

ronmental degradation or depletion. It is difficult to find more recent, reliable estimates of the number of such refugees, but in 2012, the UN projected that by 2020, there will be 50 million environmental refugees.

Estimates of any population's future numbers can vary considerably. These varying estimates depend mostly on

TFR projections. However, demographers also have to make assumptions about death rates, migration, and a number of other variables. If their assumptions are wrong, their population forecasts can be way off the mark (Science Focus 6.2).

6-3 How Does a Population's Age Structure Affect Its Growth or Decline?

CONCEPT 6-3

The numbers of males and females in young, middle, and older age groups determine how fast a population grows or declines.

A Population's Age Structure Helps Us to Make Projections

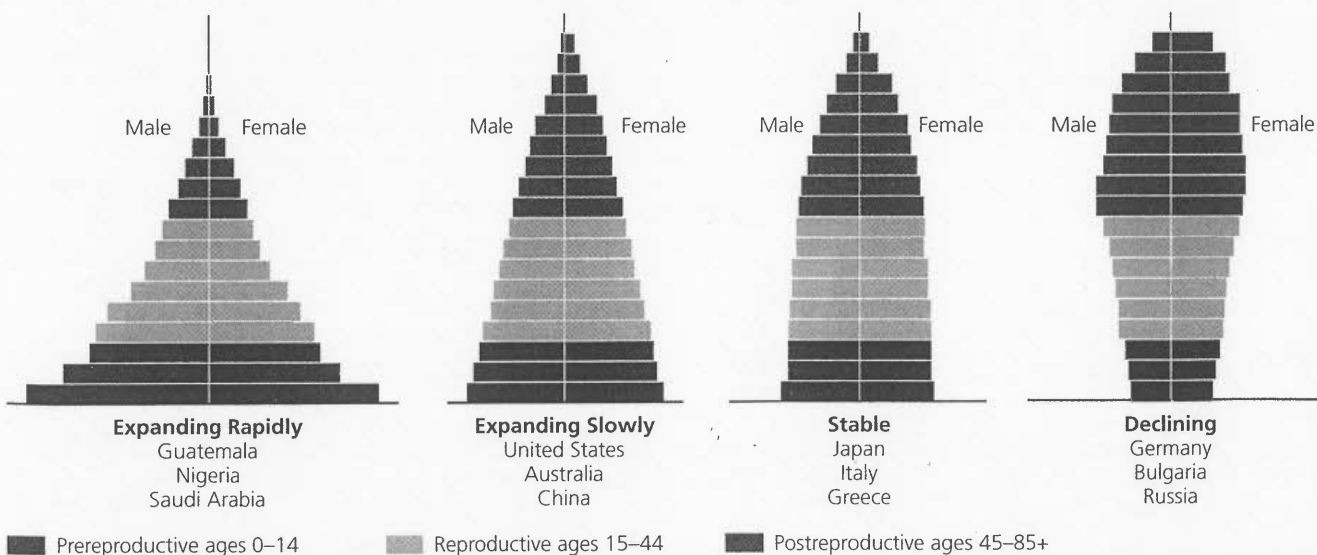
An important factor determining whether the population of a country increases or decreases is its **age structure**: the numbers or percentages of males and females in young, middle, and older age groups in that population (Concept 6-3).

Population experts construct a population *age-structure diagram* by plotting the percentages or numbers of males and females in the total population in each of three age categories: *prereproductive* (ages 0–14), consisting of individuals normally too young to have children; *reproductive* (ages 15–44), consisting of those normally able to have children; and *postreproductive* (ages 45 and older), with individuals

normally too old to have children. Figure 6-11 presents generalized age-structure diagrams for countries with rapid, slow, zero, and negative population growth rates.

A country with a large percentage of its people younger than age 15 (represented by a wide base in Figure 6-11, far left) will experience rapid population growth unless death rates rise sharply. Because of this *demographic momentum*, the number of births in such a country will rise for several decades even if women have an average of only one or two children each, due to the large number of girls entering their prime reproductive years.

In 2012, about 26% of the world's population—29% in the less-developed countries and 16% in more-developed countries—was under age 15. By 2025, the world's current 1.8 billion people under age 15—roughly one of every four persons on the planet—will move into their prime reproductive years. The dramatic differences in population age structure between less-developed and more-developed countries (Figure 6-12) show why most future human population growth will take place in less-developed countries (Figure 6-3).



(Compiled by the authors using data from U.S. Census Bureau and Population Reference Bureau.)

Animated Figure 6-11 Generalized population age-structure diagrams for countries with rapid (1.5–3%), slow (0.3–1.4%), zero (0–0.2%), and negative (declining) population growth rates. **Question:** Which of these diagrams best represents the country where you live?

