SOCIOECONOMIC IMPACT ANALYSIS OF THE CONSERVATION OF THE NYUNGWE FOREST RESERVE, RWANDA

By

MICHEL K. MASOZERA

A THESIS PRESENTED TO THE GRADUATE SCHOOL OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE

UNIVERSITY OF FLORIDA

2002
To my parents, Chrys Ngoyelha Masozera and Therese Nyirabagisha, without your special love and support, I never would have become who I am today. I am sorry that you did not live to see this accomplishment. I hope that you can see my work and that you are proud of it. More than anyone else, I dedicate this thesis to you.
ACKNOWLEDGMENTS

My study program was made successful by the generous support of many individuals and organizations, which supported and financed this research. I am particularly grateful to the Wildlife Conservation Society, the Beinecke Brothers Foundation and the Compton Fellowship Foundation. Sincere appreciation is extended to Dr. Amy Vedder and Dr. Andrew Plumptre, who gave me the encouragement and assistance to join graduate studies.

I am indebted to my committee chair, Dr. Janaki Alavalapati, for his support and encouragement during my entire study program. The members of my committee, Dr. Susan Jacobson and Dr. Clyde Kiker, also helped me greatly and I thank them sincerely.

I would like to express my appreciation to my friends and colleagues, Anecto Kayitare, Eugene Rutagarama, Ian Munanura, Dr. Liz Williamson, and Tony Mudakikwa, for their dedication for the conservation of the remaining Rwandan biodiversity. In addition, I would like to thank Dr. Beth Kaplin and her family for their encouragement and friendship during my stay in the United States. Special thanks go to the Nyungwe Forest Conservation Project staffs for their integrity and dedication for the conservation of the Nyungwe Forest Reserve. Finally, I acknowledge the support and assistance of my brothers, sisters and my extended family during my entire education. Words cannot express my gratitude!
TABLE OF CONTENTS

ACKNOWLEDGMENTS ........................................................................................................ iv

TABLE OF CONTENTS ........................................................................................................ v

LIST OF TABLES ................................................................................................................ vii

CHAPTER

1 INTRODUCTION .............................................................................................................. 1

   Background Information .............................................................................................. 1
   Problem Statement ....................................................................................................... 5
   Research Hypotheses, Objectives and Study Area ....................................................... 7
      Hypotheses ............................................................................................................... 7
      Objectives ............................................................................................................... 7
      Study Area .............................................................................................................. 8
   Significance of the study ............................................................................................ 9
   Thesis Overview ........................................................................................................... 10

2 THE CONSERVATION OF THE NYUNGWE FOREST RESERVE: INSTITUTIONAL ANALYSIS .......................................................................................... 11

   Introduction .............................................................................................................. 11
   The Role of Institutions in Natural Resources Management ...................................... 14
   Institutional and Legal Framework for Protected Area Management in Rwanda ........ 15
      Government Institutions ....................................................................................... 16
      International Institutions ....................................................................................... 17
   Property Rights as Institutional Arrangements and their Impact on the Conservation of the NFR .................................................................................................................. 19
      Evolution of Forest Institutions in Rwanda ......................................................... 19
   Towards an Improved Forest Management Regime .................................................. 26
   Conclusion .................................................................................................................. 28

3 FOREST DEPENDENCY AND ITS IMPLICATION FOR THE CONSERVATION OF THE NFR ............................................................................................................... 30

   Introduction .............................................................................................................. 30
   Conceptual Framework of the Study ......................................................................... 31
## LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1. Variable definitions and their expected sign for dependence model.</td>
<td>42</td>
</tr>
<tr>
<td>3.2. Descriptive statistics for the independent variables used in estimation of forest dependency.</td>
<td>44</td>
</tr>
<tr>
<td>3.3. Regression results showing determinants of forest dependence</td>
<td>44</td>
</tr>
<tr>
<td>3.4. Variable definitions for conservation attitude model</td>
<td>51</td>
</tr>
<tr>
<td>3.5. Variable definition and descriptive statistics for attitude model</td>
<td>52</td>
</tr>
<tr>
<td>3.6. Regression results showing determinants of conservation attitude</td>
<td>54</td>
</tr>
<tr>
<td>4.1. SWOT factors relating to CBC approach</td>
<td>54</td>
</tr>
<tr>
<td>4.2. SWOT factors and their priority and overall priority scores</td>
<td>54</td>
</tr>
</tbody>
</table>
Abstract of Thesis Presented to the Graduate School of the University of Florida in Partial Fulfillment of the Requirements for the Degree of Master of Sciences

