AGRICULTURE

Can Sustainable Farming Win The Battle of the Bottom Line?

Mainstream agriculture has become a favorite whipping-boy of environmental pressure groups. Pointing to pesticide residues in food, waterways contaminated by chemicals in farm runoff, and precious topsoil eroding from much of America's cropland, these critics say the time has come for farmers to adopt environment-friendly practices that cut back on fertilizer and pesticide use and spare the soil. But behind the clamor for "sustainable" agriculture lurks a troubling question: Can this greener agriculture ever be profitable, or are its advocates asking farmers to perform financial self-immolation for the greater good of society?

Despite the question's significance, the answer just isn't clear. "At present we have a lot of anecdotes, we have success stories and failure stories all over the continuum, but we don't have a defensible and comprehensive answer," says Patrick Madden, associate director of the U.S. Department of Agriculture's Sustainable Agriculture Research and Education program.

One reason for the confusion is that it isn't a simple matter to compare the profitability of conventional and alternative farms. The conditions on farms are always changing, since all good farmers constantly fine-tune cropping practices in response to weather, soil, and pests. What's more, government farm policies now tilt the economic scales heavily toward conventional agriculture. But economists also disagree about the scope of the comparison—whether to look only at the individual farmer's costs and benefits or to include broader environmental and social effects that never show up on a farmer's account books. Adding those costs in boosts the attractiveness of sustainable agriculture—but it invites further disputes over what price to put on such benefits as silt-free streams or reduced fertilizer runoff.

Despite economists' difficulties in reckoning a true bottom line, many experts believe farmers will discover that sustainable practices often do offer significant savings, though the best mix of sustainable and conventional practices will vary from region to region and even from farm to farm. Such experience, together with society's growing environmental sensitivity, they say, will nudge mainstream agriculture toward greater use of sustainable practices in the decades ahead—at least in North America and Europe, if not in the rest of the world (see sidebar).

Advocates of sustainable agriculture—also called "low-input," "regenerative," or "alternative" agriculture—frequently point to a number of well-publicized case studies as proof that it can boost farm incomes. These studies seem to show that setting aside some or all of the synthetic pesticides and fertilizers used in conventional farming in favor of sustainable techniques—more diverse crop rotations, organic fertilizers, and increased labor—can lower farmers' production costs. The substitutions can also reduce crop yields, but the balance can leave farmers with substantial profits. For example, one low-input farm in southwest Iowa had a gross income ranking it in the bottom 25% of farms in the region, but a net income in the top 10%, according to a case study reported in the National Research Council's 1989 book *Alternative Agriculture*.

Anecdotal accounts like these, however, are not as convincing as systematic comparisons that control for farm size, soil type, and other important variables, and those studies offer a pretty murky picture. Some comparisons find low-input farmers earning higher net profits than their conventional neighbors; others find just the opposite; still others yield mixed results.

Comparing Farming Strategies

	Pennsylvania (dollars per acre over 10 years)			Nebraska (dollars per acre over 4 years)		
	Conv. #1	Alt.#1	Alt.#2	Conv. #1	Alt.#1	Alt.#2
Gross income after production costs	753	727	453	531	503	331
– on-farm cost of soil degradation	244	237	95 (benefit)	13	9 (benefit)	13 (benefit)
= net on-farm income excluding subsidies	509	490	548	519	513	344
– off-site cost of soil erosion	492	429	204	10	9	6
= net value	17	61	344	509	504	337

Conv. #1– conventional corn-soybean rotation with conventional tillage.
Alt. #1– organic corn-beans-(wheat + clover)-clover-corn rotation with conventional tillage.
Alt. #2– same rotation as Alt. #1 with reduced tillage practices.
Conv. #2– conventional corn-soybean rotation with herbicides and fertilizer.
Alt. #3– organic corn-soybean rotation.
Alt. #4– organic corn-soybean-corn-(oats + clover) rotation.

SOURCE: FAETH, *ET AL.*

Regional differences also influence the outcome. In the American Midwest, sustainable farmers often alternate high-value corn and soybeans with less lucrative crops like oats and clover to control pest populations and build soil fertility. In the heart of the Midwest corn belt, such farmers pay a much higher cost in lost income than they would in the drier, lower-yielding plains farther west, says South Dakota State University agricultural economist Tom Dobbs, simply because they give up so much more high-value harvest per acre rotated out of corn and beans.

