Saving the Planet with Higher Yields from 21st Century Farms

by
Dennis T. Avery
Director, Center for Global Food Issues
Hudson Institute

An Economic Policy Lecture

Presented by Lindenwood University
and
Institute for Study of Economics and the Environment

Series 12, April 2007

ISEE

A unit of Lindenwood University's Center
for the Study of American Culture and Values

LINDENWOOD
LINDENWOOD UNIVERSITY ST. CHARLES, MISSOURI

This publication is an expanded version of a talk by Dennis T. Avery presented on November 14, 2006 in Lindenwood University's Economic Policy Lecture Series. The lecture series is designed to engage students, faculty and off-campus guests of Lindenwood University in discussion of key economic and environmental issues of the day. These lectures are published in order to afford a variety of audiences across the nation the opportunity to benefit from them. The Institute for Study of Economics and the Environment (ISEE) directs the lecture series. This lecture was co-hosted with the Division of Management.

ISEE is a program of teaching and research at Lindenwood University. Its mission is "to improve student and public understanding of the basic economic concepts that can be used to guide effective and efficient environmental policy making." The Institute operates within the National Center for the Study of American Culture and Values at Lindenwood. Additional information on ISEE is available at: http://www.lindenwood.edu/academics/isee.asp

Funding for ISEE is unrestricted, ensuring unbiased and independent research. The Institute is an integral part of Lindenwood University, which has been granted tax-exempt status under section 501(c)(3) of the Internal Revenue Code.

Donations can be made to the Institute for Study of Economics and the Environment at the following address:

Institute for Study of Economics
and the Environment
Lindenwood University
209 South Kingshighway
St. Charles, MO 63301
Attn: Dr. Kenneth Chilton

Saving the Planet with Higher Yields from 21st Century Farms

By Dennis T. Avery

INTRODUCTION

I come today with a heartfelt plea from the world's farmers to its environmentalists: "Please understand that high yield farming is mankind's greatest humanitarian achievement while also its greatest environmental triumph."

High-yield farming is the major factor in lowering both human death rates and human population growth rates — while minimizing the land required to feed each person. Because of this, we fully agree that humanity now has the capability of, and thus the responsibility for, saving the wildlife still on this planet. With population growth continuing — though at a declining rate — and the rapid spread of global affluence, there is only one viable strategy for conserving the world's wildlife over the next 50 years: *We must triple the food yields per acre on the current farmlands.* But be of good cheer, we have accomplished the feat before.

A HALF-CENTURY OF BENEFITS

A brief recap of the amazing achievements of high-yield farming over the present 50 years is in order.

Benefits to the Environment

- Because the Green Revolution tripled crop yields on most of the world's good farmland after World War II, the world still has 16 million square miles of forests. Better seeds, chemical fertilizers, irrigation and pesticides, brought about this amazing result.
- According to the United Nations' new *World Atlas of Biodiversity*, only 20 major species became extinct during the last one-third of the 20thcentury, compared to 40 such extinctions in the last third of the 19th century. This is mainly due to wildlands being saved from the plow by high-yield farming.
- High-yield farming has cut soil erosion risks by at least two-thirds. We use low-till farming, with herbicides to control weeds instead of bare-earth plowing and hoeing.
- In the United States, confinement feeding has preserved forests equal to the land area of Pennsylvania and New Jersey from being cleared for hog and poultry pastures.

Dennis T. Avery is a senior fellow of the Hudson Institute. His latest book (with S. Fred Singer) is *Unstoppable Global Warming: Every 1500 Years*.

- The low erosion rates of modern farming, plus the stream protection of confinement feeding under zero-discharge management, have given America's streams and rivers a level of water quality protection not seen since European colonists brought their plows to America.

