

A Billion People and Growing

In 1999, having added more than 180 million people in just a decade, India reached a population of 1 billion humans. If current growth rates persist, India will have 1.63 billion residents in 2050, and will surpass China as the world's most populous country. How will the country, which already has more than a quarter of its population living in abject poverty, feed, house, educate, and employ all those being added each year? And what's the best way to slow this rapid growth? The fierce debate now taking place about how to control India's population has ramifications for the rest of the world as well.

On one side of this issue are those who believe that the best way to reduce the number of children born is poverty eradication and progress for women. Drawing on social justice principles established at the 1994 UN Conference on Population and Development in Cairo, some argue that responsible economic development, a broad-based social welfare system, education and empowerment of women, and high-quality health care—including family planning services—are essential components of population control. Without progress in these areas, they believe, efforts to provide contraceptives or encourage sterilization are futile.

On the other side of this debate are those who contend that, while social progress is an admirable goal, India doesn't have the time or resources to wait for an indirect approach to population control. The government must push aggressively, they argue, to reduce births now or the population will be so huge and its use of resources so great that only mass starvation, class war, crime, and disease will be able to bring it down to a manageable size.

Unable to reach a consensus on population policy, the Indian government decided in 2000 to let each state approach the problem in its own way. Some states have chosen to focus on social justice, while others have adopted more direct, interventionist policies.

The model for the social justice approach is the southern state of Kerala, which achieved population stabilization in the mid-1980s, the first Indian state to do so. Although still one of the poorest places in the world, economically, Kerala's fertility rate is comparable to that of many industrialized nations, including the United States. Both women and men have a nearly 100 percent literacy rate and share affordable and accessible health care, family

planning, and educational opportunities; therefore, women have only the number of children they want, usually two. The Kerala experience suggests that increased wealth isn't a prerequisite for zero population growth.

Taking a far different path to birth reduction is the neighboring state of Andhra Pradesh, which just reached a stable growth rate in 2001. Boasting the most dramatic fertility decline of any large Indian state, Andhra Pradesh has focused on targeted, strongly enforced sterilization programs. The poor are encouraged—some would say, compelled—to be sterilized after having only one or two children. The incentives include cash payments. You might receive 500 rupees—equivalent to \$11 (U.S.) or a month's wage for an illiterate farm worker—if you agree to have "the operation." In addition, participants are eligible for better housing, land, well and subsidized loans.

The pressure to be sterilized is overwhelmingly directed at women, for whom the procedure is major abdominal surgery. Sterilizations often are done by animal husbandry staff and carried out in government sterilization camps. This practice raises troubling memories of the 1970s for many people, when then-Prime Minister Indira Gandhi suspended democracy and instituted a program of forced sterilization of poor people. There were reports at the time of people being rounded up like livestock and castrated or neutered against their will.

While many feminists and academics regard Andhra Pradesh's policies as appallingly intrusive and coercive to women and the poor, the state has successfully reduced population growth. By contrast, the hugely populous northern states of Uttar Pradesh and Bihar have increased their growth rates slightly over the past two decades to a current rate above 2.5 percent per year. How will they slow this exponential growth, and what might be the social and environmental costs of not doing so?

India's population problems introduce several of the important themes of this chapter. What are the trends in human populations around the world, what do those trends mean for our resources and environment, and what is the best way to approach population planning? Keep in mind, as you read this chapter, that resource limits aren't simply a matter of total number of people; they also depend on consumption levels and the types of technology used to produce the things we use and consume.

POPULATION GROWTH

Every second, on average, four or five children are born somewhere on the earth. In that same second, two other people die. This difference between births and deaths means a net gain of nearly 2.5 more humans per second in the world population. This means we are growing at a little less than 9,000 per hour, 214,000 per day, or almost 78 million more people per year. In 1999, the world population passed 6 billion, making us the most numerous vertebrate species on the planet. For the families to whom these chil-

dren are born, this may well be a joyous and long-awaited event (fig. 4.1). But is a continuing increase in humans good for the planet in the long run?

Many people worry that overpopulation will cause—or perhaps already is causing—resource depletion and environmental degradation that threaten the ecological life-support systems which we all depend on. These fears often lead to demands for immediate, worldwide birth-control programs to reduce fertility rates a to eventually stabilize or even shrink the total number of humans

Others believe that human ingenuity, technology, and enterprise can extend the world's carrying capacity and allow us to overcome any problems we encounter. From this perspective, more people may be beneficial, rather than disastrous. A larger population means a larger workforce, more geniuses, more ideas about what to do. Along with every new mouth comes a pair of hands. Proponents of this worldview argue that continued economic and technological growth can both feed the world's billions and enrich everyone enough to end the population explosion voluntarily.

