. In Africa the number of malnourished children is expected to increase by 45% between 1993 and 2020, reaching 40 million.

IFPRI projects that by 2020 nearly 70% of the people suffering from food insecurity will live in sub-Saharan Africa and South Asia. By 2020 every third person in sub-Saharan Africa is likely to lack food security, every eighth person in South Asia, and every 20th person in East Asia.

In many parts of sub-Saharan Africa, people often go without enough food. Worldwide, each year about 18 million people, most of them children, die from starvation, malnutrition, and related causes.

As they have throughout history, famines periodically kill millions of the world's poorest people. In 1974, for example, Bangladesh was hit by famine. While food remained available in many districts, it did not reach poor farmers who had lost their crops to widespread flooding. With their harvests ruined, and lacking cash to buy food, many starved.

The households most vulnerable to hunger and its consequences are large, poor families in rural areas and those in urban squatter settlements. Because poor families must spend most of their incomes just to eat, little remains for education, health care, sanitation, or housing. Often, villagers say that they cannot afford to feed large families and provide a decent life for themselves or their children. It is difficult to escape from this cycle of poverty. Many rural people say that, if they had known about and had used family planning when they were just entering their reproductive years, they would have had fewer.

Seasonal food shortages threaten the health and wellbeing of many subsistence farmers and their families. To survive, many farmers must move temporarily to towns and cities, looking for wage employment, or else work as farm labourers for wealthier land owners. In hard times subsistence farmers may even have to sell some of their land to buy food and pay their debts. If they cannot buy back their land in better times, they must struggle to live off smaller and smaller parcels of land. Some lose all their land.

Food Deficits and Hunger

In 1984 FAO reported that 54 of 117 countries studied over the preceding decade could not grow enough food on their own land to feed their populations using the low levels of agricultural technology available to most people. Most of these food-deficit countries could not import enough food to make up the shortfall.

Since the early 1980s FAO has issued yearly reports listing the world's low-income, food-deficit countries. In 1996 there were 82 such countries, half of them in Africa. By definition, these countries have a per capita gross national product (GNP) of US\$1,345 or less and have had a net deficit in grain trade over the preceding five years.

The situation could grow worse for food-deficit countries. In many of them, population growth is among the most rapid in the world, and most face serious constraints to increasing agricultural production. To one degree or another, these constraints affect many other developing countries as well:

- **Limited agricultural land.** The best agricultural land is already being cultivated. Most of the remaining potential agricultural land consists of clay or sandy soils, often on steep slopes with limited water supplies, or nutrient-poor tropical soils;
- **Limited water supplies.** Fresh water resources are scarce, and there often are severe water shortages during dry seasons;

- **Poverty.** Farmers often lack enough land to feed their families, let alone to produce food surpluses for sale, while their countries cannot afford to import enough food to meet people's needs;
- **Poor access to credit.** Many farmers cannot obtain loans to bridge the gap in their incomes between harvests and must seek work as labourers or even sell off some of their land to survive;
- **Lack of appropriate policies.** To produce more food, communities need help obtaining suitable technologies and crop varieties and developing sound agricultural strategies.

Limits and Constraints

In poor countries particularly, but also elsewhere, limits on natural resources and poor agricultural practices make it difficult to meet food needs, both now and in the future. Assuring food security over the long term depends on making agricultural production environmentally sustainable. Sustainable agriculture, as defined by FAO, means agriculture that conserves land, water, and plant and animal genetic resources, does not degrade the environment, and is economically viable and socially acceptable. Thus sustainable agriculture manages and uses natural resources to meet people's needs both now and in the future.

In some countries, however, environmentally destructive farming and fishing practices and poor conservation and resource management are limiting the productivity of natural resources even as population growth demands more. Because the costs of poor environmental practices are rarely taken into account, they are often given too little weight in policy decisions, point out Robert Costanza and colleagues in an assessment of the economic value of the ecosystem. If food production, water supply, and other ecosystem services continue to be undervalued and therefore overexploited, the impact on human welfare could become enormous, they warn.

Among the most serious constraints to achieving sustainable agriculture and food security in the face of population growth are: shortages of arable land, degradation of land resources, loss of agricultural land due to urbanization, water shortages and pollution, irrigation problems, collapsing fisheries, disappearing genetic diversity, and climate change.

Shortages of Arable Land

In many developing countries rapid population growth has meant that arable land per capita has declined sharply. In 1961, for example, developing countries as a whole had an average of about one-half of a hectare of arable land per person; by 1992 the amount had fallen to less than one-fifth of a hectare. If current trends in population growth and land use continue, in 2050 the amount of arable land will be just over one-tenth of a hectare per person.

In the early 1990s, when FAO surveyed 57 developing countries, over half of all farms were less than one hectare in size not enough to feed a family with four to six children and produce a surplus for sale. In India nearly three-fifths of all farms are less than one hectare. In India and other countries where sons receive equal shares of land as their inheritance, farm size diminishes with each generation.

Moreover, arable land has become increasingly concentrated in the hands of a few farmers at the expense of family farms. In Guatemala, for instance, 3% of farmers control 65% of the most productive agricultural land percentages typical throughout Latin America. Although land concentration often results in better yields, in many cases export crops have replaced food crops grown for domestic consumption.

The amount of land that could be cultivated has been estimated at 2 billion hectares, or about 40% more than is currently put to the plough. Most of the uncultivated land is marginal, however, with poor soils and either too little rainfall or too much. Bringing such land into production would require costly irrigation systems or soil enhancement measures. FAO concludes that, without substantial new financial investments or unforeseeable improvements in technology, increases in food production will have to come from land that is already being cultivated.

Meanwhile, however, much currently cultivated land is being lost. Worldwide, an estimated 5 million to 7 million hectares of farming land disappear each year, taken out of production because of accelerating land degradation and rapid urbanization. As populous agricultural areas become even more crowded, arable land is likely to come under increasing pressure. Agricultural yields could fall as land becomes more degraded, putting the livelihoods of millions of subsistence farmers at risk.

