Population Growth, Shifting Cultivation, and Unsustainable Agricultural Development

A Case Study in Madagascar

Andrew Keck
Narendra P. Sharma
Gershon Feder
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Foreword

The development community has increasingly recognized that there are important interrelationships between the environment, population, poverty and productive activities. Often, unsustainable agricultural practices, rapid population growth, and inadequate technologies, combined with market and policy failures, create negative synergies that exacerbate existing poverty and the depletion of natural resources. In order to protect the environment and alleviate poverty, developing countries must necessarily use natural resources efficiently and intensify agriculture in a manner that is ecologically sustainable.

The World Bank and other donor agencies are presently assisting developing countries to design better policies and projects to promote economic growth and environmental protection. Also, many countries in Sub-Saharan Africa are now preparing National Environmental Action Plans to achieve a more sustainable use of their natural resource endowments.

This study provides a timely assessment of the underlying factors, including service infrastructure, price incentives, and property rights systems, that contribute to stagnant agriculture and underdevelopment in a microregion in Madagascar. This case study reflects the conditions existing in many areas in developing countries. Therefore, a sound understanding of these constraints will help planners and decision-makers in developing countries to design viable development projects and to ensure better results on the ground.

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Director
Africa Technical Department

Michel J. Petit
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Agriculture and Natural Resources Department
Abstract

This study of a microregion in Madagascar illustrates important linkages and synergies between population growth, unsustainable agriculture, and natural resource decline. Further, the study shows that agricultural development has been hampered by the lack of adequate marketing, road infrastructure, extension services, credit, and inputs. Efforts to promote agricultural intensification and diversification will depend on how effectively the country can address these constraints.

A review of the tenure regime in the microregion indicates that the traditional system still prevails and is generally being enforced through customary procedures. The study cannot conclusively state that traditional land tenure systems in this microregion have created widespread insecurity and conflict over land, which is often blamed for the excessive rates of forest clearing. This suggests that the traditional property rights system may not be the most immediate obstacle to sustainable land use patterns in the short-term. However, the study does indicate that the local management of public lands is poor, fallow lengths are below sustainable levels for slash-and-burn agriculture, and that land shortages exist in some communities.

The study suggests that, in the short run, the government should place a high priority on measures that will improve factor and product markets, promote the use of improved technology and inputs, and expand infrastructure. These measures need to be complemented by a longer term perspective of the issues related to tenure security and conflict over land rights which are likely to emerge as the population increases. An important priority in the microregion is the minimization of the irreversible degradation of soils and forests and the promotion of sustainable agriculture.
Acknowledgments

The authors wish to thank the many individuals in the U.S. and Madagascar who assisted in the realization of this research. Particular thanks go out to Priya Shyamsundar and Paul Ferraro at Duke University. In the field, invaluable advice and assistance was provided by Peter Robinson, Roy Hagen, Etienne Gershom, Conservation International, SAF/FJKM, The Ranomafana Park Project Office, Mr. Herijaona of the Department of Water and Forests, and David Richards. Finally, we wish to thank Randall Kramer, Shiv Someshwar, Benoit Blarel and Adrian Otten for their review and comments on earlier drafts of this paper.
1. INTRODUCTION

PROBLEM STATEMENT

In developing countries, rural people often meet their basic needs from the surrounding land, water and forests. But with rapidly increasing population, increasing levels of poverty, and often misdirected government policies, many developing countries are experiencing depletion of their natural resources and degradation of their environment. Such depletion of the environment and natural resource base undermines economic and social progress and adversely affects the poor (World Bank 1991).

Responding to the loss of natural resources, developing countries are increasingly involved in devising natural resource management strategies. However, national governments and international donors often develop conservation objectives, policies and programs in relative isolation from the large rural populations that inevitably must abide by and support those programs (Bell 1987; Wells, and others, 1992; Dang 1991). In addition, these programs are often developed in the absence of clearly-defined property rights and incentive systems.

It is clear that successful programs, which maximize social benefits and promote the wise use of natural resources, must recognize the importance of people's access and involvement in the management of these resources. For governments to ensure meeting development objectives in these same areas, programs must identify those factors which inhibit a shift to more sustainable land use patterns (e.g. inadequate property rights, lack of infrastructure, inputs, markets, etc.). The challenge to government is often in analyzing the extent to which different constraints are binding in the short term, and which are likely to emerge in the medium term, and to design actions that will promote sustainable development in the long run.

RESEARCH OBJECTIVE

The analytical challenge of defining a development strategy that protects the environment while relying on incentives to the population to pursue their objective in a way that is compatible with environmental sustainability was applied to an investigation of rural people's use and management of land and forest resources in a "microregion" of the eastern Madagascar rain forest. The microregion is part of a larger area faced with rapid deforestation caused in large part by pressure from local communities who clear public forest land for agriculture in the absence of clearly-defined property rights and government's capacity to manage public lands efficiently. In recent years, farmers have converted most of the public primary forest areas for agriculture, and the existing secondary forest is cleared and reused with increasing frequency to the detriment of soil quality and retention, agricultural productivity, and the subsistence capacity of the land.
The government recently created a national park in the microregion to prevent the continued expansion of slash-and-burn into species-rich primary forest zones. The park strictly prohibits the use of land and forest resources within its borders. This represents an important constraint to villages located in the peripheral zone which had previously established and exploited their traditional land use rights over areas now within the park boundaries. Because of the weak enforcement capacity of the park management, the park continues to suffer from occasional encroachment by nearby villagers. Nonetheless, it is a growing source of resentment among local farmers as it fails to provide employment or income.

This paper examines existing land use patterns in the microregion and identifies major constraints to improved land use management in both productive and protected areas by analyzing local village organization with respect to production and consumption. In addition, the paper considers factors necessary to bring about improvement in agricultural productivity and resource management focusing on the role of land arrangements. Recommendations are made to improve conditions and incentives in the short and medium term for farmers to adopt more land intensive strategies to slow environmental degradation. In the long term, land policies must be prepared for the eventual increasing competition for land resources in this region.

METHODOLOGY

The analysis is largely based upon primary data collected during nine weeks of field work in Madagascar. The field research component was designed to complement recent research by natural resource economists at Duke University in the same microregion of Madagascar (Shyamsundar, Kramer and Sharma 1993). That work collected information on basic socioeconomic indicators as well as household productivity and market price data. The household productivity levels established in those surveys are used in this analysis.

Farmers were the focus of field analysis, with occasional group interviews and village leader interviews to gather information informally. Other development and conservation specialists in Madagascar were also consulted. Five villages, or groups of villages, were selected for study. The areas were selected with the help of a regional officer for the Madagascar Department of Water and Forests (DEF). The villages surveyed are representative of the microregion in their composition and population, land use patterns, proximity to the national park and a mix of public, private and common land. Data and information were also used from secondary sources including official government and professional documents, World Bank publications dealing with Madagascar, and interviews with numerous experts within Madagascar and from external agencies.
ORGANIZATION OF PAPER

Chapter 2 of the paper reviews the relationships between population, land use, property rights and resource degradation in developing countries. The chapter concludes with a brief discussion of the forces involved in the evolution away from extensive agricultural systems. Chapter 3 discusses these issues in the context of the problems found in a microregion of Madagascar's eastern rain forest, including an overview of the environmental impact of the region's agricultural and forest use patterns, and a review of development policies in the region. Chapter 4 presents results from field surveys and assesses the nature of economic incentives and land use in the villages surveyed. Local natural resource management practices are discussed. The chapter includes an economic analysis based upon survey data from one village to demonstrate the impact of intensification of rice production on the rate of land use and the economic condition of a village. The chapter concludes with a behavioral discussion to identify what factors influence land use decisions in the microregion. Chapter 5 synthesizes the paper's conclusions and provides broad recommendations for short-term and long-term objectives to improve land management and to ensure protection of the region's natural resource base.
2. DYNAMICS OF NATURAL RESOURCE MANAGEMENT

OVERVIEW

Over the last thirty years, population levels in developing countries have increased at a rate that has made many of the traditional land use practices increasingly difficult to sustain, particularly in locations with high population concentrations. From 1980 to 1989 alone, Africa experienced 3 percent annual growth in population levels, the highest of any region in the world (World Bank 1990). In Madagascar, for the same period, population increased by 2.9 percent annually (World Bank 1990).

These trends influence the quality and quantity of natural resources in a country and the survival of people who are already impoverished. It is observed with increasing frequency that a growing population in a particular area can have a negative impact on available natural resources (Bromley and Cernea 1989; Eckholm 1979; Thomson 1988). As population grows, the number of individuals with “rights” to natural resources grows with it, but the quantity of the resource is often unchanged. As person-land ratios increase, land is cultivated more intensively, spurring the evolution of agricultural systems (Hammer 1988; Boserup 1965; Ruthenberg 1980). Over time, as witnessed in Madagascar, with the intensive use of land and shorter fallow periods, there is a high incidence of topsoil erosion and soil nutrient depletion. Shifting cultivation systems, which may be sustainable under certain edaphic conditions and economical where labor is scarce, become particularly difficult to sustain with high rates of population growth. Where land becomes a limiting factor, these systems often adopt reduced fallow lengths and eventually reach a point where soils and vegetation fail to regenerate sufficiently, leading to consequent declines in land productivity, unless a technology based on fertilizers can be adopted. (Peters and Neuenschwander 1988; West 1986; FAO 1984).

As the productivity of land declines, farmers and pastoralists find themselves in a downward spiral where incomes decline, subsistence becomes more difficult, and they become poorer. Poverty can lock farmers into a production pattern focused on satisfying their most immediate needs, with little opportunity to pursue alternative production modes and longer time horizons (Wachter 1992). As population increases and economic decline continues, the rules and systems of land use and land rights in traditional farming communities may then disintegrate and eventually disappear, and while a new property rights system is evolving, irreversible damages to the natural resource base may occur.

Misguided public policies often directly influence this problem of resource depletion. This was found to be the case with Cote d'Ivoire's agricultural policies and with Brazil's tax incentives to clear Amazonian forests for cattle ranching. The forest soils could not support the clearing and grazing, leading to decreased land quality and the eventual clearing of more land for cattle (Binswanger 1989). Over time, the result is a gradual expansion of the agricultural frontier and the abandonment of already cleared areas. Forestry policies can also affect forest utilization rates,
as witnessed in many countries in Africa, such as Nigeria, Ghana, and Cameroon. Policies concerning timber harvest concessions (e.g. duration, annual yields, harvest methods, royalty and fees structures), utilization of non-wood forest products, and reforestation can all contribute to unsustainable rates of deforestation (Rowe, Sharma and Browder 1992; Repetto and Gillis 1988).

**AGRICULTURAL INTENSIFICATION**

That the evolution of agricultural systems is related to population growth was demonstrated some three decades ago (Boserup 1965). This perspective has been adopted and analyzed by numerous development specialists since that time. The concept focuses on the farming system in its entirety and how, when necessity demands that the land be farmed more frequently, individuals must reassess their land use and adopt new activities, tools and investments. In other words, individuals, acting in their economic self-interest, will modify their land use systems to ensure their livelihood. The property rights structures are accordingly modified to keep pace with this agricultural transformation.

The progression through various forms of shifting cultivation systems towards the permanent cultivation of plots implies that land is subject to more frequent cultivation. This evolution is defined as agricultural intensification (Boserup 1965; Ruthenberg 1980; Pingali, Bigot and Binswanger 1987). Various authors have presented evidence to support this theory. The variations within each category reflect the differences in soil quality and other natural factors found at different locations. Table 2.1 presents the various food-supply systems in the tropics and their associated levels of intensity, population density and tools.

Boserup (1965) first showed how, historically, the vast forests and bush land which covered the earth receded when long fallow cultivation became more frequent, creating conditions for grasses (whose roots are not killed by fire) to spread. The table also shows how the forest-fallow system can be sustained only up to a density of four persons per square kilometer. The long forest-fallow system relies on plots for one or two years of production followed by twenty to twenty-five years in fallow, sufficient time for forests to regrow. When population density makes it impossible to maintain this fallow length, the land “degrades” into bush savanna.
Table 2.1: Food-Supply Systems in the Tropics*

<table>
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<tr>
<th>System</th>
<th>Farming intensity (R value)&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Density of population&lt;sup&gt;c&lt;/sup&gt; (persons per square kilometer)</th>
<th>Tools used&lt;sup&gt;d&lt;/sup&gt;</th>
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<tr>
<td>Gathering (G)</td>
<td>0</td>
<td>0-4</td>
<td>None</td>
</tr>
<tr>
<td>Forest-fallow (FF)</td>
<td>0-10</td>
<td>0-4</td>
<td>Axe, machete, and digging stick</td>
</tr>
<tr>
<td>Bush-fallow (BF)</td>
<td>10-40</td>
<td>4-64</td>
<td>Axe, machete, digging stick, and hoe</td>
</tr>
<tr>
<td>Short-fallow (SF)</td>
<td>40-80</td>
<td>16-64</td>
<td>Hoe, animal traction</td>
</tr>
<tr>
<td>Annual cultivation (AC)</td>
<td>80-120</td>
<td>64-256</td>
<td>Animal traction and tractor</td>
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a. Description of food-supply systems:
- **Gathering**—wild plants, roots, fruits, nuts
- **Forest-fallow**—one or two crops followed by fifteen to twenty years of fallow
- **Bush-fallow**—two or more crops followed by eight to ten years of fallow
- **Short-fallow**—one or two crops followed by one or two years of fallow; also known as grass-fallow
- **Annual cultivation**—one crop each year
- **Multiple cropping**—two or more crops in the same field each year. These systems are not mutually exclusive. Two or more may very well be practiced concurrently—cultivated in concentric rings of various lengths of fallow, for example, as in Senegal.

b. R = (number of crop cycles per year x number of years of cultivation X 100) / (number of years of cultivation + number of years of fallow).


c. These figures are only approximations, the exact numbers depending on location-specific fertility of the soil and agroclimatic conditions.

Sources: Boserup (1981, 19, 23); Ruthenberg (1980).

d. Sources: Ruthenberg (1980); Boserup (1965).

In this situation, bush-fallow arises where the cultivation period lasts longer (two to six years) and fallows are reduced to six to ten years. This shortened fallow period prevents any real forest regeneration and encourages the growth of grasses (Pingali, Bigot and Binswanger 1987). The bush-fallow system persists at population densities ranging from four to sixty four persons per square kilometer. Short-fallow cultivation can arise and be maintained at a density range of sixteen to sixty-four individuals per square kilometer. The farming intensity (the relationship between cultivation and fallow lengths) can be double that of bush-fallow and the tools will become more refined, including the use of hoes and animal traction. Any additional increases in population lead to adoption of annual cultivation and multiple cropping (Pingali, Bigot and Binswanger 1987).

In assessing the population question, it is also important to determine what factors influence population growth. Beyond natural growth rates, the other factor which leads to increasing population densities in some areas is migration, which is influenced by high soil fertility, availability of transportation, better health conditions, access to markets and land laws which restrict access to certain areas (Pingali, Bigot and Binswanger 1987).

