

THE POTENTIAL OF AGROECOLOGY TO COMBAT HUNGER IN THE DEVELOPING WORLD

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Proponents of a second Green Revolution generally argue that developing countries should opt for an agroindustrial model that relies on standardized technologies and ever-increasing fertilizer and pesticide use to provide additional food supplies for growing populations and economies. In contrast, a growing number of farmers, NGOs, and analysts propose that instead of this capital- and input-intensive approach, developing countries should favor an agroecological model, which emphasizes biodiversity, recycling of nutrients, synergy among crops, animals, soils, and other biological components, and regeneration and conservation of resources.

It is argued here that agroecology—a science that provides ecological principles for the design and management of sustainable and resource-conserving agricultural systems—offers several advantages over the conventional agronomic or agroindustrial approach. First, agroecology relies on indigenous farming knowledge and selected modern technologies to manage diversity, incorporate biological principles and resources into farming systems, and intensify agricultural production. Second, it offers the only practical way to restore agricultural lands that have been degraded by conventional agronomic practices. Third, it provides for an environmentally sound and affordable way for smallholders to intensify production in marginal areas. Finally, it has the potential to reverse the anti-peasant bias of strategies that emphasize purchased inputs as opposed to the assets that small farmers already possess, such as their low opportunity costs of labor.

CASE STUDIES

Thousands of examples exist of rural producers, in partnership with NGOs and other organizations, promoting resource-conserving yet highly productive farming systems. Critics of such alternative production systems point to lower crop yields than in high-input conventional systems. But all too often it is precisely the emphasis on yield of a single crop that blinds analysts to broader measures of sustainability and the greater productivity per unit area obtained in integrated agroecological systems that feature many crop varieties together with animals and trees. Below are some examples of the agroecological approach from Latin America.

Stabilizing the Hillside of Central America

Perhaps the major agricultural challenge in Latin America has been to design cropping systems for hillside areas that are productive and reduce erosion. World Neighbors took on this challenge in Honduras in the mid-1980s. The program introduced soil conservation practices, such as drainage and contour ditches, grass barriers, and rock walls, and organic fertilization methods, such as the use of chicken manure and intercropping with legumes. Grain yields tripled, and in some cases quadrupled,

from 400 kilograms per hectare to 1,200–1,600 kilograms. The yield increase has ensured that the 1,200 families participating in the program have ample grain supplies.

In the same region, a local NGO helped some 300 farmers experiment with terracing, covering crops to smother weeds, and other new conservation techniques. More than half of the farmers tripled their corn and bean yields. Many have gone beyond staple production to grow vegetables for local markets.

Several nongovernmental organizations (NGOs) in Central America have promoted the use of legumes as green manure, an inexpensive source of organic fertilizer. Farmers in northern Honduras are using velvet beans with excellent results. Corn yields are more than double the national average, erosion and weeds are under control, and land preparation costs are lower. Taking advantage of well-established farmer-to-farmer networks in Nicaragua, more than 1,000 peasants recovered degraded land in the San Juan watershed in just one year using this simple technology. These farmers have decreased use of chemical fertilizers from 1,900 to 400 kilograms per hectare while increasing yields from 700 to 2,000 kilograms per hectare. Their production costs are about 22 percent lower than those for farmers using chemical fertilizers and monocultures.

Agroecology in the Andean Region

NGOs in Peru have studied pre-Columbian technologies in search of solutions to contemporary problems of high-altitude farming. A fascinating example is the revival of an ingenious system of raised fields surrounded by ditches filled with water that evolved in the Peruvian Andes about 3,000 years ago. These *waru-warus* were able to produce bumper crops despite floods, droughts, and the killing frosts common at altitudes of nearly 4,000 meters.

In 1984 several NGOs and state agencies assisted local farmers in Puno to reconstruct the ancient systems. The combination of raised beds and canals moderates soil temperature, thereby extending the growing season and leading to higher productivity on the *waru-warus* than on chemically fertilized normal pampa soils. In the district of Huatta, the *waru-warus* have produced annual potato yields of 8–14 metric tons per hectare, contrasting favorably with the average regional potato yields of 1–4 metric tons per hectare.

