POPULATION PRESSURE, LAND TENURE, DEFORESTATION, AND FARMING

SYSTEMS IN HAITI: THE CASE OF FORET DES PINS RESERVE

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POPULATION PRESSURE, LAND TENURE, DEFORESTATION, AND FARMING SYSTEMS IN HAITI: THE CASE OF FORET DES PINS RESERVE

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VITA

Frito Dolisca, son of Raphaël Dolisca and Appoline Dolisca, was born in Cap Haitien, Haiti. He graduated from the Philippe Guerrier High School in 1984. In 1985, he was admitted to the State University of Haiti and graduated with an Engineer of Agronomy degree in 1992. From 1991 to 1994, he consulted and worked for the Food and Agriculture Organization of the United Nations (FAO), the Canadian Center for International Studies and Cooperation (CECI), and Action against Hunger (AAC) as part of integrated projects of sustainable rural development in Haiti. From 1994 to 1999, he also worked as a manager of the Forêt des Pins Reserve at the Ministry of Agriculture in Haiti as part of the "Forest and Parks Protection Technical Assistance Project", financed by World Bank and the Haitian Government. He received his Master of Science at the University of Florida in August 2001. He entered the PhD program at Auburn University in August 2002. He is married to Sylvie Calixte and they have together two sons, Gareld and Gehu.

DISSERTATION ABSTRACT

POPULATION PRESSURE, LAND TENURE, DEFORESTATION, AND FARMING SYSTEMS IN HAITI: THE CASE OF FORÊT DES PINS RESERVE

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Doctor of Philosophy, August 8, 2005
(M.S., University of Florida, 2001)
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Forêt des Pins Reserve, a state-owned natural forest in Haiti, has suffered severe degradation due to a land tenure system that does not guarantee security for farmers, illegal harvesting of trees for the production of firewood and charcoal, and an ongoing influx of people with varying backgrounds and different socioeconomic context seeking fertile land. This situation has resulted in environmental damage and posed a threat to the welfare of the inhabitants of this Reserve. Various approaches, essentially based on "participatory" and "command and control" regulations, have been unsuccessfully tried to persuade farm households to adopt conservation measures. Negative impacts on the welfare of farmers limit the efficiency of these approaches for forest conservation. The heterogeneity of conditions faced by farmers has also amplified the challenge for conceiving and implementing development strategies. This study addresses the effects of socioeconomic and institutional dynamics of land use change, and assesses the role of different policy instruments for forest conservation in the Forêt des Pins Reserve.

First, this study investigates farmers' perceptions on the impact of the Forêt des Pins Reserve on the socioeconomic and environmental status of local people. Structural equation procedures reveal that farmers grant considerable importance to economic and environmental objectives, such as tourism and tree planting activities.

Second, this study focuses on the causes of deforestation in Forêt des Pins Reserve. A Tobit model was used to test the hypotheses about the effects of household variables (socioeconomic and institutional) on deforestation. The results show that: a) larger household size, insecure land tenure, and farm labor increase deforestation; b) length of residency and higher education of the head of the household reduce clearance. However, the effects of land efficiency and age show no influence on land clearing.

Third, cluster analysis was used to classify farm households in Forêt des Pins Reserve, based on socioeconomic and demographic variables. The results show that three types of farm households may be identified, namely, *low-income*, *middle-income*, and *large-income* farm households. Household size, forest dependency, and total family labor are the dominant factors in differentiating the groups.

Finally, a linear programming model (LP) was built to evaluate the role of various policy instruments (land tax, cost sharing, input price, and cross compliance policies) for forest conservation on two groups of farm households in Forêt des Pins Reserve. This chapter investigates the social efficiency of such policies for forest conservation in Haiti. Results suggest that subsidies tied to environmental benefits seem to be promising for sustainable resource use in Forêt des Pins Reserve.

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Style manual or journal used Forest Science, Guide to Preparation and Submission of Theses and Dissertations

Computer software used SAS 8.2, Microsoft Word 2003, Microsoft Excel 2003, LISREL 8.5, R, and ArcView GIS.

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INTRODUCTION

1.1 Problem Statement

Haiti, with a dense rural population (about 300 people per square kilometer) and a forest cover estimated at 3% of all land area (Food and Agriculture Organization [FAO] 1988), has experienced severe degradation of its natural resources and a significant change in its landscape cover. This situation has raised concern about the future of fuelwood supplies, environmental services and other forest products. Much of the deforestation is believed to be linked to:

- agricultural output failing to keep pace with increased population density;
- lack of off-farm opportunities;
- illegal harvesting of trees for the production of firewood and charcoal (85 percent of the population depends on biomass energy for domestic purposes, more than three million m^3 of fuelwood are used in Haiti per year);
- land tenure situation that provides no incentives for reforestation.

This study focuses on causes of deforestation and socio-economic dynamics of land use changes in Haiti, particularly in Forêt des Pins Reserve.

The study is based in the Forêt des Pins Reserve. No study focusing on deforestation in the area has so far been carried out, neither at the household or village level in the Reserve. Locating the study in the Reserve is important for four reasons:

- The Forêt des Pins Reserve, one of the largest state-owned natural forests in Haiti, has enormous opportunities for ecotourism because of its microclimate, its biological and cultural richness and its attractiveness.
- It represents a huge water source for different villages within the Reserve and in the lowlands below.
- The Forêt des Pins Reserve is still under tremendous pressure by the local population in spite of laws and regulations developed by the Haitian government to protect and manage this Reserve. Efforts also made through para-military and military approaches have proven unsuccessful and unsustainable.
- In spite of millions of US dollars spent to protect this Reserve, the deforestation problem remains intact; the clearing of forestlands for agriculture continues.

1.2 Purposes and Objectives

The main goal of this study is to address the effects of social, economic, and institutional dynamics of land use change and to evaluate the role of various policy instruments for forest conservation in Haiti, particularly in Forêt des Pins Reserve.

The specific objectives are to:

- Explore local community perceptions on the impact of the Forêt des Pins Reserve on the economic, social and environmental status of local people;
- Analyze the socioeconomic and institutional factors that contribute to forest depletion in Forêt des Pins Reserve;
- Construct a farm household income typology for the Forêt des Pins Reserve;
- Develop a farm household model for analysis of resource use and conservation decisions of farmers established in Forêt des Pins Reserve;
- Investigate options for sustainable land use on small farms through the design of farming systems that meet the environmental and socioeconomic objectives.

1.3 Background

With a population estimated at 8 million inhabitants in 2003, the Haitian Republic lies approximately between 18^0 and 20^0 north latitude and 71^0 4 and 75^0 west longitude (Figure 1.1). It occupies the western one-third (27,750 km^2) of the island of Hispaniola with the Dominican Republic occupying the eastern two thirds. It is bordered to the north by the Atlantic Ocean, to the south by the Caribbean Sea, and to the west by the narrow Windward Passage. The country is mountainous with two-thirds of its area in hilly or mountainous lands with slopes exceeding 20 percent (White 1994; Moral 1978). The topography of the country, coupled with the extent of eroded land, imposes serious restrictions on the availability of arable land. Thirty-seven percent of the total area is deemed arable; some 60 percent is currently in agriculture (Moral 1978).

Haiti's agricultural sector employs approximately 60 percent of the labor force (Ministère de l'Environnement [MDE] 1996). The last century has witnessed a consistent decline in this proportion, down from 70 percent in 1950 and 85 percent in 1912 (White 1994; MDE 1996). Productivity in this sector has lagged behind the national average. In 1995, the value added per worker in the agricultural sector was US $396, as compared with $570 in the manufacturing sector (MDE 1996).

One of the factors contributing to the relative and absolute declines in the agricultural workforce has been the high level of rural to urban migration; the percentage of the total population living in urban areas increased from 22 percent in 1975 to 40 percent by 1991 (MDE 1996). Contrary to the idealized results of the labor transfer models in economic development theory, this movement has not been accompanied by any significant improvement in cropping techniques; so worker productivity has stagnated. Haiti has remained a peasant nation with more than 70 percent of its population dependent on agriculture, while the agricultural sector only accounts for 37.2 percent of the Gross Domestic Product (GDP) (MDE 1996).

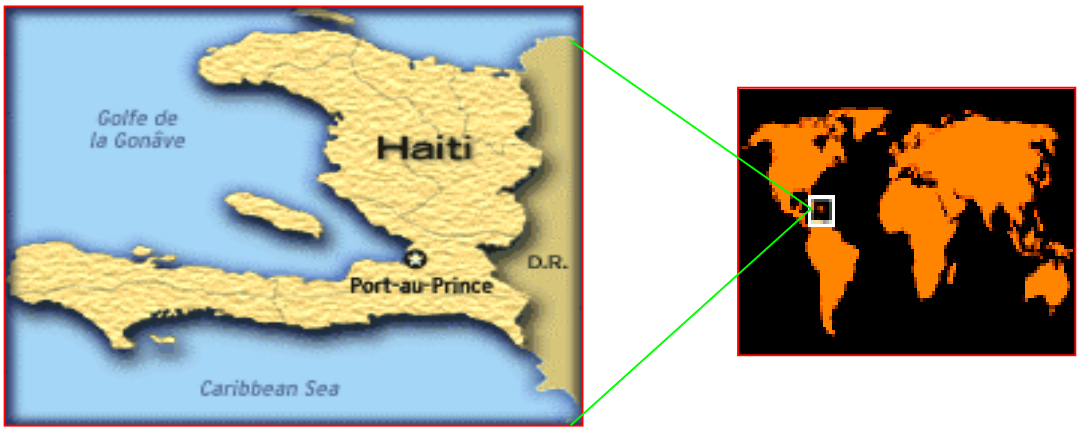


Figure 1.1 Map of Haiti

Traditionally, peasant agriculture has been Haiti's primary economic activity. Most farmers in Haiti are hillside peasants, with farm units composed of many plots distributed over wide areas (Smucker et al. 2002). Recent regional surveys confirm that the vast majority of peasants continue to be owner-operators, acquiring lands through purchase or inheritance (Table 1.1).

Land, labor, and social relations constitute the most important assets of the household economy. Cash resources are extremely rare; farm strategies tend to be labor

Table 1.1 Distribution of land tenure arrangements in Haiti

Source	Parcels of each category (%)					
	Ownership		Undivided inheritance	Rent	Sharecropping	Other
	Purchase	Divided inheritance				
Bannister (1998)	38.5	14.7	21.0	12.6	10.0	3.3
Smucker et al. 2002	32.4	33.1	7.5	8.4	11.9	6.6

intensive (Smucker et al. 2002). Land is the most significant tangible asset and serves as a powerful means for farmers to get access to labor and capital resources (Moral 1978). Farmers are acutely aware of micro-site variations, such as topography and soils, and actively diversify land portfolios and cropping patterns to manage risk and spread out harvest cycles (Smucker et al. 2002). As a strategy for survival, most peasants tend to focus on reducing risk rather than maximizing production.

1.3.1 Characteristics of the Forêt des Pins Reserve

The Forêt des Pins Reserve, a state-owned natural forest, lies in southeastern Haiti between latitudes 18^0 16 and 18^0 26 north and longitudes 71^0 42 and 72^0 07 west in the Massif de la Selle Mountain Range. The Reserve covers 30,000 hectares (Figure 1-2) and has a population estimated at 30,600 people distributed in 4,300 households (Centre de Formation et d'Encadrement Technique [CFET] 1999). The Reserve was created in 1937 and is under direct management by the Forest Resources Service (FRS) of the Ministry of Agriculture (Le Moniteur 1926). In addition to the Forest Resources Service, a number of other agencies and ministries are involved directly or indirectly in the management of this forest or forest related issues. These government agencies include the following:

- The Ministry of Finance and its tax authority, the General Direction of Taxes (Le Moniteur 1926);
- The Bureau of Mines and Energy, housed in the Ministry of Public Works;
- The Armed Forces of Haiti, including a special army unit, the Corps of Forestry Guards, and the Rural Police (Le Moniteur 1929, 1937);
- The Institute for the Safeguard of the National Patrimony (ISPAN), a semi-autonomous government agency under the Ministry of Education (Le Moniteur 1979). ISPAN shares jurisdiction over national parks along with the Ministry of Agriculture, Natural Resources and Rural Development;
- The Ministry of Planning, which in is charge of monitoring NGOs and policies on environmental protection;
- The National Tourism Office that shares jurisdiction over parks.

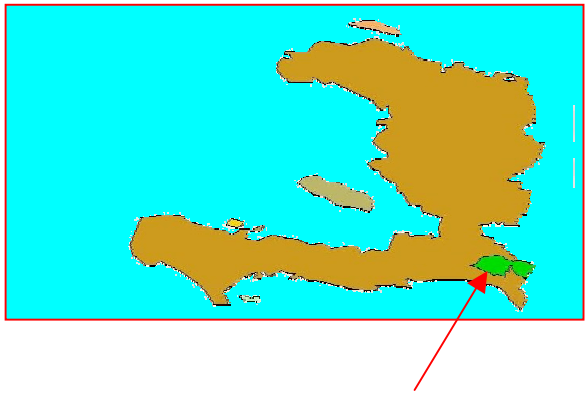


Figure 1.2 Map of the Forêt des Pins Reserve

For administrative purposes, the Reserve has been divided into two Forest Units and four ranges. Forest Unit 1 is the northeastern sector of the forest and occupies two-thirds of the total area, and Forest Unit 2 is the southeastern sector. North la Selle range covers some 3,000 hectares and is reserved for protection purposes (Berry and Musgrave 1977). Other ranges are reserved for timber production, including 66 percent of dense forest and 34 percent of open forest (Table 1.2).

The Forêt des Pins Reserve is a humid moist forest with altitudes ranging from 1,500 to 2,630m and an annual rainfall ranging form 1600 to 2000 mm. The mean annual temperature in the Reserve is approximately 14^{o}C (57^{o}F). During most of the year the maximum and minimum daily range is 5-8^{o}C. During the winter months, from December to February, temperatures below freezing have been observed around dawn. The soils in Forêt des Pins Reserve range from black layer to red silt clay and are of calcareous origin (Holdridge 1947). In flats or valleys, there are shallow, deeper and black soils, such as in the Morne of Commissaires region. In the hillier Morne la Selle region, the red silt clays

predominate with about only 10 cm of black topsoil. pH tests conducted in three different points, Gros Cheval, Oriani, and Boukan Chat, where the agricultural colonies are located, range between 6.5 and 7.2.

Table 1.2 Area of ranges by land use class (in ha)

Range	Forêt des Pins Reserve			
	Protection	Production		Total
		Dense Forest	Open Forest	
Mont des Commissaries	-	5,107	4,016	9,123
East La Selle	-	7,255	2,088	9,343
North La Selle	3,243	-	-	3,243
Mare Rouge	-	3,706	2,212	5,918
Total	3,243	16,068	8316	27,627

Source: Berry and Musgrave 1977

The natural vegetation is that of the humid mountain forest with "Bwa pen" (Pinus occidentalis) being the endemic species. This species is native to the island of Haiti and the Oriente Province of eastern Cuba (Pierre-Louis 1989) and grows on high mountains and plateaus. Pinus occidentalis is a turpentine pine, a near relation of the slash pine of the southern of the United States, and has all the latter's qualities in terms of growth rates and timber yield (Pierre-Louis 1989). It is a good-sized tree that can attain and even surpass a height of 50 meters. The normal growth form is straight, and where the trees are close together, the boles are clear of branches (cited in Pierre-Louis 1989).

Trees up to 1.2 meters in diameter have been found; however they usually have a diameter of 70 centimeters. Each tree yields approximately 1,000 board feet (Holdridge 1942). The presence of this pine species is linked to fire that favor its growth. It is a prolific species and readily colonizes relatively poor soils.

Forêt des Pins Reserve has enormous potential for attracting tourists. Attractions include: microclimate, nature watching, heritage and archeology, cultural resources, picnic facilities, gully trips, and attractive views and landscapes. Local facilities include chalets for renting (with a capacity of more than 80 guests), small bars and restaurants, small handicrafts industry, Creole cooking, and guides who take visitors to view natural attractions. However, road access to Forêt des Pins Reserve is restricted to four-wheel drive vehicles.

1.3.2 History and Colonization Process

The history of the island of Hispaniola is rich with many bloody pages, but written history is largely concerned with the centers of population and the rich, fertile plains. Haiti, called Saint Domingue in the early days, endured the almost complete destruction of the native Indians who had previously inhabited the coastal plains and river lowlands (Holdridge 1947). They were replaced by explorers and colonists from the distant continent of Europe (Latortue 1998). Furthermore, the colonists brought thousands of black slaves from Africa to work the plantations (Holdridge 1947). At the beginning of the 19th century, the blacks of Haiti threw off their yoke of servitude and largely eliminated the remaining European colonists in bloody massacres, retaining

however, many European customs and much white blood from mixed parentage (Holdridge 1942).

The high mountains of Morne des Commissaires have been isolated from events in the lowlands; however they were affected to a certain degree. There is evidence that the Arrawaks used to burn hardwood forests in the Morne des Commissaires, where the soils were fertile and humid, prior to the establishment of their agricultural plots (cited in Pierre-Louis 1989). The presence of pit ruins also attests to the phenomenon that people were present in all parts of the forest before the arrival of the Europeans (Holdridge 1942).

The history of Forêt des Pins Reserve in the nineteenth century is almost unknown. Moreau de St Mery reported the population of Haiti in 1790 as around 500,000 and this had grown to an estimated 3,000,000 inhabitants at the beginning of the twentieth century (Holdridge 1947). That increase likely translated into a continually increasing movement of new settlers into the mountains of the eastern part of the Massif de la Selle in search of land during the nineteen century.

Settlers have been moving to the area within and around the Reserve for the past one hundred years from every region in Haiti in search of fertile land and work (Moral 1978, Pierre-Louis 1989; CFET 1997; Centre Canadien d'Etudes et de Cooperation Internationale [CECI] 1999). Most have settled in communities on the eastern slope of the Massif de la Selle.

Migration into the area that would later become the Forêt des Pins Reserve expanded in the late 1920's as a road was constructed across the mountains, and for the first time connected the village of Saltrou on the south coast with the national capital,

Port-au-Prince (Berry and Musgrave 1977). This road passed through the villages of Fond-Verrettes and Forêt des Pins (from which the reserve takes its name) and stimulated new settlements.

In 1937, the wide-spread massacres of Haitians in the Dominican Republic sent the survivors fleeing back across the border to their mother country. Many arrived with only the clothes on their backs and the government of Haiti took steps to assist as much as possible. One of the colonies sets up to handle the poorly equipped immigrants was located in Savane Zombi and Oriani in the southern part of the Morne des Commissaires area where about 600 families were settled on plots of 5 hectares each (Bureau d'Enquêtes et d'Analyses Socio-Économiques [BEAS] 1985). Many refugees and their relatives established communities in the mountainous reserve. They cleared land for agriculture and established homesteads. This was the beginning of large scale impacts of settlements on the forest as land clearing and wildfires associated with "slash and burn" agriculture began to impact the composition and structure of the forest (Berry and Musgrave 1977).

At that time, considerable acreages of hardwood stands remained to the west and southwest of the Forêt des Pins Reserve in the localities of Oriani, Gros Cheval, Marie Claire, Boukan Chat, Jardin Bwa, and Mare Boeuf. Subsequently, other colonies were established in 1939 in Gros Cheval and Boukan Chat and nearly 500 plots were given out to settlers.

The 1940s witnessed increased settlement in the area as peasants migrated to the mountains in search of work in logging and sawmilling operations (Pierre-Louis 1989). Exploitation of the forest increased with the arrival in 1941 of the Haitian-American

Society for Agricultural Development (SHADA), a private Haitian company primarily funded and run by U.S. interests. SHADA constructed sawmills, developed Forêt des Pins Reserve infrastructure (aviation, road, chalets, aerial cables for logs extraction, hospital, and supplying in drinking water) and began large scale timber harvesting and processing. Throughout the second half of the twentieth century, national policy makers, worried about rising social tensions in the countryside, permitted and encouraged settlement and exploitation of forest resources by landless farmers (Pierre-Louis 1989). Moreover, the establishment of a Sunday market in the village of Forêt des Pins in 1941, where a group of workers had regular wages and salaries to spend, stimulated agricultural production and new settlement.

In our survey, we found that migration to the forest has slowed in the past decade. Sixty-nine percent of the heads of households were born inside the forest, 13 percent have lived there for more than 40 years, 10 percent for more than 15 years, and only 8 percent for less than 10 years. This is a positive signal for the potential of forest management which involves the control and the reduction of negative impacts of population growth on the forest.

1.3.3 Social Aspects

Many community groups and peasant organizations have developed in Forêt des Pins Reserve area due to religious influence (CFET 1997; CECI 1999). A Reserve Consultative Committee (CCR) composed of local group representatives, National Police Force representatives, and regional and local elected officials, was established in 1997. This committee was formed as part of the Forest and Parks Protection Technical

Assistance Project (ATPPF) to protect Forêt des Pins Reserve's interests and mediate between decision makers and the local population. Six groups of stakeholders were identified in the Reserve based on written records and identification of stakeholders by Forest Resource Service staff. Each group has different interests, and identification of these was made through discussions on stakeholders' rights, responsibilities, and returns with respect to particular activities in the Reserve (Table 1.3).

Health and education systems are deficient and very few villages have sufficient access to drinking water. In the western part of the Reserve, obtaining drinking water is a task for women and children. They spend about five hours per day transporting drinking water by foot. Illiteracy rates are about 54 percent among adults of all ages (CFET 1997), and less than 10 percent of female adults have received primary education. Forest Unit I of Forêt des Pins Reserve contains about 15 primary schools with only one public elementary school. The quality of education offered is very poor; one instructor simultaneously teaches two classes. About 80 percent of children aged 5-12 are reported to attend primary school (CFET 1997).

Table 1.3 Interests of the different stakeholders in Forêt des Pins Reserve

Stakeholders	Interests
Local Community	Community revenue, Conservation
Politicians	Political Capital
Forest Resources Service	Conservation, Protection, Revenue
Local Authority	Revenue
Non-Governmental Organizations	Conservation and Protection
National and International Citizens	Recreation and Protection

The health care system is very archaic and inadequately equipped with staff and resources. Only one public health center, under the management of the Ministry of Public Health, with a staff composed of a resident physician and a nurse exists in the Forest Unit I of Forêt des Pins Reserve. The most frequent diseases inventoried in the area are intestinal parasites, genito-urinal infections, prostate, malaria, and malnutrition. The health center does support an immunization program and between October 2002 to May 2003, 140 children from 0 to 9 years old received immunizations for Polio, BCG, and Chicken pox. Pregnant women often turn to midwives.

Seven NGOs and one autonomous body work in the area and provide subsidies and technical assistance in the following fields:

- **Caritas**, a catholic organization working in the field of agriculture, health and regional development.
- **Soil and Water Control Association (ASSODLO)** helping people inside the Reserve in the field of water tank building and seed storage.
- **Catholic Relief Service (CRS)** helping improve sanitation.
- **Belle-Anse District Development Community Foundation Training (FOCEDAB)**, a Protestant organization implementing projects in the field of regional development
- **World Lutheran Federation (FLM)** executing projects in the field of forest management, agriculture, and regional development
- **International Organization for the Help of Impoverished Children in Haiti (OISEDH)**, a Protestant organization working in the field of water tank building, education, and inputs selling
- **Coopérative de Solidarité pour le développement (COSODEV)**, a cooperative established in June 2000 through Fonds d'Assistance Économique et Sociale (FAES) in the Unit I of Forêt des Pins Reserve during the ATPPF project assists farmers in creating development opportunities in the area
- **Réseau pour la Sauvegarde de la Forêt des Pins Reserve (RESAFOP),** an autonomous body composed of representatives of four ministries (Agriculture,

Planning, Tourism, and Environment) and civil society representatives (peasant organizations, NGOs, etc.), working for the protection and conservation of Forêt des Pins Reserve and the improvement of the welfare of local people.

Because of the proximity of the Forest Unit I of Forêt des Pins Reserve and Dominican Republic, the links between Forest Unit I inhabitants and Dominicans living in the border area are strong. Illegal trade and social links proliferate across the border. Many of the residents of the Reserve work in Dominican Republic for short periods of time.

1.3.4 Economic Aspects

Rainfed agriculture is the main economic activity of people in the area. Ninety-three percent of households living in this area rely upon agriculture as their main source of income (CFET 1999). The main crops by economic importance are: potatoes, onions, cabbage, beans, and maize. Cabbage, potatoes, onions, and beans are almost exclusively commercial crops and maize is reserved for family consumption and for livestock. In our survey, we found that 100 % of farmers grew maize for the 2002 crop season. There are two main cropping seasons in the Forest Unit I of Forêt des Pins Reserve. The first season starts in February and ends in July whereas the second season starts in August and ends in December. Livestock, composed almost completely of domestic fowl and pigs, while less important than crop production, is also an important economic activity. It constitutes a reserve of capital for farmers. Horses, mules, and donkeys are also raised by families and used for transportation of harvesting products.

Forests are illegally harvested for the production of timber, charcoal and firewood, and kindling. This constitutes the main source of income for 2 percent of local households (CFET 1999). Dependence of communities on forest products has declined, due mainly to increasing resource scarcity, resulting from forest degradation. Non-timber forest products, such as peaches, avocados, strawberries, plums, and medicinal plants are also sources of revenue.

Forêt des Pins Reserve is also the locus of a wide range of non-farm activities in which farmers are engaged to increase their family income. The most important may be grouped into 3 categories:

1. The small-scale artisans include tailors, carpenters, home builders, and sawyers. Among them, only the sawyers can be expected to find jobs on a regular basis, due the high demand for wood products. The other artisans mostly operate on a seasonal basis. For instance, demand for tailoring usually peaks in August, May and September for school opening, first communion, and then the activities remain very slow for the rest of the year.
2. Gambling, including cockfights, lottery, and dice playing.
3. The service sector activities dominated by the voodoo priests, the traditional healers and midwives and the owners of small stores and restaurants.

1.4 Economic Values of Forêt des Pins Reserve

Forests have economic values so far as they are scarce and capable of generating human welfare. Unfortunately, these values are only captured if the forest products or services are extracted and sold in the marketplace. There is currently no conventional

accounting system to measure the standing stock of a forest and its maintenance in a functioning ecosystem. The total economic value of a forest system refers to a different combination of use values (direct use value, indirect use value, and option value), and non-use values (bequest value and existence value).

1.4.1 Use Values

Direct-use Values

Based on a ten-year period, the known volumes and the net harvesting costs calculated by Rousseau (2000), give a direct-use value for sustainable extraction of timber, and fuelwood across Forêt des Pins Reserve, of Gourdes 5,060,000 million (Table 1.4). Timber accounts for 88 percent of this value. Using Rousseau's unit prices the annual direct value of the Forêt des Pins Reserve is Gourdes 506,000. Little is known about the use of non-timber forest products in Haiti. However, it is the forest-adjacent households and the forest residents who use the forest to help meet their subsistence needs. Furthermore, there are quantified values for the use of the forest by these people. These values include both wood and non-wood products, but are difficult to determine.

Table 1.4 Ten-year wood yields and values (US dollar 1= Gourdes 37.50)

Items	Volume (m^3)	Unit Price (gourdes/m^3)	Value in Gourdes
Timber	30,000	125.00	3,750,000
Fuelwood	7,500	40.00	300,000
Seized forest products selling	-	-	375,000
Tourism			810,000
Total			5,060,000

Source: Rousseau (2000)

Ecotourism can also play an important role to protect this forest. In 1998, approximately 275 visitors entered Forêt des Pins Reserve and paid US $ 20 per day (equal to Gourdes 750 per day in 2003 prices). This would give a figure of Gourdes 206,250 per year as the value of tourism in Forêt des Pins Reserve. This calculation assumes that each visitor spends at least one day in the Reserve. As a result the total figure is likely to be an overestimate because the Rousseau figure (2000) still gives a tourist value of Gourdes 81,000 per year.

It is difficult to quantify the educational and research value of this Reserve. Many scientific and social studies are carried out in this natural forest yielding local, regional national, and international benefits, as well as holding value for the individuals who carry them out. The work realized by Holdridge in 1971 regarding the new climatic classification of world vegetation formations is a convincing example (Dolisca 2001).

Other Direct Values

Other direct values include the use of this natural forest for human habitat and the potential use of genetic materials from plant and animal species for modern food crops, pharmaceutical and industrial applications. Biodiversity ensures a range of choices and alternatives for the direct use of this forest. There are no monetary values available for these uses.

Indirect Values

The indirect values of this Reserve refer to the environmental goods and services that it provides. The indirect values of the Forêt des Pins Reserve are its hydrological functions through flood control and flow regulation and its maintenance of carbon stocks

in vegetation and soils. A reduction in forest cover implies an increase in soil erosion, a release of carbon into the atmosphere and an increase in the greenhouse effect. However, there has been no attempt to calculate the national benefits of the soil conservation value and the carbon stored in Haitian forests. Forest degradation and destruction might imply the loss of many of these environmental benefits, although the extent of the loss would depend on the subsequent land use. General experience indicates that few other forms of land use provide environmental benefits as valuable as those of a natural forest. It is never easy to estimate the value of indirect forest use as the data requirements are substantial and the linkages between cause and effect are difficult to determine.

Option values

The option of the Reserve is basically the premium that consumers are willing to pay for an unutilized asset, simply to avoid the risk of not having it available in the future.

1.4.2 Non-Use Values

Finally, there are non-use forest values. These refer to the intangible benefits derived from the existence of forests, above and beyond any direct or indirect use value that people may enjoy. Non-use values include both existence and bequest values. An example of the former is the value which people attach to the continued existence of certain species found in Forêt des Pins Reserve (cedar, geranium, fowls). Such values may be most apparent among those who do not live near or use the products of forests directly themselves, and perhaps benefit only very slightly from indirect uses, but who wish to see such forests

preserved in their own right. Bequest values arise when people place a value on the conservation of particular resources for posterity (future generations). Bequest values may be high among local populations using or inhabiting the forest area, to the extent that they wish to see a way of life and culture that has "co-evolved" with the forest passed on to their heirs. By the same token, those who live far from the forest may wish to ensure that their descendants have an opportunity to visit and enjoy them.