An unfair comparison? Proponents of sustainable agriculture, however, are quick to argue that their cause isn't getting a fair shake here. First of all, they argue, many of the benefits of low-input techniques—such as improved soil quality and increased populations of natural predators that keep pests in check—may take years to develop, and farmers themselves need time to learn the new techniques. Short-term comparisons may thus understate the true value of the low-input alternative, says Steve Temple of the University of California, Davis. In an experiment Temple heads, for example, organic tomato yields have only now, after 4 years, reached levels comparable to those on conventionally farmed plots.

Furthermore, most comparisons ignore sustainable agriculture's best argument, its advocates claim. The environmental benefits of low-input agriculture—surely one of its strongest selling points—don't show up on the accounts of farmers or their bankers; nor do the environmental costs of conventional practices. This omission offends some observers. "By excluding environmental costs, you're essentially saying they have zero value—zero value to long-term crop yield, zero value to groundwater depletion," says economist Paul Faeth of the World Resources Institute, a Washington environmental think tank. As a result, conventional farming looks more attractive than it really is.

In a study to be published this July, Faeth and his colleagues estimated farmers' annual hidden cost from future crop yield reductions caused by soil erosion—a cost analogous to a factory owner's depreciation cost on machinery that will wear out someday. In hilly, erodible eastern Pennsylvania, adding in this cost propelled the best sustainable practices—shallow cultivating instead of moldboard plowing, and a rotation including pasture crops—from a 40% disadvantage to an 8% advan-

tage in net operating profits compared to conventional corn and soybeans (see table). However, critics such as Pierre Crosson of Resources for the Future, another Washington environmental-policy institute, contend that Faeth's study extrapolates from limited data and may overstate erosion's effect on long-term yields.

What's more, these critics point out, the cost of soil erosion in eastern Pennsylvania may be unusually high, which gives sustainable practices a bigger advantage than they would enjoy elsewhere. Several independent analyses suggest that for the United States as a whole, the present rates of erosion would only reduce crop yields by 2% to 10% over the next 100 years, Crosson says. Indeed, in the flat, deep soils of Nebraska, Faeth's analysis did predict a much lower cost from erosion and a smaller benefit from soil-saving rotations than in Pennsylvania. Here, he found, conventional techniques still offered farmers slightly higher net profits.

Reckoning the social costs. Erosion has other costly impacts off the farm: billions of dollars worth of damages from silt-clogged waterways, degraded fish habitat, and increased water-treatment expenses, according to agricultural economist Marc Ribaudo of the United States Department of Agriculture's (USDA) Economic Research Service. Add to these the other off-farm impacts of conventional agriculture, including groundwater contamination from pesticides and fertilizers, loss of wildlife habitat as natural areas are converted to cropland, and loss of rural communities as farms grow larger and more mechanized, and the case for sustainable agriculture looks stronger—if only a price tag could be put on those impacts. "There's a lot of evidence that the offsite damages of agricultural production, the losses of a lot of kinds of social value, are significant," says Crosson. "The problem is, how do you estimate them in physical terms—and, having done that, how do you value them?"

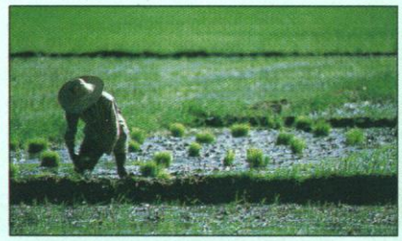
Some experts question whether society should even try to assign dollar values to environmental costs and benefits. Unlike an egg or an automobile, whose value can be pegged precisely at its selling price on the market, human health and a scenic countryside aren't bought and sold, so it may be impossible—even immoral, some suggest—to put a price on them. Others counter that dollars are the only meaningful way to add up costs and benefits of different options when policy makers come to the table. "Treating [environmental impact] as an intangible really reduces it to a minority status," says the USDA's Ribaudo. "If you put dollar values on it, you are assured of its being included in the valuation."

According to Ribaudo's analyses, the off-farm costs of erosion are highest in the densely populated northeastern U.S. Using these estimates, Faeth and his colleagues calculated that conventional agriculture in eastern Pennsylvania was a net drain on society's economic well-being—that is, its on- and off-farm environmental costs exceeded the farmer's expected net profit—whereas soil-saving crop rotations offered a positive economic contribution. In more sparsely populated Nebraska, however, they found that sustainable practices showed a negligible advantage in off-farm costs and thus offered no greater overall value than conventional farming.

