6 Home garden experiences in Costa Rica

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Some of the factors that characterize the northern region of Costa Rica are (1) an increase in deforestation; (2) the lack of arable land; (3) damage to systems caused by the wind; (4) the absence of sustainable production alternatives; (5) dependence on imported supplies which make production more expensive and end up polluting the environment, the soils and the water; (6) lack of protein in the diet of inhabitants; (7) low consumption of fruits and vegetables; (8) deterioration of soils, native flora and fauna; and (9) the migration of farmers to the big cities to look for jobs. All of these factors directly affect the small farmer by limiting the potential value gained from working their land and limiting their ability to compete in the national market.

Thus by opening the market to new timber species and to the production of farming products like coffee and vegetables using a minimum of pesticides, the goal is to strengthen and diversify the agricultural holdings so that they are competitive and sustainable within the national economy. Also, by developing production systems in organic farming that aim to produce a sufficient quantity of healthy food while minimizing the negative impact on the environment, the objective is to stimulate self-sufficiency of the farm and the country through a better use of agricultural resources and agro-industrial and livestock waste. Further, another goal was to have all the rural families involved in farming activities and to promote production diversity.

Traditional systems of soil use in Costa Rica, except shade farming of coffee and cacao, do not consider mixing forest species in with agricultural crops. In general, our farmers establish their agricultural holdings based on monoculture, mixed home gardens and annual crops put in between fruit trees, without considering the introduction of a forest specie which, if suitable, could become a medium- or long-term additional income.

The agroforestry and agro-silvopastoral systems can help reduce soil use problems because factors that favor the production system, such as the increase of soil nutrient recycling, the improvement of the soil quality, better protection from erosion, the increase of the soil's capacity to store water and the reduction of problems with insects that damage the crops, all enhance the diversity of the system and number of parasitoids and predators.

In the past, forestry research of native species was limited because it was directly carried out in forests. However, research in the last decade has proved it is feasible to include native species in plantations if the appropriate techniques to prepare the soil for pest control and for silvicultural treatment are followed.

In spite of the low international coffee prices, coffee production in Costa Rica is still an important commercial activity. Its contribution to the gross national internal product during the last few years has been around 15% and it represents approximately 4% of the total exports. About 91% of the coffee production is concentrated in small or medium size farms (Instituto del Café de Costa Rica (ICAFE), 2009, 2011); this provides employment and food for more than 50,000 farming families, 145 beneficiaries, 55 roaster companies and 60 exporting companies (Instituto Nacional de Estadística y Censos, 2009) and during the harvest for more than 300,000 people. The coffee production in Costa Rica focuses on the quality of the bean and not the volume, so different varieties of beans are grown but they are not as productive by volume as the ones produced in Brazil (Robusta) (ICAFE, 2011).

The Montes de Oro region, in the Province of Puntarenas, Costa Rica, is a marginal agricultural area with coffee production as its main activity, although during the last few years there has been a substantial migration of farmers to cities in search of better job opportunities. The region faces a number of social and economic problems, worsened by the reduction of forest areas, the increase in soil erosion, the absence of sustainable land production alternatives and a heavy dependence to imported pesticides. Therefore, there have been efforts to protect the region's biodiversity and to mitigate the negative environmental effects through maintenance or implementation of organic coffee production systems and through integrating ecological, social and economic changes to offer more sustainable and profitable production alternatives (Blanco-Metzler and Diaz-Porras, 2003). Such efforts were focused on seven components: (1) associated crops and commercialization of vegetables, (2) establishment of shade trees using fruit and native forest trees, (3) establishment of windbreaks, (4) coffee fertilization, (5) studies on bird diversity, (6) improved coffee processing systems and (7) introduction of animal protein to the diet of the farming families.

Production and marketing of vegetables

A survey was carried out to identify the crops more frequently intercropped with coffee. According to the survey, the main crops associated with coffee plantations were tomato, sweet pepper, dry and green beans and corn. These crops are grown when the coffee trees are pruned because it allows the growth of vegetables for one to two years. Farmers are said to prefer these crops as they are well known, have a safe market and are easy and fast to produce. However, crop choices also have to do with tradition and the lack of knowledge about other promising crops and improved varieties. Farmers were trained on new technologies used in organic vegetable production (greenhouses, seedling production, pest control and improved varieties).