SOCIOECONOMIC IMPACT ANALYSIS OF THE CONSERVATION OF THE NYUNGWE FOREST RESERVE, RWANDA

By
Michel K. Masozera

August 2002

Chair: Dr Janaki Alavalapati
Department: School of Forest Resources and Conservation

This study explores the role of forestry institutions on the conservation of the Nyungwe Forest Reserve (NFR), estimates the household dependency on the NFR and its impact on residents’ attitudes towards the conservation of the NFR, and assesses the applicability of Community Based Conservation (CBC) approach to managing the NFR. The institutional analysis shows that the decline in the area of the NFR is due to perverse government policies, population pressure, and inadequate capabilities of forest institutions to enforce the rules.

One hundred seventy five surveys were administrated to households in communities of five villages surrounding the NFR to estimate their dependency and its impact on their attitudes towards the conservation of the NFR. A logistic regression analysis was used to achieve this task. The results show that agricultural income, household age, access to outside market, and household size are major determinants of forest dependency. Benefits from the buffer zone, limited access to forest resources, and
forest dependency are shown to be the significant predictors of households’ attitudes towards the conservation of the NFR. Results suggest that conservation programs relating to the NFR must consider the socioeconomic characteristics of households living around the forest. In particular, conservation strategies must ensure benefits to local communities and provide alternative employment opportunities.

Strengths, Weaknesses, Opportunities and Threats (SWOT) technique in combination with Analytic Hierarchy Process (AHP) was used to analyze the applicability of CBC to manage the NFR. In particular, the applicability as perceived by members of local communities, the government agency, and an environmental organization is assessed. Results show that community leaders perceive that the CBC approach would improve their livelihood and also help to conserve the NFR. While the government agency perceives that CBC will lead to biodiversity loss, the Wildlife Conservation Society (WCS) thinks that decentralization of power to local communities may weaken the conservation capabilities of the government agency. Results from SWOT-AHP suggest that it is very critical to address the concerns expressed by members of government and the environmental organization before it is tried in the NFR.
CHAPTER 1
INTRODUCTION

Background Information

Public concerns for biodiversity conservation have prompted the establishment of protected areas around the world. In tropical countries, establishment of protected areas was identified as a key strategy to reduce biodiversity loss in tropical rainforests. However, in many places it has proven difficult to manage protected areas (Rao and Geisler 1990) because of higher dependency of population on natural resources for agricultural, energy, nutritional, medicinal, and other needs. Also, protected areas in developing countries are often viewed as a source of income from timber, oil, mineral exploitation, or tourism by the government (Putz 1988). In addition, inadequate government resources, weak management capacities and ineffective legal systems have compounded the problems of protected areas management in developing countries (Salasfky and Wollenberg 2000).

Conservation strategies in Africa have been characterized by exclusion of human use of resources in protected areas. In particular, this approach, often described as “fortress conservation” or “the fines and fences” (Wells et Brandon 1992) has been influential in sub-Saharan Africa, where there is a long history of reserve creation, beginning with the Sabie game reserve in 1892 in Natal (Adams and Hulme 1998). Post-colonial African governments continued to embrace and carry on colonial conservation strategies that excluded human use of resources of protected areas (Gbadegesin and Ayileka 2000). As many protected areas are proposed on lands that are legally or
customarily owned and managed by local people it has often been impractical, or impossible to consider these lands off-limits to human use. Furthermore, in countries where remote populations endure social and economic inequities, protected areas have further restricted their livelihood options (Salafsky and Wollenberg 2000). As a result the protectionist approach has caused skepticism, lack of trust, and even hatred between protected areas’ managers and the communities living around protected areas. There is also a growing consensus among conservationists and international conservation organizations that the protectionist approach may no longer conserve wildlife in Africa (Ite 1998; Barret and Grizzle 1999).