Land Degradation

Already, the productive capacity of much arable land is diminishing because soil is becoming degraded. Worldwide, nearly 2 billion hectares of crop and grazing land an area larger than the United States and Mexico combined suffer from moderate to severe soil degradation. The main causes are soil erosion, loss of nutrients, damage from inappropriate farming practices, and the misuse of agricultural chemicals. In the Philippines, for example, an estimated 1.2 million hectares of cropland, roughly quarter of the total, have been severely degraded by pesticides and chemical fertilizers.

Each year wind and rain erode an estimated 25 billion metric tons of topsoil from the world's croplands. China's Huang (Yellow) River alone empties 1.6 billion metric tons of eroded topsoil into the Yellow Sea each year. The United States has lost one-third of its topsoil since colonial times.

Loss of Agricultural Land to Urbanization

Urbanization affects food production in two ways—by removing agricultural land from cultivation, as cities expand, and by reducing the number of family farms, as more farmers move to cities. The spread of cities alone consumes enormous tracts of farmland in much of the world. Between 1987 and 1992, for example, China lost close to one million hectares of farmland each year to urbanization and the expansion of roads and industries. In the US, urban sprawl takes over nearly 400,000 hectares of farmland each year.

In food-deficit countries substantial migration of subsistence and small-scale farmers from the rural areas to the cities undermines food production capacities. At the same time, urban economies cannot absorb the huge influx of people looking for jobs. The number of people living in urban areas of developing countries has risen from about 300 million in 1950 to about 1.7 billion today. The world's population, estimated by the UN to be 45% urban in 1995, is projected to be nearly 60% urban by 2015. By then, the urban population of the developing world will reach an estimated 4 billion.

Water Shortages

Water shortages and water pollution constrain development in general and food production in particular. Only 3% of all water on the planet is fresh water, and most of this is frozen in icecaps and glaciers or is in underground aquifers. Only about 0.001% of the world's total water supply is readily available for human use. If evenly distributed, this amount would be sufficient for current needs. Of course, water is not distributed evenly. For example, in arid Saudi Arabia about 40 people must share the same amount of water that is available to one person in tropical Malaysia.

Hydrologist Malin Falkenmark and colleagues have calculated that, once a country's available water resources drop below 1,700 cubic metres per person per year, the country can be expected to experience regular water stress. Water stress means that for at least part of the year all water needs cannot be met without drawing down groundwater supplies or using surface waters faster than these resources are replenished. If the amount of water available per capita drops below 500 cubic metres per person per year, countries face conditions of absolute water scarcity.

Water scarcity or chronic stress makes it difficult to expand agricultural production to keep pace with population growth. The amount of irrigated land available per capita and grain production per capita generally rise or fall together. From 1950 to 1980, for example, the amount of irrigated land per capita expanded, and grain production per capita increased. During the 1980s and 1990s, however, irrigated land per capita and grain production both have declined.

In 1990, 28 countries with a combined population of 335 million faced chronic water stress or outright scarcity. By 2025, 52 countries may face water shortages, affecting over 3 billion people—about 40% of the world's projected population. The 20 countries of the Near East and North Africa face the worst prospects: annual per capita water availability already has fallen to only 1,250 cubic metres, 60% less than in 1960. By 2025 per capita supplies are projected to fall another 50%, to 650 cubic metres. Currently, Jordan and Yemen withdraw 30% more water from groundwater aquifers every year than is replenished.

Pollution. In many countries water pollution has contributed to water shortages and thus constrained food production, as well as caused health problems. For example, of 78 major rivers in China, 54 are seriously polluted. More than 40 of Malaysia's rivers are so fouled with municipal, industrial, and agricultural wastes that they are biologically dead. The nearly 450 cubic kilometres of wastewater that are discharged into surface waters every year require an additional 6,000 cubic kilometres of freshwater—two-thirds of the world's total stable water runoff—to dilute the wastewater and carry it to the oceans.

Irrigation Problems

Only 17% of all croplands are under irrigation, but these lands produce over one-third of the world's food. For example, more than 60% of the monetary value of Asia's food production comes from irrigated agriculture. During the 1960s and 1970s the amount of cropland under irrigation expanded by 2% to 4% annually. Since then, expansion has slowed to an annual pace of 1% or less, not enough to keep up with the growing food needs of developing countries where population is growing rapidly.

Fully 70% of all fresh water used every year throughout the world is used for irrigated agriculture. Only about half of all water withdrawn for irrigation, however, reaches the crops. The rest soaks into unlined irrigation canals, leaks out of pipes, or evaporates on its way to the fields. Badly planned and poorly built irrigation systems have limited the yields on one-half of all irrigated land about 120 million hectares.

Improper drainage is spoiling much of irrigated agricultural land. In many arid areas, salts that naturally occur in the soil must be drained away with irrigation runoff. If they are not drained, they accumulate in the soil. Eventually, they work their way to the surface, killing crops and poisoning the land. Poorly drained irrigation water also can raise the groundwater table until it reaches the root zone, water logging and drowning crops. Salt build-up in soil has severely damaged 30 million hectares of the world's 240 million hectares of irrigated land, and about 80 million more hectares have been damaged by a combination of salinization and waterlogging.

Collapsing Fisheries

While the world's fish catch increased fivefold between 1950 and 1989, the peak year, productivity has fallen since then in all but 2 of the world's 15 major fishing regions. The fish catch has dropped by more than 30% in the four hardest-hit regions. The main reason is overfishing. In 1995, 70% of

ocean commercial fishing areas were either "fully to heavily exploited (44%), overexploited (16%), depleted (6%), or slowly recovering from overfishing (3%)," FAO has reported.

Overexploitation occurred due to rapid expansion of the world's fishing fleet, enormous advances in fishing technologies, poor understanding of fish population dynamics (or little concern for ensuring sustainable yields), and a failure to introduce effective management systems. Chronic overfishing and mismanagement virtually wiped out one of the world's most productive fisheries the four million tons of cod on Canada's Grand Banks. In 1993 the Canadian government closed this fishery altogether, and thousands of fishermen lost their jobs.

As yields from capture fisheries have declined, yields from fish farming (aquaculture and mariculture) have risen rapidly. The gains from fish farming, however, have not been enough to offset the losses from capture fisheries. The increase in output from fish farms has gone primarily to meeting rising demand for fish in Europe, North America, and more developed countries in Asia.

