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Analysis

Farming vs forests: Trade-off between agriculture and the extraction of non-timber forest products

Prabodh Illukpitiya, John F. Yanagida *

Department of Natural Resources and Environmental Management, University of Hawai'i at Manoa, 1910 East–West Road, Honolulu, HI 96822, USA

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ABSTRACT

A number of empirical studies on tropical forests have focused on the issues of agricultural development and deforestation. According to these studies, deforestation is assumed to be an increasing function of agricultural yields hence implying a negative external effect. Contrary, this article presents a case which explores the trade-off between agriculture and extraction of forest products. We measure the technical efficiency of agriculture in natural forest peripheries and test the results from forest resource extraction. The study findings show that non-timber forest product extraction is a decreasing function of agricultural efficiency, hence producing a positive externality in the conversion of forest resources. This study also determines the level of efficiency improvement necessary to compensate the current income generated by non-timber forest products (NTFPs). Improving agricultural efficiency in forest peripheries should be an integral component of forest conservation policy.

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1. Introduction

Globally, tropical forests are subject to high rates of degradation and deforestation, with current estimates indicating a loss of some 17 million ha, or more than 1% of the total forest area, per year (Byron and Arnold, 1999). Protection is one of the methods of assuring the continuation of tropical forests (see Hyde, 1980 for alternative ways of conserving natural forests). A fundamental problem for conservation and development programs is the lack of understanding about factors that govern the use of forest resources. Several studies have shown the diversity of resource use patterns across households living in forest margins (Browder, 1992; Coomes and Barham, 1997). For example, while non-timber forest products (NTFPs) represent major sources of income for some households, others may rely primarily on agriculture for their livelihood. Thus, what factors influence household participation in NTFP extraction activities becomes a relevant question.

Forest products are used by communities living in close proximity to forests, either as an economic mainstay or as a supplementary source of household income. NTFPs are used by rural communities as energy sources, food items, medicinal products, materials for household equipment, construction materials, as well as equipment and materials for agricultural activities. Due to excessive use, the productivity of the natural forest is at a critical stage (Byron and Arnold, 1999). Reducing extraction activities in tropical forests would enhance regeneration of plants and animals, thereby, maintaining forest ecosystems. Therefore, given the present status of tropical forests, reducing forest dependency is a viable approach for conserving bio-diversity.

The extraction of plants and animals from the forest by rural populations may be less disturbing to conservation efforts than other forest activities such as logging. However there is evidence from some areas that even indigenous people far from markets can deplete forest goods (Godoy and Bawa, 1993) because population growth and/or technological change can lead people to deplete natural resources (Martin, 1994). As Homma (1992) highlighted, extraction may be a viable activity in areas with low population densities. In cases where communities are involved in management, forests are well conserved (Pagdee et al., 2006; Klooster and Masera, 2000). Forest extraction is a time consuming activity hence dependency on forest resources can be reduced if households have alternate income sources to support life.

Forest dependent households' primary income source often comes from forest products, agriculture or non-farm sources. For example, some indigenous communities living far from markets may be primarily dependent on forest gathering (Godoy and Bawa, 1993, Martin, 1994). On the other hand, households living in peripheral villages of the protected forests can be primarily dependent on agriculture and secondarily dependent on forest gatherings (Kahn, 1995; Caviglia and Khan, 2001; Coomes and Barham, 1997; Pattanayak and Sills, 2001).

In such a situation, high rates of forest dependency are driven, in part, by the effort of inefficient farmers to secure subsistence. Agricultural efficiency in forest peripheries is one aspect in which

* Corresponding author. Tel.: +1 808 956 2809; fax: +1 808 956 6539.
E-mail address: jyanagid@hawaii.edu (J.F. Yanagida).

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agricultural capacity and rural incomes can be enhanced.[1] Technical efficiency of an individual farm is defined in terms of the ratio of the observed output to the corresponding frontier output, conditional on the levels of inputs used by that farm. In biological terms, some farms may have lower output because of poor agroecological conditions, but could be considered more efficient than farms which in spite of better conditions can only obtain slightly larger output.

In view of the growing competition in the agricultural sector and high production costs, production efficiency will become an important determinant of rural farming. Developing and adopting a new production technology can improve production efficiency. In addition, farming can maintain its economic viability by improving the efficiency of existing operations with a given technology. In other words, total farm output can be increased without increasing total cost by making better use of available inputs and technology. Hence, improvements in agricultural efficiency decrease costs and *ceteris paribus* increase profits.

Increasing agricultural efficiency has a diminishing effect on forest dependency in two ways, namely, an income effect and a labor supply effect.[2] An increase in agricultural profitability can reduce forest dependency due to a large income effect. For instance, higher profits from farming, stemming from increased technical efficiency, will be an incentive for rural households to be more engaged in farming activities.[3] From the rural labor market point of view, increased farm activities imply greater involvement of household labor in farming hence, decreasing the labor allocated to forest extraction. As farming becomes profitable, the opportunity cost of participating in extraction activities increases.

Therefore the primary objective of this study is to see how efficiency of agricultural activities in forest peripheries alters forest related activities. More specifically, the study estimates a forest dependency function which is affected by the various socio-economic factors including agricultural efficiency. This study also determines the level of efficiency improvement necessary to compensate for the NTFPs gathered.