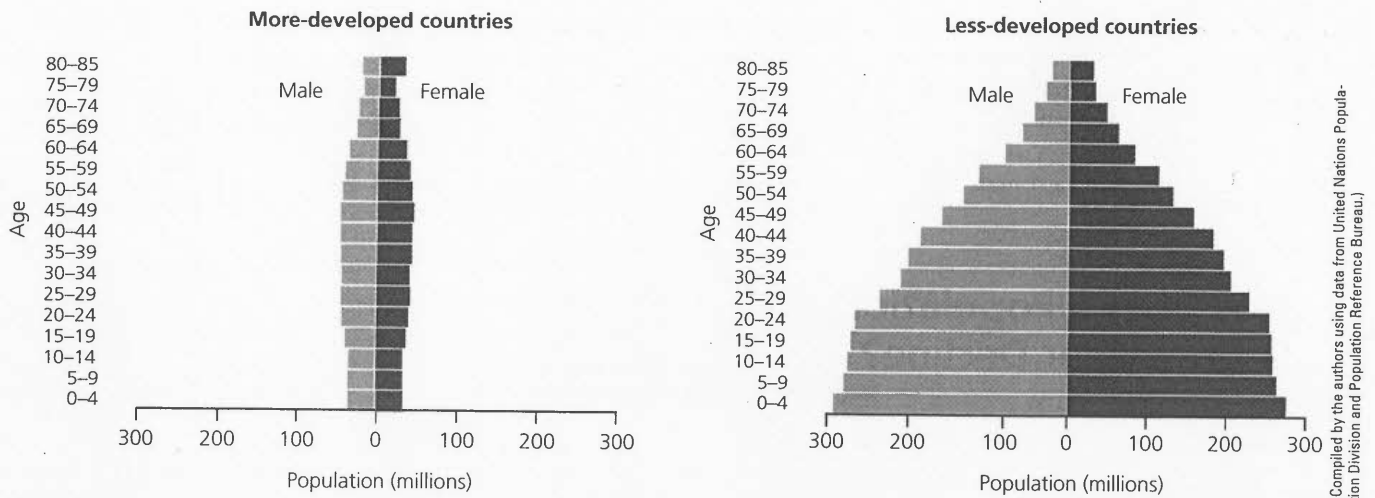


Figure 6-12 Population structure by age and sex in less-developed countries and more-developed countries for 2011. **Question:** If all girls under 15 were to have only one child during their lifetimes, how do you think these structures would change over time?

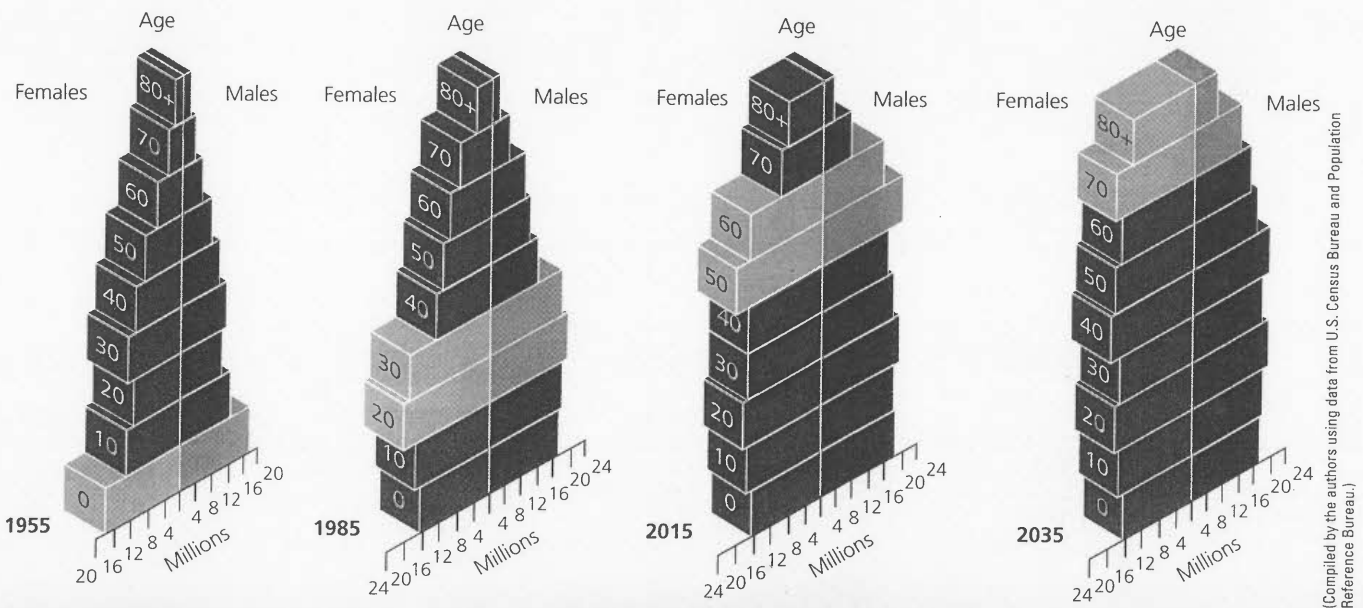
The global population of seniors—people who are 65 and older—is projected to triple by 2050, when one of every six people will be a senior. (See the Case Study that follows.) This graying of the world’s population is due largely to declining birth rates and medical advances that have extended life spans. In 2012, the three nations with the largest percentage of their population age 65 or older were, in order, Japan, Germany, and Italy. In such countries, the number of working adults is shrinking in proportion to the number of seniors, which in turn is slowing the growth of tax revenues in these countries. Some analysts worry about how such societies will support their growing populations of seniors.