One of the strongest and least-understood arguments for high-yield farming is that the best farmland has the least biodiversity, all over the world. Ecologist Michael Huston of the Oak Ridge National Laboratory points out that the American Great Plains had millions of bison, antelope and prairie dogs, but that's only three species. The Russian steppes used to have 10 million saiga (an antelope-like animal that was actually related to cattle) but not a lot of other mammals. The Australian grasslands were dominated by huge numbers of kangaroos.

In contrast, there is a Peruvian national park in the Amazon Basin that is home to more than 1300 plant species, 300 bird species, 130 species of amphibians and reptiles, 70 species of non-flying mammals, plus thousands of insect species.[1] Indeed a few square miles of tropical forests may contain more above ground species than all of North America.

Benefits to Mankind

- High-yield farming and modern transportation have banished famine everywhere they have been implemented. Africa, with its declining, all-organic food production, is the last horrifying example of a low-yield agricultural society.
- High-yield farming has enabled much of the world's population to eat high-quality protein, which provides an abundance of the micronutrients humans get mainly from livestock sources, such as iron, zinc and Vitamin A. As a result, children grow more vigorously, learn faster, and suffer fewer diseases.
- Livestock and poultry farmers have doubled their meat and milk production per acre since 1970 with higher-yielding feed crops, better livestock breeding, confinement feeding, balanced feed rations, and veterinary medicines.
- The greatest achievement of confinement livestock feeding is protecting the general public from the epidemics of influenza, cholera, smallpox and other diseases that historically afflicted humanity from the close human-domestic animal interactions of back-yard farming.
- The poorest countries have come three-fourths of the way to population stability in 46 years. *Birth rates declined earliest and most rapidly in the countries where crop yields increased the most and fastest.*

[1] Michael A. Huston, Biological Diversity, (Cambridge University Press, 1994): 546–548.

ORGANIC FARMING'S SHORTCOMINGS

By contrast, the world cannot be fed, nor its wildlife saved, through organic farming. Organic farming produces only about half as much food per acre as conventional farms. Organic farmers must use added land to grow their nitrogen, either as cattle forage or green manure crops.

Dr. Vaclav Smil of the University of Manitoba estimates that an "organic-only" farming mandate for the world would require the manure from another 5–7 billion cattle (up from 1.2 billion cattle). Each cow needs 4–6 acres of forage for a massive global land requirement of perhaps 47 million square miles! Total world forestland is only 16 million square miles.

The U.S. Department of Agriculture and the Environmental Protection Agency both agree that the United States has less than one-third of the organic nitrogen needed to support current crop production.[2] Nitrogen is the key plant nutrient. Every time we grow a crop, we take nitrogen out of the soil. Unless it is replaced, we get terrifying black blizzards and Dust Bowls. That is what happened to America's Great Plains in the 1930s, and to Soviet Russia's 80 million acres of Siberian "New Lands" that were plowed up in the 1950s.

Unfortunately, low-yield farming continues to be the goal of eco-activists, whether it is organic farming in Connecticut or slash-and-burn farming in Africa and Latin America. Low-yield farmers deal with rising populations by pushing their plows onto steeper, more erosive slopes and into the habitat of the gorilla and the tiger. Organic farming is still presented as the ideal, even though it cannot feed the people.

EFFECTS OF AFFLUENCE ON THE NEED FOR ADDED FARMLAND

There is little question that, during the 21st century, we will have to radically increase global output of food and feed, especially livestock feed for meat, milk and eggs. Humans seem to have an inherent hunger for these foods, and they require three to five times as much farming resources per calorie as rice or wheat. There has never been a voluntarily vegan, or even vegetarian, society. Mandates for vegetarian/vegan diets are likely to be quite unsuccessful.

In Asia today, some 2.5 billion people are rapidly becoming affluent. China's economy is growing at nearly 10 percent annually, and India's economy at about 7 percent. Such growth rates are almost unprecedented, but the World Bank says they are continuing and spreading.[3] Advances in research, technology, transport (such as container freight), computers and satellite communications are all hastening the spread of economic growth. So are trends toward democracy (which encourages higher incomes to spread beyond an elite class) and deregulation.

