COULD FOOD SHORTAGES BRING DOWN CIVILIZATION?

The biggest threat to global stability is the potential for food crises in poor countries to cause government collapse. Those crises are brought on by ever worsening environmental degradation

BY LESTER R. BROWN

KEY CONCEPTS

- Food scarcity and the resulting higher food prices are pushing poor countries into chaos.
- Such "failed states" can export disease, terrorism, illicit drugs, weapons and refugees.
- Water shortages, soil losses and rising temperatures from global warming are placing severe limits on food production.
- Without massive and rapid intervention to address these three environmental factors, the author argues, a series of government collapses could threaten the world order.

—The Editors

One of the toughest things for people to do is to anticipate sudden change. Typically we project the future by extrapolating from trends in the past. Much of the time this approach works well. But sometimes it fails spectacularly, and people are simply blindsided by events such as today's economic crisis.

For most of us, the idea that civilization itself could disintegrate probably seems preposterous. Who would not find it hard to think seriously about such a complete departure from what we expect of ordinary life? What evidence could make us heed a warning so dire—and how would we go about responding to it? We are so inured to a long list of highly unlikely catastrophes that we are virtually programmed to dismiss them all with a wave of the hand: Sure, our civilization might devolve into chaos—and Earth might collide with an asteroid, too!

For many years I have studied global agricultural, population, environmental and economic trends and their interactions. The combined effects of those trends and the political tensions they generate point to the breakdown of governments and societies. Yet I, too, have resisted the idea that food shortages could bring down not only individual governments but also our global civilization.

I can no longer ignore that risk. Our continuing failure to deal with the environmental declines that are undermining the world food economy—most important, falling water tables, eroding soils and rising temperatures—forces me to conclude that such a collapse is possible.

The Problem of Failed States

Even a cursory look at the vital signs of our current world order lends unwelcome support to my conclusion. And those of us in the environmental field are well into our third decade of charting trends of environmental decline without seeing any significant effort to reverse a single one.

In six of the past nine years world grain production has fallen short of consumption, forcing a steady drawdown in stocks. When the 2008 harvest began, world carryover stocks of grain (the amount in the bin when the new harvest begins) were at 62 days of consumption, a near re-

PER-ANDERS PETTERSSON *Getty Images*

CHILDREN CLAMOR for food in the village of Dubie, Democratic Republic of the Congo. The photograph was taken in December 2005.

FAILING STATES

Every year the Fund for Peace and the Carnegie Endowment for International Peace jointly analyze and score countries on 12 social, economic, political and military indicators of national well-being. Here, ranked from worst to better according to their combined scores in 2007, are the 20 countries in the world that are closest to collapse:

- Somalia
- Sudan
- Zimbabwe
- Chad
- Iraq
- Democratic Republic of the Congo
- Afghanistan
- Ivory Coast
- Pakistan
- Central African Republic
- Guinea
- Bangladesh
- Burma (Myanmar)
- Haiti
- North Korea
- Ethiopia
- Uganda
- Lebanon
- Nigeria
- Sri Lanka

SOURCE: "The Failed States Index 2008," by the Fund for Peace and the Carnegie Endowment for International Peace, in Foreign Policy; *July/August 2008*

cord low. In response, world grain prices in the spring and summer of last year climbed to the highest level ever.

As demand for food rises faster than supplies are growing, the resulting food-price inflation puts severe stress on the governments of countries already teetering on the edge of chaos. Unable to buy grain or grow their own, hungry people take to the streets. Indeed, even before the steep climb in grain prices in 2008, the number of failing states was expanding [*see sidebar at left*]. Many of their problems stem from a failure to slow the growth of their populations. But if the food situation continues to deteriorate, entire nations will break down at an ever increasing rate. We have entered a new era in geopolitics. In the 20th century the main threat to international security was superpower conflict; today it is failing states. It is not the concentration of power but its absence that puts us at risk.

States fail when national governments can no longer provide personal security, food security and basic social services such as education and health care. They often lose control of part or all of their territory. When governments lose their monopoly on power, law and order begin to disintegrate. After a point, countries can become so dangerous that food relief workers are no longer safe and their programs are halted; in Somalia and Afghanistan, deteriorating conditions have already put such programs in jeopardy.