CASE STUDY

The American Baby Boom

Changes in the distribution of a country’s age groups have long-lasting economic and social impacts. For example, consider the American baby boom, which added 79 million people to the U.S. population between 1946 and 1964. Over time, this group looks like a bulge moving up through the country’s age structure, as shown in Figure 6-13.

For decades, members of the baby-boom generation have strongly influenced the U.S. economy because they make up about 36% of all adult Americans. Baby boomers created the youth market in their teens and twen-



Animated Figure 6-13 Age-structure charts tracking the baby-boom generation in the United States, 1955, 1985, 2015 (projected), and 2035 (projected).

ties and are now creating the late middle age and senior markets. In addition to having this economic impact, the baby-boom generation plays an increasingly important role in deciding who gets elected to public office and what laws are passed or weakened.

Since 2011, when the first baby boomers began turning 65, the number of Americans older than age 65 has grown at the rate of about 10,000 a day and will do so through 2030. This process has been called the *graying of America*. As the number of working adults declines in proportion to the number of seniors, there may be political pressure from baby boomers to increase tax revenues to help support the growing senior population. This could lead to economic and political conflicts between younger and older Americans.

CONSIDER THIS . . .

CONNECTIONS Baby Boomers, the U.S. Work Force, and Immigration

According to the U.S. Census Bureau, after 2020, much higher immigration levels will be needed to supply enough workers as baby boomers retire. According to a recent study by the UN Population Division, if the United States wants to maintain its current ratio of workers to retirees, it will need to absorb an average of 10.8 million immigrants every year—more than 10 times the current immigration level—through 2050.

Populations Made Up Mostly of Older People Can Decline Rapidly

As the percentage of people age 65 or older increases, more countries will begin experiencing population declines. If population decline is gradual, its harmful effects usually can be managed. However, some countries are experiencing fairly rapid declines and feeling such effects more severely.

Japan has the world's highest percentage of elderly people (above age 65) and the world's lowest percentage of young people (below age 15). In 2012, Japan's population was 128 million. By 2050, its population is projected to be 95.5 million, a 25% drop. As its population declines, there will be fewer adults working and paying taxes to support an increasing elderly population. Because Japan discourages immigration, it may face a bleak economic future. As a result, some have called for the country to rely more on robots to do its manufacturing jobs and on selling robots in the global economy to help support its aging population.

In China, the growth in numbers of children has slowed because of its one-child policy. As a result, the average age of China's population has been increasing over the past two decades at one of the fastest rates ever recorded. While China's population is not yet declining, the UN estimates that by 2025, China is likely to have too few young workers to support its rapidly aging population. This graying of the Chinese population could lead to a declining work force, higher wages for workers, limited funds

for supporting continued economic development, and fewer children and grandchildren to care for the growing number of elderly people. These concerns and other factors may slow economic growth and have led to some relaxation of China's one-child population control policy.

Figure 6-14 lists some of the problems associated with rapid population decline. Countries currently faced with rapidly declining populations include Japan, Russia, Germany, Bulgaria, Hungary, Ukraine, Serbia, Greece, Portugal, and Italy.

Populations Can Decline Due to a Rising Death Rate: The AIDS Tragedy

A large number of deaths from AIDS can disrupt a country's social and economic structure by removing significant numbers of young adults from its population. According to the World Health Organization, between 1981 and 2012, AIDS killed more than 30 million people (617,000 in the United States).

Unlike hunger and malnutrition, which kill mostly infants and children, AIDS kills primarily young adults and leaves many children orphaned, some of whom are also infected with HIV, the virus that can lead to AIDS. Worldwide, AIDS is the leading cause of death for people of ages 15–49.