Yet another perspective on this subject derives from social justice concerns. According to this worldview, resources are sufficient for everyone. Current shortages are only signs of greed, waste, and oppression. The root cause of environmental degradation, in this view, is inequitable distribution of wealth and power rather than population size. Fostering democracy, empowering women and minorities, and improving the standard of living of the world's poorest people are what are really needed. A narrow focus on population growth only fosters racism and an attitude that blames the poor for their problems, while ignoring the deeper social and economic forces at work.

Whether human populations will continue to grow at present rates and what that growth would imply for environmental quality and human life are among the most central and pressing questions in environmental science. In this chapter, we will look at some causes of population growth, as well as at how populations are measured and described. Family planning and birth control are essential for stabilizing populations. The number of children a couple decides to have and the methods they use to regulate fertility, however, are strongly influenced by culture, religion, politics, and economics, as well as basic biological and medical considerations. We will examine how some of these factors influence human demographics.

Human Population History

For most of our history, humans have not been very numerous compared to other species. Studies of hunting and gathering societies suggest that the total world population was probably only a few million people before the invention of agriculture and the domestication of animals around 10,000 years ago. The agricultural revolution produced a larger and more secure food supply and allowed the human population to grow, reaching perhaps 50 million people by 5000 B.C. For thousands of years, the number of humans increased very slowly. Archaeological evidence and historical descriptions suggest that only about 300 million people were living at the time of Christ (table 4.1).

As you can see in figure 4.2, human populations began to increase rapidly after about A.D. 1600. Many factors contributed to this rapid growth. Increased sailing and navigating skills stimulated commerce and communication among nations. Agricultural developments, better sources of power, and better health care and hygiene also played a role. We are now in an exponential or J curve pattern of growth described in chapter 3.

It took all of human history to reach 1 billion people in 1804, but little more than 150 years to reach 3 billion in 1960. It took us only 12 years—from 1987 to 1999—to add the sixth billion. Another way

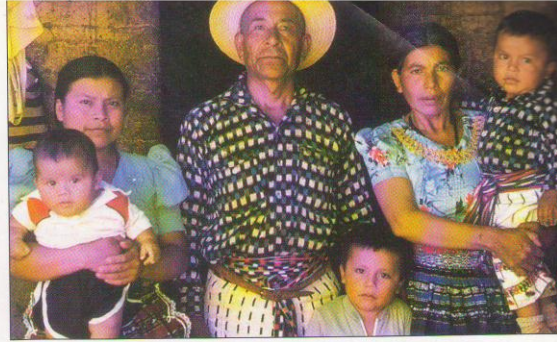


FIGURE 4.1 A Mayan family in Guatemala with four of their six living children. Decisions on how many children to have are influenced by many factors, including culture, religion, need for old-age security for parents, immediate family finances, household help, child survival rates, and power relationships within the family.

to look at population growth is that the number of humans tripled during the twentieth century. Will it do so again in the twenty-first century? If it does, will we overshoot our environment's carrying capacity and experience a catastrophic dieback similar to those described in chapter 3? As you will see later in this chapter, there is some evidence that population growth already is slowing, but whether we will reach equilibrium soon enough and at a size that can be sustained over the long term remains a difficult but important question.

Population Doubling Times

If the current world population is growing at approximately 1.3 percent per year, how long will it take to double the population if that rate persists? A useful rule of thumb is that if you divide 70 by the annual percentage growth, you get the approximate doubling time in years for anything growing exponentially. For example, a savings account or a biological population growing at a compound interest rate of 1 percent per year will double in about 70 years. By

DATE	POPULATION	DOUBLING TIME
5000 B.C.	50 million	?
800 B.C.	100 million	4,200 years
200 B.C.	200 million	600 years
A.D. 1200	400 million	1,400 years
A.D. 1700	800 million	500 years
A.D. 1900	1,600 million	200 years
A.D. 1965	3,200 million	65 years
A.D. 1990	5,300 million	38 years
A.D. 2020 (estimate)	8,230 million	55 years

Source: Data from Population Reference Bureau, Inc., Washington, D.C.

