Ecological Economics 75 (2012) 102–113

Contents lists available at SciVerse ScienceDirect

Ecological Economics

journal homepage: www.elsevier.com/locate/ecolecon

Analysis

# Alternative use systems for the remaining Ethiopian cloud forest and the role of Arabica coffee — A cost-benefit analysis[☆]

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ARTICLE INFO

*Article history:*
Received 9 August 2010
Received in revised form 5 January 2012
Accepted 6 January 2012
Available online 4 February 2012

*Keywords:*
Cost-benefit analysis
Biodiversity
Coffee
Ethiopia

ABSTRACT

This paper presents a cost-benefit analysis of three different use systems for the remaining cloud forests in Ethiopia, which at present are being depleted at the rate of 8% per year. These use systems are a) traditional conversion to crop land, b) sustainable management of the forest (e.g. by growing high-quality, semi-forest coffee), and c) strict conservation. We find that under business as usual conversion to cropland yields the highest net present income value for the local population. Taking into account watershed services, sustainable forest use is in the best interests of the country for discount rates of 10% or lower. Taking into account the *global* benefits of biodiversity conservation and carbon storage, sustainable forest management also yields the highest total economic value while strict conservation does not pass a cost-benefit test even at a discount rate of 3%.



## 1. Introduction

Considerable parts of the highlands of south-west Ethiopia are still covered by cloud forests, which are, however, being depleted at the alarming rate of 8% per year (FAO, 2003a,b). This loss is of global importance as the east African mountains are among the most biologically diverse regions in the world. Cloud forests are generally considered to be concentrations of biodiversity with high levels of endemism. A special feature of the Ethiopian cloud forests is that they provide a habitat to the last wild populations of Arabica coffee originating from there and representing the genetic base for coffee plants growing on plantations all over the world.[1] Since the genetic composition of coffee plants on these plantations is very similar, this renders them vulnerable to new pests and diseases. By contrast, the wild coffee populations growing in Ethiopia's cloud forest display a high genetic diversity, making them a valuable resource for breeding purposes.

The literature on the environmental Kuznets curve initiated by Grossman and Krueger (1995) suggests that over time environmental degradation displays an inverted U-shaped pattern. The inference from this is that economic growth may eventually take care of one of the main drivers of biodiversity loss. A different view suggests that both conservation and the use of biodiversity are integral parts of, and necessary for, sustainable development. With support from the European Commission (EU), the Ethiopian government is therefore considering to stop further deforestation and conversion to arable land and to transform the cloud forests into protected parks. This initiative, however, conflicts with the interests of the local communities, half of their territory being covered by forest that they use notably to produce so-called semi-forest coffee. On the one hand, the collection of non-timber forest products and fuel wood generates additional income and provides a safety net for subsistence farmers living close to the forests. On the other, as arable land is scarce, farmers want to extend their agricultural fields into the forest.[2]

The objective of our study is accordingly to analyze whether the interests of the global community, the Ethiopian government, and local farmers can be reconciled. Three competing use systems stand out as possible scenarios for forest use: conversion to arable land, sustainable use of the forest with production of semi-forest coffee, and strict conservation of the forest as considered by the Ethiopian government. We calculate the income associated with each of the three alternative use systems to illustrate the private economic incentives for the local communities. Subsequently, we undertake an economic analysis of the three systems, taking national and global values into consideration.

☆ Financial support by the Center for Development Research (ZEF) at the University of Bonn, Germany, is gratefully acknowledged.
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[1] During the 13th century a few trees were taken to Yemen, and they spread out from there across the globe.

[2] There is a sizeable strand of literature inquiring into local win-win options and synergies between environmental conservation and poverty alleviation. For instance, Collins and Qualset (1998), Buck et al. (1998), and Lee and Barret (2001) discuss the potential of agro-forestry systems in combining environmental objectives with the aspirations of local communities. Pearce et al. (2003) highlight the role that sustainable forest management can play in maintaining forests and biodiversity.

0921-8009/$ – see front matter 
doi:10.1016/j.ecolecon.2012.01.006

Our main findings are that, taking as given high discount rates of about 31% and higher, it is rational for the local population to convert the forest into cropland, since this yields a higher net present income value than sustainable forest management, while at discount rates of 30% and lower sustainable forest management yields the highest income provided that semi-forest coffee is grown in the forest and sold as premium coffee, and provided that future coffee prices stay at a sufficiently high level. At discount rates of 10% (and lower), as recommended for the evaluation of projects by the Ethiopian Ministry of Economic Development and Cooperation, sustainable forest management is the best alternative from a national perspective, while strict protection yields a negative net national income value due to the cost of maintenance. Taking into account global environmental services of the forest, such as carbon storage and biodiversity, in particular as a gene pool for Arabica coffee, sustainable forest management still yields the highest total economic value and dominates strict conservation at all discount rates. Taking a combined look at the financial incentives of the local population and the total economic value of the forest, we finally discuss policy instruments, such as price premiums for semi-forest coffee and markets for environmental services that will achieve both the conservation of the cloud forests and the alleviation of poverty.