The shift from extensive to intensive farming systems is influenced by more than population density. In the subhumid and humid tropics, soil properties make them more susceptible to erosion, run-off and leaching if continuously cultivated. When increasing intensity depletes soil nutrients, fertilization becomes more sophisticated, beginning with ash and household refuse and eventually including dung, green manure and chemical fertilizers (Pingali, Bigot and Binswanger 1987).

Where tools are held constant, Ruthenberg (1980) presents evidence from several African countries indicating a positive relationship between labor per hectare and farming intensity. The labor increase is associated with the increase in both intensity of some activities such as weeding and the number of procedures involved, such as manuring. In general, labor progresses from clearing (fire), planting and harvesting in forest-fallow and bush-fallow systems, to more involved methods of land preparation and sowing as the fallow period declines. In Cameroon, these two steps represent 40 percent of labor time in annual rice cultivation (Pingali, Bigot and Binswanger 1987).

The degree of mechanization is the other important component in determining the intensity of farming systems. The choice of farm tools is as follows:

- The transition to the plow would not be cost-effective in forest-fallow and bush-fallow systems because the use of the plow would increase weeding requirements and require overhead labor investments for destumping and animal maintenance.

- There is a distinct point in the evolution of agricultural systems at which the use of the plow becomes economical.
This point will be reached sooner if the soil is difficult to work, if maintaining the fertility of the soil requires a considerable input of labor, or if the market for meat is well developed, (Pingali, Bigot and Binswanger 1987).

Importantly, intensification will not necessarily engender adoption of the plow. Cases of intensification without the plow exist in Tanzania, Kenya, Rwanda and Burundi (Pingali, Bigot and Binswanger 1987). Soils and steep topography are two conditions which can discourage the use of plows.

As agricultural production intensifies, the incentives for investment in maintaining and improving the productive capacity of land increase. Lack of tenure security, however, would hamper these incentives. Therefore, societies evolving into more intensive agricultural production systems have developed property rights institutions designed to provide farmers with adequate tenure security. Depending on production technologies and investment patterns, property rights may entail use rights for a prescribed period, use rights for life, inheritable use rights with limitations on transfer to other individuals, or, ultimately, full unrestricted ownership. At earlier stages of development, the design and enforcement of the property rights system are done by local community institutions. With increasing pressures on land, more formal structures emerge, where the enforceability is taken over by the state and its local representations.

Land titles are one common mechanism of recording and enforcing individual property rights in land. Because of the costs involved in establishing this mechanism, it typically emerges at a fairly advanced stage of agricultural development, when the benefits outweigh the costs (Feder and Feeny 1991). The benefits of formal records of land ownership are higher when the scope for land-improving investments is larger, when land markets emerge where individuals from other communities are potentially involved as buyers or sellers of land, and when well-developed credit markets are present where land can be used as collateral (Feder and others 1988).

Studies have shown that traditional (less formal) land rights systems adapt as the economic circumstances change due to population growth and technological progress. Thus, Migot-Adholla and others (1991) indicated that in several African case studies, the traditional system, with some modifications, provided adequate land tenure security even though the agricultural system has become more intensive. However, as demonstrated by Feeny (1982) for the case of Thailand, when the economic circumstances change significantly and rapidly, the traditional system may require a radical overhaul which is brought about by state action.

The subsequent chapters apply concepts of this chapter to the land use patterns and environmental problems found in Madagascar followed by an analysis of the results of a case study in a microregion of Madagascar's eastern rain forest to highlight some of the salient issues involved in improving the pattern of natural resource use there.
3. THE CASE OF MADAGASCAR

BACKGROUND

Madagascar is one of the twenty poorest countries in the world with an annual per capita income of $230 (World Development Report 1992). With a total area of 590,000 square kilometers, the island has about 17 inhabitants per square kilometer. Some 8 million of the nearly 12 million total population live in rural areas (Economist Intelligence Unit, 1990) which makes Madagascar a predominantly agricultural economy and society. The agricultural sector is responsible for 80 percent of export earnings and employs approximately 85 percent of the population (World Bank 1988). Small farmers with only 1 or 2 hectare plots account for about 80 percent of total agricultural production (World Bank 1988). Rice is the primary crop in Madagascar but there are many others including coffee, cloves, vanilla (which replaced coffee as the primary export earner in 1990), cotton and sugar (EIU 1990; World Bank 1993). While these are important economic crops, the root crops (particularly cassava) contributed 10 percent to the 1992 value of agricultural production. Irrigation areas (devoted mainly to rice) now account for approximately 41 percent of the total cultivated area of nearly 3,000,000 hectares (World Bank 1988).

Although farming is extensively practiced in Madagascar, productivity and profitability have been extremely low for decades (EIU 1990; World Bank 1988). In fact, rice, the main staple food, must be imported to meet domestic demands (the imports have fallen gradually from their peak of almost 300,000 tons in 1982 to an estimated 39,000 tons in 1991). As the total population continues to grow at rates exceeding 2.5 per cent annually, open farm land is increasingly scarce, thus forcing people to clear forests. On an island that is believed to have been largely forest in the past, it is estimated that only 12 million hectares (or approximately 25 percent) of the original natural forest remain (World Bank 1988). It is believed that if corrective actions are not taken quickly, the remaining primary forests could disappear within thirty years (EIU country report 1990). These conditions imperil the country's unparalleled biological diversity and endemism (World Bank 1988).

The country faces a growing crisis in terms of the protection and productivity of its natural resource base. The problems are many; among them, the limited enforcement capacity over public land in the eastern rain forest acts as an incentive for individuals to excessively use the region's public lands for agriculture. Studies indicate that the structural instability of Madagascar's ferruginous soils and the country's heavy rains promote land loss from erosion at rates in excess of 50 tons per hectare per farm plot, and causes decreases in soil fertility and water run-off between 20-30 percent of rainfall (Madagascar Environmental Action Plan 1988). Traditional slash-and-burn agriculture in the upland areas of Madagascar leaves steep slopes open to the heavy rains, spurring rapid loss of soil and a rapid decrease in land fertility and land productivity. For subsistence-level farmers, these declines jeopardize their ability to meet their needs and simultaneously affect their ability to diversify their production and farming methods. As the land...
deteriorates, so does the local ability to rely upon that land for sustenance. The end result for the community is a decreasing level of production that leaves them poorer over time.

CONDTIONS IN THE EASTERN RAIN FOREST

The conditions described here are typical of the problems found along the eastern escarpment, a transitional zone between the expansive central highlands and the narrow low lands along the east coast. This area is dominated by rain forest which covers a large area running north and south in Madagascar (see map 1). The study was conducted in the microregion surrounding the town of Andasibe, formerly Perinet (see map 2). The area is characterized by steep terrain with altitudes ranging from 800 to 1100 meters. A principal paved national highway passes just south of Andasibe and connects the capital, Antananarivo, with the major eastern port in Tamatave. According to the Ministry of Agriculture estimate, this road presently permits the highest volume of trade by road anywhere in Madagascar (AIRD/MinAgri 1993). In addition, this forest zone has highly erodible ferric soils, with characteristic red and yellow horizons. The rainfall in Andasibe averages 1,825 millimeters per year (UNDP 1991), although it is the intensity of rainfall which is important. Close to Andasibe, there is both a protected reserve of approximately 800 hectares for the indri-indri lemur, as well as a new national park, Mantadia, of nearly 10,000 hectares, created in 1991 to protect the forests and important habitat of the lemur and other species of flora and fauna.

In the firaisana, or canton, of Andasibe total population is around 12,000 with a density of around 15 people per square kilometer (Shyamsundar 1993). Andasibe and the surrounding cantons of Ambatavola, Beforona and Moramanga all have a population density ranging between 10 and 20 inhabitants per square kilometer (UNDP 1991). The natural population growth rate is nearly 3 percent, and inward migration is believed to contribute an additional 1.3 percent (David Richards, personal communication). Literacy rates are around 40 percent.

WHY IS LAND USE IN THE REGION UNSUSTAINABLE IN THE LONG RUN?

Agricultural Patterns

Probably the most important land use affecting deforestation and soil erosion in Madagascar, and particularly in the microregion under study, is the traditional shifting slash-and-burn agriculture, known locally as tavy. Tavy refers specifically to upland cultivation of rice in areas recently burned and cleared of vegetation. The microregion is dominated by very steep, tree-covered slopes which, combined with the high rainfall, and given the present price distortions and limited infrastructure, makes tavy more suitable from the farmers' perspective than many farming alternatives. The slopes hinder the use of draft power and the rain intensity makes it difficult to maintain terraces or water-control systems. However, this topography causes fast soil loss when the slopes are denuded of vegetative cover. Overall, one can conclude that the farmers
are behaving rationally if a relatively short term horizon dominates their decision making. The most important cost is labor. *Tavy* requires relatively little labor input (estimates range from 80 to 105 days per year), it serves to meet the farmer's most important subsistence need at a lower cost than purchasing rice in the markets, and requires only the most basic tools. In comparison, irrigated rice systems require twice as much time in labor annually.

Madagascar's highly ferruginous soils offer extremely low rice yields from *tavy* with estimates ranging from a high of 1.1 tons per hectare down to 400 kilograms per hectare (Dandoy 1967; Le Bourdiec 1972). Furthermore, yields decline quickly from year to year. For example, Ratovoson shows *tavy* yields of 900 kilograms per hectare with the first harvest, and only 500 kilograms per hectare in the second year (Ratovoson 1979). By comparison, figures from Asia range from 1,500 to 1,800 kilograms per hectare in the first year. These fertility declines are accompanied by significant amounts of soil loss. Research in *tavy* areas show that in the first year 13 tons of topsoil are lost carrying with it numerous important base elements (Madagascar NEAP 1988). This raises considerable concern about the potential irreversible impact on the land of continuous *tavy* farming in Madagascar. Based upon these statistics and others, a coefficient of degradation was developed to identify areas of high conservation priority. The Andasibe region has the second highest rating on this scale.

In the best conditions, a farmer will practice *tavy* for a period of three years on forest cleared land. The rice is accompanied by subsistence crops, particularly manioc (cassava) and maize. Three years of cultivation are typically followed by five years of fallow. At that time the secondary growth forest (*savoka*) is cleared and rice is planted again. The soils are typically not as productive after the second clearing and a farmer will likely switch to manioc, beginning the second year for its ability to thrive in poor soils. After the second year, another longer fallow period of seven to ten years is necessary for the land to regenerate properly. (Le Bourdiec 1972; World Bank Working Document 1987).

As in many cultures which practice shifting rainfed cultivation, the Malagasy farming is part of a cultural lifestyle and belief system. Land is not an anonymous means of production which can be substituted, but is inherited from the ancestors and therefore ensures the continuity of descent, all embodied in the tombs, the cultivated land, the pastures, etc. (Rakotonirainy 1986).

In Madagascar, deceased relatives are part of a collective reference to the "ancestors." Pursuing a lifestyle similar to that of the ancestors is an important form of respect. Thus, the practice of *tavy* is part of paying homage to the ancestors. For outsiders moving in, assimilation is important and this encourages them to practice *tavy* as well. This facet of Malagasy culture is integral to individual land use decisions.

It is observed that farmers in the microregion use very low levels of inputs. A recent study of seventeen villages found that the region's farmers rely almost entirely on very simple hand tools such as spades and machetes, with a few individuals using hoes or pitchforks (Shyamsundar 1993). While anywhere from 35 percent to 50 percent of farmers apply insecticides, very few farmers use any chemical fertilizers (Shyamsundar 1993). As mentioned earlier, the single
greatest input of regional farmers is labor. The regional forest-fallow system might be described as one still in the earlier stages of transformation to agricultural intensification first presented by Boserup (1965). Following the theory presented in Table 2.1, this region is on the verge of evolution to a short-fallow system (farming intensity is nearing an R value of 40,\textsuperscript{1} and the population density is from 10 to 20 persons per square kilometer). Accordingly, labor time in farming can be expected to increase.

Although the population density in the microregion is moderate compared to many tropical areas, many villages are more than fifty years old. Given their long presence in the area and with almost 80 percent of households clearing close to 2 hectares of forest every year (Shyamsundar 1993), most legally available forest land has been cleared at least once, and most likely many more times since then. It is also quickly apparent that virtually all land in the region has been allocated, even though it is not all in active use.

Repeated clearing of the secondary forest quickly decreases the fertility of the soils and leads to greater labor inputs for what is an otherwise low-labor system. Agricultural decline is not the only problem. Forests provide households with a variety of essential products and services including hunting lands, honey, grasses, medicinal plants, fuel wood and construction wood (Shyamsundar 1993). Continued deforestation can also be expected to have as yet unassessed effects on the ability of households to meet their numerous extractive needs provided by secondary and primary forests.

Legal Rights to Land

The state is technically the owner of all lands that are not surveyed or titled. Despite efforts to modernize the property rights system, the legislative intent often reinforces the traditional rules through modern juridical procedures, as long as those traditional rules do not conflict with broader social goals (Rarijaona 1967). In the 1960s, the government established rules for proving traditional property rights (Annex 1 provides a detailed history of land law in Madagascar). The intended owner of the land must prove that the land has been continuously worked, and then an administrative body must verify that the working of the land is consistent with legally specified conditions. (Rarijaona 1967). Of course, having a modern title is much clearer, but the procedure is long and expensive (Oxby 1985). During the same period, the state set out rules outlining how individuals could become owners of the public land they occupied, despite the lack of a previous claim. When the land is untitled, the owner must do a sketch map of the property. The sketch map should be prepared by a surveyor, accompanied by a document describing the boundaries and/or showing the shape of the plot and indicating the property limits. The request is listed in order of receipt in a special register. The requests are passed on to the sub-provincial officer of the Direction of Public Land and Agrarian Reform (DDRA). This description says little about the limited interface that the DDRA has had in most rural farming

\textsuperscript{1}Multiplying the number of crop cycles (1) and years of cultivation (3) by 100 and dividing the total by years cultivation (3) plus years of fallow (5) gives an R value of 37.
areas. In 1992 the sub-provincial officer of the DDRA in Moramanga was the first to ever visit the villages located east of Mantadia Park.

Filing a request for land does not provide the individual with a right to occupy that land permanently. Active agricultural use of the land for ten years is required before a title can be issued. This requirement makes it impossible for farmers to title tavy areas which are necessarily left fallow every two or three years. It was recently discovered that the period of required continual use may only be five years; this does not change the conclusion reached here. For a tavy farmer, this represents a considerable obstacle to land titling. Whether titling confers any tangible benefits for farmers in the study area is questionable. In the absence of documented land disputes, the apparent tenure security under the customary land rights system (at present), the underdeveloped status of the credit system, and the absence of a land market, it does not seem that titles are an important factor in the rural economy of the study area.