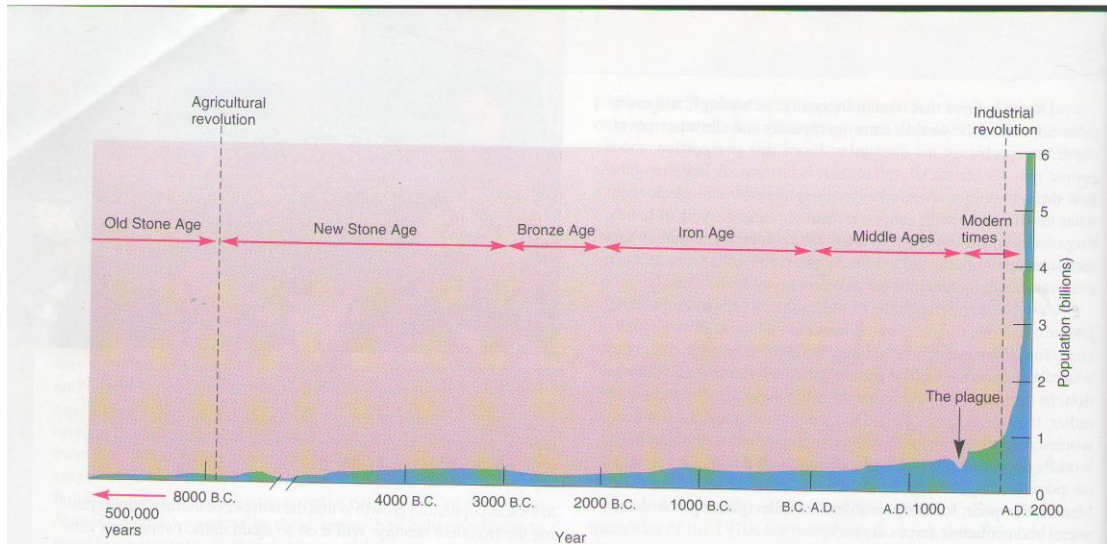


FIGURE 4.2 Human population levels throughout history. Since about A.D. 1000, our population curve has assumed a J shape. Are we on the upward slope of a population overshoot? Will we be able to adjust our population growth to an S curve? Or can we just continue the present trend indefinitely?

APPLICATION:	Population Doubling Times
Using the "rule of 70," calculate the doubling time of populations growing at the following annual percentage growth rates: 0.1 percent, 1.0 percent, 1.3 percent, 5 percent.	
Example: $\frac{70 \text{ years}}{(\text{percent growth})} = \text{doubling time in years}$	

Answers: 0.1 = 700 years; 1.0 = 70 years; 1.3 = 54 years; 5.0 = 14 years

the same measure, a population growing at 35 percent doubles every 2 years. Countries growing at 4 percent per year will double their populations in 17.5 years. A country growing at a rate of 0.1 percent annually will double its population in 700 years.

LIMITS TO GROWTH: SOME OPPOSING VIEWS

As with many topics in environmental science, people have widely differing opinions about population and resources. Some believe that population growth is the ultimate cause of poverty and environmental degradation. Others argue that poverty, environmental degradation, and overpopulation are all merely symptoms of deeper social and political factors. Which of these opposing worldviews we accept as most correct will have a great impact on our population policies. In this section, we will examine some of the major figures and their arguments in this debate.

Malthusian Checks on Population

In 1798, the Reverend Thomas Malthus wrote *An Essay on the Principle of Population* to refute the views of progressives and optimists—including his father—who, inspired by the egalitarian principles of the French Revolution, predicted a coming utopia. The younger Malthus argued that human populations tend to increase at an exponential or compound rate, while food production either remains stable or increases only slowly. The result, according to Malthus, is that human populations inevitably outstrip their food supply and eventually collapse into starvation, crime, and misery. Figure 4.3a summarizes his theory.

According to Malthus, the only ways to stabilize human populations are "positive checks," such as diseases or famines that kill people, or "preventative checks," including all the factors that prevent human birth. Among the preventative checks he advocated were "moral restraint," including late marriage and celibacy until a couple could afford to support children. Malthus himself, however, had several illegitimate children and didn't have much faith in moral restraint. Many social scientists and biologists have been influenced by Malthus. Charles Darwin, for instance, derived his theories about the struggle for scarce resources and survival of the fittest after reading Malthus's essay.