Failing states are of international concern because they are a source of terrorists, drugs, weapons and refugees, threatening political stability everywhere. Somalia, number one on the 2008 list of failing states, has become a base for piracy. Iraq, number five, is a hotbed for terrorist training. Afghanistan, number seven, is the world's leading supplier of heroin. Following the massive genocide of 1994 in Rwanda, refugees from that troubled state, thousands of armed soldiers among them, helped to destabilize neighboring Democratic Republic of the Congo (number six).

Our global civilization depends on a functioning network of politically healthy nation-states to control the spread of infectious disease, to manage the international monetary system, to control international terrorism and to reach scores of other common goals. If the system for controlling infectious diseases—such as polio, SARS or avian flu—breaks down, humanity will be in trouble. Once states fail, no one assumes responsibility for their debt to outside lenders. If enough states disintegrate, their fall will threaten the stability of global civilization itself.

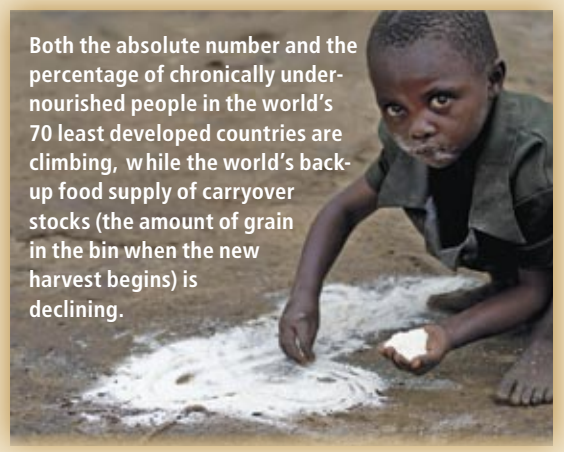
A New Kind of Food Shortage

The surge in world grain prices in 2007 and 2008—and the threat they pose to food security—has a different, more troubling quality than the increases of the past. During the second half of the 20th century, grain prices rose dramatically several times. In 1972, for instance, the Soviets, recognizing their poor harvest early, quietly cornered the world wheat market. As a result, wheat prices elsewhere more than doubled, pulling rice and corn prices up with them. But this and other price shocks were event-driven—

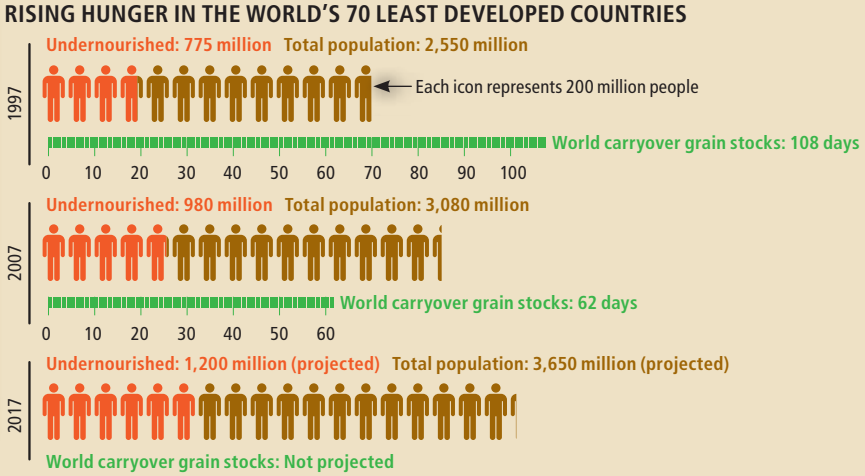
YASUYOSHI CHIBA *Getty Images*

[FOOD STRESS ON THE RISE]

Numbers That Go the Wrong Way



Both the absolute number and the percentage of chronically undernourished people in the world's 70 least developed countries are climbing, while the world's back-up food supply of carryover stocks (the amount of grain in the bin when the new harvest begins) is declining.



SOURCES: U.S. Department of Agriculture, 2008; U.S. Census Bureau

drought in the Soviet Union, a monsoon failure in India, crop-shrinking heat in the U.S. Corn Belt. And the rises were short-lived: prices typically returned to normal with the next harvest.