---

[2] Van Dyne and Gilbertson, *Estimating U.S. Livestock and Poultry Manure Nutrient Production*, U.S. Department of Agriculture, ESCS-12, 1978; and *Animal Waste Utilization on Cropland and Pastureland*, EPA-600/2-79-059, 1959, Environmental Protection Agency, Washington, D.C.

[3] World Bank, *World Development Indicators, 2006*; Washington, D.C.

As a direct result of rising affluence, China's meat consumption has recently been rising by up to 10 percent, or four million tons a year. India's consumers have been trying to buy an additional two million tons of milk per year, and far more chicken. Asians in 1990 averaged about 14 grams of animal protein per day, while Americans ate 71 grams and the Japanese 55 grams. By the year 2030, it is virtually certain that the global food system will have to provide at least 55 grams of high-quality protein per day for 4 billion Asians.

Fortunately, high-yield farming has proven it can take the environmental sting out of population growth and high-protein diets. We are already feeding more than twice as many people today as we fed in 1950. Yet the world is still farming almost the same 5.8 million square miles of land that were used for crops in 1950. Only Africa is using significantly more land because Africa is not yet using the high-yield farming systems that are beginning to be developed for that continent.

If the world's farmers today got the yields they achieved in 1950, the world would need nearly three times as much cropland to produce today's food supply. That would be about 15-16 million additional square miles of crops — all the global forest area available today. Every biologist who is worried about species extinction is worried most about lost wildlife habitat — especially forests and most of all the tropical forests. Without higher yields, we might indeed lose vast numbers of wild species over the next 50 years. With continued investments in high-yield farming and forestry research, we might not have to lose any wildlands. But a much bigger commitment to research is required to ensure this result.

PAYOFFS FROM CURRENT AGRICULTURAL RESEARCH

Let me dangle a few of the potentials that have already been achieved or have clearly become possibilities, to whet your appetites for "mundane" agricultural research.

Blight-proof potatoes. Potatoes produce more nutrition per acre than any other crop, and have become increasingly important in densely populated regions such as Asia and central Africa. Nearly 50 years ago, researchers discovered a wild Mexican relative of the potato carrying a gene code for resistance to the potato blight that caused the Irish potato famine in the 1840s. However, the blight resistance has never successfully crossbred into domestic potatoes.

The potato famine killed one million Irish and drove another two million from the Emerald Isle. Fortunately, biotech has permitted three different universities (The University of California at Davis, University of Wisconsin and Wakening University in the Netherlands) to produce blight-resistant potatoes.

Unfortunately, the activist campaign against biotech crops has kept potato processors from accepting the potatoes — so they are not being grown.

Herbicide-tolerant corn for Africa. When Monsanto first marketed its herbicide-tolerant corn in the United States, an Israeli researcher saw it as a potential weapon against the parasitic witchweed that infests tens of millions of hectares of African small farmers' cropland. The witchweed can't be pulled, hoed or sprayed because it

invades through the plant roots and grows inside the corn or sorghum stalk. It can take a fourth, a half, or even the farmer's entire crop, leaving the family hungry and helpless.

The Israeli scientist's idea was that herbicide-tolerant corn seed could be soaked in a small amount of herbicide, which would kill the witchweed as it invaded, and leave the corn to flourish. Unfortunately, due to efforts of anti-biotech activists, no permission for field trials of genetically modified herbicide-tolerant corn could be obtained.

However, the International Maize and Wheat Improvement Center (CIMMYT) in Mexico found that Pioneer Hi-Bred had discovered corn naturally tolerant of a BASF herbicide called imazopyr. That corn DNA has now been crossbred into African farmers' varieties. It is genetically researched, but not biotech-modified. Field tests have recently shown four-fold yield increases for corn in Africa, with an even bigger gain than four-fold in the food security of African families.