1.5 Property Rights in Haiti

For the purpose of this study property rights are defined as "the ability to freely exercise a choice over a good or service (Allen 1999). This definition emphasizes the most important function of property rights; determining who gains from, and who bears the costs of economic consequences and to what extent. Definitions also provided by Place and Otsuka (2001) and Roth et al. (1993) stress that the necessary components of property rights include excludability, duration, flexibility, security, transferability, and divisibility. These components determine the power of property rights. Excludability allows those with rights to exclude those without rights to a particular resource, land for example. Durability refers to the temporal extent of one's rights. Security of property rights means that the property is secure, socially acknowledged, and enforceable.

Subsequent research has revealed that title and privatization of land ownership are not necessary to ensure tenure security (Place and Hazell 1993; Bruce 1993). This result stems from the strength and effectiveness of indigenous property rights institutions that still exist in many countries in Africa and in Haiti, often having more power than national laws in the rural communities (Roth et al. 1993). Smucker et al. (2002) report that, in

Haiti, indigenous tenure systems are a source of protection against the insecurity that comes from involvement with formal state tenure systems, which often bring a threat of urban elites taking land. Where local tenure systems have broken down, registration and land titling may be needed.

There is a considerable amount of theoretical literature that examines the implications of tenure status on land clearing pressures and conservation practices. Several studies support the assertion that privatization of land is necessary for conservation. Farmers' incentives to adopt conservation practices and to make investment are inhibited by weak tenure security and by lack of land titles (Zhang and Pearse 1996; Feder and Noronha 1987; Demsetz 1967). Jamarillo and Kelly (1997) in their study on deforestation and property rights in Latin America also recognize that tenure issues have an effect on land clearing pressures. However, certain scientists cast doubts on the linkage between land tenure and conservation practices, indicating that land title is unlikely to induce tenure security (Gavian and Fafchamps 1996; Place and Hazell 1993).

1.5.1 Origins of Land Tenure in Haiti

After independence from France in 1804, the new Haitian state obtained huge properties by confiscating French colonial estates and declaring state ownership of all unclaimed lands (Moral 1978). Informally, freshly freed slaves established themselves as independent agriculturalists in areas of weak government control (Moral 1978). Latortue (1998) estimates that over a third of Haiti's present territory was settled outside of government control. Between 1807 and 1817, Pétion (former Haitian president) distributed about 170,000 hectares to some 10,000 beneficiaries (Moral 1978). Land

distribution in Haiti today remains significantly more egalitarian than elsewhere in the Caribbean and Latin America (Lundahl 1979).

Land reform subdivided plantations for the use of emancipated slaves. They squatted on the grounds of the old plantations and imposed small-scale agriculture against the wishes of the leaders of the new state. The reform was so extensive that by 1842 no plantation was in its original size (Moral 1978). The primacy of small-scale farming over the system of large plantations had consequences in terms of land fragmentation (Faustin 2003). Peasant lands became more fragmented as each heir received a piece of property. Sharecropping and renting became more popular arrangements. In the past few decades land has become scarce as soils deplete and populations increase.

1.5.2 Current Situation of Land Tenure in Haiti

There is a significant amount of literature on Haitian land tenure based on local community studies, old census data, and other more recent survey data. These studies include research in dispersed areas of the country, lowland plains, and mountain communities. Review of the literature suggests that categories of land tenure are fairly standard throughout most of rural Haiti (FAO/INARA 1997).

The major forms of land tenure in Haiti, particularly in Forêt des Pins Reserve, are rented, illegal tenant, landowners, undivided inheritance shared with other family members, and sharecropping (Moral 1978). Very few landowners obtain land through purchase or through grants from former governments (military and civil) or former corporations such as SHADA, neither do they acquire it through inheritance, or a claim of

long-term use (CFET 1997); all of these are cases in which the property rights are both divisible and transferable.

Many farmers also rent land temporarily from the state, absentee landlords, local owners or relatives (Smucker et al. 2002). In turn, renters frequently sublease some of these lands, particularly parcels owned by the state. Renters generally enjoy more rights to the land they work than do sharecroppers. In the renter case, for example, crops are sold and the proceeds go directly to the farmer. While, sharecroppers, in most agreements, give landowners half the goods they produce on the land. Unlike sharecroppers however, renters have to pay for land in advance. The prevalence of renting makes the land market extremely dynamic; even small farmers rent land, depending on the amount of extra income they derive from raising cash crops (Faustin 2003; Smucker et al. 2002). Sharecropping, also very common, is usually a shorter-term arrangement, perhaps lasting only one growing season.

In those cases (renting and sharecropping), farmers have little incentives to participate in long-term activities such as biodiversity conservation measures and ecosystem management practices. For example, residents in Forêt des Pins Reserve who depend on government land to reside, farm and graze perceive that they do not have secure rights on that land. As such, they hesitate to make long-term investment of planting trees and management. Insecure and ill defined land rights will prevent farmers to get credit because they cannot use insecure land as guarantee to acquire low interest and long-term institutional credit. As a result, household may not be able to make long-term investments such as ecosystem management.

Sixty-five percent of the population lives in the countryside, but very few actually own the land they work (CFET 1997). Instead, large landowners (grandon) own or run large areas and rent land out in an exploitative sharecropping system (Latortue 1998). Those few peasants who do own land generally have a small parcel, 70% of all farms are less than one hectare which can only be cultivated in the most basic manner (MDE 1996).

Peasant land ownership originates from formal and informal purchase, inheritances, and gifts. According to national surveys, peasant owner-operators own 35 percent of all agricultural parcels by purchase, 23 percent via divided inheritance, and 15 percent via undivided inheritance (Latortue 1998). Other forms of access derive from a variety of arrangements including usufruct, non-formalized gifts of land, plots controlled by land managers for absentees landlord and leasehold on state land (Smucker et al. 2002).

In keeping with the profound dualism of Haitian society, land tenure arrangements are marked by two parallel systems (one legal and the other customary) (CFET 1997, Moral 1978). In fact, both systems are interactive and constitute a type of legal pluralism rather than two discrete systems (Latortue 1998). Legal or statutory transactions and entitlement rely heavily on documents prepared by notaries and updated survey (Smucker et al. 2002). In general, peasant land transactions reflect distrust of notaries, land inspectors, and virtually all agents of the state including the judiciary (Bannister 1998).

In the customary system, people make land available in response to family obligations, special ties to fictive family (godparenthood), and various forms of clientship (labor relations, personal loans, banking of favors) (Smucker et al. 2002). Normatively,

affinity groups have an obligation to make land available to all family members (Bannister 1998). Customary or informal arrangements among peasant farmers tend to be self-regulatory (Smucker et al. 2002). Peasant farmers occasionally update title to inherited land. Ownership rights are regulated by community ties rather than by the law (Latortue 1998). Most farmers hold land by extra-legal agreements, but owners of informally divided inherited plots may also refer back to master deeds three or four generations ago (Barthelemy 1989, Murray 1977). Farmers avoid registering their lands because of the transaction costs involved from notary fees, survey costs, taxes, and other charges (Bannister 1998). For peasants, avoiding surveys also diminishes the risk of land loss due to the high cost of surveying and revising current plot lines to conform to old master deeds (Bannister 1998). Formal title is not necessarily more secure than informal arrangements, in the Haitian context of legal pluralism (Pierre-Louis 1989). Formal title is more expensive and less flexible than the informal system.

There is also an active land market among peasants in Haiti. Land sales are driven by consumption and the need for cash in a household economy characterized by extreme cash scarcity. In addition to its value as a basic factor of production, land is held as a store of value or insurance fund for crisis, illness, burial, ceremonial obligations, schooling, or out-migration (FAO/INARA 1997, Murray 1977).

1.6 History of Forest Management in Forêt des Pins Reserve

Organized forest management was not reported in the reserve prior to the winter of 1939-1940, probably due to the distance from the main markets (Berry and Musgrave 1977). In 1939, the Chief of the Forest Resource Service introduced managed logging

and fire protection in the Mont des Commissaries region, followed by a sawmill in the village of Forêt des Pins (Berry and Musgrave 1977). In 1941, the company SHADA was granted a 50-year lease over 60,500 hectares (150,000 acres) of the reserve (Ashley 1989). A logging and sawmill complex was established along with permanent buildings, a road system, and firebreaks. SHADA's forest and milling operations processed and marketed 2,350 m^3 of sawn timber in the first year, and this increased to around 7,000 m^3 in the second and subsequent years of operation (Berry and Musgrave 1977). SHADA sawn output has been quoted as 87,690 m^3 from 1941 to 1952, an approximate average production rate of 8000 m^3 (3,390,000 board feet) sawn per year.

The millions of board feet produced by SHADA filled a critical gap in Haiti's wartime loss of lumber imports and freed shipping space for the import of other vital goods and equipment. Part of the lumber was used in SHADA's construction program in the Forêt des Pins Reserve. The rest was either sold to the Haitian government, to the U.S. Coast Guard or to lumber dealers all over Haiti. A considerable amount of lumber sold locally was used for boat building (SHADA 1943). Optimistically, Holdridge (1942) wrote:

> "So far, the lumber operations are easily able to pay their own way. Forest-related development, such as road building and construction of [SHADA Forestry] division headquarters are too heavy a load to be borne by present timber exploitation, and are therefore capitalized; but there are excellent possibilities of canceling out all if these developmental costs within a relatively few years, at which time it should be possible to proceed with the development of other forest types in the Republic (cited in Pierre-Louis 1989)."

The great pressure for timber production during the Second World War combined with a severe shortage of trained staff, resulted in a narrow focus on logging and milling in the reserve (Ashley 1989). Important management and planning activities, such as forest inventories, growth studies, and harvest planning were not undertaken. Originally, SHADA managed the forests of the reserve under a clearcut silvicultural system (Holdridge 1947). In 1952, SHADA was declared bankrupt and full time expatriate management was replaced by a series of advisers (Berry and Musgrave 1977). Clearcutting was stopped to discourage farm cultivation, and harvesting was changed to a selective method where harvestable trees were chosen by the mill foreman. In 1957, SHADA terminated its activities and the logging concession was given to private Haitian interests. This latter arrangement was terminated in 1980 and the administration and management of the reserve was entrusted to the Ministry of Agriculture, who in turn in 1983 delegated it to the Forest Resources Service (SRF).

It is undeniable that SHADA Forestry division had a major positive impact on the development of forest activities in Haiti, and indicated the way for a well-planned development scheme for the Forêt des Pins Reserve. During the SHADA years, the inventory and the mapping of the Forêt des Pins Reserve were realized and a preliminary management plan was drawn up. A primary road system was constructed and used as firebreaks. These roads that were suitable for log transportation in good weather were laid out in such a manner that they could later be improved to constitute a secondary road system for the forest (Holdridge 1947).

In areas of good fertile soils such as Gros Cheval, located between the Morne des commissaries and the Morne la Selle, a truck garden was established where lettuce,

broccoli, Irish potatoes and onion were grown. Peaches and other temperate climate trees were also introduced. A small dairy herd was established which provided the Division with fresh milk, cream and butter (cited in Pierre-Louis 1989).

Training of personnel at all levels was a major concern. The forest administration was built, as in the United States, around the district ranger. Haitian agronomists were selected for these positions and after a tour of duty in the Forêt des Pins Reserve, they were sent overseas to study forestry. These forestry graduates were expected to eventually replace the expatriates working in the Division.

In 1983, the Projet Forestier National (PFN) developed a new management plan for the reserve. PFN delineated the reserve boundaries and created forest and land use maps. The agency inventoried 11,400 ha, conducted growth and yield studies, established reforestation trials, and conducted a census of 500 farmers living and working within the reserve (Ashley 1989).

Currently, agriculture is the main economic activity of people in the area, with 93 percent of households relying upon agriculture as their main source of income (CFET 1999). Forests are illegally harvested for the production of timber, charcoal and firewood with the lumber sold mostly in Port-au-Prince, the capital of Haiti. As would be expected, the price of this lumber increased considerably with the official ban on cutting and consequent reduction in supplies. According to one survey, this constitutes the main source of income for 2 percent of local households (CFET 1999). The economic importance of illegal harvesting is most likely much higher than this survey captured, but the extent of illegal harvesting is difficult to capture with accuracy and validity. Non-

timber forest products such as wild fruits and medicinal plants, “bwa gra” (fire sticks) are also sources of revenue, but at a declining rate due to resource scarcity.

1.7 Study Structure

This study is organized as follows. Chapter 2 investigates farmers’ perceptions on the impact of the Forêt des Pins Reserve on the economic, social, and environmental status of local people. It attempts to provide clear descriptions of farmers’ values and preferences for management in the Reserve using multivariate research methods. It also attempts (1) to describe farmers’ perceptions about protected areas; (2) to identify the underlying dimensions that comprise farmers’ perceptions about protected areas; and (3) to determine if gender, age, education level, place of birth, group membership, land tenure, and income level in the community influence farmers’ perceptions of forests.

Chapter 3 focuses on the causes of deforestation in Haiti, particularly in Forêt des Pins Reserve using annual average of forest area cleared per household as the dependent variable. Chapter 3 also reviews previous empirical analysis and develops an empirical Tobit model being the basic to determine the link between household characteristics and deforestation.

Chapter 4 was designed to statistically cluster farm households in Forêt des Pins Reserve based on their socioeconomic and demographic variables. We hypothesized that farm households are not a homogeneous group in terms of their socioeconomic and demographic characteristics and that definable and interpretable groups could be identified using cluster analysis. Chapter 4 also provides a review of conceptual issues and a brief introduction of the classification methods, and summarizes the practical

application of the household typology and the framework for farm household systems in Haiti.

Chapter 5 develops a non-separable farm household model based on linear programming (LP) to investigate the role of alternative policy instruments for forest conservation on two types of farm households in Forêt des Pins Reserve. The model has been used to simulate the effects of policy instruments (cross-compliance policies for fertilizers and improved seed inputs on farm household welfare (net revenue) and conservation investments, conservation labor subsidies (cost sharing), and land tax and input price policies related to the importance of the crops) to promote conservation.

The final chapter provides some concluding words on the study, implications of the results for enhancing forest conservation, and points to possibilities for future research.

CHAPTER 2

MODELING FARMERS' PERCEPTIONS ABOUT FORESTS IN HAITI: THE CASE OF FORÊT DES PINS RESERVE

2.1 Introduction

Local communities derive significant value from natural and rural protected areas (Paryski 1989; Paryski 1996). The natural world provides a range of resources that people employ for their everyday needs (fuelwood, timber for shelter, non-timber forest products) (Kramer et al. 1992; Dixon and Sherman 1990) as well as resources that are used for more abstract and psychological reasons (wilderness areas for spiritual purposes and for stress relief) (cited in Stein et al. 1999).

Conflict between people and natural resource use has become an increasingly important issue for conservationists, as land placed under cultivation has increased in many protected areas of rural Haiti (Paryski 1996). Development projects have been undertaken to address the complex issues of environmental degradation and deforestation. Their success depends not only on the understanding of biophysical conditions, but also on the socioeconomic and cultural contexts within which they operate (Urgessa 2003). The rate of deforestation and the extent of environmental degradation in Haiti have then required new approaches towards protected area management and conservation problems. In this respect, efforts to manage and conserve protected areas have included environmental education.

Environmental education is described as "a process of developing a world population that is aware of and concerned about the total environment and its associated problems, and which has the knowledge, skills, perceptions, attitudes, motivation and commitment to work individually and collectively toward solutions of current problems and the prevention of new ones" (United Nations Educational, Scientific, and Cultural Organization [UNESCO] 1978). Perceptions are an important element of the environmental education according to this definition. Understanding farmers' perceptions about the environment may provide a framework for the future of forest conservation, and inform future efforts in forest education.

The causes of protected area degradation are numerous and vary from country to country, sometimes at the hands of local people and other times in spite of their opposition (FAO 1999). As traditions are different, specific perceptions about the natural environment among farmers in many communities may also differ. Identifying the differences between local people may reinforce conservation efforts by providing information from which to create specific conservation programs that emphasize issues of local concern. Consequently, several studies have been conducted to investigate environmental perceptions worldwide (Thompson and Gasteiger 1985; Jacobson and Marynowsky 1997) and abroad (Infield 1988; Napier and Napier 1991; Hartup 1994; Colchester 1996; Hill 1999; Furman 1998; Mehta and Kellert 1998; Beedell and Rehman 1999). A common finding following from these studies is that conservation attitudes reflect resource-use benefits.

Because farmers in many regions of Haiti are landowners, tenant farmers, or sharecroppers, and influence depredation-related management decisions, understanding

their perceptions and attitudes and how they vary with each other may be critical to managing forests and protected areas. Likewise, some fractions of the population may firmly oppose externally-imposed forest management decisions, so their perceptions are equally important. A better understanding of rural people's knowledge of the forest, their awareness of deforestation and its perceived impact on their socioeconomic and environmental welfare is fundamental to the development and implementation of management strategies that are both sustainable in the long term and sensitive to existing local needs.

This leads to the research question guiding this chapter: Do perceptions about protected areas differ among farmers in Haiti, particularly in Forêt des Pins Reserve? This question is based on the growing international research interest in the nature of communities that surround protected areas. Forest managers and conservation researchers want to know what factors influence the resource-use benefits of these communities and how a better understanding of these benefits can lead to more effective conservation efforts (Infield 1988; Brandon and Wells 1992; Flaherty and Filipchuck 1993; Hartup 1994; Newmark et al.1992; Fiallo and Jacobsen 1995; Gibson and Marks 1995; Jacobson and Marynowsky 1997; Hill 1999; Gillingham and Lee 1999; Abbot et al. 2001).

The purpose of this chapter is to investigate farmers' perceptions on the impact of the Forêt des Pins Reserve on the economic, social, and environmental status of local people. This study attempts to provide clear descriptions of farmers' values and preferences for management in the Reserve using multivariate research methods. Specifically, this study has three objectives: (1) to describe farmers' perceptions about protected areas; (2) to identify the underlying dimensions that comprise farmers'

perceptions about protected areas; and (3) to determine if gender, age, education level, place of birth, group membership, land tenure, and income level in the community influence farmers' perceptions of forests.

Study results should help forest resource managers of the Forest Service of the Ministry of Agriculture, Natural Resources, and Rural Development, local and departmental authorities, and a variety of other government and non government decision-makers to plan, develop and manage the Reserve.

This chapter is organized as follows. The next section describes the theoretical framework guiding the analysis of farmers' perceptions about forests; section three provides background information about protected areas situations in Haiti. Section 4 describes the research method, and the fifth section discusses the empirical results. The final section illustrates conclusions from the study and proposes guidelines for future research.

2. 2 Theoretical Framework

Forests are defined as "an area set aside for the production of timber and other forest products conferring vital socioeconomic and environmental benefits to the society" (Rao 1987). The value "forest" may have multiple meanings that may or may not be consistent among farmers in Forêt des Pins Reserve. Perceptions about forests may vary depending on one's culture, class position, level of education, political or social ideals as well as religious heritage.

The conceptual framework for this study was based on the social exchange theory (Turner 1974; Ekeh 1974). The central idea of this theory is that the exchange of

social and material resources is a fundamental form of human interaction (Ingoldsby and Smith 1995). Social relationships are considered as "markets" in which individuals act out of self-interest with the goal of maximizing profits (Sabatelli and Shehan 1993). This theoretical perspective states that people are reward-seeking and punishment-avoiding creatures who attempt to maximize individual well-being in all situations. The theoretical model basically asserts that people develop attitudes toward other people and things in the context of anticipated personal beliefs and costs to be derived from contact with them. Things that generate net benefits will tend to be perceived positively, while those things that generate net losses will tend to be perceived negatively (Napier and Napier 1991).

Contemporary exchange theory stresses that farmers seek the "best value" they can get in participating in a forestry program (Napier et al. 1986). Consistent with exchange theory, Napier and Napier (1991) argue that farmers tend to contribute to an activity program that has a positive net benefit. As each individual seeks the best value in an activity, farmers will tend to choose forestry activities for which they receive more benefits. Farmers typically seek activities that offer at least as much, in terms of socioeconomic and environmental benefits as they get from alternate activities.

The argument in using social exchange theory in farmers' forest perceptions can be explained by pointing out that male-headed household and female-headed household may also look for different benefits from the forests. In selecting a benefit from the forest, male-headed households are more likely than female-headed household to view the forest as a source of revenue creation and earning power, while a female-headed household usually sees the forest as a means of meeting basic needs and as a support mechanism for increasing self-reliance (Newmark et al. 1992; Britt and Shrestha 1998).

These differences in emphasis on forest perceptions, allow men and women to maximize their individual well being.

Education and knowledge are also important determinants of how benefits from forestry programs are perceived. People cannot be expected to exhibit positive attitudes toward forests if they are unaware of the benefits and costs associated with their participation. Education and knowledge about forest conservation issues make people more positive in their views (Infield 1988; Heinen 1993; Mkanda and Munthali 1994; Fiallo and Jacobson 1995). Public education can increase public support, improve behavior, reduce vandalism, decrease poaching, and influence policies and decisions that affect public lands (Jacobson 1990). Better informed and educated people should be more aware of potential benefits to be derived from the forest than individuals who are ignorant and illiterate (Napier and Napier 1991).

Environmental organization membership and place of birth may also affect community perceptions toward forests. This occurs through a process of differential socialization (Portes 1971) in which the membership gains environmental experiences through meeting as well as an interpretive framework for these experiences which are absent among non-member farmers.

Land tenure may also influence attitudes toward benefits from forests because forest activities are designated to be permanent. Previous research suggests that farmers with secure land tenure should exhibit positive attitudes toward forestry activities. Smucker and Timyan (1995) found evidence in Haiti that secure property rights correlated positively with attitudes toward forestry programs. They also realized that

insecure property rights are related to environmental degradation. The absence of secure property rights threatens forestry activities by discouraging tree planting, agricultural investments in irrigation, terracing, and soil enrichment, essential elements in tree growing. These conclusions support those of a similar study which showed strong positive correlations between tenure status and amount of forest land cleared in Forêt des Pins Reserve (Dolisca 2001).

Characteristics of the farm household may influence the impact of forest activities at the farm level. More prosperous farmers, both in terms of material possessions and acreage of land owned, should be in a better economic position to adhere to forestry conservation programs (Infield 1988; Parry and Campbell 1992; Hartup 1993; Gibson and Marks 1995; Fiallo and Jacobson 1995; Nepal and Weber 1995). This suggests that farm household income should be positively correlated with perceptions toward a forestry program. Farmers who believe that forest activities will have an adverse impact on the farm household should exhibit negative attitudes toward the program. Forest activities that are perceived to threaten the viability of the farm household should be viewed negatively by the landowner.

Based on social exchange theory, it was hypothesized that perceptions of Forêt des Pins Reserve respondents about forests would be different according to their age, gender, place of birth, land tenure, education level, income level, and organizational membership.

Hypothesis

- There is a significant difference in perceived importance of forest benefits between farmers in Forêt des Pins Reserve.
- There is a relationship between the farmers' age, gender, and education level, group membership, born inside the forest, land tenure, income level, and the perceived importance of forest benefits.

2.3 Background

Haiti has seven national parks and eight reserved and protected zones with a total area estimated at 165,000 ha. These were created between the years of 1926 and 1983 in response to the continuous pressures from farmers, and especially squatters, and international agencies (Victor 1997). National parks, protected zones, and reserved zones, according to the Haitian legislation, are protected areas with the following objectives: 1) the protection and preservation of natural ecosystems; 2) the improvement of social and economic status of local people by promoting the development of ecotourism and making traditional resource management more sustainable; 3) the promotion of scientific and environmental education; 4) the creation of an independent government agency to be responsible for the planning and execution of conservation policies and programs (Paryski 1989).

The management of these protected areas is coordinated jointly by the Forest Resources Service and the National Parks Service of the Ministry of Agriculture. The most difficult task related to the conservation and management of these protected areas results from the presence of settlements of local populations most of whom were already

in the areas before their designation as Reserves. These local populations are generally poor, isolated communities that practice shifting agriculture and illegal harvesting of trees for fuelwood and charcoal production, and thereby often conflict with conservation objectives.

The basic approach to management of these protected areas has been a strategy of preservation. This strategy is based on the assumption that certain areas adjacent or inside of the protected areas are critical to the survival of the forest. Management of the protected areas is organized to protect them from people living inside and in adjacent areas, and to shield timber, wildlife and other natural resources from exploitation (Ashley 1989). Efforts to protect areas from human exploitation by force and coercion have led to hostile attitudes on the part of local people towards wildlife and forestry staff (Pierre-Louis 1989). The negative relations have even led to open conflict (Ramakrishnan 1992).

In the present economic and social situation, the practical and effective path to sustainable protected areas management is by seeking community participation in the management activities taking place in the Reserve. One important determinant of participation is the perception of local people. For many protected area managers, detailed knowledge of the local people whose lives are affected by the establishment and management of protected areas is as important as information about the trees and species to be conserved (McNeely 1995).

Incorporating local knowledge into protected areas management and, the decision making process has grown in popularity especially in developing countries (Lewis et al. 1990; Wells et al. 1992; Marks 1994; Western et al. 1994; Alpert 1996). The idea of

integrating local people into the management process of these protected areas is based upon the theoretical construct of communities as small populations with shared social and cultural customs (Agrawal and Gibson 1999), and the assumption that local people depend on access to protected areas to satisfy subsistence needs. Poorer people have greater resource needs, and that by receiving substantial benefits, people will change their attitudes and resultant behaviors in support of resource conservation (Gibson and Marks 1995; Hackle 1999; Abbot et al. 2001).

The role of community involvement in resource management has been studied by psychologists, sociologists, and by scientists of other disciplines. Soma (2003) found that eliciting and using local knowledge in the early stages in the planning of protected areas may well be an effective way to encourage this participation. Sewell (1973) and White (1966) indicated that the outcome of the decision-making process is affected considerably by the perceptions and attitudes of the various participants in the process. This study was motivated by a need to determine possible influences of selected socioeconomic factors on farmer's perceptions toward Forêt des Pins Reserve.

2.4 Methodology

This study was based on different samples of farmers in 15 villages of Forêt des Pins Reserve. The purpose of this section is to describe the methodological approach of this study. The section is divided in two parts, comprising: 1) the techniques used for the data collection during the field survey; and 2) an explanation of the methodology used to analyze the data collected during the survey.

2. 4.1 Data Collection

This study was carried out in 15 villages of the Forest Unit 1 of the Forêt des Pins Reserve. Data were collected from May to August 2003 through formal and informal survey techniques with the heads of the farm household living in the different villages. The purpose of this survey was to gather data on the socioeconomic aspects of peasant life and their attitude to the Reserve.

The survey aimed at gathering qualitative and quantitative data from the local community. One purpose of this part was to collect all information regarding the socio-economic aspects of the household in the area such as demography, education, sources of income, salary, land tenure, and attitude to the environment. The interviewees were selected randomly from the list of the households provided by the Forest Service. The random sample consists of 243 households in 15 villages inventoried in the area (CFET 1999).

The survey was divided in 4 main sections, each part covering different subjects (Appendix). In section one, the questions sought information on the demographic characteristics (age, sex, years of education, and relationships of all people of the household). Section two concentrated on the economic activities in the Reserve. Section three dealt mainly with questions related to farmers' perceptions towards the Reserve. The questionnaire concluded with questions of general interests.

The questionnaire was pre-tested with three research assistants, as well as a sample of 6 farmers from two villages. As a result, some questions were deleted and some modified to improve their clarity. Qualitative data were also obtained through informal, unstructured and open-ended interviews with key informants including local

leaders, elderly community members, and school teachers. Qualitative data helped verify and enrich quantitative data obtained from the survey.

During the survey process, heads of households were generally very open to describing their farming experiences and their concerns about the future of this forest. Our insistence on the clear objectives of this study greatly contributed to dispelling doubts of some peasants who might be willing to dramatize things, because they could anticipate an upcoming development project stemming afterwards. It was also attempted to interview the respondents in isolation to secure sincerity in their responses.

All the interviews were conducted in Creole in order to ensure locally relevant answers to the questionnaire. Local words were often used wherever possible to avoid technical terminology. Picture cards were used for perception questions; respondents selecting from a pre-determined list of response categories. We often provoked informal follow-up discussions and made use of our observations to assure the validity of our findings.

In our survey, we found that migration to the Reserve has slowed in the past decade. Fifty-seven percent of the heads of households were born inside the Reserve, 13 percent have lived there for more than 40 years, 28 percent for more than 10 years, and only 2 percent for less than 10 years (Table 2.1). This is a positive signal for the potential of forest management to control and reduce negative impacts of population growth on the forest.

About two hundred men (82%) and forty-two women (18%) were interviewed during the survey. The number of female-headed households, which was 6.7 percent, was lower than the 11 percent that the Centre de Formation et d'Encadrement Technique

[CFET] found in 1999. The gender of head of household seems to be affected by changes in marital status, death of the husband, and male migration. The practice of 'polygamy' may also affect women since they might be de facto heads of household (Latortue 1998). Informal discussions with some male-headed households in the Reserve revealed that most of them had a 'mistress'. The age of respondents ranged from 24 to 75 years; the respondents were relatively middle age with an average age being 49 years. The largest proportion of respondents was in the (41-50) year-old category (35.39%).

The years of education range from 0 to12, with an average of 2.1. About fifty-four percent of the respondents were illiterate, twenty percent had completed primary school, and 2 percent had graduated from high school. Women had less education than men and female-headed households tended to have less education than wives. Forty-three percent of the males had attended school, compared to 3.3 percent of the wives and 1.2 percent of the female household heads. Only 1.58 percent of the females had completed primary school, compared to with 18 percent of the male head of households. About half of the respondents (50.6%) are local group members.