In contrast, the recent surge in world grain prices is trend-driven, making it unlikely to reverse without a reversal in the trends themselves. On the demand side, those trends include the ongoing addition of more than 70 million people a year; a growing number of people wanting to move up the food chain to consume highly grain-intensive livestock products [see "The Greenhouse Hamburger," by Nathan Fiala; SCIENTIFIC AMERICAN, February 2009]; and the massive diversion of U.S. grain to ethanol-fuel distilleries.

The extra demand for grain associated with rising affluence varies widely among countries. People in low-income countries where grain supplies 60 percent of calories, such as India, directly consume a bit more than a pound of grain a day. In affluent countries such as the U.S. and Canada, grain consumption per person is nearly four times that much, though perhaps 90 percent of it is consumed indirectly as meat, milk and eggs from grain-fed animals.

The potential for further grain consumption as incomes rise among low-income consumers is huge. But that potential pales beside the insatiable demand for crop-based automotive fuels. A fourth of this year's U.S. grain harvest—enough to feed 125 million Americans or half a billion Indians at current consumption levels—will go to fuel cars. Yet even if the entire U.S. grain harvest were diverted into making ethanol, it would meet at most 18 percent of U.S. automotive fuel needs. The grain required to fill a 25-gallon SUV tank with ethanol could feed one person for a year.

The recent merging of the food and energy economies implies that if the food value of grain is less than its fuel value, the market will move the grain into the energy economy. That double demand is leading to an epic competition between cars and people for the grain supply and to a political and moral issue of unprecedented dimensions. The U.S., in a misguided effort to reduce its dependence on foreign oil by substituting grain-based fuels, is generating global food insecurity on a scale not seen before.