For farmers struggling to pay the banker on time and send their children to college, environmental costs off their farms have little impact on farming decisions in any case. The price tag, if there is one, is picked up by

Few Options for Third World Farmers

In North America, farmers and economists can take time to debate the economic plusses and minuses of cutting back on fertilizer and pesticide use and alternating grain crops with soil-saving pasture crops (see main text). But the developing world doesn't have that luxury, says Peter Hazell of the International Food Policy Research Institute in Washington, D.C. Most of these countries face an urgent need to increase food production to meet the demands of a growing population. At the same time, as irrigation depletes aquifers or erosion degrades fragile tropical soils, such countries may need a truly sustainable agriculture more urgently than most developed nations.



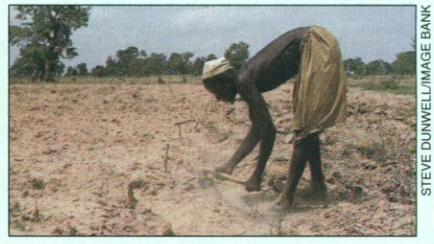
FRANÇOIS DARDELET/IMAGE BANK

Green revolution success. Planting rice in the Philippines.

These conflicting demands pull developing countries into two groups that face different imperatives. "I like to think of them as the breadbaskets and the basket cases," says Hazell. The former—countries that have already adopted high-input agriculture—may find themselves trapped there by their own success. It's the others, the countries that have been least successful at boosting food production so far, that may prove most open to sustainable techniques in the immediate future.

Hazell's breadbaskets are countries like India and much of Southeast Asia, which have used the Green Revolution's fertilizer- and pesticide-intensive technologies to create enormously productive agricultural systems that successfully feed their growing populations. In those nations, eliminating chemical inputs—especially synthetic fertilizers—is out of the question at present. "Nitrogen fertilizer is the fuel for rice," says Harvard agricultural economist Peter Timmer. "It's that simple. You put urea on and you double or triple your rice yield. If you cannot [fertilize], you cannot have high-yield cereal crops and half the world starves."

In the foreseeable future, these regions may never evolve anything resembling North American-style low-input, sustainable agriculture. They may, however, be able to mitigate some of agriculture's environmental costs. Wheat and rice farmers in the Punjab region of India, for example, could cut back on irrigation water use by 15% without reducing crop yields simply by eliminating overwatering, according to a soon-to-be-published study by the World Resources Institute. In Indonesia, careful timing of spraying has reduced the use of insecticides on rice by 50%, cut back on pest damage, and boosted yields by 12%.



STEVE DUNWELL/IMAGE BANK

Left behind. In Ghana, fertile ground for new farming methods.

The other face of Third World agriculture is especially evident in much of Africa. In these regions, economic barriers, lack of development, and a shortage of irrigation water kept the Green Revolution from taking root, says Hazell. "You can't afford the inputs, and the land isn't suitable for [input-intensive] farming." Meanwhile, population pressure has intensified traditional agriculture past the land's ability to sustain it.

For these regions, agricultural researchers are experimenting with practices such as agroforestry—growing grain and vegetable crops together with trees to control erosion—and intercropping, in which several different crops are raised together in the same field to improve the soil and increase overall yield. Such low-input techniques, says Hazell, "are the only way to go, I suspect, both for [economic] growth and sustainability."

–B.H.

others—often the government. What's more, the government effectively discourages lower-input practices like crop rotation and reduced chemical use through its farm subsidy system, most observers agree. The federal government pays most subsidies in the form of per-bushel price supports, which historically have encouraged farmers to pile on the fertilizer and pesticide to boost yields. In addition, government programs support only a handful of crops, including wheat, corn, and cotton. Farmers who expand their rotations to include soil-saving crops like alfalfa and clover thus give up much of their subsidy check. "When I'm in a bad mood, I say the United States likes corn more than it likes farmers, because it supports corn and it doesn't support farmers," grouses Iowa State University agricultural economist Mike Duffy.

Changes made in the 1990 farm bill and other legislation have broadened farmers' crop choices somewhat, Duffy says, but subsidies still favor high-input agriculture and its favorite crops. Faeth suggests leveling the field by making farm subsidies independent of which crops a farmer grows. This would clear the way for farmers to choose techniques based on their costs and benefits without the distorting effect of selective subsidies. To encourage even further reductions in environmental costs, Faeth says, the government could offer subsidies that actively reward land stewardship. Indeed, the present Conservation Reserve Program, which pays farmers to take erodible cropland out of production, will prevent billions of dollars in erosion damage, according to Ribaudo's estimates.

