

The Ecology of Population Growth

Throughout most of human existence, population growth has been so slow as to be imperceptible within a single generation. Reaching a global population of 1 billion in 1804 required the entire time since modern humans appeared on the scene. To add the second billion, it took until 1927, just over a century. Thirty-three years later, in 1960, world population reached 3 billion. Then the pace sped up, as we added another billion every 13 years or so until we hit 7 billion in late 2011.¹

One of the consequences of this explosive growth in human numbers is that human demands have outrun the carrying capacity of the economy's natural support systems—its forests, fisheries, grasslands, aquifers, and soils. Once demand exceeds the sustainable yield of these natural systems, additional demand can only be satisfied by consuming the resource base itself. We call this overcutting, overfishing, overgrazing, overpumping, and overplowing. It is these overages that are undermining our global civilization.

The exponential growth that has led to this explosive increase in our numbers is not always an easy concept to grasp. As a result, not many of us—including political leaders—realize that a 3 percent annual rate of growth will actually lead to a 20-fold growth in a century.

The French use a riddle to teach exponential growth to schoolchildren. A lily pond, so the riddle goes, contains a single leaf. Each day the number of leaves doubles—two leaves the second day, four the third, eight the fourth, and so on. Question: “If the pond is full on the thirtieth day, at what point is it half full?” Answer: “On the twenty-ninth day.” Our global lily pond may already be in the thirtieth day.²

The most recent U.N. demographic projections show world population growing to 9.3 billion by 2050, an addition of 2.3 billion people. Most people think these demographic projections, like most of those made over the last half-century, will in fact materialize. But this is unlikely, given the difficulties in expanding the food supply, such as those posed by spreading water shortages and global warming. We are fast outgrowing the earth’s capacity to sustain our increasing numbers.³

World population growth has slowed from the peak of 2.1 percent in 1967 to 1.1 percent in 2011. What is not clear is whether population growth will slow further because we accelerate the shift to smaller families or because we fail to do so and eventually death rates begin to rise. We know what needs to be done. Millions of women in the world want to plan their families but lack access to reproductive health and family planning services. Filling this gap would not only take us a long way toward stabilizing world population, it would also improve the health and well-being of women and their families.⁴

Population projections are based on numerous demographic assumptions, including, among others, fertility levels, age distribution, and life expectancy. They sometimes create the illusion that the world can support these huge increases. But demographers rarely ask such questions as, Will there be enough water to grow food for 2.3 billion more people? Will population growth continue

without interruption in the face of crop-shrinking heat waves?⁵

As human numbers multiply, we need more and more irrigation water. As a result, half of the world’s people now live in countries that are depleting their aquifers by overpumping. Overpumping is by definition a short-term phenomenon.⁶

The situation is similar with fishing, as world population growth has increased demand for seafood. A fishing fleet can continue expanding the fish catch until it exceeds the reproductive capacity of a fishery. When this happens, the fishery begins to shrink and eventually collapses. A startling 80 percent of oceanic fisheries are being fished at or beyond their sustainable yield.⁷

When oceanic fisheries collapse, we turn to fish farming. Doing this, however, takes land and water, since these fish must be fed, most often with some combination of corn and soybean meal. Thus, collapsing fisheries put additional pressure on the earth’s land and water resources.⁸

As human populations grow, so typically do livestock populations, particularly in those parts of the world where herding cattle, sheep, and goats is a way of life. This is most evident in Africa, where the explosion in human numbers from 294 million in 1961 to just over 1 billion in 2010 was accompanied by growth in the livestock population from 352 million to 894 million.⁹

With livestock numbers growing beyond the sustainable yield of grasslands, these ecosystems are deteriorating. The loss of vegetation leaves the land vulnerable to soil erosion. At some point, the grassland turns to desert, depriving local people of their livelihood and food supply, as is now happening in parts of Africa, the Middle East, central Asia, and northern China.¹⁰