The marital status at the time of the survey included respondents who were married (76.9%), widowed (0.4%), single (1.2%), and cohabitating (20.5%). The number of married respondents was higher than the 55.5 percent that the Bureau d'Enquêtes et d'Analyses Socioeconomiques [BEAS] found in 1985 in the Reserve. This is probably due to the influence of Protestant and Catholic sects in the Forest Unit I of the Reserve. Eighteen percent of the sampled female headed households were widows and old; the remainder was still in their reproductive years. Households had an average of 7.2 people,

but the male- headed households had 7.4 while the female household heads had 5. 7 people.

Table 2.1 Variation in the data set by gender, marital status, age, education, current position and land tenure.

Interviewed persons	Forêt des Pins Reserve	
	Frequency	%
Gender		
Male	201	82.72
Female	42	17.28
Marital Status		
Single	3	1.2
Married	162	76.9
Divorced	1	0.4
Widowed	27	11.1
Cohabitating	50	20.5
Age group		
21-30	8	3.29
31-40	48	19.75
41-50	86	35.39
51-60	71	29.21
61 and above	30	12.34
Years of education		
0 Illiterate	131 (74% male)	53.9
1-4 Primary school	60 (93% male)	24.69
5-8 Middle school	48 (92% male)	19.75
> 8 High school	4 (100% male)	1.64
Current Position		
Local group Member	120	50.6
Non local group member	123	49.3
Land tenure		
Landownership	42	17.2
Family land	28	8.2
Sharecropping	20	11.5
Tenant farming	143	57.6
Illegal land use	13	5.3
Place of Birth		
Inside the forest	139	57.2
Outside the forest	104	42.8

Sample size=243

Land for agricultural purposes was acquired through landownership (purchase, inheritance, gift, and illegal forest clearing), tenant farming, or by sharecropping. Tenant farming and landownership were the main sources for the different farmers in the Reserve. About fifty-seven percent of the respondents acquired land through tenant farming, 5.3 percent got land illegally. The size of land holdings in the Reserve ranges from 0.7 to 16.1 ha. Fifty-six percent of the respondents were poor (respondents who reported insufficient annual income to support basic household needs such as food, medical care, and clothing), while 12 percent were classified as 'better off'. The average monthly family income of the 243 respondents was 1250 Gourdes, with 24 of them (10.2%) earning a monthly family income in the range of 20,000 and 58,000 Gourdes (1 US$ = 37.5Gourdes).

2.4.2 Measuring Farmers' Perceptions toward Forests

For measuring farmers' perceptions of the Forêt des Pins Reserve, the respondents were asked a set of questions, which addressed farmers' perceptions toward the Reserve. Perception statements were derived from a two-phase approach to gather data (Creswell 1994). The first phase consisted of focus group interviews with Forêt des Pins Reserve farmers (Dolisca 2001). Indeed, two focus group meetings were conducted throughout the Reserve. Each meeting consisted of about 20 participants who were randomly selected throughout two different villages inside the Reserve. They were asked about their perceptions and the benefits received from the Reserve. The qualitative nature of focus groups allowed for a good understanding of farmers' perceptions of the Reserve.

The results of the meetings allowed us to identify lists of benefits which were used to build the questionnaire. The second phase expanded the first phase and took a

quantitative approach to understand the values Forêt des Pins Reserve farmers have for the "nature ecosystem". Since benefits from the Reserve have different meanings for different people, we used the same terminology within the questionnaire that participants in the first phase used in describing their perceptions about the Reserve.

2.4.3 Data analysis

A combination of descriptive and inferential statistics was used to address stated research objectives. Descriptive statistics were used to describe farmers' perceptions about protected areas. Factor analysis was used to identify latent dimensions underlying the different variables that measured farmers' perceptions. Linear structural equation modeling technique was used to analyze the differences in perceived importance of forests among farmers in Forêt des Pins Reserve based on gender, age, educational level, born inside or outside the forest, group membership, land tenure, and income level.

2.4.3.1 Factor analysis

The second research question sought to empirically identify the underlying dimensions inherent in farmers' perceptions about protected areas in Haiti. Since a pre-existing data structure was not assumed, an exploratory factor analysis with varimax rotation was used to identify the latent variables represented among the 20 perception statements. Exploratory factor analysis is a technique often used to detect and assess latent sources of variation and covariation in observed measurements. It is used in the social sciences (Joreskog 1969; Burt 1973) and in marketing (Mitchell and Olson 1981; Bagozzi and Van Loo 1978; Bagozzi 1977), operation research, and other applied sciences (Aaker and Bagozzi 1979) that deal with large quantities of data (Rummel

1970). Small samples may affect the factor analysis by making the solution unstable. Some researchers have suggested the ratio of sample size to number of variables as a criterion: the recommendations range from 2:1 through 20:1 (Sharma 1996). Others have suggested a minimum sample size of 100 to 200 observations (Guadagnoli and Velicer 1988). As part of this study, the ratio of sample size to the number of perception variables is 12.5:1.

The basic factor analysis model specifies a set of linear relationships in which *P* observable variables (indicators) $x_1, x_2, ..., x_p$ are determined by *K* unobservable variables $\xi_1, \xi_2, ..., \xi_k$, fewer in number than the observed variables, and *M* independent disturbances $\mu_1, \mu_2, ..., \mu_m$. In matrix terms, the model has

$$x_i = \lambda_{i1}\xi_1 + \lambda_{i2}\xi_2 + ... + \lambda_{in}\xi_k + \mu_i$$

Where λ is the $M \times K$ matrix of factor loadings.

In this study, we assume that all the respondents' ratings data on different attributes can be reduced down to a few important dimensions. This reduction is possible because the attributes are related (Joreskog 1969; Rummel 1970). The rating given to any one attribute is partially the result of the influence of other attributes (Sharma 1996). The statistical algorithm deconstructs the rating (called a raw score) into its various components, and reconstructs the partial scores into underlying factor scores.

In a factor analysis, the first factor is a linear combination of the variables that account for the largest amount of total sample variance; while successive factors explain progressively smaller portions of variance (Borg and Gall 1989; Sharma 1996). A varimax rotation was used to achieve a simpler data structure by spreading the variance

more equally across identified factors and minimizing the number of variables with high factor loadings (Tinsley and Tinsley 1987).

The final decision to be made when conducting factor analysis is to determine the number of factors. One rule of thumb is to use an eigenvalue of 1.5 as the cut-off value. That is, all factors with eigenvalues of 1.5 or greater were considered and then corroborated by a screen test (Kaiser 1958; Mulaik 1972; Sharma 1996). Additional factors identified by this procedure were not selected for rotation as they accounted for extremely small percentages of total variance and were considered residual or error factors. Preliminary analyses were conducted on the data in order to verify the normal distribution of the variables and to check for the presence of outliers.

2.4.3.2 Linear structural equation model

Perceptions of farmers with regards to protected areas, and particularly to forests may differ among farmers according to their socioeconomic situations. For instance, some local group members might be concerned about the degree of deforestation of the Reserve and prefer government and NGO intervention in putting in place environmental policies for management of the Reserve. Other members may be more concerned about the economic benefits of the Reserve.

Other farmers may be concerned about the social aspects of the Reserve and prefer that the state pursue forestry programs that will strengthen local communities. Thus, perceptions toward forests are a combination of characteristics of individual farmers, as well as subjective evaluations of groups, that are functions of organizational characteristics. Because farmers' perceptions are measured multidimensionally, this model integrates several family components that potentially influence each dimension of

farmers' perceptions. An empirical model, which takes into account heterogeneous perceptions for protected areas, is specified as a system of linear structural equations (Goldberger 1972; Joreskog 1973; Joreskog and Goldberger 1975; Joreskog 1976; Bielby and Hauser 1977; Joreskog and Sorbom 1986).

Linear structural equation models (SEMs) are widely used in sociology, econometrics, biology, and other sciences. A SEM has two parts: a measurement model and an associated path diagram corresponding to the causal relations among variables specified by the structural equations and the correlations among the error terms. It is often thought that the path diagram is nothing more than a heuristic device for illustrating the assumptions of the model (Joreskog and Goldberger 1975; Joreskog and Sorbom 1986). In this study, the structural equation model uses respondents' perceptions ratings with latent variables to estimate how perceptions about forests differ among farmers based on socioeconomic and other variables (Table 2.2).

Using the notation of Joreskog and Sorbom (2003), the linear structural equation is given by the following equations:

$$\eta = B\eta + \Gamma\xi + \zeta \qquad (1)$$

$$Y = \Lambda_y \eta + \varepsilon \qquad (2)$$

$$X = \Lambda_x \xi + \delta \qquad (3)$$

Such that $E(\zeta) = 0$; $E(\varepsilon) = 0$; $E(\delta) = 0$; $Cov(\zeta) = \Psi$; $Cov(\varepsilon) = \Theta_\varepsilon$; $Cov(\delta) = \Theta_\delta$. (4)

Where, ζ, ε, and δ are mutually uncorrelated; $Cov(\xi) = \Phi$; ζ is uncorrelated with ξ; ε is uncorrelated with η; δ is uncorrelated with ξ; B has zeros correlation on the diagonal; and I-B is non singular.

In equation (1), also called the structural portion of the model, B is a $m \times m$ matrix of coefficients that indicate the influence of endogenous latent variables on other endogenous latent variables; Γ is a $m \times n$ matrix of coefficients that indicate the influence of exogenous latent variables on endogenous latent variables; and ζ is a $m \times 1$ vector of errors in prediction for the m endogenous latent variables equations.

In equation (2), Y is a $p \times 1$ vector of endogenous observable variables; Λ_y is a $(p \times m)$ matrix of coefficients (factor loadings) that indicate the influence of the endogenous latent variables; η is a $m \times 1$ vector of endogenous latent variables; and ε is a $p \times 1$ vector of errors in measurement for the endogenous observable variables. In equation (3), X is a $(q \times 1)$ vector of exogenous observable variables (respondents' ratings on importance of forest benefits to preserve the Reserve); Λ_x is a $q \times n$ matrix of coefficients (factor loadings) that indicated the influence of the exogenous latent variables on the exogenous observable variables; ξ is a $n \times 1$ vector of exogenous latent variables; and δ is $q \times 1$ vector of errors in measurement for the exogenous observable variables.

Employing the LISREL program (Joreskog and Sorbom 2003), the purified measurement model was tested using confirmatory factor analysis (CFA). The use of a purification step, in the confirmatory analysis increases the ease of computation for measurement model estimation and reduces the risk of non-convergence (Anderson and Gerbing 1988) while respecting the amount of information kept in the model. The factor solutions found in the explanatory factor analysis was confirmed with a first-order CFA.

Table 2.2 Variable definitions included in the structural equation model (Gdes =Haitian Gourdes)

Explanatory variables	Definition
Age	Head of the household's age
Female	1 if female, 0 otherwise
Bornin	1 if born inside the Reserve, 0 otherwise
Illiterate	1 if illiterate, 0 otherwise
Primary	1 if primary school, 0 otherwise
Middle	1 if middle school, 0 otherwise
Highsch	1 if high school, 0 otherwise
Mlocalgr	1 if member of local group, 0 otherwise
Iltenant	1 if illegal tenant, 0 otherwise
Famland	1 if family land, 0 otherwise
Sharecrop	1 if sharecropping, 0 otherwise
Landowner	1 if ownership, 0 otherwise
Renting	1 if renting, 0 otherwise
Lowinc	1 if income < Gdes 20,000, 0 otherwise
Midinc: Gdes 20,000-40,000	1 if income between Gdes 20,000-40,000, 0 otherwise
Larinc: > Gdes 40,000	1 if income > Gdes 40,000, 0 otherwise

2.5 Results

The purpose of this chapter is to investigate farmers' perceptions on the impact of the Forêt des Pins Reserve on the economic, social, and environmental status of local people. This section is divided in 3 parts, comprising: 1) the measurement of farmers' perceptions toward forests; 2) the identification of the latent variables using factor analysis; 3) and the estimation of farmers' perceptions toward forests using linear structural model.

2.5.1 Measuring Farmers' Perceptions toward Forests

Respondents were presented a list of benefits from the Reserve. Using a six-point Likert-type scale with "0" indicating *I do not know* and "5" indicating *very important*, participants indicated how important each statement should be in the process of preserving this Reserve. On this scale, a low score showed a negative perception toward forests while a high score represented a positive perception.

Results indicated that Forêt des Pins Reserve residents have good knowledge of the Reserve (overall mean score = 3.65). Their preferences for management center around economic and environmental benefits. Twenty perception statements were used to describe farmers' perceptions toward the Reserve (Table 2.3). We asked all respondents about their perceptions of forests on a six-point scale, where zero means they are "do not know" and five means they are "very important". The overall mean scores of importance range from a high mean of 4.15 to a low mean of 3.01. Farmers strongly believe that promoting *tourism activities* (mean = 4.15) should be the most important concern in protecting this Reserve, followed by *road maintenance inside the forest* (mean = 4.09), and *increase income from cleaning operations* (mean = 4.09).

Statements that specifically addressed the natural environment received three of the seven highest mean scores. These results imply that farmers placed a high priority on the environmental attributes of the Reserve. This is not surprising; farmers are acutely aware of the fatal consequences of deforestation of the Reserve. In the late 90's, Georges and Gordon hurricanes destroyed hundreds of homes and killed at least two thousand people in Fonds-Verrettes, a town below the Reserve. Moreover, various sites where they used to grow cabbages and potatoes are no longer suitable for these crops. Along with

strengthening local community and enhancing recreation and tourism opportunities, farmers gave a good score to supply lumber, promoting environmental responsibility, and increase the number of children sent to school.

Table 2.3 Descriptive statistical summary of the perceptions of farmers.

Statements	*Mean rating of importance*
Forest attracts tourists (*Forat*)	4.15
Increase income from road maintenance (*Road)*	4.09
Increase income from cleaning operations (*Forin*)	4.09
Increase availability in drinking water (*Foria*)	4.03
Control flood (*Forcof)*	4.01
Improve soil quality *(Forim)*	3.85
Reduce soil erosion (*Fored)*	3.78
Trees planting increase property values (*Trinc)*	3.74
Increase productivity of agricultural lands (*Forac)*	3.70
Trees planting develop sense of ownership (*Trplde)*	3.65
Tree planting promotes environmental responsibility (*Trplco*)	3.65
Trees supply lumber (*Trsup)*	3.61
Number of children sent to school increase (*Nchill)*	3.60
Tree planting strengthens rural community (*Trplst)*	3.47
Trees enhance recreation (*Trenhr)*	3.40
Improve air quality (*Forinc)*	3.39
Good place to observe nature (*Forpl*)	3.39
Participation of adults value forest activities (*Parad)*	3.33
Provide habitat for plants and animals *(Forha)*	3.09
Non-timber forest products increase income (*NTFPi)*	3.01

Survey respondents were less favorable about social benefits to implement forestry programs. Farmers gave lower scores for the social features of the Reserve. The overall social aspects mean scores ranged from 3.33 to 3.65. They were also less certain about “non-timber forest products increase income” (mean = 3.01) and “forests provide habitat for plants and animals’ (mean = 3.09).

2.5.2 Factor Analysis

In this study, a 3-factor solution (termed environmental, social, and economic) was adopted and accounted for 47.2 % of total variance as shown in Table 2.4. A criterion cut-off loading of 0.40 is used to determine which variables were included in a given factor (Sharma 1996). The Kaiser's overall measure of sampling adequacy (cited in Sharma 1996) is 0.896 suggesting that the data are appropriate for factor analysis.

Table 2.4 Varimax rotation factor pattern of farmers' perceptions in Forêt des Pins Reserve

Benefits	**Factor**		
	Economic	**Social**	**Environmental**
Provide habitat for plants and animals	0.04858	0.37410	**0.55231**
Good place to observe nature	0.01861	0.42410	**0.53743**
Improve soil quality	0.23599	0.15940	**0.58535**
Control flood	0.24482	0.18787	**0.72990**
Reduce soil erosion	0.31344	0.11506	**0.71349**
Increase availability in drinking water	0.40979	-0.07249	**0.57612**
Improve air quality	0.34510	0.15509	**0.54541**
Trees increase property values	**0.49439**	0.05228	0.34659
Forest attract tourists	**0.74084**	0.02661	0.30020
Increase productivity of agricultural lands	**0.67385**	0.09501	0.19893
Non-timber forest products increase income	**0.49693**	0.35138	0.11894
Increase income from cleaning operations	**0.76243**	0.15976	0.12125
Road maintenance inside forest create jobs	**0.80875**	0.09547	0.18447
Number of children sent to school increase	**0.69741**	0.12424	0.23514
Trees supply lumber	**0.54387**	0.28198	0.13565
Tree planting strengthens rural community	0.07316	**0.72087**	0.07191
Tree planting promotes environmental responsibility	0.15017	**0.76546**	0.10871
Trees enhance recreation	0.01301	**0.69260**	0.21168
Participation of adults value forest activities	0.30966	**0.63149**	0.15457
Trees planting develop sense of ownership	0.20155	**0.72055**	0.16531
Eigenvalue	*4.18*	*2.70*	*2.56*
Percentage of variance	*20.9*	*13.5*	*12.8*

Numbers in bold indicate the factor loadings

Eight perception variables (*Forat*, *Trinc*, *Forac*, *Forin*, *NTFPi, Road*, *Trsup* and *Nchill*) concerning the importance of Forêt des Pins Reserve were loaded on factor 1 with the cross-correlation coefficients of 0.49, 0.74, 0.67, 0.49, 0.76, 0.80, 0.69, and 0.54. This factor accounted for 20.9 % of the total variance and was termed economic benefits because these variables involve improvement of the welfare of local people. Higher scores and positive responses on this factor revealed a general agreement for promoting economic activities inside the Reserve.

Factor 2 had cross-correlation coefficients of 0.72, 0.76, 0.69, 0.63, and 0.72 with the variables *Trplst*, *Trplco*, *Trenhr*, *Parad*, and *Trplde*. Because these variables imply reinforcement of the organizational structure of rural communities, factor 2 was then labeled social benefits and accounted for 13.5 % of the total variance. Seven attributes (*Forha, Forpl*, *Forcof*, *Fored*, *Foria*, *Forinc,* and *Forim*) were loaded on Factor 3 with cross-correlation coefficients of 0.55, 0.53, 0.58, 0.72, 0.71, 0.57, and 0.54. Because these attributes focus on preservation and conservation of environmental quality, factor 3 was termed environmental benefits and accounted for 12.8 % of the total variance.

2.5.3 Linear Structural Equation Model

Estimation of the CFA, using as input 243 observations, generated goodness of fit (GFI), adjusted goodness of fit (AGFI) , and the standardized root mean-square error of approximation (RMSEA) values of 0.91, 0.86, and 0.072. According to Hu and Bentler's (1999) cutoff criteria, all fit indices are well above acceptable limits providing strong evidence of model fit. χ^2 per degree of freedom is 1.92, indicating also good fit of the model. The t-values indicate that all the estimated loadings and the variance of the

error term are significant at the 95 percent coefficient level. Non-timber forest products increase income value has the lowest t-value (t-value = 2.93) (Table 2.5). Thus, all indicators are significantly related to their specified constructs verifying the posited relationships among indicators and constructs (latent variables).

Table 2.5 Estimated LISREL coefficients of the manifest variable equations

Manifest variables	Latent variables		
	Environmental	Social	Economic
Provide habitat for plants and animals	1.00[a]		
Good place to observe nature	1.58 (9.49)		
Improve soil quality	1.05 (4.58)		
Control flood	0.49 (3.13)		
Reduce soil erosion	1.02 (5.25)		
Increase availability in drinking water	0.58 (4.19)		
Improve air quality	1.52 (7.58)		
Trees increase property values			1.00[a]
Forest attract tourists			0.73 (5.35)
Increase productivity of agricultural lands			0.50 (4.48)
Non-timber forest products increase income			1.55 (2.93)
Increase income from cleaning operations			0.94 (5.48)
Number of children sent to school increase			0.55 (5.44)
Trees supply lumber			0.51 (4.71)
Tree planting strengthens rural community		1.00[a]	
Tree planting promotes environmental responsibility		1.79 (12.00)	
Trees enhance recreation		1.58 (5.13)	
Participation of adults value forest activities		1.11 (5.13)	
Trees planting develop sense of ownership		1.39 (12.50)	

- [a] Coefficient is restricted to 1.00;
- Values in parentheses are t-values

Estimation of the structural parameters is the second step in the linear perception model (Anderson and Gerbing 1988). The results of coefficient estimates are presented in Table 2-6. The overall fit of the model is good and indicates that the model's parameters differ significantly across farmers, with $\chi^2 = 104.78$. The statistical significance of

explanatory variable coefficients estimated by the latent variable equations revealed differences in farmers' perceptions about forests across respondent characteristics. Results of the linear structural model revealed that respondents with a primary degree tend to prefer all three benefits less than do respondents who do not have a primary degree, with the greatest difference being the preference for economic benefits. Respondents with a high-school degree favor environmental benefits less than do middle educated degree respondents. The coefficient for respondents' age is significant in the equation describing perceptions for economic benefits, but non-significant in the environmental and social equations. This suggests that perceptions for environmental and social benefits are constant across respondents' age, but older respondents tend to prefer economic benefits less than younger respondents.

Female-headed households find all three benefits less important than do male-headed households. The coefficient for respondents born inside the Reserve is significant in the equation describing preferences for social benefits, but insignificant in the environmental and economic benefits. This implies that social benefits are most favored by people who likely had the most social ties to Forêt des Pins Reserve. Respondents who were born inside the Reserve favor social benefits more than do respondents who were born outside the Reserve.

Importance of forest benefits for the conservation of the Reserve also vary by whether or not respondents belong to local groups. Respondents who are members of a local group favor social benefits more and prefer economic benefits less relative to respondents who are not members of a local group. People who are members of a local organization probably are most concerned with environmental benefits.

Table 2.6 Estimated LISREL coefficients of the latent variable equations for forest perceptions.

Explanatory variables	Latent variables		
	Environmental	Social	Economic
Age	0.01 (0.76)	-0.01 (-0.62)	-0.31 (-2.35)**
Bornin	0.05 (0.17)	0.21 (2.67)**	0.01 (0.53)
Primary	-0.34 (-2.98)**	-0.43 (-2.18)**	-0.41 (-3.45)**
Middle	0.16 (1.62)	0.06 (0.72)	0.24 (2.66)**
Highsch	-0.01 (-1.74)*	0.02 (1.13)	-0.04 (-0.50)
Mlocalgr	0.23 (0.21)	0.24 (2.65)**	-0.02 (-2.21)**
Female	-0.13 (-4.08)**	-0.19 (-4.64)**	-0.19 (-2.56)**
Iltenant	0.01 (1.92)*	0.04 (1.13)	-0.08 (-0.29)
Sharecrop	-0.02 (-1.52)	-0.05 (-1.34)	-0.07 (-0.40)
Landowner	0.04 (0.15)	0.18 (2.35)**	0.01 (0.46)
Renting	-0.26 (-0.78)	-0.17 (-1.97)*	-0.08 (-2.40)**
Lowinc: < Gdes 20,000	0.21 (1.76)*	0.19 (1.92)*	0.19 (1.81)*
Midinc: Gdes 20,000- 40,000	0.18 (1.25)	0.05 (0.79)	0.09 (2.41)**

t-values are given in parentheses, * and ** denote significance at 10 and 5 percent respectively

An examination of responses by landowners, illegal tenants, renters, and sharecroppers revealed landowners were more positive than illegal tenants, renters, and sharecroppers towards promoting social benefits in forestry programs through different strategies such as tourism activities, tree planting, and cleaning operations (Table 2.6). Renters who participated in this survey were less likely to promote economic benefits than landowners and illegal tenants. Sharecroppers were less likely to understand the economic, environmental, and social role of forestry activities. Data revealed that farmers' perceptions vary significantly across different income levels. Farmers with incomes less than 20,000 tend to favor environmental benefits more than farmers with incomes between 20,000 and 40,000 Gourdes. Respondents with household incomes between 20,000 and 40,000 Gourdes were more likely to promote economic benefits than respondents in the other groups.

2.6. Conclusions and Policy Implications

The purpose of this chapter was to investigate farmers' perceptions on the impact of the Forêt des Pins Reserve on the economic, social, and environmental status of local people. Our hypothesis was formulated regarding the link between the farmers' age, gender, and group membership, education level, born inside the forest, land tenure, income level; and the perceived importance of forest benefits.

Findings from this study show farmers value the Reserve in ways consistent with the social exchange theory. Respondents who believe that their farming activities would benefit from forestry programs through soil protection tended to be more positive. Past research shows people's values of protected areas vary according to their needs (Kempton et al. 1995; Bengston 1994) and the way they believe the environment should be managed is also evolving (Vining 1993).

Mean preference ratings suggest that tourism activities, tree planting, and road maintenance are viewed by farmer residents of Forêt des Pins Reserve as a major issue to promote forestry programs. Focus group participants often saw local tourism activities as an income generating asset and a powerful incentive for conservation, by making traditional resource management more sustainable, and by substituting degrading activities. This finding is consistent with the theoretical perspective and supports past studies regarding people perceptions of land use who found that creating opportunities for local people to utilize and benefit from the forest is the main incentive to stimulate local communities to become involved in forest management (Dolisca 2001; Wunder 2000; Adebisi 1996; Pearce 1989). However, mean ratings of importance suggest that promoting non-timber forest products is not a major issue in forest protection activities.

Through factor analysis we demonstrated that economic benefits such as road maintenance inside forest, increase income from cleaning operations, and tourism activities should be the most important benefits of a forestry conservation program. Farmers' perceptions of economic benefits differ from perceptions for social benefits, such as strengthening rural community, participation of adults, and promoting environmental responsibility. In particular, people believe that increases in non-timber forest products income should be the least important benefits goal in promoting forestry programs. Farmers believe that environmental benefits such as improving air quality and habitat for plants and animals should not be viewed as the most important objective of forestry programs.

Through a series of structural equations model tests, we found evidence of farmers' perception differences with respect to the relationship between the socioeconomic variables and perceived importance of forest benefits. Socio-demographic characteristics such as middle and low income and age groups correlated with economic objectives in promoting forestry programs. Kellert (1980) found these groups generally hold more negative views toward the environment. Female-headed households had an effect on all three identified factors. Female-headed households reported less positive perceptions toward environmental objectives of forestry activities than did males. This finding was consistent with previous studies that found that males are more likely to express positive attitudes towards conservation (Britt and Shrestha 1998).

Respondents who indicated that they were members of local groups were more favorable toward the social and economic objectives in promoting forestry activities inside the Reserve. More informed individuals apparently were better able to assess the

potential impacts of forestry programs on their farming operations (Portes 1971; Gregersen et al. 1989). Farmers who are not members of a local group, and not well informed about forestry programs may overvalue the costs and underestimate the benefits. Such a situation would explain negative attitudes of farmers to the Reserve.

Better understanding of the capability of forest activities in increasing incomes, strengthening local communities, and reducing soil erosion may increase favorability toward forestry programs (Dixon and Sherman 1990; Wunder 2000). Respondents who were more aware of environmental degradation associated with deforestation apparently perceived benefits resulting from reduced off-site damage as potentially benefiting them.

The results suggest that farmers most value economic and environmental objectives in promoting forestry programs inside the Reserve. In addition to jobs and money from the forest activities, farmers do care about the natural environment to help them get complete life-style benefits. Much literature regarding protected areas management argues for a focus on both economic and non-economic values (Vining 1993). This is very encouraging because 45 percent of the forestlands are in agriculture and highly erodible (Rousseau 2000). Forest managers should work through a process of participation, information, and education about the potential benefits to be derived by local farmers. Specific methods to engage and incorporate local community into management planning require specific management to be defined by forest managers and by future research.

This chapter has been written as an attempt to understand how farmers value protected areas in Haiti, particularly in Forêt des Pins Reserve. First, study findings cannot be inferred to all 52 villages of the Reserve. To strengthen and expand this study's

results, future research needs to be conducted that includes a wider sample of farmers in both Forest Units 1 and 2 of the Reserve. A representative sample of farmers in both Forest Units could provide more information as to how all farmers value benefits from the Reserve.

This study provides evidence that people grant considerable importance to economic and environmental objectives such as tourism and tree planting activities, contrasting the official government point of view stipulating that farmers are detrimental to forest conservation (Dolisca 2001). Future research should be conducted that examines local economic alternatives for the Reserve that will have both a development impact and serve as conservation incentives.

Moreover, the Forest Resource Service of the Ministry of Agriculture, Natural Resources, and Rural Development (MARNDR), should continue to provide information about the potential benefits to be derived by local farmers from forestry activities. Particular attention on the impacts of forestry programs on farm household income is recommended. If it can be shown that forestry activities can generate substantial benefits at the farm level without increasing the amount of land used for agriculture, it is likely that the implementation of such programs will be much appreciated.

CHAPTER 3

MODELING LAND TENURE, POPULATION PRESSURE, AND DEFORESTATION IN HAITI: THE CASE OF FORÊT DES PINS RESERVE

3.1 Introduction

Global deforestation has grown in concern to foresters, environmentalists, and policy makers during the last three decades. Deforestation is most significant in the tropics, where about 2.5 billion people depend on natural resources for many economic and environmental goods and services (Sharma et al. 1992). The causes of deforestation are numerous and vary from country to country. In developing countries, the economic value of natural resources, such as forests, has been shown to be the major cause of deforestation (Munasinghe 1993). At least 120 million hectares of tropical forest were cleared between 1950-1975 in South and South-East Asia alone (Wickramasinghe 1994). Every year, about 2.5 million hectares disappear in Central America to make room for cattle ranching; about 1.3 million hectares in India go to commercial plantation crops (Wickramasinghe 1994). For many countries, fuelwood gathering is often the initial step in deforestation; 1.5 billion people living in developing countries rely on fuelwood for cooking and/or heating (Tucker 1999).

Different theoretical approaches have been proposed ranging from a neo-Malthusian view that population growth leads to environmental degradation through

intensification of land use, a neoclassical economics framework focusing on the effects of population on labor supply, wages, prices; Boserupian theory of intensification of the farming systems in response to population pressure; and a political ecology approach in which resource use decisions of households are linked to broader socio-economic and institutional processes.