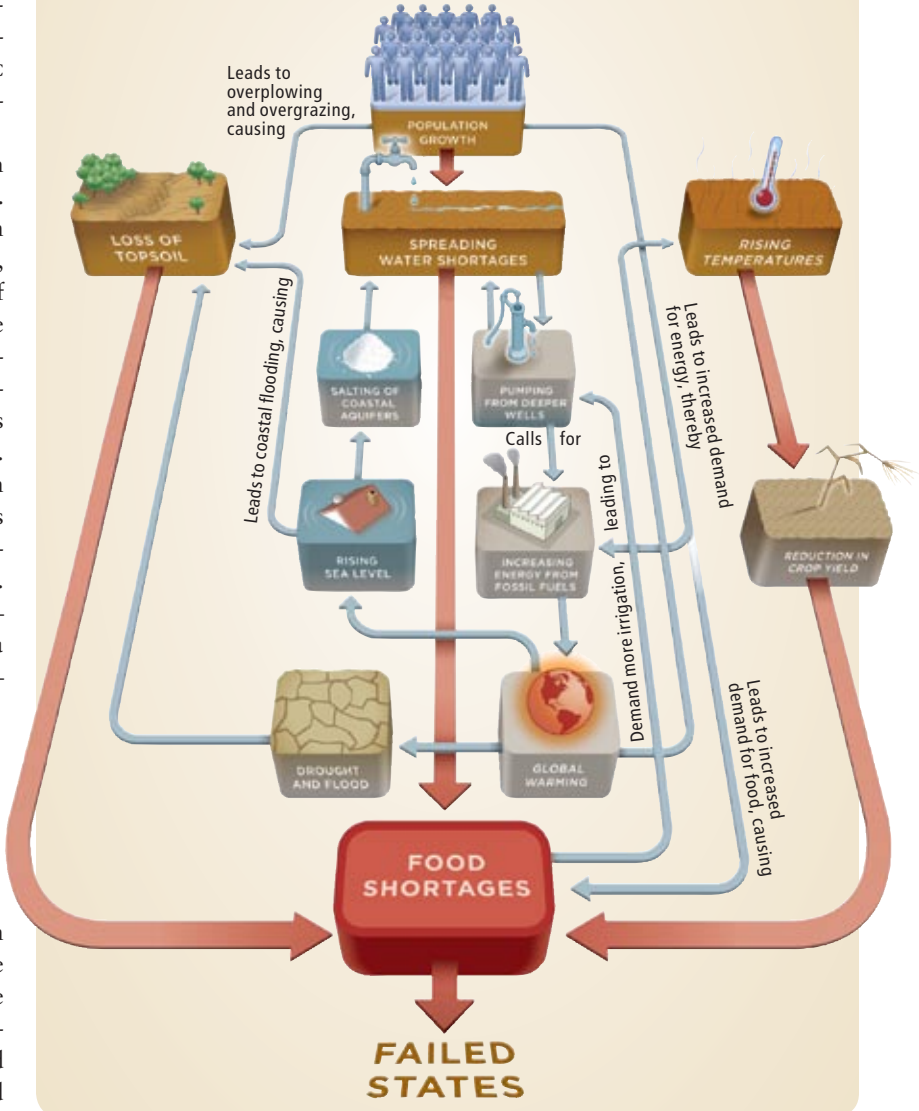
Water Shortages Mean Food Shortages

What about supply? The three environmental trends I mentioned earlier—the shortage of freshwater, the loss of topsoil and the rising temperatures (and other effects) of global warming—are making it increasingly hard to expand the world's grain supply fast enough to keep up with demand. Of all those trends, however, the spread of water shortages poses the most immediate threat. The biggest challenge here is irrigation, which consumes 70 percent of the world's freshwater. Millions of irrigation wells in many countries are now pumping water out of under-

[CAUSES AND EFFECTS]

Key Factors in Food Shortages

The spreading scarcity of food is emerging as the central cause of state failure. Food shortages arise out of a tangled web of causes, effects and feedbacks whose interactions often intensify the effects of any one factor acting alone. Some of the most common factors are depicted in the diagram. According to the author, today's food shortages are not the result of one-time, weather-driven crop failures but rather of four critical long-term trends (*below*): rapid population growth, loss of topsoil, spreading water shortages and rising temperatures.

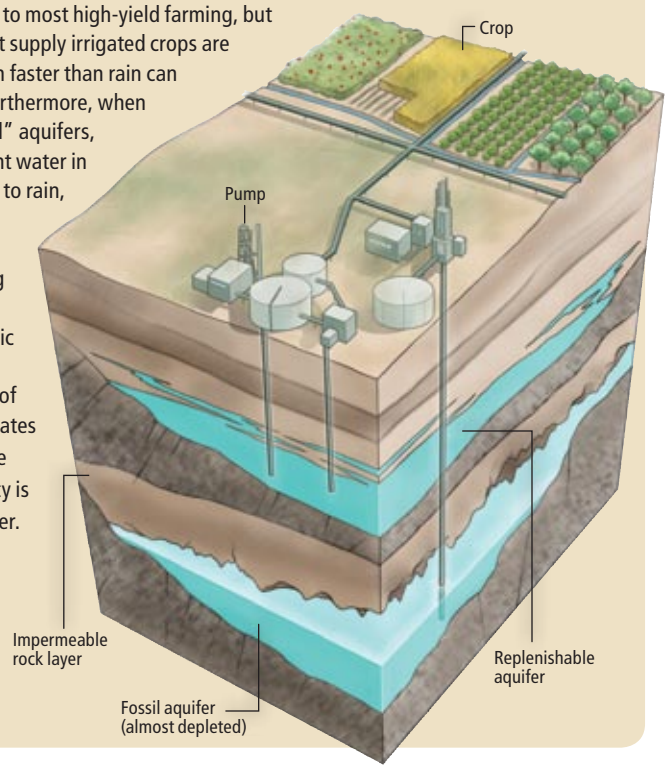


SAMUEL VELASCO *SW Infographics*

[FALLING WATER TABLES]

Irrigation Can Lead to Severe Water Shortages

The greatest drain on supplies of freshwater is irrigation, which accounts for 70 percent of freshwater usage. Irrigation is essential to most high-yield farming, but many aquifers that supply irrigated crops are being drawn down faster than rain can recharge them. Furthermore, when farmers tap "fossil" aquifers, which store ancient water in rock impermeable to rain, they are mining a nonrenewable resource. Pumping from ever deeper wells is problematic in another way as well: it takes a lot of energy. In some states of India, half of the available electricity is used to pump water.



[THE AUTHOR]

Lester R. Brown, in the words of the *Washington Post*, is "one of the world's most influential thinkers." The *Telegraph* of Calcutta has called him "the guru of the environmental movement." Brown is founder of both the Worldwatch Institute (1974) and the Earth Policy Institute (2001), which he heads today. He has authored or coauthored 50 books; his most recent is *Plan B 3.0: Mobilizing to Save Civilization.* Brown is the recipient of many prizes and awards, including 24 honorary degrees and a MacArthur Fellowship.

ground sources faster than rainfall can recharge them. The result is falling water tables in countries populated by half the world's people, including the three big grain producers—China, India and the U.S.

