Environmentally Sustaining Agriculture

by Dennis T. Avery

The biggest danger to the world's natural environment today is low-yield agriculture. Amazingly, the world's agricultural professionals have been so busy apologizing for the supposed sins of monocropping and pesticide spraying that we have missed the most important environmental benefit of modern farming: It produces more food from fewer acres, so it leaves more land for nature.

Advanced farming methods utilize monocultures, potent new seed varieties, irrigation, fertilizer and pesticides to minimize land needs; medicines keep livestock and poultry healthy and productive; and the best genetics help herds and flocks convert feed more efficiently.

In 1960, farmers cropped 3.44 billion acres of land (according to the Food and Agriculture Organization [FAO]). In 1992, they cropped only 3.56 billion acres to get twice the grain and oilseeds and feed better diets to 80 percent more people. Most of that small cropland increase was on sustainable land in places like Canada, eastern Bolivia, and Brazil; most of the Brazilian expansion was not in the rain forest but in its southern and central savannahs. If the Green Revolution had not more than doubled the yields on the world's best farmland, the world would already have lost more than 10 million additional square miles of habitat (about the land area of North and Central America).

An analysis by the World Conservation Monitoring Centre found that the big threat to wildlife species and populations for the future is neither population nor pesticides, but the loss of habitat (Edwards). Modern pesticides present no documented threat to push any species into extinction. Of course, only a tiny fraction of the world's wildlife lives in cropped fields where it is subject to any potential harm from properly applied modern pesticides. Nor does a peak estimated population of nine to ten billion people (Seckler and Cox), living mostly in cities, threaten wildlife unless it takes too much land to grow their food and forest products.

The vast majority of these people will be rich enough to eat large quantities of resource-costly foods: meat, milk, eggs, fruits, and vegetables. They will wear lots of cotton clothing. Nowhere are people becoming vegetarian in large numbers. Billions of people are adopting, not rejecting, modern lifestyles. Thus the world's agricultural output must increase by at least 250 percent, and may need to triple (McCalla).

Roger Sedjo of Resources for the Future suggests we could probably produce the industrial wood needs for nine billion people from about 5 percent of the current forest area put in high-yield plantations—even though the world may well have ten

times the industrial wood consumption in 2050 that it has today.

If high yields permit us to produce the food and forest products for nine billion people without using more land, then high-yield research and technology will have protected virtually all of the existing wildlife, wild habitats, and wild species, along with their unique food webs and contributions to climate patterns.

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Modern high-yield farming is also the most sustainable agriculture ever practiced. When U.S. farmers triple their crop yields, they cut soil erosion per ton of food by two-thirds. In the last twenty years, conservation tillage has been cutting soil erosion by another 65 to 95 percent using herbicides for weed control instead of plowing, fallow, and mechanical cultivation. Conservation tillage systems also cut water runoff from fields by up to 90 percent, and pollution potential accordingly. It also turns out that plowing discourages earthworms and soil microbes far more than herbicides (Zaborski and Stinner).

From this perspective, the only food strategies likely to protect the world's remaining wildlife are *(a)* further advances in sustainable crop and livestock yields, and *(b)* radically liberalized trade in farm products.