Seedling production

The objective of this program was to familiarize the farmers with modern techniques in the germination and handling of seedlings. Farmers participated in all the research phases: substratum elaboration, filling of trays, sowing, monitoring germination and measurement of the growth of seedlings, both by aerial measurement and by measurement of roots. Some of the practices are:

- Greenhouse with antivirus net that will protect it from the insects that transmit viruses and diseases. Farmers also learned the advantages of having a double door; sanitizing their shoes, appropriate weeding with cleaning practices where weeds are not supposed to be thrown back on the floor but into a box
- Use of trays (plastic and Styrofoam) in the production of seedlings
- Use of appropriate substratum. Seven substrata were used (Photo 6.1, Table 6.1)

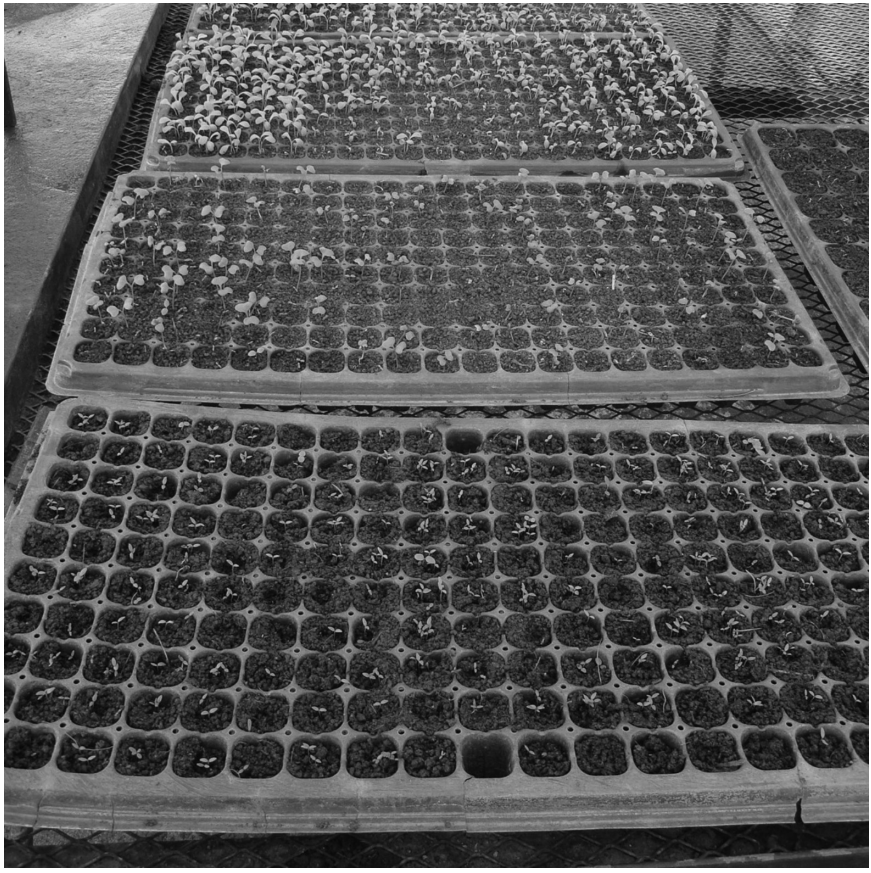

Photo 6.1 Seedlings grown in different substrata evaluated, Montes de Oro, 2003

Table 6.1 Evaluation of two substrata and the types of measurements done by farmers

	Germination (%)	*Number of leaves*	*Number of true leaves*	*Height (cm)*
Scallion				
Peat moss + soil	90.8	1		2.5
Bocashi + soil	91.8	1		2.5
Lombricompost				
Fermented soil	3	1		0.5
Compost + soil	80.6	1		1.5
Lombricompost + soil + parchment	37.8	1		2.5
Coffee dregs + soil + rice husks + lime	93.8	1		2.5
Iceberg lettuce				
Peat moss + soil	99	2	1	2.5
Bocashi + soil	97	2	2	3.5
Lombricompost				
Fermented soil	7.1	1	0	0.3
Compost + soil	8.1	3	0	0.5
Lombricompost + soil + parchment	92.8	2	2	1.8
Coffee dregs + soil + rice husks + lime	91.8	2	2	2.9

Source: Prepared by authors.

- Sowing of different vegetable seeds
- Introduction of vegetable seeds with high genetic value
- Storage of seeds
- Incidence of various types of risks and frequency.