This research provides an in depth investigation of technical efficiency for agriculture in forest peripheries and its effect on rural household dependency on forest resources. Technical efficiency is an important factor in determining the future of farming by households in forest peripheries. There is very little or no information on technical efficiency of agriculture in forest peripheries. Information generated by this study will be useful for households in terms of decision making regarding input use in farming and the allocation of household labor to farm and non-farm activities (including forest gathering). The efficiency analysis will also help identify sources of inefficiency and suggest factors that can increase agricultural efficiency.

The remainder of the paper is organized into four sections. Section 2 reviews the literature on the role of forestry in farm households and weaves in literature on production efficiency to form the theoretical background for this study. The empirical model is discussed in Section 3. Section 4 presents the data and methodology used for the study. Section 5 analyzes and discusses model results. The last section presents conclusions and policy implications respectively.

2. Review of Literature and Theoretical Background

Ethnobotanical studies have shown that the livelihood of rural households living in forest margins depends on a variety of forest products. Since the 1980's, various studies on NTFPs have occurred in different parts of the world (a few examples include Falconer, 1990; Panayotou and Ashton, 1992; Godoy and Bawa, 1993; Ruiz Pérez and Byron, 1999; Cavendish, 2000; Godoy et al., 2000; Sheil and Wunder, 2002; Vedeld et al., 2004). Income from forest products seldom appears to account for a large share of a household's total income, but is often important in filling cash flow gaps.

According to Wilkie et al. (2001), contribution of NTFPs to local and national economies is typically small relative to agriculture. This seemingly small contribution of NTFPs to household economies is mirrored by the results of a recent review of global forest valuation studies (Costanza et al., 1997). Average worldwide values (converted to 1994 dollars with an additional correction for purchasing power) of tropical forests for food production, raw materials, and intangibles (i.e., carbon sequestration, biodiversity conservation, and ecological services) were $32, $315, and $1660 per hectare per year respectively. Estimates of the direct (i.e., tangible) value of the forest may, however, be exaggerated given the short duration of most studies. According to Peters et al. (1989), the gross annual per hectare value of fruits and latex in the Amazon amounts to US$ 700. However their approach and conclusions have been criticized because of the small area surveyed. However according to Godoy et al. (2000) the combined value of consumption and sale of NTFPs to rural communities in Honduras were US $ 6–8 per acre. In India, Narendran et al. (2001) reported that mean annual per capita household income from NTFPs ranges from US $ 3–110 per acre. Dominant NTFPs contribute 25–60% of household income. Studies from other parts of the world have shown varying levels of contribution (see Sheil and Wunder, 2002 for further discussion on this issue). In highly productive forests, benefits from NTFPs exceed the returns from other less-sustainable alternative uses of forests. Returns from NTFPs in less productive forests have shown lower benefits when compared to alternative land uses.

Rural households harvesting and consumption decisions on forest products are influenced by market prices for forest products (see Kohlin, 1998 for a detailed discussion). Several studies have shown that households are more price responsive regarding consumption decisions for forest goods (see Cooke, 1998; Amacher et al., 1998).

A limited, but growing number of empirical studies examine the relationship between household characteristics and tropical deforestation. These models typically define the dependent variable as either the average rate or total amount of deforestation on a homestead. Common independent variables include: the number of adult males (DeShazo, 1993), household size (Pichon and Bilsborrow, 1992), tenurial conditions (Southgate, 1990; Pichon and Bilsborrow, 1992; Bedoya, 1987; Almeida, 1992; Lopez, 1993), assets at the time of settlement (Almeida, 1992), place of origin (Almeida, 1992), and accessibility to markets (Pichon and Bilsborrow, 1992; Southgate et al., 1991). Few studies have also included explicit economic variables such as crop prices, wage levels, other input prices, and income from various sources (Almeida, 1992; Lopez, 1993; Panayotou and Sungsuwan, 1992; Southgate, 1990).

Shively (2001) has developed a model of lowland technical progress and upland activities at a tropical forest margin. This lowland agricultural production model is combined with a labor allocation model to form a representative lowland farm which is used to illustrate how labor productivity, agricultural wages, and the returns from upland activities determine the rate of forest clearing. The empirical analysis based on farm level data from the Philippines demonstrates how agricultural intensification in the form of lowland irrigation development led to an increase in

[1] Raising incomes and returns to agricultural activities may also provide incentives to convert forestland to farmland (see Faris, 1999; Mattos and Uhl, 1994; Nickerson, 1999; Theil and Wiebelt, 1994; Barbier and Burgess, 1996; Wunder, 2001). According to these studies, deforestation is assumed to be an increasing function of agricultural yield. However, this assumption may not be applicable to countries where forest cover has already declined to a critical level (Repetto and Gillis, 1998) and where protected forests have been well demarcated with buffer zones and laws restricting conversion of forest lands to agriculture.

[2] Additional income from farming improves the household's purchasing power. Therefore, households could substitute marketable goods for forest goods (e.g., purchasing fuelwood from the market rather than collecting fuelwood through a labor intensive and time consuming activity) For the labor supply effect, see Tachibana et al. (2001) and Shively (2001).

[3] Improved technical efficiency of agriculture makes rural households wealthier due to increases in profit from farming. As shown by Godoy and Bawa (1993), wealthier households are less interested in the extraction of forest resources hence their dependency will decline. However in extreme cases, wealthier households and villages may use greater quantities of environmental resources (Cavendish, 2000). For instance, wealthy households could allow villagers easier access to modern technologies such as automobiles to speed up forest gathering and firearms for hunting. Considering the local situation, where, modern technology (such as firearms for hunting) is banned in natural forests, this situation would not arise.