**Agricultural Policy and Infrastructure**

Because of food security problems, and the fact that rice is the primary staple crop of the Malagasy diet, agricultural rice policy in Madagascar is focused on improving the output of irrigated rice farming. Irrigated areas provide most of the surplus rice in Madagascar and so are the focus of policies to end food shortages. However, the area of irrigated land is very small in the microregion because of the topography. This seems to have influenced the extent of government investment in support services for farmers in the region. As a consequence, farmers in the region do not have significant access to extension services, credit programs, and fertilizer supplies.

The office of agricultural extension for the microregion is based in the sub-provincial capital of Moramanga which, working through representatives at the canton level, is involved in technical support and diffusion of information among farmers. Efforts to improve the extension services in the Moramanga sub-province are part of an ongoing World Bank project begun in 1990 which has included the objective of adopting new training systems consisting of group visit methods with specific technical themes presented. Unfortunately, the extension services have very limited capacity to successfully adapt new systems and effectively provide assistance to the region's farmers, a shortcoming which needs to be addressed.

Access to credit is very poor in Madagascar with only 1.5 percent of small farmers receiving any formal credit (World Bank 1993). The principal credit provider is the National Rural Development Bank (BTM), created in 1977. The BTM has improved the number of smallholder loans since structural adjustment began in 1986. Other credit systems exist through farmer associations, but these are more common in the central highlands where extension agents have worked vigorously to promote them (World Bank 1993). There are also examples of initiatives led by non-governmental organizations (NGOs) to establish savings and loan associations.
Credit provision in the region under study is focused on the high rice production areas near Lake Alaotra, located north-west of the Andasibe microregion. According to a UNDP report, in 1989, total agricultural credit to the Moramanga sub-province was 13.3 million FMG or US $7,400 approximately (UNDP 1991). A recent review of the agricultural sector found that there is considerable potential for increased rural finance among small-scale rural producers, particularly in the form of short-term credit (World Bank 1993), and through development of new initiatives such as rice paddy banks (guarantees), and decentralized programs. Some notable problems remain; the risks of lending are high, the transactions costs for providing services to remote areas are high, the institutions themselves have some weaknesses, and overall policy has not encouraged the development of a self-sustaining credit market (World Bank 1993).

Agricultural research has also tended towards the irrigated areas around Lake Alaotra. While this is necessary research, there appears to be little taking place within the tavy zones of the eastern rain forest (with the exception of a small agroforestry research station near the town of Beforona) which could help find ways to encourage communities to experiment with alternative farming systems which rely less on tavy rice production.

Fertilizers are difficult to access in much of Madagascar. When fertilizers are applied at all, they tend to be manure. The problem is not simply one of provision. Many farmers believe that yields are sufficient without fertilizer, given the high initial fertility of the soils (UNDP 1992). Furthermore, given the high prices for fertilizers, it is difficult to convince farmers otherwise.

Agricultural tax policies have acted as another important disincentive to the pursuit of intensive market crops. The principal export-earning crops, coffee, vanilla and clove, have traditionally been subject to much higher taxes than the non-traditional export crops. Between 1975 and 1983, it is estimated that coffee producers earned only 40 percent of the world price and vanilla and clove producers earned only 25 percent. World Bank and IMF calculations indicate that the rates of taxation between 1972 and 1987 averaged 50 percent on coffee, and 70 percent on vanilla and clove (Dorosh, Bernier and Sarris 1990). Further, agricultural policies have not sufficiently sought to identify those crops in which different regions have a comparative advantage.

Given the declines in world prices for these crops, the government lifted the unfavorable taxes on both coffee and clove. It is in the process (1993) of considering a similar policy for vanilla. Even though these taxes may be removed, they have been an important factor influencing small farmer decisions. Where farmers can expect to earn only a small fraction of the market price because of taxation, it is no surprise that there would be an incentive for farmers to avoid the traditional export crops in favor of subsistence and non-traditional crops such as cassava, rice, wheat, corn and others. In addition, the microregion is at too high an altitude for viable vanilla and clove production, although coffee is produced along the escarpment. The role of agricultural prices and taxes will be revisited at the end of Chapter 4 in the context of reviewing those factors which influence land use and resource degradation.
An important question is the extent to which the land tenure system in the area has become a source of degradation and an obstacle to the adoption of a more environmentally sustainable production system. If tenure security, which was protected under the rule of the customary land rights system, has declined, or is inadequate to induce a shift to a more intensive form of agriculture (i.e. the use of modern inputs and technology), then there may be a need for government intervention to amend the tenure system.

Forestry

Forestry policy and programs are far more developed than agriculture in the microregion. The microregion has a considerable number of forest concessions, serving a constant urban demand for construction wood and charcoal as well as the needs of the national railroad company (RNCFM) for railroad ties and telephone poles. Concessions are issued and overseen by the Department of Water and Forests (DEF). There also exist two private forestry companies in the area. The DEF is also responsible for dealing with tavy requests by farmers, enforcement of boundaries and maintenance of state forest lands, including parks and reserves, and is involved in reforestation work with local communities. Regulations require farmers to file requests prior to clearing. They forbid clearing on slopes of 50 percent or more to protect the soils (see Annex 1 for details on forestry legislation). In short, DEF is the effective land management unit for the entire microregion and beyond. Since 1990, DEF has been involved in the Integrated Forest Valley Program (AIVF), which has begun in several villages south of the Mantadia National Park, discussed subsequently. DEF provides technical support under this program in many areas including rice paddy farming, apiculture and agroforestry (Shyamsundar 1993). However, the DEF has significant difficulties in performing all these functions, largely because of understaffing, insufficient training and budgetary problems. These weaknesses were compounded when the World Bank withdrew its support of AIVF activities.

Both forestry extension and agricultural extension are insufficient in the microregion, which has meant very little supervision, coordination or organization of local use of forest and agriculture lands.

Conservation

The government and conservation groups have worked at many levels to try and protect the country's soils and to ensure that agricultural production can satisfy subsistence needs in rural areas. The Integrated Forest Valley Management Plan was implemented to encourage better land use through improved techniques and diversification of household production (World Bank 1988).

There are also efforts aimed to protect the natural habitat containing the rare species of the region and to simultaneously generate revenues through ecotourism. In the Andasibe area, an 810 hectare special reserve for the indri-indri lemur exists and the 10,000 hectares Mantadia National Park, or MNP was established in 1991 (see map 2). Legislation also protects the region's primary forest from deforestation (Annex I reviews forest legislation from 1960 to the present). The villagers outside the park have no access rights to the park (even for secondary
forest products) and realize no benefits from the park’s existence. Today, the MNP is negatively viewed by many farmers of the microregion and the DEF struggles to protect its boundaries from neighboring village farmers who need the land for tavy. This same lack of enforcement capacity leads to the pursuit of tavy without permits on hill slopes steeper than legally sanctioned. This situation further exposes the farmers to environmental degradation as water run-off increases, carrying the organic components of soils with it.
4. PRESENTATION AND ANALYSIS OF FINDINGS

SURVEY DESIGN AND OBJECTIVES.

A survey was undertaken in the microregion to collect primary data. The survey was designed to collect the following information:

- Socioeconomic indicators
- Property rights structures and land use patterns
- Renting and sharecropping arrangements
- Possibility and means of land expansion
- Forest harvesting practices
- Use of collective and public lands
- Natural resource management tactics and issues
- Attitudes about the Mantadia Park
- Income sources

In addition to the formal survey, field work considered factors including physical parameters of the microregion, organization and authority structures in villages and the nature and extent of interaction between farmers and external agencies (NGOs, agricultural extension agents, forest service agents).

The analysis of data consists of basic statistics on farmer land use patterns, followed by a discussion of the nature of property rights in Madagascar and the microregion and an assessment of the role of land tenure in inducing current land use patterns.

Finally, an economic analysis was made to estimate the costs and benefits at a village level under two scenarios. Case 1 illustrates village-level production under a situation of continuation of the present level of inputs. Case 2 demonstrates the potential changes in village-level rice production expected with intensification through fertilizers and the wider use of tools. This chapter concludes with a consideration of what actions could lead to this type of transformation.

STUDY FINDINGS

The findings discussed in this chapter focus on results of a field survey of 183 farmers in the microregion. Because several colleagues at Duke University had already implemented field surveys in the region, it was possible to take advantage of their prior knowledge and more quickly design a survey and reduce the time needed for testing and revisions. The analysis of the survey findings is interspersed with information collected through informal discussions as well as from the literature.
The study area is located in the canton of Andasibe and Ambatavolo which are both part of the Moramanga sub-province. The five village areas surveyed were Fanovana, Maravoalavo, Madiorana, Falierana, and Menalamba. In all cases except Maravoalavo the villages represent clusters of several small villages or hamlets. Map 2 identifies the location of all villages surveyed within the different village areas.

Socioeconomic Statistics

In a socioeconomic context, the survey population can be described as one dominated by farmers under the age of 40, most of whom have a primary education or less. Only a fifth of households have more than eight members and almost three-quarters of the population has lived in the area for at least ten years. Agriculture is the primary source of income for 65 percent of the households and is at least a partial source for virtually all the individuals surveyed. Only in the Falierana area is salaried work more important than agriculture as an income stream. Fifty percent rely on salaried work as either a primary or secondary source of income. Forestry remains a minor source of income although 8% of Menalamba area farmers rely on it.

Among those surveyed, 78 percent are Betsimisaraka, another 11 percent are Bezanozano, and 6 percent are Merina. The Betsimisaraka are historically from the region while the Bezanozano are from nearby areas to the east. The remaining 6 percent come from several other ethnic groups. Maravoalavo is particularly ethnically homogeneous where nearly all farmers are Betsimisaraka. The relatively numerous employment opportunities in the Falierana area helps explain its young age distribution as well as its higher ethnic mix and reliance on salary work for income. This also explains why so many of the town's residents are recently installed there (30 percent for less than ten years).

Farming

Survey results indicate that agriculture is the primary activity of 95 percent of farmers surveyed. This figure is consistent with other recent survey work (Shyamsundar, Kramer and Sharma, forthcoming). Tavy and tanety (cultivation of rice on low hills), are practiced by nearly all of the survey farmers. Only 10 percent of the farmers practice some form of irrigated farming, and in every case irrigation is accompanied by other forms of cultivation. Rice, manioc and maize are present on over 90 percent of all farms. Other subsistence crops include beans, taro and sweet potato.
Table 4.1: Socioeconomic Statistics of Individual Villages and Total Sample (percent)

<table>
<thead>
<tr>
<th>Village</th>
<th>Age (years)</th>
<th>Education (years)</th>
<th>Household size</th>
<th>Ethnic composition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;40</td>
<td>&gt;40</td>
<td>Illiterate</td>
<td>1-4</td>
</tr>
<tr>
<td>Fanovana</td>
<td>60</td>
<td>40</td>
<td>12</td>
<td>69</td>
</tr>
<tr>
<td>Maravoalavo</td>
<td>44</td>
<td>66</td>
<td>6</td>
<td>94</td>
</tr>
<tr>
<td>Madiorano</td>
<td>45</td>
<td>65</td>
<td>17</td>
<td>72</td>
</tr>
<tr>
<td>Falierana</td>
<td>73</td>
<td>27</td>
<td>11</td>
<td>67</td>
</tr>
<tr>
<td>Menalamba</td>
<td>46</td>
<td>64</td>
<td>69</td>
<td>23</td>
</tr>
<tr>
<td>Total sample</td>
<td>55</td>
<td>43</td>
<td>20</td>
<td>64</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Village</th>
<th>Time living in area (in years)</th>
<th>Primary income</th>
<th>Secondary income</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;5</td>
<td>5-10</td>
<td>&gt;10</td>
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<tr>
<td>Fanovana</td>
<td>7.5</td>
<td>9</td>
<td>83.5</td>
</tr>
<tr>
<td>Maravoalavo</td>
<td>0</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>Madiorano</td>
<td>3.5</td>
<td>0</td>
<td>96.5</td>
</tr>
<tr>
<td>Falierana</td>
<td>18</td>
<td>11</td>
<td>71</td>
</tr>
<tr>
<td>Menalamba</td>
<td>8</td>
<td>0</td>
<td>92</td>
</tr>
<tr>
<td>Total sample</td>
<td>9</td>
<td>6</td>
<td>85</td>
</tr>
</tbody>
</table>

*A.H. = Animal husbandry*
Bananas are commonly grown by farmers (85 percent) throughout the region. The distribution of those who farm the "cash" crops, coffee and ginger, is skewed towards the two eastern villages. These crops do not replace the cultivation of others. The cultivation of coffee and ginger is very rare among farmers in the Falierana and Menalamba areas. In Fanovana and Maravaloavo, the easternmost villages, 58 percent and 75 percent, respectively, of farmers grow coffee, and 20 percent and 31 percent of farmers in those two areas produce ginger. Typically, the cultivation of coffee and ginger only takes place once the basic food crops are grown. Thus, amongst farmers with only four or five different crops, coffee and ginger are virtually never present. The Maravaloavo farmers may also be taking advantage of their close proximity to the market in Beforona by producing coffee and ginger while Fanovana farmers may be at an advantage because of the easy access by rail to the markets in Andasibe and Ambatavolo. A recent study confirms that these farmers produce coffee in excess of consumption demands (Shyamsundar 1993). Both villages are also in a sub-region where the soils are more conducive to coffee production than the three other village areas. Sugar is rare throughout the region, although 13 percent grow it in and around Falierana. Around a third of farmers in Madiorana produce groundnuts and coffee.

Forestry and Animal Husbandry

None of the farmers surveyed responded that they undertake forestry activities commercially. It was discovered that farmers who work in forestry do so as wage labor. The survey found that the forest concessionaires rarely live in the area although they rely on local labor. One concern is that since concessionaires encourage individuals to move to the area to earn a salary, these people will simultaneously undertake tavy to supplement their livelihood. This phenomenon was not encountered during field work. Most forestry workers appear to already be residents in the region.

The region's farmers are not extensively involved in animal husbandry. Only 6 percent of those surveyed have zebus but three quarters of them raise chickens. Still, animal husbandry is a secondary or tertiary source of income for 30 percent of the surveyed population.

Land Ownership and Use Rights

Almost 65 percent of the 183 individuals surveyed consider themselves owners of their land. Table 4.2 gives the results for the entire sample as well as for each of the five village areas. With the exception of Falierana, most farmers consider themselves land owners. Falierana and other villages located in the south-west corner of the Mantadia park are unique in that they live in an area where two graphite mining companies have already established legal title to much of the land. This has eliminated almost all traditional land ownership. As a result, the people living there must "borrow" land from the mining company to grow crops.

Although they consider themselves owners, most land controlled by the region's farmers is technically public land. Only 5 percent of the total survey sample have legal documentation of land ownership. This highlights how rare the modern, formal system of land tenure still is in this region. Some land is registered by the province but most of the land remains both non-cadastral
and untitled, thereby belonging to the state by default. Land titles are held by the mining companies, the railroads, and private and forestry enterprises.