Drought-tolerant wheat with no-till. Genetic engineers have also made some remarkable progress with drought-tolerant crops. One of the most startling developments is an Egyptian wheat variety that contains a gene from the barley plant and needs one irrigation per growing season instead of eight. This saves on irrigation water and reduces the tendencies toward water logging and salt buildup on irrigated fields.

No-till farming uses herbicides to kill weeds instead of such "bare-earth" farming systems as hoeing and plowing. One of the benefits of no-till is that it increases the opportunity for water to infiltrate the soil through root canals and earthworm tunnels.

What if we combined the new drought-tolerant wheat variety with no-till farming to radically increase the productivity of major semi-arid land areas such as central Turkey, which is now mainly pasture? What about this system applied to the newly warming territories of Siberia? The food production potential could be dramatic.

HOW DANGEROUS ARE PESTICIDES?

A decade ago, my home state of Virginia banned what it said was the most dangerous farm chemical for wildlife — a soil insecticide called Furadan 15G. This chemical had caused at least hundreds, and perhaps thousands, of bird deaths over a period of years because birds too often mistook the granules for seeds and ate them.

Fortunately, this was only one pesticide, and we could give up that formulation with no major yield loss. However, if Virginia had to ban all pesticides, the 50-percent reduction in harvested yields, would require its farmers to plow another 2 million acres of wildlands to make up the production loss. How many birds live in two million acres of Virginia wildlands? Millions of birds do. The tradeoff is obvious, but seldom discussed.

As for endangering people, I take the word of Bruce Ames of the University of California at Berkeley who was awarded the National Science Medal by President Clinton. He says that 99.99 percent of all the cancer-causing materials we ingest are

natural pesticides, mostly in the fruits and vegetables we eat.[4] Celery, for example, contains a potent carcinogen called psoralans.

Dr. Ames says his testing shows that growing organic food only reduces our carcinogen ingestion by about one-hundredth of one percent. We do know, however, that eating more fruits and vegetables — natural and trace amounts of manmade pesticides included — is the single best way to reduce our cancer risks.

The most infamous pesticide of all is DDT. After World War II, DDT was credited with saving more than 50 million lives from such insect-borne epidemics as typhus, malaria, and yellow fever. DDT eradicated malaria across the United States, where it had been endemic from Florida to Minnesota. Its inventor won a Nobel Prize.

But in 1962, Rachel Carson published her internationally famous book, *Silent Spring*, saying that DDT and "six-of seven other pesticides now in use" caused cancer and would soon be rated as proven human carcinogens. She also said that DDT killed robins that fed on worms from soils treated with the chemical. Most famously, Ms. Carson told us that DDT thinned the eggshells of birds, causing sharp declines in bird populations.

We know now that Rachel Carson was wrong. Over 50 years, extensive experiments have shown that DDT does not cause cancer in humans, and poses no threat to mammals, birds or fish. (It does, however, kill honeybees.)

Moreover, Rachel Carson's evidence for the thinning of birds' eggshells was based on "the well-known experiments of Dr. DeWitt," which she said proved that few of the eggs from birds exposed to DDT could hatch. Actually, De Witt's study, published in the Journal of Agriculture and Food Chemistry in 1956, found that more of the eggs from DDT-exposed birds hatched than of the eggs from control birds.[5]

The real tragedy of the international DDT ban has been the 30 million people who have since died from malaria, needlessly. Perhaps a billion more people have suffered the chronic ravages of the disease without dying. The dead and the dying from malaria epidemics may have been a big enough millstone around the necks of tropical societies to prevent their economic growth, and destroy prospects for better lifestyle choices for billions of children.

South Africa recently banned DDT from its malaria program, and malaria case numbers began to surge out of control. When indoor DDT spraying was resumed, and backed with other public health measures to suppress the mosquitoes outside the homes, malaria rates were reduced by nearly 90 percent.[6]

---

[4] James Brady, "Scientist at Work," *New York Times*, July 5, 1994.