Disappearing Genetic Diversity

Genetic erosion is potentially a serious impediment to increasing food production. Despite the discovery of some 50,000 varieties of edible plants, only 15 varieties provide 90% of the world's food energy intake. Just three of them rice, wheat, and corn are the staple foods for nearly two-thirds of the world's people. Like all cultivated plants, these crops need to be reinvigorated every 5 to 15 years to provide continued protection against diseases and insects, as well as to introduce new yield-enhancing traits such as increased tolerance for drought and saline soils.

The most effective way to provide enhanced traits is to interbreed domestic varieties of plants with wild ones. Since 1900, however, about three-quarters of the genetic diversity of domestic crops has been lost, as tropical deforestation, urbanization, destruction of wetlands, and cultivation of drylands have destroyed the habitats of many wild progenitors of domestic crops.

Dryland plant species are particularly hard hit. In the world's genetic centre for wheat the Near East widespread deforestation and poor use of water and land resources have caused massive losses of natural habitat. Areas that once sheltered valuable genetic reserves of wild wheat have become desert.

Increasing population density and pressures for faster economic development have played large roles in the loss of genetic resources. In a study of 50 countries in Asia and Africa, Paul Harrison found that loss of natural habitat was greatest in high-density areas and least in low-density areas. In the 10 countries that had lost the most habitat (averaging a loss of 85%), the average population density was close to 200 people per square kilometre. In the 10 countries that had lost the least habitat (averaging a loss of 41%), the average population density was 29 people per square kilometre.

Preserving genetic diversity is necessary to assuring continued genetic improvements in food crops. In the 1960s, for example, when an epidemic of wheat rust struck the US, genes from a wild wheat found in Turkey provided resistance. Even more strikingly, when virulent plague devastated one-sixth of the US corn crop in 1970, plant breeders found two ancestors of modern corn in Mexico. Once developed, these two varieties of wild corn conveyed resistance to seven of the domestic crop's major diseases. Remarkably, all that could be found of these ancient progenitors were a few stalks on a small plot of land slated for development.

Unless the rate of plant genetic loss is halted or slowed substantially, as many as 60,000 plant species roughly 25% of the world's total could be lost by the year 2025, according to the International Centre for Agricultural Research in Dry Areas. Assuring food security in the future may depend partly on finding ways to conserve areas rich in crop plant diversity as well as on expanding collections of germplasm in seed banks and tissue culture facilities.

Climate Change

Scientists and journalists have focused attention on global warming, popularly called the "greenhouse effect." The scientific community generally accepts that heat-trapping gases mostly carbon dioxide, chlorofluorocarbons (CFCs), and methane have been building up in the lower atmosphere, trapping rising heat and causing temperatures on the earth's surface to rise. The projected effects of such climate change on agricultural production vary depending on the particular model used. Most models project a drop in corn production, particularly in sub-Saharan Africa. Human activities are chiefly responsible for the build-up of greenhouse gases in the atmosphere. The accumulation of carbon dioxide in the atmosphere closely parallels the increased use of fossil fuels by a growing global population. If current trends in energy production and use continue, population growth alone will contribute half of the increase in carbon dioxide emissions between 1985 and 2025.

International efforts to limit greenhouse gas emissions often lead to disagreements between developing countries and developed countries over responsibility for causing such problems and for solving them. Unless emissions are eventually reduced, however, it is likely that the world's climate will continue to become warmer, with largely unknown but potentially serious effects on world food production.

Overcoming Constraints

What is the outlook for overcoming the constraints that could prevent food supply from keeping pace with population growth in the future? Expert opinion varies widely.

Some have argued that the earth's capacity to produce food is virtually unlimited and that human inventiveness, together with the economic forces of supply and demand, will solve future resource problems and food needs. Others, in contrast, have warned that the developing world may be headed for serious food shortages in the next century as population grows by the billions and shortages of natural resources occur. FAO and the World Bank, while pointing to serious problems with food production and to population growth trends, have argued that better land-use practices and advances in agricultural technologies accompanied by soil enhancement measures that do not depend on fertilizers and pesticides in effect, a "greener" Green Revolution could push back the limits to food production.

The level of resource consumption per person has a powerful effect on efforts to meet the needs of rising numbers of people. If the entire world were to have a standard of living like the average in Western Europe or the United States, it would require three planet Earths to provide enough natural resources at current levels of consumption, waste, and technology. The developed world, with only 20% of the world's population, consumes 80% of the natural resources used each year.

The US population, at over 260 million and growing by over 25 million each decade, consumes most. As the US President's Council on Sustainable Development concluded in 1996, "For America's future, the United States must strive to manage its resources, reduce waste products, and stabilize population so that the total impact of its activity is sustainable". The same could be said of the entire planet.

Steps Toward Food Security

The World Food Summit in 1996 focused new attention on achieving food security. What can countries and communities do to help reach food security?

Achieving food security over the long term depends partly on slowing population growth. Providing family planning to all couples who want it would go far to reducing fertility rates and slowing population growth in many developing countries. An estimated 100 million married women, and probably millions of other women, are interested in avoiding pregnancy but are not currently using contraception.

At the same time, a second Green Revolution could increase yields and buy more time for world population eventually to stabilize. In this revolution practicing sustainable agriculture that is, protecting natural resources from becoming increasingly degraded and polluted will be essential. Also, developing countries can explore new ways to help meet their food needs. These include improving yields on marginal land, farming forests, expanding aquaculture, rediscovering forgotten foods, and encouraging urban agriculture.

A Sustained Reproductive Revolution?

What are the prospects for slowing population growth through a sustained reproductive revolution in developing countries? The world's population has become so large that even small *rates* of growth still mean rapid increases in *absolute numbers* of people—a more relevant measure of food demand than growth rates. For example, the population of India, estimated at 970 million in mid-1997, is growing at an annual pace of 1.9%. At this rate India's population has a net gain of 18 million people each year. If the 1.9% rate were to continue, India's population would double in 36 years, reaching 1.9 billion in 2033. Also, following three decades of an intense government effort to limit the number of children per family, China has a population growth rate of 1.1% per year. Even at this rate, there are another 12 to 13 million mouths to feed in China each year.

At current fertility rates in most developing countries, women give birth to an average of more than three children over their lifetimes. In some countries women average five or six children, or even seven children in a few countries. These numbers, of course, far exceed "replacement-level" fertility of about two children per woman—the fertility rate at which population growth would level off and population size would eventually stabilize. Even if the next generation has fewer children than the previous one, the population will grow as long as couples average more than two children each.