If Malthus's views of the consequences of exponential population growth were dismal, the corollary he drew was even more bleak. He believed that most people are too lazy and immoral to regulate birth rates voluntarily. Consequently, he opposed efforts to feed and assist the poor in England because he feared that more food would simply increase their fertility and thereby perpetuate the problems of starvation and misery. (See the related story "The Saga of Easter Island" at www.mhhe.com/apps.)

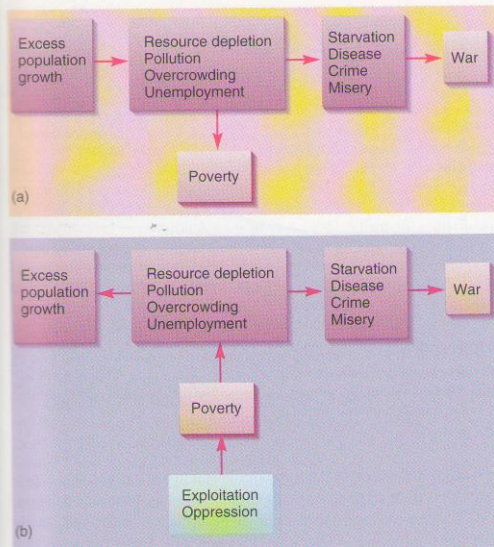


FIGURE 4.3 (a) Thomas Malthus argued that excess population growth is the ultimate cause of many other social and environmental problems. (b) Karl Marx argued that oppression and exploitation are the real causes of poverty and environmental degradation. In his view, population growth is a symptom or result of other problems, not the source.

Not surprisingly, Malthus's ideas provoked a great social and economic debate. Karl Marx was one of his most vehement critics, claiming that Malthus was a "shameless sycophant of the ruling classes." According to Marx, population growth is a symptom rather than a root cause of poverty, resource depletion, pollution, and other social ills. The real causes of these problems, he believed, are exploitation and oppression (fig. 4.3b). Marx argued that workers always provide for their own sustenance, given access to means of production and a fair share of the fruits of their labor. According to Marxians, the way to slow population growth and to alleviate crime, disease, starvation, misery, and environmental degradation is through social justice.

Malthus and Marx Today

Both Marx and Malthus developed their theories about human population growth in the nineteenth century, when understanding of the world, technology, and society were much different than they are now. Still, as the opening story in this chapter shows, the questions they raised are relevant today. While the evils of racism, classism, and other forms of exploitation that Marx denounced still beset us, it is also true that at some point available resources must limit the numbers of humans that the earth can sustain.

Those who agree with Malthus that we are approaching—or may already have surpassed—the earth's carrying capacity are

called **neo-Malthusians**. In their view, we should address the issue of surplus population directly by making birth control our highest priority. Cornell University entomologist David Pimentel expressed a version of this view when he said, "By 2100, if current trends continue, twelve billion miserable humans will suffer a difficult life on Earth." The optimum population, he argues, would be about 2 billion, or about the number on the planet at the beginning of World War II. He believes that this population would allow everyone to enjoy a standard of living equal to the average European today.

Neo-Marxians, on the other hand, believe that only eliminating oppression and poverty through technological development and social justice will solve population problems. Claims of resource scarcity, they argue, are only an excuse for inequity and exclusion. They believe that, if distribution of wealth and resources were more fair, there would be plenty for everyone. As Mohandas Gandhi said, "There is enough for everyone's need, but not enough for anyone's greed."

Perhaps a compromise position between these opposing views is that population growth, poverty, and environmental degradation are all interrelated. No factor exclusively causes any other, but each influences and, in turn, is influenced by, the others.

Can Technology Make the World More Habitable?

Technological optimists argue that Malthus was wrong in his predictions of famine and disaster 200 years ago because he failed to account for scientific progress. In fact, food supplies have increased faster than population growth since Malthus's time. There have been terrible famines in the past two centuries, but they were caused more by politics and economics than lack of resources or sheer population size. Whether this progress will continue remains to be seen, but technological advances have vastly increased human carrying capacity so far.

The burst of world population growth that began 200 years ago was stimulated by scientific and industrial revolutions. Progress in agricultural productivity, engineering, information technology, commerce, medicine, sanitation, and other achievements of modern life have made it possible to support approximately 1,000 times as many people per unit area as was possible 10,000 years ago. Economist Stephen Moore of the Cato Institute in Washington, D.C. regards this achievement as "a real tribute to human ingenuity and our ability to innovate." There is no reason, he argues, to think that our ability to find technological solutions to our problems will diminish in the future.

