

Sustainable Use of Forest Resources

By Angelika Stoll

Cloudbridge Nature Reserve
Costa Rica

1. Introduction

The study took place in the community of San Gerardo de Rivas, Perez Zeledon, Costa Rica. The area is located on the west side of the Talamanca Mountains between 1.000 and 2.500 m above sea level. It includes 303 hectares. Today 15% (45 ha) of the area are used for agriculture, from which 25 ha are covered by coffee plantations, 48% for pasture, 15% fragments of primary forest and 22% include secondary forest, plantations and fallow land.

Since the beginning of the settlement in the 1950s the farmers applied clear cutting by forest fires to win their land for cultivating coffee or establishing extensive cattle pasture. Due to the growing economic pressure they have started clear cutting on steep slopes and near water spring areas. This led to environmental problems like landslides, erosion and water pollution. That is why the Costa Rican government introduced a new forest law that prohibits the clear cutting by forest fires and the not sustainable use of wood to conserve the left primary forest und the water springs.

In the following study that was extended over 5 month, the production systems in the smallholder farms were described and analyzed under ecological, economic and social aspects. The study was focused on the forest management, the importance of forest products and the utilization of certain tree species in agro forestry systems because they play a decisive role in the conservation politics (conservation of water springs, soil and biodiversity) of the Costa Rican government.

In the following phases will be developed purposes and utilization approaches for the forest.

2. Methodology

For the collection of the data were various methods used. The first step was a survey to record the general characteristics of the region San Gerardo de Rivas like the size and

structure of the families, size of the fincas (farms), land use, production systems and sources as structure of the income, used tree species. The passive as well as the active observation and interviews were applied.

For the second step four smallholder farmers were selected for a case study. These serve for the confirmation and illustration of the data gained by the survey. The criteria were representation, size of the finca and the structure/ sources of income, so that every production system in the study area could be explained more detailed. At the end the data were presented, explained and discussed with the farmers. Additional data sources were interviews of experts from the MINAE (Ministerio Nacional de Ambiente e Energia) as well as the study of literature. Further the IUCN (International Union for Conservation of Nature) of Costa Rica and gtz Nicaragua (German organization for technical development) placed some literature at disposal.

While the stay in the study area some characteristically data of on secondary forest and two tree plantations were taken. One plantation only includes 15 years old Cypress (*Cupressus lusitanica*) and the plantation of Cloudbridge includes exotic as endemic species. The data will help to describe the state of the different forest types and the possibilities of the maintenance and use. There was no actual data collected for the primary forest because they are almost out of use. The information has their origin in the found literature.

3. Characteristics of the analyzed smallholder farms (fincas)

The fincas have an average size of 9.20 ha. In the fig.1 the percentage of the parts per land use can be seen. Pastures occupy the biggest part of the finca, followed by forested areas (3.42 ha/ finca). The word pasture includes pastures with and without shade trees, which makes a sum of 4.64 ha/finca.

The agriculture is composed by coffee plantations (0.83 ha/finca) and annual cultures as tomatoes, potatoes or house gardens (0.37 ha/finca). Other important products as platano and banana can be harvested because they build shade above the coffee plantation. The production area is considered the same size as for the coffee.

In six fincas (15%0 are workers employed. The average salary reaches 6000-700¢ per hour, which corresponds to 3.600-4.200¢ per day.

A peculiarity of the study area is the high percentage of farmers who are members in a cooperative. Today there are two of them established: CoopeAgri (Cooperacion de Agricultores), which is dedicated to the coffee farmers, and Apilac (Asociacion de produccion e industrializacion de lacteos) for the cattle farmers. In average the farmers are active in the cooperatives since 23 years.

A third cooperative (Volcafe) was founded a few years ago but until now it could not reach a representative number of members.