Beginning in 1983 an NGO and some peasant communities in Cajamarca planted more than 550,000 trees and reconstructed about 850 hectares of terraces and 173 hectares of drainage and infiltration canals over the course of 10 years. About half the population in the area—1,247 families—now has land under conservation measures. For these people, potato yields have increased from 5 to 8 tons per hectare and oca (wood sorrel) yields have jumped from 3 to 8 tons per hectare. Enhanced crop production, fattening of cattle, and raising of



Performance of traditional, modern, and agroecological potato-based production systems in Bolivia

	Traditional low-input	Modern high-input	Agroecological system
Potato yields (metric tons/hectare)	9.2	17.6	11.4
Chemical fertilizer (Nitrogen + P ₂ O ₅ , kilograms/hectare)	0.0	80 + 120	0.0
Lupine biomass (metric tons/hectare)	0.0	0.0	1.5
Energy efficiency (output/input)	15.7	4.8	30.5
Net income per invested Boliviano	6.2	9.4	9.9

Source: S. Rist, "Ecología, economía y tecnologías campesinas," *Rural-ter* 10 (1992): 205-227.

alpaca for wool have increased family income from an average US\$108 per year in 1983 to more than \$500 today.

Various NGOs and government agencies in the Colca valley of southern Peru have sponsored terrace reconstruction by offering peasants low-interest loans or seeds and other inputs to restore abandoned terraces. First-year yields of potatoes, maize, and barley showed a 43-65 percent increase compared to yields from sloping fields. A native legume was used as a rotational or associated crop on the terraces to fix nitrogen, minimizing fertilizer needs and increasing production. Studies in Bolivia, where native legumes have been used as rotational crops, show that though yields are greater in chemically fertilized and machinery-prepared potato fields, energy costs are higher and net economic benefits lower than with the agroecological system (see table). Surveys indicate that farmers prefer this alternative system because it optimizes the use of scarce resources, labor, and available capital, and is accessible to even poor producers.

Integrated Production Systems

A number of NGOs have promoted diversified farms in which each component of the farming system biologically reinforces the other components—wastes from one component, for instance, become inputs to another. Since 1980 an NGO has helped peasants in south-central Chile reach year-round food self-sufficiency while rebuilding the productive capacity of the land. Small, model farm systems, consisting of polycultures and rotating sequences of forage and food crops, forest and fruit trees, and animals, have been set up. Components are chosen according to their nutritional contributions to subsequent rotations, their adaptability to local agroclimatic conditions, the local peasant consumption patterns, and market opportunities.

Soil fertility on these farms has improved and no serious pest or disease problems have appeared. Fruit trees and forage crops achieve higher than average yields, and milk and

egg production far exceeds that on conventional high-input farms. A nutritional analysis of the system shows that for a typical family it produces a 250 percent surplus of protein, 80 and 550 percent surpluses of vitamin A and C, respectively, and a 330 percent surplus of calcium. If all of the farm output were sold at wholesale prices, the family could generate a monthly net income 1.5 times greater than the monthly legal minimum wage in Chile, while dedicating only a few hours per week to the farm. The time freed up is used by farmers for other on- or off-farm income-generating activities.

Recently a Cuban NGO helped establish a number of integrated farming systems in cooperatives in the province of Havana. Several polycultures, such as cassava-beans-maize, cassava-tomato-maize, and sweet potato-maize were tested in the cooperatives. The productivity of these polycultures were 1.45 to 2.82 times greater than the productivity of the monocultures. The use of green manure ensured a production of squash equivalent to that obtainable by applying 175 kilograms of urea per hectare. In addition, such legumes improved the physical and chemical characteristics of the soil and effectively broke the cycle of insect-pest infestations.

CONCLUSIONS

The examples summarized above are a small sample of the thousands of successful experiences of sustainable agriculture implemented at the local level. Data show that over time agroecological systems exhibit more stable levels of total production per unit area than high-input systems; produce economically favorable rates of return; provide a return to labor and other inputs sufficient for a livelihood acceptable to small farmers and their families; and ensure soil protection and conservation and enhance agrobiodiversity.

With increasing evidence and awareness of the advantages of agroecology, why hasn't it spread more rapidly and how can it be multiplied and adopted more widely? Clearly, technological or ecological intentions are not enough. Major changes must be made in policies, institutions, and research and development to make sure that agroecological alternatives are adopted, made equitably and broadly accessible, and multiplied so that their full benefit for sustainable food security can be realized. Existing subsidies and policy incentives for conventional chemical approaches must be dismantled, and institutional structures, partnerships, and educational processes must change to enable the agroecological approach to blossom. In addition, participatory, farmer-friendly methods of technology development must be incorporated. The challenge is to increase investment and research in agroecology and scale up projects that have already proven successful, thereby generating a meaningful impact on the income, food security, and environmental well-being of the world's population, especially millions of poor farmers yet untouched by modern agricultural technology.

For more information, see Miguel Altieri, *Agroecology: The Science of Sustainable Agriculture*, Westview Press, 1996; Lori Ann Thrupp, *New Partnerships in Sustainable Agriculture*, World Resources Institute, 1997; and Francis Moore Lappé, Joseph Collins, and Peter Rosset, with Luis Esparza, *World Hunger: Twelve Myths*, 2nd ed., Grove Press/Food First, 1998.

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