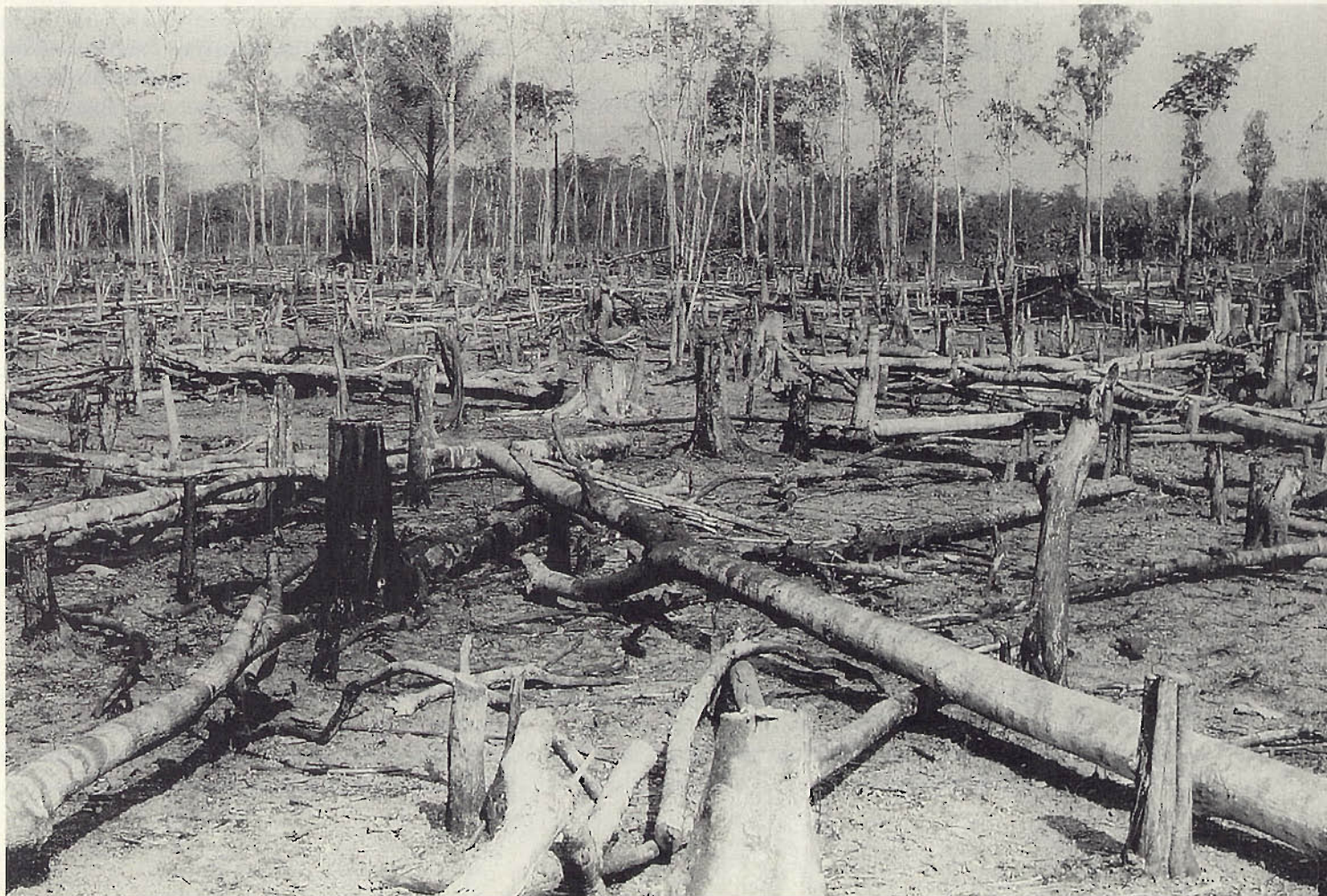
Of course there are still environmental shortcomings in high-yield agriculture: We need still-safer and more effective pesticides and application technologies, particularly to safeguard the health of Third World applicators. We need more attention to soil compaction and preserving water quality. We clearly are not pursuing biotechnology as avidly as its potential environmental benefits warrant; nothing else in our knowledge base promises so much for future crop yields increased, wildlife habitat saved, and pollution avoided.

Despite these shortcomings, modern high-yield agriculture is the best available model for environmentally sustaining farming.

Land is the scarcest natural resource

Agriculture dominates the world's land use. Cities

Indonesian deforestation.



take only 1.4 percent of the earth's land area and will occupy less than 4 percent in 2030 (Crosson and Anderson). Agriculture (with pastures) takes about one-third of the land area, and its high yields have left another third for forests—on the land left over after we have "enough" food.