Introduction of new horticultural crop varieties

When the greenhouse stage finished, the different varieties of vegetables were sown. In order for people to see the development of the crops, a farm located in a high traffic area was selected. To give an example, the farmers were used to seeing one single variety of lettuce, but in this project six varieties of lettuce were evaluated. Hence, it was possible to learn about other types of lettuces such as iceberg, Boston and red lettuce and to evaluate their adaptability under the weather conditions of the area. At the same time, palatability tests were carried out to verify its commercial potential.

Fertilization and pest management in vegetables

The elaboration of *bioles* (a type of organic fertilizer) and insect repellents made out of molasses as an extractor of secondary metabolites and medicinal plants was taught through participative training (Photos 6.2a, 6.2b and 6.2c).

(a)

Photo 6.2a Farmers chopping fruit and medicinal plants to make bioles

(b)

Photo 6.2b Addition of molasses to chopped fruits and medicinal plants

(c)

Photo 6.2c Oxygen extraction during the elaboration of bioles and insect repellents

Products commercialization

One of the elements that affects the economy of farmers is the lack of organization among them when they try to sell their products in the market. Each time they harvest their crops, the ones that have the resources move their products to the wholesale marketplace that is located in the capital of the country. Thus there are high transportation costs to the farmer. The farmers that cannot afford transportation costs are forced to sell their harvest to brokers that pay lower prices for their products. Therefore, an inter-institutional effort was made with the purpose of organizing a vegetable gathering center for the region through different visits to the communities and also through farmers' surveys. The main market problems identified in the survey were high transportation costs (43%), brokers (15%), lack of markets (13%), low and unstable prices (8%), bad roads (6%), poor farmers' organization (5%) and other factors (10%). In this case, farmers were asked to suggest ideas to improve the crop market. They are aware that a change in their attitudes is necessary and the fact that they should organize themselves to access safer markets, obtain better prices and reduce production costs. However, they pointed out that there is a

need for more efforts from the local authorities to help them and also for more support to their activity as farmers.

Establishment of shade plants

The use of shade trees benefits coffee plantations in various ways: they enhance fauna diversity and help improve the ecological conditions of the production unit, and they also produce goods of immediate use (Benzing, 2001). Shade plants were produced in the Cedral Farmers' Association nursery. The production of nursery trees was low quality. For that reason, field training was included. In this training, substratum mixture tests were carried out for the filling of bags in which a third part of the mixture was made of organic substances such as compost, bocashi and lombricompost. Also, they were taught about the right way to fill bags and the best collocation of those bags on the threshing floors.

A total of 8,400 shade trees were distributed among farmers of Montes de Oro for 77.6 ha of coffee with shade. The tree species that were planted were: *Leucaena, Gliricidia sepium, Albizia adinocephala, Erythrina poeppigiana, Cassia* and *Alnus jorullensis*; of this number, 1,934 were fruit trees (avocado, various citrus species, macadamia and soursop). The aim of the inclusion of fruit trees in the coffee plantations and other production systems was to provide the farmers with a second income source by means of the commercialization of fruits. In that way, they could see it as a compensation for the days they had economic problems because of the lower prices of coffee.

Establishment of windbreaks

Windbreaks are formed by planting one or more lines of trees or foliage, of the same or of different plant species and of varying heights. They are planted parallel and perpendicular to predominant wind. The use of windbreaks reduces eolian erosion; protects crops, animals and water springs; and keeps pastures from drying out during summer (Photo 6.3). A total of 46,000 trees were planted for 37,000 m of windbreaks, with 367 ha of land protected five years later, when maximum growth of the trees was expected. Different arrangements of the following tree species were used: *Cassuarina equisetifolia, Eucalyptus* spp., *Eugenia jambos, Coutorea latiflora, Cupressus lusitanical* and tubu.

Coffee fertilization

With the aim of reducing the high costs of fertilization without affecting grain quality and production, four fertilization alternatives were evaluated, together with a generalized application of Bocashi (5 ton/ha); two annual applications of a physical mixture of nitrogen (N), potassium (K) and boron (B) at a cost of USD 60/ha per year; two annual applications of a physical mixture of N, K, magnesium (Mg) and B at a cost of USD 66/ha per year; two annual

Photo 6.3 Windbreak of *Eucalyptus deglupta* and *Casuarina* spp.

applications of a physical mixture of N, K, at a cost of USD 47/ha per year; two annual applications of a physical mixture of the formula 18-5-15-6-2 (600 kg/ha per year) at a cost of USD 100/ha per year. All of the fertilizer alternatives resulted in higher productions than the conventional fertilizer scheme accounting for an increase of 8%–10% yield for alternatives 1 and 3 and an increase of 18% yield for alternative 2. In conclusion, it is possible to reduce production costs without negatively affecting yield.