Usually aquifers are replenishable, but some of the most important ones are not: the "fossil" aquifers, so called because they store ancient water and are not recharged by precipitation. For these—including the vast Ogallala Aquifer that underlies the U.S. Great Plains, the Saudi aquifer and the deep aquifer under the North China Plain—depletion would spell the end of pumping. In arid regions such a loss could also bring an end to agriculture altogether.

In China the water table under the North China Plain, an area that produces more than half of the country's wheat and a third of its corn, is falling fast. Overpumping has used up most of the water in a shallow aquifer there, forcing well drillers to turn to the region's deep aquifer, which is not replenishable. A report by the World Bank foresees "catastrophic consequences for future generations" unless water use and supply can quickly be brought back into balance.

As water tables have fallen and irrigation wells have gone dry, China's wheat crop, the world's largest, has declined by 8 percent since it peaked at 123 million tons in 1997. In that same period China's rice production dropped 4 percent. The world's most populous nation may soon be importing massive quantities of grain.

But water shortages are even more worrying in India. There the margin between food consumption and survival is more precarious. Millions of irrigation wells have dropped water tables in almost every state. As Fred Pearce reported in *New Scientist:*

> Half of India's traditional hand-dug wells and millions of shallower tube wells have already dried up, bringing a spate of suicides among those who rely on them. Electricity blackouts are reaching epidemic proportions in states where half of the electricity is used to pump water from depths of up to a kilometer [3,300 feet].

A World Bank study reports that 15 percent of India's food supply is produced by mining groundwater. Stated otherwise, 175 million Indians consume grain produced with water from irrigation wells that will soon be exhausted. The continued shrinking of water supplies could lead to unmanageable food shortages and social conflict.

Less Soil, More Hunger

The scope of the second worrisome trend—the loss of topsoil—is also startling. Topsoil is eroding faster than new soil forms on perhaps a third of the world's cropland. This thin layer of essential plant nutrients, the very foundation of civilization, took long stretches of geologic time to build up, yet it is typically only about six inches deep. Its loss from wind and water erosion doomed earlier civilizations.

In 2002 a U.N. team assessed the food situation in Lesotho, the small, landlocked home of two million people embedded within South Africa. The team's finding was straightforward: "Agriculture in Lesotho faces a catastrophic future; crop production is declining and could cease altogether over large tracts of the country if steps are not taken to reverse soil erosion, degradation and the decline in soil fertility."

In the Western Hemisphere, Haiti—one of the first states to be recognized as failing—was

KOREAN FEDERATION FOR ENVIRONMENTAL MOVEMENT (*Brown*); SAMUEL VELASCO *SW/Infographics* (*illustration*)

largely self-sufficient in grain 40 years ago. In the years since, though, it has lost nearly all its forests and much of its topsoil, forcing the country to import more than half of its grain.

The third and perhaps most pervasive environmental threat to food security—rising surface temperature—can affect crop yields everywhere. In many countries crops are grown at or near their thermal optimum, so even a minor temperature rise during the growing season can shrink the harvest. A study published by the U.S. National Academy of Sciences has confirmed a rule of thumb among crop ecologists: for every rise of one degree Celsius (1.8 degrees Fahrenheit) above the norm, wheat, rice and corn yields fall by 10 percent.

In the past, most famously when the innovations in the use of fertilizer, irrigation and high-yield varieties of wheat and rice created the "green revolution" of the 1960s and 1970s, the response to the growing demand for food was the successful application of scientific agriculture: the technological fix. This time, regrettably, many of the most productive advances in agricultural technology have already been put into practice, and so the long-term rise in land productivity is slowing down. Between 1950 and 1990 the world's farmers increased the grain yield per acre by more than 2 percent a year, exceeding the growth of population. But since then, the annual growth in yield has slowed to slightly more than 1 percent. In some countries the yields appear to be near their practical limits, including rice yields in Japan and China.

Some commentators point to genetically modified crop strains as a way out of our predicament. Unfortunately, however, no genetically modified crops have led to dramatically higher yields, comparable to the doubling or tripling of wheat and rice yields that took place during the green revolution. Nor do they seem likely to do so, simply because conventional plant-breeding techniques have already tapped most of the potential for raising crop yields.