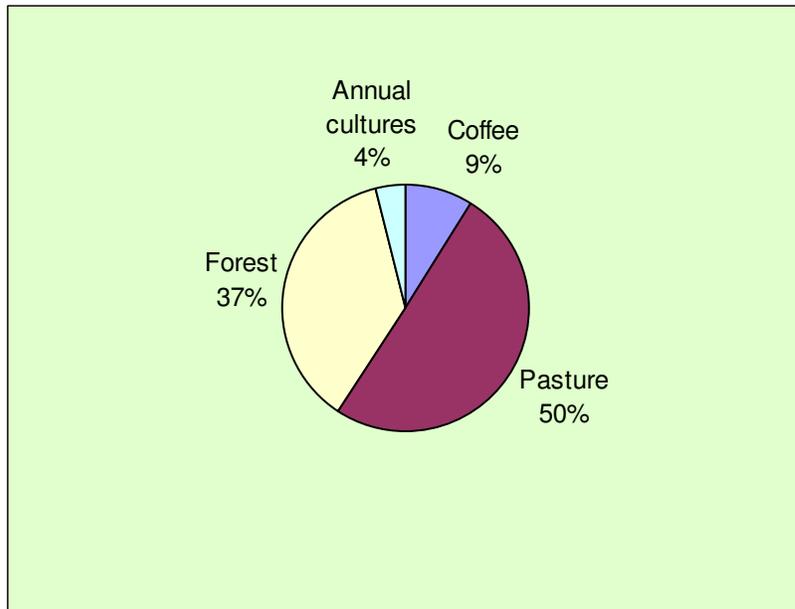


Figure 1: Percentage of each land use on the total area in a typical finca of the study area San Gerardo de Rivas, Costa Rica.

4. Production systems

The analyzed production systems can be classified into:

- a) Agro forestry systems
- b) Forestry systems
- c) Agricultural systems

The most frequent production systems are agro forestry systems with coffee as well as pastures under shade trees. They cover 127 ha. The utilization of living posts is very distributed as well.

These are followed by forestry systems like secondary forest and plantation management, which form an area of 113 ha. This is mainly due to the actual forest

politics. It is dedicated to conservation of closed forest areas in the surrounding of the National Park Chirripo. This is necessary because of the clear cutting by forest fires and the extensive cattle farming lots of slopes are exposed to erosion and landslides.

Smaller parts of the farms are used for agricultural production systems like pasture without trees or annual cultures.

a) Agro forestry

The most precious product of the region is the coffee. Approximately 62% of the interview households have planted this shrub to gain their main income. These 20 farmers harvest 32.6 fanegas/ha (= 11.460 kg/ha) in average. The CoopeAgri paid 28.000¢/fanaga, which corresponds to 912.800¢/ha. The costs for the maintenance of coffee are normally occupying the half of the income.