The key wildlands losses have been focused in places where high-yield farming is not being widely practiced, such as Middle Africa, and on fragile Andean lands in Bolivia and Ecuador.

- Africa used 422 million acres for crops in 1970, and 452 million acres in 1992, a 7 percent increase that went mostly into more slash-and-burn, environmentally damaging farming.
- In Ecuador, crop yields have been nearly stagnant, and cropping has been expanded at nearly 2 percent per year since 1980, at the expense of forest. Using modern methods, Chilean crop yields have nearly doubled on similar terrain, preventing the need to expand cropland despite a major increase in Chile's farm exports (Southgate).

Moral concerns aside, famine is not an option for saving the environment. Poor people in the newly emerging countries are clearly willing to chop down forest and kill wildlife to get adequate calories—or even to get high-quality protein.

From this perspective, the only food strategies likely to protect the world's remaining wildlife are (a) further advances in sustainable crop and livestock yields, and (b) radically liberalized trade in farm products.

A reasonable estimate is that at least 20 million square miles of additional cropland will be needed by 2050 if we give up the monocultures, chemical fertilizers, and pesticides which have produced today's high yield—if the new land was as productive as the existing croplands. But the new cropland wouldn't be as productive.

- Only a small proportion of the additional land would be irrigated. Irrigation currently supports about one-third of the world's food output, plus virtually all of its cotton production and some forages. Thus the world has been getting nearly 40 percent of its crop output from only 20 percent of its cropland. However, the best sites have been developed, and environmental opposition has escalated. FAO data show irrigated land has expanded only 27 percent since 1960, to a total of 593 million acres.

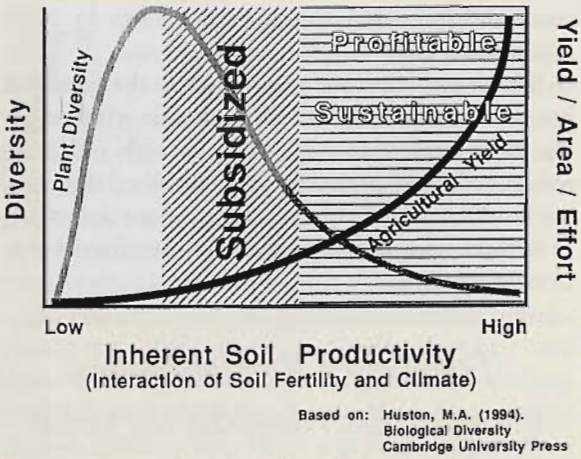


Figure 1. The best farmland has the least biodiversity

- Most of the additional cropland would be in the Third World where farmers have gotten far less support from research institutions, infrastructure, and government policies.
- The agroclimatic quality of the additional drylands plowed would be poorer. There is no new Corn Belt to plow. Nonirrigated yields in the Third World have been low because of high soil temperatures and monsoon rainfall patterns. We assume the added cropland would be only 70 percent as productive as existing cropland.

The best land has the fewest species

If our goal is to save the world's biodiversity, it is most important to save the poor-quality land from being cropped. Ecologist Michael Huston points out in his book *Biological Diversity* that the poorest lands harbor the greatest variety of wildlife species all over the world (see figure 1). Good cropland typically has thriving populations of a *few* wild species. In rain forests and swamps, the tough conditions force wildlife into narrow niches—producing lots of species.

Huston notes that America cleared about 100,000 square miles of wild forest in Ohio and Indiana during the nineteenth century, and apparently lost *no* wildlife species. Neither Ohio nor Indiana today harbor a single unique native plant species. In contrast, Florida has 385, Texas 389, and California 1,517—because those states have warmer climates and lots of poor-quality land.

The world's big reservoir of biodiversity is the tropics, where tropical forests harbor 60–80 percent of the world's various wild species.

The environmental need for free farm trade

By 2030 Asia will have 8–9 times as many people per acre of cropland as North America. Moreover, FAO data show Asians currently average less than 20 grams of animal protein per person per day,

compared to 71 in the U.S. and 55 in Japan. In the near future, Asia will almost certainly demand Japan's current 55 grams of animal protein per day, for 4 billion people instead of the present 2.8 billion.