Because of high fertility in the past, most developing country populations are young. In the developing world as a whole, half of the population is under age 23. In sub-Saharan Africa children under age 15 comprise almost 40% of the population. As young people reach childbearing age themselves, most will have several children of their own. Even after fertility falls to replacement level, it takes at least another generation or two for population size to stabilize. Also, it takes at least 15 years for the smaller size of age groups to have an appreciable effect on food demand and resource needs.

Time is of the essence. Each 20-year delay in reaching replacement-level fertility of about two children per woman would add at least 1 billion people to the world's eventual stable population size. If replacement-level fertility were reached worldwide by the end of this decade—which is virtually impossible—world population would eventually level off at less than 9 billion. If, at the other extreme, replacement level were not reached until the year 2080—which might be the case if family planning programs did not expand to meet the needs of larger populations and the rising interest in contraception—the world's ultimate population size would be at least 14 billion. The actual date—and thus the ultimate world population size—is likely to be somewhere in between.

If fertility were to decline to replacement level by the year 2050, the world population would be about 9.4 billion, according to the UN "medium" projection, the case considered most likely to occur. In this case world population would level off at 11.6 billion around the year 2100. To reach replacement-level fertility by 2050 would require that contraceptive prevalence—the percentage of married women of reproductive age using contraception—rise from the 1990 level of about 50% in developing countries to 73% by 2025, matching current levels in developed countries. The

reproductive revolution is most likely to be sustained if commitment to family planning programs in developing countries expands to meet people's increasing interest in having smaller families and the large amount of unmet need for family planning.

A Second Green Revolution?

To help bring food security to the 8 billion people projected in 2025, the world needs another Green Revolution, as many delegates to the World Food Summit urged. The Green Revolution that began in the 1960s has helped keep food supply ahead of rising demand over the past 30 years. By doubling and tripling yields, it bought time for developing countries to start dealing with rapid population growth.

But the Green Revolution represented only a "temporary success," as Norman Borlaug, the Danish-American plant geneticist who was one of its architects, noted upon receiving the 1970 Nobel Peace Prize for his contribution. Borlaug pointed out that it is not enough to boost yields on existing cropland; slowing population growth also is crucial.

The first Green Revolution raised the productivity of the three main staple food crops—rice, wheat, and corn. Between 1950 and 1990 grain yields increased by nearly two and a half times, from 1.06 metric tons per hectare to 2.52 tons. A second revolution also must raise the productivity of other important food crops such as sorghum, millet, and cassava—foods produced and consumed mainly by the world's poor.

So far, the outlook for a second Green Revolution is uncertain. Because most increases in food supplies must come from currently cultivated land, raising productivity will require new technologies and better farming practices. Poor people, however, cannot afford the large amounts of fertilizers, pesticides, and other agricultural inputs that increased yields in the first Green Revolution. Moreover, the population of developing countries is much larger than it was in the 1960s, the amount of arable land per person is less, and natural resources are more degraded. Nevertheless, three recent developments are promising:

- **Super rice.** The International Rice Research Institute (IRRI) in the Philippines has developed a new strain of super rice capable of boosting yields by 25%, amounting to an extra 100 million metric tons a year—enough to feed an additional 450 million people. This rice does not promise to produce well on marginal land, however, and therefore its use may be limited to well-irrigated bottom land.
- **Improved corn.** The International Centre for the Improvement of Maize and Wheat in Mexico has engineered several improved varieties of corn that could increase yields by up to 40%. These varieties could be grown on marginal land under difficult growing conditions and thus could be raised by poor farmers. If widely used, the new varieties could feed an additional 50 million people a year.
- **A new potato.** The International Potato Centre in Peru claims that, for an investment of US\$25 million, it could produce a new potato that would be resistant to a virulent form of potato blight that has reached every continent except Australia.

These developments, encouraging as they are, could well be offset, however, if current patterns of soil degradation and damaging agricultural practices continue.

Protecting Natural Resources

In many areas the two natural resources most essential to agricultural production—arable land and fresh water—are becoming degraded, and unless steps are taken soon to reverse this course, the risks of irreversible damage to the resource base will increase.

Land resources. Adopting such soil conservation measures as matching crops closely to soil types, using farming methods appropriate to the terrain, enhancing the soil with organic matter, terracing steep hillsides, ringing farm plots with soil-anchoring trees, and managing watersheds better can reduce loss of productive agricultural land due to soil erosion and degradation. Farmers also can protect the land by adopting low-till or no-till farming and rotating crops, thus giving soils a chance to recover nutrients.

In many degraded areas land rehabilitation has proved to be so time-consuming, labour-intensive, and expensive that it is virtually impossible. India, for example, has grappled with land degradation in arid and semiarid regions for decades but with little result. Other places, however, have had more success. In 1979, for example, after an extensive land rehabilitation project, China increased food production by some 70% in Mizhi County on the Loess Plateau. The project, carried out in cooperation with the United Nations Development Programme, helped farmers turn steep slopes over to permanent vegetation, terrace other slopes, and control gully erosion by erecting small dams of rocks and sandbags. Many farmers also replaced annual crops with perennials, such as alfalfa, which hold the soil in place.

Water resources. The world needs a "blue revolution" as much as it needs another Green Revolution. Based on the UN medium population projection, over 4 billion people would be affected by water shortages in the year 2050. By then, for example, in Nigeria only about 900 cubic metres would be available per person, compared with 3,200 cubic metres per person in 1990.

A water-short world is an unstable world. More than 200 river systems cross international borders; nearly 100 countries share just 13 major rivers and lakes. Water use practices in upstream countries can affect water supplies in downstream countries. Disputes can arise, especially where countries with rapid population growth and limited arable land and water supplies vie for access to water. For example, Ethiopia plans to divert more of the Blue Nile's waters for irrigated agriculture, while Egypt, downstream, depends on the Nile's waters for its very existence. Instead of a "first come, first served" approach to water management, countries and regions need to manage distribution and use of water resources to ensure that everyone gets a fair share. Guaranteeing access to water supplies also would help food-deficit countries improve their agricultural production. Some countries have successfully negotiated agreements over use of water resources—for example, India and Bangladesh, which share the Ganges, the largest and most important river on the Indian subcontinent.