The development of the coffee prices can be seen in the fig. 2

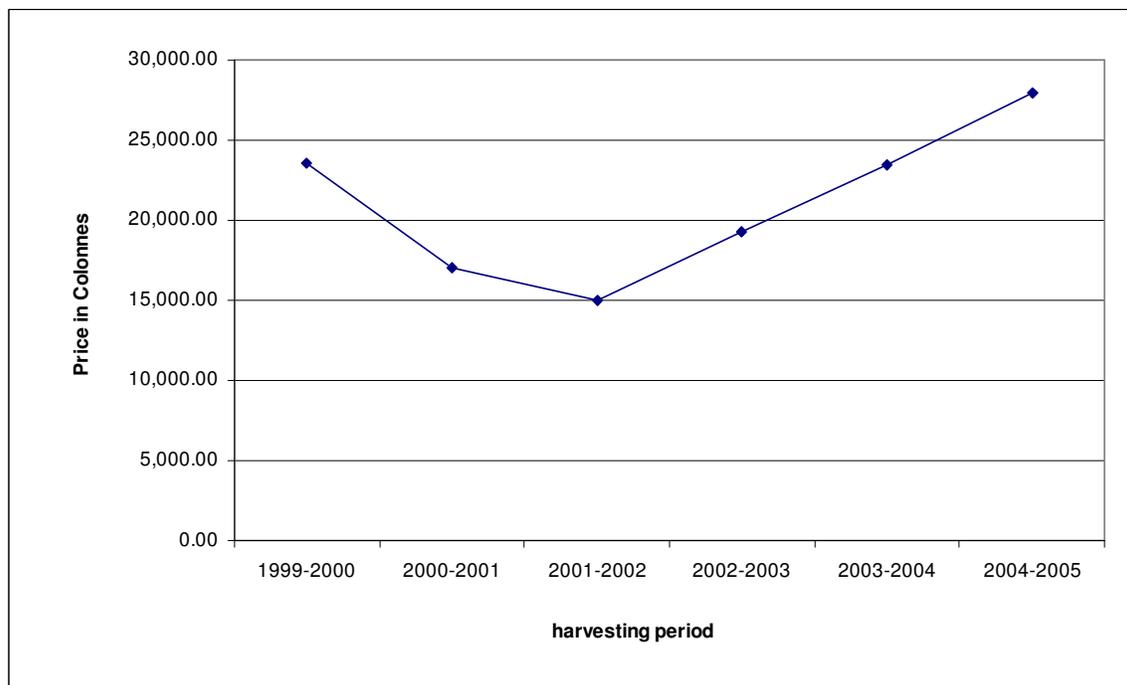


Figure 2: Developmetn of the coffee price. Reference: Informe anual de la CoopeAgri

There are cultivated two different types of *Arabico* coffee but In the study area dominate the highland coffee *Caturra* and *Catuai*. The saplings are planted in distance 1m x 2m (Tree x Row distance). With seven years they start flowering. For a good harvest the coffee shrub needs half shade. There for the tree species Poro (*Erythrina poeppigiana*), Banana and Platano (Musaceae) are mostly used. The first harvest starts in the middle of

November. In this high elevation the quality is still low, because it contains 30-40% of green coffee beans. The second and third harvests in the months of December to January show really high quality. The red beans have slowly matured. They are in first place for the export. The last harvest in March has again a lower quality, so that the price starts to reduce.

Besides the beans coffee offers a good fuel wood. Out of the 20 coffee producers 11 of them are using the wood from the shrub.

Two of the coffee farmers utilize the branches as organic fertilizer. Others occupy the fruit flesh to make organic fertilizer as well.

42% of the interviewed farmers keep cattle on pastures with shade trees. So 143.5 ha of the study area are in use for an extensive cattle farming. An overview over the collected data can be seen in tab. 1. In comparison to the cattle farms from San Gerardo there are data about Canaan, a town 3km south. It shows clearly that the productivity per area decreases. The main reasons are the difficult grazing conditions for the cattle (extremely steep slopes) and the cooler climate where the vegetation need more time to regenerate.

Table 1: Comparison between the productivity of milk producing cattle farms in San Gerardo und Canaan. Reference: Interviews; Madrigal - Congreso nacional de agricultura conservacionista, 2002

	San Gerardo de Rivas	Canaan
Pasture pro Finca (ha)	14.4	4.5
Average Number of milk cows/Finca	17.4	6.4
Pasture (ha) / cow	0.8	0.7
Production l/ day* cow	3.1	7.7
Production l/day*ha	4.3	11.2
Production pro Finca (l)	49.7	51.9

To offer enough food and protection to the cattle during the rainiest period (Sept-Oct.) as well as in the driest months (Jan-March), the farmers have left old trees with big crowns (see the tree species in cap. 5).

b) Forestry

In the study area originally *Quercus*-species were dominating the primary forest. Fagaceae and Lauraceae mainly compose the highest tree story. In the second tree story grow various palm species and tree ferns (KAPPELLE, M. 1996). In the tab. 2 is

shown an overview over the coverage of forest types as well as the distribution of primary, secondary and planted forest.

Table 2: Distribution of different forest types in the study area

	Total	Forest	Primary Forest	Secondary forest	Plantation
	ha	ha	ha	ha	ha
	17.00	1.50	1.50		
	2.00	0.50			0.50
	21.00	10.00	8.00	2.00	
	20.00	15.00	15.00		
	7.00	1.00			1.00
	10.00	8.00		8.00	
	4.00	3.00	3.00		
	1.00	0.75			0.75
	2.00	1.75		1.75	
	3.00	1.00	1.00		
	70.00	35.00	10.00	25.00	
	2.00	0.50		0.50	
	8.00	4.00	1.50	2.00	0.50
	2.50	2.00			2.00
	2.50	1.00			1.00
	10.00	8.00		5.00	3.00
	20.00	5.00			5.00
	70.00	15.00	7.00	8.00	
Total	272.00	113.00	47.00	52.25	13.75
Owners	18	18	8	8	8
%	100	60	27	27	27
Average ha/Finca			5.88	6.53	1.72

The management of the primary forest confine to the extraction of dead trees. The main reason is found in the actual forest politics (see Cap. 1). High fines can be expected for illegal tree cuttings. Because the farmers live in the surroundings of the National Park, a frequent presence of park rangers or other employees from the MINAE is given, so that there is a certain control.