Growing populations also increase the demand for firewood, lumber, and paper. The result is that demand

for wood is exceeding the regenerative capacity of forests. The world's forests, which have been shrinking for several decades, are currently losing a net 5.6 million hectares per year. In the absence of a more responsible population policy, forested area will continue to shrink. Some countries—Mauritania is one example—have lost nearly all their forest and are now essentially treeless. Without trees to protect the soil and to reduce runoff, the entire ecosystem suffers, making it more difficult to produce enough food.¹¹

Continuous population growth eventually leads to overplowing—the breaking of ground that is highly erodible and should not be plowed at all. We are seeing this in Africa, the Middle East, and much of Asia. Plowing marginal land leads to soil erosion and eventually to cropland abandonment. Land that would otherwise sustain grass and trees is lost as it is converted into cropland and then turns into wasteland.

In summary, we have ignored the earth's environmental stop signs. Faced with falling water tables, not a single country has mobilized to reduce water use so that it would not exceed the sustainable yield of an aquifer. Unless we can stop willfully ignoring the threats and wake up to the risks we are taking, we will join the earlier civilizations that failed to reverse the environmental trends that undermined their food economies.

The good news is that 44 countries, including nearly all those in both Western and Eastern Europe, have reached population stability as a result of gradual fertility decline over the last several generations. Their populations total 970 million people, roughly one seventh of humanity.¹²

Two other geographic regions are now moving rapidly toward population stability. East Asia, including Japan, North and South Korea, China, and Taiwan, a region of over 1.5 billion people, is very close to stabilizing its

population. Japan's population is already declining. The populations of the two Koreas and Taiwan are still growing, but slowly. China's population of 1.35 billion is projected to peak in 2026 at 1.4 billion and then start shrinking. By 2045 its population will likely be smaller than it is today.¹³

In Latin America, a combination of poverty reduction and broad access to family planning services is slowing population growth. Its population of just over 600 million in 2012 is projected to reach 751 million by 2050. Brazil, by far the largest country in the region, is projected to expand from 198 million in 2012 to 223 million in 2050, a growth of only 12 percent over nearly four decades.¹⁴

The bad news in our demographic future is that virtually all of the population growth will be in developing countries, the areas least able to support them. The two regions where most future population growth will occur are the Indian subcontinent and sub-Saharan Africa. The Indian subcontinent, principally India, Pakistan, and Bangladesh, which now has nearly 1.6 billion people, is projected to reach almost 2.2 billion by 2050. Africa south of the Sahara, with 899 million people today, also is projected to hit 2.2 billion by 2050. The big challenge for the world today is to help countries in these two regions accelerate the shift to smaller families, both by eradicating poverty and by ensuring that all women have access to reproductive health care and family planning services, thus avoiding stressful growth in population.¹⁵

The contrast between countries that have essentially stabilized their populations and those where large families are still the rule could not be greater. On one end of the spectrum are Germany with 82 million people, Russia with 143 million, and Japan with 126 million. Populations in all three are projected to shrink by roughly one tenth by 2050. With elderly populations and low birth rates, deaths now

exceed births in each of these countries. Meanwhile, Nigeria, Ethiopia, and Pakistan are anticipating massive growth. Nigeria, geographically not much larger than Texas, now has 167 million people and is projected to have 390 million by 2050. In Ethiopia, one of the world's hungriest countries, the current population of 87 million is expected to reach 145 million by 2050. And Pakistan, with 180 million people living on the equivalent of 8 percent of the U.S. land area, is projected to reach 275 million by 2050—nearly as many people as in the United States today.¹⁶

The “demographic transition” helps us understand what happens to population growth in individual countries as they develop. In 1945, Princeton demographer Frank Notestein outlined a three-stage demographic model to illustrate the dynamics of population growth as societies modernized. He pointed out that in pre-modern societies, where both births and deaths are high, there is little or no population growth. In stage two, as living standards rise and health care improves, death rates begin to decline. With birth rates remaining high while death rates are declining, population growth accelerates, typically reaching close to 3 percent a year. As living standards continue to improve, and particularly as women are educated, the birth rate also begins to decline. Eventually the birth rate drops to the level of the death rate. This is stage three of the demographic transition, where births and deaths are in balance and population is again stable.¹⁷