Even without major policy changes, however, the gap between conventional agriculture and its sustainable alternatives has narrowed gradually over the past few years as mainstream farmers recognize and adopt individual lower-input practices that prove to save money. "What we used to call conventional agriculture in Iowa is pretty much sneered at by the conventional farmer today," says Dennis Keeney, director of Iowa State University's Leopold Center for Sustainable Agriculture. "Very few of them plow anymore. Conservation tillage and cutting back on chemical use are becoming bragging points in coffee shops." Relatively few farmers are likely to buy the whole sustainable agriculture package any time soon, especially in the productive heart of the Midwest. But as research expands the repertoire of alternative techniques and—perhaps most important—as farmers grow comfortable with what were once unorthodox approaches to cropping, mainstream agriculture seems certain to continue its piecemeal absorption of sustainable methods.

–Bob Holmes

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FORESTRY

How to Make the Forests of The World Pay Their Way

Almost all biologists agree that the world's forests are in trouble. Despite a decade of intense international attention to the problem of deforestation, 17 million hectares of forest in Central and South America, Asia, and Africa are vanishing each year, up from 11.4 million hectares a year in 1980, according to the UN Food and Agriculture Organization. Over the next 30 years, human population in the tropics is set to double, which will undoubtedly put the forests under even greater pressure. Says Bruce Cabarle, manager of the Latin America Forestry Program at the World Resources Institute, "There really is a catastrophe waiting to happen, both for the forests and the people who live off them."

FRANCIS PUTZ

Destructive embrace. Slashing lianas and other vines before felling a tree spares other trees.

To many conservationists, it's increasingly clear that most of these forests, surrounded by poor and growing populations, can't be preserved simply by fencing them off. "The tropical forests are much too important an economic resource to expect developing countries to simply stop using them," says Richard Harwood, professor of sustainable agriculture at Michigan State University. What's needed are ways of exploiting the forests without clearing them for timber or farming. By and large, these efforts are too late to save the world's temperate forests. There is still time, however, to prevent tropical forests from disappearing. "The situation is serious and demands attention now, but there are concrete things we can do to both protect and utilize to some degree the world's tropical forests," adds Harwood.

In isolated spots around the world, small-scale programs are already showing that low-intensity harvesting, combined with total preservation, can conserve the forest and protect the ecological services it performs, such as erosion control and rainwater retention, while providing food, fiber, and income for those who must live off the forest's bounty. These "sustainable forestry" schemes also include plans to restore forest-like agriculture to previously cleared areas (see sidebar).

These schemes are far from perfect: Advocates admit that even the least obtrusive of these practices—harvesting fruit and nuts or very selective logging—can erode a forest's biodiversity. "We have to accept that using the forest means changing the forest to some degree," says Cabarle. But he adds that with the best of these practices, "the forest retains its ecological functions and its ability to recover over some extended period of time."

One approach is to set aside tracts of forest as extractive reserves, from which area residents can harvest nontimber goods, such as latex, nuts, fibers, and medicines. Conservationists began touting extractive reserves as the solution to deforestation following a 1989 *Nature* paper in which Charles Peters of the New York Botanical Garden's Institute for Economic Botany and his colleagues argued that a hectare of Amazonian rain forest was worth nearly 13 times more as an extractive reserve than as a source of timber.

The researchers had done a systematic inventory of the patch of forest, 30 kilometers southwest of Iquitos, Peru, and found that 26% of the species and 42% of the individual plants yielded products that could be sold in Iquitos. They then determined that the market value of the fruit and latex, minus wages and transportation costs, was $422, while the value of the timber was $1000. But timber, once cut, is gone, while fruit and latex can be harvested yearly. The Peters group assumed that 25% of the fruits were left each year for regeneration; pegging the annual inflation rate at 5%, the researchers determined that the forest was worth $6330 over 20 years, compared to $490—the value of the lumber at the end of that same period.

Numbers such as these are misleading, however, as these researchers and many others were quick to note. For example, not all the fruits are easy to collect—some grow high in the canopy—and harvesting often damages the trees nearly as much as cutting them down. Indeed, recent surveys around Iquitos have found that many of the region's fruit-producing trees are declining in number. And in areas where extractive reserves do exist, the harvesters often receive little of the income from their labors.

Moreover, the slow rate of return on such schemes means that for many countries, logging will remain the most tempting way to