ENDNOTES

1. A futures market for commodities is one that attempts to avoid large, unpredictable price swings by allowing investors to commit to buy the commodity at a specified future date for a particular price. They gamble their profits on being right about future prices.
2. The oil slick from the 1990 Exxon *Valdez* accident is known to have killed 580,000 birds, up to 5,500 sea otters, 30 seals, 22 whales, and unknown numbers of fish. It oiled more than 3,200 miles of coastline. The final toll on wildlife will never be known because most of the animals killed sank and decomposed without being counted. Even after the most expensive cleanup in history, the congressional Office of Technology Assessment estimates that only 3 to 4% of the volume of oil spilled by the Exxon *Valdez* was recovered. Beach cleaning crews and their equipment consumed three times the amount of oil spilled by the tanker. The Exxon company shipped 27,000 metric tons of oil-contaminated solid waste to an Oregon landfill (Miller, 1992: 616–617).
3. A *calorie* is the amount of energy needed to raise 1 gram of water 1 degree centigrade.
4. Sir Patrick Geddes was a Scottish biologist, sociologist, city planner, and cofounder of the British Sociological Society in 1909. Unlike Spencer, he sought a unified calculus of energy flows to study social life (1890/1979). Wilhelm Ostwald and Frederick Soddy were both Nobel Prize–winning chemists in the early twentieth century. T. N. Carver was an American economist, who gave energetic theory an ideological coloration. He argued that capitalism was superior because it was the system most capable of maximizing energy surpluses and transforming them into "vital uses" (Rosa et al., 1988: 150–151).
5. The most meticulous study of contact between high- and low-energy societies is Pelto's 12-year study of the consequences of the introduction of snowmobiles among the Sami people (Lapps) of northern Finland. The introduction of snowmobiles and repeating rifles were the energy and technological means of the gradual absorption of the Samis into Scandinavian societies. They readily adopted these material culture items, and it transformed their life. It vastly increased the geographic mobility of hunters and the amount of game that could be killed. It shortened the workweek of hunters and trappers, increased their leisure time, increased their earnings, and established a new basis for stratification in their communities (based on who owns and who does not own a snowmobile). It also generated a serious ecological imbalance, as populations of snowbound game animals were wiped out. And it increased their dependence on the Finns, Swedes, and Norwegians for gasoline, consumer goods, and so forth (see Pelto, 1973; Pelto and Muller-Willie, 1972: 95).

CHAPTER FIVE

Population, Environment, and Food

Fertilizer and agrochemicals ready to be applied to farmland. Such "technified farming" is more productive, but it may pollute ground water, leave toxic residues in soil and on crops, and reduce the biological diversity of nature. Producing and applying such agrochemicals may use a lot of fuel and resources, adding to the cost of modern agriculture.

The earth's rapidly growing population makes more demands on all kinds of natural resources and increases the amount of waste and pollution produced.

Imagine a human community with 100 people, 50 women and 50 men. Imagine further that during the next 25 years each of the women had four children (two boys and two girls) and that each of the girls grew up and also had four children. Thus, the original 50 mothers had 200 children ($50 \times 4 = 200$). Of these, 100 became mothers, giving birth to 400 grandchildren (100×4). Our hypothetical community has now grown from 100 to 700 ($100 + 200 + 400$), a sevenfold increase. This imaginary scenario illustrates *exponential growth*, and, like all living populations, human populations have the capacity to grow at exponential rates. In fact, the human population of the world has grown at a dramatically exponential rate.

For thousands of years, the human population grew at a snail's pace. It took over a million years to reach about one billion people by the beginning of the nineteenth century. But then the pace of population growth quickened: A second billion was added in the next 130 years, a third in the next 30 years, and the fourth billion in just 15 years (McNamara, 1992). By the 1990s, there were more than five billion people on the planet, and the United Nations estimated that in early October 1999 human baby number six billion was born. The overwhelming odds are that baby six billion was born to a poor family in a poor nation (Gelbard et al., 1999). See Figure 5.1.

Another way of expressing the rate of exponential growth is by computing the *doubling time*—the number of years it takes for population size to double. From 1750 to about 1950, the doubling time for the world population was about 122 years. But by 2003 the doubling time was only about 58.[1] World average growth rates mask lots of variation between nations: For the MDCs, the doubling times are 60 to 70 years and for LDCs with higher birth rates, they may be as low as 23 years (Weeks, 2005: 39). Think of that: Every 23 years the poorest nations of the world (such as Haiti, Bangladesh, and Rwanda) must double their supplies of food, water, housing, and social services just to maintain current dismal living standards. The global mean growth rate has declined somewhat in recent decades, and in 2003 world population was growing at a rate of 1.2% per year. Even so, a world population of seven billion could come very quickly with such a large base of absolute numbers and many women in their prime childbearing years. The U.N. Population Division projects standardized world future growth outcomes using different scenarios for fertility and mortality. Three of them—a low, medium, and high scenario—span the range of plausible outcomes. In 2003, projections for the year 2050 were 7.3 billion (low scenario), 8.9 billion (medium scenario), and 10.7 billion (high scenario) (United Nations, 2000).

These numbers are truly staggering, and the popular term "population explosion" is indeed a proper description for the demographic history of recent times. If the present 6.3 billion humans have visibly stressed the environmental carrying systems (as demonstrated in earlier chapters), what impact will eight to ten billion have? This chapter will discuss (1) the dynamics of human population change, (2) the controversy about the role of population growth related to environmental and human problems, (3) the relationship among population

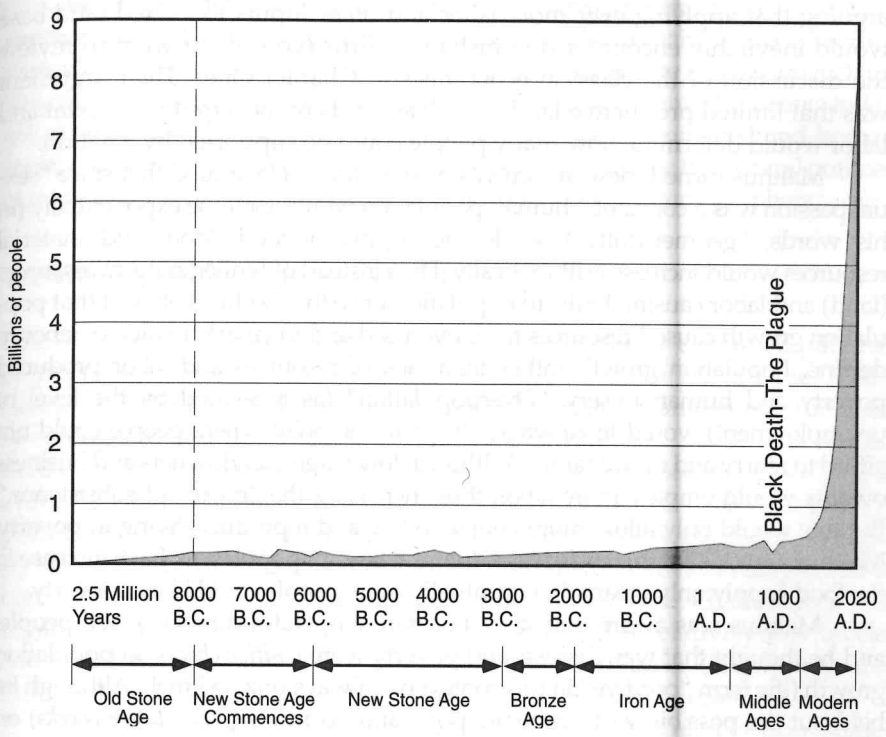


Figure 5.1 World Population Growth Throughout History
Source: Adapted from M. Kent (1984), *World Population: Fundamentals of Growth.* Population Reference Bureau.

growth, food supply, and the prospects of feeding a much larger population, and (4) some contentious policy questions about stabilizing the growth and size of the world's population.

THE DYNAMICS OF POPULATION CHANGE

Concern with exponential population growth is not new. Contemporary concerns about population growth are still framed by questions raised by Thomas Malthus (1766–1834) in his *Essay on Population,* first published in 1798. His book went through seven editions and has undoubtedly been the world's single most influential work on the social consequences of population growth. Malthus and other classical economic thinkers wrote at the start of the nineteenth century, when accelerating population and industrial growth were raising demands for food faster than English agriculture could respond. They saw real wages falling and food imports rising. Most classical economic thought emphasized the limits that scarce farmland imposed on agricultural expansion,

arguing that applying ever more labor and other inputs to a fixed land base would inevitably encounter diminishing returns (you might want to review the discussion of the classical economists in Chapter One). Their argument was that limited productive land as well as limits of the supply of capital and labor would determine how many people could be supported by a nation.

Malthus turned these arguments upside down. He argued that since "sexual passion was a constant," human population would increase exponentially (in his words, "geometrically"), while the supply of land, food, and material resources would increase arithmetically. Thus instead of limited natural resources (land) and labor causing limits to population growth, Malthus believed that population growth caused resources to be overused and the market value of labor to decline. Population growth rather than lack of resources and labor produced poverty and human misery. "Overpopulation" (as measured by the level of unemployment) would force wages down to the point where people could not afford to marry and raise a family. With such low wages, landowners and business owners would employ more labor, thus increasing the "means of subsistence." But this would only allow more people to live and reproduce, living in poverty. Malthus argued that this cycle was a "natural law" of population: Each increase in the food supply only meant that eventually more people could live in poverty.

Malthus was aware that starvation rarely operates directly to kill people, and he thought that war, disease, and poverty were *positive checks* on population growth (the term "positive" in this context has always puzzled me!). Although he held out the possibility of deliberate population controls (*preventative checks*) on population growth, he was not very optimistic about their effectiveness. Rejecting both contraception and abortion as morally unacceptable, he believed that only moral restraint (such as sexual abstinence and late marriage) was acceptable.

In sum, Malthus argued that poverty is an eventual consequence of population growth. Such poverty, he argued, is a stimulus that *could* lift people out of misery if they tried to do something about it. So, he argued, if people remain poor, it is their own fault. He opposed the English Poor Laws (that provided benefits to the poor) because he felt they would actually serve to perpetuate misery by enabling poor people to be supported by others (Weeks, 2005: 77–78). Interestingly, many in our day criticized the governmental welfare system on just such grounds. Malthus's ideas were attacked from all sides in his day. I will save these criticisms for later, because they foreshadow many contemporary objections to demographic explanations of environmental problems. Certainly, in the short run, events have not supported the Malthusian view. He did not foresee

> [the] expansion of world cropland to more than double its 1850 acreage; development of agricultural technologies capable of quadrupling yields achieved by traditional farming methods . . . the diffusion of health services and improved hygiene, lowering death rates and then birth rates. He would never have predicted, for instance, farmers being paid not to plant, in order to cut surpluses and to reverse erosion. . . . And he would be amazed at the growth in world population. (Hendry, 1988: 3)

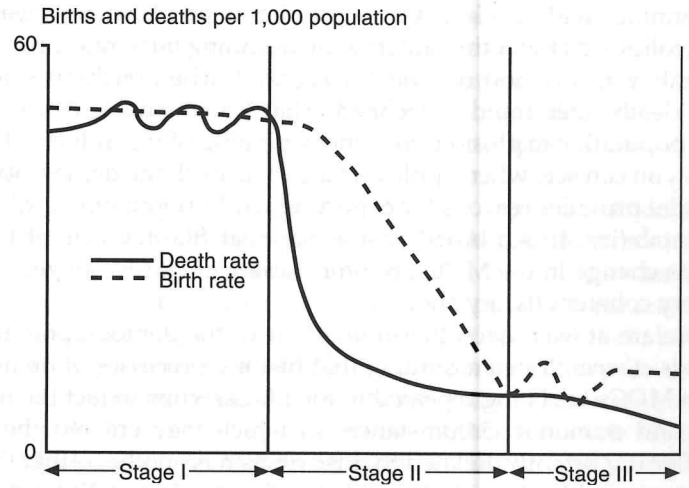
Whether Malthus will continue to be seen in error during the next century is another matter, as world population and related problems continue to grow dramatically. As you can see from the questions I have raised here and in earlier chapters, there are plenty of grounds for concern, and indeed, *neo-Malthusians* today are alarmed about population growth as a cause of environmental and human social problems. But before returning to this issue, I'll examine the general outlines of population dynamics and change, as it is understood by demographers.