In an attempt to reconcile human needs and conservation goals, since the late 1970s conservationists have been searching for innovative solutions. One of the earliest approaches used was the creation of the biosphere reserve (Sayer 1991). The key feature of the biosphere reserve model is to create a spatial compromise by enabling local people to continue to meet their livelihood needs while still protecting key species and their habitats. This approach also attempts to decrease local people’s reliance on natural resources by substituting alternative livelihood activities.

In recent years, in many parts of Africa, and specifically in Southern Africa, different models of community based conservation programs (CBC) that seek to link conservation with the alleviation of rural poverty, as well as encouraging community participation were undertaken (Gbadegesin and Ayileka 2000). Community based conservation (CBC) stresses the need to include local people, either physically in protected areas management or politically in the conservation policy process (Western and Wright 1994).
The emerging literature on biodiversity conservation suggests that current CBC approaches are failing to achieve their goals. The main reasons are the failure to meet communities’ expectations, unwillingness of national governments to devolve ownership and management responsibility to local communities, and the lack of capacity to manage CBC projects by communities (Wainwright and Wehrmeyer 1998; Songorwa 1999; Songorwa et al. 2000). This suggests that protected areas management in Africa is very challenging. One of the big challenges is that areas of outstanding conservation importance coincide with dense human settlement (Balmford et al. 2001). Therefore implementation of a management strategy will require an understanding of the extent of community’s dependency on natural resources in protected areas and the perceptions of different stakeholders about the management strategy.

While biodiversity conservation in Africa is complex (Vogel 2001), the Rwandan situation is even more complex. Establishment of protected areas in Rwanda started in early 1918 by the colonial government and in 1933 all remnants of mountain forests were set aside as protected forests (Weber 1987). Currently Rwanda, a country of 26,338 km$^2$, has approximately 7% of its land under protected areas (Fig. 1-2). They include:

- The Nyungwe Forest Reserve (NFR) (970km$^2$) in the Southwest, which is the largest remaining lower mountain forest in Africa;
- The Volcanoes National Park (425 km$^2$) in the northern part, which harbors highly-endangered biota, including mountain gorillas and golden monkeys; and
- The Akagera National Park in the East, which is a complex of savanna/wetland that provides habitat for a diverse fauna, including nearly 600 species of birds.
Figure 1-1: Map of Africa showing the location of Rwanda

Figure 1-2: Protected areas of Rwanda
These protected areas are located in the Albertine Rift region, the richest region in biodiversity and the most populated in Africa. Therefore, Rwandan protected areas conserve some of the world’s greatest concentrations of birds’ species and some of the most endangered species such as mountain gorilla, golden monkey (*Cercopithecus mitis kandti*), owl-faced monkey (*Cercopithecus hamlyni*) eastern chimpanzee (*Pan troglodytes schweinfurthii*) and Ruwenzori Touraco.

Although concern for the environment is not a recent phenomenon, management of protected areas in Rwanda has become very complex. Growing population pressure, limited land resources, and a decade of war\(^1\) that has resulted in movement and resettlement of population in protected areas are the major challenges to manage protected areas. For example, two-thirds of the Akagera National Park was degazetted in 1997 to legalize the occupation of the western grasslands by thousands of returning refugees.

**Problem Statement**

Similar to many developing countries, Rwanda is also dependent on agriculture. Over 90 percent of Rwandans are engaged in subsistence agriculture. In many areas of the country, intensive crop cultivation is a common practice, which cannot be sustained. It is especially prevalent where farms have been subdivided several times as they pass from one generation to another. In many cases, the inherited farm lots are too small, averaging less than 1 ha to support a family. This fragmentation of family holdings through generational transfers has led to the expansion of cultivation onto marginal lands and natural forests. Due to this and other factors pointed out earlier, natural forests in

\(^1\) In 1994 political conflicts in Rwanda resulted in a war and genocide that created a huge displacement of the population.
Rwanda have reduced from approximately 30 percent at the turn of the last century to 7 percent of the total land area (Olson et al. 1999).