Table 4.2: Respondents Who "Own" Land (percent)

<table>
<thead>
<tr>
<th>Ownership of land</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total survey sample</td>
<td>64</td>
<td>36</td>
</tr>
<tr>
<td>Falierana</td>
<td>2</td>
<td>98</td>
</tr>
<tr>
<td>Fanovana</td>
<td>84</td>
<td>16</td>
</tr>
<tr>
<td>Madiorana</td>
<td>83</td>
<td>17</td>
</tr>
<tr>
<td>Maravoalavo</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Menalamba</td>
<td>81</td>
<td>19</td>
</tr>
</tbody>
</table>

In addition to those who claim ownership of land, the remainder of the survey population cites authorization to the land they use. As mentioned previously, these authorizations are particularly important to residents in the Falierana area, where mine owners let their workers use mine-owned lands for agriculture. Another important source of authorization comes from the DEF. These authorizations permit *tavy* and, in some locales, are arranged at a village level.

Many farmers considered themselves owners as well as having authorization to farm their land. For example, the villagers of Maravoalavo are untitled land owners whose land use is authorized by the DEF. Similarly, almost half of the respondents from Menalamba said their authorizations are part of the DEF’s five-year plan. In contrast, in the less accessible village of Fanovana only 15 percent said they had an authorization. Few authorizations and ownerships, less than 10 percent, come through requests to the local council, *tangalamena* (the village priest), or *fokontany* chief.

Renting and Sharecropping

Renting and sharecropping arrangements are virtually non-existent in this region as one would expect in an area where unutilized public land is still available. These findings are consistent with those of the previous summer when many of the same villages were surveyed (Shyamsundar, personal communication). The lack of sharecropping arrangements is both cultural and legal. Farmers explained that when someone needs farm land, they will usually give land to use. This is discussed in greater detail subsequently. Since sharecropping is also illegal, farmers may be reluctant to discuss such arrangements with surveyors. The Malagasy survey team remained confident that sharecropping does not exist in this region. A few farmers do rent land bordering the train line from the RNCFM at the nominal cost of FMG5,000 (US$3) per year.

It may be concluded therefore that land is not yet at the level of scarcity that induces sharecropping and rentals.
Traditional Property Rights Regimes

For farmers, land use rights begin with one's access rights. Historically, use rights to land were guided by the principle of the *folakala* whereby the first individual to clear and use the land became owner (Rarijaona 1967). This was declared a legal requirement for ownership during the 18th century. A caveat was that the individual who cleared the land was required to work the land to retain the use rights. If the land was not farmed, it risked being reallocated to other community members.

The rights associated with the *folakala* are bestowed upon the entire extended family of the farmer so that family members most often acquire their land as an inheritance. While the idea of *folakala* is respected, land is typically allocated in a hierarchical manner with the family of the village chief having priority in selecting parcels to cultivate. Other village members then have relative priority in selecting land based upon the length of ancestry of each family in the community (Le Bourdiec 1972). The stratification of land rights is one example of the relative influence of the oldest families within their communities.

**Land Acquisition**

In general, the *folakala* idea still applies in the region but the lack of unexploited land and the cultural rules make it unlikely that an individual, particularly an outsider, will simply seize a parcel of land. For example, in the zone east of the Mantadia park and west of the Sahatandra river (see map 2), there is effectively no primary forest land left (Shyamsundar, Kramer, and Sharma, forthcoming). In some other areas land is still available. In the Menalamba area, 33 percent of the land owners said that they had established ownership simply by converting unused land to agriculture.

If an individual is new to the area, or returns to the area, and seeks a parcel of land for cultivation, a request must be made to be given the land. The process of acquiring that land then depends upon the individual's relationship to other villagers. If a community member from one family wants to farm land belonging to an unrelated farmer, then the entire family of the latter must agree to either accept or refuse the request. In most cases, the request is approved because the notion of a friendly brotherhood, or *fiHAVANANA*, remains strong among the Malagasy. When an individual is new to the area, a request for land is processed through an assembly of the village. Once again, the request is typically approved and in both cases the land is given, not sold, although there may exist some initial in-kind payments to acquire the land. This appears to be the extent of anything like an informal land market. Formal sale of land is very rare since it requires a title or cadastral survey and few individuals are official land owners. In fact, none of the farmers surveyed had purchased the land they use.

The links between land use and property rights in Madagascar are not immediately evident, nor are they uniform, and the degree to which communities regulate the farming practices of community members appears to vary greatly. In the villages surrounding Beforona, a small town southeast of Andasibe, two traditional forms of farming rules exist. The first is the
*sembotrano* which refers to the allocation of land to each community member strictly for upland rice farming with a fixed fallow period (four, six, eight years or more). The tradition is practiced only on hillsides where clan or village tombs are located on the hill crest. The process of allocating and cultivating these lands traditionally includes a sacrifice of a zebu, a significant cost to many villages where zebu populations are small or nonexistent. The second, more common form of farmland is the *jinjeranto* under which all possible crops are grown. These lands are not regulated by the village and farmers can establish long-term use rights by planting trees like coffee and banana (Aeberhard 1992). Today, declining rice yields have led to the adaptation of some of the basic rules described here, such as the inclusion of low lands in production and abandonment of the eight-year fallow rule on *sembotrano* lands in some areas (Aeberhard 1992).

In Maravoalavo, the easternmost village surveyed, the *tavy* system is controlled by the *sembotrano* and *jinjeranto* system previously described. Land is allocated to farmers through the village priest and strict farm/fallow cycles enforced. Maravoalavo was the only village surveyed where the *sembotrano* system was found. The reasons for this remain unclear. The other villages, all farther to the west, may have never followed a controlled *tavy* system. Farmers in Menalamba were familiar with the process and explained that sacrifice of zebu, part of the *sembotrano*, became unaffordable, leading these villages to adapt their land use rules. Today, there is no sign that these other villages have land parcelled out through the *sembotrano*.

**Traditional Authority and Land**

From pre-colonial days to the present, an important level of community organization has been the *fokonolona*, or village assembly. The *fokonolona*, which was formally recognized by rulers as early as the 18th century has had an evolving role in Madagascar. Before colonization, land within a *fokonolona* was shared by the families who were members; holders had user rights but no one owned the land and the *fokonolona* retained the right to take the land back. Furthermore, land use was to conform to guidelines set by the *fokonolona*. The community's rights consistently outweighed the individual ones (Rakotomanga 1976). During the colonial period, the *fokonolona*’s authority was initially recognized and even legally defined. However, the *fokonolona* was not given legal right to register land. This form of community organization was formally replaced by the French colonial authorities in the 1940s, which served only to confuse the nature of organization and responsibility at the village level.

Since independence (1960), the *fokonolona* has been rejuvenated. In the 1970s, the role of the *fokonolona* was again defined, this time as the basic level of authority in Malagasy society. Its responsibilities included the administration and use of land, and the authority to establish collective titles to land. The full extent of the relationships between the *fokonolona* and property rights can be found in *Le Fokonolisme et Droit Foncier*, by George Rakotomanga (1976). See Bibliography.
fokonolona or whether this has been usurped by the more modern authority embodied in the fokontany president and council.

The tangalamena is another important form of authority involved in resolving disputes, counseling villagers, presiding over various ceremonies, and helping ensure agricultural production. However, the tangalamena is not associated with all households. Rather, the tangalamena exists for some families, which appear to be part of a higher caste than the rest of the community, which might be referred to as the peasant class. This social stratification, and the power of the tangalamena in general, was found to be more important in the eastern villages of Maravoalavo and Fanovana.

Extent of Common Property Lands

In the microregion today (1993), the two most important forms of common property systems, grazing and irrigation, are very limited and so common property resources are both less common and much more difficult to identify and understand. Farmers often did not clearly understand what was meant by common property and how it differs from public land. Some members of a village would say that there were common lands while others insisted that there were none. One possible explanation is that only some extended families have shared land for non-agricultural uses. Another likely possibility is that farmers have different perceptions of who controls the land they use. Table 4.3 summarizes the responses to the question whether villagers have common lands and whether individuals collected products from public lands.

Table 4.3: Extent of Common Lands and Use of Public Lands (percent)

<table>
<thead>
<tr>
<th>Village</th>
<th>Does your village have common lands?</th>
<th>Do you collect products from public lands?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Total sample</td>
<td>20</td>
<td>79</td>
</tr>
<tr>
<td>Falierana</td>
<td>2</td>
<td>98</td>
</tr>
<tr>
<td>Fanovana</td>
<td>19</td>
<td>79</td>
</tr>
<tr>
<td>Madiorano</td>
<td>24</td>
<td>76</td>
</tr>
<tr>
<td>Maravoalavo</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Menalamba</td>
<td>0</td>
<td>100</td>
</tr>
</tbody>
</table>
The farmers of Maravoalavo all recognize the presence of common lands. Discussion with community members revealed that they have a well-defined relationship with the DEF under which their land for *tavy* is recognized as community land with individually-farmed plots. In contrast, the farmers in the Falierana area clearly recognize a lack of available community and public-owned land for collecting forest products, since most land is titled by the mining companies or controlled by the DEF.

The inconsistency of responses to direct questions on common property and public land has several important implications. First, it indicates the ambiguity over the definition and source of access rights in this region. Second, it suggests the mixed nature of property in these communities where rules for common use may exist for some land areas or uses while *de facto* private property governs other areas and uses. Finally, there exists a communication gap between locals and "outsiders," other Malagasy who do not live in the area, which complicates the discussion of land use issues.

Even though the land officially does not belong to the residents, the inheritance system still actively guides property rights. Such a system provides for families to have exclusive farming rights to land. Among the Betsimisaraka, once the land was left in fallow, the use right ends and another farmer can convert that land for agriculture (Le Bourdiec 1972). However, field-work conducted for the present study indicated that farmers can secure their property rights during fallow by planting perennials such as banana trees, coffee plants, fruit trees and others. The trees help distinguish land already claimed and will prevent others from clearing the area for agriculture. The same property becomes open to others during the fallow period for non-farming subsistence uses such as the collection of grasses, fuel wood, medicinal plants, hunting, etc. The fallow areas in this region are in this sense very different from typical fallow lands in swidden agricultural systems. It is not clear if this system has always existed or is a relatively recent phenomenon brought on perhaps by population growth and the needs of villagers to exert ownership over fallow areas as well.

The land available for agriculture is predominantly *savoka* land, since it is all that is left that is not protected by the DEF. The system of inheritance rights takes on great significance for *savoka* since only the descendants of those who cleared and farmed that land in the past have the right to cultivate it today.

Expansion of Land Holdings

Nearly half the survey population stated that it was impossible to increase their agricultural holdings. Most of those farmers live in Falierana and Maravoalavo. Falierana farmers are obviously constricted by the titled lands which surround them. For farmers in Maravoalavo, the total available land appears to have already been distributed through the *sembotrano* and *jinjeranto* systems. Many farmers in the three other village areas, Fanovana, Madiorano and Menalamba, perceive available land for expansion of agriculture. The principal mechanism of increasing lands is through forest clearing, most often of *savoka* land. In all villages the farmers did not communicate a sense of serious shortages of forest products. However, half the
respondents (particularly in Falierana and Maravoalavo) did express concern over shortages of land and fertile forests for their children. Around Menalamba, the Torotorofotsy swamp is perceived as a potential area to be converted for agriculture. These various situations illustrate how the land resource is already allocated and being intensively reused in most areas and why the quality and productivity have been in decline.

Tables 4.4 and 4.5 present the survey results of percentages of farmers using community land and public land for non-agricultural needs.

**Table 4.4: Farmers Collecting Products from Public Lands (percent)**

<table>
<thead>
<tr>
<th></th>
<th>Fuel wood</th>
<th>Building wood</th>
<th>Grasses</th>
<th>Medicinal plants</th>
<th>Clothing fiber</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total sample</td>
<td>39</td>
<td>20</td>
<td>11</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>Falierana</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Fanovana</td>
<td>70</td>
<td>46</td>
<td>25</td>
<td>34</td>
<td>27</td>
</tr>
<tr>
<td>Madiorano</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Maravoalavo</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Menalamba</td>
<td>27</td>
<td>23</td>
<td>15</td>
<td>8</td>
<td>27</td>
</tr>
</tbody>
</table>

**Table 4.5: Farmers Collecting Products from Community Lands (percent)**

<table>
<thead>
<tr>
<th></th>
<th>Fuel wood</th>
<th>Building wood</th>
<th>Grasses</th>
<th>Medicinal plants</th>
<th>Clothing fiber</th>
<th>Rice farming</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total sample</td>
<td>7</td>
<td>1</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>11</td>
</tr>
<tr>
<td>Falierana</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Fanovana</td>
<td>15</td>
<td>3</td>
<td>9</td>
<td>3</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Madiorana</td>
<td>10</td>
<td>0</td>
<td>14</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Maravoalavo</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>Menalamba</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

The people of Fanovana rely heavily on public lands for their fuel wood collection. This correlates with the village belief that forest resources are still abundant. Once again, Falierana has no nearby public lands to be exploited, which is one more reason for the area residents' resentment of the park. Madiorano and Fanovana were the only areas where farmers use common lands to gather non-agricultural goods. All farmers surveyed in Maravoalavo described their *tavy* as occurring on common lands even though farming takes place at the household level. It may be that some of the rice harvest is reallocated within the community but the surveyed farmers gave...
no indication that this was the case. While farmers rely on public lands for a variety of goods, they perceive their tavy practice as one which does not rely upon the public domain to persist.

The property rights structure can be summarized as one in which most farmers have individual farming plots, acquired through inheritance. Farmers are not typically constrained in their agricultural decisions by traditional rules, except in Maravoalavo where land appears to be very clearly allocated and regulated. Their constraints and decisions are related to the paucity of infrastructure services, total available land, soil characteristics, labor, and subsistence needs. The savoka land is at times communal and at others de facto private land, depending upon whether it is being actively farmed. The savoka area also defines the maximum amount of land available for farming in the microregion and is most in need of improved long-term management.

Size of Farmer Land Holdings

The farmer land holdings are relatively uniform in the microregion. While there are a few individuals with very small areas, a large majority holds more than 1 hectare and almost 70 percent of the respondents hold more than 2 hectares. This exceeds the average sizes of rural farms reported in most studies in the region. However, around Fanovana, a third of the farmers have holdings of less than 1 hectare. The higher than expected size of land holdings reflects the combined area farmers have under cultivation and in fallow.