The Demographic Transition Model

One of the most universally observed but still not clearly explained patterns of population growth is termed the *demographic transition*. By the 1960s, George Stolnitz reported that "demographic transitions rank among the most sweeping and best documented trends of modern times . . . based upon hundreds of investigations, covering a host of specific places, periods, and events" (1964: 20). This model of population change has three stages: (1) primitive social organization, where mortality and fertility are relatively high, (2) transitional social organization, where mortality declines, fertility remains high, and population shows a high rate of natural increase, (3) modern social organization, where mortality and fertility stabilize at relatively low levels, and a stationary population is possible in the near future (Humphrey and Buttel, 1982: 65). You can see this process schematically in Figure 5.2.

Explanations of this transition vary and are pasted together from somewhat disparate elements, but in general they flow from assumptions about the demographic consequences of modernization and industrialization.

Figure 5.2 Demographic Transition Model



First, industrialization upgraded both manufacturing and agricultural productivity so that the economic base could support much larger populations. Second, medical advances in the control of epidemic disease and improvements in public services like urban sewerage, water systems, and garbage disposal contributed to improved health and reduced mortality rates. Third, as populations became increasingly urbanized, family changes occurred. The children of rural peasants are generally an economic asset: They eat little and from an early age contribute substantially to the family farm and household. But urban children—their education and rearing—become more of an economic burden than an asset (Weeks, 2005: 90–98).

Industrialization was also coupled with opportunities for women to work outside the family and eventually improved the status of women. Birth rates are high where the status of women remains low and they are economically dependent on men (Keyfitz, 1990: 66). Industrialization also produced societies that established national social security programs apart from kinship, which meant that parents were less dependent on the support of their children in old age. Industrial modernization had, in other words, a variety of incentives that promoted smaller families. As social and economic incentives changed, cultural norms promoting large families began to weaken. Finally, research demonstrated that while industrialization was inversely related to fertility, it also changed the level of economic equality. In the European nations "the demographic and economic transitions led to a general improvement in living standards for all persons and a gradual reduction in income inequalities" (Birdsall, 1980). There is good reason to doubt the unique impact of family planning programs as a cause of fertility decline apart from deeper socioeconomic causes, but abundant evidence exists that information about birth control and access to contraceptives have been important factors in fertility declines in all countries (Keyfitz, 1990: 66).

However it happened, the demographic transition process has meant that beginning with social and economic modernization, death rates declined, followed after a time interval by declining birth rates. But between these events was a period of *transitional growth* when birth rates remained high but death rates rapidly declined. That transitional growth period is what the population explosion since the beginning of the industrial era is all about. As you can see, when applied at a global level, the demographic transition model provides reasons for expecting world population growth eventually to stabilize. It is a broad abstraction that fits the facts of long-term population change in the MDCs, but the variety of causes suggested do not form a very coherent theory about it.

There are at least two other limitations of the demographic transition model. It is *ethnocentric* in assuming that historic processes of demographic change in MDCs are being repeated in the LDCs, when in fact the historical, political, and economic circumstances in which they entered the modern world differ importantly. Related to this criticism is another—that the model has not been capable of precisely predicting levels of mortality or fertility or

the timing of fertility declines at national, much less at global, levels. This is both because the causes of demographic transition are not well understood, and also because historical events (such as wars or economic collapse) cause unpredictable changes in the stability of demographic projections. Small differences in projected numbers stretched over long periods of time can add up to big differences. That is why agencies that make population projections typically make high, medium, and low ones, letting the user decide which is most reasonable. This means that some really important questions such as "How rapidly will global stabilization occur?" and "At what equilibrium number?" cannot be answered with much certainty. The uncertainties here are much like those discussed about climate change in Chapter Three.

The Demographic Divide: MDCs and LDCs

As MDC populations went through the period of transitional growth, they expanded into less densely populated frontier areas, rich with land and resources to be developed. This process of European expansion and colonization began in the 1500s, before the industrial revolution. Until 1930, European and North American countries grew more rapidly than the rest of the world. But since then, population growth has slowed and geographic outward expansion has virtually ceased. Today most MDCs are far along the path toward population stabilization, well into stage III of the demographic transition. They exhibit declining birth rates and slow rates of growth. Many are coming close to the equilibrium or replacement rate of fertility, which would result in zero population growth (2.1 children per female). By 2000 in Western Europe, population growth was almost zero or even declining, even with the impact of immigrants from other parts of the world. Germany and Italy were declining by 1 percent each year. In France and the United Kingdom, populations grew slowly, and the United States had the highest MDC growth rate (0.9% per year). In these populations growth is almost entirely due to the influx of immigrants. In much of postcommunist Eastern Europe, including Russia, Romania, Lithuania, and Ukraine, economic and social conditions were so bad that birth rates were below replacement levels and population size declined slightly each year (Population Reference Bureau, 1998: 8; Weeks, 2005: 5).

In LDCs, the story is very different. Their rapid transitional growth came later in the twentieth century without the benefit of territorial expansion—that is, without the relatively unpopulated land or colonies to absorb the pressure of population growth. In addition, they have birth rates and levels of mortality much higher than European MDCs. As a result, LDC populations are growing rapidly, especially in the poorest of the poor nations. In the MDCs, demographic transition proceeded apace with internal economic development. But the decline of death rates in LDCs was more related to the rapid introduction of effective techniques of disease control by outsider agencies like the World Health Organization. Babies born in the poor nations

today have a historically unprecedented chance of surviving to adulthood, and the average life spans of nations have converged. The vast majority of babies born in the world today live in the LDCs. At the turn of the year 2000, the world was adding about 86 million people per year, and at least 90% of this growth was happening in the LDCs.

Even so, economic development—with its widespread improvement in living standards, improved education and opportunities for women, incentives for smaller families, and the establishment of national social security systems—has not kept pace in the poorest LDCs. Cultural and religious norms favoring large families are still powerful. Even when the world economy was growing, people in the poorest nations experienced little economic growth, while population growth continued vigorously. Often economic growth has been literally "eaten up" by exploding populations. The continuation of this demographic divergence between MDCs and LDCs into the next century may increase geopolitical tensions, pressure on migration and refugee flows, and a corresponding social and environmental duality among rich and poor nations. In LDCs both rural and urban populations are growing rapidly, pressures on natural resources are increasing, and economic and technical resources are often overwhelmed as local and national governments try to provide employment for increasing labor forces and infrastructure for expanding cities, like electricity, clean water, and waste disposal.

Population Redistribution: Urbanization and Migration

So far, I have focused on population growth in terms of the dynamics of demographic transition. Another type of population change is *population redistribution*, meaning the net spatial changes in population as individuals and families move from place to place. The two most important forms of population redistribution are urbanization and migration. Both are related to the pressures of population growth.

Urbanization

Most North Americans now live in—and were born in—cities. While we may be attracted to the amenities of cities or curse their problems, we recognize that urban life is the cultural, economic, and political center of modern society. Urbanization, or the redistribution of people from the countryside, is not new but has dramatically accelerated with the explosive transitional growth just described. Compared to rural dwellers, urban dwellers made up only about 11% of the world's population in 1850, but 30% in 1950, and 48% in 2000. Among the MDCs, at least 75% did so by the turn of the twentieth century (United Nations, 1998b).

Cities are, of course, nothing new. They emerged with the agricultural revolution, but those cities were not very large by today's standards. Ancient Babylon might have had 50,000 people, Athens maybe 80,000, and Rome as many as 500,000 (Weeks, 2005: 456). To put this in perspective, Rome, the premiere imperial capital of much of the Mediterranean world and hinterlands beyond, was at its peak a bit smaller than my hometown of Omaha, Nebraska. Ancient cities were unusually dense settlements that were the political, ceremonial, and administrative centers in a diffuse "sea" of rural villagers. Villagers made up perhaps 95% of the total population of such societies, and their crops and livestock were the real sources of wealth, on which urban elites lived by imposing taxes. Ancient (and medieval) cities were neither economically nor demographically self-sustaining. Poor sanitation and the rapid spread of epidemic disease (the plagues of ancient and medieval worlds) meant that they had higher death rates and lower birth rates than the countryside. They often had an annual excess of deaths over births, which meant that they had to be replenished by migrants from the countryside. They were not demographically self-sustaining.

Urbanization of the MDCs. Industrial era urbanization was fueled not only by expanding urban opportunities, but by the push of rural overpopulation, poverty, consolidation of land holdings, and declining farm labor markets resulting from the industrializing of agriculture (noted in Chapter Two). As economic development proceeded in Europe and North America, cities grew because they were more efficient. They brought more raw materials, workers and factories, financiers, and buyers and sellers together in one location than did dispersed rural production. Furthermore, as industrial societies developed, evolving modes of production continually reshaped the economic base of cities from the commerce and trading centers of the 1600s and 1700s (e.g., Amsterdam, London, Boston), to those centered on factories and industrial production in the late 1800s (e.g., Birmingham, Pittsburgh, Chicago). Since World War II, improvements in technology and the growth of an economy based on "services and information" has meant that the economic base of many cities is no longer manufacturing but, more often, the corporate headquarter locations of far-flung multidivisional and multinational firms and banks (e.g., Minneapolis, Dallas–Fort Worth). Now the largest MDC cities, such as Tokyo, New York, and Los Angeles, are really "world cities" that produce wealth by organizing and controlling international trade, commerce, and finance.

After the year 2000, the world passed something of a milestone when over half of its population was classified as urban. Fifteen years later (in 2015), the LDCs will be more than 50 percent urban (in 1950 only one-fourth were).

Urbanization of the LDCs. Consider the world's ten largest cities. In 1950, only two of the ten largest urban conglomerations in the world (Shanghai and Calcutta) were located in the LDCs. But by 2025, United Nations demographers project that nine of the top ten will be in the LDCs. In order, they are Mexico City, Shanghai and Beijing (China), Saõ Paulo (Brazil), Greater Mumbai and Calcutta (India), Jakarta (Indonesia), Dacca (Bangladesh), and Madras

(India). New York, Chicago, London, and Paris, all on the 1950 list, will be nowhere in sight. While Tokyo–Yokohama will still be the largest urban area in the world, it will be followed in 2025 by the demographic giants of the third world, Mexico City and Saõ Paulo (Brazil) (United Nations, 1998b).

As in the MDCs in an earlier era, the explosive urbanization in the contemporary LDCs is fueled by the poverty, hunger, and destitution of peasants pushed off the land and also by the less visible but powerful forces of high birth rates and population pressure. But there is a fundamental difference between the two eras. MDC urbanization was also accompanied by the pull of exploding economic opportunities in the industrializing cities. Urbanization in the LDCs today is largely a matter of the push of rural poverty without the simultaneous pull of dynamic urban economic growth. In other words, the LDCs have developed very rapidly in the post–World War II period, but they have skipped the prolonged period of industrial and manufacturing economic growth the MDCs experienced. Although less developed, many LDC cities have come to represent service economies without passing through the transitional stage of industrial growth (Walton, 1993: 289–302).

A service economy, as we have discovered in the United States, often produces less employment and comparatively lower wages for many people than do industrial and manufacturing economies. Thus, cities such as Calcutta, Cairo, Dakar, Jakarta, and Rio de Janeiro are becoming awash with displaced peasants with grim prospects for fruitful urban employment.

