

The Human Numbers Crunch

The next half century promises unprecedented challenges

By JANET RALOFF

Around 1830, Earth's population reached a billion people. Since then, another 4.7 billion have been added, the last billion of them in just 12 years. Today, the population increases by 90 million persons annually.

What this adds up to is that people age 40 and over have lived through a doubling of the human population. "Never before the second half of the 20th century had any person lived through a doubling of world population," notes Joel E. Cohen, head of the Laboratory of Populations at Rockefeller University in New York.

This spiraling growth and the strains it inevitably places on natural resources are fostering increased discussion of how many more people Earth can sustain. Some argue that the forests, oceans, croplands, and atmosphere that form Earth's life-support system are already crumbling under humanity's heavy heel. Others believe Earth can sustain an extra 6 billion or more people.

Unfortunately, a test of those limits is imminent, notes geographer Robert W. Kates of Ellsworth, Maine. "We face a real crunch. At issue is whether we can do what is totally unprecedented—feed, house, nurture, educate, and employ as many more people in the space of maybe 4 decades as are alive today."

Optimists, "and I'm one of them," Kates says, "believe that if we can survive this extraordinarily difficult challenge, we'll probably be in fairly good shape."

Until recently, scientists have tended to analyze the demands placed on natural resources by human population growth in the context of Earth's carrying capacity—the maximum population its ecosystems can sustain indefinitely. While this concept works reasonably well when defining how many elephants, fish, or seagulls a habitat can support, it falls apart when applied to people.

Humans have developed a much greater variety of habits, cultures, and environmental patterns than their wild brethren. This variation plays out in patterns of resource consumption and waste generation. The typical suburban Kansan or

New Yorker, for instance, draws upon 10 to 1,000 times more resources daily than the average Chilean, Ghanaian, or Yemenite. So for practical purposes, the concept of an average human makes far less sense than the concept of an average cod.

Moreover, humans have a far greater ability than animals to alter their physical environment or culture for survival—through damming, agriculture, urbanization, fossil fuel burning, and a host of other activities. So they do not live in the type of definable ecosystem that is implicit in the concept of carrying capacity.

Many resource economists are beginning to argue that they can't hope to gauge reliably how many people Earth can sustain—much less suggest strategies for living within that cap—until there exists a better accounting of the environmental resource base, various consumption habits, and the effects of social, cultural, and demographic factors on these.

That's a tall order. But Wolfgang Lutz of the International Institute for Applied Systems Analysis in Laxenburg, Austria, offers a telling example of the usefulness of such an accounting.

"I was dissatisfied with the frequent use of the very simplifying [mathematical] model which assigns a lot of the blame for environmental problems just to the number of people," he explains. This formula estimates environmental impact as the product of population times affluence times the technological efficiency of a culture. Some scientists, Lutz notes, use this formula (I=PAT) to calculate the economic and environmental costs associated with each new birth.

To Lutz, the formula didn't seem to hold up in studies of carbon dioxide (CO₂) emissions. Stemming largely from fossil fuel and biomass burning, these emissions risk precipitating a global warming.

Lutz's group compared energy use patterns—and CO₂ emissions—around the globe to changes in population and household size between 1950 and 1990. Although the researchers linked about

half of all CO₂ emissions to the number of people in a society, they found that the other half correlated best with the number of households.

Over the 40 years examined, the average number of persons per household throughout the industrialized world dropped from 3.6 to 2.7—a "massive" decline, says Lutz. It now appears, he observes, that the splintering of a nuclear family by divorce "may cause more CO₂ emissions than would an additional birth."

Among other factors contributing to smaller households are more single young adults setting up on their own, a trend toward postponing or forgoing marriage, an increase in life expectancy and in the number of elderly people living on their own, and a growing taste for privacy.

China, with its strict one-child-per-couple policy and increasing proportion of elderly, also saw a drop in household size.

Because this move toward more and smaller households is most prevalent in the nations that already use the most resources, it could have substantial global impacts. For instance, Lutz found that accounting for this trend hiked projected annual CO₂ emissions over the next century to 128 percent above 1990 levels—some 50 percent higher than the figure suggested by the I=PAT formula.

The environmental impacts of providing food for people exhibit a more direct link to population.

At the American Association for the Advancement of Science (AAAS) meeting in Baltimore last February, ecologist David Pimentel of Cornell University noted that since 1955, nearly one-third of the world's cropland—an area larger than China and India combined—has been abandoned because its overuse has led to soil loss, depletion, or degradation. Finding substitutes for the lost acreage accounts for 60 to 80 percent of the world's deforestation, he reports. Most of this land is less well suited for agriculture than the farmland it is replacing, and the supply of potential substitutes is increasingly limited.

Agriculture also takes a toll on the world's water. "About 87 percent of the world's freshwater is consumed or used up by agriculture" today, says Pimentel—far more than is used up by any other human activity. In addition to using surface water, farmers are mining underground aquifers.

In their 1995 report, "Conserving Land," Robert Engelman and Pamela LeRoy of the Washington, D.C.-based Population Action International similarly found that "farmers are literally draining the continents, just as they are allowing billions of tons of topsoil to erode."