Table 4.6: Size of Land Holdings by Village (percent)

<table>
<thead>
<tr>
<th>Village</th>
<th>&lt; 1/2 ha.</th>
<th>1/2 to 1 ha.</th>
<th>1 to 2 ha.</th>
<th>&gt; 2 ha.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total sample</td>
<td>4</td>
<td>12</td>
<td>16</td>
<td>67</td>
</tr>
<tr>
<td>Falierana</td>
<td>0</td>
<td>11</td>
<td>27</td>
<td>62</td>
</tr>
<tr>
<td>Fanovana</td>
<td>12</td>
<td>22</td>
<td>22</td>
<td>43</td>
</tr>
<tr>
<td>Madiorano</td>
<td>0</td>
<td>7</td>
<td>0</td>
<td>93</td>
</tr>
<tr>
<td>Maravoalavo</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>94</td>
</tr>
<tr>
<td>Menalamba</td>
<td>0</td>
<td>0</td>
<td>12</td>
<td>88</td>
</tr>
</tbody>
</table>

NATURAL RESOURCE MANAGEMENT

How farmers can become involved in a more sustainable pattern of agriculture, less reliant on tavy, also requires understanding their perceptions of the quality and quantity of the resource. This is also important to assessing whether they are aware of the gradual degradation of the environment which surrounds them.

In general, local farmers do not believe they have any problems acquiring forest products, to the extent that a full 100 percent say so in three of the five areas surveyed. As mentioned
earlier, some area farmers feel strongly that their children will not have enough land or forests in the future. This was particularly true in Falierana and in Maravoalavo, the two areas where farmers reported they had little or no unused land. Again, this is likely to be related to the privatization of most lands around Falierana and the very structured communal allocation of lands in Maravoalavo. The relatively remote villages, particularly Menalamba, have less concern that shortages in forest products will be a problem in the future.

**Fallow and Fallow Length**

Almost all regional farmers base fallow decisions upon soil quality, which determines both agricultural productivity and the amount of weeds which arise. But the results in Table 4.7 clearly show that fallow lengths are often shorter than the desired length necessary for the region's soils to regain their fertility.

*Table 4.7: Reported Average Fallow Lengths of Regional Farmers (percent)*

<table>
<thead>
<tr>
<th>Fallow length:</th>
<th>No fallow</th>
<th>&lt;3 years</th>
<th>3-5 years</th>
<th>&gt;5 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total sample</td>
<td>13</td>
<td>24</td>
<td>43</td>
<td>17</td>
</tr>
<tr>
<td>Falierana</td>
<td>33</td>
<td>42</td>
<td>18</td>
<td>2</td>
</tr>
<tr>
<td>Fanovana</td>
<td>0</td>
<td>6</td>
<td>49</td>
<td>36</td>
</tr>
<tr>
<td>Madiorano</td>
<td>14</td>
<td>28</td>
<td>52</td>
<td>7</td>
</tr>
<tr>
<td>Maravoalavo</td>
<td>6</td>
<td>6</td>
<td>88</td>
<td>0</td>
</tr>
<tr>
<td>Menalamba</td>
<td>4</td>
<td>46</td>
<td>31</td>
<td>19</td>
</tr>
</tbody>
</table>

*Note:* Totals do not equal 100 percent because a small percentage of respondents had too recently migrated to make fallow periods relevant.

In Falierana, a third of respondents reported no fallow period at all and another 42 percent say their fallow period is less than three years, reflecting the shortage of land in the area. Just the opposite is found in Fanovana where only 6 percent have fallow periods less than three years. The fallow periods of farmers in Fanovana and Maravoalavo are on average the longest. In Fanovana, this is most likely associated with the relative abundance of land although it is difficult to reconcile this finding with the small land holdings already reported for that area. One explanation is that because this land is particularly steep, the farming area is distinctly limited by labor constraints and that enough land remains in the area to maintain the relatively long fallow periods. In addition, the farmers here have soils more conducive to coffee which, when marketed, can reduce their annual demand for tavy farm land. Perhaps the soils are, in general, much richer, reducing the area farmers must cultivate each year.

The long fallow regimes in Maravoalavo are much more closely associated with the very structured community that lives there. Because the Betsimisaraka community in Maravoalavo has
strong rules regarding *tavy*, the large majority of farmers have similar fallow lengths (three-five years).

The inadequacy of fallow regimes is more apparent in Falierana, Menalamba and Madiorano than in the two eastern villages. For the Falierana residents, it is obvious that land is in short supply. The Menalamba and Madiorana farmers must be facing similar constraints because they are well aware of the low productivity associated with reduced fallow lengths.

**Assistance with Agriculture**

Despite their productivity problems, farmers in most areas report limited external assistance with farming. The exceptions are in Maravoalavo and Madiorano. In Maravoalavo, around 80 percent of the farmers have worked with extension agents and in Madiorano almost 60 percent have had extension assistance. Assistance in agriculture often comes from the DEF and not the agricultural extension services which reflects the prevailing policy that the DEF is responsible for land use in forested zones, including the farmers that live there. Whether they are qualified or not, DEF agents are working in agricultural extension in this microregion. In Maravoalavo, farmers were very vocal about their dissatisfaction with extension services. Consequently, many farmers solve their problems themselves or discuss them with other farmers.

**PERCEPTIONS OF THE MANTADIA NATIONAL PARK**

In general, individuals are aware of the park, although there are some (26 percent) who are not, mostly individuals farther away. People are well aware of their relative distance from the park, and this awareness transforms into their perception of benefits or problems caused by the park. This park, like others in Madagascar, has been a source of conflict with the established patterns of resource use amongst nearby communities and villages. The villagers have found themselves suddenly excluded from agricultural use of the land inside the park. In some cases, lands in the park have already been cleared by farmers and their exclusion now conflicts with their perception of ownership arising from clearing that land.
Table 4.8: Farmer Perceptions of Benefits and Problems Associated with Mantadia National Park (percent)

<table>
<thead>
<tr>
<th>Village</th>
<th>Benefit</th>
<th>Problem</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Falierana</td>
<td>16</td>
<td>84</td>
</tr>
<tr>
<td>Fanovana</td>
<td>31</td>
<td>69</td>
</tr>
<tr>
<td>Madiorano</td>
<td>41</td>
<td>59</td>
</tr>
<tr>
<td>Maravoalavo</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Menalamba</td>
<td>8</td>
<td>92</td>
</tr>
<tr>
<td>Total sample</td>
<td>27</td>
<td>73</td>
</tr>
</tbody>
</table>

In terms of problems caused by the park, the most important is that it limits access to agricultural land. No individual mentioned a problem related to limited access to fuel wood and only one mentioned a problem of getting building material. A rough calculation quickly summarizes both the extent and potential for conflict between the farmers and the protectors of the park. If 16 percent of Fanovana area residents are concerned about the unavailability of agricultural land, this suggests that there is a potential land scarcity problem for approximately 30 to 35 households and more than 200 people in that area alone. There are numerous villages to the north of Fanovana that are located along the eastern border of the park where many farmers have similar attitudes about the park. This relatively new land constraint caused by the park’s creation is likely to exert greater pressure on these farmers to decrease the length of their fallow regimes in the secondary forest outside the park. While there are as yet relatively few land conflicts between farm families within and across villages, their frequency could potentially rise in the communities east and southeast of the park in the future.

Finally, farmers discussed how they feel the forests should be managed. Not surprisingly, the farmers have a strong sense of community. When asked who would be best suited to control and manage the forest areas in the region, 63 percent favored the community. This finding should be interpreted carefully since there was not a follow-up discussion of the specific role farmers would expect the community to assume. It may be that farmers believe community management of forest resources is equivalent to the status quo. Another 18 percent suggested that one public agency or another would be most suitable. Very few, only 7 percent, favored local traditional leaders like the tangalamena and village elders, or local administrative officials as appropriate entities to control forest management. Nevertheless, these findings hint at the possibilities for effective community-government interaction in better managing the region’s forest resources including redefining access rights, encouraging reforestation programs, promoting group experimental projects on common lands which benefit from scale economies, and ensuring greater local participation in park management and tourism.
COMMONALITIES AND DIFFERENCES ACROSS VILLAGES

In all five village areas, tavy is the predominant land use, agricultural technology and intensity is extremely low, and technical assistance is limited. This is true regardless of population densities, existence of salaried income, or the size of land holdings. Unanimously, farmer land ownership is based upon traditional rules of inheritance, with a very small fraction of farmers having legal title to their land. Yet reliance on areas of common property and public property vary considerably from one village to the next. Maravoalavo is highly organized around individual production with the approval of and under the supervision of traditional village authorities. For farmers there, land is perceived in short supply and is composed of common property land individually managed. Fanovana is very similar, relying heavily on traditional authority systems, although with much less central decision-making over access to land than in Maravoalavo. Fanovana farmers perceive that more land is available for agricultural expansion while the Maravoalavo farmers feel that such expansion is impossible. For this same reason, and also because Fanovana is more remote, its farmers place greater reliance on public lands for forest resources. Both villages have very high levels of ethnic homogeneity which probably contributes to the power of the village priests and elders. In contrast, the Falierana area residents are much more mobile, less heterogeneous, and have much greater opportunities for alternative income with the mines, forest concessionaires and enterprises and railroad. The Falierana residents still rely on tavy to supplement their low incomes and, unlike the other villages, this reliance and close proximity to the park have made the area's residents particularly resentful of the park because it has limited their potential for agricultural expansion. All the village areas except Menalamba are very hilly which limits farmer capacity to pursue irrigation and plow-based agriculture.

While tavy rice production in the microregion is suitable in some respects (cultural, topographical, etc.), discussions indicated that the practice is threatening to both the carrying capacity of available land (causing soil and productivity loss) and the maintenance of the protected area borders. At their present level of income, and given their limited access to infrastructure services and inputs, the region's farmers lack the resources and incentives to attempt rice intensification, use fertilizer, expand cash crops production, or otherwise invest in alternative sources of income.

Maravoalavo has effectively maintained its traditional structures of authority and rules systems. This has allowed its farmers to maintain at least some community-directed farming land for tavy and many are able to supplement their incomes through ginger and coffee production. But individual holdings are small, land is scarce and rice productivity remains low. The potential for salary income near Maravoalavo is also very low so farming will remain important. The DEF has already had mixed results from this involvement with the villagers.

Although there is an agroforestry station very close to Maravoalavo, the farmers show little interest in the techniques encouraged by the staff at the station. It is likely that the benefits of agroforestry are not well understood. Also, inputs being low and subsistence needs great, agroforestry alternatives are difficult and expensive to adopt.
Farmers in Falierana and the nearby villages are perhaps the most limited in land area. The park is very close and strictly off limits and most other land is owned by the mines and other business interests. As users of mine-owned farm lands, their land security is much less and this would eventually reduce their investment incentives. This unique situation presents some very different problems around Falierana compared to the other village areas. Traditional structures are much weaker probably because the residents are more diverse and more recently established. The easy access to the Andasibe market area fails to overcome these other difficulties and poverty remains widespread. Like Maravoalavo, the successful undertaking of intensification of rice, or the pursuit of alternative cash crops requires not only the resources to acquire inputs, but also access to infrastructure services, and ultimately, tenure security. Unlike the other village areas, the potential for non-agricultural income is great because of the proximity to Andasibe. However, there already exists a system whereby mine workers make a nice profit by hiring labor to practice *tavy* on their land and then sell the harvested rice (Shyamsundar 1993).

Increases in non-agricultural employment could easily lead to more *tavy*, not less, if this kind of arrangement is allowed to persist. It is interesting that the farmers around Falierana do not put their land into cash crops. The most likely explanation is that the total area is just too small, the soil too poor, and the costs too high to jeopardize necessary rice production on the land that is available.

The situation of the villagers of Fanovana is very similar to that of the other villagers living along the eastern border of the park. Their access to land is constrained by the presence of other villages and by the park making holdings somewhat smaller than average, although they are able to grow coffee and ginger. While there are train lines to access markets to the east and west, Fanovana is relatively isolated, and this is reflected in the low level of interaction with the DEF, and also in the importance and influence of the *tangalamena*. The relative proximity of Fanovana to the park has created a distinct boundary for villagers to extend *tavy*. Villagers in Fanovana are also dependent on public and common lands for forest products. Finally, the Fanovana area has several villages which border it to the north and south. Combined, these factors are creating conditions for rapid resource decline from increased reliance on the secondary forests and for greater conflict over land between villagers, the park and adjacent villages. This suggests that this area has a particularly urgent need to consider how land should be allocated in the future to avert outright degradation and to defuse potential conflict through more organized planning to diversify land use.

Various conditions prevail for the village farmers around Madiorano. Few residents are new to the area and they are almost all reliant on agriculture as a major income source. The groundnut production in the area is a signal of its potential in the region in general. Land availability pressures appear to be much less for farmers here than in the other communities surveyed. Perhaps for this reason, the use of common property and public lands is very limited for farmers around Madiorano. The introduction of the Integrated Forest Valley Management program (AIVF) has led to greater interaction between communities and the DEF in agriculture, forestry and other activities. Such was the case in Maromizaha where the residents have established a eucalyptus plantation. The *tangalamena* appears to be much less influential as an
authority in this area and the case of a family in Madiorano pursuing a diverse range of activities demonstrates that the extended family is one level of intervention which can serve to change land use patterns. Whether this interesting case will persist remains to be seen.

The Menalamba area farmers are the most remote in the study. Andasibe is sixteen kilometers away, although a spur of the train line runs from Menalamba to Andasibe twice a week. Its relative isolation is preferred by the large group of Bezanozano who live in the area. Land area holdings in Menalamba exceed, on average, those in the other villages. In general, land appears to be in good supply and few farmers use all their land in a given season. Despite this fact, almost half the area's farmers have fallow regimes of less than three years. The reasons for this are not clear although one explanation may be that the soil has been less exploited and regains its fertility sooner, requiring shorter fallow periods. Because of the presence of the swamp and flat areas, the Menalamba farmers are far more likely to undertake irrigation work (33 percent) than the other villages farther east.

Unlike the other four village areas, the Menalamba farmers appear to be classic open access resource users because there is less interference from the DEF and the land in general is more abundant. Uncontrolled clearing could pose a threat to the health of the swamp, as could hasty programs to expand rice paddy cultivation. At the same time, considerable potential for sustainable use and higher rice yields exists if technical and market support is increased. There is also a need to bring their open-access use of forest land under some greater control in the long term. To do this will require better local organization and interaction with the government and development NGOs.

The findings do not provide evidence that villagers are experiencing insecurity of tenure and land use conflicts. However, the fallow periods (often less than three years) under the tavy system have become shorter than ecologically desirable. Also, some communities are facing shortages of available land for farming. Generally, farm sizes are small and are likely to become smaller through inheritance practices. The results show that farmers have access to public lands but that these lands are not properly regulated and controlled by the state.

BEHAVIORAL ANALYSIS OF FARMERS

Economic analysis of two production systems (see Annex 2) shows that under an improved policy environment with easy access to credit and inputs (improved seeds, fertilizer, tools, etc.), and better marketing arrangements, the value of output under an intensive (fertilizer based) annual production system will be significantly higher than under a traditional system which uses limited levels of agricultural inputs and technology. Under the traditional production system, total rice output in the villages of Fanovana, Sandranady, and Ambodinikoma would be 192,000 kilograms per year through year 5 at which point output would begin to decline as land begins to go out of production because of loss of soil fertility. The net present value of the output over twenty years is equal to US $430,300 for the village, and US $ 1,900 per farm. By contrast, under improved conditions and intensive agriculture, total rice production in the same villages
would increase over time to 326,000 kilograms annually. The net present value at this new level of production over the same period is equal to US $533,000 for the village, or US $2,400 per farm.