This pandemic has had a devastating effect in some countries, and has changed their population age structures

Some Problems with Rapid Population Decline








Can threaten economic growth	
Labor shortages	
Less government revenues with fewer workers	
Less entrepreneurship and new business formation	
Less likelihood for new technology development	
Increasing public deficits to fund higher pension and health-care costs	
Pensions may be cut and retirement age increased	

Figure 6-14 Rapid population decline can cause several problems. **Question:** Which two of these problems do you think are the most important?

Top: ©Slavoljub Pantelic/Shutterstock.com. Center: Iofoto/Shutterstock.com. Bottom: Yuri Arcurs/Shutterstock.com.

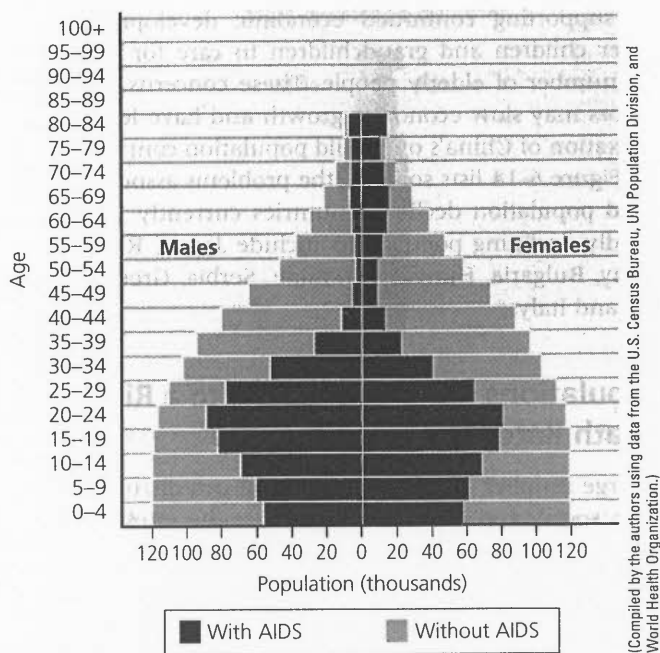


Figure 6-15 In Botswana, more than 25% of people ages 15–49 were infected with HIV in 2011. This figure shows two projected age structures for Botswana’s population in 2020—one including the possible effects of the AIDS epidemic (red bars), and the other not including those effects (yellow bars). **Question:** How might this affect Botswana’s economic development?

(Figure 6-15). This has had a number of harmful effects. One is a sharp drop in average life expectancy, especially in several southern African countries where 15–26% of all people between ages 15 and 49 are infected with HIV. Another is the loss of productive young-adult workers and trained personnel such as scientists, farmers, engineers, and teachers, as well as government, business, and health-care workers. The essential services they could provide are therefore lacking, and there are fewer taxpayers and fewer workers available to support the very young and the elderly. Many experts have called for the creation of a massive international program to help countries ravaged by AIDS.

6-4 How Can We Slow Human Population Growth?

CONCEPT 6-4

We can slow human population growth by reducing poverty, elevating the status of women, and encouraging family planning.

The First Step Is to Promote Economic Development

Scientific studies and experience have shown that the three most effective ways to slow or stop population growth are to reduce poverty, primarily through economic development and universal primary education; to elevate the status of women; and to encourage family planning and reproductive health care (**Concept 6-4**). Let’s begin by looking at the role of economic development.

In the world’s most desperately poor countries, couples tend to have more children for reasons listed earlier in this chapter (p. 128). Thus, in many less-developed countries, total fertility and population growth rates tend to be high, and large numbers of poor people are increasingly being crowded into unsanitary and difficult living conditions in slums and shantytowns.