In recent years there has been great interest in determining the causes of the rapid deforestation in the tropics. Studies have been focused on both microeconomic causes (Repetto and Gillis 1989, Repetto 1988) and macroeconomic causes (Shafik 1994; Kahn and McDonald 1995; Capistrano and Kiker 1995). Microeconomic behavior of farmers and other rural inhabitants has been analyzed to understand the roots of environmental degradation. Other approaches have examined the role of population density, infrastructure, land tenure, education level, income per capita, length of residency migration and energy prices as factors influencing deforestation (Pfaff 1999; Uitamo 1999; Godoy et al. 1997; Pichon 1997a; Pichon 1997b; Godoy 1994; Bilsborrow 1992).

Analysis of deforestation and other types of land degradation tend to be shaped by the scale (household/firm, regional, and national levels) at which the analysis is conducted (Blaikie and Brookfield 1987). Global level cross-national studies have been generally successful in establishing statistical correlations between deforestation and macro-level variables such as, population, income, investment, government policies, exchange rates, trade policy and external debt. But the utility of such findings is limited to the extent that they represent inter-regional averages that may not apply on a case-by-case basis and offer little insight into how the macro-causes being investigated interact with the proximate land use activities that constitute the immediate sources of forest loss.

Farm-household deforestation models have been developed to explain, and to establish the relationship between household characteristics and deforestation (Kaimowitz and Angelsen 1998; Foster et al. 1997; Godoy et al.1998; Holden et al. 1998; Pichon 1997a; Godoy et al. 1996; Jones et al. 1995; Ozorio de Almeida and Campari 1995) based on socioeconomic and demographic variables, but the conclusions of the majority of these models were different and only applied to the cases studied which may or may not represented of other areas. Differences found in the models above may be explained by the lack of consistency in the definition of the dependent variable (deforestation). Some studies take into account the amount of land deforested since farm establishment (Ozorio de Almeida and Campari 1995), amount of annual forest cleared (Holden et al. 1998), change in average forest cover cleared per household (Foster et al. 1997) and percentage of farmland still in forest (Pichon 1997a; Muñoz 1992), while others use amount of primary forest cleared annually (Godoy et al. 1996; Godoy et al. 1997) and average forest area cleared per year (Jones et al. 1995). These differences are significant because they influence the interpretation of the coefficient estimates (Kummer and Sham 1994).

Haiti, with a dense rural population (about 300 people per square kilometer) and a forest cover estimated at 3% of all land area (Food and Agriculture Organization [FAO] 1988), has experienced severe degradation of its natural resources and a significant change in its land cover. This has raised concern about the future of fuelwood supplies (3.3 million m^3 of fuelwood used in Haiti per year), environmental services and other forest products. Much of the deforestation is believed to be linked to: 1) the agricultural output failing to keep pace with increased population density and migration (Ashley

1989); 2) the land tenure system and the lack of off-farm opportunities (Pierre-Louis 1989); 3) and the illegal harvesting of trees for the production of firewood and charcoal (85 percent of the Haitian population depends on biomass energy for domestic purposes) (CFET 1997). Experts generally mention Haiti's complex system property rights (land tenure system) and population as key elements explaining deforestation (Bannister 1998; Smucker 1988).This chapter will focus on the causes of deforestation in Haiti, particularly in Forêt des Pins Reserve using annual average of forest area cleared per household as dependent variable.

This chapter is organized as follows. Section 2 provides a review of the previous empirical analyses. Section 3 presents the theoretical framework. Section 4 outlines the methodology and data. Section 5 presents the results of the empirical analysis of the impact of household characteristics and deforestation. The final section provides some concluding words and policy implications of analysis presented in the chapter.

3.2 Literature Review

For the purpose of this study, deforestation is defined as a conversion process, a change in forestland use from forestry to a non-forestry use (Uitamo 1999; World Commission on Forests and Sustainable Development [WCFSD] 1999; Tole 1998; Panayotou and Sungsuwan 1994). Land previously under forest and now under cultivation is considered deforested even if the new land use is more valuable than forestry (Panayotou and Sungsuwan 1994. In contrast, forest degradation is a gradual deterioration in the quality of forest cover and its ecosystem.

The major causes of change in land use in the tropics appear to be expansion of subsistence agriculture in Africa, and Asia, large economic development programs involving resettlement, agriculture and infrastructure in Latin America and Asia (FAO 1996), overgrazing in North Africa, the Middle East, South Asia and the Sahel area in Africa (Sharma et al. 1992) are also important contributors. World statistics continue to show an increase in the number of grazing animals (Sharma 1992) and an increasingly intense gathering of trees for fuel (charcoal, fuelwood) combined with other causes of forest depletion, tenure insecurity, clearing of forest for agriculture and ranching, commercial logging, infrastructure and industrial development, and population growth and rural poverty.

Investigations of the factors influencing deforestation began, for the most part, in the 1950s. Studies have suggested the connection between chronic underproductivity in the domestic agricultural sector and farmers' adoption of destructive land use practices (International Fund for Agricultural Development [IFAD] 1996; Prosterman and Riedinger 1987). Using global cross-national data, Shafik (1994) finds an insignificant impact of rural productivity on deforestation, while Southgate (1994) and Barbier (1997) find a negative relationship on a cross-section of Latin American countries. On the regional scale, Katila (1992) generates a negative coefficient of agricultural productivity using data from Thailand, while Reis and Guzman (1994) obtain positive coefficients using data on Brazil. Decreasing productivity at the household level in Haiti led to local and regional environmental problems, including forest degradation (Bannister 2001).

Larger households intensify pressure to convert forest cover to other uses by increasing the demand for food, land and energy (Tole 1998; Bilsborrow 1992).

Household size contributes to deforestation by raising the demand for energy, agricultural land, and food and by generating land and resource scarcities that stimulate migration by the poor. With this point of view, small farmers, constrained by the Malthusian necessity of a growing population, leave their lands fallow less and less (Rudel 1994; Smucker and Timyan 1995). The shortened fallow periods prevent forest regeneration and favors deforestation. Using cross-sectional analysis, Cropper and Griffiths (1994), Rudel (1989), Allen and Barnes (1985); Palo et al. (1987); Lugo et al. (1981) analyzed the effect of population on deforestation. They found a strong positive relationship between population growth and deforestation. Catanese (1991) found that the rates of deforestation are correlated with population size in Haiti. However, Godoy et al. (1997), using data from Amerindians in Honduras, have found that household size has a negative impact on deforestation. Using data from Brazil, Wood et al. (1996) and Pfaff (1999) found that the effect of population disappears with the addition of other variables such as income, level of education, agricultural expansion. Piland (1991) found positive relationship between number of children in the household in Bolivia and deforestation.

Godoy et al. (1997) looked at the effect that age of household head on deforestation using data from Ameridians in Honduras. They found that age bore a positive relation to forest clearance. Young heads of households clear forest to build inheritance for their children, but the amount of forest cleared falls after their children move out and people reach a peak of physical strength. Bandara and Tidell (2004) found age is the second major factor positively associated with conservation responses in a study realized in Sri-Lanka. However, Thapa et al. (1996) found a negative relationship between female-headed household and deforestation.

Shafik (1994), using cross-national data, found no significant effect of income per capita on either annual deforestation or total deforestation, while Burgess (1991) and Capistrano (1994) found deforestation to be positively correlated with levels of income per capita in a cross-section of poor countries. Deacon (1994) and Rock (1996), also using cross-sectional data, find evidence of a negative relationship between income per capita and deforestation**.** Anderson and Thampapillai (1990) draw positive association between high rates of inflation and deforestation. Using a cross national data, Shafik (1994) finds no effect of trade policy on total deforestation, but some significant effects in the case of annual rate of deforestation.

Using data among lowland Bolivian Amerindians, Godoy et al. (1997) found that farmers are more likely to make capital investments and increase labor inputs in the presence of secure tenure. It is not surprising that productivity is much higher under owner-operated systems than under less secure forms of tenure. Productivity has implications in terms of land use: the more secure and productive the land, the less need for farmers to clear more land. Moreover, chronic underproductivity in agriculture has been responsible for decreasing off-farm employment opportunities and reinforcing the dependency of the poor on their natural resources (IFAD 1992).

Off-farm activities should lower forest clearance (Godoy 1994). Households working in non-farm jobs such as trade should depend less on the forest for their income and will consequently need to clear less forest. Organizational membership and place of birth may also affect community perceptions toward forests. This occurs through a process of "differential socialization" (Portes 1971) in which membership gets environmental experiences through meeting as well as an interpretive framework for

these experiences that are absent among non-member farmers. Participation in local groups should provide motivation for conservation by increasing local protection against illegal activities.

Using information from rural households from India, researchers found that education lowers the dependence of rural people on the forest by increasing their chances of making income from jobs inside and outside the farm (Hedge et al. 1996). Researchers also found, by using data from many nations in Africa, that the rates of enrollment in primary school reduce the area of wilderness lost (Cleaver and Schreiber 1992).

Bedoya (1995) and Pichon (1997a) show a negative relationship between length of residency and deforestation. The number of years a household has lived in a village should proxy for more informal rights to property, greater knowledge of local ecology for farming, and should lower the amount of forest a household clears.

There has also been a long debate in many developing countries, particularly in Haiti over whether or not land tenure system influences deforestation. The results of research worldwide show that clearly defined, secure and enforceable property rights are fundamental for encouraging sustainable use of forests. Many experts have argued that tenure problems and, in particular, the absence of well-defined property rights are among the key causes of deforestation in Haiti (Jamarillo and Kelly 1997). Haitian peasants claim land ownership through legal and customary procedures (See chapter 1). In a national-level study on the dynamics of rural production and poverty, Smucker et al. (2002) found strong relationship between land tenure and tree cover, except for landownership acquired through statutory procedures. In the same study, they found that sharecropping and renting were positively correlated with tree cover, adopting

conservation practices and negatively associated with the proportion of agricultural output represented by maize, sweet potatoes and cassava. Sharecropping and tenancy were also positively associated with the practice of fallowing. They concluded that tenure status was a constraint on land conservation. These findings corroborated those of a similar study assessing correlations between tenure and adoption of soil conservation (Pierre-Jean and Tremblay 1986).

At the local level, White and Runge (1995) found a significant relationship between tenure status and land degradation in the collective adoption of watershed management in multi-owner watersheds of Maissade (North of Haiti). The most pertinent study was Smucker (1988) who carried out field research and summarized findings from six community studies assessing factors affecting peasant cutting of project trees. He found that peasants preferred to cut on undivided inheritance lands and other short-term forms of tenure; however, they regularly planted on purchased and divided inheritance lands. In some communities, with less purchased land available, the majority of trees were planted on undivided inheritance lands (Buffum 1985). In a separate, but related survey, Conway (1986) concluded that planting trees on undivided land was a strategy to enhance individual claims to specific portions of jointly inherited land.

Out of the previous theoretical discussions, one issue emerges in explaining deforestation in Haiti: land tenure. It indicates that ill-defined and insecure property rights discourage investment in natural resources management by removing incentives for it, as one may not be able to collect the expected flow of benefits of one's effort if there is possibility of losing the property in the future. The lack of secure land rights should then be the main cause of deforestation in Haiti. We were, however, unable to find studies that

directly answered the questions related to socio-economic determinants of deforestation either at the household level or in a comparative way in Haiti. This chapter explores the relationship between household socioeconomic and institutional characteristics and deforestation in Haiti, particularly in Forêt des Pins Reserve.

3.3 Theoretical Framework

Farm household modeling, based on the household economic theory initiated by Becker (1965) that considers households as joint units of production and consumption, is appropriate for the unique characteristics of smallholder farmers. For the purpose of this chapter, a household is defined as a group of persons, who share the same living accommodation, who pool some or all of their income and wealth and who consume certain types of goods and services collectively, mainly housing and food (United Nations [UN] 1993). Peasant farm households dominate the Haitian economy. These households are simultaneously producers and consumers and generally behave rationally, given their resource constraints, preferences, and limited access to information and the imperfect market they face.

Given that smallholder farmers maximize cash income subject to fulfilling subsistence requirements and resource constraints, it is hypothesized that the behavior of farmers is a function of different independent factors: household specific and exogenous variables. Household-specific variables include farm size, labor, and capital; demographic characteristics (size and age-sex composition) of the household; the background of the household on the knowledge of agronomic and ecological conditions, and possibly the levels of education of the head and other household members.

Exogenous factors include the quality of the natural resource base (soil fertility) and local and national policy and institutional environment, including access to and quality of local infrastructure (property rights), access to labor markets (off-farm employment), and access to technology. These household and exogenous factors, together with a household production function, determine returns to land, labor, and capital in different uses. Therefore, they influence decision-making regarding household behavior, including land use and their decision about whether or not to clear forest, which is assumed to provide him or her with a certain level of utility. Then, the decision to clear or not to clear forestland is deeply rooted on the assumption of utility maximization (Huffman 1980; Weersink 1992).

Farm households in the Forêt des Pins Reserve differ in terms of production, the source of income, the amount of labor available and the amount of cultivated land. Some farm households clear forestlands for agricultural purposes, others do not. Therefore, there are a cluster of household farms with zero annual forest cleared at the limit. For such a case, the application of Tobit analysis is suitable given the censored nature of the distribution of the amount of forest area cleared.

Applications of Tobit regression analysis exist in almost every field. Tobit regression models have been developed in several disciplines (notably, biometrics and engineering) more or less independently of their development in econometrics. Biometricians use the model to analyze the survival time of a patient. Similarly, engineers use the models to analyze the time to failure of material or of a machine or of a system. Sociologists and economists have also used Tobit models to analyze the duration of such phenomena as unemployment, welfare receipt, marriage, and the period of time

between births. Godoy et al. (1998), Pichon (1997a), Godoy et al. (1997), and Pichon and Bilsborrow (1992) used this model to explain the effects of household variables on deforestation.

3.4 Methodology

The purpose of this section is to describe the methodological approach of this study. The chapter is divided in two sections, comprising: 1) the techniques used for the data collection during the field survey and 2) the Tobit regression analysis to determine the link between deforestation and the socioeconomic variables.

3.4.1 Data collection

This study was carried out in 15 villages of the Forest Unit 1 of the Forêt des Pins Reserve. Data were collected from May to August 2003 through formal and informal survey techniques with the heads of the farm household living in the different villages. The purpose of this survey was to gather data on the socioeconomic aspects of peasant life and their attitude to the Reserve.

The survey aimed at gathering qualitative and quantitative data from the local community. One purpose was to collect all information regarding the socio-economic aspects of the household in areas such as demography, education, sources of income, salary, employment, capital, consumption, and attitude to the environment. The interviewees were selected randomly from the list of the households provided by the

Forest Service. The random sample consists of 243 households in 15 villages inventoried in the area (CFET 1999).

The survey was divided in 4 main sections, each part covering different subjects (Appendix). In section one, the questions sought information on the demographic characteristics (age, sex, years of education, and relationships of all people of the household). Section two concentrated on the economic activities in the Reserve. Section three dealt mainly with questions related to farmers' perceptions towards the Reserve. The questionnaire concluded with questions of general interests.

The questionnaire was pre-tested with three research assistants, as well as a sample of 6 farmers from two villages. On the basis of this pretest, some questions were deleted and some modified to improve their clarity. Qualitative data were also obtained through informal, unstructured and open-ended interviews with key informants including local leaders, elderly community members, and schoolteachers. Qualitative data helped verify and enrich quantitative data obtained from the survey.

During the survey process, heads of households were generally very open to describing their farming experiences and their concerns about the future of this forest. Our insistence on the clear objectives of this study greatly contributed to dispelling doubts of some peasants who might be willing to dramatize things, anticipating an upcoming development project stemming afterwards. We also attempted to interview the respondents in isolation to secure sincerity in their responses.

All the interviews were conducted in Creole in order to ensure locally relevant answers to the questionnaire. Local words were often used wherever possible to avoid technical terminology. Picture cards were used for perception questions; respondents

selecting from a pre-determined list of responses categories. We often provoked informal follow-up discussions and made use of our observations to assure the validity of our findings.

3.4.2 The empirical model

The empirical model uses a set of farm household socio-economic characteristics and institutional characteristics as explanatory variables that are assumed to influence deforestation in the Reserve. The choice of variables employed in this chapter is adapted from deforestation literature. Description of the explanatory variables used in the Tobit regression analysis and their expected relationship with annual average of forest area cleared (dependent variable) are summarized in Table 3.1.

We regressed annual average of forest area cleared with socioeconomic and institutional variables related to annual average of forest area cleared. The dependent variable, the annual average of forest area cleared per household during the five-year period (1997-2003), is the difference between the size of the plot measured in 1997 and the size of the plot in 2003. The stochastic model underlying Tobit may be expressed as follows:

$$y_i = X_i\beta + \mu_i \quad i = 1, 2, 3, \ldots, n$$

$$Y_i = \begin{cases} y_i, & if \quad y_i > 0 \\ 0, & if \quad y_i \leq 0 \end{cases}$$

Where, n is the number of observations, μ_i is assumed to be independent and normally distributed with $N(0,\sigma^2)$ and β is a vector of unknown coefficient parameters to be estimated. y_i is the dependent variable (annual average of forest area cleared (*Fcleared*)), and X_i are vectors of endogenous and exogenous explanatory variables, including age (*Age*), household size (*Hsize*), marital status (*Mstatus*), head education level (*HeadEduc*), residency duration (*Lresidency*), total children in the household (*Totchildren*), land efficiency (*Lefficiency*), farm labor (*Farmlabor*), annual income per capita (*AnIncome*), crop growers (cabbage, beans, and potatoes), and land tenure. The variables *Age*, *Educ*, *Farmlabor*, *Mstatus*, and *Lresidency* represent head of the household characteristics. Crop growers include three categories (*BeaGrowers, PotatGrowers*, and *Cabbage*, which is a dummy variable).

Table 3.1 Variable definitions and their expected sign for deforestation model

Variable	Variable definition	Expected sign
Fcleared	Average annual of forest area cleared in ha	
Age	Head of the household's age	+
HeadEduc	Years of education of the head of the household	-
Mstatus	1 if married, 0 otherwise	+/-
Hsize	Number of people in the household	+
Landowner	1 if landowner, 0 otherwise	+
Rented	1 if rented, 0 otherwise	+
Lefficiency	Land efficiency	+
AnIncome	Annual income per capita	-
BeaGrowers	1 if beans are growing, 0 otherwise	+/-
PotatGrowers	1 if potatoes are growing, 0 otherwise	+/-
Farmlabor	1 if earned income only from farm labor, 0 otherwise	-
Totchildren	# of kids between 8 and 18 years old in the household	+
Sharecropped	1 if sharecropped, 0 otherwise	-
Iltenant	1 if Illegal tenant, 0 otherwise	+
Lresidency	Residence duration in Forêt des Pins Reserve	-

The status of household land tenure is also measured as variable of deforestation. Five categories of land tenure are included as dummy variables (D_0 to D_4) in the model, including: undivided inheritance shared with other family members (*Famland:* D_0 – made up 8.2% of the household surveyed), owned/titled (*Landowner*: D_1 – 17.2% of households), sharecropped (*Sharecropped*: D_2 – 11.5% of households), rented (*Rented*: D_3 – 57.6% of households), and illegal land use (*Iltenant*: D_4 – 5.3% of households). D_0 represents undivided inheritance and serves as the base dummy variable and is therefore not included in the regression estimation.

3.5 Results and Discussions

This section presents the characteristics of the farm households; determines the nature of the association among the different socioeconomic variables; and with the help of Tobit regression analysis reports the link between the socioeconomic variables and the annual average of forest area cleared.

3.5.1 Farm Household Characteristics

In our survey, we found that migration to the Reserve has slowed in the past decade (Table 3.2). Fifty-seven percent of the heads of households were born inside the Reserve, 13 percent have lived there for more than 40 years, 28 percent for more than 10 years, and only 2 percent for less than 10 years. This is a clear indication that population change is being controlled by natural population growth rather than migration. We should also point out that 77 percent of landowners hailing from the Reserve are primarily

second- generation settlers, i.e. children of migrant farmers inheriting part of their parent's farm. The average duration of residence in the Forêt des Pins Reserve was 41 years.

Table 3.2 Variation in the data set by gender, marital status, age, education, and land tenure.

Interviewed persons	Forêt des Pins Reserve	
	Frequency	**%**
Gender		
Male	201	82.72
Female	42	17.28
Marital Status		
Single	3	1.2
Married	162	76.9
Divorced	1	0.4
Widowed	27	11.1
Cohabitating	50	20.5
Age group		
21-30	8	3.29
31-40	48	19.75
41-50	86	35.39
51-60	71	29.21
61 and above	30	12.34
Years of education		
0 Illiterate	131 (74% male)	53.9
1-4 Primary school	60 (93% male)	24.69
5-8 Middle school	48 (92% male)	19.75
> 8 High school	4 (100% male)	1.64
Land tenure		
Landownership	42	17.2
Family land	28	8.2
Sharecropping	20	11.5
Tenant farming	143	57.6
Illegal land use	13	5.3

Sample size = 243

A vast majority of the respondents were male (82%) and 18% female. The average ratio male-female of respondents was 1.43. The number of female-headed

households, which was 6.7 percent, was lower than the 11 percent that the Centre de Formation et d'Encadrement Technique [CFET] found in 1999. The gender of household head seems to be affected by changes in marital status, death of the husband, and male migration. The practice of 'polygamy' may also affect women since they might be de facto heads of household (Latortue 1998). Informal discussions with some male-headed households in the Reserve revealed that most of them had a 'mistress'. The age of respondents ranged from 24 to 75 years; the respondents were relatively middle aged with an average age being 49 years. The largest proportion of respondents was in the (41-50) year-old category (35.39%).

The years of education range from 0 to12, with an average of 2.1. About fifty-four percent of the respondents were illiterate, twenty percent had completed primary school, and 2 percent had graduated from high school. Women had less education than men and female-headed households tended to have less education than wives of male-headed households. Forty-three percent of the male had attended school, compared to 3.3 percent of the wives and 1.2 percent of the female household heads. Only 1.58 percent of the female had completed primary school, compared to with 18 percent of the male household heads. About half of the respondents (50.6%) are local group members.

The marital status at the time of the survey included respondents who were married (76.9%), widowed (0.4%), single (1.2%), and cohabitating (20.5%). The number of married respondents was higher than the 55.5 percent that the Bureau d'Enquêtes et d'Analyses Socioeconomiques [BEAS] found in 1985 in the Reserve. This is probably due to the influence of Protestant and Catholic sects in the Unit I of the Reserve. Eighteen

percent of the sample female heads of household were widows and old; the remainder was still in their reproductive years. Households had an average of 7.2 people, but the male- headed household had 7.4 while the female-headed household heads had 5. 7. The average number of children between 8 and 18 years old in the household was 2.35.

Land for agricultural purposes was acquired through landownership (purchase, inheritance, gift, and illegal forest clearing), tenant farming, or by sharecropping. Tenant farming and landownership were the main sources for the different farmers in the Reserve. About fifty-seven percent of the respondents acquired land through lease from the Forest Resources Service of the Ministry of Agriculture, while 5.3 percent got land illegally. The size of land holdings in the Reserve ranges from 0.7 and 16.1 ha. Fifty-six percent of the respondents are estimated to be poor (respondents who reported insufficient annual income to support basic household needs such as food, medical, and clothing), while 12 percent were classified as 'better off'. The average monthly family income of the 243 respondents was 1250 Gourdes, with almost 24 of them (10.2%) earning a monthly family income in the range of 20,000 and 58,000 Gourdes. In total, about 33% of the total household is engaged in non-farm activities as a secondary occupation.

Overall land use patterns in the sample reveals a process of continuing intensification over time, with the cultivated land area at the expense of forest cover. In 1997, an average plot was 1.8 ha with 1.4 ha in annual crops and the remaining in buildings and in pasture. By 2003, the average plot was 2.7 ha, with 92 % in annual and perennial crops and the remaining was used for construction and in livestock. Mean land

use values for sample farms were as follows: 85 percent of the farm area was planted in food crops and 15 percent in construction of home sites (Rousseau 2000). Cabbage, potatoes, onions, and beans are exclusively commercial crops and maize is reserved for family consumption and for livestock. Cabbage, beans, and potatoes, the main cash crops, were cultivated by 75% and 69 % of the surveyed households, respectively. At the time of the survey, nearly 11 percent of the households have some cattle varying from 1 to 5, but only 4 households had over 3 head and only 6 over 2 head. In our survey, we found that 100 % of farmers grew maize for the 2002 cropping season.

In many aspects, farmers in the study area are subject to a similar climatic situation: the entire area is humid with altitudes ranging from 1500 to 2630m and an average annual rainfall of 1800mm. The mean annual temperature in the Reserve is approximately 14^{o}C (57^{o}F). During most of the year the maximum and minimum daily range is 5-8^{o}C. During the winter months, from December to February, temperatures below freezing have been observed around dawn. The soils in Forêt des Pins Reserve range from black layer to red silt clay and are of calcareous origin (Holdridge 1947). In flats or valleys, they are shallow, deeper and black soils, such as in the Morne of Commissaires region. In the hillier Morne la Selle region, however, the red silt clays predominate with about only 10 cm of black topsoil. pH tests conducted in three different points, Gros Cheval, Oriani, and Boukan Chat where the agricultural colonies are located, have values comprise between 6.5 and 7.2.

3.5.2 Correlations

A Pearson's correlation coefficient matrix indicates only weak collinearity among the independent socioeconomic and policy variables. Some noteworthy correlations include the following. The signs on correlation between variables were as expected. Interestingly, years of education (*HeadEduc*) is negatively correlated with annual income (*AnIncome*). While counter-intuitive, this relationship between education and income makes sense within the context of the Forêt des Pins Reserve economy. Income is entirely based on agriculture with no opportunities for off-farm wage employment. In addition, remittances from family members who have migrated to Port-au-Prince are rare in the Reserve (CFET 1997). With incomes coming solely from agricultural production and illegal timber harvesting, there are no economic incentives for households to keep children in school. Time spent in school is time not spent in the fields, and unfortunately, this translates into less income.

The size of the household (*Hsize*) is positively correlated with annual income (*AnIncome)* (ρ =0.28), while there is a somewhat weak positive correlation between the size of the household and years of education (ρ =0.015). Landownership is positively correlated with household size, while there is a weak negative correlation between rented land and household size.

3.5.3 Tobit Regression Analysis

Regression results for the Tobit model are presented in Table 3-3. The high squared correlation of 0.532 between observed and expected values indicate the existence

of useful information in the estimated Tobit model. The results reveal that demographic and farm characteristics are important factors in explaining deforestation. Deforestation differs significantly across farm sizes, education of the head of the household and off-farm activities.

I expected household size (*Hsize*) to be positively correlated to forest clearance because of increased food needs and the greater availability of workers. Table 3.3 indicates that households with fewer members were more likely to clear less forestland, while greater availability of family labor was positively associated with more farm land planted in agronomic crops. This is consistent with an observation made by several scientists (Boserup 1965; Godoy et al. 1998). As population increases, the land frontier diminishes and, eventually, new families must find land from within existing agricultural areas.

The investigation here cannot distinguish empirically whether a production or consumption effect is more significant in shaping deforestation patterns, although household size may include both the supply and demand side effects on deforestation. Therefore, it would be useful to study the possible effects on the extent of forest depletion considering both the demand side (more people to feed provokes more clearing, and, possibly also, more use of land for food production) and the supply side (more adults on the farm means more people to clear the land). From the supply side, it is desirable to know which age-sex groups normally participate in land clearing operation and in each type of land use. However, for both the demand side and supply side reasons, a larger household size is expected to be associated a priori with larger proportion of forest cleared.

Table 3.3 Regression results indicating factors determining farm household deforestation.

	Tobit	
Variable Name	Coefficient	Standard Error
Age	-0.014	0.089
PotatGrowers	0.487	0.388*
Hsize	0.111	0.058***
Mstatus	-0.058	0.064
HeadEduc	-0.084	0.056**
Totchildren	-0.003	0.006
Lresidency	-0.553	0.275***
AnIincome	0.984	0.453***
Lefficiency	-0.037	0.259
BeaGrowers	-0.169	0.103
Farmlabor	0.457	0.173***
Iltenant	0.594	0.138***
Rented	-0.149	0.265
Sharecropped	0.165	0.322
Landowner	0.125	0.041

* Significant at 15%
** Significant at 10%
*** Significant at 5%

As expected, the educational achievement of the head of household (*HeadEduc*) had a significant negative effect on forest clearing, which may be interpreted as evidence that more education discourages the desire to increase household consumption and

production by increasing the size of the plot. This finding is consistent with scientists who advocate educational approaches as a tool to improve farmers' understanding of the value of managing forests.

Specific agricultural production activities appear to determine the amount of forest cleared. Indeed, bean growers (*BeaGrowers*) in general had a limited impact on natural resources, whereas potato growers (*PotatGrowers*) had a substantial impact. This analysis conforms to that of Larrea et al. (2001) who found that natural resource management was a function of income-generating strategy or productive activity.

Land tenure status appeared to significantly affect farmers' decisions. Farm households who occupy land illegally converted more forest to agricultural land. The prevailing hypothesis is that farmers with insecure land titles are more likely to clear forest. The finding that farmers without title lead to faster agricultural expansion than those with title suggests that development efforts should focus on land titling to reduce patterns of excessive deforestation. However, several examples in Haitian literature show that the introduction of improved land titling by itself has often produced a climate that has tended to favor land speculation and eventually the consolidation of large landholdings by those with enough capital to buy out small farmers.

The availability of off-farm labor in the Reserve constitutes also a potentially important policy variable. Table 3.3 shows the relationships between household participation in off-farm employment and area of forest cleared. Households in which members worked more time off-farm converted less forest to agriculture, corroborating the idea that income diversification from off-farm activities can slow down economic pressure to clear large areas of forest to support families; or generate resources that can

be used to purchase inputs such as fertilizers and pesticides; labor-saving technologies or investments in the sustainability of the natural resources (Pichon 1997a, 1997b).

The analysis suggests that residence duration is associated with less forest clearance. Table 3.3 shows the relationship between the number of years since farmers were first established and deforestation. The longer households have lived in the Reserve, the less likely they are to clear the forest because they have more secure rights to their land. However, there was no evidence that land use changed the same way for all farmers over time.