[5] James De Witt, "Chronic Toxicity to Quail and Pheasants of Some Chlorinated Insecticides," *Journal of Agriculture and Food Chemistry*; Vol. 4, 1956:863.

[6] Reuters, "South Africa Says DDT Helping to Slash Malaria Rates," June 6, 2006.

NEW AGRICULTURAL POLICIES ARE NOT ALWAYS NATURE'S FRIEND

Currently, corn ethanol may be the biggest threat to wildlife in the United States. Thanks to an unusual set of circumstances, corn ethanol is the only energy source that is currently approved for expansion by a majority of Americans. Environmental and agricultural groups in support of non-fossil renewable fuels have voiced fears about global warming, energy dependence, and nuclear meltdown.

Because farmers hold the keys to selecting half of the country's Senators each election, Congress always loves to lavish subsidies on them. Environmental activists are embarrassed that solar power and wind power are such flops despite decades of subsidy. They are in favor of corn ethanol to take our minds off the fact that most of us lack the requisite amount of sunshine and wind to meet our energy needs.

Thus, we have a federal mandate to produce 7.5 billion gallons of biofuels by 2012, and virtually nothing but corn with which to meet the mandate. Unfortunately, we are already using virtually all of our corn land to grow food and feed. Few people have looked at the massive land requirements of corn ethanol to produce auto fuel.[7]

The nation uses 134 billion gallons of gasoline a year, and each acre of corn produces only about 250 gallons gasoline equivalent a year. Worse, corn ethanol produces only a tiny net energy gain — about 20 percent after we subtract the fertilizer, tractor fuel, pesticide and process heat required to make it. That means we effectively get only 50 gallons worth of transportation fuel per acre of corn! Given the low quality of the forest land left to be cleared, the small net gains in fuel, and the massive transport fuel requirement, America might have to clear an additional 50 million acres of forest in the Corn Belt and mid-South to make any significant part of its auto fuel from corn ethanol.[8]

Brazilian sugar cane is a far more effective source of fuel, with a net energy gain of 260 percent. Sugarcane yields twice as much feedstock per acre, needs half the fertilizer, and the leftover leaves and stalks fuel the sugarcane-ethanol process.

Cellulosic ethanol can theoretically be made from forest gleanings and switchgrass from dryer climates that can't grow corn. But we can't yet make ethanol from cellulose. If and when we can make ethanol from woodchips, that will put today's corn ethanol plants out of business.

The farmers and agribusinesses have already built and started more ethanol plants than it would take to meet the 2012 mandate, and their thirst for government-guaranteed profits is not yet satisfied. Look for a bid to double the farmers' corn ethanol guarantee in the upcoming federal farm bill. Though weather conditions also certainly affect corn supplies and prices, corn has already gone from about $2 a

[7] Dennis T. Avery, *Biofuels, Food or Wildlife? The Massive Land Costs of U.S. Ethanol*, Competitive Enterprise Institute, Washington, D.C., September 21, 2006.
[8] H. Shapouri, "The 2001 Net Energy Balance of Corn Ethanol," U.S. Department of Agriculture, AER-721, Washington, D.C., 2001.

bushel to $3 a bushel. Midwest economists are predicting prices up to $5 a bushel in the next few years.

U.S. ethanol policy will hand the truly profitable markets for corn to Brazilian farmers. Then, when Americans tire of seeing heartland forests cleared to grow small amounts of low-quality auto fuel — and/or cellulosic ethanol grabs the fuel market —American corn farmers will be left in the lurch. By that time, however, they will have pocketed lots of public money for cutting down lots of forest.

The recent Chevron oil strike in the deep rock strata under the Gulf of Mexico will do far more to provide U.S. energy independence and energy security than all the corn farmers can grow. It could increase our proven oil reserves by at least 50 percent. Meanwhile, the Canadians are ramping up production in the Alberta tar sands, where steam injection units are now producing oil for less than $15 a barrel in a region that the provincial government says has 2.5 trillion barrels of oil. It also takes the nasty oil out of a watershed where it has been polluting the rivers for eons.