With the prospect of less water per person, countries must conserve available water resources and manage them better than in the past. Many strategies and technologies exist to help save water and distribute it equitably. These include building reservoirs and small catchment dams to collect water during the rainy season for use during the dry season, allowing aquifers to recharge, reducing leaks in urban water pipes, protecting watersheds by planting trees to reduce erosion, and recycling municipal waste water for agricultural use.

Since irrigation water is wasted almost everywhere, there is great scope in the short run for water conservation in agriculture. In particular, the following steps can encourage efficient use of water and can promote conservation:

- Improving the design of irrigation systems and using technologies better suited to climate and terrain can greatly reduce waste and improve crop yields. For example, Israeli farmers use drip irrigation: each plant receives water through its own little drip tube. With this technique they have increased the efficiency of irrigation by as much as 95%. Over the past 20 years Israel's food production has doubled without using any more water.
- Pricing water at its real value, instead of subsidizing it, can have an immediate effect on water use, encouraging farmers to save water and use it more efficiently.
- For some agricultural purposes waste water from households and municipalities ("brown water") can substitute for fresh water. For example, in Calcutta sewage lagoons are used to

raise carp and irrigate vegetable gardens. In most cases sewage water needs to be pre-treated in order to eliminate pathogens.

- Water harvesting and low-cost irrigation schemes can help poor farmers meet their water needs. Water harvesting involves digging holes to collect runoff for irrigating crops, pastures, and trees during dry months. Where this technique has been used, as in Kenya, Burkina Faso, and Niger, crop yields are twice those produced by dryland farming methods.
- Reforesting upland watersheds can reduce water runoff and raise soil moisture levels, helping to recharge groundwater aquifers and capturing more water for human use.

In the long run, countries must design and implement strategies to manage entire watersheds. In some cases, where two or more countries share watersheds, management efforts need to transcend national borders.

Exploring Other Food Options

Still other options to help meet food needs at the national or local level include improving yields on marginal land, farming forests, expanding aquaculture, rediscovering forgotten foods, and encouraging urban agriculture. Innovative approaches that increase agricultural productivity while protecting the natural resource base also can help.

Improving yields on marginal land. FAO estimates that there may be some two billion hectares of marginal land that could be converted to agriculture, but three-quarters of it is too dry, too steep, too wet, too cold, or too shallow to support sustainable food production. There is some scope for introducing more efficient farming techniques to help subsistence farmers working marginal lands, however.

For example, the International Institute of Tropical Agriculture has pioneered "alley farming," which could substitute for slash-and-burn, shifting cultivation on fragile and highly erodible tropical soils. Alley farming is now being introduced in over 20 countries in Africa and Asia. The concept is simple: leguminous crops, such as mucuna, which fix nitrogen and improve soil organic matter, are planted between rows of food crops, such as peas and beans. The legumes help hold the soil in place and improve nutrient content while preventing weeds from taking root. If crops are used in the right combination, alley farming can greatly improve yields on poor soils in hilly regions and thus reduce the need to clear forests for farmland.

Farming forests. Forests are generally worth more standing and managed sustainably than when cut down for short-term profit. For example, in Peru harvesting forest products from one hectare could be worth over US\$400 annually, year after year. Logging the same area and selling the timber would yield a one-time return of \$1,000. FAO studies in Peru, the Brazilian Amazon, the Philippines, and Indonesia suggest that harvesting forest products on a sustainable basis is twice as productive in the long-run as clearing forests for agricultural and grazing land. Cleared land often takes 50 to 100 years to recover. Furthermore, once forest is cleared, the biological diversity of secondary growth never matches that of pristine wilderness.

Many plant products found in forests are harvested for food. These include mushrooms, coconuts, saps, and gums. The sago palm is a food staple for more than 300,000 Melanesians. Grasses, foliage, and bamboo are used as animal fodder and for building materials. Forests contain thousands of different species of plants that could be used for medicines and pharmaceuticals. For example, a derivative of the rosy periwinkle, found in Madagascar, has improved the survival of children suffering from leukaemia. Taxol, found in the western yew, which grows in the forests of the American northwest, is being used in anti-cancer drugs.

Forest plants and trees are also exploited for horticulture and extractive products such as natural rubber, oils, and resins. Some 1.5 million people in the Brazilian Amazon derive a major portion of their income from harvesting natural rubber and other forest products. Vines and fibres are used in

furniture making. Rattan supports a thriving furniture industry in Southeast Asia, bringing in US\$2 billion a year.

Expanding aquaculture. About 17% of the world's animal protein for human consumption comes from fish. In some Asian countries that figure is over 50%. Between 1984 and 1994 the amount of fish and other products farmed in the sea and from freshwater ponds more than doubled, rising from 10 million metric tons to 23 million metric tons.

In the developing world, where the world's aquaculture and mariculture industries are concentrated, most fish farming operations are for export and not for local consumption. Exports of such species as shrimp, prawns, and grouper bring in substantial foreign exchange earnings for a number of poor countries. Where farming fish for local consumption has been tried, the results have been encouraging.

For example, faced with the loss of their livelihoods because of overfishing and increased competition from commercial trawlers, poor fishing communities in Capiz Province, on the island of Panay, the Philippines, turned to fish farming and crab fattening. The mariculture operations were established by the women of these fishing villages with loans and technical assistance from the Philippine offices of FAO and the United Nations Population Fund. As part of the project, the women were offered family planning, and in a few years over half were using contraception. With smaller families, the women's health is better, they are able to earn more money, and their children are able to stay in school longer.

Rediscovering forgotten foods. Another way to help make up for food shortages, especially in the world's poorest countries, is to rediscover forgotten traditional food plants. Amaranth and quinoa, two grains that historically were cultivated by the Incas of Peru and the Aztecs of Mexico, provide examples. Both grains are versatile and nutritious foods, containing more high-quality protein than most other commercial grains, including corn, rice, and wheat. Moreover, both grow well under difficult conditions. Amaranth thrives in hot climates. The quinoa plant, because it is frost-resistant, can be grown at high altitudes.