3.6. Conclusions and Policy Implications

The purpose of this chapter was to examine the causes of deforestation in Haiti, particularly in Forêt des Pins Reserve. The evidence supports many of our hypotheses concerning deforestation in Forêt des Pins Reserve. The results of the Tobit analysis indicate strong evidence that household size, education of the head of the household, land tenure regime, farm labor, and length of residency are important factors affecting land clearing. However, we erred on the effect of land efficiency and age.

Household size and income appear from the Tobit regression to have a greater effect on deforestation. The significance of household size and income in land use choice provides evidence for non-separability between production and consumption. This is an effect of rural market imperfections. With respect to deforestation, participation in off-farm employment did also have a greater effect in land use change. Participation in off-farm employment or investment in other non-agricultural activities may also compete

with agriculture for both labor and capital, and are therefore likely to reduce directly and indirectly land use on the plot.

More educated farmers are more likely to cause less forest clearing. Although there is nothing wrong with educational approaches to improve farmers' understanding of the value of preserving forests, but such programs have been disappointing in their results. The problem is that whereas education may be a necessary condition for behavioral change (differential socialization); it is by no means a sufficient one. Improving the flow of information to a decision maker may not be a necessary condition to increase his or her capacity to act on it. A poor farmer, for example, may know about fertilizers, improved seeds, etc., without being able to gain access to them to practice sustainable farming methods.

Policies designed to improve land tenure system are essentially policies to reduce the problem of deforestation. As the above findings show, untitled farmers deforested more than those with title. The combination of insecure tenure and the availability of free land encourage farmers to minimize the costs of occupation by turning to premature deforestation. The results suggest that introducing clear property rights is essential to establish greater responsibility for land use. In addition to this, there is a strong need to develop off-farm activities (forest conservation practices, floriculture, and handicrafts) that provide immediate benefits to poor households. Enhancing the welfare of people can do much to encourage farmers to invest in their children's education and seek more alternative sources of off-farm employment (Pichon 1997a).

Most of farm households in Forêt des Pins Reserve do not have access to credit facilities. Institution of incentive structures to promote conservation efforts may include

linking farm subsidies and credit facilities with conservation. In the long-term, the need to ease subsistence pressure requires, among other things, development of the non-agricultural sector (e.g. ecotourism), control of population growth, and improvement of the schooling quality inside the Reserve. Specific policies addressing the constraints and limitations of peasants through technical change, development of rural markets, and provision of appropriate incentives are required.

CHAPTER 4

APPLYING CLUSTER ANALYSIS TO DEFINE A TYPOLOGY OF FARM HOUSEHOLD INCOME IN HAITI: THE CASE OF FORÊT DES PINS RESERVE

4.1 Introduction

Farm household diversity is a critical aspect of a number of issues in rural development. This diversity has been identified as a problem for conceiving and implementing development interventions by several agricultural extension services (Ellis 1993). Farm household diversity also manifests itself in the large quantity of responses to development actions, and in the different livelihood systems in a same natural environment (Ruthenburg 1980).

Rural economics, as a discipline, usually does not emphasize social organization of agricultural production (Perret and Landais 1993). It is, however, true that short-term economic decisions by farm households in developing countries are inseparable from the larger social relations within which production takes place (Ellis 1993). These social relations are manifested by departures in various degrees from pure market relations (Perret and Kirsten 2000). Small farmers in developing countries differ from other types of farm enterprises because non-market interactions still figure in their access to resources, in the farm system they adopt, and in the livelihood system they resort to (Capillon 1986). The failure of developmental policy to take into account local variation

in these social relations frequently results in a misuse of resources and other unintended side effects (Ellis 1993).

In contrast to rural economics, other social science-related approaches to rural development tend to emphasize local participation, and attempt to identify problems and development needs at the community level, within social groups in rural communities such as farmers groups, cooperatives (Perret and Kirsten 2000).

The decision of taking farm household diversity into account implies, for development agents, that rural households do not have the same activities or source of income that farmers do not have the same techniques of production, and that farmers do not have the same amount of labor available. These variations have to be analyzed independently from variations in both the physical environment of production and the economic context (Duvernoy 2000). The heterogeneity of conditions faced by small farmer activities has amplified the challenge for more precise and operational strategies.

Methods of classification have been developed to describe, and to represent the diversity of rural households in terms of their action modes and strategies (Capillon 1986). Several authors have proposed farming households' typologies (Hazell et al. 2003, Crossa et al. 2002; Duvernoy 2000; Viaud and Roland-Levy 2000; Landais 1998; Davis et al. 1997; Olsen 1996; Fuller 1991, 1990) based on socioeconomic, motivational, attitudinal and demographic variables.

Given this list of possible situations for classifying farm households, it seems unlikely that farm households are an economically homogeneous group. Instead, individual farm households may be characterized by different economic situations. For instance, some farmers may be driven by a need to increase landholding size; other

farmers are motivated to reduce their dependence on the Reserve. Similarly, land tenure concerns may be of primary importance for some, while social considerations could be preeminent for others.

If farm households can be differentiated in terms of their economic situations to manage their farm, they may also differ on demographic variables. For example, certain groups of farmers may be characterized as older opposed to young farmers, less educated versus best educated. This study was designed to statistically cluster farm household income in Forêt des Pins Reserve based on their socioeconomic and demographic variables. It was hypothesized that farm households are not homogeneous group in terms of their socioeconomic and demographic characteristics and that definable and interpretable groups could be identified using cluster analysis.

This chapter begins, in the next section, with a review of conceptual issues. The third section presents a brief introduction of the classification methods. In sections 4 and 5, we summarize the practical application of the household typology and the framework for farm household systems in Haiti. This is followed by a description of the method and data used to form the final groups for the classification. Section 7 presents the analytical results and discussions. The final section provides concluding remarks and policy implications.

4.2 Conceptual Issues and Typologies

Theoretical premises that underlie the typological approach to farm household may be summarized as follows. The farm household as a whole should not be considered as a simple sum of its components but as a set of highly interconnected and interrelated

phenomena and processes (Klatzmann 1952 cited in Crossa et al. 2002). Therefore, it should be treated as a complex (Birch 1972), in terms of a system approach. Farm households, understood as such complexes or systems, can be compared with each other and then grouped into types according to their similarities.

There is limited consensus on the meaning of farm household and the factors that influence this multifunctional aspect of rural life. As Hill and Cook (1999) point out, the complexity rises when attempting to establish a common definition of agricultural households across regions of the European Union. Lass et al. (1989) and Ahearn (1996) outline several assumptions that have tended to reinforce narrow views of farm household income. First, they define it as operators who work in small farms and seek off-farm work as a way to increase family incomes. Second, the household economies of those engaged in off-farm work are thought to be quite modest due to insufficient agricultural resources and poorly remunerated off-farm jobs.

Fuller (1990) links poor understanding about farm household income to the term itself and he indicates: operators who work off-farm do not necessarily have small, inefficient or different farm operations. Fuller (1991) refers to this issue as a 'production bias', insofar as the phrase farm household income connotes marginal production. However, Fuller argues that multiple job-holding has so long been an integral component of farm household activities that it is the norm and that full-time farm is the anomaly. Few researchers recognize "that multiple job-holding is, to a varying degree, part and parcel of all these farming systems and rural situations, and as such is a structural feature of farming and not a temporary or residual side effect" (Fuller 1991).

Significant studies have been impeded by terminological vagaries about the origins and nature of farm household income. Conceptual debate persists over how to characterize diverse features and forms of farm-household income. Recently, terms such as multiple job-holding, pluriactivity, farm based, diversified, low and large farm income have been proposed in an effort to resolve the ambiguities and negative connotations associated with earlier language. According to Fuller (1990), "multiple job-holding" is limited more so to gainful employment, whereas "pluriactivity" includes a wider range of activities and types of return derived from farm and non-farm sources.

Several authors have developed typologies or classifications of farm household income. Olsen (1996) defines three types of farm household incomes on the basis of their long-term interest in off-farm work. Harris et al. (1974) distinguish among individuals who (a) engage in off-farm work to assist their transition into full-time farming (expanding farmers), (b) consider both farm and non-farm activities necessary elements of their lifestyle (farming-working farmers) or (c) rely principally on off-farm income (hobby-farmers). Fuguitt (1961) also proposes a typology of the part-time farmer that integrates factors such as the amount of time allocated to the principal non-farm occupation, the number of off-farm jobs and the total commitment to non-farm employment.

Davis et al. (1997) identify four (4) types of farm household incomes based on the interrelationships of the social, ownership, organizational, and technical variables. They describe a category of *farm based* farmers essentially dependent on farm income. These individuals have very strong social and ownership attachments to farming. A *diversified* group is composed of farmers who combine fairly substantial off-farm incomes with

secondary reliance on farm incomes. A third category, composed of v*ery low farm income* farmers, includes farmers who hope to make the transition into full time agriculture and, as such, they are more committed to farming despite low incomes. Finally, Davis et al. (1997) identify a *larger more prosperous income* farm situation as a category that involves fairly social and economic attachments to agriculture, and their primary interest is in rural living.

Barlett (1986) describes three "ways" to farm income that take into account variable features of farm operations, socio-demographic characteristics of household members and motivational factors. First, *low-income farmers* fit the stereotype of sharecroppers who have had to take additional farm employment to remain in agriculture. Second, individuals who have been relied on off-farm activities and who are termed *middle-low income farmers*. Third, *large income farmers* include those who hire labor to operate farmland that typically has been inherited or purchased. Ahearn (1996) affirms that both *middle-low income farmers* and *low-income farmers* have adopted part-time farming as a stable family choice. These latter two part-time farming situations differ from the *large- income farmers* in which operators have added a farm to a full time job, as opposed to working off the farm to sustain the agriculture operation. Fuguitt (1961) remarks, farmers who take non-farm jobs may be expected to be quite different in many ways from non-farm workers who go into agriculture while retaining a non-farm job.

Although Ahearn (1996) acknowledges the importance of earning additional income, she also asserts the role of lifestyle considerations in making the decision to work off the farm. Ahearn (1996) suggests that the combination in making the decision and lifestyle benefits afforded by part-time farming provide a way for rural families to

meet a complex range of needs and goals. Bollman and Smith (1987) likewise caution against viewing off-farm employment narrowly as an attempt to acquire capital to expand the farm enterprise or to shore up the family income. Off-farm participation patterns are multifaceted and, as such, require the consideration of numerous factors, including the place of the family in the farm structure (Smith 1988). The motives for combining farm and non-farm activities can include factors such as lifestyle choices, attachment to agriculture, commitment to off-farm work and economic needs.

4.3. Classification Methods

Classification procedures are divided in two main categories: cluster analysis and discriminant analysis. Cluster analysis is a technique used to classify observations, or variables, into homogeneous subpopulations using hierarchical or nonhierarchical methods (Sharma 1996). Its goal is to sort cases (people, diseases, distances, events) into groups, or clusters, so that the degree of association is strong between members of the same cluster and weak between members of different clusters (Sharma 1996). It has been usually used in the biological sciences to classify animals (Barbini et al. 1998) and plants (Franco et al 1998; Crossa et al. 1995; Franco et al. 1997a; Franco et al. 1997b) or in the medical field to identify diseases and their stages, or in entomology to classify insects. However, there are also precedents for its use in social science and, in particular, for classifications of rural households in Malawi (Kydd 1982), in Mexico (Crossa et al. 2002), and in Bangladesh (Pryer 1990).

Clustering methods can be either hierarchical or nonhierarchical. In hierarchical methods such as the Ward method, individuals or groups are organized into a tree or

hierarchy where groups are fused one at a time to other groups with the most similar patterns for all attributes (Ward 1963). These methods can be used to form a fixed number of groups by truncating the tree at a fixed level (Crossa et al. 2002). In the nonhierarchical clustering methods such as the K-means and the Gaussian Mixture model (Wolfe 1970), initial groups must be defined *a priori*, and then a certain method or algorithm is used to improve the previous classification by optimizing a particular objective function (Sharma 1996).

Discriminant analysis is also a technique used to achieve the following two objectives: 1) either to assess the adequacy of classification, given the group memberships of the objects under study; or 2) to assign objects to one of a number of known groups of objects (Goldstein and Dillon 1978). Discriminant analysis may thus have a descriptive or a predictive objective analysis (Crossa et al. 2002). In both cases, some groups must be known before carrying out the discriminant analysis. Hence discriminant analysis can be employed as a useful complement to cluster analysis in order to judge the results of the latter.

Classification methods also require a multivariate data set consisting of measurements of several variables (Franco et al. 1997a). The effective use of classification methods require an understanding of the properties of the forms and type of data collected as well as of the measures of association (Crossa et al. 2002). Data form consists of a two-way table of n farmers and p variables (or attributes), and the type of variables can be continuous or nominal. The two-way table of n farmers and p variables can have one type (only categorical or only continuous) or a mixture of types (categorical and continuous) (Crossa et al. 1995). Classification based on all available information on

the farmers is much more reliable than the one based on only some variables (Franco et al. 1999).

The objective of this study is to use the clustering Ward strategy to classify 243 farmers in 15 villages in Forêt des Pins Reserve by using categorical and continuous socioeconomic variables.

4.4 Application of Farm Household Typology

As part of this study, typology is defined as "any conceptual classification scheme. The role and utility of any typology is relative to the theoretical or practical perspective (Jary and Jary 1995). " The purpose of farm household income typology is not only to obtain better knowledge and understanding of reality but also to use the results as an instrument to change reality (Kostrowicki 1977). Typological studies can therefore be of practical importance, particularly for programming and implementing agricultural development and its spatial organization.

Farm households are a dynamic phenomenon. Individual holdings not only vary in space along with their varied environmental and other exogenous conditions, but also change in time following the modification of their variables (Landais 1998). The variation of one or more variables will not, however, change a type until their number is so great that they change the entire character of a given agricultural system, i.e. until quantitative changes will be enough to transform a given type into a new quality, a new type of agriculture (Duvernoy 2000). Some successful attempts have been made already to apply typological methods for forecasting and programming further changes in the spatial organization of agriculture (Daskalopoulou and Petrou 2002; Duvernoy 2000; Landais 1998; Perret and Landais 1993; Kostrowicki 1976, 1975b, 1974).

The studies cited above (Daskalopoulou and Petrou 2002; Duvernoy 2000; Landais 1998; Perret and Landais 1993; Kostrowicki 1974, 1975b) were not limited to merely forecasting. Moreover, the outline data of future demand for agricultural products, of the tasks of agriculture and possible means for their implementation, have been used to revise and correct the results of extrapolation (Davis et al. 1997). As typology has revealed the weak points of the development of agriculture, it was also possible to access which of them could be improved, with the means to be allocated for agricultural development in long-term planning, and what would be the possible outcome of such an improvement (Kostrowicki 1974, 1975a, 1975b).

4.5 Farm Household in Haiti

Agriculture is a key factor in the economic development of Haiti; approximately 70 percent of all Haitians depend on the agriculture sector, which consists mainly of small-scale subsistence farmers and employs about two-thirds of the economically active work force (Haiti-Guide 2003). Agriculture accounted for about 30 percent of GDP and for 24 percent of exports in 2002. The role of agriculture in the economy has declined severely since the 1950s, when the sector employed 80 percent of the labor force, represented 50 percent of GDP, and contributed 90 percent of exports (U.S. Library of Congress 1996). Many factors have contributed to this decline. Some of the major ones included the continuing fragmentation of landholdings, low levels of agricultural technology, migration out of rural areas, insecure land tenure, lack of capital investment, high commodity taxes, low productivity of undernourished farmers, animal and plant diseases, and inadequate infrastructure (Latortue 1998). As Haiti entered the 1990s,

however, the main challenge to agriculture was not economic, but ecological (Pierre-Louis 1989). Extreme deforestation, soil erosion, droughts, flooding, and the ravages of other natural disasters had all led to a critical environmental situation.

In such a context, development agents were regularly asked to propose solutions to cope with this situation. However, theoretical and practical considerations showed that, considering the degree of diversification to which Haitian agriculture faces, straightforward solutions do not exist (Groupe de Recherche et d'Echanges Technologiques-Faculté d'Agronomie et de Médecine Vétérinaire [GRET-FAMV] 1990). Farming structure differs considerably, from farm household to farm household, according to ecological and socioeconomic conditions.

Diversity of ecological conditions in which Haitian peasants work is probably the most important issue. From agricultural landscape to agricultural landscape, annual precipitation differs considerably. The amount of rainfall in the different watersheds varies significantly depending on the altitude and orientations of the slopes (McLain and Stienbarger 1988). The average annual rainfall at the mouth of a river in Les Anglais (south of Haiti) is about 1300 mm whereas the average annual rainfall for a small town located at an altitude of 200 meters in the adjacent watershed is about 1500 mm. Annual rainfall on the upper slopes of the Forêt des Pins Reserve is estimated at 2000mm (Bureau d'Enquêtes et d'Analyses Socio-économiques [BEAS] 1985). Each of these ecological units faces specific problems of agricultural development that necessitates particular solutions.

Many of these agricultural landscapes are small-scale and located on a multitude of slopes, elevational zones, and soil types. They also are surrounded by many different vegetation associations. The combinations of diverse physical factors, therefore, are numerous and are reflected in the diverse cropping patterns chosen by farmers to exploit site-specific characteristics. On the lower mountain slopes of Haiti, peanuts, sorghum, Pigeon peas, sweet potatoes, and cassava predominate, whereas peasants on the upper mountain slopes of the Forêt des Pins Reserve grow black and red beans, onions, cabbage, potatoes, etc.

The heterogeneity of the agricultural landscape also varies greatly from region to region. In some parts of Haiti, where commercial agriculture predominates, the heavy use of agricultural chemicals, mechanical technology, and irrigation over large areas have made the landscape relatively homogenous (e.g. region of Artibonite Valley, north of Haiti). In such areas, the agricultural landscape is made up mostly of large areas of single crop agricultural production. In other parts, the use of traditional farming practices with minimal industrial inputs has resulted in a highly heterogeneous landscape possibly even more heterogeneous than would exist naturally.

Diversity of socioeconomic situations of Haitian farmers also constitutes a problem to which development agents face. From the sharecropper peasants of northern Haiti to the 'grandon' (large farmer) of the Léogane plain (southern Haiti), the range of socioeconomic situations is large. Three major forms of land tenancy, with a different degree of security, were inventoried in Haiti: ownership, renting and sharecropping. Renters generally enjoyed more rights to the land they worked than did sharecroppers.

Thus, a farmer with secure tenure is much more likely to think of long-term production and conservation activities than do sharecroppers. The amount and types of land under stewardship of the farm household is also critical and can influence farmer decision making. In northern Haiti, the average farm size 1.34 ha while in the southeastern part, the mean farm size is 0.78 ha.

Household composition and allocation of responsibilities to different family members are also important in explaining farm diversity. From farm household to farm household, the number of dependents and the amount of labor available differ significantly. Division of family chores by gender partially determines how resource allocation decisions are made. For example, studies have shown that women households tend to prefer the planting of trees for fuelwood, fodder and fruit while men are said to prefer the production of timber that can be sold commercially (BEAS 1985; Latortue 1998). This has much to do with women's role in fodder and fuelwood collection; a role that can take them far away from the farm and requires heavy labor. Likewise, children often play an important role in caring for livestock.

Most of Haitian peasants rely heavily on household labor to assist in farm production (GRET-FAMV 1990). Depending on the age, the number of available workers in the households and his capital supply, a farmer can supplement the farm household labor with external labor. The amount and type of labor that a farmer can draw upon throughout the year greatly influence his land-use decisions. In addition, farmers who are short of cash may sell their labor to buy food and seed.

Subsistence farmers typically have different aspirations from market-oriented or commercial farmers (Faustin 2003 and Latortue 1998). These ambitions are reflected in their beliefs, attitudes, and investment patterns. Different farmers also have varying risk tolerance levels based on savings and basic food security (GRET-FAMV 1990). Subsistence farmers tend to have less tolerance for risk because they are closer to the borderline in terms of savings and liquid assets (Latortue 1998).

4.6 Methodology

This section is divided into three parts, including: 1) a presentation of the techniques used for the data collection during the field survey, and 2) an explanation of the methodology used to analyze the data collected during the survey.

4.6.1 Source of data

The conceptual framework outlined above suggests that variables describing resource and social differences between households are likely to provide a valuable basis for a classification that captures differences in both household decisions about activities and household welfare. The choice of variables and data analysis employed in this study is adapted from Davis et al.'s (1997) typological approach to classify farm household situations. Davis et al. (1997) argue that farm household income typologies should be based on (a) a variety of objectives (i.e., socio-economic) characteristics of farmers, families and farming operations and (b) subjective factors, for instance, "motives, aspirations, and needs".

The variables used to create the classification of farmers in this study include age, education level, household size, gender, marital status, dependency ratio, forest dependency, total family labor, total family labor sold outside the household, number of hectares managed by the household, land tenure, and income per capita. Farmers were classified based on 3 categorical and 9 continuous socioeconomic variables (Table 4.1).

The purpose of this survey was to gather data on the socioeconomic aspects of peasant life in Forêt des Pins Reserve. Data were collected using a face to face interview between May and July 2003. The interviewees were selected randomly from the list of the households obtained from the Forest Resources Service of the Ministry of Agriculture, Natural Resources, and Rural Development (MARNDR). The random sample consists of 243 households in 15 villages inventoried in the area.

Table 4.1 Description of socioeconomic variables used for farm income classification

Variables	**Definition**
Hsize	Respondent's household size
Educ	Respondent's years of education
Age	Respondent's age
Gender	Respondent's gender; 1 if female, otherwise 0
Mstatus	Respondent's marital status; 1 if married, 0 otherwise
Depratio	Number of children and elderly as a proportion of total household size
Fdependency	Household forest dependency
Tflabor	Total family labor available for each household (man-day)
Tflabout	Total family labor sold outside the household (man-day)
Fsize	Number of hectares managed by the household
Ltenure	Respondent's land tenure; if landownership 1, 0 otherwise
Incpercapita	Household's income per capita

During the survey process, heads of households were generally very open to describing their farming experiences and their concerns about the future of this Reserve.

Our insistence on the clear objectives of this study greatly contributed to dispelling doubts of some peasants who might be willing to dramatize things, because they could anticipate an upcoming development project stemming afterwards. It was also attempted to interview the respondents in isolation to secure sincerity in their responses. The latter was cross-checked by asking the same questions at different time. All the interviews were conducted in Creole in order to ensure correct answers to the questionnaire. We often provoked informal follow-up discussions and made use of our observations to assure the validity of our findings.

4.6.2 Data analysis

Analysis of the data was carried in three phases. First, squared Euclidean distance method was used to identify the similarity between variables. Second, similarities as measured by the squared Euclidean distances were submitted to the process of standardization. Standardization of the data was necessary because of sensitivity of the distance measures to differing scaling or magnitude among the variables. The descriptors 'forest dependency' and 'dependency ratio', for example, are presented in percentages while the other descriptors are not. Without standardization, certain variables could be dominant in determining the classification.

Third, a log-likelihood profile was performed to estimate the optimal number of groups by observing the changes to the log-likelihood function (cited in Crossa et al. 2002) . Fourth, data once standardized were submitted to a hierarchical cluster for the purpose of sorting individual cases into groups. The Ward's method was used for clustering the individuals and forming the different groups. Fifth, stepwise discriminant

analysis was applied to the data, which consisted of 3 categorical and 9 continuous socioeconomic variables, to obtain the list of potential discriminating variables forming the discriminant functions. During the stepwise procedure, Wilks' Λ, which is a multivariate measure of group differences over several variables, was used as a selection criterion to determine the addition or removal of variables in the discriminant function. At each step, a variable was either added or deleted from the discriminant function according to the value of Wilks' Λ.

Finally, canonical variate analysis was used for a better visualization of the different groups; the canonical variables were plotted in discriminant space. SAS for Windows statistical software (SAS 8.2, 2001) was used for all statistical analyses in this study.

4.7 Results

This section presents a summary of socio-demographic variables for the 243 households and illustrates the nature of the association among the different socioeconomic variables. This section also gives a log-likelihood profile to estimate the optimal number of clusters using the log-likelihood function. The results of the stepwise discriminant and canonical variate analysis were also presented.

4.7.1 Socio-demographic variables

The socio-demographic profile of the respondents is presented in Table 4.2. About two hundred men (82%) and forty-two women (18%) were interviewed during the survey. The number of female-headed household, which was 6.7 percent, was lower than

the 11 percent that the Centre de Formation et d'Encadrement Technique [CFET] found in 1999. The gender of household head seems to be affected by changes in marital status, death of the husband, and male migration. The practice of 'polygamy' may also affect women since they might de facto heads of household (Latortue 1998). Informal discussions with some male-headed households in the Reserve revealed that most of them had a 'mistress'.

The marital status at the time of the survey included respondents who were married (76.9%), widowed (0.4%), single (1.2%), and cohabitating (20.5%). The number of married respondents was higher than the 55.5 percent that the Bureau d'Enquêtes et d'Analyses Socioeconomiques [BEAS] found in 1985 in the Reserve. This is probably due to the influence of Protestant and Catholic sects in the Unit I of the Reserve. Eighteen percent of the sample female-headed household was widowed and old; the remainder was still in their reproductive years. Households had an average of 7.2 people, but the male-headed household had 7.4 while the female household heads had 5.7. The age of respondents ranged from 24 to 75 years; the respondents were relatively middle age with an average age being 49 years. The largest proportion of respondents was in the (41-50) year-old category (35.39%).

The years of education range from 0 to12, with an average of 2.1. About fifty-four percent of the respondents were illiterate, twenty percent had completed primary school, and 2 percent had graduated from high school. Women had less education than men and female-headed households tended to have less education than wives. Forty-three percent of the male had attended school, compared to 3.3 percent of the wives and 1.2 percent of

the female household heads. Only 1.58 percent of the female had completed primary school, compared to 18 percent of the male household heads.

Table 4.2 Socio-demographic profile of the respondents

Characteristics of Interviewed persons	Forêt des Pins Reserve	
	Frequency	**%**
Gender		
Male	201	82.72
Female	42	17.28
Marital Status		
Single	3	1.2
Married	162	76.9
Divorced	1	0.4
Widowed	27	11.1
Cohabitating	50	20.5
Age group		
21-30	8	3.29
31-40	48	19.75
41-50	86	35.39
51-60	71	29.21
61 and above	30	12.34
Years of education		
0 Illiterate	131 (74% male)	53.9
1-4 Primary school	60 (93% male)	24.69
5-8 Middle school	48 (92% male)	19.75
> 8 High school	4 (100% male)	1.64
Land tenure		
Landownership	42	17.2
Family land	28	8.2
Sharecropping	20	11.5
Tenant farming	143	57.6
Illegal land use	13	5.3

Land for agricultural purpose was acquired through ownership (purchase, inheritance, gift, and illegal forest clearing), tenant farming, or by sharecropping. Tenant farming and landownership were the main sources for the different farmers in the Reserve. About fifty-seven percent of the respondents acquired land through tenant farming, 5.3 percent got land illegally. The size of land holdings in the Reserve ranges

from 0.7 and 16.1 ha. Fifty-six percent of the respondents were poor (respondents who reported insufficient annual income to support basic household needs such as food, medical care, and clothing), while 12 percent were classified as 'better off'. The average monthly family income of the 243 respondents was 1,250 Gourdes, with 24 of them (10.2%) earning a monthly family income in the range of 20,000 and 58,000 Gourdes.

4.7.2 Nature of the association among the socioeconomic variables

A Pearson's correlation coefficient matrix indicates only weak collinearity among the socioeconomic variables. There is a positive correlation between the amount of labor in a household and the size of holdings (ρ=0.008). It seemed that heads of households who had more land also had more people in their households. Informal discussions with elder female-headed households who lived alone revealed that women often preferred to cultivate small parcels land and expend less labor, while women in their productive years and those who have relatives living with them required more land. Total family labor, farm size and income per capita are positively correlated. The greater the farm size, the greater the number of man-days in the family and the greater the income per capita.

Sharecropping and income per capita are negatively correlated. This negative correlation might have been due by the fact sharecroppers divide their harvest with the landowners on a fifty-fifty basis and do not have incentives to increase costs of production by buying fertilizers and improved seeds. Years of education (*Educ*) is positively correlated with income per capita (*Incpercapita*, ρ=0.220), while there is a somewhat negative correlation between the sharecropping and years of education (ρ=-0.222). The variable *Age* shows a negative correlation with forest dependency; this

suggests that younger people are more dependent on forest resources. This may be due because forest dependent activities in the Reserve are illegal and it is risky to undertake them. Young farmers generally are willing to take greater risks than elderly in rural communities. Moreover, with the lack of off farm activities, younger-headed households rely more on forest resources to meet their basic needs.

4.7.3 Estimation of the optimal number of groups

The optimal number of groups was determined using the log-likelihood profile (Franco et al. 1998). The likelihood profile is used as a graphical display for observing the changes to the log-likelihood function in relation to the number of groups. The optimal number of clusters occurs when the log-likelihood function shows its largest increase. Using the Ward method on the 243 farmers, the log-likelihood profile for one to eight groups showed that the optimal number of groups is 3. Figure 4.1 indicated that the highest increase of the log-likelihood occurs for 3 groups. The log-likelihood increased up to 3 and then remained stable up to 8 groups.

4.7.4 Determining the best discriminant variables

A stepwise discriminant analysis was performed to determine the importance of the 12 variables on the delineation of the 3 groups. Table 4.3 gives the summary of the stepwise discriminant function analysis. Data are reported under three criteria: Wilk's Λ, equivalent F-ratio, and the p-value. Table 4.3 shows that out of 12 variables entered, seven variables (*Incpercapita, Age, Ltenure, Hsize, Gender, Depratio, and Tflabout*) were selected for the analysis ($\chi^2 = 877.03$, d.f. = 241, $p<0.0001$). The five other variables

were omitted by the program to be the least effective for discrimination of farm household income. In the first step, *Incpercapita* is included in the discriminant function because it provides the maximum discrimination as evidenced by the selection criterion, Wilks' Λ (0.0068).