It is difficult, if not impossible to restrict access of local people to forest resources due to social, economic and political challenges. There is growing evidence that without reducing people’s dependence on the forests, it is likely that protected areas or natural forests are difficult to conserve (Gunatilake 1998; Hedge and Enters 2000). In the face of the growing biodiversity crisis, resource managers and conservationists in Rwanda are looking for innovative management strategies that could ensure community stability and survival of protected areas. This suggests that conservation must be perceived in a holistic framework by integrating biological and ecological with social and political processes.

In this study, it is premised that peripheral communities may not support conservation efforts when their livelihoods depend on the extraction of resources from protected forests. In other words, it is believed that the forest dependency would influence people’s attitudes towards conservation programs. Clear understanding of local dependency on protected areas provides insights for formulating policies to conserve biodiversity and find alternative economic opportunities. Furthermore, some people think that the CBC approach provides an effective framework to conserve biodiversity and to improve livelihoods of local people. However, there is no consensus on the success of this approach in many African countries. This is because CBC programs that are designed to suit a specific setting and context were replicated elsewhere under different constraints. It is suggested that assessment of the applicability of CBC programs from
various stakeholders perspectives, before they are implemented is a prerequisite to effective management.

Research Hypotheses, Objectives and Study Area

Hypotheses

This research was designed and carried out to test three main hypotheses of the study:

Hypothesis I: There is no variation in forest dependency across communities surrounding the NFR.

Hypothesis II: Forest dependency does not impact people’s attitudes towards the conservation of the NFR.

Hypothesis III: Stakeholders in the NFR have the same perceptions about community-based conservation.

To test the above hypotheses a structured questionnaire survey was designed to measure attitudes, resources use and socioeconomic variables. It was administrated to 175 households in five villages around the NFR. Logistic regression analyses were performed to identify socioeconomic factors determining forest dependency and attitudes towards NFR conservation. In addition, for hypothesis III, stakeholders’ perceptions about CBC in the NFR were assessed using SWOT-AHP technique (Kurtilla et al. 2000).

Objectives

This study aims at assessing the socioeconomic impacts of conservation activities in the Nyungwe Forest Reserve. Specifically, this study aims at accomplishing the following objectives: 1) assess the role of forest institutions in the sustainable management of the NFR, 2) identify socioeconomic factors determining forest
dependency and its impact on peoples’ attitudes towards the conservation of the NFR, 3) assess the potential for the CBC approach to manage the NFR.

**Study Area**

The NFR was established in 1933. It is a high-altitude, tropical mountain forest covering 970 km² in Southwest Rwanda (Fig. 1-1). Together with neighboring Kibira National Park in Burundi, it forms one of the largest tropical mountain forests in Africa (Offut 1990). Nyungwe is Rwanda’s largest remaining forest and one of the most biologically rich lower mountain rainforests in Africa. The forest contains a wide variety of ecosystems ranging from marshes, bamboo groves to dense forest. Although perhaps best known for its colobus monkeys, it also contains 12 other types of primates (Appendix G), at least 260 bird species, and more than 260 species of trees and shrubs, and over 100 species of orchids. The ornithological research has found this area to be the second richest forest for Albertine Rift endemics (Dowsett 1990). The biodiversity is particularly rich and important because the high-altitude ridge served as a refuge for and source of recolonization of forest plants and animals during and after the drying of much of East Africa during the Ice Ages. Also, the forest is situated in an overlap region between several large-scale biogeographical zones and therefore contains species originating from Tanzania, Ethiopia and the Zaire Basin (Offutt et al. 1990).

The Nyungwe area is densely populated with an average of more than 300 inhabitants per sq km. Over 90% of the population are subsistence farmers, with family farms averaging less than 1 ha in size. Despite the fact that this forest has little agricultural value with its steep slopes and poor soils, local pressures have resulted in substantial loss of forest for agriculture over the last 40 years. In addition, systematic
game hunting has extinguished all the buffalo and many forest antelopes known as duikers.