> To escape deepening rural poverty . . . [millions] of "environmental refugees" are on the move in Latin America, Africa, and parts of Asia, mostly from rural to urban areas. City services are collapsing under the weight of urban population growth, and unmanageable levels of pollution are creating a variety of threats to human health . . . solid waste could quadruple . . . [many] rivers are virtual open sewers, and many waterways flowing through metropolitan areas are biologically dead. (Camp, 1993: 130–131)

Such urban masses live in shantytowns and typically scrape out a meager existence as street vendors of petty goods and services.

Migration to these cities is fueled not only by rural misery, but by political policies that give preferential treatment to city dwellers. In cities, national governments concentrate on schools, receive investments from multinational firms, and are most concerned with regulating the price of foodstuffs. By subsidizing the price of food (a policy practiced among most LDCs), life is made easier for urbanites while farm incomes are depressed. Urbanites have fewer children and higher incomes (Harper, 1998: 263).

The urban-to-rural diffusion of new consumption patterns and diets also exacerbates rural deprivation. Rural dwellers quickly learn to desire and emulate consumption patterns of the MDCs, and there is an increasing demand for goods (such as rice, hybrid grains, beef, tea, bread, biscuits, beer, and soft drinks) that cannot be produced by the average rural farmer. Consequently the demand for the traditional cereals and foodstuffs of the countryside decreases while the most successful and "modern" farmers produce for export markets (Hendry, 1988: 22). Understand what is going on here: In a bizarre and perverse urban development process, production of the traditional food available to the poor in both cities and the countryside declines as products (including foodstuffs) are increasingly manufactured for export markets in a world market economy. Government investment and price policies, intended to benefit urban dwellers, depress the income of small traditional farmers (who would produce cheap food).

Notwithstanding that the new urban dwellers of the LDCs are somewhat better off than their village cousins, such rapid urbanization has overwhelmed the ability of cities to provide jobs, water, sanitation, and food, and the resulting misery and degradation among recent migrants is historically unprecedented. Desperate peasants left behind in declining economic circumstances are most likely to survive by overfarming marginal land.

Migration

Urbanization is really a special form of *migration,* which means the relatively long-term movement of an individual, household, or group to a new location outside their community of origin (de Blij, 1993: 114–115). Being cultural foreigners and new claimants for existing jobs and services, their presence in new host communities is usually contentious and difficult. They may send money and information to their nonmigrant kinfolk back somewhere. Indeed, you need to understand migration as not only the numerical redistribution of people, but also as a slow but pervasive *social interaction process* which diffuses and reshapes human cultures—and the distributions of power and wealth.

Migration may be *forced,* as in the case of prisoners that the British shipped to penal colonies in Georgia and Australia. It was also the case of the African slaves brought to the New World, and the 50,000 Asians forcibly expelled from the African nation of Uganda in the 1970s—with only the belongings that they could carry on their backs. But migration may also be *voluntary,* as in the case of most Europeans who came to North America in the late nineteenth and early twentieth centuries seeking material improvement and greater opportunities. While they were attracted by better opportunities, they were also often fleeing from rotten conditions in their homelands. Some, such as the Irish immigrants to Boston and New York, came fleeing from famine, poverty, and unemployment in their homelands (remember the Irish potato blight and subsequent famine mentioned in Chapter One?). Others fled wars or political and sometimes religious oppression.

High-volume waves of internal migration weaken but do not destroy extended kinship networks. The phenomenon requires that host institutions adjust to shifts in the numbers and characteristics of people served. It alters,

for example, the availability of labor, the demands for geriatric medicine, and the numbers and characteristics of students to be served by educational systems. Since migrants always insert themselves into or remove themselves from community status hierarchies, they always change the stratification system of communities: In-migrants tend to improve their status by moving into communities, while out-migrants improve it by moving out. In sum, adjustments, often difficult ones, are required in both the communities that migrants leave as well as in their new host communities. *Internal migration* is usually "free," in the sense that people are choosing to move in relation to their perception of better living conditions elsewhere. *International migration* is sometimes free, but it usually means that the migrant has met fairly stringent entrance requirements, is entering illegally, or is being granted refugee status.

Explaining Migration. The most common theory about the causes of migration is what demographers and geographers have called the *push-pull theory,* which says that some people move because they are pushed out of their homelands, while others move because they have been pulled or attracted to a new place. In reality, a complicated mix of both push and pull factors operates jointly to impel migratory behavior. Pushes can include poverty and lack of economic opportunity; fears for personal safety; political, cultural, or ethnic oppression; war, including civil war; and natural disasters such as droughts, floods, and so forth. Often underlying the push of these concrete factors is population pressure from rapid growth. The pulls are the mirror image of these and are likewise complex: the perception of better economic opportunities; greater social stability; and affiliation (desire to join relatives and friends). At any rate, social science conjures up the migrant as a rational decision maker who calculates the costs and benefits of either pulling up stakes and moving or staying put. This thesis was posed as long ago as 1885 by British demographer Ernest Ravenstein, who studied internal migration in the British Isles (1889).

Ravenstein found, as have many investigators since, that migrants have some common characteristics: They are younger than nonmigrants; they are less likely to have families, or if they do, they have fewer and younger children; and they are likely to be better educated (Weeks, 1994: 197–203). In fact, voluntary migrants are a select population, usually more talented, capable, adaptable, and ambitious than nonmigrants. In addition to personal characteristics such as these, the push-pull causes of migratory behavior are also conditioned by intervening factors or barriers. These include the costs of moving, lack of knowledge about migration options or managing complicated moves, broad themes of the sociocultural environment like established values about the importance of geographic "roots," risk taking, and openness to change. As you can see, in spite of the simple attractiveness of the push-pull thesis, the actual situation is quite complicated and not simple to predict. (See De Jong and Fawcett [1981] for an ambitious effort to conceptualize the complex causes of migratory behavior.)

Old and New Patterns of Global Migration. We do not know exactly how many persons have migrated around the world at any given time, but beginning with the modern era (in the 1500s) there were discrete waves of immigration involving particular locations that accounted for the greatest volume of immigrants. One such stream, as I'm sure you are aware, virtually *constituted* the nations of North America. Except for Native Americans, the citizens of the United States, Canada, and Mexico are *all* descendants of immigrants from somewhere else. In the United States, immigrants from Europe (and particularly Britain) were always more welcome, and by the 1920s the United States was so concerned about the flow of "unsuitable" non–Anglo-Saxon immigrants that it passed laws establishing quotas by nations that severely restricted non-European immigration.

Before World War II, the main currents of migration were out of the more densely settled regions in Europe and Asia and into North and South America and Oceania. Since the 1950s, that changed so that the net migration flows were back into Europe, out of South America, and (still) into North America, but increasingly from non-European nations. About half of all international migration is from one LDC to another, but the net flow of international migration is now from the LDCs to the MDCs (Gelbard et al., 1999: 16). The pressure of rapidly growing LDC populations since World War II enormously increased the pressure on natural resources and the demands for employment and social services, while in the MDCs a slowly growing population and buoyant economic growth often created a demand for lower-cost workers from the LDCs. Thus "guest" workers flowed into northern Europe from nearby Algeria, Egypt, Turkey, and the Middle East as well as from comparatively less developed southern and Mediterranean Europe and—more recently, as the communist world collapsed—from Eastern Europe. War, including civil war, often creates the social chaos that stimulates a flood of immigrants and refugees. Immigrants are considered refugees or asylum seekers if they can demonstrate that they left their home countries to avoid persecution.

Refugees and asylum seekers to Europe and America are both legal and illegal. They arrive on foot and by rail, air, and sea from diverse origins. Some are smuggled in trucks and ships jammed together under terrible conditions. As always, floods of immigrants create conflict and controversy as they seek employment and raise questions about the political and cultural coherence of nations. By 2006, immigration had triggered a significant and volatile political controversy in the United States and many European nations. Germany in particular was busy revising its generous asylum laws. As LDC populations rapidly grow, it becomes harder and harder to find a niche in the domestic labor force, and people are often compelled to move. And as the United States and Europe are learning, it is very difficult and costly to stem the tide of immigrants who want to move and find ways.

Whether we like it or not, a significant portion of people from the LDCs are coming to be our neighbors. And they will change the demography, culture, and eventually the politics of the nation. The U.S. Census Bureau, for

BOX 5.1 IMMIGRATION TO THE UNITED STATES

Nearly 700,000 foreigners arrive in the United States every day. Most are visitors, not settlers. More than 60,000 are tourists, business people, students, or foreign workers. About 5,000 enter illegally; 4,000 of them are apprehended, and about 1,000 elude detection. During the 1960s, most immigrants were from Europe. Now they are mostly from Latin America:

- 52% from Latin America (more than half from Mexico)
- 30% from Asia
- 13% from Europe
- 5% from other countries

Because American birth rates and death rates have reached relatively low levels, Migration's role has increased in recent decades. Immigration contributed about 30% of the total population increase between 1990 and 1998. The foreign-born population has increased from 19.8 million in 1990 to 26.3 million in 1998. (Population Reference Bureau, 1999)

instance, predicts radical shifts in the racial and ethnic composition of the nation, fueled by both immigration and the higher birth rate of ethnic minorities. The proportion of whites is expected to diminish from about 74 percent in 2000 to a tenuous majority of 53 percent by 2050, and Hispanics may well replace African Americans as the largest minority group (Martin and Midgeley, 1999: 23). The prime immigrant entry ports, such as Los Angeles, Miami, and New York, may in fact become "global" as well as American cities.

Population, Environment, and Social Stability. I have discussed types of population change—growth, urbanization, and migration—in some detail. Now I would like to summarize their relevance as hypothetical causes of environmental problems. It has been argued since the time of Malthus that the tremendous population growth of modern times has damaged the environment. It has done so by increasing demands for food, water, energy, and natural resources; most think that this problem will become increasingly acute as the world population increases to nine or ten billion in the next century. Recall the discussion of soil erosion and water problems in Chapter Two. Population pressure contributes to both migration and urbanization so that the environmental impact of population growth is not evenly distributed. Problems are particularly acute in urban areas where the air, water, and land cannot absorb the wastes and toxic by-products of industry

and dense populations. Other than problems of population density, the very *location* of cities causes environmental hazards. Because urban populations and industries need lots of water, they tend to be located along lakes, rivers, and bays. As a consequence, rivers like the Missouri, Mississippi, and Ohio; lakes like Erie and Michigan; and bays like the Chesapeake and New York Harbour become badly polluted (Eitzen and Baca Zinn, 1992: 101). Finally, by creating chaos and hardship in the LDCs, population growth will further accelerate the streams of internal and international immigration. However enriching immigration is in the long term, at a given time host nations and communities will find it a socially and politically disruptive burden. Evidence suggests that large flows of refugees are associated with social disruption and civil violence (Homer-Dixon, 1996). This is particularly so when the world economy is sluggish. It is a fantasy to think that because of the demographic divide just noted, the problems associated with population growth will be "contained" in the LDCs. Like it or not, much of the Third World is coming to live with us!

In sum, many demographers and ecologists argue that population growth threatens global social stability, human material well-being, and environmental integrity. In the next century, population growth may effectively overwhelm the carrying capacity of the planet. That, at least, is the *demographic* and *neo-Malthusian* interpretation of things. But, as I noted earlier, it has been a controversial and contentious point of view since the time of Malthus. Many scholars, then and now, have found it fundamentally flawed. How so?

HOW SERIOUS IS THE PROBLEM OF WORLD POPULATION GROWTH?