Although currently there is enough land and water, in theory, to feed Earth's

population, Pimentel reports that per capita availability of cereal grains, the source of 80 percent of the world's food, has been declining for 15 years. Most nations today rely on imports of surplus grains. Only a handful of countries account for 80 percent of all cereal exports, with the United States providing the largest share.

"If, as projected, the U.S. population doubles in the next 60 years, then its cereal and other food resources would have to be used domestically to feed 520 million hungry Americans," Pimentel observes.

Meanwhile, if China's population climbs by another 500 million and the country's loss of productive cropland to erosion and industrialization continues unabated, its demand for imports by 2050 might be "more than the world's entire 1993 grain exports," forecasts agricultural economist Lester R. Brown of the Washington, D.C.-based Worldwatch Institute.

Who could supply grain on this scale? "No one," he says.

Acknowledging these daunting numbers does little to answer the question of how many people Earth can sustain.

There is no answer, Cohen argues. At least, no single answer.

The number of people Earth can support, he argued at the AAAS meeting, depends in part on how many people are willing to wear clothes made from cotton, a renewable resource, versus polyester, a nonrenewable petroleum-based product. Similarly, he says, it will depend "on how many will eat beef and how many bean sprouts; on how many will want parks and how many will want parking lots; on how many will want Jaguars with a capital J and how many will want jaguars with a small j. These choices will change in time, and so will how many people the Earth can support."

Thomas Lambert of the Center for the Study of American Business at Washington University in St. Louis acknowledges that population growth "will certainly raise demand for natural resources and energy." However, he argues, if markets were "free," the price of goods would begin to rise as the materials that went into them grew limited. Rising prices would alert entrepreneurs to the approaching scarcity and the promise of rewards for circumventing it.

Indeed, Lambert argues, resource scarcity will lead to technological developments that leave everyone better off than before. "The entire history of humanity indicates that, with enough economic freedom, overpopulation relative to natural resources or energy will not occur."

All things being equal, there might be

merit to that argument, observes Thomas Homer-Dixon, director of the Peace and Conflict Studies Program at the University of Toronto. The problem is, he says, all things aren't equal.

For instance, Homer-Dixon argues that Lambert ignores inequalities in human capital—that is, the minds available for tapping. In regions where young children receive inadequate nutrition, stimulation, or education, many will mature into cognitively stunted adults unable to meet the challenge of innovation.

Other people face formidable social impediments to technical innovation—such as business corruption, banking systems that resist investments in novel ideas, and poverty. The latter may prevent the clever not only from making their ideas heard but also from getting access to the tools needed to develop their inventions.

Poverty can also impede social ingenuity, ideas that would reform institutions



Even U.S. diners could feel the pinch if the population doubles by 2050, as predicted. The share of their diet from animal products would drop by about half, to perhaps 15 percent, and food would cost up to 50 percent of each paycheck, according to analyses by Pimentel's group. That's about what Europeans spend now, but it's far more than U.S. residents typically pay.

as opposed to creating technology. In some cases, he says, politicians need money to influence entrenched groups that would otherwise block socially beneficial institutional changes.

As resource scarcity and population stresses rise, Homer-Dixon says, "the smarter we have to be, both socially and technically, just to maintain our well-being." The more dire the problem, he adds, "the more quickly we're going to have to respond."

Like Kates, Homer-Dixon remains a qualified optimist. He is buoyed by ideas that could help increase the supply of ingenuity, such as strengthen-

ing research institutions in developing countries.

"Most of the ingenuity that is going to be particularly useful in solving scarcity and food production problems is going to be locally generated, by people familiar with local geography, social relations, and resources," he says. Unfortunately, many such people flee to industrialized nations, where greater research opportunities exist, he notes. "We can improve the situation by funding local research" and by providing scientists in the developing world with computers, modems, and fax machines—a communications lifeline to peers around the globe.

This is precisely the idea behind a newly proposed initiative: Global Research on the Environmental and Agricultural Nexus (GREAN).

GREAN would set up a partnership among U.S. universities, national programs in developing countries, and the 16 international centers belonging to the Consultative Group on International Agricultural Research.

Demand for food in developing countries is expected to double by 2025 and triple by 2050. "We wanted to engage the outstanding scientists of the world—including those in developing countries"—in projects aimed at developing sustainable, environmentally friendly food production by and for the world's poorest people, says Ronnie Coffman, director of the Agricultural Experiment Station at Cornell and cochair of the committee that drafted the GREAN proposal.

As yet, Cohen believes, "neither panic nor complacency is in order. Earth's capacity to support people is determined both by natural constraints and by human choices. In the coming half century, we and our children are less likely to face absolute limits than difficult trade-offs," largely among population size, environmental quality, and lifestyle.

Many people are already beginning to question the culture of consumption that has characterized industrialized countries since the 1950s.

Environmental mediator Paul Wilson, a lawyer in Portland, Ore., is one of them. He has spent 7 years simplifying his life, from diet to aspirations, after realizing that many of the things he was buying didn't seem worth the hours of work required to pay for them.

"My sense is that a transition will occur, with little people and little organizations each perceiving the sweep of this imbalance in their own way and making incremental adjustments—until things snowball." □