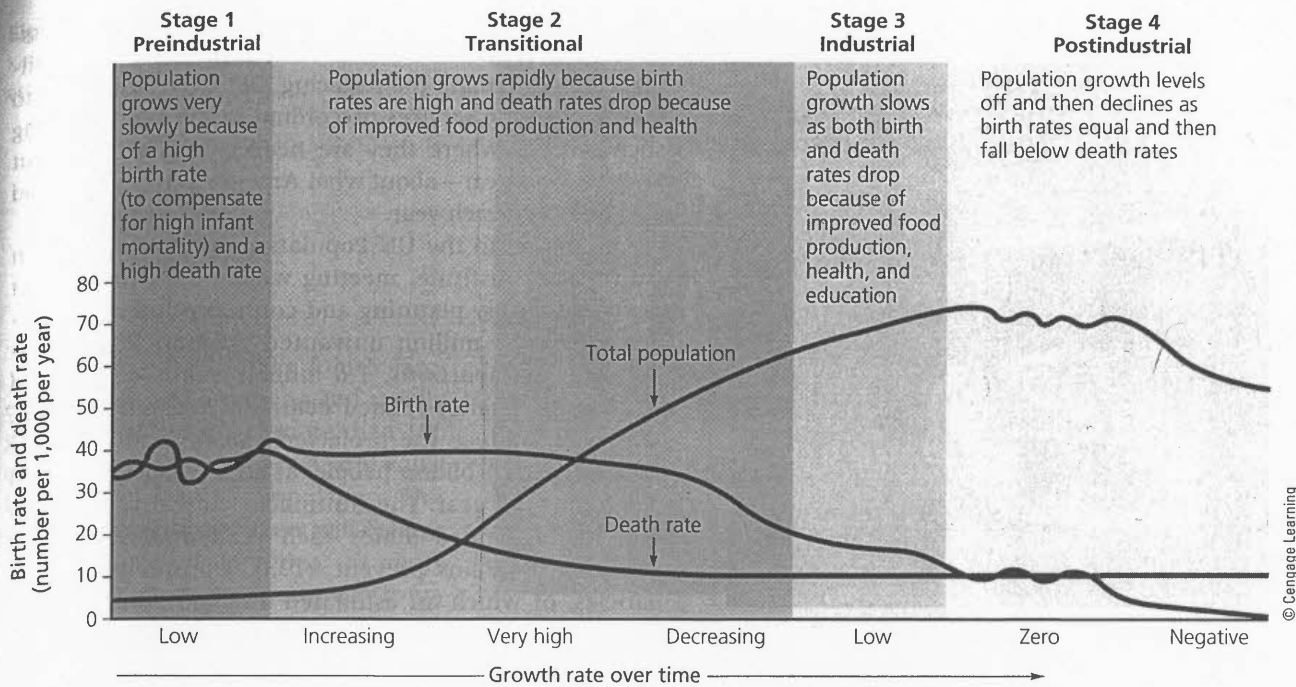
Demographers, examining the birth and death rates of western European countries that became industrialized during the 19th century, have developed a hypothesis of population change known as the **demographic transition**: As countries become industrialized and economically developed, their populations tend to grow more slowly. According to the hypothesis, this transition takes place in four stages, as shown in Figure 6-16.

Some analysts believe that most of the world’s less-developed countries will make a demographic transition over the next few decades, mostly because newer technologies will help them to develop economically and to raise their per capita incomes. Other analysts fear that rapid population growth, extreme poverty, and increasing environmental degradation and resource depletion in some low-income, less-developed countries could leave these countries stuck in stage 2 of the demographic transition.

Another factor that could hinder the demographic transition in some less-developed countries is that since 1985, economic assistance from more-developed countries has generally dropped. The resulting shortage of funds, coupled with poor economies in some countries, could leave large numbers of people trapped in poverty, which could in turn keep population growth rates high in such countries. Many experts argue that more-developed countries should help less-developed nations to make the demographic transition by aiding them in their economic development. They contend that such an effort could help to stabilize the global population, thereby making for a more sustainable world.

Empowering Women Can Help to Slow Population Growth

A number of studies show that women tend to have fewer children if they are educated, have the ability to control their own fertility, earn an income of their own, and live in societies that do not suppress their rights. Although women make up roughly half of the world’s population,



Animated Figure 6-16 The demographic transition, which a country can experience as it becomes industrialized and more economically developed, can take place in four stages. **Question:** At what stage is the country where you live?

in most societies they have fewer rights and educational and economic opportunities than men have.

Women do almost all of the world's domestic work and child care for little or no pay and provide more unpaid health care (within their families) than do all of the world's organized health-care services combined. In rural areas of Africa, Latin America, and Asia, women do 60–80% of the work associated with growing food, gathering, and hauling wood (Figure 6-17) and animal dung for use as fuel, and hauling water. As one Brazilian woman observed, "For poor women, the only holiday is when you are asleep."

While women account for 66% of all hours worked, they receive only 10% of the world's income and own just 2% of the world's land. They also make up 70% of the world's poor and 66% of its 800 million illiterate adults. Because sons are more valued than daughters in many societies, girls are often kept at home to work instead of being sent to school. Globally, the number of school-age girls who do not attend elementary school is more than 900 million—almost 3 times the entire U.S. population. Poor women who cannot read often have an average of five to seven children, compared to two or fewer children in societies where almost all women can read.

