

APPROPRIATE TECHNOLOGY FOR SUSTAINABLE FOOD SECURITY

FARMER-BASED AGROECOLOGICAL TECHNOLOGY

JULES PRETTY

FOCUS 7 • POLICY BRIEF 2 OF 9 • AUGUST 2001

A more sustainable agriculture seeks to make the best use of nature's goods and services as functional inputs. It does this by integrating regenerative processes (such as nutrient cycling, nitrogen fixation, soil regeneration, and natural enemies of pests) into food production processes. It minimizes the use of inputs that damage the environment or harm human health. It builds on farmers' knowledge and skills and seeks to make productive use of social capital, namely people's capacities for collective action for pest, watershed, irrigation, and forest management.

The success of modern agriculture in recent decades has often masked significant externalities that affect ecosystem services and human health, as well as agriculture itself. Sustainable agriculture relies more on agroecological and organic approaches to food production. While any farmer or agricultural system with access to sufficient inputs, knowledge, and skills can produce large amounts of food, most farmers in developing countries are not in such a position. The central issue today is to what extent farmers can improve food production with cheap, low-cost, locally available technologies and inputs without causing environmental damage.

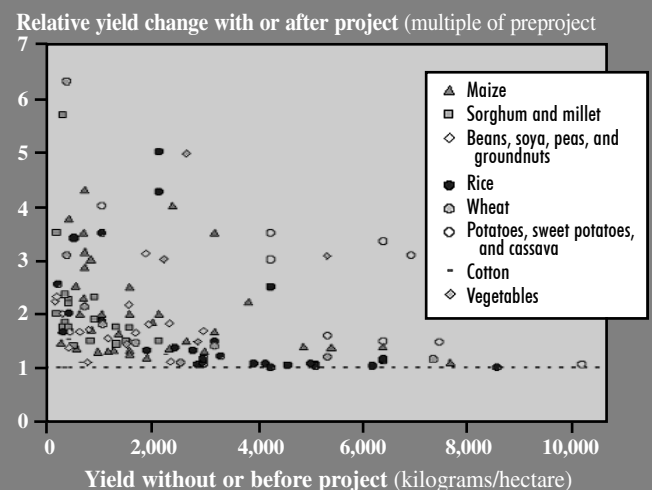
RECENT EVIDENCE

The University of Essex recently completed an audit of progress toward sustainable agriculture in 52 developing countries. This audit indicated that improvements in food production are occurring through one or more of four mechanisms:

- Intensification of a single component of the farm system—such as home-garden intensification with vegetables and trees;
- Addition of a new productive element to a farm system—such as fish in paddy rice—that boosts the farm's total food production, income, or both but that does not necessarily affect cereal productivity;
- Better use of natural capital to increase total farm production, especially water (by water harvesting and irrigation scheduling) and land (by reclamation of degraded land), enabling growth of additional new dryland crops, increased supply of water for irrigated crops, or both; and
- Improvements in per-hectare yields of staples through introduction of new regenerative elements into farm systems (for example, integrated pest management) or locally appropriate crop varieties and animal breeds.

The dataset contains details of 89 projects (139 entries of crop-project combinations) with reliable data on per hectare yield changes with the introduction of new regenerative elements (see figure). These data illustrate that sustainable agriculture has led to an average 93 percent increase in per-hectare food production.

CHANGES IN RELATIVE CROP YIELDS WITH SUSTAINABLE AGRICULTURE PROJECTS



Source: J. Pretty and R. Hine, Reducing Food Poverty with Sustainable Agriculture: A Summary of New Evidence, final report from the SAFE-World Research Project, University of Essex, Colchester, U.K., 2001.

SOCIAL LEARNING FOR SUSTAINABILITY

Farmers require timely information on pest-predator relationships, moisture and plants, soil health, and the chemical and physical relationships between plants and animals. Farmers who understand that they can manipulate these agricultural elements, and who are confident about experimentation, are better innovators. Social learning is a vital part of the process of adjustment in sustainable agriculture projects, as participatory and interactive processes help people learn about agroecology and how better to manage it. The empirical evidence indicates that social learning leads to greater innovation, together with increased likelihood that social processes producing these technologies are likely to persist.

AGROECOLOGICAL IMPROVEMENTS

Four types of agroecological improvements have played substantial roles in the food production increases found in the audit: more efficient water use, improvements to soil quality, pest and weed control with minimum or zero pesticide or herbicide use, and redesigns of whole systems.

When better harvested and conserved, water improves productivity. Such water harvesting can lead to extra crops in irrigated lands—particularly important in dryland Asia, where



IFPRI

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE • 2033 K STREET, N.W. • WASHINGTON, D.C. 20006-1002 • U.S.A.
PHONE: +1-202-862-5600 • FAX: +1-202-467-4439 • EMAIL: ifpri@cgiar.org • WEB: www.ifpri.org

IFPRI, a Future Harvest center, is part of a global agricultural research network, the Consultative Group on International Agricultural Research

small patches of irrigated rice now produce two crops per year rather than one. In rainfed environments, better water harvesting and conservation improves productivity by enabling new lands to be brought under farming and by increasing cropping intensity on existing lands.