The ethanol subsidy has eliminated American farmers' past desire for greater freedom in trade in agricultural products. American farmers could have obtained access to Asia's growing markets for food and feed, forestalling the tendency for densely populated countries to clear species-rich tropical forests to grow chicken feed and cooking oil.

THE ROLE OF PRIVATE FOUNDATIONS IN HIGH-YIELD AGRICULTURE

One of the world's more remarkable recent developments has been the creation of Bill and Melinda Gates' massive charitable foundation. In the past, public subsidies for the poor have tended to create a spreading dependence on the government and a massive drag on economic growth that made all citizens poorer in the long run. Foreign assistance from rich governments to poor governments has an equally sorry history of "white elephant" projects and massive diversions of cash to dictators' Swiss bank accounts.

Rather than giving money to poor people or corrupt governments, the Gates are trying to eliminate the external constraints on health and wealth creation: diseases, malnutrition and bad farming systems. They started by giving more than $250 million dollars of their $30 billion for the development of a malaria vaccine. The Gates are also funding a massive drive for an AIDS vaccine.

Then the Gates extended their philanthropy to overcoming malnutrition. Their foundation has supported research to enhance the levels of vitamins and other key micronutrients in rice, corn, cassava, sorghum, and bananas, all of which represent the major sources of calories for the world's poorest peoples. Most recently, the Bill and Melinda Gates Foundation turned to investments in agricultural research for the Third World, especially for the tropics and Africa where the Green Revolution has never really reached.

In all of these efforts, the Gates have worked to create new and independent networks for research and delivery of new technology. In agriculture, for example,

they have put together a network that includes the Rockefeller Foundation, which launched the original Green Revolution in Mexico in the 1940s, and the worldwide network of semi-public Green Revolution agricultural experiment stations now called the FutureHarvest. It also provided funding to Dr. Norman Borlaug, 1970 Nobel Peace Prize winner for breeding the famous semi-dwarf wheat varieties that tripled yields in Latin America and Asia.

The early achievements of the Bill and Melinda Gates Foundation have been so impressive that billionaire Warren Buffett has added more than $30 billion of his wealth to the Gates Foundation's charitable resources. This is a powerful combination of the productive power of capitalism and technology, amplified by the philanthropy of the global economy's "big winners." The promise of capitalism's productivity combined with private charity is huge, especially in contrast to past failures of governments.

GLOBAL WARMING'S EFFECTS ON NATURE

Although global warming is a bit off my subject on high-yield farming, I believe it bears on the topic of man's impact on nature. Furthermore, because I have co-authored a book on this issue that was released in November, I would like to answer the question, "Will humanity destroy a million wild species with greenhouse gasses and global warming from fossil fuels?"

The short answer is, "Probably not." Global warming must today be viewed in light of the moderate, erratic 1500-year climate cycle that was revealed by the first 250,000-year long ice cores brought up in 1983 from the Greenland ice sheet. The cores showed the big 100,000-year Ice Age climate cycle, but superimposed on it was a small-but-persistent 1500-year cycle. The small climate cycle raised temperatures at the latitude of Washington and Paris by about 2 degrees C for centuries at a time—and then dropped them 2 degrees below the mean for centuries more.

In 1986, a Russian-French team brought up an even longer ice core — 400,000 years in the making — from the other end of the Earth, in Antarctica. It, too, provided evidence of the 1500-year climate cycle. The cycle was ubiquitous, persistent and global.

Since then, scientists working all over the world have found the 1500-year climate cycle in the seabed sediments of at least six oceans, in tree rings around the Northern Hemisphere, and in cave stalagmites and glacier movements on every continent plus New Zealand. Archeologists find prehistoric villages moved up the mountainsides of both Europe's Alps and South America's Andes during the Medieval Warming (950–1300AD) and back down during the cold, unstable weather of the Little Ice Age (1300–1850 AD). The North American Pollen Database shows nine complete reorganizations of our trees and plants in the past 14,000 years — or one every 1650 years.