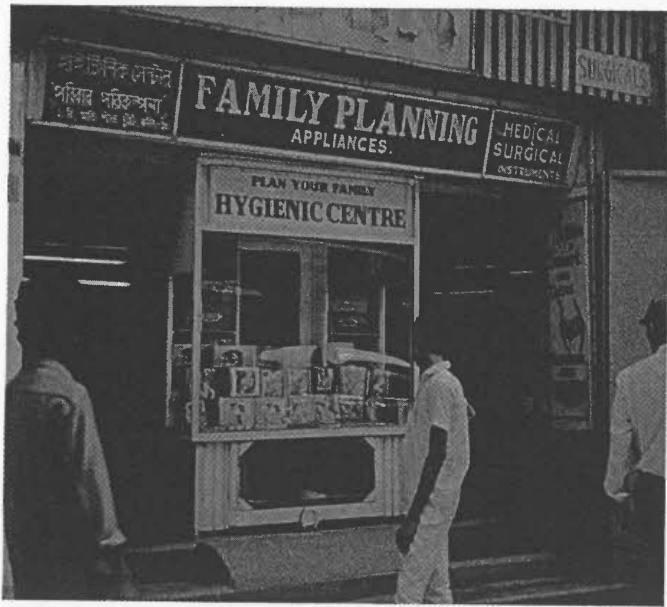
However, an increasing number of women in less-developed countries are taking charge of their lives and reproductive behavior. As it expands, such bottom-up change driven by individual women will play an important role in stabilizing populations, reducing poverty and environmental degradation, and allowing more access to basic human rights.

Family Planning Can Provide Several Benefits

Family planning provides educational and clinical services that help couples choose how many children to have and when to have them. Such programs vary from culture to culture, but most of them provide information on birth spacing, birth control, and health care for pregnant women and infants (Figure 6-18).



Figure 6-17 This woman in Nepal is bringing home firewood. Typically, she spends 2 hours a day, 2 or 3 times a week, on this task.



Helene Rogers/Art Directors & TRIP/Alamy

Figure 6-18 This family planning center is located in Kolkata (Calcutta), India.

Family planning has been a major factor in reducing the number of births throughout most of the world. It has also reduced the number of abortions performed each year and has decreased the numbers of mothers and fetuses dying during pregnancy, according to studies by the UN Population Division and other population agencies.

Such studies indicate that family planning is responsible for a drop of at least 55% in total fertility rates (TFRs) in less-developed countries, from 6.0 in 1960 to 2.6 in 2012. For example, family planning, coupled with economic development, played a major role in the sharp drop in the TFR in Bangladesh from around 6.8 to 2.3 by 2012. Between 1971 and 2012, Thailand also used family planning to cut its annual population growth rate from 3.2% to 0.5%, and to reduce its TFR from 6.4 to 1.6. According to the UN, had there not been the sharp drop in TFRs since the 1970s, with all else being equal, the world's population today would be about 8.5 billion instead of 7 billion.

Family planning also has financial benefits. Studies have shown that each dollar spent on family planning in countries such as Thailand, Egypt, and Bangladesh saves \$10–\$16 in health, education, and social-service costs by preventing unwanted births.

Despite these successes, certain problems have hindered progress in some countries. There are two major problems. *First*, according to the UN Population Fund, about 42% of all pregnancies in less-developed countries are unplanned and about 26% end with abortion. So ensuring access to voluntary contraception would play a key role in stabilizing the populations and reducing the number of abortions in such countries.

Second, an estimated 215 million couples in less-developed countries want to limit their number of children and determine their spacing, but they lack access to family planning services. According to the UN, providing such services where they are needed would cost about \$6.7 billion a year—about what Americans together spend on Halloween each year.

According to the UN Population Fund and the Alan Guttmacher Institute, meeting women's current unmet needs for family planning and contraception could prevent about 53 million unwanted pregnancies, 24 million induced abortions, 1.6 million infant deaths, and 142,000 pregnancy-related deaths of women per year. This could reduce the projected global population size by more than 1 billion people, at an average cost of \$20 per couple per year. The Guttmacher Institute estimates that in the United States each year, domestic family planning programs prevent 973,000 unintended pregnancies, of which an estimated 406,000 would end in abortion.

Some analysts call for expanding family planning programs to educate men about the importance of having fewer children and taking more responsibility for raising them. Proponents also call for greatly increased research in order to develop more effective birth control methods for men.

The experiences of countries such as Japan, Thailand, Bangladesh, South Korea, Taiwan, and China show that a country can achieve or come close to replacement-level fertility within a decade or two. Thus, the real story of the past 50 years has been the sharp reduction in the *rate* of population growth (Figure 6-2) resulting from a combination of the reduction of poverty through economic development, empowerment of women, and the promotion of family planning. However, the global population is still growing fast enough to add possibly several billion more people during this century (Figure 6-1).