In addition to its biodiversity values, the NFR is highly important for the well being of its surrounding human population. It provides vital ecological services, via water catchments, for the majority of the country and stabilizes soil erosion for the surrounding communities. Furthermore, the NFR constitutes the second most popular nature based tourism attraction in Rwanda after the Volcanoes National Park.

**Significance of the study**

Attempts to link conservation and community development through natural resource management projects are emerging as important conservation strategies in Africa, and elsewhere around the world (Ghimire and Pimbert 1997). However, there is an extensive debate as to when and how such projects are likely to achieve effective results (Barrett and Arcese 1995; Shyamsundar 1996). The specific geographical, ecological, cultural and socioeconomic contexts in which conservation strategies are implemented make it difficult to generalize the outcomes. Very often conservation strategies are emulated that were developed under different conditions without consideration to location specific socioeconomic, political and cultural conditions. Therefore a thorough understanding of the interactions between protected forests and communities is crucial for the successful implementation of conservation strategies.

Although protected area managers and conservationists are searching for management strategies to reduce pressure on the NFR, understanding of community dependency and its impact on community member’s attitudes toward conservation and assessing the potential for CBC from various stakeholders in the NFR is of paramount
importance. The findings of this study will provide a basis for protected area managers and decision-makers to formulate or modify existing conservation strategies for the NFR.

**Thesis Overview**

Chapter 2 discusses the role of national and international institutions in the conservation and management of the NFR. This chapter takes an historical approach to describe the evolution of forest institutions and their impact on the management of Nyungwe. From this discussion, I conclude that institutions play a critical role in the sustainable management of forest resources.

Chapter 3 explores the issue of dependency and its implication for the conservation NFR. I begin by presenting the conceptual framework for my study and then provide a detailed description of research design and data collection. Two models are presented namely the forest dependency model and conservation attitude model. Key variables used in these models are defined and discussed in depth before they were used in estimating their relationship with forest dependency and conservation attitude.

Chapter 4 explores stakeholders’ perspectives about the applicability of CBC to manage the Nyungwe Forest Reserve. Drawing on the literature, I begin with an overview of the CBC in Africa. I then discuss SWOT-AHP methodology and its applications. The chapter concludes by examining the perceptions of three stakeholders-community members, government agencies, and environmental organization about CBC in the context of the NFR.

Chapter 5 provides an overview of the research findings and offers recommendations related to the conservation and management of the NFR.
CHAPTER 2
THE CONSERVATION OF THE NYUNGWE FOREST RESERVE: INSTITUTIONAL ANALYSIS

Introduction

During the last 40 years Nyungwe forest cover has been reduced in size from 114,125 ha to 97,000 ha (Fig.2-1). As a result, considerable concern has been expressed by government and conservation non-governmental organizations over the need to manage effectively the NFR.

![Graph showing Nyungwe forest cover change during the last 40 years](image)

Source: PCFN 2001

Figure 2-1: Nyungwe forest cover change during the last 40 years

The government of Rwanda has tried different strategies ranging from establishing a green belt of pine plantations to appointing forests guards to monitor the effective use of resources and enforcement of regulations. It has been a challenging task to manage the NFR in the face of a huge population density ranging from 300 to 400.
people per km$^2$. As a result of population pressure and their dependence on the NFR for subsistence needs, several activities such as hunting and mining are continuing to take place. For example the number of snares collected by the Nyungwe Forest Conservation Project staff (PCFN) between 1996 and 1999 indicates that the pressure for illegal forest use is phenomenal (Fig. 2-2).

![Graph showing number of snares collected between 1996 and 1999](image)

Source: PCFN 2001

Figure 2-2: Measures of poaching levels in Nyungwe between 1996 and 1999

Several studies have been conducted to understand the driving forces behind tropical deforestation. Population growth, shifting cultivation, commercial logging and weak forestry institutions were identified as major factors of deforestation (Allan and Barnes 1985; Burges 1992; Rudel 1994; Myers 1994; Capistrano 1994; Brown and Pearce 1994). Although population pressure was noted to be a factor affecting deforestation in previous studies (Myers 1994; Cropper and Griffiths 1994; Allan and Barnes 1985), there is growing evidence suggesting the absence of relationship between population growth and loss of forest cover at local levels (Varughese 2000; Agrawal 1995; Templeton and Scherr 1999). A study by Bhattari and Hamming (2001) across
countries of Latin America, Africa and Asia revealed that institutional structure and macroeconomic policies significantly affect the tropical deforestation process. Angelsen and Kaimowitz (1999) reviewed more than 140 economic models analyzing the causes of tropical deforestation and found less empirical basis for population growth, poverty and land tenure security.