The extracted wood is only used for fuel wood. But because of the high work intensity most farmers have other ways of getting fuel wood. Just one out of 33 households collects the wood in primary forest. He takes 5m³ per year (0.6m³/ year*ha). The tree species does not matter, he says.

The secondary forest grows especially on former pastures. Because of the decrease of the prices for milk, a lot of farmers abandon their land to gain income by other ways such as

tourism. The fallow land was planted with coffee, tree plantations or left to succession. As in the case of the primary forest the only utilization is collecting fuel wood. Just two households described this as their method. As said before the work intensity and difficulties for transportation are the main reason to not to collect. Other uses were not named.

c) Agriculture

The cultivation of tomatoes plays a very important role in the study area. Seven farmers (21%) are gaining their main income from selling tomato. They own about 2000 to 3000 plants, which produce 660kg tomato per week. The fruits are sold on the regional market in San Isidro, few are offered in San Gerardo de Rivas. The middleman buys the tomatoes in *cajas*. One *caja* corresponds to 18kg. Each one has an average price of 4.200¢.

In the study one smallholder farm was analyzed that gains its main income by cultivating and selling tomato (tab. 3). During the season 2004 were harvested 730 *cajas* that are 13.104 kg tomatoes.

Table 3: Summary of the case study

	expends per year in ¢	income per year in ¢
costs for buying plants	84.000	
fertilizer	96.000	
plastic to cover field	74.000	
chemicals	180.000	
transportation	2.340.000	
income by sale		3.057.600
Total	2.774.000	3.057.600
		+ 283.000

In 18 of the 33 interviewed households (=55%) are cultivated different agricultural plants in so called *hortalizas*. The most frequent products are coriander, red beans, peppers, potatoes and spicy herbs. These normally serve for a commercial use. About the produced quantity of spicy herbs and peppers the farmers could not give any information because estimation was difficult for them. But all of them said, that just a little part of the products stays in household, most of it is sold on the regional market in San Isidro.

5. Combined Tree species

The favorite tree species for the farmers in this high elevation is the Poro (*Erythrina poeppigiana*). It belongs to the family of Fabaceae and like most of them it joins a symbiosis with certain kind bacteria. These are able to fix the Nitrogen in the air so that the soil gets richer in Nitrogen. As well its leafs and flowers can be easily destroyed and serve the coffee as nutrition. The Poro forms a light crown that spends the desired half shade to the coffee. In December at the beginning of the dry season the Poro loses its leafs so the coffee beans get enough sun light to mature.

In the cattle farming the flowers, leafs and fruits of Poro are very popular. They are additional fodder for the cattle. Thanks to the deep root system this tree has even in the dry season green leafs. These contain the double quantity of protein as the common pasture. 500 Poro/ha can cover 20% of the daily fodder need of milk cows (Madrigal, V.J 2002). Because of the ability to fix Nitrogen and the easy composting of its leafs, the Poro improves the soil quality of the pastures. Another kind of Poro is the Poro Cimarron (*Erythrina costaricensis*), which is often used for living posts along the pastures.

The perennial plants banana and platano, belonging to the family of Musaceae, are commonly used as shade trees over coffee plantations. They refresh by growing saplings out of their roots so that within 5 years a new group is established. They do not need a lot of maintenance and through their fast living circle they can contribute to the soil improvement. The bananas and platanos are used for subsistence. No farmer from the study area sells the fruits.

Some of the interviewed farmers told that they have planted fruit trees between the coffee shrubs as well as on pastures. Especially popular are Avocado (*Persea americana*), Jogote (*Spondias purpurea*), Zapote (*Pouteria spec.*), Nispero (*Prunus spec.*) and Guaba (*Inga spec.*).