Most countries have made it at least as far as stage two, while many industrialized countries have long since reached stage three. Sadly, many countries have not been able to lower their birth rates to make it into stage three. Stage two becomes a demographic trap for them. Their populations are growing continuously at 3 percent a year—a rate that, as mentioned earlier, leads to a 20-fold increase in a century. For example, if the 2012 population

of Tanzania, one of Africa's larger countries, of nearly 48 million continued to grow at 3 percent a year, the country would have 916 million people within a hundred years. Iraq's population of 34 million, also expanding at 3 percent a year, would reach 648 million a century hence.¹⁸

Governments in countries that have experienced such rapid population growth for two generations are showing signs of demographic fatigue. Worn down by the struggle to build schools and provide jobs for an ever-expanding population, they are facing political stresses on every hand.

Countries that fail to shift to smaller families risk being overwhelmed by land and water shortages, disease, civil conflict, and other adverse effects of prolonged rapid population growth. We call them failing states—countries where governments can no longer provide personal security, food security, or basic social services such as education and health care. Governments lose their legitimacy and often their authority to govern. Countries in this situation include Yemen, Ethiopia, Somalia, the Democratic Republic of the Congo, and Afghanistan. Among the more populous failing states are Pakistan and Nigeria.¹⁹

Based on a Fund for Peace list published each year in *Foreign Policy* magazine, the top 20 failing states, almost without exception, have high levels of fertility. In Afghanistan and Somalia, for example, women have on average six children. These countries demonstrate how population growth and state disintegration can reinforce each other.²⁰

The countries that have made it into stage three, with lower fertility and fewer children, benefit from higher rates of savings. They are reaping what economic demographers call the “demographic bonus.” When a country shifts quickly to smaller families, the number of young dependents—those who need nurturing and

educating—declines sharply relative to the number of working adults. As household savings climb, investment rises and economic growth accelerates.²¹

Virtually all countries that have quickly shifted to smaller families have benefited from this bonus. After World War II, Japan made a concerted effort to slow its population growth, cutting its growth rate in half between 1948 and 1955. It became the first country to gain the bonus benefit. The spectacular economic growth over the next three decades, unprecedented in any country, raised Japan's income per person to one of the highest in the world, making it a modern industrial economy that was second in size only to the United States.²²

South Korea, Taiwan, Hong Kong, and Singapore followed shortly thereafter. These four so-called tiger economies, which enjoyed such spectacular economic growth during the late twentieth century, each benefited from a rapid fall in birth rates and the demographic bonus that followed.²³

On a much larger scale, China's declining birth rate, mainly a result of its one-child family program, created an unusually large demographic bonus, helping people save a good share of their incomes and thus spurring investment. The phenomenal investment rate, coupled with the record influx of private foreign investment and accompanying technology, is fast propelling China into the ranks of modern industrial powers. Other countries with age structures now conducive to high savings and rapid economic growth include Sri Lanka, Mexico, Iran, Tunisia, and Viet Nam.²⁴

We all have a stake in ensuring that countries everywhere move into stage three of the demographic transition. Those that are caught in the demographic trap are likely to be politically unstable—often overcome by internal conflict. These failing states are more likely to be breeding grounds

for terrorists than to be participants in building a stable world order.²⁵

If world population growth does not slow dramatically, the number of people trapped in hydrological poverty and hunger will almost certainly grow, threatening food security, economic progress, and political stability. The only humane option is to move quickly to replacement-level fertility of two children per couple and to stabilize world population as soon as possible.

Data, endnotes, and additional resources can be found at Earth Policy Institute, www.earth-policy.org.