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When Eco-Agriculture Loses its 'eco' – Conversion of Shade Coffee Among Smallholders

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Abstract:
Shade coffee systems are important sources of trees in agricultural landscapes, where provision of environmental services is among the management objectives. This study assesses the loss of shade coffee and associated trees during a 9 year period in a biological corridor in Costa Rica. Mediating factors of land use change are investigated by applying an ordered probit model to household and land use data for 2000 and 2009 from former and present farmers. The results show a reduction of nearly 50 % in the coffee area and a corresponding loss of trees as farmers either intensify or extensify the land use. Family labor, age of household head, farm gate coffee prices, and use of shade tree products significantly reduce the probability of converting the coffee field. Contrary, lack of savings and the number of family members engaged in other agriculture and non-farm work increase the probability. A stronger tie to coffee farming is found to abate the influence of land use change drivers, whereas the younger generation downgrades the labor intensive coffee farming. This complicates conservation policies, which often rely on economic incentives.

Figure 2. Total coffee area in ha among the 441 studied farms.
Background: "Coffee with milk and sugar". A shade coffee plantation and the two main alternatives: pasture and sugar cane. Photo: A. Bosselmann

Introduction

As forested areas in the tropical world continues to be converted into agriculture, the pressure increases on agricultural areas to provide a larger part of the ecosystem services deemed important for human well-being. This calls for a land-use management that aims both for agricultural production and the conservation of environmental services; a dual objective which may be met through 'ecoagriculture' management.

Shade coffee systems are generally perceived as being ecologically important, e.g. as habitat for flora and fauna. Therefore, coffee farmers are important actors in ecoagriculture landscapes such as biological corridors. Conversion of shade coffee into land uses with less tree cover may result in loss of environmental services. As other landowners, coffee farmers face multiple factors that influence land use decision making: from changing markets to changing cultures. Understanding how and why farmers react to these underlying driving forces is important for the management of ecoagriculture landscapes.

The objective of this study is to assess the rate at which shade coffee is converted to other land uses, and investigate household and farm characteristics, i.e. mediating factors, as determinants for land use change among coffee farmers.

Study Area

The study was carried out in the Volcanica Central Talamanca Biological Corridor (VCTBC) in Costa Rica (Fig. 1). The function of this corridor is to allow the movement of organisms and genes between protected areas. However, having been an agricultural area for millennia large parts of the VCTBC today is a matrix of agricultural activities. Nonetheless, large felines have been observed using shade coffee areas for passage.

The corridor is situated in the Cartago and Limón provinces, it covers an area of 115.000 ha, and connects nine protected areas. Turrialba is the only town of substantial size with around 80,000 inhabitants. Among the three main agricultural activities – pasture, coffee and sugar cane – only coffee offer a tree cover when grown in agroforestry systems. According to the National Coffee Institute in Costa Rican (ICAFE) there were approximately 2000 coffee farms inside the corridor in 2001. 75 % of the farms were less than 5 ha and 90 % were shaded.

Data Collection and Analysis

In 2009 a household survey was carried out with 217 former and present coffee farmers, randomly selected from a census. The survey included questions related to the years 2000 and 2009 regarding household characteristics, activities, assets, and farm descriptors. Furthermore, the coffee area and use of shade trees was registered for the entire nine year period. The survey was supported by short telephone interviews with another 224 farmers, as well as focus group meetings and key informant interviews.

The 217 surveyed households were grouped according to ordered levels of change in the coffee area during the period 2000-2009;
Group 1: No reduction in coffee area
Group 2: Partial reduction in coffee area
Group 3: Total conversion of coffee area.

An ordered probit model was developed in order to identify the effects of a range of household and farm level factors on the land use decisions made by farmers. Group 1-3 constituted the dependent variable while the explanatory variables were comprised of household and farm characteristics based on 2000-data. This temporal priority of the independent variables resolved any endogeneity issues and ensured causal direction.
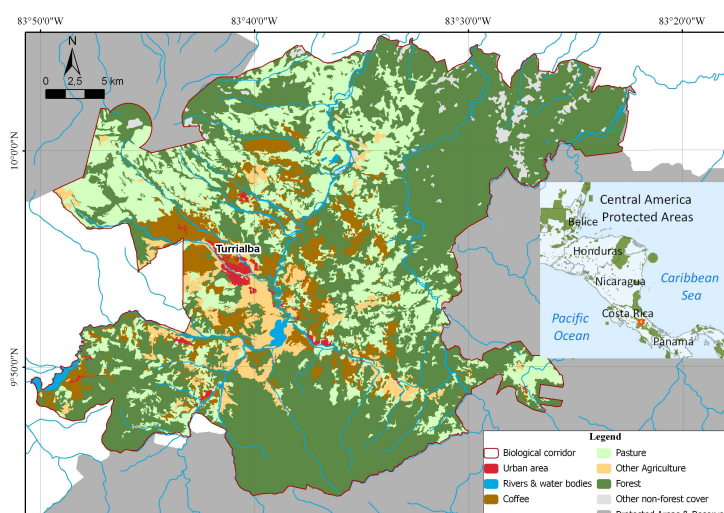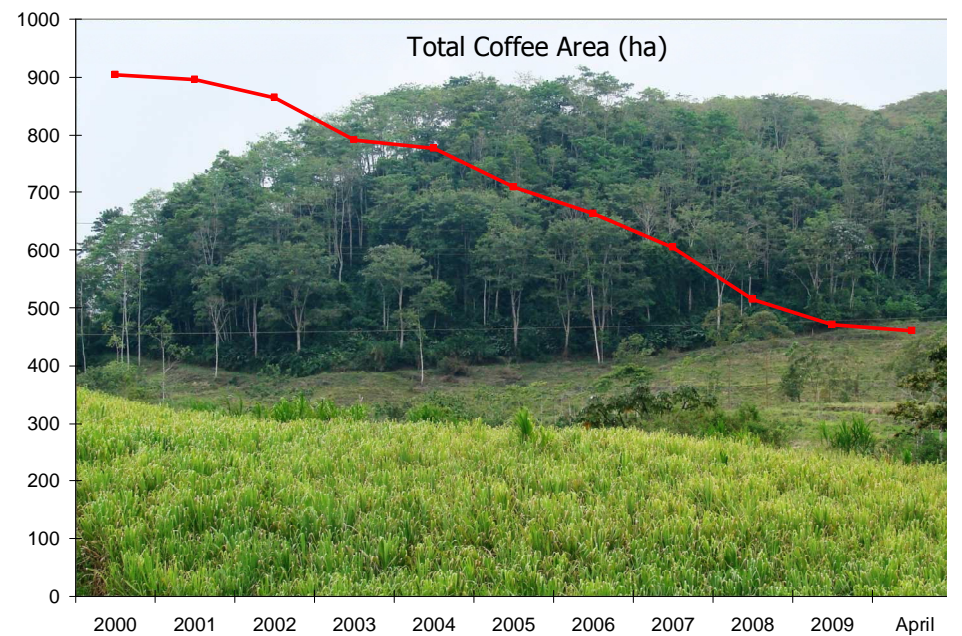
The Loss of 'eco'