Empirical evidence from studies carried out in Uganda has shown that effective monitoring and rule enforcement are good predictors of sustainable management (Becker, Banana, and Gombya-Ssembajjwe 1995; Banana, and Gombya-Ssembajjwe 2000). In addition, a study by Banana, Gombya-Ssembajjwe and Bahati (2001) revealed that poor monitoring and rule enforcement coupled with limited participation of local communities in forest management explains the continued degradation of forest resources. These results are consistent with studies by Tucker (1999), Agrawal and Yadama (1997), Bruce and Miggot-Adholla (1994).

A recent study by Bruner et al. (2001) on the effectiveness of parks in protecting tropical biodiversity found that effectiveness correlates with basic management activities such as enforcement, boundary demarcation, and direct compensation to local communities. This suggests that institutions play a critical role in the sustainable management of forest resources.

During the last 20 years forestry research in Rwanda has focused mainly on ecological and human impact (Bahigiki and Vedder 1987; Weber 1989; Kurt and Fimbel 1994). Less attention has been devoted to institutional issues since very little information is available about institutions relating to forests. This chapter fills that gap by assessing the role of institutions and their impacts on the conservation of the NFR. The analysis is
The Role of Institutions in Natural Resources Management

Institutions are commonly understood rules and norms that stipulate what actions are required, permitted, or forbidden in particular situations (Poteete and Ostrom 2002). Koahene et al. (1993) defines institutions, as persistent and connected sets of rules and practices that prescribe behavioral roles, constrain activity, and shape expectations. The broadest definitions of institution include both formal institutions such as administrative structures, and also informal institutions such as customs and practices (Cortner et al. 1998).

Institutions are crucial determinants of societies’ capacity to manage and govern natural resources (Mehta et al. 1999). While environmental degradation is the result of aggregated individual decisions and choices, individual choices are responses to incentives and other forms of guidance from governments and other national institutions via laws, taxes, and even normative pronouncements (Kay and Jacobson 1983). Without effective institutions to limit and regulate harvesting levels and management practices, natural resources such as forest resources can be overharvested and even irreversibly destroyed, as is often the case in “open access” forests (Ascher 1995; Ostrom 2000, 2001; Tucker 1998; Gibson, McKean, and Ostrom 2000).

Keohane et al. (1993) argued that even on environmental issues that primarily affect and are caused by individuals in developing countries, international institutional pressures guide national actions. According to Keohane et al. (1993) international institutions can affect the political process of environmental policy making and policy
implementation in three ways: 1) They can contribute to more appropriate agendas, reflecting the convergence of political and technical consensus about the nature of environmental threats; 2) they can contribute to more comprehensive and specific international policies; and 3) they can contribute to national policy responses which directly control sources of environmental degradation.

In this regard our discussion in the following section will be focused on the effect of national and international institutions on the conservation of the NFR.

**Institutional and Legal Framework for Protected Area Management in Rwanda**

Currently there is no elaborate legal framework that specifically addresses wildlife or forestry conservation apart from decrees setting up institutions such as Office Rwandais du Tourisme et Parcs Nationaux (ORTPN) and forest law (no. 47/1988). A National Strategy for the Environment and the Environmental Action plan was developed in 1991 and the government has been using this as the basis for developing a new national policy for environment, which would reflect current issues in the environmental sector. This policy is expected to provide the legal framework and is also expected to suggest mechanisms of coordination among various institutions involved in environmental issues.

In Rwanda, conservation is a crosscutting theme; numerous government, non-government agencies and bilateral and multilateral agencies are involved in various ways in protected area management. However, the fragmentations and overlap of agency authorities have resulted in conflicts and obstruction between agencies.