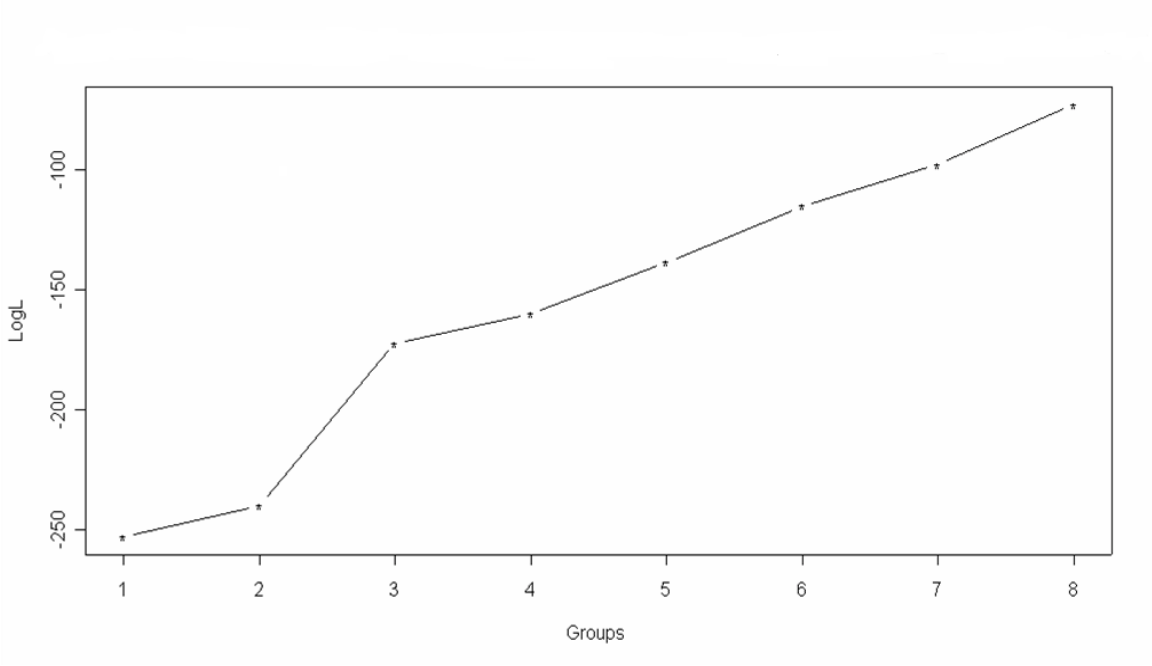


Figure 4.1 Profile of the log-likelihood function for the number of groups obtained using the Ward method

Also the corresponding F-value (291.88) is significant (p<.0001), indicating that the discriminant function is statistically significant. Once *Incpercapita* was analyzed, the remaining variables were reexamined and selected according to the Wilks' Λ level. The maximum *Age* having the least Wilks' lambda value was entered from the remaining variables as step 2. Included also in the analysis were the maximum *Ltenure*, *Hsize, Gender, Depratio, and Tflabout* as step 3, step 4, step 5, step 6, and step 7 respectively.

The analysis was terminated after step 7 because of the low value of F-ratio of the remaining five variables, which were below the threshold of criteria for entrance.

Based on the Wilks' Λ and the equivalent F-ratios given in the Table 4.3, it appears that *Gender* (Respondent' sex), *Depratio* (Number of children and elderly as a proportion of total household size), *Tflabout* (Total family labor sold outside the household), and *Hsize* (size of the household) would provide the best important variables for discriminating among the farmers in different groups because they have the lowest values for Wilks' Λ.

Table 4.3 Summary of the stepwise discriminant function analysis

Step	Variables entered	Criteria		
		Wilks' Λ	Equivalent F-ratio	p-value
1	*Incpercapita*	0.0068511	291.88	<0.0001
2	*Age*	0.0004390	29.21	<0.0001
3	*Ltenure*	0.0000415	18.98	<0.0001
4	*Hsize*	0.0000056	17.54	<0.0001
5	*Gender*	0.0000012	7.29	<0.0001
6	*Depratio*	0.0000002	6.46	<0.0001
7	*Tflabout*	0.0000001	2.55	<0.0001

4.7.4 Differences among the different groups

Three cluster solutions with the clusters labeled (*low-income farmers* (G1), *middle-income farmers* (G2), and *large-income farmers* (G3) were formed using the

Ward method. A chi-square analysis comparing the cluster classification of farmers was significant ($\chi^2 = 877.03$, p<0.0001). About 25% of farmers were assigned to *low-income farmers* (G1), 60% formed part of *middle-income farmers* (G2), and *large-income farmers* (G3) accounted for 15%. To verify differences among the clusters and to provide descriptive data concerning the clusters, a discriminant analysis was performed. As expected, the discriminant analysis, approximate Wilks' Λ=0.023, p<0.0001 was significant. Then, we have sufficient evidence to conclude that the three groups are significantly different. Post hoc tests were conducted to identify differences among the different groups. All three clusters were significantly different from each other; each pair-wise squared distances comparison being significant (Table 4.4). Then, all three groups are fairly compact and well separated each other.

Table 4.4 Pair-wise generalized squared distance between the three groups

	G1	*G2*	*G3*
G1	0.00	69.95	136.93
G2		0.00	237.99
G3			0.00

T-tests were also used to assess the differences in the means among the three groups. The t-values for testing equality of the means of the three groups are shown in Table 4.5. The t-test suggests that the three groups are significantly different to the following variables (*Incpercapita*, *Age, Tflabor, Hsize, Depratio*, and *Tflabout*) a significance level of 0.05. That is, all of these variables do discriminate between the three groups and consequently use to form the discriminant function. *Incpercapita*, *Age, Tflabor, Hsize, Depratio*, and *Tflabout* by group t-test analyses were significant.

Table 4.5 Means and t-values for G1, G2, and G3

Variables	*Groups (Means)*			*t-values*		
	G1 (n=66)	G2 (n=146)	G3 (n=31)	G1/G2	G1/G3	G2/G3
Hsize	3.56	7.97	11.77	24.62	24.89	11.70
Fsize	0.85	1.92	2.59	2.78	2.00	1.10
Age	61.72	48.52	48.77	7.11	6.44	0.17
Educ	0.86	2.15	2.38	3.25	2.32	0.38
Depratio	0.11	0.20	0.20	3.25	2.79	0.00
Fdependency	4289.39	11587.91	21110	30.43	26.29	14.76
Tflabor	608.25	1068.00	1519	10.47	11.6	5.61
Tflabout	109.20	7.69	8.06	19.56	15.59	0.06
Incpercapita	1.40	1.30	1.29	9.18	0.73	7.49

Means and t-values for the different variables are presented in Table 4.5. *Fsize* and *Educ* were not significantly different among the groups G2 and G3. Omnibus t-tests were significant for the remaining variables, suggesting differences among the socioeconomic variables in terms of the size of the household, gender, forest dependency, and total family labor. Finally, there is no significant difference among the groups in terms of farm size.

4.7.5 Characteristics of the three (3) groups

Cluster analysis of farm income household for this sample of farmers produced three distinct groups of farmers. A brief discussion of the clusters demonstrates the various types of farm households.

G1 was labeled *low-income farmers*. This group accounted for 27.2 percent of the sample and tended to be disproportionately female (proportion of female headed households in this group is 22%). This group of farmers is the oldest and least educated

and has the highest number of members in the oldest age group. They own the smallest landholdings either in sharecropping or tenant farming. Farm size characteristics for this cluster are very similar to results obtained from Haiti land tenure statistics in 2003; that is less than 1.0 ha (Institut Haitien de Statistiques et d'Informatique [IHSI] 2003). The annual average income is about 17,000 Gourdes. They have a very small family size. The main characteristic of this group is the dependence on selling labor activities as additional source of income. These families are probably the worst off; they are old, have little available labor and very few assets.

G2 was labeled *middle-income farmers* and they accounted 60 percent of the sample. These families have access to family labor, given that most of their members are in the age groups of 25-60 years. Twelve percent of the male and female-headed households can read and write. Eighty-nine percent of this group is male-headed households. They are either landowners or tenant farmers. Farm size ranges between 1.5 and 2.2 ha. Their characteristics are their reliance on off-farm activities. This category also includes the households heavily dependent on remittances from family members living outside the Forêt des Pins Reserve. They have about 7 and 8 children.

G3 accounted 12.8 percent of the sample and consisted of *large-income farmers* with the youngest and the best-educated families. They own the largest landholdings; farm size is greater than 2.5 ha. They also own, on average, the highest income per capita. These farmers are probably the better off families, with strong connection with the non-farm economy. The main characteristics of this group are the dependence on hiring

labor for farming activities and the daily spending of their time in off-farm activities. About 74% are large families with more than 8 dependents.

4.7.6 Canonical analysis and canonical plot

The canonical discriminant function explained almost 92 percent of the total variation among clusters. The first canonical correlation (the correlation between the first pair of canonical variables) is 0.9757. This value represents the highest possible correlation between any linear combination of the socioeconomic variables. Table 4.6 also displays the likelihood ratios and associated statistics for testing the hypothesis that the canonical correlations in the current row and all that follow are zero. The first approximate *F* value of 104.6 corresponds to the test that both canonical correlations are zero. Several multivariate statistics (Wilks' Λ and Pillai's trace) and *F* test approximations are also provided. These statistics test the null hypothesis that all canonical correlations are zero. The small *p*-values for these tests (< 0.0001), suggest rejecting the null hypothesis that all canonical correlations are zero.

The canonical variables involving all 12 socioeconomic variables are shown in Table 4.6. The first canonical variable is positively correlated with *Hsize, Fdependency Educ, Fsize, and Tflabor*, and negatively correlated with G*ender, Mstatus,* and *Ltenure*. This indicates that the first canonical variable is associated with the size of the household, the household forest dependency, and the security of land tenure. The second canonical variable is positively correlated with *Age, Gender, Fsize, Incpercapita,* and *Mstatus*, and negatively correlated with *Hsize*, *Fdependency*, and *Tflabor*. This shows that this canonical variable is associated with the age and the gender of the head of the household.

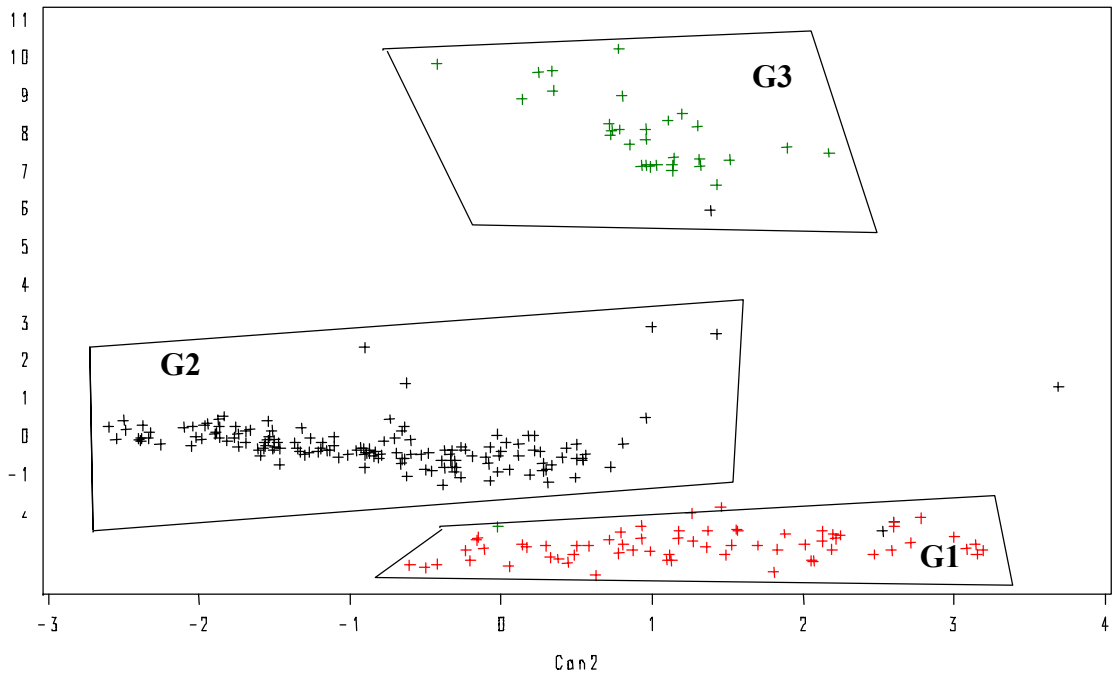
Table 4.6 Canonical variables for each of the 12 socioeconomic variables

Variables	Canonical Variables	
	Can1	*Can2*
Hsize	0.8214	-0.5505
Fsize	0.0504	0.0570
Gender	-0.2256	0.2957
Mstatus	-0.1422	0.1758
Age	-0.0447	0.1119
Educ	0.0588	-0.0299
Depratio	-0.0606	0.1225
Fdependency	0.9162	-0.3878
Tflabor	0.5771	-0.3562
Tflabout	-0.0114	0.0057
Incpercapita	-0.0708	0.1347
Ltenure	-0.1910	-0.0146

Thus, the demographic structure of the household and gender of the head of the household are fundamental components of the classification. The coefficients *Hsize*, *Fdependency*, and *Tflabor* are the dominant factors in differentiating the groups since they have the largest values for canonical variables. These three variables are critical in delineating the groups; their effects on the system must be considered when targeting groups of farmers in the area for research and extension efforts.

This graphical representation is very useful to visualize the relationship between the 3 groups. Figure 4.2 indicates a significant distinction between groups G1, G2, and G3. It is very clear that G1 (*low-income farmers*) forms a very compact group well separated from G2 (*middle-income farmers*) and G3 (*large-income farmers*), as well as G2 and G3.

Figure 4.2 Plot of the two canonical variables for 243 farmers



4.8. Conclusion and Policy Implications

This chapter was undertaken with the purpose to statistically cluster farm household income in Forêt des Pins Reserve. Our hypothesis was formulated regarding the non-homogeneity of farm income households in terms of their socioeconomic and demographic characteristics. Cluster and canonical-discriminant analysis were conducted to describe socioeconomic differences among the clusters. The analysis allowed the use of different types of variables, provided a systematic approach to decide the number of groups present in the data.

The results of the cluster analysis demonstrated that farm households in the Reserve are indeed a heterogeneous group. Their conditions are sufficiently diverse that

the farmers can be statistically clustered based on their socioeconomic situations. Cluster analysis for this sample produced three distinct groups of farmers. Although the three clusters do not account for all variation among socioeconomic profiles, it is obvious that three categories of farmers provide sufficient evidence that farm households form a heterogeneous group. These three groups are not only distinguishable by their pattern of economic level but also by demographic variables.

It is not surprising that *low- income* farmers tented to be exclusively sharecroppers and dependent on selling labor outside their household, while *large- income* farmers were landowners and dependent on hiring labor for farming activities. In both cases, these finding are consistent with previous research. Several studies have suggested that *low- income* farmers perceive more benefits from selling farm labor than any other groups (Barlett 1991; Davis et al. 1997; Pierre 2000; Dolisca 2001). Benefits cited in the literature included: increase farm size, increase income, opportunities to feed themselves, opportunities to meet people and improve social lives (BEAS 1985; GRET-FAMV 1990; Latortue 1998; Faustin 2003).

Middle- income farmers tended to be tenant farmers. This cluster differs in several ways from the *large- income* farmers but have in common at least the dependence on off-farm activities. Many researchers have noted that tenant farmers and landowners in Haiti tend to be much more likely oriented to off-farm activities than do sharecroppers. Thus, it is not surprising that *middle- income* farmer clusters containing some type of attributes include a disproportionate representation of tenant farmers.

In addition to clarify the conceptual and methodological matters, the construction of the typology of farm income household can contribute to our understanding of the

multifunctional nature of this phenomenon. As agriculture has evolved, so have farmers' production activities. A good knowledge of farmer's capability in terms of capital, labor, and land may be a very good asset to farm management decision when production means are limited. Gregersen et al. (1989), GRET-FAMV (1990), and Barraclough and Ghimire (2000) argue that without knowing the capacities and motivations of farmers, the inclusion of effective measures to help them becomes a matter of chance. The significance of such an issue is punctuated by the presence of farm income, farm labor, across various types and size of households.

As more is learned about farmers' economic situations we come to a better understanding of farm household diversity by using both demographic and economic characteristics. Hopefully, this knowledge will be useful in conceiving and implementing development actions. It is recommended that researchers continue to investigate farm household income by including motivational and attitudinal variables. The consideration of motivational factors permits more in-depth analyses of farm income households. This finding could have significant implications. Finally, more researchers investigating the influence of secure tenure on farm income management is also important. For example, we hypothesize that sharecroppers may experience more psychological and motivational difficulty than landowners. The degree to which farm production is used to deal with ecological conditions may also differ among the different groups.

CHAPTER 5

FARM HOUSEHOLD MODELING FOR ESTIMATING THE EFFECTIVENESS OF POLICY INSTRUMENTS ON SUSTAINABLE LAND USE IN FORÊT DES PINS RESERVE

5.1 Introduction

During the last several decades, Haiti has experienced a series of changes in its social, physical, and economic environment. High population (2.1 percent per year), and urbanization (4.5 percent per year) growth rates have increased the demand for food and fuelwood (Center for International Health Information [CIHI] 1999). Average rainfall has declined (1 percent per year); growing seasons have become shorter; arable land per capita has fallen, fallows have been shortened and abandoned, pressure on natural resources has increased, and soil quality has deteriorated (CFET 1997).

Population growth and rising food demand led to considerable forest clearing in many parts of Haiti, largely to plant food crops (maize, beans, cassava, potatoes, and cabbage) and to establish plantations of crops such as cotton, sisal, and sugar (Moral 1978). In Haiti, state-sponsored settlement schemes were instrumental in clearing large areas of forests for agronomic crops grown by smallholders and large estates. Illegal commercial logging also facilitated the conversion of forests to agriculture, particularly where land use for agriculture conferred property rights over it (Faustin 2003).

Concern over environmental sustainability of agricultural activities has led many governments to attempt to encourage forest conservation. Some governments have undertaken laws and regulations to prevent farmers from undertaking degrading activities or to compel them to adopt conservation practices. However, such measures are not costless. Regulation options rely on administrative measures which often exceed government's financial and technical resources, and even then are also questionable policies when evaluated in terms of cost-benefit analyses (Palmer et al. 1995). Other measures concentrated on "negative incentives" such as fines and taxes to coerce farmers into compliance with best management practices. Again, Haitian governments and farm households cannot effectively guarantee the use of such tools since necessary regulatory mechanisms are often costly and inadequate.

Policy reforms proposed to resolve the problem of regulation in managed forests include measures focusing on improving tenure security and resource valuation and on negative incentives such as taxation and penalty systems. Although these policy instruments and economic tools may provide greater justification for observing sustainable management practices, they do not provide positive economic incentives for adopting more costly practices nor do they provide a mechanism of revenue generation for farm households (Gillis 1992). Concrete policy measures and institutions that permit a simultaneous improvement of agricultural productivity, alleviation of poverty, and conservation of the natural resource base are then urgently needed in Haiti which suffers from a declining resource base.

Farm household land-use decisions are generally made based on household specific and exogenous variables taking into account their own objectives. Household

specific variables include land, labor, and capital; demographic characteristics of the household; and possibly the levels of education of the head and other household members. Important exogenous variables to the household include institutional arrangements, access to labor markets, and soil fertility. These household and exogenous factors influence decision making regarding household factor allocation, including land use and technology investments intended to enhance productivity and sustainability. Household objectives may be in conflict with social goals, differ from household to household, and may not converge. The complexity of household behavior in combination with changes in the state of natural resources make it necessary to use economic models to evaluate whether changes in policy may induce farm households towards more sustainable land use while maintaining or improving their welfare. The aggregate effects of such farm household decisions on environmental and welfare indicators form a benchmark for evaluating different policy decisions.

The purpose of this chapter is to evaluate the role of various policy instruments for forest conservation. Emphasis is given to incentive agreements such as cross-compliance and cost sharing policies, which are expected to offer positive distributional benefits to farmers. Moreover, the role of land tax and input price policies related to the importance of the crops is also examined. The chapter's layout is as follows. The next section presents a brief background to the forestland change issue and to the institutional framework that are driving Haitian policies for reducing deforestation. A review of the agricultural sector and forest degradation problem in Haiti is presented in section 3. Section 4 develops the analytical model used. The analytical results and discussions are presented in section 5. The final section provides some concluding words on this chapter

and implications of the results for sustainable forestland use, and points to avenues for future research.

5.2 Background

5.2.1 Institutional Instruments to Stimulate Forest Conservation

The purpose of this chapter is to investigate alternative solutions to the problem of deforestation of Forêt des Pins Reserve. This investigation is based on the production function. Theoretically, for any given set of inputs, the maximum amount of output that can be produced is determined by a production function. A farmer may have several options for increasing his resource supplies. Some of these options involve different technologies, defined in the sense that the assumed input-output relations of the production function, for the crop or animal, are different for each method. Such choices might involve different crop varieties and animal breeds, or irrigated crops. Other options in production relate to the amount of a variable input to use per hectare or per animal, or to the combination of factors to use in producing a unit of a given crop or animal product. Approaches to addressing the problem of natural resource degradation must deal with the core issue of how to motivate small farmers to adopt new policy instruments that can increase net annual income, substitute degrading activities, and reduce the rate of forest depletion.

Approaches to forest conservation have been changing in recent years. For many years, it was believed that forest depletion was primarily a physical problem which could be overcome by the application of physical conservation works. It was also believed that the answers lay in technology which had to be developed by research workers. While

technology options remain an important approach for forest conservation, they have proven difficult to implement in many settings, especially in the developing world (Rao et al. 2003). This approach failed for two main reasons. First, forest degradation is usually only a symptom of other problems (economic, social, political and legal pressures). Second, the solutions offered were often unattractive to the farmers and did little to solve their immediate problems of improving yields or increasing their incomes.

Traditional approaches of forest conservation and management sometimes referred to "command and control" regulations are increasingly viewed as having failed in their goals of preserving biological diversity in the tropics. These types of regulations may exceed the financial means and technical expertise available to developing countries (Sharma and Rowe 1992) and are frequently not economically advantageous. Regulations require activities that tend to be costly. Furthermore, because compliance with strict environmental standards is often quite costly, there is no positive incentive to control damaging activities, although there is the negative incentive to avoid penalties. Not only there is no incentive to do better than required by regulations, but also the incentives to comply with minimum standards may be too weak to overcome the disincentive of bearing the costs (Freeman 1993). A more systematic approach is needed to address the feasibility of environmental regulation as a means of promoting sustainable management of forest resources, including appropriate cost-benefit analyses and incentive measures (Palmer et al. 1995).

Initiatives aiming to address environmental issues in economic terms propose environmental or "green taxes" as a means of promoting environmental protection. Environmental taxation is a disincentive that affects economic activities through its

secondary effects. “Green taxes” have been considered by many economists to enhance the efficiency of the tax system while minimizing environmental damage. However, such fiscal policies are not costless. Taxation options rely on administrative measures which often exceed government’s financial and human resources, and therefore, may be applicable in more developed economies, and even then are also questionable policies when evaluated in terms of cost-benefit analyses (Palmer et al. 1995; Farber 1991). These indirect linked approaches have also been difficult to implement (Newmark et al. 1992; Mehta and Kellert 1998). The biggest problem has been that this approach has not been directly tied to conservation behavior and has not provided local people with incentives to stop external threats to the biodiversity, such as pit sawyers and logging company clear-cutting.

Beyond regulation and taxation policies for development with conservation, research has emphasized participatory approaches to sustainable development. With this new insight, we have seen increasing emphasis being placed on the involvement of local communities in the whole process of identifying the problems of forest degradation, developing solutions and then implementing forest conservation programs. Chambers (1994) has argued that involvement of a community is vital in making development projects effective through ensuring sustainability and building local capacities. As a complement to this work on participatory development, the literature on communities has recently focused on the social and cultural attributes of local people as assets for sustainable management (Agrawal 1997; Agrawal et Gibson 1999). Promising as this approach may be, participation by itself does not appear to be enough to overcome all the problems of forest degradation. Given the opportunity, land users may well be able to

identify the underlying problems and work out possible solutions. However, the solutions may not be within their reach without financial and other forms of help. Also, the solutions which are developed may not be sufficiently attractive for them to adopt social, institutional, or economic reasons.

Another approach with ramifications for development and conservation in tropical countries refers to proposals for improved forestry practices, including reduced-impact logging (RIL) and forest certification. RIL is designed to lower damage to commercial inventories and minimize impacts on forest ecosystems through improved planning and extraction (Boltz et al. 2001; Uhl et al. 1997; Pinard et al. 1995). Forest certification seeks to promote sustainability of forest resources for export to specialty markets for higher added-value products (Perz 2004; Forest Stewardship Council United States [FSCUS] 2000, Vogt et al. 1999). In contrast, the economic incentives approach utilizes market-based instruments designed to modify the behavior of the generators of the externality through their effect on the prices of resource inputs used in economic activities.

The economic incentives approach to forest conservation may use a combination of policy tools. These include security of land tenure, price support and reduction of export taxes to major cash crops, cost sharing arrangements, subsidies, rewards and prizes, inexpensive loans and credits, and input and output prices. When there is poor specification of property rights and tenure insecurity over important assets such as land, farmers are more likely to have short planning horizons so that long-term effects of deforestation on productivity will have less influence on land use decisions (Shiferaw and Holden 2000; 1999; Panayotou 1993). Insecure and ill defined land rights will prevent

farmers from obtaining credit because they cannot use insecure land as a guarantee to acquire low interest and long-term institutional credit. As a result, households may not be able to make long-term investments, such as ecosystem management. Besides, macro-policies, such as devaluation of overvalued exchange rates and interest rate adjustments, can also be used. Combination programs offering positive economic benefits, with preferred land management practices are important incentives to limit mismanagement of forest resources.

Another approach to the correction of the distortion of misuse of forest resources associated with farming practices is the Pigouvian taxation and subsidy measures. The Pigouvian approach serves to internalize the external costs by calling for taxes on degrading inputs and subsidies on conserving inputs in proportion to the marginal external damages or benefits resulting from the use of each input (Baumol and Oates 1975). The choice of policy instruments, however, depends on (a) efficiency of use of scarce information, (b) contracting, monitoring, and enforcement costs, (c) distributional effects, and (d) cultural norms and political preferences (Shiferaw and Holden 2000). An ideal instrument may be the one satisfying the goals of efficiency, equity, and simplicity (Chisholm 1987) as well as political feasibility. Accordingly, due to the lack of information on land-specific optimal levels of soil erosion, and prohibitive costs of monitoring the production activities of millions of scattered smallholders and enforcement of standards, the regulatory approach has very limited relevance for soil conservation. A mix of regulatory and incentives approaches may, however, be useful in some cases.

5.2.2 Environmental cross-compliance policies

One of the policy measures to create incentives for conservation is based on the twin objectives of providing support for agriculture and, at the same time, limiting environmental damage. Arnalds (1999), based on his Iceland experience, illustrated that, without linkages to conservation schemes, production incentives can become detrimental to the environment. Environmental cross-compliance is one policy by which government can seek to influence farmers through subsidies so that they give greater weight to environmental goods in their decisions. Environmental cross-compliance (ECC) may thus be defined as the linking of environmental conditions to the receipt of agricultural support payments (Baldock and Mitchell 1995).

ECC under farm households may offer some advantages. First, interlinked contracts may help alleviate forest degradation (Shiferaw and Holden 2000) and second, subsidies linked to conservation result in more efficient outcomes than could be achieved through isolated transactions (Bose 1993; Hoff et al. 1993). ECC measures provide an innovative approach for countering forest degradation without adverse impacts on the welfare of the poor and the marketable food surplus. In food deficit countries, like Haiti, increased production may also contribute to self-sufficiency and reduce food imports. Such policies may thus represent improvements in efficiency, equity and environmental quality (win-win-win policies). Their efficiency, however, depends, among others, on the productivity effect of conservation technologies, and the social discount rates (Shiferaw and Holden 1999).

5.3. Agriculture and Forest Depletion in Haiti

Agriculture is a key factor in the economic development of Haiti; approximately 70 percent of all Haitians depend on the agriculture sector, which consists mainly of small-scale subsistence farming, and employs about two-thirds of the economically active work force (Haiti-Guide 2003). Cropping activities account for 93 % of current agricultural land use, while pastures occupy less than 5% of available land. Fallow is almost eliminated since land has become a scarce factor. Current agricultural activities guarantee full absorption of the labor force, of which 6% is used for livestock herding and more than 90% for cropping activities. Family work represents the majority of the labor force, but wage labor is gradually becoming more important. Agriculture contributes 23 percent of the gross domestic product (GDP), and accounts for 24 percent of exports in 1998 (International Monetary Funds [IFM] 1998 cited in Bayard 2000). In spite of its fundamental role, the performance of the sector has remained largely behind the satisfactory level. Food self-sufficiency remains an unattained objective.

Another serious concern, coupled with the decline of the sector, has been the degradation of the resource base mainly due to the topography and soil erosion. The topography of the country, coupled with the extent of eroded land, imposes serious restrictions on the availability of arable land. With sixty-three percent of the country having slopes of over 20 percent, and only 20 percent of the land with slopes less than 10 percent, good agriculture lands are very limited (Pierre-Louis 1989). The problem of degradation of the stock soil and loss of production potential is severe in the highlands that constitute 60% of the cultivated lands. FAO (1996) estimates that 41% of the highlands are significantly eroded, of which 26% are seriously, and 33% have reached a

point of no return. In 1978, the World Bank estimated annual rates of soil erosion at a national level average 36.6 t/ha (Association Internationale de Développement 1990 cited in Bayard 2000). In such a context, deforestation and environmental degradation were inevitable due to the fast growing population, and the natural fragility of the mountain ecosystems.