Most contemporary objections to Malthusian theory were raised 150 years ago. One of his contemporaries, French political economist Condorcet, foreshadowed contemporary technological optimists by arguing that scientific advance would offset diminishing returns. Condorcet said: "New instruments, machines, and looms can add to man's strength . . . [and] improve at once the quality and accuracy of man's productions, and can diminish the time and labor that has to be expended on them. . . . A very small amount of ground will be able to produce a great quantity of supplies . . . with less wastage of raw materials" (Condorcet, 1795). Fifty years later, Marx in particular fulminated against Malthus's theory. He dismissed it as nothing more than a rationale for class exploitation and argued that the real cause of human misery and deprivation was the increasing concentration of wealth in the hands of the few capitalist owners. It was they, who exploited workers to the point of misery and exhaustion—rather than population pressure—who were the cause of human poverty and misery. Then as now, the dominant currents of economic thought discounted natural resource constraints

(including population size) to emphasize the adaptability of market-induced substitution and innovation. In another classical objection to Malthusian views that foreshadowed modern objections, Nassau Senior asserted that improved living standards for the poor would not lead them blindly to expand their numbers but to restrict their fertility in order to preserve the gains they had realized (Hutchinson, 1967). So you can see that even though his book was a bestseller for decades, then as now Malthus got it from all sides (Poor Tom!). Even so, scholars have been unable to dismiss completely his haunting forecast of an impending demographic apocalypse.

Few debates in the social and natural sciences have been so heated or protracted as this one about the consequences of population growth. In contemporary discourse, there are three broad positions (the same paradigms I have been talking about since Chapter One!). *One* argues that population growth is a severe threat, perhaps *the* most significant underlying cause of environmental degradation and human misery. A *second* argues that population growth is not an important threat because markets will allocate scarce resources and stimulate efficient innovations. A more recent variant of this position, termed *supply-side demography*, argues that population growth may in fact be a benefit because the historical record demonstrates that as world population has grown, human welfare has improved: The more people, the better. *A third position* argues that human misery and environmental problems are caused by maldistribution that results from the operation of social institutions and economic arrangements (global or national inequality, poverty, trade policies, high prices, wars) rather than population growth per se. This argument, in effect, turns the table on Malthus, arguing that structurally induced misery causes both population growth and environmental deterioration, rather than the other way around. Let me elaborate each of these perspectives.

Neo-Malthusian Arguments

The standard ecological neo-Malthusian perspective is that population growth causes human misery and environmental degradation. This has been the position of many demographers, but particularly of biologists, ecologists, and natural scientists (Ehrlich and Holdren, 1974; Ehrlich and Erlich, 1992). Some predictions of global demise have been concrete and dramatic. In 1968, Stanford University zoologist Paul Ehrlich wrote, "The battle to feed humanity is over. In the 1970s the world will undergo famines—hundreds of millions are going to starve to death" (cited in Stark, 1994: 558). There were indeed famines and widespread malnourishment in the 1970s in particular parts of the world, such as sub-Saharan Africa. But nothing on the magnitude predicted, and global food production continued to outstrip population growth.

Modern history has not been kind to the neo-Malthusians, who have been arguing that "the wolf is at the door" routinely since the 1940s. But the wolf has—so far—failed to materialize. *Or has he?* Neo-Malthusians don't

believe that one actually dies from overpopulation, but from other, more concrete causes (disease, war, malnutrition, or famine). They argue that the doubling of the world's population in about one generation is the broad underlying cause of the stress placed on the global environment and human well-being, even though it is manifest in more concrete causes. For example, population growth helps widen income disparities among nations. In the past 20 years, the LDCs as a group have actually raised total economic output more rapidly than have the MDCs. But many of these gains have been offset by higher population growth rates. In per capita terms, the relative gap has narrowed negligibly while the absolute gap has widened substantially. Compare India and the United States from 1965 to the mid-1980s. Total GNP grew significantly faster in India, but because population grew twice as fast, India's average annual per capita income growth was 1.6%, slightly less than that of the United States, 1.7% (Repetto, 1987: 13). As population has mushroomed, so have wars. The number of armed conflicts around the world has grown from 12 in 1950 to 31 in 1998, with an all-time high of 50 in 1991 (Renner, 1999: 112). These were intrastate conflicts, but often having international dimensions and involvement, such as in Somalia, Rwanda, Serbia's Kosovo province, and East Timor.

Neo-Malthusians do not think that other factors (drought, poverty, wars) are unimportant sources of environmental or social stress, only that population growth must be considered primary. If, they think, all other factors could be made environmentally neutral, population growth of this magnitude would still spur resource social stress and environmental degradation (Stern et al., 1992: 76–77). Indeed, they argue that once population has reached a level in excess of the earth's long-term capacity to sustain it, even stability and zero growth at that level will lead to future environmental degradation (Ehrlich and Ehrlich, 1992). These scholars believe that, indeed, there is a carrying capacity and that in the long run, it applies to humans as it does to the bacteria in a petri dish. At some point there are limits to the physical capacity of the planet to sustain growth.

Economistic Arguments

Neoclassical economic theory maintained that population growth is not a problem, and may be a source of progress (Boserup, 1981; Simon, 1990). It argues that population growth—and other resource problems—stimulates investment in increased efficiency, resource substitution, conservation, and innovation. When resources become scarce, well-functioning markets encourage people to allocate them in the most efficient ways and protect them by raising the price. It is a fact that in the long sweep of human history, population growth has been correlated with growing, rather than declining, resources—as well as with improvements in human health, longevity, and well-being. Today more people live longer and better than when the human

population was much smaller. Even in the rapid post–World War II population explosion, global food production always outstripped population growth. Contrary to neo-Malthusian expectations, shortages—whether the result of population growth, increased consumption, or environmental problems—have left us better off than if shortages had not arisen.

The reason is that the accumulating benefit of intellectual inventiveness (human capital) met and overcame the challenge of shortages. We have found human-made substitutes for natural resources and more abundant natural resources for scarce ones, and we have invented technologies that allow more efficient use of the resources available. Neoclassical economists argue that finding substitutes for scarce natural resources is likely, and they rely on the ability of markets to respond effectively to resource scarcities (Jolly, 1993: 13). In this view, the cause of problems is not growth, but policies and market failures that do not price things realistically and that subsidize waste, inefficiency, and resource depletion. You get what you pay for, and you lose what you don't pay for (Panayotou, cited in Brown and Panayotou, 1992). Neoclassical economists argue that the neo-Malthusians ignore the role of markets in generating adjustments that bring population, resources, and the environment back into balance (Simon, 1998).

A newer variety of this argument, termed *supply-side demography*, maintains that population growth is not a problem, but a positive benefit (Camp, 1993). In contrast to the Malthusian view of diminishing per capita resources over time, the holders of this view argue that the ultimate resource is human inventiveness, which itself accumulates over time as populations grow, and has multiplied resources as they are available to people. A wide range of illustrations can support this view. When a shortage of elephant tusks for ivory billiard balls threatened in the last century and a prize was offered for a substitute, celluloid was invented, followed by the rest of our plastics. When whales were almost hunted to extinction in the nineteenth century to produce oil for lamps, petroleum distillates such as kerosene were substituted to fuel lamps and thus created the first petroleum industry. Englishmen learned to use coal when trees became scarce in the sixteenth century. Satellites and fiber optics (derived from sand) replaced expensive copper for telephone transmission. Importantly, the new resources wind up cheaper and more plentiful than the old ones were. Such, it is argued, has been the entire course of civilization (Simon, 1990). Since people create wealth, population growth can never long be a problem in a properly organized free-market economy. To neoclassical economists, the notion of a human carrying capacity is a static population-resource equation that conceals more than it reveals and has no empirical validity. It ignores technical inventiveness and market allocation. Counterintuitive as it may seem, as populations grow, resources multiply rather than become scarce. Rather than stressing a finite resource base, it is more correct to recognize that 10,000 years ago only 4 million humans could keep themselves alive, but by the nineteenth century the earth could support 1 billion people and today it can support 6 billion (Simon, 1998). This view is a recent and radical articulation of the notion that the unique potentials of humans make them almost exempt from the physical limits of the earth.

Inequality Arguments

The inequality (or stratification) argument maintains that human misery and environmental degradation, as well as population growth, are caused by vastly unequal social structural arrangements. This is a more complex and nuanced argument. It is favored by neo-Marxians, but also by a wide variety of other social scientists, economists, agronomists, and some biologists. Unlike the neoclassical economists, they argue that population size *is* a problem. It's just that Malthusians have always gotten the causation wrong. The operation of global political and economic structures and inequality cause population growth, human misery, and environmental problems rather than the other way around. They argue, for example, that instead of rapid population growth stalling economic development, economic stagnation in the LDCs is caused by poverty, inequitable trade policies, and ongoing dependencies. In other words, continued LDC poverty is maintained by the operation of the global economy, and in a condition of deep poverty and stalled development there are few incentives to have smaller families.[2] The final act of the world demographic transition, so the argument runs, is delayed by stalled economic development in the LDCs, not overpopulation.

Strongly objecting to the neo-Malthusian arguments of Paul Ehrlich and others, biologist Barry Commoner argued that plans to limit population that focus on birth control, abortion, or sterilization of people in LDCs ignore the principle cause of rapid population growth—poverty. Furthermore, Commoner argued that on the whole, advanced technology and affluent lifestyles are more environmentally damaging than growing numbers of people (1992). He and many others argue that the reality of global environmental deterioration is that large multinational corporations, not the growing masses of the poor in the LDCs, are responsible for most environmental destruction. It is not, for instance, the indigenous people and subsistence farmers who are destroying the world's rainforests. It is the lumber companies, large cash crop estates, and mining companies.

In a similar vein, others argue that neither the malnutrition that now routinely afflicts at least one-fifth of humanity nor the periodic famines in which people actually starve are produced by population growth. The most direct cause of hunger is not too many people, but lack of money and high food prices. At the *system level* of analysis, hunger and malnutrition are most directly caused by the political economy of agriculture, here meaning patterns of investment and land holding, and the structure of trade in the world economy (Norse, 1992). Consider, for instance, the following:

- The 22 most food-deficient African countries could meet their food needs with just 11% of the food *surplus* held by neighboring countries.
- China has only half the cropland per capita as India, yet Indians suffer widespread and severe malnutrition, while the Chinese do not.

- In Thailand, rice production increased 30%, but with exports of rice increasing nine times faster, per-person availability of rice has fallen.
- In Chile, farm exports have increased over 30% since the early 1970s. However, 40% of Chileans consume only 75% of the calories necessary for survival.
- In the 1970s, when India had more than 300 million malnourished people, the Indian government, working with large corporations, ensured that India ranked as one of the biggest exporters of food among the LDCs (Lappé et al., 1998).

Globally, the LDCs now export more agricultural products *to* the MDCs than they receive in food aid or agricultural subsidies. Consequently, the majority of the world's population remains poor and often hungry. The problem, then, is not with the lack of food but its global distribution patterns (Buttel, 2000a).

Another variety of the inequality argument finds causes of human misery and environmental degradation not in the operation of world markets or structures of inequality, but in authoritarianism and the absence of responsive governments or free markets (Sen, 1981). Nations with democratic regimes, free markets, and a free press can deal with droughts and fluctuations in prices and food supplies to prevent famine, whereas authoritarian regimes do not. It is no accident that the worst starvation happened in one-party states, dictatorships, or colonies: Maoist China, British India, or Stalin's USSR. The last great Chinese famine, in which perhaps 30 million starved, was in the 1960s during Mao's Great Leap Forward, which forcibly confiscated and collectivized the landholdings of villagers. Famine vanished when the Chinese reprivatized agriculture during the reforms of the 1970s. And while there were food shortages in India in 1967, 1973, 1979, and 1987, and western India had half the food per capita of sub-Saharan Africa, democracy, relief, and public works programs averted widespread starvation. Not so in Somalia, Ethiopia, and the Sudan, where wars, corruption, the absence of democracy, and government reluctance to admit problems let droughts grow into mass starvation (Sen, 1993).

Perhaps more familiar to Americans were the gruesome pictures of starving Somali children that dominated the media in 1992–1993. But that starvation was not caused—most directly, anyway—by too many people or even too little food, but rather by civil war, chaos, and the looting of the nation's food supplies by warring clan factions.

