Preserving biodiversity can be compatible with intensive agriculture

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Preserving genetically diverse local crops in areas where small-scale farms are rapidly modernizing is possible, according to a Penn State geographer, who is part of an international research project investigating the biodiversity of maize, or corn, in hotspots of Bolivia, Peru and Mexico.

Hotspots are areas where cultivation of peaches and other non-traditional crops has exploded over the past decade, noted Karl Zimmerer, professor and head of the Department of Geography, and where small-scale farms are often female-run and have been previously regarded as marginal to mainstream agriculture.

"Peach-growing in central Bolivia is a vitally important income-generating strategy, even while farmers also desire and succeed in producing their Andean maize, both for eating and seed, as well as some sale," said Zimmerer, whose findings were recently published in the Proceedings of the National Academy of Sciences.

The researcher analyzed small-scale farm, or smallholder, landscapes and their farming and livelihood practices, including labor migration and irrigation issues, from 2000 to 2010 over three areas within Bolivia's Valle Alto region. Farmers had low-to-moderate incomes by national standards.

Zimmerer and his colleagues surveyed land use among 174 smallholder households to assess production inputs and outputs of maize and peach

crops. Among the factors they examined were farm-level management, varietal choices and water and soil management. Zimmerer designed this data collection and analysis to use with high-resolution satellite imagery and Geographic Information Systems. These techniques enabled him to create geographic models, maps and estimates of the areas devoted to intensified peach- and maize-growing.

Zimmerer also interviewed diverse groups of land users and officials to determine similarities and differences of perspectives on biodiversity in changing farming and food systems.

In addition to determining the compatibility of traditional plants, or landrace, diversity and intensified agriculture, Zimmerer also addressed important links between migrant communities and smallholder farms.

"Many of these farmers rely on money sent back home from relatives abroad, primarily in the United States and Spain," he said. "This money is key to the farmers' ability to run successful smallholder farms and grow high agrobiodiversity maize."

The farmers' families tend to become better educated, and local non-profit groups currently supporting food security, health, and agrobiodiversity see the migrants as potential major allies for their projects and policies they advocate, according to Zimmerer.

"Migrants are adept at global and other long-distance opportunities on the one hand, and still well aware of the value of their local agrobiodiversity traditions on the other hand," he said. "The migrant communities also are developing international outlets for these products. For example parched or toasted maize and a kind of popular fermented beverage from Bolivian maize are both readily available in Washington, D.C., and in northern Virginia, where there is a community of 60,000 Bolivians."

In recent years, several prominent summits on ecological concerns have identified biodiversity in agricultural ecosystems as a major sustainability issue with implications for food security, conservation, health and well-being and adaptation to such global concerns as climate change.

"Sustainable development is crucial in Bolivia and other places in hotspots worldwide," Zimmerer said, "since it's these landscapes and peoples' livelihoods there that will ultimately determine the fate of humankind's global centers of biodiversity and agrobiodiversity in particular—unequalled and unique types of many major food plants, as well as minor and increasingly familiar ones. Sustainable development means protecting the future of these environments through the social-ecological systems in which they exist and change."

Maize agriculture, for example, is both a subsistence crop—ideal for helping to ensure food security, which is most important among the rural poor—and a cash crop.

"Women farmers, food-preparers and small-scale commercial processors are vitally important as those responsible for a majority of the management and knowledge of the diverse types of maize," Zimmerer noted, "and they have the highest levels of expertise in this knowledge and management."

Zimmerer's project included activities with Bolivian non-governmental organizations, and faculty and institute colleagues at Penn State and the University of Wisconsin, Madison. Grants from the Biocomplexity and Human-Social Dynamics programs at the National Science Foundation supported the research.

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