Jockeying for Food

As the world's food security unravels, a dangerous politics of food scarcity is coming into play: individual countries acting in their narrowly defined self-interest are actually worsening the plight of the many. The trend began in 2007, when leading wheat-exporting countries such as Russia and Argentina limited or banned their exports, in hopes of increasing locally available food supplies and thereby bringing down food prices domestically. Vietnam, the world's second-biggest rice exporter after Thailand, banned its exports for several months for the same reason. Such moves may reassure those living in the exporting countries, but they are creating panic in importing countries that must rely on what is then left of the world's exportable grain.

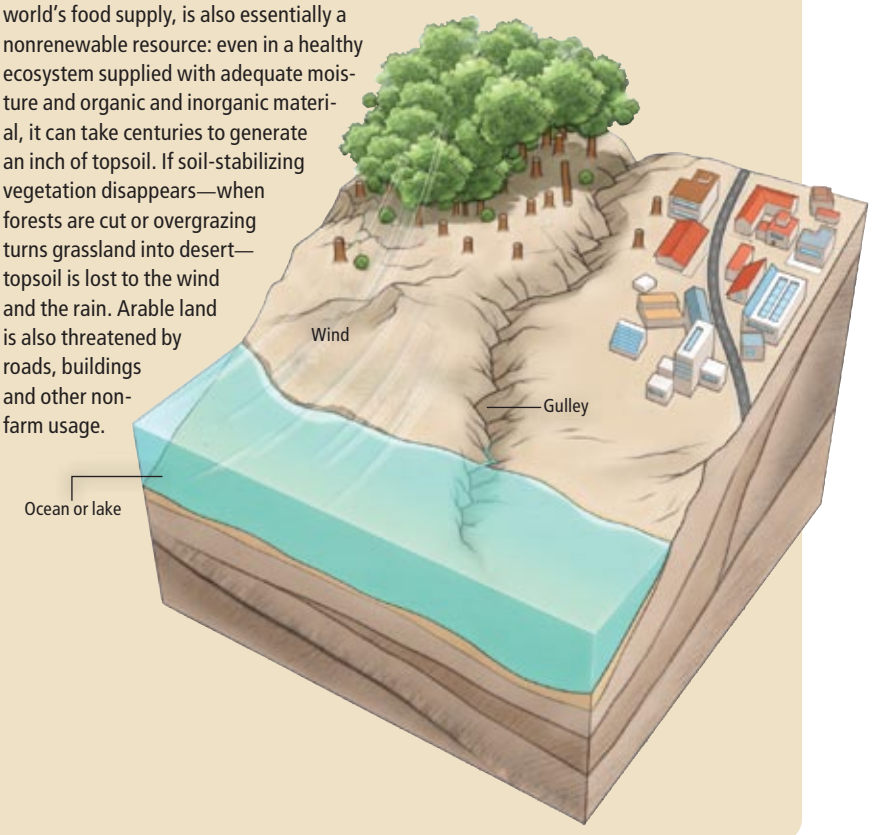
In response to those restrictions, grain importers are trying to nail down long-term bilateral trade agreements that would lock up future grain supplies. The Philippines, no longer able to count on getting rice from the world market, recently negotiated a three-year deal with Vietnam for a guaranteed 1.5 million tons of rice each year. Food-import anxiety is even spawning entirely new efforts by food-importing countries to buy or lease farmland in other countries [*see sidebar at top of next page*].

In spite of such stopgap measures, soaring food prices and spreading hunger in many other countries are beginning to break down the social order. In several provinces of Thailand the predations of "rice rustlers" have forced villag-

[ERODING SOILS]

Arable Land Is Disappearing

Topsoil, another vital factor in maintaining the world's food supply, is also essentially a nonrenewable resource: even in a healthy ecosystem supplied with adequate moisture and organic and inorganic material, it can take centuries to generate an inch of topsoil. If soil-stabilizing vegetation disappears—when forests are cut or overgrazing turns grassland into desert—topsoil is lost to the wind and the rain. Arable land is also threatened by roads, buildings and other nonfarm usage.