The inequality perspective maintains that poverty is not only the more direct cause of high fertility and human misery, but is connected to environmental destruction. Notwithstanding the larger role of multinational mining, agribusiness, and lumber companies on the environment, it is still true that poverty adds considerably to the resource pressures in the LDCs. Poor households are often virtually forced to overuse natural resources daily for subsistence. Thus, desperate farmers grow cassava and maize on highly erodible hillsides. Rural households in fuelwood-deficit countries strip foliage and burn crop and animal residues for fuel rather than using them for fertilizer.

This practice also contributes to desertification, since land stripped of trees and plant residues is less likely to hold moisture. Underemployed men in coastal villages overexploit already depleted fisheries (Repetto, 1987: 13).

Controversy about the significance of population growth is not, and never has been, just an academic one. Population issues are so important that in recent decades the U.N. has organized three international population conferences, at Bucharest in 1974, Mexico City in 1984, and in Cairo in 1994. As you might guess, grappling with the scientific, economic, moral, and political issues that surround doing something positive about population problems was *very* contentious. Under different presidential administrations, the government of the U.S. has alternately funded, and withdrawn, funds from such U.N. efforts. The most recent meeting in Cairo, the International Conference on Population and Development, was the most widely attended gathering of government officials and representative of many nongovernmental organizations. It finally agreed on an ambitious agenda to promote population stabilization.

MAKING SENSE OUT OF THIS CONTROVERSY

Are you a bit confused about the complexity of population issues and problems? If so, don't worry, because you're in pretty good company. In beginning to make them more understandable, you need to recognize that this, like some of the controversies discussed earlier, is not only a debate about facts but about different paradigms.

Physical scientists and ecologists—and many demographers—see the world in terms of problems of growing scale in a world with ultimately physical limits. Neoclassical economists, in contrast, see the world as a largely mutable system of possibilities because of human technical inventiveness and the capacity of market allocation to adjust to scarcities and stimulate investment in resource substitution. They argue that ecologists simply fail to appreciate the magic of the market.

Ecologists retort that the reason that economists believe this is that they miss entirely the environmental "debts" that growth incurs, which results in a delayed form of deficit financing. Those who fail to recognize the ultimate physical limits of the planet, says environmental economist Herman Daly, are "treating the earth as if it were a business in liquidation" (cited in Brown, 1991: 9).

Inequality and stratification arguments are similar to economic ones because they emphasize the importance of human social factors rather than natural limits as causes. But proponents of this view are like the ecologists in seeing both exponential population growth and environmental degradation as real problems. Briefly, in understanding the relationships between population growth and human and environmental problems, neo-Malthusian arguments emphasize *scale issues,* neoclassical economic arguments emphasize

market allocation issues, and inequality arguments emphasize *distribution issues.* Although these paradigms have very different views of the way the world works, they are each partial—and not necessarily mutually exclusive (Jolly, 1993: 21). I think it is possible to reconcile some of their differences.

Considering the broad sweep of human history, the neoclassical economists and technological optimists have a better factual argument. There were, to be sure, particular times and cases where population growth contributed to environmental and social disasters, particularly in the preindustrial world. But, in the industrial world as a whole, technological progress has always outrun the pressure of population growth. In sum, the neo-Malthusians have always been wrong about a global demographic disaster: The wolf never *was* really at the door.

In its own way, however, the neoclassical economic paradigm is as static and ahistoric as the physical science notion of fixed limits. It posits an unchanging linear relationship between population size and the ability of technological innovation and markets to overcome problems. It fails to recognize that the enormous *growth in scale* of the human population since World War II has put us much closer to absolute physical planetary limits than ever before in human history. To put it in economic terms, the elasticities of substitution between natural and human-made resources are historically quite variable and are now declining. *Elasticies of substitution* simply asks how much human technical capacities can stretch (are "elastic" enough) to surmount natural limits. If it is high, there is no problem, but if elasticity is low, then beyond a certain point, human inventivenesss is not enough to overcome resource limits. I have argued that it is higher in industrial than in preindustrial societies, but is now declining because of absolute population growth and accumulated environmental damage.

Furthermore, there are physical limits beyond which *no* substitution is viable. Wheat, for example, cannot be grown with only labor, or without water (Jolly, 1993: 15). I think that the enormously large world population—which may reach 10 billion in the next 50 years—means we will have fewer options, less maneuvering room, a more degraded resource base, and less ability to absorb and recover from environmental damage than ever before in history. We may face an "ingenuity gap." I believe that the dependability of economic and technological capabilities diminishes relative to the threats of scale posed by the present and future population size. Ecological neo-Malthusian theory should be taken more seriously because the population–environment equation is historically dynamic. The wolf is not yet at the door, but he's certainly in the neighborhood, and a lot closer than he was as recently as 100 years ago!

Finally, I think that the conflict between neo-Malthusian and inequality arguments is more apparent than real. Neo-Malthusian arguments are more persuasive in the abstract and on the long-term horizon. But stratification arguments are more convincing explanations of human misery and environmental degradation in the concrete here and now. In other words, things like hunger, poverty, and water pollution are more directly and concretely caused by social, political, and economic arrangements than by the

underlying specter of overpopulation. Whether you prefer a demographic or a stratification argument depends upon whether you prefer more direct and concrete or more distant and underlying causes. It also depends on whether you emphasize short- or long-term time spans. But as you can see from the foregoing, they do have very different policy implications for how human and environmental problems are addressed.

One more thing: Contrary to the arguments of the new "supply-side demography," the vast majority of responsible scholars now believe that in general more people is not necessarily better and quite probably worse. The most damaging evidence comes from a review of existing evidence from a panel of experts of the National Research Council (within the National Academy of Sciences), who found little evidence that "lower population densities lead to lower per capita incomes via a reduced stimulus to technological innovation, efficiency, and economies of scale." Regarding the LDCs, the panel concluded that "slower population growth would be beneficial to economic development for most of the developing world, but . . . a rigorous quantitative assessment of these benefits is context-dependent and difficult" (National Research Council, 1986: 90). In sum, there is a large consensus that virtually all current and future problems with resource supplies, human material security, and environmental integrity would be easier to deal with if world population growth slowed more rapidly and stabilized at a lower "equilibrium number" (Reppetto, 1987; National Research Council, 1986).

The emerging consensus among demographers and environmental scientists argues that population growth is one among many causes of human misery and environmental deterioration, but not the only one. Here is how two demographers described this consensus as it applies to problems in the LDCs:

> The most important lesson learned from continued study of the relationships between population and development is the key role of institutions in mediating these relationships. . . . Institutional obstacles . . . [include] the unequal distribution of wealth and political power, poor management and organization, and waste of resources on military activities. Rapid population growth exacerbates many of the resulting problems but slowing population growth will not remedy the situation without positive steps toward change. Some . . . characterize rapid population growth as the "accomplice" rather than the "villain" in this story. (Merrick, 1986: 29, citing King and Kelly, 1985)

This is a more complex and nuanced consensus than any of the broad paradigms described earlier.

POPULATION, FOOD, AND HUNGER

Perhaps population growth is only one aggravating cause of human misery and environmental degradation, but what about food and hunger, the elementary human need about which Reverend Malthus speculated 200 years

ago? Surely, many argue, there is reason for concern, with booming world population growth and evidence that most agricultural resources (soil, water) are under visible stress. Hunger agencies estimate that about 30 million Americans are malnourished, and the U.S. Department of Agriculture reported in 1999 that at least 10% of all American households do not have access to enough food for a healthy diet (Charles, 1999). Malnutrition is indeed a real presence in America and around the world.

You can think of global food consumers as being on three levels or tiers. *At the bottom* are about 1.1 billion people (about 20% of the world's people) who are unable to provide themselves with a healthy diet. These people are classified as *food-energy deficient*, and at least 60% of them are children. Chronic malnutrition may not be as grotesquely visible as massive famine, but its consequences are nonetheless devastating. In children it delays physical maturity, impairs brain development, and reduces intelligence, even if replaced by an adequate diet later on. Malnourished adults are unable to work hard or long and have lower resistance to diseases. The danger of epidemics is always high in overpopulated and underfed areas. *On the middle level* are about 4 billion grain eaters, who get enough calories and plenty of plant-based protein, giving them the healthiest basic diet among the world's people. They typically receive less than 20% of their calories from fat, a level low enough to protect them from the consequences of excessive dietary fat. *At the top* are the world's billion meat eaters, mainly in Europe and North America, who obtain close to 40% of their calories from fat (three times that of the rest of the world's people). As people in the middle level (in China, for instance) become more affluent, they tend to "move up the food chain" to emulate people at the top (Brown, 1994b). The high meat diet of those at the top is not only unhealthy, but creates a demand for meat production that causes a substantial share of the global inequity of food resources and environmental abuse. To illustrate, ignore the high inputs of fuel and chemicals it takes to produce meat and consider only how many liters of water it takes to produce 1 kilogram of various foods:

Potatoes	500
Wheat	900
Maize (corn)	1,400
Rice	1,910
Soy beans	2,000
Chicken	3,500
Beef	100,000

(Baylis, 1997)

At least a third of the world's grain is fed to animals to produce meat. Hence the simple act of eating less meat could "stretch" the world's grain supplies, making it possible to feed a much larger population and significantly to reduce the current global food inequity.

Change and the Contours of World Hunger

Importantly, since the 1950s, as population has grown the prevalence of world hunger has declined. It is equally important to note that the steepest declines were in the earlier decades, from about 30% to 20% from the 1960s to the 1980s. In the 1990s the decline in alleviating hunger lost momentum, declining only slightly from 20 to 19% (Buttel, 2000a). While declining hunger rates may be cause for optimism, it is also true that in terms of absolute numbers there are more hungry people in the world and in America than ever before, because of the continued momentum of population growth. Of the world's 6 billion plus people alive in 2000, 1.1 billion people were undernourished and underweight. Hunger and fear of starvation literally shape their lives (Young, 1997: 27, 30). Hunger is highly concentrated in different regions. Sub-Saharan Africa had the highest rate of undernourishment (39% in 1996), while North Africa and the Near East had the lowest rate among developing regions (12%). Latin America, the Caribbean, Southeast Asia, and South Asia, particularly the Indian subcontinent, had intermediate levels (13 to 15%). Most countries have the best data about malnutrition among children because they are so vulnerable. In India, 53 percent of children are malnourished; in Bangladesh, 56%; and in Ethiopia, 48%. But there has been remarkable progress in some regions. In Latin America, the proportion of children who were undernourished dropped from 14% in 1980 to 6% in 2000. But because East Asia and Southeast Asia, especially China, have much larger populations than does sub-Saharan Africa, the vast numbers of the world's hungry people are found in these regions. While East and Southeast Asia showed an impressive decline in the number of the malnourished in recent decades, the rise in absolute numbers of the malnourished are accounted for by sub-Saharan Africa, the Near East, and (particularly) South Asia (Buttel, 2000a; DeRose et al., 1998; Pinstrup-Andersen et al., 1997).

Getting a handle on the factual contours of chronic hunger is relatively easy. Trying to explain why it persists in America and the world is more complex and contentious. Some things related to the causes of hunger are matters agreed on by all observers, regardless of political and ideological differences about food issues. *First*, for the present at least, chronic hunger is not caused by too many people or too little food. The world's farmers produce enough cereals, meat, and other food products to adequately feed the world's population. Taken all together, there is enough to provide 2,800 calories per day per person, well over the minimum daily calorie requirement, even for those whose jobs involve physical labor (2,200–2,800 calories) (Halweil, 2006). *Second*, problems of hunger are caused by the way food is distributed—put another way, because people lack access to the food that exists (Field, 1993). Beyond this consensus, the causes of the perpetuation of chronic hunger are controversial and contentious. In addition to citing biophysical factors, explanations of hunger allude to things like inequality and income distribution, population density and growth, agricultural research

agendas, social disruptions like wars, social welfare and insurance policies, and agricultural trade and commodity prices. In other words, explanations of hunger and how to address it are controversial and contentious because they take us into the heart of the dominant social institutions in societies around the world in the twentieth century.