We now know from satellite measurements that the sun's irradiance is not a constant, but varies slightly. We know from measuring carbon, beryllium, and sunspot cycles that the impact of the sun's variations is magnified on Earth by cosmic rays hitting our atmosphere more or less frequently.

If the natural 1500-year cycle produced the pre-industrial warming from 1850 to 1940, a very supportable theory, then we can credit human-emitted CO2 only with causing some part of the post-1940 increase of 0.2–0.3 degrees C. That makes man-made warming far less threatening than the newspapers and alarmists have claimed.

More to the point of conservation, all of today's wild species are survivors of the very warm Holocene Optimum 5,000 years ago, when the temperatures were about 2 degrees C warmer than today in southern Scandinavia — and up to 4 degrees C warmer above the Arctic Circle.[9] The Sahara Desert was then full of giraffes and rhinos, and Egypt's Nile Valley was so wild and flood-ravaged that no humans lived there.[10]

While our planet's life forms are generally cold-limited, they are rarely heat-limited.[11] Further, the species and/or their reproduction systems are mobile. The very biologist who predicted the world would lose a million wild species to global warming (Chris Thomas of the University of East Anglia)[12] has documented butterflies taking up new food sources, and bush crickets producing offspring with longer wings, the better to find new habitats farther away.[13]

In fact, despite the "unprecedented warming" of the past 150 years, not a single wild species is documented to have gone extinct due to rising temperatures. Instead, biologists have found a startling enrichment of biodiversity, as warmth-loving species have moved northward and upslope, without displacing the existing cold-tolerant species in those territories.[14]

The Earth's cities currently take up only about 1.5 percent of the planet's land area. By the year 2050, they will occupy perhaps 3.5 percent. If tomorrow's citizens treat their sewage and tend to live in high-rise apartments, what threat do they represent to wildlife? The answer is, "Not much, unless it takes too much land to produce their food."

---

[9] Jonathan Adams, *Europe During the Last 150,000 Years*, Oak Ridge National Laboratory, www.esd.ornl.gov/gen/nercEUROPE.html, Oct. 23, 2006.

[10] Rudolph Kuper and Stefan Kropelin, "Climate-Controlled Holocene Occupation in the Sahara: Motor of Africa's Evolution," *Science*, 313 2006: 803–807.

[11] C. Loehle, "Height Growth Tradeoffs Determine Northern and Southern Range Limits for Trees," *Journal of Biogeography* 25, 1998: 735–42.

[12] C. D. Thomas et al., "Extinction Risk From Climate Change," *Nature* 427, 2004: 145–148.

[13] C.D. Thomas et al., "Ecological and Evolutionary Processes at Expanding Range Margins," *Nature* 411, 2001: 577–81.

[14] S. F. Singer and D. T. Avery, *Unstoppable Global Warming Every 1500 Years*, Chap. 6: 86–96. The chapter cites a wide variety of peer-reviewed studies documenting the trend toward species enrichment during the current warming among birds, mountain plants, insects, and both marine and land-based invertebrates.

Global warming should actually help in this regard. The Earth's current warming is almost certain to be moderate and beneficial — and because it is being caused primarily by the sun, it is unstoppable anyway. Investments in stopping the warming, such as the Kyoto Protocol, will be wasted. We should invest, instead, in adapting to moderate increases in warmth and wetness.