SAMUEL VELASCO *SW Infographics*

HOW FAILED STATES THREATEN EVERYONE

When a nation's government can no longer provide security or basic services for its citizens, the resulting social chaos can have serious adverse effects beyond that nation's own borders:

- **Spreading disease**
- **Offering sanctuary to terrorists and pirates**
- **Spreading the sale of drugs and weapons**
- **Fostering political extremism**
- **Generating violence and refugees, which can spill into neighboring states**

SIDE BETS IN THE GAME OF FOOD POLITICS

Anxious to ensure future grain supplies, several nations are quietly making deals with grain-producing countries for rights to farm there. The practice tightens supplies for other importing nations and raises prices. Some examples:

- **China:** Seeking to lease land in **Australia, Brazil, Burma (Myanmar), Russia** and **Uganda**
- **Saudi Arabia:** Looking for farmland in **Egypt, Pakistan, South Africa, Sudan, Thailand, Turkey** and **Ukraine**
- **India:** Agribusiness firms pursuing cropland in **Paraguay** and **Uruguay**
- **Libya:** Leasing 250,000 acres in **Ukraine** in exchange for access to Libyan oil fields
- **South Korea:** Seeking land deals in **Madagascar, Russia** and **Sudan**

ers to guard their rice fields at night with loaded shotguns. In Pakistan an armed soldier escorts each grain truck. During the first half of 2008, 83 trucks carrying grain in Sudan were hijacked before reaching the Darfur relief camps.

No country is immune to the effects of tightening food supplies, not even the U.S., the world's breadbasket. If China turns to the world market for massive quantities of grain, as it has recently done for soybeans, it will have to buy from the U.S. For U.S. consumers, that would mean competing for the U.S. grain harvest with 1.3 billion Chinese consumers with fast-rising incomes—a nightmare scenario. In such circumstances, it would be tempting for the U.S. to restrict exports, as it did, for instance, with grain and soybeans in the 1970s when domestic prices soared. But that is not an option with China. Chinese investors now hold well over a trillion U.S. dollars, and they have often been the leading international buyers of U.S. Treasury securities issued to finance the fiscal deficit. Like it or not, U.S. consumers will share their grain with Chinese consumers, no matter how high food prices rise.

Plan B: Our Only Option

Since the current world food shortage is trend-driven, the environmental trends that cause it must be reversed. To do so requires extraordinarily demanding measures, a monumental shift away from business as usual—what we at the Earth Policy Institute call Plan A—to a civilization-saving Plan B.

Similar in scale and urgency to the U.S. mobilization for World War II, Plan B has four components: a massive effort to cut carbon emissions by 80 percent from their 2006 levels by 2020; the stabilization of the world's population at eight billion by 2040; the eradication of poverty; and the restoration of forests, soils and aquifers.

Net carbon dioxide emissions can be cut by systematically raising energy efficiency and investing massively in the development of renewable sources of energy. We must also ban deforestation worldwide, as several countries already have done, and plant billions of trees to sequester carbon. The transition from fossil fuels to renewable forms of energy can be driven by imposing a tax on carbon, while offsetting it with a reduction in income taxes.

Stabilizing population and eradicating poverty go hand in hand. In fact, the key to accelerating the shift to smaller families is eradicating poverty—and vice versa. One way is to ensure at least a primary school education for all children, girls as well as boys. Another is to provide rudimentary, village-level health care, so that people can be confident that their children will survive to adulthood. Women everywhere need access to reproductive health care and family-planning services.

The fourth component, restoring the earth's natural systems and resources, incorporates a worldwide initiative to arrest the fall in water tables by raising water productivity: the useful activity that can be wrung from each drop. That implies shifting to more efficient irrigation systems and to more water-efficient crops. In some countries, it implies growing (and eating) more wheat and less rice, a water-intensive crop. And for industries and cities, it implies doing what some are doing already, namely, continuously recycling water.