If today's pervasive farm trade barriers persist, densely populated Asia will continue to try to maintain national food self-sufficiency (to placate their own farmers) at the expense of their wildlands.

- China is a vivid case in point: its population is nearly stabilized, but its meat consumption has been rising at more than 10 percent—and four million tons—per year. Chinese farmers are already using high-yield seeds, and double- or triple-cropping their land. China needs to pursue still-higher yields—but it also needs to consider the economic and environmental benefits of importing part of its diet improvement from high-yield farmers with export potential, in such countries as the United States, Argentina, Brazil, and Turkey.
- India is trying to produce its own milk, even though it has to steal one-third of its dairy fodder from the forests and much of the rest from its crop residues.
- Indonesia is clearing tropical forest to grow low-yielding soybeans for chickenfeed. And it has announced plans to drain one of the world's largest freshwater wetlands (on Kalimantan) to grow rice it could buy at less cost from Thailand.

What about organic and alternative agriculture?

Data from eight countries endorse the experience of a British farm manager who told me his 50,000-acre farm is "lucky to get half as much yield" from its organic fields as from its chemically supported crops (Landell Mills Research Group, Smith et al.).

Worse, the world lacks the organic nitrogen to support *current* crop output organically, let alone tripling it for the future. The United States apparently has less than one-third of the organic nitrogen which would be needed today (Van Dyne and Gilbertson). Targeting all of our sewage sludge for farm use would make up for only 2 percent of the current chemical nitrogen being used.

The only realistic way to get huge increases in organic N? Clear more forests to grow lots more clover, trading wildlife for legumes.

The Wallace Institute for Alternative Agriculture recently denounced the "myth" that high-yield farming will be able to feed so many people and still preserve wildlands and wildlife biodiversity. Actually, we cannot guarantee high-yield farming will be able to do it. However, it is clear that low-yield farming will not.

The Wallace Institute cited two pieces of evidence on the "dangers" of high-yield farming for wildlife:

- Chesapeake Bay oyster populations have fallen 96 percent in 100 years, and the Bay receives an overabundance of N and P. But Wallace fails to mention the MSX virus, which has ravaged the Bay's oysters in recent decades. Nor does it point out that cities are still the most serious sources of nutrient pollution.
- Researchers found 6 percent of the bald eagles in Virginia's James River area were being killed by secondary pesticide poisoning in 1991. Wallace didn't know, or didn't mention, that the eagle poisonings ended with withdrawal of one granular soil insecticide (Furadan 15G) in 1992.

Can these tiny and poorly founded criticisms offset millions of square miles of wildlands saved with safety-tested chemicals?

A reasonable estimate is that at least 20 million square miles of additional cropland will be needed by 2050 if we give up the monocultures, chemical fertilizers, and pesticides which have produced today's high yield...

Technology and the future

There is increasing evidence that the noted Dutch economist, deWit, was correct in believing that agriculture is dealing less with a pattern of diminishing returns than with the serial removal of constraints, and that there should be much more yield potential on most of the world's farmland. deWit calculated maximum crop yields for various parts of the world that ranged from 6 to 9 tons of edible yield per acre, compared with world-average yields in 1990 of wheat at 1.05 metric tons/acre, rice at 1.4 metric tons/acre, and maize at 1.5 metric tons/acre. Biotechnology and future breakthroughs may make even deWit's estimates of potential seem low.

Agriculturists have been eager to claim the hunger benefits of high-yield farming, but they have been strangely silent on the environmental benefits. Both are critically important to the quality of life on Planet Earth for the twenty-first century. ■

■ For more information

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Dennis T. Avery is director of global food issues for the Hudson Institute of Indianapolis. He was formerly the senior agricultural analyst for the U.S. Department of State.

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Note: *AJAE* is the *American Journal of Agricultural Economics, LE is Land Economics.*