The Agroecological Revolution

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In the debate over the future of agriculture, one school of thought holds that only industrial farming, enhanced and made less polluting by technologies such as genetically engineered crop varieties, can produce enough food to feed future populations. But many agricultural analysts and scholars argue that this reasoning is fundamentally flawed — that industrialized farming and its associated technologies not only degrade natural resources and accelerate climate change, they also exacerbate and in many cases create the poverty and unequal distribution of land, water, and seeds that are the primary causes of hunger around the world.

Among the latter group is ESPM professor **Miguel Altieri** (above), who argues that food systems should be transitioned away from fossil fuel–based industrial, large-scale production of commercial crops for export, toward small family farms designed to be biodiverse, climate-change resilient, and highly productive.

"By their nature, small-scale agroecosystems or small farms conserve natural resources and help reduce rural poverty by allowing small farmers and rural communities to become more self-sufficient," says Altieri, who has served as an advisor to the United Nations and partnered with academic research institutions and nongovernmental organizations to facilitate the spread of these farming systems worldwide.

Agroecology is rooted in traditional peasant agricultures, which make multiple uses of natural resources, creating landscape mosaics of rich biological diversity. Agroecologists combine knowledge gleaned from these traditional practices with modern ecological science to design farming systems that produce a variety of crops, trees, and livestock.

"These polycultures result in synergisms that create optimized ecological processes or services, such as natural pest control, pollination, and soil biological activity, which sponsor the functioning of farming systems without the need for external inputs," Altieri explains.

Studies have shown that agroecological farms produce more food overall than monocultures — from 20 to 60 percent more food per hectare, according to Altieri. Not only do they free small farmers from dependence on inputs like chemical pesticides, fertilizers, and transgenic crop varieties; because the inherent biodiversity increases resilience, farmers are less vulnerable to losses from drought, flooding, or the failure of any one crop.

Altieri has documented many existing sustainable agroecosystems, from heritage systems like Peru's Andean agriculture and the Maasai pastoral systems of Kenya and Tanzania, to Cuba's urban farms and the complex coffee and cacao agroforests maintained by farmers in Meso-America. There are thousands of such examples throughout the developing world, he says.

And, in Latin America in particular, Altieri says, small farmers have joined forces with nongovernmental organizations and some academic institutions to spearhead what amounts to an agroecological revolution — for improving food security and health as well as the environment — a development he says is spreading around the world.

"In the future there will be less land, water, and nitrogen available to produce crops, and in a context of climate, food, and energy crises, it is now largely proven that agroecology is the only path to significantly increase production and improve farmers' income and livelihoods," Altieri says. "It is imperative that institutions like CNR invest heavily in educating the agricultural professionals of the future, so they are well versed in agroecology and can tackle the challenges that lie ahead."

PHOTO: Courtesy of Dirt! The Movie (www.dirtthemovie.org)

forests. "In California, 35 million acres of rangelands are providing all kinds of services, from habitat for pollinators to livestock products to viewsheds," says Huntsinger, a range ecologist and manager (see "Preserving Rangeland Biodiversity," this page).

Some heritage systems, like the Ifugao rice terraces of the Philippines, maximize the use of mountainous terrain for rice production while incorporating stands of managed forest and a variety of aquatic and terrestrial wildlife. Other systems combine traditional farming techniques with modern ecological science and innovative marketing and distribution methods; Kremen points to Full Belly Farm in California's Capay Valley, which successfully raises more than 80 different crops, wresting a huge amount of produce from a small area.

Even industrial farms can become more biodiverse through the application of improved techniques. Monocrops such as vineyards, for example, can be broken up with flowering cover crops, hedgerows, and corridors that help control pests without chemical inputs.

HOW TO FEED 9 BILLION?

For all their potential benefits, the question remains: Can diversified farming systems feed a growing, changing world? Perhaps a better question might be, can we feed the world without them? Despite the tremendous crop yields made possible by industrial farming and the technologies of the Green Revolution of the 1960s and '70s, 900 million people still do not get enough to eat, and starvation has become a recurrent feature of life in sub-Saharan Africa. Increasing the food supply is not enough; that food needs to get to those who can least afford it.

"The Green Revolution didn't solve world hunger; it solved the number of calories," Kremen says.

Most of the food consumed in developing nations is produced by small farmers, many of them still using subsistence methods. Their farms are where the productivity gains must come from, and the question, Kremen says, is whether countries will adopt policies that favor industrial intensification, or sustainable intensification based on agroecological principles.

One of the key reasons that the Green Revolution bypassed the world's poorest farmers is that they couldn't afford its technologies. In his report to the UN, De Schutter pointed to evidence that

PHOTO of Nathan Sayre: James Block

Preserving Rangeland Biodiversity

"Ranching isn't the first thing that leaps to people's mind as diversified farming," says ESPM professor **Lynn Huntsinger** (left), who specializes in rangeland conservation and management. Yet "privately owned rangeland is perhaps the most biodiverse undeveloped land in California," she says, because early settlers chose the most productive, best-watered land, and because grazing alters native ecosystems less than other uses, such as crop agriculture. This biodiversity supports a host of ecosystem services, including the pollination provided to farmers by wild bees (see Briefs, page 4).

Both Huntsinger and **Nathan Sayre** (left), an associate professor in the Geography Department who also studies rangeland management and ecology, collaborate with ranchers to devise land management practices that promote biodiversity and preserve their land from development.

Huntsinger has just begun a study of how California ranchers manage their wetlands. Many have man-made stock ponds that are important habitat for some of the more rare vernal pool species, including California tiger salamanders and red-legged frogs, because most of the state's natural wetlands have been drained. Sayre is currently collaborating with scientists and ranchers in Arizona and New Mexico, learning about historical range management practices and how they have interacted with climate to change the land's ecology, with the goal of integrating those insights into current ecological research.

Today, Huntsinger says, "many ranchers manage their land for a high-quality environment." Restoring grasslands and controlling erosion can improve forage production for livestock as well as promote biodiversity. New markets are developing for ecosystem services and niche products such as grass-fed and organic meats, augmenting income for ranchers who are able to diversify to take advantage of them. But the challenges are many, including low profit margins, difficulties in accessing new markets, limited funds for supporting ecosystem services, regulatory costs, and uncertainty.

The greatest threat to rangelands today, both Sayre and Huntsinger say, is land-use conversion. Hundreds of millions of rangeland acres across the western United States have been fragmented for residential developments, although the recent housing bust has slowed the trend. Still, private land is so much more valuable for development that "urbanization is a constant background threat," Sayre says.