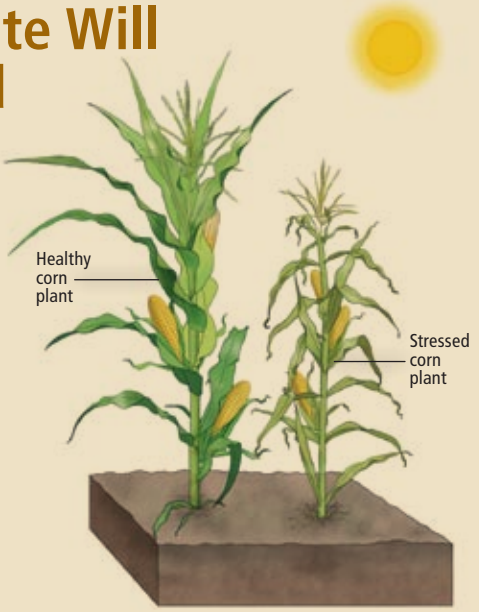
At the same time, we must launch a worldwide effort to conserve soil, similar to the U.S. response to the Dust Bowl of the 1930s. Terracing the ground, planting trees as shelterbelts against windblown soil erosion, and practicing minimum tillage—in which the soil is not plowed and crop residues are left on the field—are among the most important soil-conservation measures.

There is nothing new about our four interrelated objectives. They have been discussed individually for years. Indeed, we have created entire institutions intended to tackle some of them, such as the World Bank to alleviate poverty.

[RISING TEMPERATURES]

Hotter Climate Will Reduce Yield

Agriculture as it exists today has been shaped by a climate system that has changed little in the 11,000-year history of farming. Because most crops were developed for maximum production under these stable conditions, the higher temperatures that are expected from global warming will reduce crop yield, measured in bushels per acre harvested. Crop ecologists reckon that for every rise of one degree Celsius (1.8 degrees Fahrenheit) above the norm, wheat, rice and corn yields fall by 10 percent.



SAMUEL VELASCO *SW/Infographics*

[SOLUTIONS]

WHAT IS TO BE DONE?

Plan B, the author's road map to correcting the factors that threaten our civilization, has four main components: a massive effort to cut carbon emissions by 80 percent from their 2006 levels by 2020; the stabilization of the world's population at eight billion or fewer by 2040; the eradication of poverty; and the restoration of the planet's forests, soils and aquifers. This box highlights a few of the major actions needed to accomplish these goals.

◀ Plant trees to reduce flooding, conserve soil, sequester carbon and halt net deforestation.

▲ Replace fossil fuels with renewables for electricity and heat.

▲ Offer universal basic health care, reproductive health care and family planning.

▲ Recycle wastewater to raise its productivity, as this sewage treatment plant does for Orange County, California.

And we have made substantial progress in some parts of the world on at least one of them—the distribution of family-planning services and the associated shift to smaller families that brings population stability.

For many in the development community, the four objectives of Plan B were seen as positive, promoting development as long as they did not cost too much. Others saw them as humanitarian goals—politically correct and morally appropriate. Now a third and far more momentous rationale presents itself: meeting these goals may be necessary to prevent the collapse of our civilization. Yet the cost we project for saving civilization would amount to less than $200 billion a year, a sixth of current global military spending. In effect, Plan B is the new security budget.

Time: Our Scarcest Resource

Our challenge is not only to implement Plan B but also to do it quickly. The world is in a race between political tipping points and natural ones. Can we close coal-fired power plants fast enough to prevent the Greenland ice sheet from slipping into the sea and inundating our coastlines? Can we cut carbon emissions fast enough to save the mountain glaciers of Asia? During the dry season their meltwaters sustain the major rivers of India and China—and by extension, hundreds of millions of people. Can we stabilize population before countries such as India, Pakistan and Yemen are overwhelmed by shortages of the water they need to irrigate their crops?

It is hard to overstate the urgency of our predicament. Every day counts. Unfortunately, we do not know how long we can light our cities with coal, for instance, before Greenland's ice sheet can no longer be saved. Nature sets the deadlines; nature is the timekeeper. But we human beings cannot see the clock.

We desperately need a new way of thinking, a new mind-set. The thinking that got us into this bind will not get us out. When Elizabeth Kolbert, a writer for the *New Yorker*, asked energy guru Amory Lovins about thinking outside the box, Lovins responded: "There is no box."

There is no box. That is the mind-set we need if civilization is to survive. ■

MORE TO EXPLORE

Outgrowing the Earth: The Food Security Challenge in an Age of Falling Water Tables and Rising Temperatures. Lester R. Brown. W. W. Norton, Earth Policy Institute, 2004. Available at **www.earthpolicy.org/Books/Out/Contents.htm**

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