Bird diversity

A study was carried out to evaluate bird diversity and abundance in two areas of Montes de Oro. The first area (1,300 masl (meters above sea level)) was located in the very humid premontane life zone, dominated by coffee plantations, cattle farms, secondary forest and border of harvested forests. The second area (1,000–1,450 masl) corresponded to the montane life zone. A total of 151 bird species was found in the study area (Stiles, 1991). Ten species were exclusive to the border area between the premontane and montane forest, i.e., they were not present in coffee farms. From the 141 species found in the zone where coffee is grown (premontane forest), 28 species were never registered in coffee plantations, while the rest (80%) were observed in coffee and surrounding farms. The 28 species not registered in coffee plantations were insectivorous and frugivorous birds, dependent on the forest for feeding, or that occasionally come out the forest but needed native fruits for their nourishment (Stiles and Skutch, 1989; Fogden, 2000).

The number of birds found in coffee farms was similar to that of the surrounding zone. However, bird diversity was higher in the surrounding areas than in the coffee farms. Hence, we decided to plant native fruit trees within the coffee plantations to attract bird populations. The recommended tree species were *Citharexylum caudatum* (Verbenaceae), *Ficus pertusa* (Moraceae), *Trichilia havanensis* (Meliaceae), *Ocotea* and *Nectandra* spp. (Lauraceae), *Conostegia xalapensis* (Melastomataceae), *Dendropanax arbore* (Araliaceae) and *Sorocea trophoides* (Moraceae). It was also suggested that increasing the number of shade trees within the coffee plantations would increase the insect population for insectivorous birds. After being presented with the information about bird diversity and then planting trees to increase feeding sources within the coffee crops, the farmers were able to diversify their products and also improved sales of ground coffee by 15%.

Coffee processing

Multiple efforts had been made to improve the production of coffee in the field. However, it was necessary to address weaknesses in the processing of the final grain and in the differentiation between organic coffee and conventional coffee. A Compact Ecological Processing Unit (UCBE) was purchased to process the organic coffee (Photo 6.4). This unit reduces the water required

Photo 6.4 Compact ecological processing unit (UCBE) purchased to process organic coffee

for processing from 800 L to only 11 L (for 258 kg of coffee), also reducing contamination and the cost of treatment of residual water. In addition, there is a significant saving in energy, since there is no need to use the main plant to process the small amounts of coffee produced at the beginning and at the end of the harvesting season.

The use of the new unit also reduced the time from depulping to storage from ten days in conventional processing to three days, which increases the grain yield and quality. All these improvements resulted in the Coopemontes de Oro processing plant being granted ISO 14000 certification, which implies an improvement regarding environmental quality.

Farmers were receptive to the improvements suggested. From a total of 250 farmers from Montes de Oro, Puntarenas, 10% went into organic farming and are certified by ECOLOGICA. Their production was sold at USD 200/100 kg

of roasted coffee in 2006; 80% sell their coffee as fair trade with a price of USD 131/100 kg; the rest of the producers are conventional, and their production is paid at USD 80/100 kg.

Introduction of protein sources of animal origin

Pasture hens were introduced in order to increase the consumption of animal protein through the availability of meat and eggs (Photo 6.5). At the same time gandul (*Cajanus cajan*) was sown in the areas surrounding the henhouses as a way to reduce the dependency and the cost of commercial chicken feed. Both animals and humans could eat this grain. Annatto (*Bixa orellana*), plantain (*Musa* spp.) corn, sweet potato and beans were also sown and the surplus egg production was sold in the community.

Photo 6.5 Pasture hens and plants sown for feed, Caño Negro, Alajuela, Costa Rica, 2011

(a)

(b)

Photos 6.6a and 6.6b Care network organization for women involved in vegetable and tree production, Caño Negro, Alajuela, Costa Rica, 2011

Care network

A care network for women and children was organized with the aim of giving women equal opportunities to participate in training and in the fieldwork production of trees and vegetables. A physical space was set up with a roof, chairs, table and some hammocks. This care network was led by women in advanced stages of pregnancy, by women who were breastfeeding, or by women who did not have the physical ability for the field work. These women were in charge of feeding and taking care of children. Moreover, children were equipped with sheets of paper and colored pencils to facilitate their entertainment while their mothers were at work (Photos 6.6a and 6.6b).

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