Explaining World Hunger

Within academic and food policy circles there are several styles of thinking to explain why hunger exists, each with different emphases, some supportive evidence, and very different policy implications (Buttel, 2000a). I want to discuss several of them here. *Agricultural modernization* argues that the world hunger problem is caused by not enough food and the poor productivity of traditional agriculture, particularly as it is practiced in the LDCs. This approach, which has great intuitive and popular appeal, is the favorite of Western agribusiness firms and agencies like the USDA. However appealing, it is misleading, since everyone admits that the problem is not that there isn't enough food, but how it is distributed. Furthermore, there is reason to think that if such "modernization" of traditional agriculture were to take place under the aegis of large multinational agribusiness firms, the world would have more total food, but still there would exist the hunger of those who are malnourished because they are poor. *Ecological neo-Malthusianism* is the second way of theorizing about the causes of hunger. Its logic seems straightforward: The more people there are, or the faster the rate of population growth, the less food and other materials will be available to other people. But as all food analysts agree, even as rapidly as population has grown, it has been outstripped by total food production increases. Old-fashioned Malthusianism, which viewed population growth as a simple and direct cause of human problems, is very much out of fashion. Neo-Malthusianism, however, which views population as an important underlying condition related to many problems, is very much alive. Population size or growth may not directly cause people to be hungry or die, but it may be a distant but pervasive factor related to more direct causes. Ecological neo-Malthusianism sees population growth in conjunction with the progressive degradation of food-producing environmental resource bases like soil and water.

In its most sophisticated forms, ecological neo-Malthusianism sees environmental sustainability—the need to increase food availability while protecting the land, water, and the environmental services of living resources that make human sustenance possible—as being more important than population size/growth alone in explaining hunger. This is particularly the case in terms of future threats to food security. Scholars have documented how many gains of the second agricultural revolution in the twentieth century were achieved by environmentally threatening practices and techniques. Earlier we discussed many of these, like soil erosion, waste and degradation of water

resources, oversalinization from continual irrigation, declining biodiversity, overuse of petroleum resources, and pervasive pollution from confined animals and agrochemicals. Although agricultural environmental degradation affects farmers in the United States, analysts recognize that it is particularly threatening to the food status of the poorest rural farmers around the world (Halweil, 2000). Moreover, even though there is enough food to go around, the rapid *per capita* production, not total production, leveled off in the 1980s and 1990s. Agricultural resources (fertile soil, water for irrigation, soil, rangeland) are under stress everywhere. See Figures 5.3–5.5.

Ecological neo-Malthusianism is a well-established academic viewpoint that has only modest influence in food and agricultural policy circles. Cross-national research, for instance, finds population size and growth rates to be less strongly related to hunger than other factors, and the significance of population as a driver of hunger is very regionally specific. But there are other reasons why its influence in policy circles is modest. It does not bolster the legitimacy of prevailing institutions by providing reasons to extend Western-dominated world food trade, to "modernize" the world, or to provide technological substitutes for social reform (e.g., as with genetically engineered crops). By contrast, ecological neo-Malthusianism views the limits of the global resource base as constraining consumption and requiring more sustainable forms of agriculture. It would require shifts in agricultural technology and practices away from those that have been successful and profitable but environmentally damaging. And it would limit food consumption by the affluent. You can see why it is not a dominant perspective explaining hunger.

Given its lack of appeal for policy makers and venture capitalists, ecological neo-Malthusianism is a compelling perspective. Hunger is concentrated in nations and regions where poverty and population growth reinforce each other. The Indian subcontinent, for instance, is adding 21 million people a year, the equivalent of another Australia. According to U.N. projections, India alone will add 515 million more people by 2050, in effect adding roughly twice the current U.S. population. The subcontinent, already the hungriest region on earth, is thus expected to add another 787 million people by mid-century (Buttel, 2000a: 156–217).

Ideas about *inequality and political-economy* (I & PE) shape a third style of explaining hunger. It assumes that social inequality and poverty produced in the United States and developing nations—both locally and globally—cause hunger. In a globalizing era, inequality and poverty are perpetuated, and perhaps amplified, by growing world markets for food and other traded goods. Such world markets are organized by large corporations with the support of government subsidies and international regimes like the World Trade Organization. World markets concentrate economic assets and increase the total volume of goods to be sold, but displace and disadvantage small producers and workers in many nations. Such huge markets work very well for the people with money, but not well at all for those who have little money, or who are pushed out of jobs or off their land in the process.

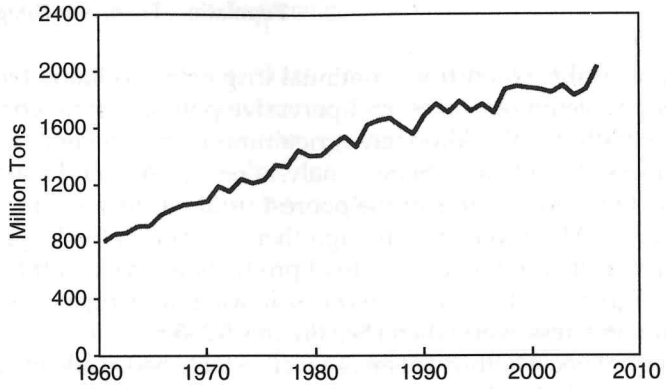


Figure 5.3 World Grain Production, 1961–2004
Source: Food and Agricultural Organization and Halweil, 2005.

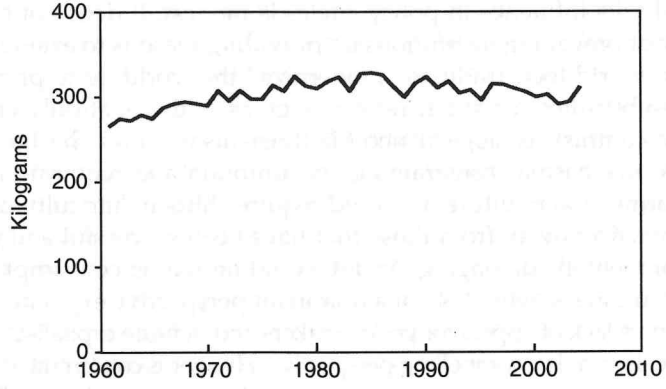


Figure 5.4 World Grain Production Per Person, 1961–2004
Source: Food and Agricultural Organization and Halweil, 2005.

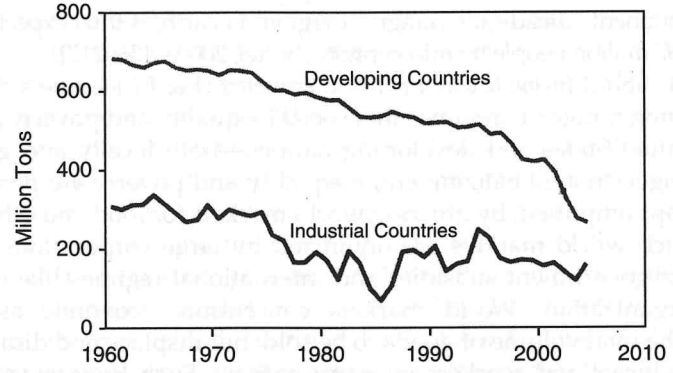


Figure 5.5 Grain Stocks in Industrial and Developing Countries, 1961–2005
Source: Food and Agricultural Organization and Halweil, 2005.

I have noted things that lend credibility to I & PE explanations. For instance, chronic hunger is more directly related to the distribution of food rather than to the total supply, and hunger is a problem of access to food in nations where others eat and are overnourished. Furthermore, many of the difficulties with agricultural modernization ideas explaining hunger support I & PE styles of explanation:

- When self-provisioning peasants and farmers are driven off the land by modernization and consolidation of land
- When modernization produces more food for markets but not for displaced and poor people
- When investing in more productive technology amplifies hunger by putting people out of work
- When affluence encourages meat-rich diets, requiring much grain to feed animals that could support the diets of many hungry people

These different styles of theorizing about the causes of hunger all have virtues and limitations. The agricultural modernization approach rightly points to lack of capital investment in agriculture and agricultural research and development as related to both poverty and hunger. But while investing in agricultural modernization, attempts to produce food security must take into account environmental sustainability. Ecological neo-Malthusianism reminds us that solutions must be developed within the limits of the biosphere and must be understood from a long-term perspective, but it overemphasizes population and environmental resources as independent causes of hunger rather than in context with the social and political factors that shape hunger. I agree with Frederick Buttel that the inequality and political-economy approach is best able to incorporate insights of the other three perspectives, while pointing to dynamics that the other three downplay—that the taproots of hunger lie most fundamentally in social relations.

While going a long way toward explaining hunger, these three perspectives gloss over several explanatory factors found related to the persistence of malnutrition. For instance, research demonstrates that *social disruptions* like wars and civil unrest are the main antecedents of famine, particularly in areas where "entitlements to food" are low. Even people in very poor countries can usually manage to avoid famine where there are no social disruptions (Messer, 1998). Second, *natural disasters,* such as severe storms, hurricanes, floods, droughts, and so forth are related to famine. Although natural disasters and famine are of some importance, researchers and policy circles have overemphasized them. Famines and natural disasters are estimated to cause only about 10% of all hunger deaths, and they are in many respects made by people. Third, *local social relations,* like rural landholding structures, ethnic stratification, class and caste relations, regional inequalities, and community power structures shape hunger (Buttel, 2000a). Fourth, *gender relations,* gender inequality, and household power dynamics are not dealt with directly by the four perspectives. But all perspectives and scholars recognize that access to food is strongly gendered. Finally, Nobel prize-winning economist Amartya K. Sen emphasized that hunger is

related to food *entitlements*, or the ability of individuals and groups to "command food." Entitlements defined by custom, social status, and law shape who eats and who doesn't because they reflect access to social power. They reflect power relations at international, national, local, and household levels (1993).

FEEDING EIGHT BILLION PEOPLE IN THE NEXT FIFTY YEARS?

Clearly, dealing with inequality, poverty, and social circumstances such as those noted that surround food are the keys to addressing world malnutrition in the short term. Though there is theoretically enough food to feed everybody adequately, per capita production has declined and the world's margin of safety regarding food has declined. (Look at Figure 5.3 again.).[3] Even though the "more food" and "population growth as the singular cause" arguments about hunger are flawed, it is still true that we will need more food in the longer term. Accomodating the larger population that will appear by the end of the next century will require a much greater increase of current food output levels on stressed global food resource bases. This feat will challenge the ingenuity of the world's policy makers and farmers under *any* circumstances, and particularly if it is done in a sustainable way. We will need to simultaneously produce more food and halt the destruction of the agricultural resource base. How?

The most obvious way of increasing food supplies is to extend the technologies that have served us so well since the 1950s: Bring more land into cultivation; use more fertilizer, pesticides, and herbicides; irrigate more; and so on. Yet continuing these techniques produces little significant increase in crop yields. The J-shaped curve of early rapid growth slows down, reaches its limits, and levels off, becoming an S-shaped curve. Grain yields per hectare still increase in most nations, but at a slower rate. But not only do the intensive agricultural techniques from the 1950s no longer produce increasing per capita yields, they measurably degrade the resource bases for agriculture (Bender and Smith, 1997: 25–40). It is doubtful whether even current yields of such intensive agriculture as practiced in Europe and the United States are environmentally sustainable throughout this century without considerable modification. It is even more doubtful that temperate zone monoculture agriculture could be successfully exported wholesale to the tropics and subtropics—even if companies and governments were willing to *give it away* or the LDCs had the money to *buy it*. On the scale required, we won't and they don't.

Biotechnology?