From 2000 to 2009 the accumulated coffee area of the 441 interviewed and surveyed farmers decreased steadily from 904 ha to 461 ha; an average annual reduction of 7 % (Fig. 2). The dominant replacement for coffee is pasture, which covers more than 40 % (186 ha) of the total converted area (Table 1). As the coffee area decreases, so does the use of shade trees. The average number of trees/ha in 2000 was 148. By 2009 this was reduced to 91 in group 2 and 45 in group 3, corresponding to a total loss of around 40.000 shade trees among the 441 participating farms.

Table 1. Area of crops or activities replacing coffee, in ha and percentage. Includes coffee areas that were sold (103 ha) and subsequently converted by new owners.

New crop	Area, ha	Pct.
Pasture	185.8	40.6
Fruit trees	63.6	13.9
No crop	54.2	11.9
Sugar cane	46.2	10.1
Vegetables	31.8	6.9
Other	29.5	6.5
Unknown	31.5	6.9
Coffee, after sale	14.5	3.2
Total	457.1	100

Table 2. Average partial effects of selected variables, i.e. the change in probability of a household being in group 1-3 given a one unit change in the variable, *ceteris paribus*. 'd' indicates a dummy. Variables not shown include education, children, biophysical variables, livestock, assets, and loan.

Coffee area change / Variables	Group 1 (84 HH)	Group 2 (72 HH)	Group 3 (61 HH)
Age	-0.026	0.003	0.022
Age^2	0.031*	-0.004	-0.027*
Adults	0.071***	-0.009**	-0.062***
Organization, d	0.143*	-0.032	-0.112**
Coffee price	0.014***	-0.002**	-0.012***
Shadetree prod., d	0.126**	-0.008	-0.118**
# Farmers	-0.137***	0.017**	0.120***
# Non-farmers	-0.072***	0.009*	0.063**
Remittances, d	-0.032**	0.004	0.028**
Savings, d	0.099*	-0.016	-0.083
Crisis, d	-0.092*	0.012**	0.081*

Economic Aspects

In accordance with conventional land rent models, economic benefits from the coffee area, indicated by higher prices and use of shade tree products, increase the probability of maintaining the coffee area (Table 2). Contrary, households already engaged in non-farm income activities (*non-farmers* as proxy) or non-coffee agriculture (*farmers* as proxy) have a higher probability of replacing/reducing their coffee area, often in favor of the alternative income sources.

Economic crises in the household and savings had opposing effects, indicating the importance of a healthy household economy to manage and balance the skewed distributions of costs and income within a coffee season.

Cultural Changes

Two reasons for converting coffee to less intensive land uses were frequently mentioned; conversion to pasture frees family labor that can be put to use elsewhere and expand the portfolio; due to changed perception of family farming and alternatives presented by better education, the younger generation do not want to continue coffee farming, resulting in households deciding for less labor intensive farming. This combined with higher non-farm to farm income ratios, rising average age of farmers, and increasing role of remittances are components of a deagrarianization process. However, the study found that households with a closer tie to coffee farming, indicated by years of experience, membership of producer organizations, and the farm being inherited (as opposed to acquired in agrarian reform) were less influenced by this process.

Implications for Ecoagriculture

The 50% reduction in coffee area and associated loss of tree cover since 2000 is expected to have adverse effects on the corridor function, as well as other ecosystem services. Elsewhere in Costa Rica the national program of payments for environmental services (PES) has turned the situation around and increased tree cover on agricultural lands. Since 2009 the VCTBC has been a priority area for PES, and a new payment, targeted at coffee farmers and shade systems, is currently being developed. This may be part of the solution for the VCTBC. Land use studies at household level, as the one presented here, are important for such targeted payment schemes.

Relevant References

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Figure 1. Study area: The Volcanica Central Talamanca Biological Corridor (VCTBC) in Costa Rica. (Data source: C. Brenes. CATIE. Imagen ASTER 2008).