This economic analysis shows that the direct benefits of intensive agricultural rice production in the three villages are significant, with notably higher production per hectare and a farm gate value which exceeds the incremental in costs. Another benefit is that less land is required on an annual basis, thus reducing the rate of further diffusion and reliance on tavy. If this is a better production system, it is necessary to ask what factors have influenced farmers to not pursue this type of intensification, or more generally, why do farmers in this region not pursue a more diversified cropping pattern with greater reliance on perennial crops and fertilizers.

In the microregion under study, forest valley land is limited, few farmers have access to these areas, and much of it suffers from poor drainage making cultivation difficult. In view of these conditions, most farmers allocate low hills to crops such as manioc, sweet potato, taro and others. Rice is also grown in this area. The steeper, higher hills are then used for rice production, interspersed with cassava and maize. In terms of total available farm land, the greatest percentage is on the steep mountain slopes.

The farmers are making a rational decision under existing conditions and constraints. Typically, wage labor has been very small, only the simplest tools are affordable, and fertilizers are unavailable and, when available, expensive. In this situation, farmers have chosen to continue tavy, relying on family labor, although they may hire individuals for a brief time during harvest (less than one month). Fallow periods are now shorter than desirable, and it is clear that farming intensity in the microregion is reaching levels where a transformation in technology must occur.

There are other important constraints to agricultural transformation which have emerged in the analysis and in the review of other work on Madagascar. First, the government's taxation policy on the traditional export crops was for long a disincentive to farmers in expanding or improving their cultivation of these crops. Towards the east coast where coffee is a major crop, farmers made the minimum effort necessary to keep their existing plants thriving but were discouraged from increasing their coffee production in these unfavorable pricing conditions (World Bank 1993). This created a favorable environment for the expanded production of crops such as rice, cassava, beans and others.

Underdeveloped agricultural markets and inadequate rural infrastructure have also been impediments to land intensification. Extension services are not adequate in the study areas, and farmers are therefore not fully aware of the various technologies available. Input supply systems, in particular fertilizers, are not well developed and thus the inputs are expensive. If farmers perceive limited opportunities and high costs in marketing their surplus, there is little incentive for them to abandon tavy to produce goods which they cannot move to market or sell at attractive prices. The microregion is unique in that it is traversed by a high quality all-weather highway. This has not, however, translated into easier marketing for farmers only a few kilometers off the highway. More profound is the problem of market infrastructure. A study of the rural marketing
system found that there is almost a total lack of marketing infrastructure, institutions and services which severely restricts their efficiency (World Bank 1993). Because of the underdeveloped nature of organized, permanent rural market centers, transaction costs are high, information is limited, and the markets are too dispersed to overcome the existing dominance of rural trade by a few. Improvements in this situation have occurred with trade liberalization but they have focused on areas of developed transportation and communications. Furthermore, the rural finance sector is characterized by high lending costs which have prevented its effective expansion in most rural areas. Informal credit markets do exist but are still small. Given these conditions, it is not surprising that farmers have not been motivated to intensify and diversify their agricultural production for marketing.

What is the impact of the present land tenure situation on agricultural development? First, the study cannot determine with certainty that the traditional property rights system which governs land use and access has degenerated to a point where land conflicts and insecurity are widespread in the microregion. In fact, the customary system provides tenure security to farmers who continuously cultivate tracts of land, and the planting of certain tree crops secures tenure even for plots which are not under annual cultivation. In this context, the traditional land tenure system may not represent the most immediate obstacle to the adoption of a different production technology which may entail the increased use of tools and inputs.

Cultural and social norms encourage the persistence of tany. The tany system is an established cultural practice which is respected as highly as other aspects of their traditional collection of rules and beliefs. As Rarijaona (1967) explains, the traditional property rights systems in Madagascar are intended to maintain internal social harmony. However, historically, the pattern of land use, and the rules governing land tenure, tend to be modified when changes in economic, physical and technological conditions lead to the incompatibility of the old socio-cultural structure. The pace of change may be slow, however, and some irreversible degradation may take place before the system adapts.

The level of poverty has another important implication. When farmers are already poor and producing at subsistence levels, shortened fallow regimes are not compensated by the increased use of unaffordable techniques to maintain productivity. The lack of production surplus is a constraint to reinvestment in land productivity or other activities (Mink 1993). A well-functioning credit system would facilitate the transition, but such a system is not yet established. As a result, the farming base expands as far as possible and yields stagnate or decline.

The analysis and literature lead to the conclusion that in the short term, agriculture transformation towards a sustainable cropping pattern, and improved resource management require a focus on improvements in price policy, infrastructure, extension services, marketing and research.

However, in the longer term, an agricultural development strategy would require attention to tenure issues (dealing with private, commercial and public lands). The level of population growth is very high, approximately 3.5 percent annually and the in-migration rate is estimated to
be quite high as well. Improved provision of health services in the Andasibe area, including, for example, recent immunization programs, has led to higher than normal child survival rates (Richards, personal communication). Shyamsundar (1993) found evidence of a very young population with more than 50 percent below twenty years of age. An increasing level of forestry and mining activities and the favorable position along the national highway will contribute to the continuing in-flow of migrants to the area. The recent changes in agricultural pricing policies, and a continuation of recent trends in agricultural growth could be felt in this region as well.

These factors will likely converge in the future to create conditions of severe land scarcity in the microregion. In these circumstances, the traditional system of land allocation and tenure will become strained and may eventually fail, leading to tenure insecurity and insufficient incentives to invest in permanent farming. While traditional systems have shown a capacity to evolve and adapt over time to changing circumstances, waiting for indigenous adaptations to occur in a period of rapid environmental degradation would jeopardize the stability of these communities, and may result in irreversible losses of land productivity. This suggests that while short-term strategies focus on agricultural markets and services, a long-term perspective for sustainable natural resource use requires an improved land policy in the region in the context of a national land use policy. This will mean anticipating the growing potential for land insecurity and conflict in this region and elsewhere and initiating discussion and research in the near future to determine how the public sector, with its limited financial resources, and local communities can improve the management of public lands to avert conflicts and environmental degradation before they become overwhelming.
5. CONCLUSIONS AND RECOMMENDATIONS

The study shows that agriculture, the mainstay of the economy in the microregion, is adversely affected because of the lack of adequate marketing, infrastructure, extension services, and inputs. A review of the tenure regime indicates that the traditional system still prevails and is generally being enforced through customary procedures. Although there is demand for land and shorter fallow periods, the study cannot prove that the farmers in this region are plagued by insecurity over their farming land rights nor that there is significant landlessness. There may be conflicts and disputes over land rights in these communities, but there is no evidence that they are numerous, and thus one cannot assert a condition of widespread tenure insecurity. It is anticipated, however, that with population growth, tension over land, a weakening of the enforceability of the traditional system, and tenure insecurity will increase in coming years. Already, there are areas in the microregion that are facing land shortages. Furthermore, there is some confusion regarding the rights to public land. These conditions could be exacerbated by an increasing population, thus resulting in the further decline of the region's resource base.

The study points out several factors that deter the adoption of alternative cropping patterns (other than shifting cultivation) which may be more sustainable. Heavy coffee taxation policies until 1992 (as well as the rapid decline in international coffee prices) created little incentive for farmers to undertake investments in expanding coffee production. Formal credit is very rare in the region for numerous reasons (high administrative costs, risks, limited branch network) and informal credit is driven by more immediate needs than agricultural investments such as ceremonies, weddings, school fees, and others (World Bank 1993). The relative poverty of farmers makes it difficult to afford capital inputs (many farmers do not even have hoes) and fertilizers, although this is further complicated by supply-side problems. While the main highway and railroad are important, the scarcity of feeder roads prevents attractive farm gate prices. Finally, the extension services (both public and NGOs) are insufficient and do not act as an effective link between the government's agricultural objectives and field assistance.

When considered collectively, this represents a formidable set of constraints to the intensification of agriculture and adoption of an alternative cropping system, based on input intensive, permanent farming. This thus blocks improved natural resource management and agricultural transformation in this region.

SHORT- AND MEDIUM-TERM PRIORITIES

The study has cited the many shortcomings of the agricultural sector environment which impede agricultural transformation. A recent World Bank review of the sector has analyzed these problems and proposed policies to improve production through the promotion of comparative
regional advantages in specific crops. The study region is difficult to categorize as belonging to either the highlands, to the west, or to the low altitude east coast region. For this reason, a clear identification of its comparative economic advantages for crop production has been difficult.

As the study points out, local rice production is always competitive for local consumption, although not necessarily for marketing. Both cassava, which is already a common household crop in this microregion, and potato, which performs well in rainfed systems, should be assessed for their growth potential in both domestic and export markets. If cassava continues its current growth in production, then some testing should be done to identify ways to raise yields. Some areas in the microregion may also be suitable for expanded peanut production.

The microregion could have potential for coffee production. Most coffee produced in Madagascar is robusta, which fetches a lower price than arabica in the world market. The microregion is at the lower altitude range for arabica cultivation. However, the barriers to coffee are more related to transportation costs now that the taxation has been removed. Another significant constraint is that the financial returns to planting coffee (rather than relying on existing trees), have been shown to be lower than those for hillside rice production. Overcoming this requires improvements in credit and better infrastructure to reach markets. Finally, the production of ginger in this region should be assessed. The crop does not figure in the national accounts and it is known to deplete soils, but it has proved to be marketable in the area.

The improvement of incentives for agricultural intensification and diversification also requires improved rural roads. The microregion does have national highway 2, but there are few maintained secondary roads and/or a system of feeder roads which link with the highway. Care must be taken not to develop roads which will later degrade because no policy was enacted to ensure maintenance. In a review of rural roads, it was found that there was a limited planning capacity at the central level with particular weaknesses in road rehabilitation and maintenance. In addition, rural roads are not built to any uniform standard and a central administration and project approach has prevented the decentralization of technical capacities, implementation and the supervision of rural road work. The problem of road maintenance is linked to the lack of appropriate resources and recommendations have been made to decentralize financing and establish a system of local matching funds.

The inadequacies of the marketing system in Madagascar were mentioned in Chapter 3. The major constraints to efficient rural markets include the lack of market places, storage facilities, rural town infrastructure and others. A visitor to Andasibe will quickly realize the importance of this shortcoming when buying provisions at the local store at prices far higher than those in Moramanga, thirty kilometers away. The physical shortcomings are, however, driven by policy problems. The local governments which are responsible for market infrastructure

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are saddled with financial, technical and managerial constraints exacerbated by insufficient support from the central government.

The rural financing needs in this region are particularly acute. The focus of most financing in the sub-province is in the Lake Alaotra region. The Bank's agricultural sector review emphasizes that rural financial services have been hampered by high cost, high risk, poorly adapted institutions, and inappropriate policy. The system is presently top-down and too limited in scope to benefit most small Malagasy farmers. Given a positive past experience with farmer associations, recommendations focus on developing small-scale rural financial services which can operate at lower costs. The existing system of working with farmer groups can be built upon and introduced in the microregion. Components of such a program would include:

(i) Accurate monitoring and evaluation so that programs maintain their effectiveness;
(ii) Recognizing that the relevant size for group associations may vary and that smaller groups can be part of a larger federation; and
(iii) Legislation to recognize the powers and responsibilities of groups and their members.

Improvements in credit combined with better extension services will be important in identifying cropping alternatives which interest farmers. The farmers will require financial and technical support to match plans for agricultural diversification and intensification with the selection and financing of appropriate tools, fertilizers and seeds.

All these issues and suggestions for the agricultural sector should be considered for trees as well. The microregion's high rainfall is conducive to rapid tree growth. Agroforestry and village plantations can take advantage of this as well as of the creation of local credit services which can diversify the risks and reduce the opportunity costs of land taken out of agriculture. Once a harvesting cycle is complete, the capacity to sustain plantations will significantly improve. However, consideration should be given to species besides eucalyptus in this process.

LONG-TERM PRIORITIES

The measures related to agricultural transformation that have been reviewed here are feasible, but their implementation will necessarily occur gradually given that the government will face constraints to the achievement of rapid change and communities will need to be persuaded to adopt new farming systems. The new strategy will need to be complemented by a long-term perspective of the issues related to tenure security and conflict over land rights which are likely to emerge under conditions of high population growth. A key concern within this context is the minimization of irreversible degradation.

In the long term, as agricultural productivity, community organization, land markets and institutional support develop, more secure forms of land ownership may be necessary. Generally, given that the structure of production is already based on individual use rights, the system of private property may need to be formalized and long-term tenure security will need to be
enhanced. This does not necessarily imply titling, and intermediate levels of documentation, less costly to administer, should be considered. In the transition, if traditional authorities are not taken into consideration, and their spheres of influence not well understood, there is potential for opposition to any changes in property rights arrangements.

One recommendation made in Zambia, and relevant here, is to abandon such an approach in largely inaccessible regions in favor of general physical boundaries. This method relies on delineation based upon the physical features of a region, rather than precise field-survey maps of individual properties (Amankwah and Mvunga 1986). This requires up-to-date, detailed maps of a region's physical features. Such detail could be achieved through either low-level aerial photography, or the enlargements of existing photographs taken of the region in the last few years.

The eventual need for titling programs will have to be judged carefully to ensure that the benefits justify the costs (delineation, enforcement, etc.). One particular problem is the provision of titling on demand which can lead to land grabbing by the wealthier and more influential community members. In lieu of formal titles, local user groups and organizations could develop better procedures for their authority to enforce rules concerning access and sale of land. Eventually, with higher degrees of commercialization, a more formal recognition of both community and individual titles to land may be necessary. In this way, both public and private land (currently de facto private and common property) can be formally transferred to some form of land title. This approach is preferable to officially shifting all common land, and periodically used lands, over to the state, which has exhibited a limited capacity to enforce the rules of access and use on public land.

Equally, the over-proliferation of rules should be avoided. Land reform in Malawi included an effort to consolidate the fragmented land holdings. The village became a unit with a utilization plan. This proved unsuccessful over time, in part because changes in methods were not easily adopted: fixed rotations, rather than shifting agriculture were too sophisticated and the system also created inflexible rules regarding fallow regimes which later had to be relaxed (Nothale 1986). Supervision was inadequate, particularly in the case of extension workers who did not yet understand the systems introduced. A more successful approach was adopted in place of this system in Malawi whereby individual ownership was created under a customary land right. This appears to have been a more powerful incentive for the titling and consolidation of land holdings.