CASE STUDY

Slowing Population Growth in India

For six decades, India has tried to control its population growth with only modest success. The world's first national family planning program began in India in 1952, when its population was nearly 400 million. In 2012, after 60 years of population control efforts, India had 1.26 billion people—the world's second largest population. Much of this increase occurred because the country's life expectancy rose from 38 years of age in 1952 to 65 in 2012, mostly as a result of declining death rates.

In 1952, India added 5 million people to its population. In 2012, it added 19 million—more than any other country. Also, 31% of India's population is under age 15, which sets the country up for further rapid population growth. The United Nations projects that by 2030, India will be the world's most populous country, and by 2050 it will have a population of 1.69 billion.

Figure 6-19 These people are shopping at Kolkata's (Calcutta's) South City Mall, the largest shopping mall in India.

India has the world's fourth largest economy and a thriving and rapidly growing middle class of more than 100 million people—a number nearly equal to a third of the U.S. population. This growing class of consumers will enlarge India's ecological footprint, as more Indians use more resources with every passing year (Figure 6-19).

STEVE RAYMER/National Geographic Creative



CASE STUDY

Slowing Population Growth in China: A Success Story

China is the world's most populous country, with 1.35 billion people (Figure 6-21), followed by India with 1.26 billion and the United States with 314 million. In 2011, the U.S. Census Bureau projected that if current trends continue, China's population will increase to about 1.4 billion by 2026 and then will begin a slow decline to as low as 750 million by the end of this century.

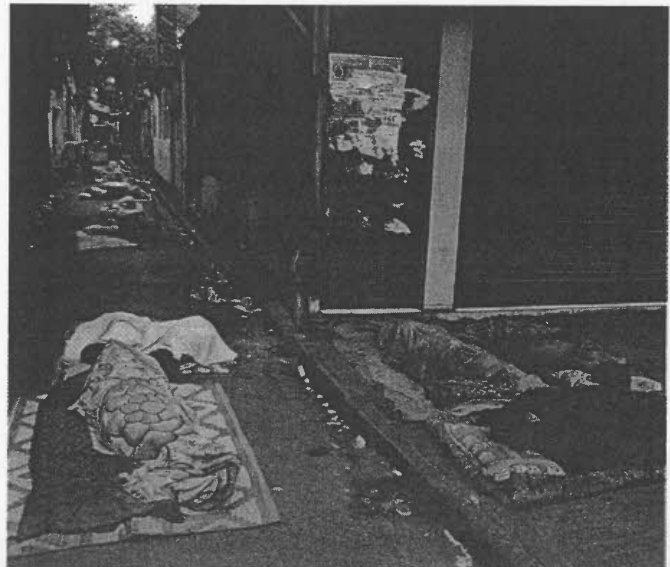
In the 1960s, China's large population was growing so rapidly that there was a serious threat of mass starvation. To avoid this, government officials decided to take measures that eventually led to the establishment of the

For decades, the Indian government has provided family planning services throughout the country and has strongly promoted a smaller average family size. Even so, Indian women have an average of 2.5 children.

Two factors help to account for larger families in India. *First*, most poor couples believe they need several children to work and care for them in old age. *Second*, the strong cultural preference in India for male children means that some couples keep having children until they produce one or more boys. The result: even though 90% of Indian couples have access to at least one modern birth control method, only 47% actually use one (compared to 85% in China).