Encouraging urban agriculture. As cities continue to expand in developing countries, people are growing more and more food in urban areas. Worldwide, some 200 million city dwellers are growing food, providing about 1 billion people with at least part of their food supply.

The scale of urban agriculture varies a great deal, including household gardens covering no more than 20 square meters, small commercial operations occupying 200 to 1,000 square meters, and greenhouses that cover 20 to 30 hectares. Some urban farmers raise fish, shellfish, and aquatic plants in small tanks, ponds, sewage lagoons, and estuaries. Others use vacant city lots to grow vegetables and fruits. Still others keep guinea pigs, rabbits, and chickens in cages hung on walls or grow vegetables using hydroponic techniques.

Urban farmers produce impressive amounts of food. In Accra, Ghana, for example, urban gardens supply the city with 90% of its vegetables. In Dar-es-Salaam, Tanzania, one adult in every five grows fruits or vegetables. Over 60% of the area around Bangkok has been devoted to vegetable gardens, cultivated mostly by women and children.

Adopting new approaches. Some countries with traditional farming systems are improving yields with new approaches that use low-level agricultural inputs—fertilizing with animal wastes instead of chemicals, recycling nutrients, conserving water, and selecting a variety of crops well-suited to soil conditions and climate. In Indonesia, for example, the Javan rice crop was nearly wiped out in 1984 by a plague of pesticide-resistant brown plant hoppers. In response, the government introduced a new approach, Integrated Pest Management (IPM).

IPM involves taking several related steps—preserving natural pest predators, using pest-resistant seed varieties, and drastically reducing the amount of chemical pesticides used. Using this

approach, the infestation of brown plant hoppers was controlled with only minimal crop losses. Within a few years, Javanese farmers who used the IPM methods had higher yields than those who continued to spray their crops with pesticides.

***C*oordinating Population and Agricultural Policies**

Better coordination between population policies and agricultural policies could help improve food security. In the long run, policies that help couples avoid unintended pregnancies and achieve good health may be as important to food security as policies that improve crop yields. The World Food Summit Plan of Action called on governments to "fully integrate population concerns into development strategies, plans, and decision-making."

At the World Food Summit the International Fund for Agricultural Development unveiled a "household food security" strategy that focuses on helping rural households become better food producers. The strategy advocates providing access to reproductive health and family planning services along with making improvements in agricultural production.

Meeting Women's Needs as Food Producers

In developing countries women grow up to 90% of all food for home consumption. In sub-Saharan Africa women grow 80% to 90% of all such food; in Asia, 50% to 60%; in the Caribbean, 45%; and in Latin America, over 30%.

As food producers, however, women face even more difficulties than men. In many countries women are not able to own or inherit property. Women have fewer opportunities than men to take advantage of technical training, agricultural extension services, and financial credit. In sub-Saharan Africa, for example, women comprise 60% of the total agricultural labour force but receive less than 1% of the credit available to agriculture. These handicaps have contributed to a "feminization of poverty"—that is, a disproportionate share of the world's poor are women.

Furthermore, in some countries women are the victims of food discrimination. In parts of South Asia, for example, despite the fact that women and older girls do most of the heavy work (except ploughing), men and boys often consume twice as many calories. Only 20% to 40% of all women of childbearing age in the developing world receive the minimum caloric requirement for a healthy, productive life—an daily diet of 2,200 calories.

Policies and programmes can address discrimination against women and girls. For example, in the early 1990s India passed a law granting women equal rights with men, including the right to own and inherit land. Authorities hope that, if the law can be enforced at the district level, women will be on a more equal footing with men and will be better able to participate in community development programmes. Introduction of school gardens and supplemental feeding programs for children in day care centres and primary schools can encourage poor families to send their girl children to school so they can be fed.

Agricultural services can be linked with family planning services in the field wherever practicable and appropriate. In some poor rural areas, where reproductive health services are not widely available, agricultural extension agents have been trained to provide contraceptive information and supplies, at least until health services could be introduced. For example, in the Philippines and Kenya women are being employed as agricultural extension workers in an effort to address the needs of women farmers. Some of these workers have been trained to provide family planning information and advice.

Improving access to health care, including a range of reproductive health and family planning services, is vital to help women improve their lives, including being better able to obtain enough to

eat. Giving women more choices—to have the number of children they prefer, to go to school, and to participate more in economic activities—can benefit communities, as well, with higher productivity, better resource management, and greater family well-being.

Meeting Unmet Need for Family Planning

Over the past 30 years, as family planning has become increasingly accepted and accessible, fertility levels and family size have fallen rapidly. Still, at least 100 million married women have unmet need for family planning—that is, they would prefer to avoid pregnancy but are not using any contraceptive method.

Finding ways to serve these women better is one of the greatest challenges facing family planning programmes. Many women do not use contraception because they do not know enough about it, worry about its side effects, have other health concerns, or face disapproval from husbands and communities and may not feel free to act on their own preferences

Meeting much of the unmet need for family planning would reduce fertility in the developing world substantially. In sub-Saharan Africa, where fertility is high, meeting all unmet need could reduce fertility by an average of about one birth per woman and bring most countries 20% to 30% closer to replacement-level fertility.

Involving Farming Communities

To improve food security, policies can help small-scale farmers boost yields of staple foods and other crops by practicing sustainable agriculture. Many poor people currently have little choice but to over-exploit and degrade natural resources in order to feed their families. Rural development that meets the needs of small-scale farmers is as important to food security as developing new production technologies and new "super crops".

In the past some countries have concentrated on developing large-scale commercial agricultural production, much of it intended for export, reasoning that its success would have a multiplier effect on food production and help small-scale farmers, too. If anything, however, this strategy made life even harder for poor farmers by driving down prices and forcing many to sell land to bigger enterprises.

Use of new, improved varieties of crops—like other innovations such as family planning—becomes self-sustaining only if most people, and particularly opinion leaders and other influential community members, accept and adopt the new practices. New agricultural practices will be slow to spread unless they respond to local needs and unless farmers are involved in introducing them. For example, in Rwanda, women, not men cultivate beans. When plant breeders developed several higher-yielding, disease-resistant varieties of bush bean in the late 1970s, however, they worked with male farmers to introduce the varieties. A decade later only 10% of the beans being grown were the improved varieties. After extension agents began working with women farmers in the late 1980s, bean yields rose by as much as 40%.