An important priority in this region and elsewhere in Madagascar is to minimize irreversible degradation of soils and forests and to promote sustainable agriculture. To this end, short term recommendations have focused on improvements in markets, inputs, technology and infrastructure. Long term recommendations have considered potential mechanisms for facilitating a gradual transition in better management of land resources.
ANNEX 1: REVIEW OF LAND LAW AND FOREST LAND REGULATION

LAND LAW

Prior to 1881, land use and property rights in Madagascar were largely informal; first identified with wandering tribal groups seeking pasture land, followed by collective property rights (the clan, fokonolona, family). Since 1881 the country has established legislation moving the land increasingly towards private property structures. This annex provides a detailed discussion of the principal land laws and forest land use regulations since 1881.

Land Law in the Late 1800s

A law passed in March 1881 was the first which stated in writing the state's right to all unused land. The law simultaneously recognized an individual's right to lands that are under cultivation. Since that time, a series of laws has been enacted elaborating on property rights and procedures for proving ownership.

The first such law of February 4, 1896, defined the basic property rights of individuals and laid out the basic rules for land registration. Legal land ownership could be established simply by taking land and it persisted as long as the land was cultivated. To establish an official property right, a land user could file a request for a title and survey of the land with the Director of Land Registration, including an advance payment to cover costs. Titles were issued upon proof of an existing pattern of cultivation and a certain length of time having been spent in living on the land prior to 1896. Procedures for optional land registration were introduced in 1897.

Registration under the 1911 Decree

During the colonial period, land registration remained optional except in three specific cases defined by law in 1911: the case of alienation or concession of public lands, case of foreigners claiming land, and in denser urban areas, particularly Antananarivo and others located on the highland plateau (Rakotonirainy 1984). Family tombs could be titled including tomb access rights for all descendants of the dead.

Eligibility and Requirements for Land Registration

Originally, those legally eligible to file documents for registration included the owner, the co-owner (with the consent of other co-owners), any holder of land rights (such as usufruct, usage and living, mortgage, and others), and finally a representative of any incapacitated individual (Rakotonirainy 1984).
Registration required a site description, a property name, and estimated sale value. The land could be contiguous or fragmented and still be placed under one title. All requests had to be officially publicized and advertised so that others could take care to protect their rights if they had a competing claim to the land (Rakotonirainy 1984). The owner and neighbors were to be present during demarcation of property. Any conflicts which arose were written down even as the marking continued. Contested areas were noted on the map and a period set aside to file disputes. If no contest was made, a judge ordered registration of the property. If any competing claims were filed, a hearing was convened and the judge ruled on the appropriate boundaries of the registration map.

The voluntary aspect of registration on most land meant the persistence and coexistence of other property rights structures. Foreigners had only long-term lease rights through a rather precarious title while indigenous people were often granted occupancy and use rights on the lands held by colons (French residents). Thus, during the French colonial regime, three forms of property existed simultaneously:

- The French civil code (rare);
- Traditional Malagasy rights; and
- "Modern" registration law.

Changes in Rules Governing Land Use and Property

A public decree enacted in 1926 addressed questions concerning management of public land. It required individuals who argued a right to a parcel of public land to prove that right through demonstrated use of the area for twenty years. Upon such proof, the government granted permanent titles to all land thus developed. The 1926 decree created important juridical categories of public and private lands as well. Public lands were inalienable and to be managed and protected by the "service des domaines." Private land was either "affected" or "non-affected." "Affected" private land referred to goods placed at the disposition of public services to help them perform their functions. Private, "non-affected" land was subdivided into three groups: indigenous reserves, colonial areas and concessions.

The French colonial system recognized areas of cultivable land that were set aside to safeguard the satisfaction of local subsistence needs. The indigenous areas were dedicated to local inhabitants as collective land authorizing their possession of ancestral lands with a potential for the land to become private. The fokonolona was the recognized community level of organization to address allocation of land within the collective and ensure that land was used in approved ways. The only caveat was an obligation of any indigenous collective to use the land thus held. The indigenous collectives had free use rights in these areas as well as the right to title the land. The collectives had voting power to admit additional members with the same rights. However, these use right could be annulled and the area restricted in size by order of the general governor. Use rights could also be converted into a thirty-year inviolable property right for the group.
Colonial areas consisted of the largest and most fertile farmlands. These were largely awarded to the colons who were also obliged to use the land over time, depending upon the size of the land. Free concessions were also available, again mostly to colons. The French citizens could have a hundred free hectares of public land whereas indigenous people had the right to only ten hectares. Like any other category, concession land had to be worked, too.

The Colonial Decree of 1929

This law defined indigenous individual property and guaranteed the use rights accruing to the local land owner. A less costly and time-consuming cadastral system was established whereby a state mobile land board was created to establish land registers for each zone (at the time cantons) in the country. The mobile land board traveled from one canton to another to hear all cases and applications for property rights within a zone. The initial requests were processed and for a thirty-day period, all interested parties could file for land rights in the canton and dispute other requests. At the end of thirty days, disputes were settled and titles issued to those who had successfully filed. All individuals who failed to claim land rights during this period, and thus did not receive a registration title no longer had legal protection for their land (Rakotonirainy 1984). Registration titles and land titles were equally legal documents protecting a peasant's right to land.

Thus, from 1929 until 1960, legal rights to land could be established either through individual registration (since 1897), by collective registration (since 1926), or by means of the collective land register (since 1929).

Legislation in the 1960s

The basis for awarding titles and surveying remained unchanged until the early 1960s following the draft of a new constitution and the departure of the French. Ordinance 60-146 basically rescinded the 1911 law. The ordinance removed the system of direct registration created in 1896. It was replaced by a procedure whereby an individual obtained certification from an administrative commission verifying that he/she had used the land for at least ten years. Once this certification was received, the land registrar was authorized to issue a registration title with no further requirements.

The 1960 legislation spelled out guidelines concerning the qualifications of applicants, documents to be filed, registration procedures, public notification procedures, all topographic procedures and requirements, review procedures by the registrar, dispute resolution procedures, the role of the judiciary, actual land title procedures, rights and responsibilities of title holders, and other measures.
The 1960 constitution also had an effect on the official property rights laws. It reiterated earlier legislation proclaiming an inviolable right to property with the condition that the individual exploit the land as part of the greater public interest. When lands of more than five hectares were not used for more than five years, the constitution authorized their transfer to the state.

**Applicant Qualifications, Documents Filed and Fees**

The 1960 law reiterated the same categories of those who had rights to file an application for a land title. No mention was made of the rights or the lack of rights of women to title land. All requests had to include details of the civil and marital status of the applicant, home address, description of the sites (position, limits, qualities, etc.), name of the property, its sale value, and a description of rights and responsibilities of individuals holding a mortgage, easement, or trust for more than three years.

Further, all applications were to be accompanied by a description of the laws establishing the rights of the applicant, a fee for registration and demarcation ranging from FMG10,000 (US$5.5) to FMG15,000 (US$8.3), and a sketch of the property appropriately scaled to match topographic service boundary maps.

**Registration and Public Announcement**

The application to register land was publicized according to specific guidelines to solicit any competing claims; a two percent tax on the land’s sale value was assessed to cover this cost; and the owner received a request number. After the public advertisement period, the registrar authorized the topographic service to carry out a survey of the area. The regional chief for titling and registration passed the request to an officially sanctioned land surveyor who served a public notice twenty-five days in advance that an area would be demarcated and that disputing claims would be accepted. In the presence of the applicant, stone markers were laid delineating the property; any disputed areas were also delimited simultaneously.

A site plan was drawn to ensure the exact location and limits of the property, and estimate its value. If for any reason the applicant delayed these procedures for more than one year, the request was annulled. The registrar verified the demarcation; if the registrar was unable to verify, or if there were disputes over property rights, a judicial review was made. Besides an absolute title, special titles could also be issued for usufruct rights, long-term renters, or to a recognized squatter, as long as the initial certification title was granted. The law also provided for squatter’s rights such that if one could demonstrate use and improvement of land for at least twenty years, there was ground for the granting of tenure.
The Rights of Land Owners

Registration of property represented a legally definitive and unassailable arrangement. Once a registered title was issued, the boundaries of the property were no longer disputable; only those rights and responsibilities defined in the documents were applicable, and no additional rights could be added.

Modifications in Land Titling

The process of land registration titling was slow and riddled with detail; a survey title was given the same legal standing. A 1962 ordinance specified that land already surveyed could be changed from a survey title to a land title upon request of the survey title holder and the payment of a fee. Another important modification concerned the unification of several parcels of land under a single new title, assuming no disputes arose in the process.

Around the same time, a new category of title was announced called an "Aire de mise en valeur rurale" (AMVR) which succeeded the concept of colonial zones. The AMVR was an experimental area for modern farming and could be registered as private property of the state; or the user could receive a personal permanent title once the owner met all conditions set by the government to improve productivity.

Abuse of Property Rights

In 1962 and 1964, legislation defined property rights as more than a right to enjoy and dispense of one's property in an absolute sense; property rights represented an ensemble of prerogatives defined by the greater public good. Thus, property took on a more prominent social function; individuals unable to use the land had no right to keep it, and the land was to be transferred to a more productive owner/user. This was proceduralized by initially proving that an area of more than five hectares had been unused for five years. Lands were to be visited after three years to verify that the land was in actual use.

Land Law Since 1972

While the political regime changed in 1972, the land law stayed virtually the same. Some additional ordinances were introduced to address new problems in Madagascar, particularly economic problems. These focused on the more socialist objectives of collective action of the rural Malagasy and thus encouraged new forms of property.

Ordinance no. 73-013 was intended to define and direct the course of rural development including methods to ensure that farmers and the state were working towards economic betterment. It authorized the new repartition of lands and the orientation of related work towards production. The rights to new lands brought into use was awarded first to rural collectives. To manage uncultivated lands which might be put into use, three forms of development were encouraged: individual or family exploitation; collective; and direct state intervention. Collective exploitation was to benefit producers by reducing their costs through the communal use of the
means of production. *This same ordinance formally forbade sharecropping practices in Madagascar in order to eliminate absentee landlordism.*

Ordinance 74-021 gave the land proprietor a new social function: develop and farm land in order to be part of the country's economic development. Each *fivondronana* was ordered to carry out a survey in rural areas of all registered and cadastred land of more than five hectares.

Ordinance 74-022 developed additional specifications for land improvement in rural areas. It ordered the restructuring of land areas designated as land development zones either by awarding lots, or by regrouping lands to create lots of reasonable farming size and shape. The act pertained to all public lands, private lands in fallow, inadequately used private land, land exploited by sharecroppers, and land exploited by owners with salary help or mechanical assistance. Once the land improvement work was complete, the beneficiary could either become the owner or remain as a land user. In either case, the beneficiary was expected to work the land in "a rational fashion" in keeping with a set of pre-established conditions.

**Collective Titling**

A 1967 law introduced procedures for collective land titles. The goal of the law was to undertake an accelerated registration program for all lands in the country, using a simplified format and incurring lower costs and thereby quickly clarifying the land use situation at a national level. The collective registration was no longer a strictly cadastral title but a registration land use title. The process was obligatory and individuals lost all rights without compensation for costs or damages.

This law was not applied at all until around 1974 when Ordinance 74-034 spelled out a three-phase collective registration procedure. The first phase included delimitation of shared areas and the filing of any disputes. The topographic service announced the beginning of cadastral operations, divided the canton into several cadastral sections, and set the conditions for achieving the survey. There was an initial thirty-day period when residents were notified of their responsibility to state their land claims at the time of demarcation. The topographic service delimited the region based on all documents and claims submitted by residents. These initial maps constituted the surveying of a cadastral section. They also determined which lands should belong to the state under the use guidelines discussed previously. The initial findings and maps were left for sixty days with the *fokontany* president during which time all additional claims or disputes could be filed.

In phase two, after sixty days, the topographic service submitted a copy of the collective title documents including all areas demarcated and maps to the mobile land board. The mobile land board had special jurisdiction to grant property rights based on the collective registration procedure and to resolve any disputes. The land board was composed of representatives from the "service des domaines," an assessor from the public auditor, a member of the *fokontany* committee where the land was located, and was assisted by the topographic service and a secretary who also handled complaints.
The land board visited areas to issue the property titles of applicants on lands that had not been repossessed nor disputed, and they also heard disputes on lands either repossessed or under disputed claim. The hearing was publicly announced a month in advance and all parties were notified fifteen days in advance. The board ruled on disputes and allocation of land to the state or return to individuals.

In the final phase, the district chief for land tenure (CCDF) was authorized to issue titles once the period for dispute had expired. The CCDF required all owners with recognized rights to provide a name for the property and to pay a fee relative to the costs of registration and topographic work. In practice, the costs were calculated as 50 percent of the present fee. No land found within the zones demarcated for collective titling could be titled by private individuals.

As of the mid-1980s, the "service des domaines," concerned with uniformity in the property rights regime, has been trying to apply collective titles to widespread areas of land. This new system is intended to be less time-consuming, since people do not have to leave their villages and the title cost is shared by all.

Agrarian Reform

The 1975 constitution included general guidelines for property rights, in three articles in particular. Article 30 guarantees individual property rights for a home for the family, for subsistence goods, for those things which contribute to material well-being and for economic exploitation, family or artisanal, within the limits imposed by the collective, national interests and the expropriation for the public good. Article 31 states that individual property rights cannot run contrary to social needs. Article 32 specifies that to realize the appropriate use of land, increase national production, and establish social and economic equality in the collective, the law can impose limits on private property rights.

To this end, agrarian reform nationalized some colonial company holdings. Although tenure rules were unchanged, the agrarian reform legislation espoused the virtues of socialist cooperative production and thus, collective property above private property. This effectively set a priority course of action for the topographic service towards collective titling.

Throughout the many changes and modification in legislation and procedures for determining land rights, burial grounds and tombs (and access to those areas) have remained protected from sale and seizure.
Impact of Taxes

A tax code in 1978 identified tax levels for different land uses. It laid the highest taxes on cash crops. Farmers in the highlands practicing subsistence agriculture and marketing vegetables could keep their taxes low. Since these taxes were low, farmers paid them quickly since they have a strong sense of property over their land (Rakotonirainy 1984). Non-payment of taxes is one measure of non-ownership of land.

Tax reform in 1984 raised taxes on all land uses. The 1984 reform also placed higher taxes on land not under agriculture. While many farmers are still illegal squatters, and, in remote areas, can avoid production and land taxes, the 1984 reform is a strong disincentive to land owners to pursue alternative land uses, particularly forestry.

FOREST LAND USE REGULATIONS

Forest Legislation in the 1960s

Many of the existing rules concerning land use in forest areas were established in Ordinance 60-127 in 1960. In that ordinance, the government recognized the significant negative impact of tavy (Malagasy term for upland slash-and-burn rice cultivation) and brush fires on the country's soils, affecting both erosion and soil productivity. The legislation reasoned that soil protection in forest zones was tantamount to ensuring the ability of subsistence farmers to reap their living from the land over time. Intended to regulate the practice of tavy, the regulation categorized forest lands into zones where tavy and brush fires were prohibited or permitted.

