Ecological processes and farmer livelihoods in shaded coffee production

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Most tropical primary forests have been transformed into landscapes containing many different types of land uses. The challenge to maintain and conserve some of the original biodiversity of these forests has resulted in a need for farming systems to develop and manage biodiversity. Recent research, as well as the experiences of farmers in many parts of the world, shows that shaded coffee agroecosystems have exceptional potential for the conservation of tropical plant and animal species, in addition to producing high quality coffee. This article shows how this potential is linked to farmers' livelihood strategies in six co-operatives in El Salvador and Nicaragua. The article is based on work carried out by these co-operatives together with two local non-governmental partners, the *Central de Cooperativas Cafetaleras del Norte* (CECOCAFEN) in Nicaragua, and *Asesoría e Investigación Interdisciplinaria para el Desarrollo Local y la Conservación* (ASINDEC) in El Salvador.

In El Salvador we worked with three coffee co-operatives in the municipality of Tacuba, in the western part of the country. These farms are of high ecological importance as they surround the *El Imposible* National Park, the largest protected area in the country. The farms are situated at elevations ranging between 650 and 1400 meters above sea level, and the co-operatives grow two varieties of shade coffee ("Borbon" and "Pacas"), which both produce high quality beans, although their productivity is much lower than that of full sun coffee varieties. In Nicaragua we also worked with three co-operatives in the communities of Yasika Sur and Yúcul. These farms are located about 25 kilometres from the city of Matagalpa, in the northern part of the country. Coffee varieties found here include "Tipica", "Maragogipe", "Borbon" and "Caturra", with a few farmers having also planted newer hybrid varieties such as "Catuai" and "Catimor". Yields in Nicaragua range from 140 kg/ha among certified organic farmers to as much as 285 kg/ha among conventional producers.

Photo: Ernesto Mendez

Members of the "La Concordia" cooperative in El Salvador were keen to learn about the ecological processes taking place in their fields, recognising the potential these have for improving their livelihoods.

Ecological processes and livelihoods

In 2000 we started using a Participatory Action Research approach, trying to involve a wide diversity of stakeholders as active participants in the research activities and to integrate research into an action agenda that would contribute to local development and increase biodiversity conservation. The aim of this approach was to foster a mutual learning process which would help improve management of on-farm ecological processes and support farmer livelihood strategies.

Work ranged from developing rigorous inventories of the diversity of shade trees on-farm; to providing training on ecological management and support for marketing efforts. We supported farmers through the processes of organic certification, and trained individuals from the co-operatives on ecological methods for identifying, monitoring and managing shade trees. In addition, we have continually supported the efforts of these farmers to incorporate different forms of agroecotourism within their livelihood strategies. In both countries, organic certification and agroecotourism have the potential for increasing the incomes of the organisations and their members. This, however, requires making connections with different local and international networks. Success, though, has come slowly and with many obstacles. The obstacles have included the costs of organic certification, the difficulties in marketing and the cost of constructing the necessary infrastructure for agroecotourism.

Advantages and disadvantages

Although coffee is traditionally grown under shade, farmers in many countries have been encouraged to shift to coffee varieties which need full sun, as this reduces fungal infections and increases yields. Emphasis on faster maturation and higher yields, however, overlooks other aspects. In shade grown coffee, shade trees protect sensitive coffee bushes from harsh winds and excessive light; protect the soil against erosion, and regulate temperature and humidity. The shade trees have multiple uses (timber, fruit production, fuel wood, medicines) and most important, there is growing evidence that shade positively affects coffee quality.

Shade trees also have other effects. They improve nutrient cycling by absorbing nutrients through the roots at lower depths in the soil and depositing leaf litter on the surface. They reduce the growth of weeds and also increase local biodiversity by providing food or shelter for many other species, such as birds and insects.

Farmers' interest in better understanding the ecological processes occurring on their farms is closely linked to the direct impact that this learning and management can have on improving their livelihoods. Our work focused mainly on how to manage the shade trees and coffee plants, i.e. the competition between different plant species within a cropping system, and on developing ecological management practices for organic production.

Shaded coffee management

Shade coffee agroecosystems have a high potential for strengthening ecological processes. This is partly due to the similarity between the structure of shaded coffee farms, and the natural forest ecosystems that they have displaced. Ecological processes such as nutrient and water cycling, energy flows and

population regulation mechanisms function in a manner that is similar to those occurring in tropical forests. Our focus therefore was on the management of shade species in coffee plantations, particularly in terms of biodiversity and on-farm agroforestry management.