In India geneticists from the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) have designed a new drought-resistant variety of pearl millet, which is being tested in the state of Rajasthan. By working with local farmers to introduce the crop, rather than working only on experimental plots, ICRISAT staff have been able to speed up the adoption process. Radio and television have helped spread the word, and the new variety is being disseminated among farmers faster than ever before.

Winning the Food Race

Winning the food race is likely to require decades of effort at international, national, and local levels. It will require cooperation among policies and programmes in agriculture, resource

management, health care including family planning, and economic development. In any strategy, reaching replacement-level fertility as quickly as possible provides a needed foundation. Particularly for the more than 80 low-income food-deficit countries, slowing population growth could buy more time to address the needs of farmers, improve living conditions, and raise agricultural productivity, while helping to protect the soil and water resources needed for food production in the future.

With less need to demand greater yields from already overworked agricultural resources, governments could give more attention to improving the quality of life, emphasizing health care, nutrition, family planning, education, and opportunities for women as well as men. In the next century we cannot expect to ask ever more of the earth's resources or continue to disregard natural systems as we have in this century. With a stable population and sustainable use of natural resources, however, the world might be able to feed itself on a healthy diet for centuries to come.

Figures

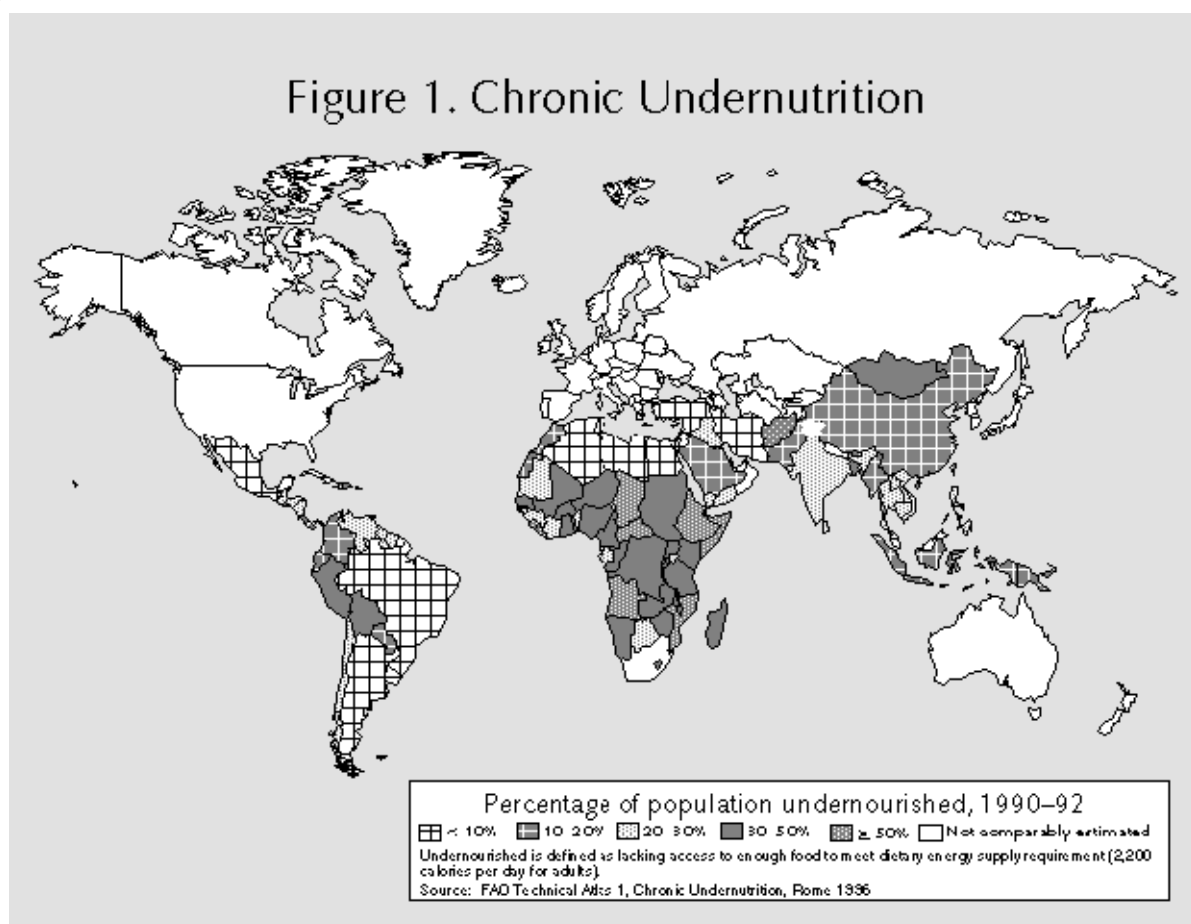


Figure 2. Low-Income Food-Deficit Countries, 1996



Low-income food-deficit countries do not have enough food to feed their populations and for the most part lack the financial resources to pay for imports. FAO defines low-income countries as those with a per capita gross national product (GNP) (in 1993) of US\$1,345 or less and a net deficit in grain trade averaged over the preceding five marketing years.

Africa:

Angola; Benin; Burkina Faso; Burundi; Cameroon; Cape Verde; Central African Republic; Chad; Comoros; Congo; Côte d'Ivoire; Djibouti; Equatorial Guinea; Eritrea; Ethiopia; Gambia, The; Ghana; Guinea; Guinea-Bissau; Kenya; Lesotho; Madagascar; Malawi; Mali; Mauritania; Morocco; Mozambique; Niger; Nigeria; Rwanda; São Tome and Principe; Senegal; Sierra Leone; Somalia; Swaziland; Tanzania; Togo; Zaire; Zambia; Zimbabwe

Asia:

Bangladesh; Bhutan; Cambodia; China; India; Indonesia; Laos; Maldives; Mongolia; Nepal; Pakistan; Philippines; Sri Lanka

Near East:

Afghanistan; Egypt; Jordan; Sudan; Syrian Arab Republic; Yemen

Latin America:

Bolivia; Dominican Republic; Ecuador; Guatemala; Haiti; Honduras; Nicaragua

Southwest Pacific:

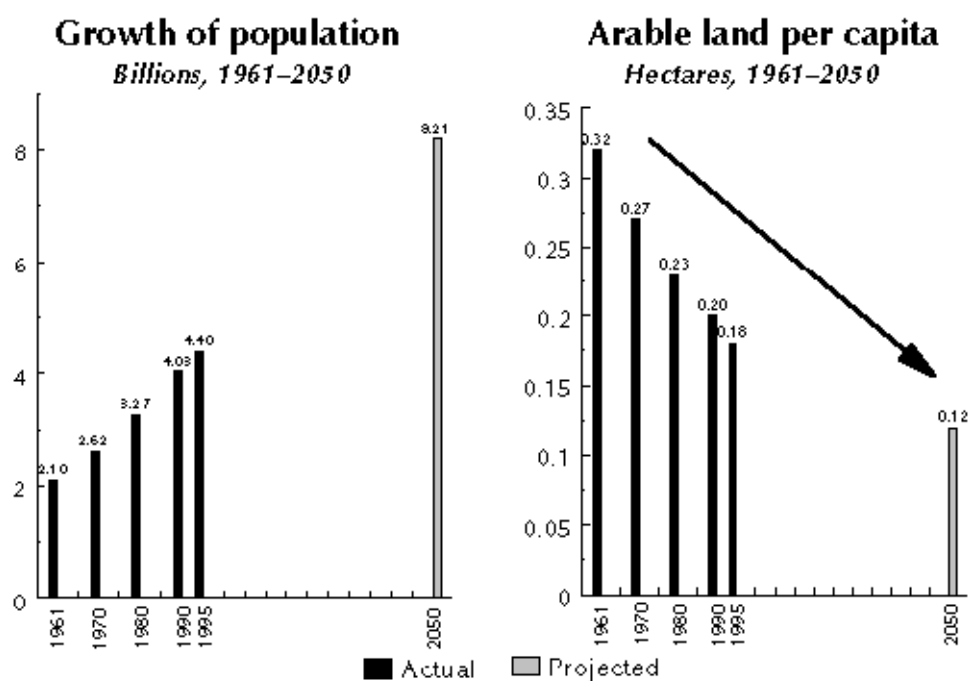
Kiribati; Papua New Guinea; Samoa; Solomon Islands; Tuvalu; Vanuatu

Others:

Albania; Armenia; Azerbaijan; Georgia; Kyrgyzstan, Macedonia (former Yugoslav Republic); Tajikistan; Turkmenistan; Uzbekistan

Source: UNFAO 1996 (99)

Figure 3. Population and Arable Land in Developing Countries



Source: UNFPA/FAO

Population Reports

Declaration

We, the Heads of State and Government, or our representatives, gathered at the World Food Summit at the invitation of the Food and Agriculture Organization of the United Nations, reaffirm the right of everyone to have access to safe and nutritious food....

We consider it intolerable that more than 800 million people throughout the world, and particularly in developing countries, do not have enough food to meet their basic nutritional needs. This situation is unacceptable. Food supplies have increased substantially, but constraints on access to food and continuing inadequacy of household and national incomes to purchase food, instability of supply and demand, as well as natural and manmade disasters, prevent basic food needs from being fulfilled.

The problems of hunger and food insecurity have global dimensions and are likely to persist and even increase dramatically in some regions unless urgent, determined, and concerted action is taken, given the anticipated increase in the world's population and the stress on natural resources....

Increased food production, including staple food, must be undertaken. This should happen within the framework of sustainable management of natural resources, elimination of unsustainable patterns of consumption and production, particularly in industrialized countries, and early stabilization of the world population.

We acknowledge the fundamental contribution to food security by women, particularly in rural areas of developing countries, and the need to ensure equality between men and women. Revitalization of rural areas must also be a priority to enhance social stability and help redress the excessive rate of rural-urban migration confronting many countries....

We agree that trade is a key element in achieving food security. We agree to pursue food trade and overall trade policies that will encourage our producers and consumers to utilize available resources in an economically sound and sustainable manner....

Particular attention should be given to those who cannot produce or procure enough

Plan of Action

1 The Rome Declaration on World Food Security and the World Food Summit Plan of Action lay the foundations for diverse paths to a common objective food security at the individual, household, national, regional and global levels.... Coordinated efforts and shared responsibilities are essential....

2 Poverty eradication is essential to improve access to food. The vast majority of those who are undernourished either cannot produce or cannot afford to buy enough food. They have inadequate access to means of production such as land, water, inputs, improved seeds and plants, appropriate technologies, and farm credit....

3 A peaceful and stable environment in every country is a fundamental condition for the attainment of sustainable food security.... Farmers, fishers, and foresters, and other food producers and providers, have critical roles in achieving food security, and their full involvement and enablement are crucial for success.

4 Poverty, hunger and malnutrition are some of the principal causes of accelerated migration from rural to urban areas in developing countries. The largest population shift of all times is now under way. Unless these problems are addressed in an appropriate and timely fashion, the political, economic and social stability of many countries and regions may well be seriously affected, perhaps even compromising world peace....

5 Availability of enough food for all can be attained. The 5.8 billion people in the world today have, on an average, 15% more food per person than the global population of 4 billion people had 20 years ago. Yet, further large increases in world food production, through the sustainable management of natural resources, are required to feed a growing population and achieve improved diets....

6 Harmful seasonal and inter-annual instability of food supplies can be reduced. Progress should include minimizing the vulnerability to and impact of climate fluctuations and pests and diseases....

7 Unless national governments and the international community address the multifaceted causes underlying food insecurity, the number of hungry and

food for an adequate diet, including those affected by war, civil strife, natural disasters, or climate related ecological changes. We are conscious of the need for urgent action to combat pests, drought, and natural resource degradation including decertification, overfishing, and erosion of biological diversity....

We pledge our actions and support to implement the World Food Summit Plan of Action.

Rome, November 13, 1996

Not included in this report

- **Transgenic (GM) crops**
- **Renewable fuels development**

malnourished people will remain very high in developing countries, particularly in Africa south of the Sahara; and sustainable food security will not be achieved. This situation is unacceptable. This Plan of Action envisages an ongoing effort to eradicate hunger in all countries, with an immediate view to reducing the number of undernourished people to half their present level no later than 2015, and a mid-term review to ascertain whether it is possible to achieve this target by 2010....