The 1960 legislation was much less restrictive than previous law. Prior to 1960, the forest code specified that it was strictly forbidden to set fire to virgin forests with intent to establish agricultural fields. Only land that was previously cut and burned was available for cultivation. Punishment for any individual caught using fire to clear new areas was five years in prison.

The 1960 ordinance prohibited clearing any of the following public lands within national forests and protected areas:

- Forêts classées;
- Natural reserves;
- National parks;
- Réserves spéciales;
- Reforestation and restoration areas;
- Forestry and pisciculture stations; and
- Land managed by DEF.
A protected area, or "zone en defens" refers to hillsides with a slope greater than 50 percent, ravine-prone lands, coastal dunes, and areas within twenty meters of the high water mark of rivers and streams.

All lands not included in the preceding list are available for clearing but require the authorization of a forestry agent. Authorizations are granted only on flat lands or on the lowest third of a hill, when the slope is less than 50 percent. Clearing of slopes with grades between twenty and fifty percent must be accompanied by anti-erosive measures. Failure to meet these conditions within one year bars the title holder from receiving future clearing rights until the necessary work is completed. The penalty for violating the rules guiding deforestation and brush fires ranges from FMG15,000 to FMG300,000 (US$8.3 to US$1,666.6), and/or six months to three years in prison.

Residents on either public land or some form of public collective, which was part of a riverine system were prohibited from clearing that area if the land was not clearly demarcated. The owner was responsible for all costs associated with demarcation. The legislation also specified that rural communes and traditional or modern rural collectives were responsible for monitoring deforestation and fires within their traditional or legal faritany, including lands under temporary or permanent title.

Where deforestation occurred the responsible party was expected to compensate for the loss with a fixed number of days working on forestry or soil conservation projects in the district. When an infraction occurred in an area that has been artificially planted, outside of the national forest, the punishment was two to five years in prison. The same punishment extended to the case when a fire was lit near an artificially planted area with the intention of the fire spreading. When a fire was illegally started within any category of the national forests, the punishment was three to ten years in prison. If the person responsible for lighting an illegal brush fire was not known, traditional and legal rural collectives were held responsible. The collectives had to either pay a fine of FMG 15,000 to FMG 300,000 (US$8.3 to US$1,666.6), or work for the government until the fine was paid.

**Procedures for Forest Clearing**

Legislation in 1961 (decree no. 61-079) laid out the procedures for forest clearing. The term deforestation was also clarified to include "any felling of all or part of a forest, whether or not it is followed by burning." (Ordinance 62-121, 1962). In permanent agricultural zones the provincial forest service chief could grant permanent authorization to clear the lands if the slope was less than 50 percent. The priority was for requests in agricultural zones with slopes of less than 20 percent. Individuals with temporary or permanent title to land preceding this ordinance could get a permanent authorization for clearing their lands on slopes of less than 20 percent. For lands with slopes between 20 percent and 50 percent, annual authorizations were required. The law specified that the lower third of hills could be cleared only after the lowlands had been cultivated. No authorizations were granted on lands that had been cleared in the preceding four years.
All clearing authorizations on public lands with slopes greater than 20 percent, as well as on lands with permanently or temporarily titled lands with the same slope conditions, had to be accompanied by anti-erosion measures. The alternative to this was to work on demarcation of public forest land with lines of planted trees.

Those interested in growing cash crops on public lands could get permanent authorizations without special clauses on lands with a slope less than 20 percent. Once again, anti-erosion measures had to be undertaken on slopes between 20 percent and 50 percent. In all cases, authorizations were only awarded every four years for a given area. On slopes greater than 50 percent, it was forbidden to clear trees in the overstory to be replaced by lesser tree species.

**Authorization for Deforestation Permits**

The regional forest officers were the only ones who could authorize a cut. All authorizations required a site visit during which the area was sketched on the back of the authorization form and markers were laid down to delimit the borders of the authorized area. Legislation in 1987 set the modes of deforestation but the terms were very similar to those established in 1960. It was illegal to proceed with a clearing without an authorization from the chief of the forest canton and the fokontany president. Probably to process requests more rapidly, the 1987 legislation made the fokontany president responsible for verification of all information presented in a request, rather than require verification by forest agents.

An authorization was valid from one year of issuance date and could be issued individually or to a rural collective that had no land and to the extent necessary to satisfy their subsistence needs. The 1987 law also prohibited burning or clearing within fifty meters of a highway or within ten meters of an irrigation canal and established a fire break zone ten meters wide. All members of a rural collective that would benefit from a deforestation authorization were required to participate in reforestation work whose specifics were determined by the forest district chief.

**The AFARB Program**

In 1985 the government enacted legislation to create a more active program in forest management. The legislation, entitled "Action en faveur de l'Arbre", or AFARB, had three general components:

- To protect existing forest cover and watershed vegetation;
- To expand reforestation and forest plantations in general; and
- To work on tree management and information dissemination such as tree uses and research.

The same legislation created a National Forest Fund to be established with financial support from grants, subscriptions, earnings from sales of forest products, taxes on forestry and agricultural products, and eventually an endowment by the government. Citizens unable to undertake the reforestation described in AFARB would also contribute to the Fund. The use of
the Fund was to be established by an inter-ministerial order. The ministries in the legislation were the Ministry of Finance and the Economy, the Ministry of Forest Administration, and the ministry charged with scientific research. To date, the Fund is non-functional.

Implications of Malagasy Land Law and Forest Legislation

The Malagasy legislation for maintaining and establishing property rights has consistently hinged upon active use of the land. In fact, according to some conservation workers in Madagascar, land must be continually used for at least five years for it to be eligible for registration. Tavy production cycles of two or three years of cultivation followed by a fallow period defy such specifications for land titling.

The review of the legislation identifies numerous ambiguities and shortcomings which have negatively impacted on patterns of land and forest use and hastened natural resource degradation in general. For example, the policy that artificially planted lands cannot be burned does not adequately address the issue of whether individuals have the rights to cut trees that they plant without a concession. While conservation programming has clearly excluded regional farmers from pursuing their tavy and any form of extractive activity within Mantadia National Park and within the "foret classee" which surrounds the park, there has been no comprehensive program to provide compensation to these communities. This is a particularly difficult and crucial problem to address in both Falierana and the eastern villages.

Open access resources appear to be spreading as the forest resources themselves are drawn down and the local communities, which abide by their own system of de facto land use and access rights, are forced to modify their rules to help ensure that subsistence needs are met. Because of these changes, and the institutional incapacity to effectively manage public lands, both forests and agricultural areas suffer.

The system has also been unable to create a sense of true land security for farmers. The lack of security is far more noticeable as relates to trees. For example, it is unclear how farm families are to be encouraged to replant on their land if, once the trees are planted, there are laws which forbid cutting those trees for agriculture.

In general, the conditions point to insufficient incentives for farming communities to diversify their land use, manage forest resources for the long term, and invest in their land. This situation is further exacerbated by the distinct absence of any functioning land market in the region.

Finally, the institutional capacity to survey, demarcate, and provide land titles has proved to be limited, and the costs of programs are often prohibitive for farmers. Similarly, there is insufficient data on land use, suggesting the need for increased and continual support to programs for cadastral surveying, titling, mapping, etc.

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ANNEX 2: ECONOMIC ANALYSIS: ILLUSTRATIVE CASES OF AGRICULTURAL PRODUCTION

The model presents two cases of agricultural production systems. The first case depicts the actual situation in the field described in Chapter 4 characterized by traditional property regimes loosely directing land use patterns. This situation is accompanied by conditions of insufficient enforcement of regulations relating to public land use, low levels of agricultural technology and inputs, no credit and marketing support, and very little technical assistance which allow unsustainable rates of land through tany to persist.

The second case presents a situation of improvements in the provision of effective technical and institutional support as well as credit access (discussed in Chapter 2) which improves the potential for the community to access tools and inputs like improved seeds and fertilizer which can intensify productivity of the land. Improved productivity through better farming practices means a greater value from agriculture. This also creates possibilities for farmers to work with forestry and agricultural experts to diversify and pursue alternative land use patterns which rely far less on tany. Such systems might rely on the economies of scale of group involvement in programs such as agroforestry (tree crops, alley cropping, etc.), forest plantation farming, and village woodlots which offer alternative sources of income generation and improve soil fertility by removing land from the tany system.

The analysis considers an entire village as a unit of development aggregating costs and benefits for that unit. This approach is logical if one considers that the members of a village community are endowed with a more or less fixed quantity of land and that villagers share a basic production objective. The rights and responsibilities associated with the fixed land base can then be assigned in a variety of ways. Presently, most land is relatively evenly distributed among community members as either de facto private farming land or common property areas in various stages of fallow. The remainder is either unsuitable for farming or taboo.

Information from the Fanovana area villages is used in the analysis. For analytical purposes, rice is the only output from land and labor and capital are the only inputs. In reality, fields often contain a variety of subsistence crops simultaneously. The present level of inputs derived by Shyamsundar (1993) is used in the base case. The revised model has changes in inputs based upon improved technical assistance and credit access. In both models, the total costs of rice production are subtracted from the total benefits of rice production to determine the net present value of production. Data used in the model comes from three sources. First, information on the farming area is used from the results of the survey. Data on rice productivity per hectare, the level and cost of inputs, and the farm gate price of rice is taken from survey data (Shyamsundar, unpublished dissertation, 1993) collected in the nearby village of Volove located to the north of Fanovana. Improvements in agricultural production associated with introduction of improved seed, fertilizer and more labor days are based on estimates from a World Bank farm model of tanket rice production (World Bank 1990). Such improvements, and those in capital
inputs as well, are consistent with observations from numerous studies of agricultural production (Dayanatha and Hojati 1993; Khan 1975; Bhalla 1979; Schutjer and Van der Veen 1977).

The benefit-cost analysis covers a twenty-year production period and applies the following conditions and assumptions.

i. Total farm land controlled by the village is fixed at 516 hectares, extrapolated from the survey land area figures per farmer;

ii. The rice market price in the region is set at FMG580 (US$0.32 at FMG1,800=$1) per kilo (Shyamsundar, Kramer and Sharma, forthcoming);

iii. The cost of labor is the official minimum wage of FMG 1,000 (US$0.55)/day;

iv. Capital inputs to agriculture were limited to the spade and coupe-coupe, the two most common tools used by rural farmers in the microregion;

v. Seed and insecticide levels are fixed;

vi. Manure is used in both the base case and revised case;

vii. The fertilizers NPK and urea are unavailable in the initial case. Both fertilizers are made available in the revised model;

viii. Costs associated with extension and other services are ignored; and

ix. The discount rate is 10 percent.

The initial case assumes that the existing patterns of land use persists over time. Rice production per farm household is 560 kilograms per hectare per year based upon the use of 65 percent of total land available. (Shyamsundar, Kramer and Sharma, forthcoming). This amount is modified to reflect production on 100 percent of the available land, or 862 kilograms per hectare per year. Total labor days are 105 per year (Shyamsundar 1993). Spades are used by 22 percent of farmers and 25 percent use coupe-coupes (Shyamsundar, unpublished dissertation). Manure inputs are assumed to be 1.7 kilograms per farmer per year (World Bank 1990). The farmers lack access to credit, and have limited technical and marketing support prohibiting improvements in the use of seed, capital and fertilizer.

Assuming that total available land is presently used, the nature of present taro agriculture suggests that yields on that land will gradually fall over time, and at some point of overuse, will cease to be economically viable even to the farmers. Such conditions are realistic and have prevailed in lands farther east of the Andasibe region visible from the national highway 2. To reflect this loss to degradation, the initial case reduces total available area by 1 percent annually over the twenty-year period.

The second model reflects an improved policy environment which provides necessary support and incentives for farmers to assume responsibility and organize their land use around intensification of production with greater credit markets and technical support for improved methods, seeds, higher use rates of other capital inputs, and introduction of other fertilizers. Productivity levels and unit costs in the second case are based upon a World Bank farm model of hillside rice production in Madagascar used in an on-going agricultural extension project (World Bank 1990).
The introduction of inputs infers an increase in both total costs and labor time. Total labor days increase to 210. In the most optimistic of circumstances, capital tools, fertilizers and seeds would be available to the extent that productivity would increase by 100 percent or more. This is not an unrealistic increase in productivity and has been demonstrated recently on farmer test plots in Malagasy communities near the Ranomafana national park (Roy Hagen, personal communication). However, given the present conditions of low technical support complicating adoption and access to inputs and the marketing difficulties associated with underdeveloped infrastructure, the agricultural increases in the second case are scaled down by 50 percent in years 2 through 5 and thereafter are 70 percent of the estimates used in the World Bank farm model.

Similarly, spade and coupe-coupe use increases to 50 percent of farmers in the first five years and then to 75 percent of village farmers after five years. Manure input increases to 2.5 kilograms per farmer per year (World Bank 1990). The fertilizers NPK and urea are applied at a cost of FMG76,000 (US$42.2) and FMG19,000 (US$10.6) per farm, per year, respectively (World Bank 1990).

EFFECT OF POPULATION AND FALLOW REGIMES

Population growth and the length of fallow regimes cannot be incorporated into the model. It is obvious that population growth would be the same in both cases, but in the base case, there would not be any planning to accommodate that growth in the farming area. Total land area would have to increase, but it is likely that the size of land holdings would eventually decrease when the maximum land area is reached. In the revised case, population growth would be less stressful on the resource base for several reasons. First, the increases in agricultural productivity in the revised case could make a larger population easier to support given a fixed area of land, and free a larger percentage of the population to pursue alternative sources of income. Second, increased participation could allow for more advanced planning to address the larger demand for land.

There is no information in the literature to determine the effect of declining fallow regimes on the level of rice productivity in Madagascar. It has already been established that the length of fallow periods in the region is on the decline and that this is associated with population increases. It is also established that agricultural productivity declines as the length of the fallow period declines, assuming changes only in farming frequency without improvements in inputs and productivity. The primary concern is that poverty and low production in the base case leads eventually to a point where the output on land is not worth the effort and people must move, or stop tavy. The model highlights the importance of improved per hectare agricultural productivity to arrest the decline in fallow lengths over time.
RESULTS

The analysis shows that, assuming present conditions, total rice output in the villages of Fanovana, Sandranady and Ambodinikoma would be 191,952 kilograms per year through year 5 when it would begin to decline because land begins to go out of production. The decrease in available land leads to declines in annual net cash flows. Initially, the per farmer net income is US$211, a figure which is somewhat higher than existing calculations of agricultural production in nearby Volove (Shyamsundar, unpublished dissertation, 1993), since there is no modification for land in fallow and assumes that 100 percent of the area is in rice. Regardless, the figure is below the average national income of $230. The net present value of the output over twenty years is equal to US$430,271 for the village, and $1,929 per farm.

The revised case indicates that the total rice output in the same villages increases over time to 326,318 kilograms annually. The result is that, despite increasing costs associated with intensification, the net cash flows increase in time. The net present value over twenty years at this new level of production is equal to US$533,284 for the village, or US$2,391 per farm, which represents a 24 percent improvement.
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