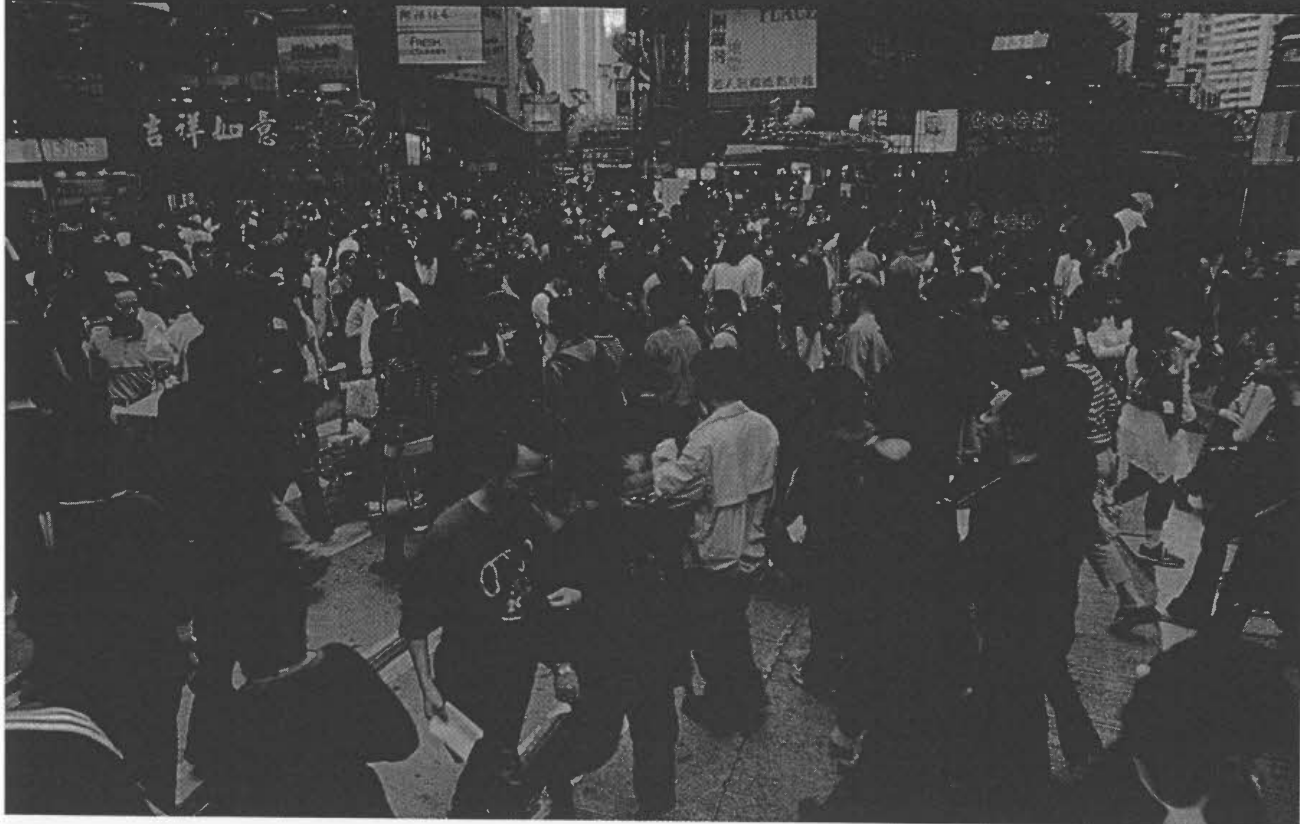
India also faces critical resource and environmental problems. With 18% of the world's people, India has just 2.3% of the world's land resources and 2% of its forests. About half the country's cropland is degraded as a result of soil erosion and overgrazing. In addition, more than two-thirds of its water is seriously polluted, sanitation services often are inadequate, and many of its major cities suffer from serious air pollution.

India is undergoing rapid economic growth, which is expected to accelerate. This not only will help many people in India, but it will also put more pressure on the country's and the earth's natural capital. On the other hand, economic growth may help India to slow its population growth by accelerating its demographic transition.



Samrat35/Dreamstime LLC

Figure 6-20 Homeless people in Kolkata, India in 2011.



JUSTIN GUARIGLIA/National Geographic Creative

Figure 6-21
Thousands of people crowd a street in China, where almost one-fifth of all the people on the planet live.

world's most extensive, intrusive, and strict family planning and birth control program.

China's goal has been to sharply reduce population growth by promoting one-child families. The government provides contraceptives, sterilizations, and abortions for married couples. In addition, married couples pledging to have no more than one child receive a number of benefits, including better housing, more food, free health care, salary bonuses, and preferential job opportunities for their child. Couples who break their pledge lose such benefits.

Since this government-controlled program began, China has made impressive efforts to feed its people and bring its population growth under control. Between 1972 and 2012, the country cut its birth rate in half and reduced the average number of children born to its women from 5.7 to 1.5, compared to 1.9 children per woman in the United States.

Since 1980, China has undergone rapid industrialization and economic growth. According to the Earth Policy Institute, between 1990 and 2010, this reduced the number of people living in extreme poverty by almost 500 million. It also helped at least 300 million Chinese—a number almost equal to the entire U.S. population—to become middle-class consumers. Over time, China's rapidly growing middle class will consume more resources per person, expanding China's ecological footprint (see Figure 1-11, p. 13) within its own borders and in other parts of

the world that provide it with resources. This will put a strain on China's and the earth's natural capital unless China steers a course toward more environmentally sustainable economic development.

Some have criticized China for having such a strict population control policy. However, government officials say that the alternative was mass starvation. They estimate that China's one-child policy has reduced its population size by as many as 400 million people.

Big Ideas

- The human population is growing rapidly and may soon bump up against environmental limits.
- Even if population growth is not a problem, the increasing use of resources per person is expanding the overall human ecological footprint and putting a strain on the earth's resources.
- We can slow human population growth by reducing poverty, elevating the status of women, and encouraging family planning.