Some view new biotechnology (or genetic engineering) as a technological panacea of the coming decades that will give an enormous boost to agricultural productivity, becoming a gene revolution like the green revolution seed

hybrids of the 1960s. The *green revolution* refers to a massive global effort to crossbreed species producing crop seeds that were much more productive per unit of cultivated land, thereby increasing total food production. The global diffusion of the new green revolution hybrids significantly decreased the genetic diversity of crops around the world. By gene splicing and injection, the new genetic engineering techniques could produce new varieties that "Mother Nature never knew"; more pest resistant, earlier maturing, drought resistant, salt resistant, and more efficient users of solar energy during photosynthesis. Because of such potential benefits and their profitability, genetically modified (GM) crops were rapidly entering the American farming/food system by the year 2000. For instance, about two-thirds of soybeans were grown from engineered seed species. In fact, soybeans accounted for 63% of all GM crops in 2001. Corn made up about 19 percent, and other crops (cotton, canola, tomatoes, potatoes) made up miniscule proportions. Just three countries (the United States, Canada, and Argentina) accounted for 96% of all GM crops in 2001, and most of them (77%) were engineered for a single trait: being able to tolerate higher doses of herbicides (Buttel, 2002). Not by accident, GM seeds are patented and sold by the same corporations that market herbicides. It is important to note that, in spite of the publicity and hoopla about the "global biotechnology revolution," it has mostly been one crop in three nations for a single trait (herbicide resistence). So far, the diffusion of GM crops has been deep but very narrow. Outside of soybeans (and to a lesser extent, corn) in three countries, very little of the world's crop acres are planted in GM crops. Given that the world's three major food crops are rice, wheat, and maize (corn), there is scarcely a real beginning of such a revolution in the staple crop sectors (Buttel, 2002: 7).

There are ecological reasons for caution about GM crops. Without huge amounts of fertilizer and water, most green revolution crop varieties (of the 1960s) produced yields that were no higher (and sometimes lower) than traditional varieties. Similarly, if genetically engineered crops increase productivity by accelerating photosynthesis, they could also accelerate the loss of soil nutrients, requiring more fertilizer and water. Without ample water, good soil, and favorable weather, new genetically engineered crops could fail. Furthermore, new species would be inserted into natural food chains, predator systems, and mineral cycles with unpredictable results. Weeds might acquire the special defenses or enhanced photosynthetic capacity of a GM crop plant, and crop plants with built-in pesticides might harm many insects other than target pests. Furthermore, new organisms introduced into an environment can themselves become pests. Please don't think this an unimportant issue: In the United States, nonnative plant invaders cause an estimated $138 billion in damage, including the costs of controlling them (Pimentel, 1999). Historically, more than 120 intentionally introduced crop plants *have* become such weed pests in the United States. Unlike people in the United States, Europeans have demonstrated strong skepticism about the biotechnology industry's claims that no

adverse health effects are associated with consuming GM food. Europeans are also wary of the unintentional—and damaging—introduction of genes or substances into the environment. At the turn of the twenty-first century, a serious food trade war between the United States and Europe was brewing about this issue (Halweil, 1999, 2000).

Other reasons why biotechnology is a questionable panacea for malnutrition around the world have to do with economics and institutional contexts. Genetic engineering requires heavy capital and technical investments and is being conducted by large private companies that will hold patents on "their organisms," available to buyers at the right price—rather than cheaply to those most in need of food. So far, biotechnology research has been more driven by the desire for agribusiness sales and profits rather than for food for the hungry or agricultural sustainability. Priorities have been, for example, to develop herbicide-resistant crops producing higher sales and profits for herbicide companies. In the most widely known illustration, the Monsanto company was developing a high-yield seed with a *terminator* gene, meaning that after the crop was grown, harvested seeds could not be regrown. Rather than being saved by farmers, each year's seed had to be purchased anew from the company. Reactions were so negative that the company has abandoned the project, but in corporate circles the race is on. Because of risky but extraordinarily high profit potentials, agribusiness firms now compete vigorously to develop and patent engineered species. The prospect of producing more food cheaply for the world's poor and hungry has so far eluded researchers, and—more important—attracted little interest by investors.[4]

None of this means that genetically engineered crop species should be rejected out of hand, particularly if the research agenda could be redirected toward more food and fewer ecological impacts rather than more profits. Doing this would mean shifting some control of research and development agendas to the world's food consumers and farmers. But lest you think it is only environmental scientists and industry critics who doubt that biotechnology is a solution to the world's food problems, listen to Donald Duvick, for many years director of research at Pioneer HiBred International (one of the world's largest seed producers). "No breakthroughs are in sight. Biotechnology, while essential to progress, will not produce sharp upward swings in yield potential except for isolated crops in certain situations" (cited in Miller, 1998: 607). Like many new scientific technologies, genetic engineering has impressive promises mixed with serious and sometimes sinister possibilities—environmental but also economic and political.

Sustainable Agriculture: Agroecology and Low-Input Farming?

As the limitations of modern intensive agriculture and the hazards of biotechnology become apparent, agronomists and ecologists are rediscovering some of the virtues of more labor-intensive traditional agricultural practices. These

are most obvious for increasing food in tropical LDCs, where rural labor is plentiful but capital and technology are scarce. Though often less profitable in the world market economy, many traditional methods were superior in productivity per hectare when energy inputs and long-term sustainability were considered (Armillas, 1971). Now a newer agricultural paradigm of *agroecology* recognizes that a farm is also an ecosystem and uses the ecological principles of diversity, interdependence, and synergy to improve productivity as well as sustainability (Altieri, 1995). The tools of industrial intensive agriculture are powerful and simple and mean using products like insecticides bought off the shelf. By contrast, agroecology is complex and its tools are subtle. It involves intercropping (growing several crops simultaneously in the same field), multiple cropping (planting more than one crop a year on the same land), crop rotation, and the mixing of plant and animal production—all time-honored practices of farmers around the world (Lappé et al., 1998: 77–78). Agroecology can be combined with *organic* and *low-input* techniques. Farmers can, for instance, recycle animal manures and "green manure" (plant residues) for fertilizer, and they can practice low-tillage plowing that leaves plant residues to prevent erosion and improve soil productivity.

Consider an example. In 1999 on a 300-acre farm near Boone, Iowa, farmer Dick Thompson rotated corn, soybeans, oats, and wheat interplanted with clover and a hay combination that includes an assortment of grasses and legumes. The pests that plagued neighboring monoculture farms were less of a problem because insect pests usually "specialize" in one particular crop. In a diverse setting, no single pest is likely to get the upper hand. Diversity tends to reduce weed problems because complex cropping uses nutrient resources more efficiently than monocultures, so there is less left over for weeds to consume. Thompson also keeps weeds in check by grazing a herd of cattle, a rarity on Midwestern corn farms. Most cattle are now raised in feedlots. Cattle, hogs, and nitrogen-fixing legumes maintain nutrient-healthy soil. Moreover, Thompson is making money. He profits from his healthy soil and crops and the fact that his "input" costs—for chemical fertilizer, pesticides, and the like—are almost nothing (Halweil, 1999: 29).

Such techniques can be highly productive, *but only when human labor is carefully and patiently applied.* Evidence from developing nations is impressive. The agriculture of China, Taiwan, Korea, Sri Lanka, and Egypt is now close to this mode—with high yields to show for it (Hecht, 1989). But it was in Cuba that such alternative agriculture was put to its greatest test. Before the collapse of the communist world, Cuba was a model green revolution–style farm economy, based on enormous production units using vast quantities of imported chemicals and machinery to produce export crops while over half the island's food was imported. When, around 1990, Cuba lost trade and subsidies from socialist bloc nations, Cuba was plunged into the worst food crisis in history, with per capita calories dropping by as much as 30%. Faced with the impossibility of importing either food or agrochemical inputs, Cuba

turned inward to create more self-reliant agriculture based on higher crop prices to farmers, smaller production units, and urban agriculture. By 1997, Cubans were eating almost as well as they had before 1990 (Rosset, 1997).

Urban agriculture is based on the idea of getting urban dwellers to grow vegetable crops in empty lots, backyards, and other spaces in and around cities. In 1996 such gardeners in Havana supplied 5 to 20% of the city's food. Urban gardening is not a new idea. For instance, during World War II such "victory gardens" produced 40 to 50% of the fresh vegetables in the United States. Urban gardening is now a major source of food in the large cities of the LDCs, such as Shanghai and Calcutta, where food security is often a matter of survival. In the United States, organizations have been formed in many American cities to support urban gardeners, who meet regularly to sell and swap their produce. Advocates see urban agriculture as one means of helping urbanites to reclaim neighborhoods from crime and pollution, training low-income residents business skills, and teaching young people about nutritional, environmental, and food security issues. Thus, a movement toward community-supported agriculture that started in the 1970s recently included 600 programs around the world (Nelson, 1996).

Is organic agriculture economically viable? Organic farming is a small but rapidly growing part of a sustainable agroecology. Many Americans identify organic food with delusional hippies, hysterical moms, and self-righteous farmers, and many scientists don't think organic food production could address world food problems. As a Cambridge University chemist bluntly put it: "The greatest catastrophe . . . is not global warming, but a global conversion to organic farming—an estimated two billion people would perish" (Halweil, 2006:18). But a number of agribusiness executives, agricultural and ecological scientists, and international agriculture experts believe that a large-scale shift to organic farming would not only increase the world's food supply, but might be the only way to eradicate hunger and lower the impacts of agriculture on the environment. The "external costs" of organic agriculture are lower than conventional production—in terms of soil erosion, chemical pollution of drinking water, the death of birds and wildlife, and toxic agrochemical residues on food.

Many studies from around the world show that organic farming can produce about as much, and in some settings more, food than conventional farms. Where there is a gap, it is largest in MDCs, where lots of agrochemicals and pesticides are used. Looking at data from more than 200 studies in Europe and North America, a Cornell University study found that organic yields were about 80% of conventional yields. Reviewing 154 growing seasons' worth of data on U.S. rain-fed and irrigated land, University of California–Davis scientists found that organic corn yields were 94% of conventional yields, organic wheat were 97%, and organic tomatoes showed no yield difference. Importantly, British researchers at the University of Essex found that in poorer nations where most of the hungry live, the yield gaps completely disappeared, and were sometimes higher on organic farms (Halweil, 2006).

Whether a complete conversion to a sort of organic utopia could address the world's hunger and environmental problems is the wrong question. Roland Bunch, an agricultural extension agent with decades of experience in Africa and the Americas points instead to "a middle path" of agroecology, or

> low input agriculture that uses many of the principles of organic farming and depends on a small fraction of the chemicals. Such systems can immediately produce two or three times what small farmers are presently producing, and is less costly per unit of production. More small farmers in LDCs will adopt it rather than going completely organic, because they aren't taking food from their childrens' mouths. If five farmers elimate half their use of chemicals, the effect on the environment will be two and a half times as great as if one farmer goes totally organic. (Bunch, cited in Halweil, 2006:23–24)

After noting this compelling evidence and possibilities for change, I note that, ironically, U.S. agriculture is *not* presently evolving toward such smaller alternative farming systems, but rather toward larger, chemically intensive monoculture farms owned or controlled by large agribusiness firms. This is true for both grain crops and animals, as illustrated by the huge cattle feedlots and confined animal feeding operations (CAFOs) that raise hogs and chickens. Agricultural research, state and Federal subsidies, and pricing policies have favored such operations. Altieri, the agricultural scientist who coined the term *agroecology*, recently observed that "it is clear that the future of agriculture will be determined by power relations, and there is no reason why farmers and the public in general, if sufficiently empowered, could not influence the direction of agriculture toward goals of sustainability" (1998: 71).

STABILIZING WORLD POPULATION: POLICY OPTIONS

The rate of population growth has been falling around the world for about a decade as fertility rates fall around the world. Several causes contribute to the world decline in the rate of growth, which are enormously variable among nations and regions: (1) the socioeconomic development and falling birth rates that complete the demographic transition in some LDCs, (2) the successes of family planning programs, (3) the global diffusion of feminism and women's rights movements, and (4) the increasing malnutrition, misery, and HIV/AIDS that increase the death rates.