6. Additional income

67% of the interviewed households (22 families) have additional incomes. In 64% of the cases the activity is directly connected to the tourism, e.g. as a carrier in the National Park Chirripo, owners of hotels or restaurants.

The study by Fürst, E (2004) about the influence of tourism to the formation of income in the community of San Gerardo shows that in total 243 Mio. ¢ has been gained from which 26% stayed in the community itself.

Tabelle 4: Different income sources from the tourism. Reference: FÜRST, E. (2002) Rumbo a las aguas eternas – Parque nacional Chirripó

Activity	Receiver	Estimated income	% of the total income
Hotel, Restaurants, Bungalow	8 family business	11.847.969	19
Employees in Hotels, etc	Employees, expends for their salaries	10.130.000	16
Shop, trout farm	6 family business	2.238.400	4
Shop, trout farm	Expends for their salaries	2.304.000	4
Career, horse transportation	16 Persons	11.672.000	19
Guides	8 Persons	1.787.520	3
Cooks for tourists in base camp	3 Persons	378.000	1
Activities in N.P. Chirripo	Community of San Gerardo	6.000.000	10
Rent equipment		9.000.000	14
Other		3.988.940	6
TOTAL		59.346.829	100

7. Summary of the results

- The population of San Gerardo does not consider the actual environmental problems like landslides or the drying of water springs as very urging. But problems with the contribution of water in the dry season were mentioned; mostly among the farmers who are cultivating annual cultures. A decrease of species was not recognized.
- The described production system can be divided into three classes: agro forestry, agricultural systems and forestry systems. For the generating of income the two first named are the most important.
- The most frequent agro forestry systems are the cultivation of coffee and cattle pasture under shade trees. Further living posts are very popular as fences. The two named production lines form the main source of income in the studied cases. Just a few farmers need an additional income.
- The combined tree species are: *Erythrina poeppigiana*, *Erythrina costaricensis*, Musaceae as well as *Persea americana*, *Spondias purpurea*, *Pouteria spec.*, *Prunus spec.*, *Inga spec.*.
- Agriculture describes the cultivation of tomato, potato or spicy herbs. The products are sold on the regional market in San Isidro. From the information gained by the

interviews, just a part of the farmers can cover all their expenses. Approximately 50% of them get additional income from the tourism.

- In the study area the forest is not managed regulated or sustainable. That means there are no management or using plans to maintain the forest as well as earn money out of it. The value for coming generation is not seen. The used wood from the primary and secondary forest has its origin from dead trees and the farmers utilize it for fuel wood. To cut a living tree the MINAE has to give permission what the farmers consider as too much work for one tree. The demanded wood is bought in San Isidro.
- Some farmers established tree plantation with exotic species on their fallow land, e.g. *Cupressus lusitanica*, *Pinus caribaea*, *Eucalyptus deglupta* and *saligna*. There are no maintenance activities applied like cutting branches along the stem or evaluating young trees and give qualitative good individuals room to grow. The harvested trees are only used for domestic demands.
- Since the last 10 years the tourism gets more and more important for generating of income. 67% of the interviewed households profit directly from the tourism. But less than 15% consider it as their main income. The activities include career for the National Park Chirripó, owner of hotels and restaurants, guides. There is one family that runs a trout farm. In the study area has been seen as well the employment as farm worker or constructors and the breeding of chickens and pigs.

8. Literature

- COOPEAGRI (2004) Informe anual de la CoopeAgri. San Isidro. Perez Zeledon. Costa Rica
- FÜRST, E. (2002) Rumbo a las aguas eternas – Parque nacional Chirripó. CINPE
- HOLDRIGE, C. R.; POVEDA, L. J.; JIMENEZ, Q. (1997) Árboles de Costa Rica Vol. I. Centro Científico Tropical, San Jose, Costa Rica
- MADRIGAL, V. (2002) Técnicas para la conservación y uso de recursos naturales aplicadas en una lechería de las laderas del Chirripó – estudio de caso. I. Congreso Nacional de Agricultura conservacionista. San José, Costa Rica
- ZAMORA V., N.; JIMENEZ M., Q.; POVEDA, A., L. J. (2000) Árboles de Costa Rica Vol. II. Editorial INBIO. Costa Rica