During the 21st century, the Earth will probably warm perhaps another 1 degree C, with more rainfall and with fewer-and-milder storms. (The warming of the poles will narrow the temperature differential with the equator, subtracting power from all storms.) Sea levels will rise at only about 6–7 inches per century because the Antarctic ice cap contains 90 percent of the world's ice and melts very, very slowly, due to reflectance and the extreme cold of the South Pole. Currently, the Antarctic ice is *gaining* mass from increased snowfall.[15]

There may be some serious multi-year droughts, with California at particular risk. The Sahara may become wetter again, due to a northward shift in the tropical rain belts—leaving more droughts in parts of central Africa. On the other hand, the Mayan civilization collapsed due to long-term drought during the *cold* Dark Ages.[16] There are always droughts, floods and storms, and we cannot predict where they will be.

However, solar-linked warming will produce some large benefits. Crops and forests will be stimulated by longer growing seasons, the fertilizing effect of CO2 on plants and trees, and the warming of big tracts of arable land in Canada and Siberia.

CONCLUSION

Humanity is not the threat to Nature that many would have us believe. While pessimists insist that increasing human population must damage the rest of the planet, modern man appears to be protecting nature through innovations in agriculture and conservation.

Even the current fear of catastrophic human-induced climate change appears overblown. A 1500-year natural warming cycle may well prove to be a better explanation for current warming than manmade greenhouse gas emissions. Further, whatever the cause of apparent warming, the result likely will be modest and, on balance, beneficial.

Just as population fears have proved popular but incorrect, so too fear of man's impact on nature likely will be proved to be exaggerated. The power of intellect and economic incentives should produce optimism for the future of humanity and the planet.

---

[15] C. Davis, et al., "Snowfall Driven Growth in East Antarctic Ice Sheet Mitigates Sea Level Rise," *Science* 308, 2005:1898-1901.

[16] G. H. Haug et al., "Climate and the Collapse of the Maya Civilization," *Science* 299, 2003: 1731–1735.

Dennis T. Avery is Director of the Center for Global Food Issues and a Senior Fellow of the Hudson Institute. He served as agricultural analyst for the U.S. Department of State from 1980-1988, where he was responsible for assessing the foreign policy implications of food and farming developments worldwide. At Hudson, Avery continues to monitor developments in world food production, farm product demand, the safety and security of food supplies, and the sustainability of world agriculture.

As a staff member of the President's National Advisory Commission on Food and Fiber, he wrote the Commission's landmark report, "Food and Fiber for the Future." He holds awards for outstanding performance from three different government agencies and was awarded the National Intelligence Medal of Achievement in 1983.

Avery studied agricultural economics at Michigan State University and the University of Wisconsin.

Other Publications in the Series Include:

1. **Meeting America's Future Energy Needs**, Murray Weidenbaum, January 2003
2. **Toward Better Environmental Education**, Jane Shaw, March 2003
3. **The Effects of Globalization: A View from the Developing World**, Andrès Mejia-Vernaud, September 2003
4. **Moving Beyond Conflict: Private Stewardship and Conservation Partnerships**, Lynn Scarlett, March 2004
5. **Globalization's Effects on the Environment – Boon or Bane?** Jo Kwong, July 2004
6. **Motivating China to Play Fair in Global Markets**, William H. Lash III, January 2005
7. **Is Climate Change the 21st Century's Most Urgent Environment Problem?** Indur Goklany, April 2005
8. **Improve the Environment … Leave it to the States … and People**, Becky Norton Dunlop, October 2005
9. **How Dangerous is the U.S. Current Account Deficit?** William Poole, February 2006
10. **Breathing Easier About Air Quality**, Joel Schwartz, April 2006
11. **How Serious is the Global Warming Threat?** Roy W. Spencer, September 2006

For additional copies of this study or a single copy of previous studies, write or phone:

Dr. Kenneth W. Chilton
Institute for Study of Economics and the Environment
Lindenwood University
209 South Kingshighway
St. Charles, MO 63301

Phone: (636) 949-4742

LINDENWOOD
209 S. Kingshighway
St. Charles, Missouri 63301

NON-PROFIT
ORGANIZATION
U.S. POSTAGE
PAID
PERMIT NO. 84
ST. CHARLES, MO

BULK RATE