During the 1980s, women around the world began forming small nongovernmental organizations (NGOs) to lobby for improvements in their social, economic, and political circumstances. By the 1990s, women in LDCs were advocating improvements in family planning programs in order to improve information and access, and encouraging service providers to treat clients with greater respect. Opposition by women's groups to existing family planning programs as well as ethical, scientific, and religious debates

about population growth formed the backdrop for the fifth U.N. conference on population. The International Conference on Population and Development (ICPD) was unique in directly linking population problems with development issues. When the ICPD met in Cairo, Egypt in 1994, the level of participation by NGOs was unprecedented; over 1,200 NGOs participated as observers or delegates and worked with government officials to craft the ICPD program of action. Directly linking population and development issues was unique among population conferences (Gelbard et al., 1999: 34).

By an overwhelming consensus, delegates of the ICPD argued that population growth *is* a serious problem that exacerbates core social and environmental problems, while they rejected the notion that population growth is *the* cause of all human problems. They emphasized the necessity of creating conditions under which couples willingly lower the number of children they have. Like previous conferences, they affirmed (1) making the traditional strategies of family planning/contraception available to all people, and (2) addressing poverty and destitution that amplify population growth. Powerful evidence suggests that everywhere these strategies have made a difference. But the ICPD emphasized something quite new: (3) empowering women. Many women—particularly in LDCs, where 90% of the world's population growth will happen—have large families simply because they have no other way to achieve social and economy security for themselves. Women in strongly patriarchal (male-dominated) societies are often forced to marry young. They get paid much less than men when they are allowed to work, have little access to land or bank credit, and have few opportunities to participate in political life. A pervasive consensus among women's organizations as well as scholars about development and population policy maintains that the policies designed to improve the well-being of and to expand the social choices available to women would go far to limit population growth, address environmental problems, and promote human development. Where women have low status and are financially dependent on their husbands, fertility remains high. There are no known exceptions to this generalization (Camp, 1993: 134–135; Sachs, 1995: 94). But you can understand why those in power in patriarchal societies may strongly resist such changes.

What is the "scorecard" for demographic change a decade after the ICPD? "Mixed," I think. Global decline in fertility rates continued in the 1990s, and progress in improving the status and social choices of women has been measurable in many nations. But confronting volatile demographic pressures on societies and the environment requires tackling population growth head on. Extending population and family planning programs requires international cooperation and resources. The MDCs, however, are not keeping their part of the bargain, and will need to increase contributions of expertise, supplies, and funding. The world is facing critical shortages in supplies needed for contraception, HIV/AIDS prevention, and other reproductive services. For instance, the annual cost of supplying enough free and

affordable condoms worldwide is expected to double to about $557 million by 2015 (Mastny and Cincotta, 2005:36). Unfortunately, just when the need is most urgent, international support decreases. By 2000 it was only half of the $17 billion goal that the ICPD agreed to at Cairo (the U.S. share of that pledge was $1.9 billion, of which about one-third was actually contributed). In 2004, the U.S. government withheld the $35 million it owes the United Nations Population Fund—which represents about 10% of the budget of that agency—as it has done until 2006 (Mastny and Cincotta, 2005:36–37).

CONCLUSION

While the signs that the demographic transition is working in some fashion on a global basis provide the basis for some optimism, world population is an enormous problem because of the built-in momentum of absolute growth. Using a metaphor of a semi truck speeding toward us for population growth, the optimist would note that it has slowed from 80 to 60 miles an hour. The pessimist would note that while we were looking the other way, someone just doubled the weight of the cargo!

PERSONAL CONNECTIONS

Implications and Questions

You can intellectually comprehend large-scale population change, but my guess is that it is so abstract and pervasive that you rarely think about your everyday life circumstances, problems, and opportunities as related to population change. Here are a few leading questions to help explore the demographic contexts of your life:

1. High population density means that people live more closely together, interact more frequently, and compete with each other more intensely for living space and all resources for which supplies are limited. Think of the times when you have lived in a smaller, dense environment with others (in a shared apartment, college dormitory, boarding school, or military base, for instance). How would you describe the experience? What kinds of problems did you and others experience? What kinds of things became important that weren't important in a less densely populated living environment? What kinds of special rules or regulations evolved to deal with problems of increased population density? You might think of all the special rules that college dorm systems and military bases need to deal with problems of living in such facilities. Not all such rules deal with crowding and density problems, but many do.

2. The stabilization of population growth has been on the world's political agenda for some years, and most notably from the ICPD conference at Cairo. That conference defined strategies for slowing population growth that involved the continuation of established family-planning programs, social development in LDCs, with assistance from international agencies, and enhancements in the status of women around the world. How much of a priority do you think this should be, compared to other issues? How urgent should it be for the politicians who collect your tax money? How do your age, family status, education, political attitudes, or religious background shape answers to these questions?

What You Can Do

This chapter's twin concerns were population and food. Food security may be an alien concern to you, unless you're among the minority of Americans whose food supply is chronically in jeopardy. But food security is a problem for an estimated 30 million Americans, in addition to people in many other nations. In the midst of a seeming surfeit of food in America, what contribution could you make to increase the food security in the world?

1. You could buy food in bulk, uncooked, with fewer layers of packaging. That makes food cheaper per unit of production, likely to be healthier, involves less energy to produce, and creates less trash. More of your food costs go directly to producers and to corporate intermediaries who process it. And by selective buying, you can support natural or organic food production, and local or regional producers. These may be very difficult to do among busy dual-income families, and in food systems increasingly dominated by fast foods, supermarkets, and prepared meals. They are for my family!

2. As to hunger and food security itself: The most obvious way of helping is to give generously to food banks and international food relief agencies. That does help feed people who are desperate, but it does not contribute in any way to increase their ongoing food self-sufficiency. Most food relief agencies, such as Oxfam International, now emphasize contributing to the development of food producing capacity. You can contribute to both public and private food development programs. If you or your friends want a really challenging but important project, try to organize on behalf of the world's hungry people. Try to get food agricultural development programs to those who directly produce food rather than state ministries or firms. While you're at it, you might try to redefine domestic political priorities at any level—city, state, federal—more toward enhancing the food for the hungry. As you can see, addressing food security issues is not easy, and can be as much political as personal.

4. Among the important personal things you can do is to grow some of your own food in a backyard plot, a window planter, a rooftop garden, or a cooperative community garden. Spending $31 to plant a living room-size garden can give you vegetables worth about $250. Try getting a return like that in the stock market! (Miller, 1992: 386).

5. Even more important is eating "lower on the food chain," meaning eating less meat and more grains, fruits, and vegetables. If this lifestyle change became common, the benefits for environmental problems, dietary health, and food security would be enormous. It would save money and energy and reduce your intake of fats that contribute to obesity, heart disease, and other disorders. It also would reduce air and water pollution, water use, reforestation, soil erosion, overgrazing, species extinction, and emissions of greenhouse gases (methane) produced by cattle. In the United States, animal agriculture pollutes more fresh water than all municipal and industrial uses combined. If Americans reduced their meat intake by only 10%, the savings in grain and soybeans could adequately feed 60 million people. More than half of U.S. cropland is devoted to growing livestock feed. Livestock also consume more than half of the water used in the United States, either by direct consumption or irrigating to grow their feed or processing their manure. Each time a single American becomes a vegetarian, 1 acre of trees and 1.1 million gallons of water are saved each year, and that individual pollutes half as much water. Currently only about 3% of Americans are vegetarian (Miller, 1992: 368).

6. The beef about beef: I hate to mention this. Particularly since I live in Omaha, which comes close to being the beef capital of the nation. Its hinterlands are loaded with cattle ranches, feedlots, and packinghouses, and the beef industry is terribly important to the local economy. (Have you seen those ads for "luscious" Omaha steaks that could be shipped to you?). In fact, in Nebraska nothing comes closer to sacrilege than encouraging people to eat less beef. But you should. Why? Most obvious are health reasons, because it is high in saturated fat. Beef requires more inputs of feed and other agricultural inputs per pound than any other livestock. It takes about 9 calories of energy input to get 1 calorie of food output from beef. So, you can see that in energy terms, it's a net loss. Most rangeland degradation in the United States is from cattle, not hogs or chickens. Not all the beef we eat comes from the United States. The most ecologically damaging beef is from cattle raised on tropical soils of Latin America.

After all this, I have to be honest. My family and I still eat meat, including beef, but we often buy "naturally raised" beef from smaller regional farmers. I'd feel a lot better about eating beef if more of it were raised grass fed on ecologically managed rangeland rather than in crowded feedlots where cattle are usually fattened up with processed food, pumped full of

growth hormones and antibiotics, and produce concentrated waste disposal problems. But little American beef is currently produced on open rangeland.

Real Goods

The Chinese Diet. It consists overwhelmingly of rice or noodles, vegetables like onions, peppers, and tomatoes, and locally produced pork—sometimes with chicken, beef, fish, or shellfish for variety. The Chinese eat one-fifth as much meat as Americans, making them paragons of low-on-the-food-chain ecological correctness. It also reduces their saturated fat and cholesterol consumption to levels the National Cancer Institute and the American Heart Association don't let themselves dream of in America. Consequently the Chinese suffer fewer heart attacks, strokes, and cases of breast cancer. They also have lower levels of anemia and osteoporosis in spite of their lower calcium intake (Durning, 1994: 98). As China develops, many Chinese are giving up their traditionally healthy diet and learning to eat more like affluent Americans.

My family likes Chinese food and we cook some of it, both with meat and without. But watch it. Chinese-American restaurant food often comes with fried rice, which loads the fat and cholesterol back in. Most restaurants are happy to substitute ordinary steamed rice.

MORE RESOURCES

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ELECTRONIC RESOURCES

http://www.census.gov/main/www/cen2000.html
Gateway to the 2000 U.S. Census

http://popenvironment.org
Links to a variety of topics about population and environment

http://www.populationenvironmentresearch.org

http://www.jhuccp.org/popenviro/
Johns Hopkins University, information program, population and environment

http://worldwatch.org/alerts/000304.html
National Wildlife Federation population pages

http://www.fao.org
United Nations Food and Agriculture Organization home page.

http://www.ucsusa.org/resources/index.html
The Union of Concerned Scientists. Many reources here, but click on "global resources" and "population growth" and go from there.

ENDNOTES

1. The doubling time can be computed by the *rule of 70*—that is, 70 divided by the growth rate per year (expressed in percentage). So at the growth rate in the 1990s of about 2 percent per year, the doubling time was 35 years. Exponential growth is expressed in logarithms. So to find the doubling time, you must find the natural logarithm (or $\log_e$) of 2, which turns out to be 0.70, which is multiplied by 100 to get rid of the decimal point.
2. Although I have noted this several times before, you may still be wondering just how this works. Indian scholar M. Mamdani (1972) has provided what I think is the clearest explanation why the poor in developing nations have large families: (1) Children provide a form of old-age support in nations that provide no public retirement security; (2) children provide economic support through their labor on the farm or the sale of their labor to others; and (3) children add little to household expenditures in a condition of deep poverty. Living in chronic poverty, he argued, does not provide incentives for reduced fertility, and population control policies are likely to fail.
3. A key measure of food security is the "carryover stocks" measured in days of consumption. Carryover stock is the amount of grain left in the bins when the new yearly harvest begins. In 1990s the carryover stock would feed the world for about 75 days, down from the 1960s, when it would feed the world for about 80 days, and the all-time high of 104 days in 1987. When the carry-over stock falls below 60 days as it did in the early 1970s, grain prices become highly volatile, sometimes doubling (U.S. Department of Agriculture, 1993).
4. But consider the only example I know of for a biotech food that would address the needs of the world's hungry. In 2000, a Swiss research institute was developing a strain of rice that would supply vitamin A (beta carotene) and not block the absorption of iron, both problems among rice-eating populations. Moreover, the so-called "golden rice" strain was not patented or sold by a multinational corporation, but given to the International Rice Research Institute for distribution in the Third World. Even so, many food experts believe that even though the golden rice has such miniscule amounts of beta carotene that it would not make a meaningful difference, multinational corporations would use it for public relations to promote GM-based food in poor nations.