The decline of the agricultural sector and depletion of the natural resource have been attributed to several interrelated factors: insecure land tenure, population pressure, political instability, ill-defined policy formulation and lack of government commitment, weak institutional support, over-dependence on foreign resources, lack of local peasant organizations, unavailability of credit for agricultural production, and technological stagnation (Pierre-Louis 1989; Moral 1978; Ashley 1989). Agricultural policies in Haiti are poorly defined. Some authors believe that Haitian agricultural policies can be inferred from the "whereas" of the laws and decree-laws of the agricultural legislation (Faustin 2003; Latortue 1998; Pierre-Louis 1989). Others maintain that despite the numerous formulations of a national agricultural policy, successive Haitian governments never formally adopted a comprehensive one; instead, they limited themselves to politically motivated declarations of intent (Pierre-Louis 1989; Pierre-Louis 1985; Raeder-Roitzsch and Zenny 1975). Haiti's agricultural policies were developed according to the traditional top-down approach by dedicated technicians who sometimes honestly believed that they knew what was necessary to face the problems of the agricultural sector. These technocrats rarely consulted the people they wanted to help, however, and systematically excluded certain population groups, for instance women, from agriculture and reforestation programs.

The Haitian land reforms of 1843, 1915, and 1997, allowing peasants to have usufruct rights to farmland, coupled with institutional weaknesses also failed to provide impetus to boost production and enhance sustainable land use. Although these reforms allowed many landless farmers to gain access to land, the state ownership of land and the insecurity of usufruct rights hindered consummating the reform. Land still remains under state ownership while farmers only possess use rights. The absence of secure property rights precludes farmers to receive credit and threatens agricultural production by discouraging agricultural long-term investments in terracing, and soil enrichment. By reducing agricultural yields, the failure to invest forces the clearing of more land to make up for the loss of food output.

The pauperization of the Haitian people is also another important cause of misuse of forest resources. The tendency of the peasants to "decapitalize" by selling their animals and transferring their land for as little as 15 percent of its value for debt reasons and migration purposes to urban centers in Haiti and abroad (New York, Miami, The Bahamas and the French Antilles in the Caribbean, etc.) is signal that degradation has reached its sorry end (Pierre-Louis 1989).

5.4 The Model

Many sophisticated analytical tools have been developed to comprehensively analyze rural household economics and farming systems at multiple scales and serve as decision-making tools. Though most of these tools operate on similar basic principles, each has its components and is unique in the way it is handled. This chapter develops a non-separable farm household model based on linear programming (LP) to investigate

the role of alternative policy instruments for forest conservation on two types of farm households in the Forêt des Pins Reserve. The LP model has been chosen because the farm income is linear in output prices and quantities (Buongiorno and Gilless 2003). The methodology has been used successfully for many years in operations research for both agricultural and forestry production and conservation (Merry et al. 2002; Bernet et al. 2000; Shiferaw and Holden 2000; Delforce 1994; Jolayemi and Oloami 1995; Nicholson et al. 1994; Howard 1993; Bezuneh et al. 1988**;** Ahn et al. 1981), and in the empirical estimation of deforestation at the household and firm level (Kaimowitz and Angelsen 1998). The LP model is an optimization model that identifies a production plan that maximizes peasant net annual income under various policy instruments.

5.4.1 Model Construction Procedure

The purpose of this part is to describe the procedures used to model two of the different farm households in the Forêt des Pins Reserve. Based on the data collected in the survey, the situation was simulated by a linear programming model with the objective of maximizing the net annual income, which is consistent with the cash-oriented foundations of the Haitian peasant agriculture (Murray 1987; 1977). The assumptions for this model were:

- Input-output prices are assumed to be constant at May-July 2003 levels (time of the survey);
- Production technology in agriculture is constant at the level of the year of survey (May-July 2003);
- All land is assumed to be free and equal in fertility;
- The aim of the model is to satisfy the basic needs of individual households and then to maximize the net annual cash income.

The linear model includes the following activities and constraints:

5.4.1.1 Activities considered in the model

Activities (columns) refer to a wide range of alternative options of combining the limited resources available at the household level. Each column consists of positive and negative numbers accounting for the resource requirements and yields per unit of activity respectively. Activities in the model are limited to crop (cereals and cash crops) and livestock production. Potatoes, cabbage, beans, and onion are solely for sale while the cereals can be sold and/or used for consumption as staple food. Columns or activities can be grouped into 6 major categories:

1. Cropping activities (production, consumption, and selling) based on the two different cropping seasons;
2. Labor activities: There are two types of labor. One is domestic i.e., supply from one's own family/household (on farm, off-farm and leisure) and the second one is hired and/or sold labor. Available labor resources were calculated for the average household and were incorporated in the model. The resource units have been distinguished as adult males and females, adolescent males and adolescent females. Labor availability is considered in terms of man-days only. There exists no system of working in terms of labor hours. Normally a man-day is considered to extend from morning 6 am to 12 pm;
3. Livestock activities (production, selling, and consumption) consisting of different types of livestock.
4. Activities for accounting the future productivity impact of deforestation.

5. Crop storage is a necessity for the households in order to meet the food and seed requirements for the next season.
6. And any other non-farm activities.

5.4.1.2 Constraints Provided in the Model

The rows report the amount of unit required to perform each unit of activity. The constraints simply require that the sum of resources used to perform the activities included in any feasible solution be less than or equal to the amount of available resources. Rows or constraints can be grouped into 5 major categories:

1. Land (amount of land owned, rented or sharecropped available for each kind of use (agriculture, livestock, etc))
2. Labor (on farm, off-farm and leisure)
3. Cash (seasonal cash needs for fertilizers, pesticides, seed buying, hiring labor, and animal feed requirements)
4. Food (amount of food for the household (including special foods for children, and workers outside the household). Constraints on subsistence consumption were based on the household survey

The objective function maximizes the net annual income. The mathematical presentation of the non-separable farm household LP model can be written as follows:

Mathematical Presentation

$$\boldsymbol{MaxZ}= \sum_{j=1}^{n} - PL_j - Ps_j^i Se_j^i - Pf_j^z Fe_j^z - Pp_j^v Pe_j^v - Pl_j^k Li_j^k + Ps_j^i SCr_j^i + Pl_j^k SLi_j^k + PSFl_j$$

$$\forall \text{ i, z, v, k}$$

s.t.

First season

$$\sum_{i=1}^{6} LaCr^{i} + \sum_{k=1}^{3} LaLi^{k} \leq A$$

$$\sum_{i=1}^{6} Fl^{i} + \sum_{k=1}^{3} Fl^{k} + \sum_{j=1}^{n} SFl \leq TFl$$

$$\sum_{i=1}^{6} PL^{i} + \sum_{i=1}^{6} Ps^{i} Se^{i} + \sum_{z=1}^{4} Pf^{z} Fe^{z} + \sum_{v=1}^{2} Pp^{v} Pe^{v} + \sum_{k=1}^{3} Pl^{k} Li^{k} \leq C$$

$$\sum_{i=1}^{6} Tm^{i} - \sum_{i=1}^{6} Fl^{i} - \sum_{k=1}^{3} Fl^{k} - \sum_{i=1}^{6} L^{i} = 0$$

$$Q^{i} - Se^{i} \leq 0$$

$$Q^{v} - Pe^{v} \leq 0$$

$$Q^{z} - Fe^{z} \leq 0$$

$$-Li + SLi \leq 0$$

$$-PnCr_{j}^{i} + SCr_{j}^{i} + SeSt_{j}^{i} + CnCr_{j}^{i} \leq 0$$

$$-CaTr_{j} + CaTr_{j+1} \leq 0$$

$\forall$ i, z, v, k

Second season

$$\sum_{i=1}^{6} PL^{i} + \sum_{i=1}^{6} Ps^{i} Se^{i} + \sum_{z=1}^{4} Pf^{z} Fe^{z} + \sum_{v=1}^{2} Pp^{v} Pe^{v} + \sum_{k=1}^{3} Pl^{k} Li_{j}^{k} - CaTrj + CaTr_{j+1} \leq 0$$

$$\sum_{i=1}^{6} LaCr^{i} + \sum_{k=1}^{3} LaLi^{k} \leq A$$

$$\sum_{i=1}^{6} Fl^i + \sum_{k=1}^{3} Fl^k \leq TFl$$

$$\sum_{i=1}^{6} Tm^i - \sum_{i=1}^{6} Fl^i - \sum_{k=1}^{3} Fl^k - \sum_{i=1}^{6} L^i = 0$$

$$Q^i - Se^i \leq 0$$

$$Q^v - Pe^v \leq 0$$

$$Q^z - Fe^z \leq 0$$

$$-Li + SlLi \leq 0$$

$$-PnCr_j^i + SCr_j^i + SeSt_j^i + CnCr_j^i \leq 0$$

$\forall$ i, z, v, k

$$Fl, L, LaCr, LaLi, Tm, SLi, Li, Se, Fe, Pe, PnCr, SCr, CnCr, SeSt, Q,$$
$$CaTr, A, TFl \geq 0$$

Where,

j is the season identifier beginning at 1;

n is the number of seasons;

i is the agricultural crop (maize, beans, French beans, onion, cabbage, and potatoes);

k is the livestock (pigs, chicken, and turkey);

z is the fertilizer (12-12-20, 16-10-20, chicken waste, urea);

v is the pesticide (insecticide, fungicide);

Z is the objective function stated in Haitian Gourdes (1 US $ = 37.5 Haitian Gourdes);

Fl is the family labor stated in man-days;

TFl is the total family labor available;

L is the hired labor stated in man-days;

Tm is the total man-days required to produce one unit of activities

Q is the quantity of seeds, fertilizer or pesticides required during each season;

A is the amount of land available;

C is the amount of cash available;

Li is the livestock production (head of animal);

LaCr is the land used for crop;

LaLi is the land used for livestock;

PnCr is the production per crop;

CnCr is the quantity of crop used for consumption;

SLi is the livestock selling;

SFl is the family labor selling

SCr is the crop selling;

Se is the quantity of seed bought;

Pe is the quantity of pesticide bought;

Fe is the quantity of fertilizer bought;

SeSt is the quantity of seed stocked for next season;

TrCr is the transfer per crop;

P is the labor price;

Pl is the price of livestock

Pp is the pesticide price;

Pf is the fertilizer price;

Ps is the seed price

$CaTr_j$ is the transfer of beginning cash first season to the end cash first season;

$CaTr_{j+1}$ is the transfer of end cash first season to the beginning cash second season.

$Se, Fe, Pe, PnCr, SCr, CnCr, SeSt, Q$ are in kg;

The data for this chapter primarily originated from farm surveys conducted in the Forêt des Pins Reserve in summer 2000 and 2003 and from an existing long-term data base of the Centre de Formation et d'Encadrement Technique (CFET). Data related to crop yield in the research area also came from the experiments conducted on farmers' fields at Boucan Chat by the Ministry of Agriculture (2000-2001), and at Gros Cheval in 2001. Secondary sources such as other Centre de Recherche et de Documentation Agricole (CRDA), Projet d'Assistance Technique pour la Protection des Parks et Forêts monthly reports, and revue of literature were used to complement the collected data.

There is a large variation among farmers according to household composition, land holding, wealth, farm equipment, and their risk-bearing capacities. In the previous chapter, we have identified three major farm household groups. This functional classification is summarized as follows: a large-income farm *Type A* with at least 2.5 ha of land and a beginning cash of Gourdes 105,000 (US$ 2800), dependence on hiring labor for farming activities and almost daily spending of their time in on and off-farm activities; a middle-income farm household *Type B* with at least 1.9 ha of land available and dependence on remittances from family members; and a low-income farm household *Type C* with scarcity of land, beginning cash of Gourdes 17,000 (US$ 453), and dependence on selling labor activities as additional source of income. *Type A* and *Type C* are the focus of this study.

The model has been used to simulate the effects of some policy instruments (cross-compliance policies) for fertilizers and improved seed inputs on farm household welfare (net revenue) and conservation investments, conservation labor subsidies (cost sharing), and land tax and input price policies related to the importance of the crops to promote conservation. In the cross-compliance and labor policies, subsidies were linked to conservation (i.e. the peasant is eligible for program benefits if he/she accepts to reduce by 10 percent the amount of his/her agricultural land for reforestation purposes). A labor subsidy policy, paid per unit of labor used for conservation, was specified to subsidize the initial high cost of reforestation. The farmer is paid for the reforestation process, except for maintenance and protection against fire and animals. An estimated 1600 wildlings at Gourdes 5 (US$ 0.13) per wildling is required for 1 ha of reforestation. The total amount for the reforestation is Gourdes 8000 (US$ 213) per ha. Input prices were specified as a percentage of the 2002/2003 market prices. The amount of cash required for a farm household to simultaneously buy seeds, fertilizers, pesticides, and family needs for food and non-food items is Gourdes 105,000 and 17,000 for *Type A* and *Type C* respectively.

5.5 Results

The results of the simulation compared with known data are presented in Table 5.1. The 1999 CFET reports average farm sizes of 3.5 ha and 0.75 ha, respectively, for *Type A* and *Type C* households. On average, a *Type A* household allocates 3.2 ha to intercropping beans, French beans, potatoes, and maize, and 0.3 ha to cabbage and onion. The results of the simulation were 3.2 ha and 0.2 ha, respectively, for intercropping

beans, French beans, potatoes, and maize; and cabbage and onion. *Type C* households allocate 0.70 ha to intercropping beans, French beans, potatoes, and maize, 0.05 ha to cabbage. The simulation resulted in 0.73 ha and 0.02 ha, respectively, for intercropping beans, French beans, potatoes, and maize; and cabbage. The farm households are not really dynamic in their evolution and decision-making. Based on the 1999 CFET, it can be concluded that the model simulates the situation for both household *Type A* and *Type C* in the Forêt des Pins Reserve and can be used to test policy instruments.

Table 5.1 Allocation of land to different crops by *Type A* and *Type C* farm households in the Reserve

Intercropping/Crops	LP simulation		CFET 1999	
	Type A	*Type C*	*Type A*	*Type C*
Intercropping (Maize, Potatoes, Beans, French Beans	3.2	0.73	3.2	0.70
Cabbage	0.1	0.02	0.15	0.05
Onion	0.1	-	0.15	-

5.5.1 Effects of land tax on agricultural land

The model was run to evaluate the effects of a land tax on agricultural land use (Table 5.2). In response to the land tax, farm households adjust their land use and cropping patterns. Results are given for the two household types distinguished: large-farm household income (*Type A*) and low-farm household income (*Type C*). The difference between both household types refers to the availability of resources (cash, labor, and farm size). The net annual income based on the base-run simulation of the model for *Type A* and *Type C* is Gourdes -5747 and 5,552 respectively (Table 5.2). For both *Types A and C*, a land tax will induce conservation by decreasing the amount of land use for agriculture. As a result, the land tax has further diminished possibilities for buying

more seeds and labor for agricultural purposes. Income also decreases with the introduction of land taxation. Thus, when investment in input becomes a difficult alternative, the introduction and rise of land tax are compensated by a decrease in the area of agricultural land. As returns to farm household fall and threaten livelihood, the household also cuts its leisure time and increases on-farm labor supply until the seasonal constraints are binding. For *Type A*, increasing the tax from 35 Gourdes/ha to 100 Gourdes/ha results in land conversion decreases ranging from 0.08 ha and 0.58 ha compared to the initial value from the base-run plan.

Table 5.2 Incentive effects of a land tax and a 10% tax on the input price of a cash crop on land use

	Type	Base-Run	Land Tax (Gourdes/ha)						Input Potato Price
			35	40	45	50	75	100	(+10%)
Land conversion (ha)	A		0.08	0.11	0.14	0.17	0.36	0.58	0.18
	C		0.16	0.17	0.18	0.19	0.24	0.30	0.21
Land conversion (%)	A		2.6	3.4	4.2	5.2	11.1	18.1	5.6
	C		18.8	22.1	20.7	22.3	28.2	35.2	24.7
Net income (Gourdes)	A	-5747	-8824	-9731	-10740	-11845	-18556	-26583	-7389
	C	5,552	5065	4983	4892	4793	4216	3571	6028

When the land tax was raised to Gourdes 75/ha, there was a decrease of land use for agriculture of 11 percent. *Type A* also suffered some monetary reduction and achieved an 87% decrease of the farm household net income for the raised land tax (Gourdes 50/ha). A rise of land tax above Gourdes 75 forces the household to switch crop labor onto expanding livestock size until the land and labor constraints are binding. Introduction of a land tax resulted also, for *Type C*, in a decrease of the agricultural land

use and income relative to the base-run case. A land tax seems effective in abating forest degradation by reducing the amount of agricultural land use, although the actual mechanism to implement such policies may be difficult. Decreases in net annual income for both *Types A* and *C* may also reduce the social acceptability of this approach.

5.5.2 Effect of pricing policies

This scenario examines the effect of increasing by 10% the price of a major cash crop (potato) on farm household welfare and sustainable land use (Table 5.2). The model predicts for *Type A* that the net income level decreases from Gourdes -5,747 (base-run plan) to Gourdes -7,389 at current price levels representing a decrease of 28 percent. The area under agronomic crops decreases by 10% compared to the area used in the base run model. The fall in income reduces the consumption of hired labor by up to 3%. Since Beans is not a substitute for potatoes and due to the fall in income, the consumption of beans also decreases by up to 2%. The price policy also decreases in marketed supply in potatoes. Thus, beans substitute in the market output of potatoes. The decrease in marketed surplus of potatoes may have an eventual effect of driving up potato prices. The increase supply in beans may also reduce its own price. For *Type C*, the model predicts that the net annual income increases from Gourdes 5552 (base-run model) to Gourdes 6028 representing an increase of 8%. The input potato price forces the households to switch on-farm labor to selling labor until the labor constraint is binding. A 10% increase in input potato price seems to be more efficient for *Type C* than *Type A*. A decrease in net annual income may reduce the social acceptability of this approach for *Type A* farmers.

5.5.3 Effects of cross-compliance policies

The model was run to examine the impact of cross-compliance policies for fertilizers and improved seeds on farm household welfare and conservation investments (Table 5.3 and 5.4). This scenario introduces a subsidy on the installation costs of agricultural crops but, at the same time, reduces by 10% the amount of agricultural land for reforestation. In the base-run, the net annual income is negative (Gourdes -5747) for *Type A*, indicating that agriculture is not a valuable economic activity in the area. When conservation reduces agricultural land by 10%, for *Type A*, the net income is positive beyond about 50 percent of the price of fertilizer, or improved seeds is covered through the subsidy. To the contrary, for *Type C*, the net income is positive at any level of subsidy for fertilizers and improved seeds. Farm household net income increased relative to the base-run plan by 35% for a 5% fertilizer subsidy for *Type C*. Increasing the level of the subsidy for fertilizers to 50 and 75 percent raises net income 49 and 58 percent respectively.

Table 5.3 Incentive effects of fertilizer subsidies on forest conservation.

	Type	Fertilizers					
		5	**10**	**25**	**35**	**50**	**75**
Net income	A	-6811	-5783	-2697	-639	2449	7593
	C	6376	6564	7162	7590	8282	8784
Present value	A	424500	426725	433406	437861	444546	455681
revenues	C	98646	99053	100347	101274	102772	103858
Present value	A	460444	458708	453497	450022	444808	436122
Costs	C	73290	72972	71963	71240	70072	69224
Benefit/costs							
i = 0.05	A	0.92	0.93	0.96	0.97	1.00	1.04
	C	1.35	1.36	1.39	1.42	1.47	1.50
i = 0.1	A	0.65	0.64	0.66	0.67	0.70	0.73
	C	1.12	1.14	1.21	1.26	1.36	1.43
i = 0.2	A	0.53	0.52	0.54	0.55	0.57	0.60
	C	0.95	0.94	0.97	0.99	1.03	1.06

While for the same 5% fertilizer subsidy, the net income for *Type A* decreased by 22% compared to the base-run model. The benefit-cost ratios for 50-75% fertilizer or improved seed subsidies show that, considering a 5-year cash flow schedule, the policy instrument for *Type A* will not increase net social benefits unless the social rate of discount is close to 5%. At the rate of discount of $i \geq 0.1$, the policy instrument is unlikely to be socially profitable for *Type A*. Only a lowering of the social rate of discount could make the instrument a Pareto improvement. It requires for *Type A* 75% of the improved seed subsidy, at $i \leq 0.05$ to induce some conservation behavior. To the contrary, the policy is socially profitable for *Type C* for any fertilizer and improved seed subsidies at the rate of discount of $i \leq 0.2$. Since switching into a conserving practice lowers immediate income, it requires at least a 50% fertilizer subsidy for *Type A* before the instrument could have a significant impact on land use. The net annual income for *Type A* increases progressively from Gourdes -5747 without the subsidy to Gourdes 4207 with 75% subsidy. Since the linked seed subsidy relaxes the credit constraint, the returns to the policy instrument increase with the level of the subsidy.

Table 5.4 Incentive effects of improved seed subsidies on forest conservation.

	Type	Improved Seeds					
		5	**10**	**25**	**35**	**50**	**75**
Net income	A	-7037	-6233	-3825	-2219	191	4207
	C	6328	6464	6894	7196	7672	8562
Present value	A	371434	372958	377522	380566	385134	392746
revenues	C	98542	98836	99767	100421	101451	103378
Present value	A	491254	486798	473454	464553	451198	428942
Costs	C	73306	73012	72081	71427	70397	68470
Benefit/costs							
i = 0.05	A	0.92	0.92	0.95	0.96	0.98	1.02
	C	1.34	1.35	1.38	1.41	1.44	1.51
i = 0.1	A	0.63	0.64	0.65	0.66	0.68	0.71
	C	1.12	1.13	1.18	1.22	1.27	1.40
i = 0.2	A	0.53	0.52	0.53	0.54	0.55	0.58
	C	0.93	0.94	0.96	0.97	1.00	1.04

5.5.4 Effects of a mix of improved seed and fertilizer contracts linked to conservation

Table 5.5 summarizes the effect of a mix of fertilizer and seed subsidies. When conservation reduces the amount of agricultural land by 10%, for both *Types A* and *C*, a 25% seed subsidy was combined with different levels of fertilizer subsidies. Although the 25% subsidy alone brought a negative net annual income for *Type A*, combining it with a fertilizer subsidy of 25%, 50%, and 75% raised the net annual income by 122%, 212%, and 446% respectively. At $i \leq 0.1$, the combination of seed and fertilizer subsidies (25-75) are socially efficient, but the combinations 25-25 and 25-50 scenarios were only marginally so. For *Type C*, the policy instrument is socially efficient for any combination of seed and fertilizers subsidies at $i \leq 0.1$. The policy instrument increases net annual income for *Type A* from -5747 Gourdes without the subsidies to 19921 Gourdes with the 25-75 seed-fertilizer subsidies.

Table 5.5 Incentive effects of a mix of improved seed and fertilizer agreements linked to conservation

	Type	Improved seed and fertilizer subsidies (%)		
		25-25	25-50	25-75
Net income	*A*	1319	6463	19921
	C	7972	8994	9622
Present value	*A*	442099	453235	482368
revenues	*C*	102101	104313	105672
Present value	*A*	444494	433358	404225
costs	*C*	69747	67535	66176
Benefit/costs				
i = 0.05	*A*	0.99	1.05	1.19
	C	1.46	1.54	1.60
i = 0.1	*A*	0.87	0.95	1.24
	C	1.31	1.46	1.57
i = 0.2	*A*	0.69	0.72	0.83
	C	1.01	1.07	1.10

In most cases, *Type A* can react by getting back their land parcels that were traditionally rented out under the sharecropping system. These results support the prediction that the adoption of a positive policy instrument will hurt the small farmers who relied on sharecropped system as additional source of income (Pierre 2000).

5.5.5 Effect of cost sharing

The results for the cost-sharing policies for *Types A* and *C* farm households are presented in Table 5.6. When conservation decreases the amount of agricultural land by 10%, for *Type A*, the net income is positive once the labor subsidy is covered by at least 5 Gourdes/man-day. This amounts to 113% of the total cost of reforestation program. Therefore, the cost sharing policy failed to induce conservation unless the contract covers more than the entire investment cost. This is because investing labor in conservation becomes unprofitable unless the incentive payment is large enough to compensate for the lower initial yields. Increase in the labor subsidy to 5, 10, and 15 Gourdes/man-day raised the net annual income 218%, 260%, and 371%, respectively. For *Type A* at $i \leq 0.1$, all levels of the labor subsidy are efficient when the labor subsidy is covered at 5 Gourdes/man-day or more. For *Type C* at $i \leq 0.1$, the policy instrument is socially efficient for any coverage of the labor subsidy. For *Type C*, net annual income increased progressively from 5552 Gourdes without subsidy to 6608 Gourdes with a 2.5 Gourdes/man-day labor subsidy representing an increase of 19%. For *Type A*, however, the net income has an increase of 23% for the same level of labor subsidy.

Table 5.6 Incentive effects of a cost sharing policy on conservation

	Type	Labor subsidy				
		2.5	4.5	5	10	15
Net income	*A*	-4377	-711	6783	9217	15629
	C	6608	6960	7050	8024	8784
Present value	*A*	429769	437705	456837	459197	473077
revenues	*C*	99148	99910	100105	102213	103858
Present value	*A*	456824	448888	427470	427397	413516
costs	*C*	72700	71938	71743	69635	67990
Benefit/costs						
i = 0.05	*A*	0.94	0.98	1.07	1.07	1.14
	C	1.36	1.39	1.40	1.47	1.53
i = 0.1	*A*	0.79	0.84	1.00	1.04	1.13
	C	1.15	1.19	1.20	1.32	1.43
i = 0.2	*A*	0.65	0.67	0.74	0.74	0.79
	C	0.94	0.96	0.97	1.02	1.06

5.6 Conclusions and Policy Implications

The simultaneous rate of rapid population growth and stagnation of agriculture yields in large parts of poor countries, particularly in Haiti, have caused a steady decline in food production per capita, and a deterioration of the resource base (Pinstrup-Andersen 1994). It has been estimated that more than 60 percent of the Haitian population depends on agriculture for subsistence. The failure of this sector to keep pace with the increased population and the eradication of the indigenous pigs (Cochon Creole) has provoked disturbing changes in the farm household system: drastic reduction of peasant saving capacity and accelerated soil erosion. Peasants are left with very limited options for tree growing and soil replenishment with predictable consequences: increased soil erosion, flooding, declining soil fertility, and decreasing yields per hectare.

Several attempts to abate the forest degradation problem through conservation subsidies in the past have often fallen short of expectations (Lutz et al. 1994; Pierre-Louis 1989). Conservation may, for example, create perverse incentives: so that to qualify for subsidies, farmers may increase deforestation by cultivating land that may not have been cultivated. Subsidies may also modify behavior as long as they are continued. Thus, a subsidy proposal needs to be designed carefully and in close cooperation with local people to ensure that they have the motivation and capacity to carry their share of the responsibility. The proposed farm household modeling combines agro-ecological and socio-economic elements into an integrated analytical framework, where farm household decisions are considered key components. It is at the household level that the final decisions are made about land use, crop and policy choice, production and consumption. This chapter was undertaken with the purpose of evaluating whether changes in policy instruments may induce Forêt des Pins Reserve farm households towards more sustainable land use while maintaining or improving their welfare.

The modeling results indicate that the interlinkage production subsidies with forest conservation can provide opportunities for facing land degradation-induced productivity declines without adverse impact on the welfare of the people. Such policy instruments, may, therefore, represent improvements in efficiency, equity, and environmental quality. However, if conservation practices reduce farm household income, fertilizer and seed subsidies linked to conservation failed for *Type A* to be efficient unless the social rate of discount is less than equal 0.05. A mix of seed and fertilizer subsidies were, however, more efficient since they facilitate substantial

increases in net annual income. If the social rate of discount is as high as 20%, such economic incentives also become socially inefficient for both *Types A* and *C*.

At low discount rates, the cost sharing (labor subsidy) policy for *Type A* was inefficient until the labor subsidy is covered at 5 Gourdes/man-day. When peasants anticipate lower or the same returns from switching into a conservation regime, lower yields and/or substantial installation costs prohibit farm households from investing in sustainable conservation methods. It also suggests that policies to enhance forest conservation should look for cost-effective methods which serve the dual purpose: forest conservation and higher yields. When this is lacking, society may have to look for other incentives to persuade the land users to install conservation practices.

Moreover, the efficiency of economic incentives for conservation depends on the future productivity impacts of current forest degradation, the social rate of discount and the productivity effects of conservation measures. A decrease in discount rates and an increase in the productivity of conservation measures improve the efficiency of policy interventions. Areas for future research include investigating how agroforestry development and/or reforestation may influence farmers' responsiveness to incentive contracts, and how they are likely to achieve long-term sustainable benefits. When economic benefits are low, farmers either fail to adopt the recommended practices or abandon them once the subsidized projects are phased out (Lutz et al. 1994; Reddy et al. 2001).

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

This study was undertaken with the purpose of addressing the effects of social, economical, and institutional dynamics of land use change and evaluating the role of different policy instruments for forest conservation in Forêt des Pins Reserve. Specifically, this study was concerned about: 1) exploring farmers' perceptions on the impact of the Forêt des Pins Reserve on the economic, social and environmental status of local people; 2) analyzing the socioeconomic, and institutional factors that contribute to forest depletion in Forêt des Pins Reserve; 3) exploring an approach for the construction of a farm household income typology in Forêt des Pins Reserve; 4) developing a farm household model for analysis of resource use and conservation decisions of farmers established in Forêt des Pins Reserve; 5) and investigating options for sustainable land use on small farms through the design of farming systems that meet the environmental and socioeconomic objectives.

First, it was hypothesized that perceptions of Forêt des Pins Reserve respondents about forests would be different according to their age, gender, place of birth, land tenure, education level, income level, and organizational membership. Through a series of structural equations model tests, we found evidence of farmers' perceptions differences with respect to the relationship between the socioeconomic variables and perceived importance of forest benefits. Respondents who indicated that they were members of

local groups were more favorable toward the social and economic objectives in promoting forestry activities inside the Reserve. More informed individuals apparently were better able to assess the potential impacts of forestry programs on their farming operations (Portes 1971; Gregersen et al. 1989). Farmers who are not members of a local group and not well informed about forestry programs may overvalue the costs and underestimate the benefits. Such a situation would explain negative attitudes of farmers to the Reserve.