This paper is organized as follows: The next section describes the main characteristics of the three competing forest use systems. Section 3 presents the income analysis for the local population. In Section 4 we provide an analysis of total economic value from local, national, and global perspectives. In Section 5 we wrap up our results and present some policy conclusions.

## 2. The Competing Forest Use Systems

In this section we describe the three competing use systems: maize production, strict conservation of the forest as currently stipulated by the Ethiopian government, and the sustainable use of the forest with production of semi-forest coffee. Our study areas have been the two districts of Sheko and Yayu (see Table 1). We chose these two districts because (a) they are close to the cloud forests, (b) they are typical of other districts in terms of size, and (c) because environmental data from these forests were readily available due to close collaboration with Ethiopian research organizations and other research groups from the University of Bonn, Germany. In the preparation for this study, primary and secondary data were collected in Sheko, Yayu, and Addis Ababa in 2003. Additional secondary data from earlier years were converted into 2003 US dollars. The respective data sources are indicated in the text. A list of experts consulted in the course of the field research is given in the Appendix. In the study area several experts from the local departments of agriculture and the administration were interviewed and provided us with access to data. These sources are indicated by "DoA." Due to space limitations we restrict detailed data report and cost-benefit analysis to the case of Sheko. The results for Yayu turned out to be similar.

### *2.1. Maize Production*

Farmers in the study area practise low-input, rain-fed subsistence farming. On average they cultivate 1.5 ha of land in Sheko and 1 ha in Yayu (DoA). In Ethiopia 1 ha is the average amount of land per household and is regarded as the absolute minimum providing sufficient food for one household (Berhanu et al., 2002, p. 58). The current cultivation practices are considered ecologically unsustainable. In the face of a rising population and the scarcity of arable land, farming communities largely employ two coping strategies. They reduce fallow periods by cultivating continuously, and they cultivate unsuitable land with steep slopes of up to 50%. Only 10% of the farmers use fertilizer. This practice results in serious land degradation involving a high degree of soil erosion and nutrient mining. The concomitant annual productivity losses on croplands in the south-western highlands of Ethiopia are estimated to be 10% (Denboda, 2005).

**Table 1**
The study areas Yayu and Sheko in 2003, source: DoA.

| | Sheko | Yayu |
|---|---|---|
| Number of households | 4454 | 17,127 |
| Number of villages | 17 | 37 |
| Total area | 50,000 ha | 163,000 ha |
| Total forest | 25,042 ha | 80,420 ha |
| Protected forest | 9025 ha | 10,000 ha |

To achieve ecologically sustainable increase in production, farmers would have to intensify their land management by using fertilizers and improved seeds and to adopt soil conservation measures. However, the profitability of these new technologies is severely constrained by imperfect input and output markets and a poor infrastructure (Demeke, 2001; Techane, 2001), and their dissemination among farmers is difficult. The main obstacle to sustainable land use, however, is the ill-defined allocation of property rights. Private ownership and land markets are not permitted.[3] Instead, the government allocates land use rights to the farmers which can be expropriated. Repeated land redistribution practices in Ethiopian history have led to high uncertainty concerning the tenure rights of the farmers' holdings.[4] This uncertainty reduces incentives to invest in the maintenance of land. To take account of the two possible forms of maize production, the traditional but ecologically unsustainable method on the one hand, and the improved but currently impracticable method on the other, we will calculate income, costs, and benefits for each of the two in Sections 3 and 4.

### *2.2. Strict Forest Conservation*

The polar strategy for converting forest to farm land is strict conservation. While in the distant past one third of Ethiopia was covered by forest, the northern and central highlands have been deforested completely, and only 2% of the former forest is left. This remaining forest is currently under the special protection of the Ethiopian government, which has demarcated 58 national forests as National Forest Priority Areas (NFPA) (EFAP, 1994). By law, no encroachment on the NFPA is tolerated, and cutting down trees is frequently punished by prison sentences. In practice, the enforcement of this policy in most of the NFPA is difficult and expensive. The forests of Sheko and Yayu, however, receive special attention since they contain remaining populations of wild coffee. The Coffee Improvement Project financed by the European Commission aimed at conserving this coffee gene pool for future breeding activities (Agrisystems, 2001).[5] The conservation authorities in Ethiopia suspect that permitting the local communities to enter the demarcated areas would entail further disturbance through illegal logging and harvesting of wild coffee. Therefore guards are supposed to patrol the demarcated areas in Yayu and Sheko, which cover areas of 10,000 and 9000 ha respectively.

[3] According to the country's constitution, the ownership of land rests with the state and the people of Ethiopia. For a detailed discussion of the land tenure system see Crewett et al. (2008).

[4] During a nationwide survey on tenure rights and farmers' reactions, only 3.5% of the households believed that they could retain their current holdings for over 20 years, while the overwhelming majority of households did not believe that their claim to their existing holdings would last more than five years (Berhanu et al., 2002, Table 19).

[5] Conservation of coffee germ plasma ex situ in seed gene banks is difficult since seeds do not stay viable for very long. To store genes in field gene banks is expensive and also unsafe, as the plants may succumb to diseases and pests. By contrast, according to Gole et al. (2002) conserving coffee plants in situ, i.e. in their natural forest ecosystem, is more viable since the evolutionary process can continue as the plants adapt to changes in environmental conditions.