To be sustainable, agriculture must also reduce soil erosion and make improvements to soil organic-matter content, water-holding capacity, and nutrient availability. The adoption of zero-tillage methods and diversification within crops and rotations of crops have been particularly successful approaches to soil improvement. The use of zero-tillage—combined with the use of green manures, herbicides, or both—has spread to 20 million hectares in southern Brazil and Argentina.

In Bangladesh, 80 percent of the 150,000 farmers using integrated pest management now no longer use any pesticides. A positive side-effect of using low-pesticide systems is the incorporation of fish, shrimp, and crabs into rice fields, which increase protein production. Novel research in dryland East Africa has found that the chemical cues (semiochemicals) produced by maize when fed upon by the stalk-borer pest, and which cause increased foraging and attack by parasitic wasps, are also released by a variety of grasses. In western Kenya, 2,000 farmers have adopted new “push-pull” pest-management systems (pushing the pests and pulling in the predators), resulting in 60–70 percent increases in maize yields.

The last area of innovation involves simultaneous changes to many farm variables, resulting in synergistic effects. In Madagascar, the system of rice intensification involves 6-day rather than 40-day transplanting, wide spacing, and regular weeding to encourage root growth, and water stressing during the vegetative growth period. With increased tiller numbers and grains per tiller, yield increases from 2 to 10 metric tons per hectare are now common. The system is now being replicated in Asia and elsewhere in Africa, despite initial scientific scepticism.

TRADE-OFFS OF SUSTAINABLE AGRICULTURE

In most contexts, critical trade-offs and contradictions will emerge from sustainable agriculture. For example, building a road to improve marketing near a forest can aid timber extraction. Closing grazing land to rehabilitate it could force people with no other source of food for their livestock to sell them. An increase in cropping intensity or the amount of land cultivated could increase the household workload, with the burden most likely falling on women and the profits going to men, who are less likely to invest in children and the household.

New winners and losers will emerge with the widespread adoption of sustainable agriculture. Producers of current agrochemical products are likely to suffer market losses from a more limited role for their products. The increase in assets that could come from sustainable livelihoods based on sustainable agriculture may simply increase the incentives for more powerful interests to take over.

POLICIES FOR SUSTAINABILITY

Several things are now clear about sustainable agriculture:

- The technologies and social processes for local-level agroecological improvements are well tested and established.

- The social and institutional conditions for the spread of sustainable agriculture are less well known but have been established in several contexts.
- The political conditions for the emergence of supportive policies are the least established, with only a few examples of real progress.

Most of the sustainable agriculture improvements seen in the past decade have arisen despite existing national policies. Although global recognition of the need for policies to support sustainable agriculture is increasing and almost every country would now say it supports sustainable agriculture, the evidence points toward only patchy reforms.

Some countries have seen state-level support for zero-tillage, watershed and soil management, and participatory irrigation management. A much larger number of countries have reformed elements of agricultural policies through new regulations, incentives and environmental taxes, and administrative mechanisms, and these are having considerable though partial effect. Only Cuba and Switzerland have given explicit national support for sustainable agriculture, putting it at the center of agricultural development policy and integrating policies accordingly.

CONCLUSION

Research indicates that sustainable agriculture is making a significant contribution to reducing poverty and improving rural livelihoods and could do more. As it is management and knowledge intensive, sustainable agriculture requires building the capacity of farmers and their communities to learn about the complex ecological and biophysical complexity in their fields and farms and so change their actions. It tends to succeed when organizations operate together, and so work should progress from the local to the national and international levels and links should be fostered between government, non-governmental organizations, and the private sector.

Sustainable agriculture needs enabling policy frameworks that deliberately encourage its spread. Policies framed to deliver increased food production must change if they are to help deliver environmental and social benefits, too. In addition, rural development policies and institutions focusing on exogenous solutions to the economic and social problems of rural communities must change to match the needs of community-based and participatory development. Finally, a larger proportion of research and science budgets needs to be directed toward agroecological technologies and better linkages between scientists and farmers. ■

For further information, see J. Pretty and R. Hine, *Reducing Food Poverty with Sustainable Agriculture: A Summary of New Evidence. Final Report from the SAFE-World Research Project* (Colchester, U.K.: University of Essex, 2001), <www2.essex.ac.uk/ces>; J. N. Pretty, “Can Sustainable Agriculture Feed Africa?” *Environ. Dev. and Sustainability* 1, no. 3/4 (1999): 253–274; and J. N. Pretty and R. Hine, “The Promising Spread of Sustainable Agriculture in Asia,” *Natural Resources Forum* 24, no. 2 (2000): 107–126.

Jules Pretty (jpretty@essex.ac.uk) is professor of environment and society at the University of Essex, Colchester, United Kingdom.