Tree biodiversity conservation
Agroecology places a high value on the conservation of biodiversity as a tool for managing competition and pests. In shaded coffee, it is especially important to assess the existing tree biodiversity since, in providing shelter to other species, trees multiply the biodiversity levels of a farm and its surrounding areas. In the Nicaraguan coffee co-operatives we found 106 tree species used for shade. In El Salvador we identified 123 species, from 46 families. The number of shade tree species found on the coffee farms was similar to the number of species found in sample plots in the *El Imposible* National Park. However, the species themselves were very different, and reflected the farmers' preferences for useful species, instead of rare, endangered forest species.

Shade tree management
The similar results from Nicaragua and El Salvador reflect similar management practices in both countries. Farmers manage the shade tree canopy so as to optimise coffee production while maximising the use of the different tree species. This means that all shade trees are pruned once or twice every year, aiming to leave a 40 to 50 percent shade cover. During this yearly activity tree heights are also controlled so that they remain at between five and ten metres. Sometimes farmers leave larger trees in place, to use for construction timber. Weeding is done manually with *machetes* at least twice a year and farmers always take care to leave naturally regenerated tree seedlings to grow. They are left to grow to provide additional shade in a specific area (regardless of the species), or until they can be identified. Farmers often uproot and transplant desirable, naturally regenerating, trees.

Individual small scale farmers also tend to plant a high diversity of trees to meet the family's needs of firewood, fruit, and timber. This is less common in collectively managed co-operatives, where the shade trees are used for firewood or timber. Co-operatives do not make as much use of fruit trees because there is no clear definition of the responsibilities for taking care of them, nor of ownership of the produce.

Shade management is directly linked to the yields obtained. Although "full sun" coffee varieties have the potential to produce more coffee beans per plant, they require high levels of synthetic fertilizers and pesticides to do so. The co-operatives cannot afford this type of management, nor the cost of replacing their shade-loving varieties with those resistant to full sun. Instead, farmers are improving production without changing the shade tree system. Examples of improved management include replanting coffee in areas where the plants are too old, improving fertility management, and following basic agronomic practices like the regular pruning of the coffee plants.

Supporting agroecological management

The use of Participatory Action Research has helped us reach a better understanding of the ecological processes in shade grown coffee in the co-operatives, and this understanding has made it possible to develop better management practices. The action agenda facilitated exchange of information between researchers and farmers. In this way, the understanding developed during research can be used to support co-operatives and their members' livelihoods.

Table 1: The most abundant shade species and their multiple uses

	Tree Species	Common name	Uses
El Salvador			
	Croton reflexifolius	Copalchí	firewood, windbreak
	Cordia alliodora	Laurel	timber, shade, fruit
	Mangifera indica	Mango	firewood, fruit, shade
	Eugenia jambos	Manzana rosa	firewood, fruit, windbreak
	Inga punctata	Pepeto	shade, firewood
	Inga oerstediana	Cuje purito	shade, firewood
	Ricinus communis	Higuerillo	shade
	Critonia morifolia	Vara negra	shade, firewood
	Inga pavoniana	Cuje cuadrado	shade, firewood
	Eugenia salamensis	Guayabillo	timber, shade
Nicaragua			
	Inga edulis	Guaba roja	shade, firewood
	Cordia alliodora	Laurel	timber, firewood
	Inga punctata	Guaba negra	shade, firewood
	Guazuma ulmifolia	Guasimo	timber, firewood
	Lippia myriocephala	Mampas	firewood
	Juglans olancha	Nogal	timber
	Citrus sinensis	Naranja dulce	fruit
	Persea americana	Aguacate	fruit
	Mangifera indica	Mango	fruit, firewood
	Vernonia patens	Tatascame	firewood

We believe that agroecological management offers great possibilities to achieve both production and conservation goals in co-operative coffee plantations, but there are several key issues that require immediate attention. To improve production, co-operatives need access to financial and technical assistance. Secondly, they need help in finding better markets for coffee that support the conservation of biodiversity. Finally, a comprehensive approach is needed to assist the co-operatives in diversifying their livelihoods through improved food production and agroecotourism. This development will require solid partnerships with a diversity of actors. In our role as the Participatory Action Research partners, we are strongly supporting the co-operatives in finding and developing the partners and networks that will work best for them. ■

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