Much of our growth in the past 200 years, however, has been based on availability of easily acquired natural resources, especially cheap, abundant fossil fuels. Whether we can develop alternative, renewable energy sources in time to avert disaster when current fossil fuels run out is a matter of great concern.

Could More People Be Beneficial?

Larger populations can have benefits as well as disadvantages. More people mean larger markets, more workers, and efficiencies

of scale in mass production of goods. Greater numbers also provide more intelligence and enterprise to overcome such problems as underdevelopment, pollution, and resource limitations. Human ingenuity and intelligence can create new resources through substitution of new materials and can discover new ways of doing things for old materials and old ways. For instance, utility companies are finding it cheaper and more environmentally sound to finance insulation and energy-efficient appliances for their customers rather than build new power plants. The effect of saving energy that was formerly wasted is comparable to creating a new fuel supply.

Economist Julian Simon was one of the most outspoken champions of this rosy view of human history. He argued that people are the "ultimate resource" and that no evidence suggests that pollution, crime, unemployment, crowding, the loss of species, or any other resource limitations will worsen with population growth. Leaders of many developing countries share this outlook and insist that, instead of being obsessed with population growth, we should focus on the inordinate consumption of the world's resources by people in richer countries.

HUMAN DEMOGRAPHY

Demography (derived from the Greek words *demos* [people] and *graphein* [to write or to measure]) encompasses vital statistics about people, such as births, deaths, and where they live, as well as total population size. In this section, we will survey ways to measure and describe human populations and discuss demographic factors that contribute to population growth.

How Many of Us Are There?

On October 12, 1999, the United Nations officially declared that the human population had reached 6 billion. The U.S. Census Bureau, however, had put the date for this landmark three months earlier on July 19. Even in this age of information technology and communication, counting the number of people in the world is like shooting at a moving target. Some countries have never even taken a census, and those that have been done may not be accurate. Governments may overstate or understate their populations to make their countries appear larger and more important or smaller and more stable than they really are. Individuals, especially if they are homeless, refugees, or illegal aliens, may not want to be counted or identified.

We really live in two very different demographic worlds. One of these worlds is poor, young, and growing rapidly. It is occupied by the vast majority of people who live in the less-developed countries of Africa, Asia, and Latin America. These countries represent 80 percent of the world population but more than 90 percent of all projected growth (fig. 4.4). (See Investigating Our Environment, p. 81.)

The highest population growth rates occur in a few "hot spots" such as sub-Saharan Africa and the Middle East, where economics, politics, religion, and civil unrest keep birth rates high and contraceptive use low. In Chad and the Democratic Republic

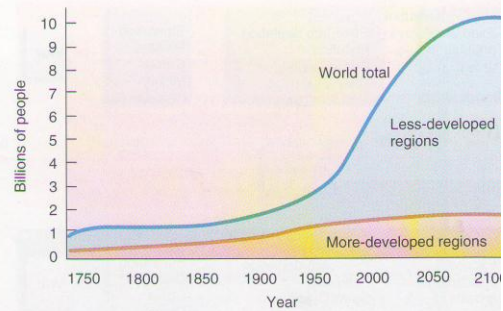


FIGURE 4.4 Estimated human population growth, 1750–2100, in less-developed and more-developed regions. More than 90 percent of all growth in the twentieth century and projected for the twenty-first century is in the less-developed countries.

of Congo, for example, annual population growth is above 3.2 percent. Less than 10 percent of all couples use any form of birth control, women average more than seven children each, and nearly half the population is less than 15 years old. Even faster growth rates occur in Oman and Palestine, where the population doubling time is only 18 years.

Some countries in the developing world have experienced amazing growth rates and are expected to reach extraordinary population sizes by the middle of the twenty-first century. Table 4.2 shows the ten largest countries in the world, arranged by their projected size in 2050. Note that, while China was the most populous

MOST POPULOUS IN 2000		MOST POPULOUS IN 2050	
COUNTRY	POPULATION (MILLIONS)	COUNTRY	POPULATION (MILLIONS)
China	1,265	India	1,628
India	1,002	China	1,369
United States	281	United States	404
Indonesia	212	Indonesia	312
Brazil	170	Nigeria	304
Pakistan	151	Pakistan	285
Russia	145	Brazil	244
Bangladesh	128	Bangladesh	211
Japan	127	Ethiopia	188
Nigeria	123	Congo	182

Source: Data from Population Reference Bureau, 2002.