The results strongly suggest that farmers most value economic and environmental objectives in promoting forestry programs inside the Reserve. In addition to jobs and money from the forest activities, farmers do care about the natural environment to help them get complete life-style benefits. Much literature regarding protected areas management argues for a focus on both economic and non-economic values (Vining 1993). This is very encouraging because 45 percent of the forestlands are in agriculture and highly erodible (Rousseau 2000).

This study provides evidence that people grant considerable importance to economic and environmental objectives such as tourism and tree planting activities, contrasting the official government point of view stipulating that farmers are in opposition to forest conservation (Dolisca 2001). Future research should be conducted that examines local economic alternatives for the Reserve that will have both a development impact and serve as conservation incentives.

Second, we hypothesized that there is a link between socioeconomic and institutional attributes to deforestation in the Reserve. The results of the Tobit analysis indicate strong evidence that household size, education of the head of the household, land

tenure regime, farm labor, and length of residency are important factors affecting land clearing. However, we erred on the effect of land efficiency and age.

The analyses provide empirical support for the Malthusian idea that population growth contributed to high rates of deforestation. The significance of the demographic variable (*Hsize*) suggests that growing peasant populations are largely responsible for deforestation inside the Reserve. More educated farmers are more likely to cause less forest clearing perhaps. Although there is nothing wrong with education approaches to improve farmers' understanding of the value of preserving forests, but such programs have been disappointing in their results. The problem is that that whereas education may be a necessary condition for behavioral change (differential socialization), it is by no means a sufficient one. Improving the flow of information to a decision maker may not be a necessary condition to increase his or her capacity to act on it. A poor farmer, for example, may know about fertilizers, improved seeds, without being able to gain access to them to practice sustainable farming methods.

Policies designed to improve land tenure system are essentially policies to reduce the problem of deforestation. As the above findings show, untitled farmers deforested more than those with title. The combination of insecure tenure and the availability of free land encourage farmers to minimize the costs of occupation by turning to premature deforestation. The results suggest that introducing clear property rights is essential to establish greater responsibility for land use. In addition to this, there is a strong need to develop off-farm activities (forest conservation practices, floriculture, and handicrafts) that provide immediate benefits to poor households. Enhancing the welfare of people can

do much to encourage farmers to invest in their children's education and seek more alternative sources of off-farm employment (Pichon 1997a).

Most of farm households in Forêt des Pins Reserve do not have access to credit facilities. Institution of incentive structures to promote conservation efforts may include linking farm subsidies and credit facilities with conservation. In the long-term, the need to ease subsistence pressure requires, among other things, development of the non-agricultural sector (e.g. ecotourism), control of population growth, and improvement of the education quality inside the Reserve. Specific policies addressing the constraints and limitations of peasants through technical change, development of rural markets, and provision of appropriate incentives are required. Further research is needed to investigate the most efficient ways of promoting forest conservation.

The third hypothesis is that farm households in Forêt des Pins Reserve are not a homogeneous group in terms of their socioeconomic and demographic characteristics and that definable and interpretable groups could be identified using cluster analysis. The results of the cluster analysis demonstrated that farm households in the Reserve are indeed a heterogeneous group. Their conditions are sufficiently diverse that the farmers can be statistically clustered based on their socioeconomic situations. Cluster analysis for this sample produced three distinct groups of farmers. Although the three clusters do not account for all variation among socioeconomic profiles, it is obvious that three categories of farmers provide sufficient evidence that farm households form a heterogeneous group. These three groups are not only distinguishable by their pattern of economic level but also by demographic variables.

Finally, analysis was undertaken with the purpose evaluating whether changes in policy instruments may induce Forêt des Pins Reserve farm households towards more sustainable land use while maintaining or improving their welfare. The modeling results indicate that the interlinkage production subsidies with forest conservation can provide opportunities for facing land degradation-induced productivity declines without adverse impact on the welfare of the people. Such policy instruments, may, therefore, represent improvements in efficiency, equity, and environmental quality. However, if conservation practices reduce farm household income, fertilizer and seed subsidies linked to conservation failed for *Type A* to be efficient unless the social rate of discount is less than equal 0.05. A mix of seed and fertilizer subsidies were, however, more efficient since they facilitate substantial increases in net annual income. If the social rate of discount is as high as 20%, such economic incentives also become socially inefficient for both *Types A* and *C*.

At low discount rates, the cost sharing (labor subsidy) policy for *Type A* was efficient until the labor subsidy is covered at 5 Gourdes/man-day. When peasants anticipate lower or the same returns from switching into a conservation regime, lower yields and/or substantial installation costs prohibit farm households from investing in sustainable conservation methods. It also suggests that policies to enhance forest conservation should look for cost-effective methods which serve the dual purpose: forest conservation and higher yields. When this is lacking, society may have to look for other incentives to persuade the land users to install conservation practices.

Moreover, the efficiency of economic incentives for conservation depends on future productivity impacts of current forest degradation, the social rate of discount and

the productivity effects of conservation measures. A decrease in discount rates and an increase in the productivity of conservation measures improve the efficiency of policy interventions. The user costs depend on the crop yield-deforestation relationship, input prices and the rate of discount. Increase in prices and a decrease in the discount rates also raise the user costs. Moreover, taxing the most cash crops (potatoes) is more effective in abating deforestation. Areas for future research include investigating how agroforestry development and/or reforestation may influence farmers' responsiveness to incentive contracts, and how they are likely to achieve long-term sustainable benefits.

The role of environmental cross compliance as an incentive for conservation is promising with multiple land use practices that combine the objectives of maximizing farm households' net income and maintaining forest environment. Several studies of forest benefits from community-based forest management in the Philippines suggest that community investments in reforestation are likely to achieve long term sustainable benefits (Johnson 1998; Johnson 1993).

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APPENDIX

POPULATION PRESSURE, LAND TENURE, DEFORESTATION, AND FARM SYSTEMS IN HAITI: THE CASE OF FORET DES PINS RESERVE

Household Survey Questionnaire

***Purpose*:** This survey is designed to investigate the factors that influence deforestation in Haiti, particularly in Forêt des Pins Reserve and to explore options for sustainable land use on small farms through the design of farming systems that meet the environmental and socioeconomic objectives. The survey is divided into four sections, each section covering different subjects. In section one; the survey seeks information on the demographic characteristics (age, sex, education, relationship with the head of the household, sanitation facilities). Section two concentrates on the economic activities in the reserve (system of production, forest activities, livestock, and other sources of income). Section three deals mainly with activities related to participation. The survey concludes with questions of general interests.

Date: *Village:* *Code number:*

Interviewer: *Head of household:*

SECTION ONE

Demographic Characteristics:

Characteristics of the head of the household:

1. – Laj Moun kap reponn: /_____/

2. - Seks moun kap reponn:

a) ----------Gason b) --------- fanm

3. – Konbyen ane ou pase lekol: /_____/

4. – Depi konbyen tan ou rete nan forè dè pen? /_____/

5. – Eske ou:

a) ---------- Celibatè b) ------marye c) ---- divòse

d) ------vèf e) -------plase f) ----lòt (eksplike) ----------

6. – Eske ou ka pale nou de lòt moun kap viv avek ou nan eksplwatasyon an?

Non	Seks	Laj	Ane lekòl	Ki lekol	Relasyon ak chèf la	Ki kalite travail lap fe	Ki kantite kòb li fè pa mwa

7. – Kek depans nan eksplwatasyon nan ane sa-a?

Non	Depans/ane					
	Edikasyon	1st Kominyon	Rad	Doctè	Maryaj	Lòt

9. – Ki kalite groupman ou jwenn nan lokalite-a?

a) ------- Groupman kap regle zafe anviwònman
b) ------- Ti Komès
c) ------- Groupman kin an zafe edikasyon
d) ------- Groupman plantè
e) ------- Groupman fanm
f) -------- Lòt (eksplike) ----------

10. – Eske ou se yon manb nan yon groupman?

a) ---------- Wi b) ---------- non; si li di non, ale nan # 12

11. – Ki posisyon ou okipe nan groupman si la?

a) ----------Prezidan
b) ---------- Vis prezidan
c) ----------Secretè
d) ----------Trezorye
e) ----------Konseye
f) ----------Semp manb
g) ---------- Lòt (eksplike) ----------

12. – Okipasyon ou nan lokalite-a ki pa agrikilti

a) ---------- Chapentye b) ---------- Mason c) ----------Tayè

d) ---------- Pastè e) ---------- Komesan

f) ----------Lòt (eksplike) ----------

SECTION TWO

Economic activities

Factors of production

Tè

13. – Eske ou ka pale nou de tè ou travay sou yo-a?

# Pasèl	Kantite deklare			Kantite (cx)*			Depi konbyen tan ou sou li	Ki kote li ye	Eske ou ka vann li (wi ou non)	Eske ou ka pase li bay lòt pitit (wi ou non)
	1996	2003 (1)	2003 (2)	1996	2003 (1)	2003 (2)				

*: To be measured

(1): Size of the plot including area planted under trees and area of forest cleared
(2): Size of the plot including only area of forest cleared

13. – (Swit)

# Pasèl	Tenure						
	Achte	Eritye	Kado	Fèm leta	Fèm nan men lòt moun	Demwatye	Tè ilegal

14. – Characteristiques des Parcelles

# Pasèl	Pant [1]	Elevation	Kalite sol	Degree of deforestation[2]	Kilti	Degree of erosion[3]

[1:] 0-3, 3-5, 5-8, 8-16, 18-30, 30-35, 35-40, 40-50 and >50 percent

2: *Very high, high, average, low*

[3:] Very eroded, fairly eroded, slightly eroded, no erosion problem

15. – Si nap compare kantite tè wap travay konn ya ak kantite ou te genyen 5 ane de sa, eske li?

a) ----------Ogmante b) ---------diminye c) ---------- mèm kantite

If ogmante oswa diminye, di nou pou ki sa?

16. – Eske ou te gen tè ou te konn travay avan andedan forè-a ke ou abandonnen konnye la?

a) ---------wi b) --------non; si non ale nan # 19

17. – Pou ki rezon ou te abandonnen tè avan yo?

a) ------- Pèdi fètilite'l
b) ------- Li pa ka travay ankò
c) ------- Ministè agrikilti pran li
d) ------- Kontra mwen te gen ak met li te fini
e) ------- Lòt (eksplique) ----------

18. – Tè yo ou te abandonnen an ki sa yo devni?

a) --------- Yo plante bwa sou yo b) -------- yo pa ka fe anyen anko
c) --------- li gen brosay sou li d) ----- lòt (eksplike) ----------

Kantite tan ak depans nan jaden

19. – Eske ou ka di nou ki kantite tan ak depans ou pase nan jaden?

Pasèl # ---------- Kantite tè pou jaden an: sezon:

Kilti oswa Asosyasyon:	Main d'oeuvre familiale (homme-jours)				Main d'oeuvre exterieure (homme-jours)		Manje+kleren			
Aktivity	Adultes gason	Adultes fanm	Timoun gason	Tim oun fanm	Achte	Gratis	Dejene	dine	Klerenak lòt	Qte
Preparasyon sòl										
Plantasyon										
Semans										
Angrè òganik 1										
Aplikasyon 1										
Angrè òganik 2										
Aplikasyon 2										
Angrè mineral 1										
Aplikasyon 1										
Angrè mineral 2										
Aplikasyon 2										
Insèkticid 1										
Insèkticid 2										
Fongicid 1										
Saklaj 1										
Saklaj 2										
Rekòlt										
Sechaj										

Stokaj										
Vant										

*: Ti moun: moun ki gen laj pi ba ke 18 an.

Zouti

20. – Ki kalite zouti ou genyen nan eksplwatasyon an?

a) -------- Manchèt b) -------- Houe c) ---------Hache

d) -------- Pikwa-derapin e) -------- Pomp f) -------- Kouto digo

g) ---------Lòt (eksplike) ----------

21. – Eske ou ka di nou konbyen kòb ou depanse pou zouti sa yo?

Zouti	Achte			Lwe	
	Pri	Depi ki lè	Konbyen tan li ka dire?	Pri	Pou konbyen tan?
Manchèt 1					
Manchèt 2					
Manchèt 3					
Houe 1					
Houe 2					
Houe 3					
Hache 1					
Hache 2					
Pikwa 1					
Pikwa 2					
Pomp 1					
Pomp 2					
Kouto digo 1					

Kouto digo 2					

Elevaj

22. – Eske ou ka pale nou sou elevaj ou?

	Kantite achte						Main d'oeuvre familiale (è/jou)			
	Piti	kou	Mwayen	Pri	Gro	Pri	Adultes gason	Adultes Fanm	Ti moun gason	Ti moun fanm
Kochon										
Poul										
Kòk										
Kòdenn (mal)										
Kòdenn (femèl)										
Kabrit (mal)										
Kabrit (femèl)										
Cheval										
Bourik										
Mulèt										
Bèf (mal)										
Bèf (femèl)										

* Ti moun: moun ki gen laj pi ba ke 18 ane

23. – Eske ou ka di mwen konbyen kòb ou depanse pou pran swen bèt sa yo?

Ki kalite	Manje/mwa			Swen sante/mwa			
	Kalite	Kantite	Pri pou yonn	Kalite	Kantite	Pri pou yonn	Teknisyen Veterinè (Pri M.O.)
Kochon							
Poul							
Kòdenn							
Kabrit							
Cheval							
Bourik							
Mulèt							
Bèf							

Aktivite Forè

24. – Kalite aktivite fore ou konn patisipe:

Aktivite	Main d'oeuvre (jou/mwa)				Kantife kòb ou fè ane sa-a	Kantite kòb ou te fè ane pase
	Adultes Gason	Adultes Fanm	Timoun gason	Timoun Fanm		
Collection des produits non ligneux						
Operation de netoyage						
Operations d'elagage						
Production d'arbres de Noel						

Activites de Plantation						
Amenagement sentier						
Lutte contre le feu						

25. – Ki kalite "produits non ligneux" ou konn colèkte?

a) -------Plantes medicinales b) -------bois de feu c) --------fruits

d) --------semans pen e) ---------- Bwa gra f) -----lòt (eksplike) ----------

26. – "Produits non ligneux" sa yo eske se pou:

Kalite	Mache?	Pou lakay?
Plantes medicinales		
Bois de feu		
Fruits		
Semences de Pins		
Bwa gra		

27. – Si se pou mache ki kote ou vann yo?

a)----Foret des Pins b)----Thiotte c)----Fonds Verrettes d)----Port-au-Prince

e)----- Lòt (eksplike)----------

<u>Prodiksyon</u>

28. - Kilti

	Kantite rekòlte	Kantite vandi	Kantite stoke
Pasel #			
Mayi			
Chou			
Pwa rouj			

Pwa nwa			
Pwa Frans			
Pòm de tè			
Pasel #			
Mayi			
Chou			
Pwa rouj			
Pwa nwa			
Pwa Frans			
Pòm de tè			
Pasel #			
Mayi			
Chou			
Pwa rouj			
Pwa nwa			
Pwa Frans			
Pòm de tè			

29. - Elevaj

Kalite	Kantite disponib			Vant					
	Piti	Mwayen	Gwo	Piti		Mwayen		Gwo	
				Kantite	Pri	Kantite	Pri	Kantite	Pri
Kochon									
Poul									

Kok									
Kòdenn (mal)									
Kòdenn (femèl)									
Kabrit (mal)									
Kabrit (femèl)									
Cheval									
Bourik									
Mulèt									
Bèf (mal)									
Bèf (femèl)									

30. – Ki kalite pwoblèm ou rankontre nan jaden jodi-a?

a) ------- Semans b) -------Zouti c) -------Kantite tè twò piti

d) -------Pa gen sekirite nan tè e) ------- Ensèkticid f) ------- Fongicid

g) -------Angrè h) -------Moun pou travay j) -------Erozyon sòl

31. – Ki kalite pwoblèm ou rankontre nan elevaj jodi-a?

a) -------Manje pou bèt b) ------ Maladi bèt

c) ------- Medikaman pou bèt pa disponib d) -------Lòt (eksplike) ----------

32. – Si wap compare pwoblem sa yo ak pwoblèm ou te konn rankontre 5 ane avan eske yo

	Ogmante?	*Diminye?*	*Rete menm jan?*
Semans			

Zouti			
Kantite tè twò piti			
Insekirite nan zafè tè			
Ensèkticid			
Fongicid			
Angrè			
Moun ki pou travay			
Manje pou bèt			
erozyon sòl			
Maladi bèt			
Medikaman pou bèt pa disponib			

33. – Eske ou ta renmen pran mezi pou redwi erozyon sòl yo?

a) ------- wi b) ------- non; si non, ale nan # 40

34. – Ki kalite mezi ou ta renmen pran?

a) --------- Mi sèk b) --------- Culture en couloir c) --------- Haies vives

d) --------- Canal Contour e) --------- Terraces f) --------- Lòt (eksplike) -----

35. – Eske ou gen jaden anba pye pen?

a) ------- wi b) -------- non; si non ale nan # 43

36. – Pou ki rezon ou fè jaden anba pye pen?

a) -----kalite kilti-a b) ------bezwen plis tè c) ------ Regulations

d) ---- tradisyon e) -------- Lòt (eksplike) ----------

37. – Ki kilti ki ka plante anba pye pen?

a) ------- Mayi b) ------- Pòm de tè c) ------- Chou

d) ------- Pwa rouj e) ------- Pwa nwa f) ------- Pwa frans

g) -------Lòt (eksplike) ----------

38. – Kilès nan kilti sa yo ou bezwen plis tè pou ou ka jwenn yon bon randman?

a) ------- Mayi b) ------- Chou c) --------Bwa rouj

d) --------Pwa nwa e) --------Pwa frans f) -------- Pòm de tè

g) ------- Lòt (ekplike) ----------

39. – Eske ou ka di nou pou ki sa ou bezwen plis tè pou kilti sa-a?

Kilti	Reasons							
	Fètilite tè yo bese	Vin gen plis moun pou nouri	Vin gen plis lajan ki rantre nan Kay la	Vin gen plis moun pou travay	Vin kredi ki disponib	Nou vin gen èd de ONG	Nou vin gen èd de MARNDR	Lòt (eksplike soup le)
Mayi								
Chou								
Pwa rouj								
Pwa nwa								
Pwa frans								
Pòm de tè								

40. – Eske ou konn jwenn èd nan men ONG?

a) ------wi b) -----non; si wi, eksplike ki kalite èd----------

41. – Eske ou konn jwenn èd nan men MARNDR?

a) ------wi b) -----non; si wi, eksplike nou ki kalite èd----------

42. – Eske ou konn jwenn èd pou fè jaden?

a)-----trè souvan b)----souvan c)-----pafwa d)-----rareman e)-----jamais

43. – Eske ou konn jwenn kredi pou fè jaden?

a) --------wi b) ----------non, si non ale nan # 51

44. – Ki kote ou konn jwenn kredi?

a)--------ONG b)--------MARNDR

c)-------Lòt (eksplike) ----------

45. – Konbe kòb ou te prete ane ki sot pase-a?

Enstitisyon	Kantite prete	Pou konbe tan	Enterè ou te peye
ONG			
MARNDR			

Oganizasyon pou travay

46. – ki kalite òganizasyon pou travay nou gen nan lokalite-a?

a) ------Kombit b) ----- Escouad c) -----Lòt (eksplike) ----------

47. – Eske ou fè pati nan yonn nan òganizasyon sa yo?

a) ---- Kombit b) ----Eskouad c) ------- Lòt (eksplike) ----------

48. – Depi konbe tan ou nan òganizasyon sa-a? /_____/

49. – Eske ou ka di nou moun kap vann jouden kote yo soti?

a) -----Andedan fore-a b) ----Andeyò fore-a, eksplike ----------

<u>Transpò prodwi nan mache</u>

50. – Eske transpòte rekòlt jaden nan mache jodi-a

a)----trè fasil b)----fasil c)----difisil d)----trè difisil?

51. – Eske mwayen yo transpòte jodi-a vin pi bon lè wap kompare li ak 5 ane ki sot pase-a?

a) ----anpil b) ----yon ti kras c) ----preske pa d) ----pa di tou

52. – **Lòt sous ou fè lajan**

Sous	Main-d'ouvre familiale (jou/mois)				Kantite kòb li fè pa mwa
	Homme-jou	Femme-jou	Timoun-gason/jou	Timoun-fanm/jou	
Semans pen					
Plantes medicinales					
Bwa di fe					
Fri					
Bwa gra					
Vann jounen nan jaden lòt moun					
Chapant					
Mason					
Rebwazman					
Repare wout					
Ab de Noel					
Ti komès					
Pastè					
Tayè					
Don					

SECTION THREE

Patisipasyon

53. – konbe manb ou genyen nan òganizasyon ou ye-a /_____/

54. – Konbe moun nan eksplwatasyon ou-an ke manb nan òganizasyon sa? /_____/

55. – Eske ou ka di gwoup ou-a estriktire?

a) ----Trè byen b) ----byen c) ----yon ti kras d) ----mal e) -----trè mal

56. – Ki kalite aktivite ou patisipe nan gwoup ou an?

a) -----Rebwazman b) -----Amenaje wout c) -----Kombat dife nan fore

d) -----Kontwole Kamyon kap pote planch e) -----Aktivite eklèsi nan fore-a

f) -----Aktivite netwyaj g) -----Kotwole moun kap koupe bwa

h) ------Lòt (eksplike) ----------

57. – Konbe moun nan eksplwatasyon ou-an ki te patisipe nan aktivite sa yo?

a) -----Rebwazman /_____/
b) -----Amenaje wout /_____/
c) -----Kombat dife nan fore /_____/
d) -----Kontwole kamyon bwat kap pote planch /_____/
e) -----Aktivite eklèsi nan fore-a /_____/
f) -----Aktivite netwyaj /_____/
g) -----Kotwole moun kap koupe bwa /_____/

58. – Konbe fwa pa mwa nou organize reyinyon nan òganizasyon ou-an?

a) ---yon sèl fwa b) ---2 fwa c) ---3 fwa d) ---4 fwa e) ---lòt (eksplike)----------

59. – Konbe fwa ou asiste reyinyon nan òganizasyon ou-an?

a) ------ 100% reyinyon b) ------75% reyinyon c) ------50% reyinyon

d) ------25 % meeting e) ------- lòt (eksplike) ----------

60. – Konbe fwa nou organize reyinyon sou pwoblèm fore?

a) ------ 100% reyinyon b) ------75% reyinyon c) ------50% reyinyon
d) ------25% reyinyon e) ------- lòt (eksplike) ----------

61. – Konbe fwa ou patisipe nan activite yo organize nan rezèv la?

Aktivite	Tout tan	Preske tout tan	Pafwa	Rareman	Jamais
Rebwazman					

Konbat dife nan fore-a					
Eklèsi					
Kontwole kamyon					
Netwayaj					
Repare wout					

62. – Eske ou satisfè de rezilta travay sa yo ou patisipe-a?

Aktivite	Trè satisfè	Satisfè	Yon ti kras satisfè	Pa satisfè	Dekouraje
Rebwazman					
Konbat dife nan fore-a					
Eklèsi					
Kontwole kamyon					
Netwayaj					
Repare wout					

SECTION FOUR

Questions of general interests

63. – Eske pwoteksyon Forêt des Pins se yon bagay ki empòtan pou ou?

a) ----wi b) -----non Pou ki sa?

64. – Eske ou satisfè de eta forè-a ye koulye-a?

a) ----trè satisfè b) ----satisfè c) ----yon ti kras satisfè d) -----pa satisfè

e) ----dekouraje

65. – Kòman ou te ka dekri eta fore-a koulye-a compare ak 5 ane avan?

a) ------Meyè b) ------menm jan c) ------mal d) -------pi mal

66. – Eske ou ka di nou kòman benefis sa yo, yon moun ka jwenn de fore empòtan pou ou?

Benefits	0-mwen pa konnen	1—pa di tou	2—Yon ti kras	3—Empòtan	4—Ase Empòtan	5—Trè Empòtan
Forè kontwole klima (tanperati)						
Forè bay kay pou plant ak zanimo						
Forè se yon bon kote pou yon moun obsève lanati						
Forè atire touris						
Forè ede kontwole inondasyon						
Forè ede redwi erozyon sòl						
Forè ogmante disponibilite dlo pou moun bwè						
Forè amelyore kalite lè-a						

67. - How important to you are the following social benefits of forest?

Benefits	0-mwen pa konnen	1—pa di tou	2—Yon ti kras	3—Empòtan	4—Ase Empòtan	5—Trè Empòtan
Plante pye bwa ede ranfòce èstrikti kominote wap viv la						
Plante pye bwa ede chak moun konprann responsabilite'l nan anviwonman an						
Pye bwa amelyore						

rekreasyon						
Patisipasiyon adilts nan aktivite fore bay plis jarèt						
Plante pye bwa develope sans de propriete kay ti moun						

68. - How important to you are the following economic benefits of forest?

Benefits	0-mwen pa konnen	1—pa di tou	2—Yon ti kras	3—Empòtan	4—Ase Empòtan	5—Trè Empòtan
Pye bwa ogmante vale te						
Aktivite nan fore ede moun jwenn jòb						
Forè ogmante randman tè moun fe jaden						
"Produits non ligneux" yo ede moun fe plis lajan						
Netwajaj andedan fore ede moun fè plis kòb						
Repare wout andedan forè ede moun fè plis kòb						
Aktivite andedan fore ka ede ogmante kantite ti moun kay lekòl						
Pye bwa ka bay bwa pou fè mèb						

69. – Ki sa ou panse ki prensipal bezwen pou moun kap viv nan Forêt des Pins?

a) --------Dlo
b) --------Bwa pou dife
c) --------Bwa pou planch
d) --------Jòb ki pa nan fè jaden
e) --------Lekòl
f) -------- Swen pou lasante
g) --------Plis tè pouf è jaden
h) --------Lòt (eksplike) ----------

70. – Eske ou ka range bezwen sa yo nan lòd yo pi empòtan pou ou?
1= plis empòtan; 1>2>3>4>5…….

Bezwen	Lòd
Dlo	
Bwa pou dife	
Bwa pou planch	
Jòb ki pa nan fè jaden	

Lekòl	
Swen pou lasante	
Plis tè pou fè jaden	

71. – Ki kalite ankourajman nou panse ki ka ede pwoteje forè-a?

a) -------Ranfòse òganizasyon local yo
b) -------Amelyore nivo edikasyon an
c) -------Subventione depans nap fè nan jaden
d) -------Vini ak lòt mwayen pou moun fè lajan nan jaden
e) -------Mete yon system kredi sou pye
f) -------Vini ak lòt sous pou moun fe lajan ki men pa fè nan jaden
g) ------ Amelyore vale "Produits non ligneux" yo
h) ------ Vini ak semans amelyore
i) ------- Legalizasyon pasèl illegal yo
j) -------Pataje ak moun nan fore-a pwodwi leta sezi yo
k) ------ Pataje ak moun yo pwodwi ki sòti nan operasyon netwayaj yo
l) -------Lòt (eksplike svp) ----------

72. – Eske ou ka range ankourajman sa yo nan lòd yo pi empòtan pou ou?
1= plis empòtan; 1>2>3>4>5…….

Ankourajman	Lòd
Ranfòse òganizasyon local yo	
Amelyore nivo edikasyon an	
Subventione depans nap fè nan jaden	
Vini ak lòt mwayen pou moun fè lajan nan jaden	
Mete yon system kredi sou pye	
Vini ak lòt sous pou moun fe lajan ki men pa fè nan jaden	
Amelyore vale "Produitd non ligneux" yo	
Vini ak semans amelyore	
Legalizasyon pasèl illegal yo	
Pataje ak moun nan fore-a pwodwi leta sezi yo	
Pataje ak moun yo pwodwi ki sòti nan operasyon netwayaj yo	

73. - Ki kalite lòt sous pou moun ka fè kòb ou wè ki ta empòtan pou zòn lan?

a) -------Ankouraje touris monte nan zòn lan
b) -------Entrodwi pwodiksyon myèl nan zòn lan
c) ------- Entrodwi prodiksyon flè nan zòn lan
d) ------- Entrodwi lòt kalite kilti nan zòn lan

e) ------- Entrodwi transfomasyon fri pou fè konfiti
f) ------- Lòt (eksplike)----------

74. – Kisa ou panse ki se prensipal kòz debwazman nan Forêt des Pins?

a)--------Insekirite nan zafè tè
b) -------Ogmantasyon papilasyon
c) -------Bezwen pi plis tè pou travay
d) -------Eksperyans SHADA-a
e) -------Bezwen Bwa pou fè dife
f) ------- Koupe bwa ilegal
g) -------Randman nan agrikilty ki bese
h) -------Pa gen yon system kredi pou ede moun yo
i) --------Lòt (eksplike svp) ----------

75. - Eske ou ka range kòz sa yo nan lòd yo pi empòtan pou ou?
1= plis empòtan; 1>2>3>4>5…….

Causes	Rank
Insekirite nan zafè tè	
Ogmantasyon papilasyon	
Bezwen pi plis tè pou travay	
Eksperyans SHADA-a	
Bezwen Bwa pou fè dife	
Koupe bwa ilegal	
Randman nan agrikilty ki bese	
Pa gen yon system kredi pou ede moun yo	

76. – Nan opinion pa wou, ki lès nan aktivite sa yo ki ka mache pi byen pou ede yo amelyore forè-a?

a) --------Subvensyone depans pou fè jaden
b) --------Patisipasyon moun òganizasyon yon an desizyon kap pran pou fore-a
c) --------Distribisyon tè a peyizan yo
d) --------Bay forè-a a sektè prive
e) --------Kreye lòt sous pou moun fè lajan nan zòn
f) --------Empòte anpil bwa pou peyia-
g) ------- Lòt (eksplike svp) ----------

77. – Eske pa gen lòt bagay ou ta renmen ajoute? Mèsi anpil pou tan ou.