The following is a brief description of the various organizations and their role in conservation:
**Government Institutions**

The following government institutions are involved in protected area management:

- **Ministry of Land, Human Settlement and Environmental Protection (MINITERE)**

  This ministry has the mandate to formulate and monitor implementation of plans that aim at preservation and protection of natural resources such as wildlife and fauna and to ensure that developmental activities are undertaken in a manner that protects the national environment. This ministry is the implementing agency of National Biodiversity Strategy and Action Plan.

- **Ministry of Commerce, Industry and Tourism (MINICOM)**

  This ministry has the mandate to oversee the management of national tourist sites, including game parks. It also has the mandate to develop, initiate and administer programs to enhance balanced and sustainable growth of domestic industry including agro-industry, cottage industries, mining, industry and tourism.

- **Ministry of Energy, Water and Natural Resources (MINIRENA)**

  This ministry has the mandate to formulate policies and strategies aimed at achieving appropriate management and utilisation of national resources including water.

- **Ministry of Agriculture, Animal Resources and Forestry (MINAGRI)**

  This Ministry has the mandate to develop and manage ecologically suitable national forestry resource plans that are integrated with other farming activities in the nation.
• **Ministry of Local Government (MINALOC)**

This Ministry has the mandate to develop policies on government decentralization. Attempts to decentralize decision-making within the government have been taking place over the past year. With this move local government agencies and the local communities are likely to have greater participation in government decision-making process and activities, including those decisions affecting protected area management.

• **Ministry of Finance and Economic Planning (MINIPLAN)**

This Ministry is responsible for the development of national and sectoral development plans and programmes. Also, it develops, oversees, and coordinates programmes of external cooperation and support.

• **Office Rwandais du Tourisme et Parcs Nationaux (ORTPN)**

The ORTPN was established by decree in 1974 with the following responsibilities: promotion of tourism, protection of nature, scientific research and protection of sites and monuments of historical, archeological and tourist importance and implementation of biodiversity conventions and agreements.

Although a wide range of Ministries are related either directly or indirectly to protected areas management, it is the Ministry of Commerce, Industry and Tourism that is more responsible because it oversees major tourist sites and national parks and protected areas are major tourist centers in Rwanda.

**International Institutions**

There are many organizations involved in the conservation and management of protected areas in Rwanda. They play a major role in policy advocacy, research, institutional support and capacity building. For the purpose of our study we will focus on
non-governmental organizations (NGOs), bilateral and multilateral agencies that are or have been involved in the management of the Nyungwe Forest Reserve:

- **The Wildlife Conservation Society (WCS)**

  This non-governmental organization has been involved in the NFR since 1987. The objective of the WCS is to support the Government of Rwanda in the long-term conservation of the NFR through scientific research, training of Rwandan professionals, promotion of ecotourism and conservation education programs.

- **The Swiss technical assistance**

  This agency has been supporting the Department of Forestry in the management of the NFR since 1967. It has been operational in northern part of the NFR and the main objective was to create buffer zone plantations to demarcate the boundaries of the natural forest.

- **The World Bank**

  This agency has been operational in the southeastern part of the NFR since 1984. The main objective was to establish a buffer zone and to conduct forest inventory.

- **The French Cooperation**

  This agency operated in the Western and Southwestern part of the NFR since 1984 and the main objective was to support the Department of Forestry in establishing the buffer zone to demarcate boundaries of the natural forest.

- **European Development Fund**

  This agency also supported the Department of Forestry to establish buffer zones in the eastern part of the NFR since 1984.
However, due to prevailing political and economic instability all bilateral and multilateral agencies’ projects were terminated in 1994.

**Property Rights as Institutional Arrangements and their Impact on the Conservation of the NFR**

The knowledge of how property rights regimes, as important types of institutions, function in relation to humans and their environment is critical to the design and implementation of effective environmental protection (Hanna and Munasinghe 1995). The rights and duties characterizing the relationship of individuals to one another with respect to natural resources, e.g. forest, define the property regime (Gluck 2002). This can be a private, state or common property regime.

Property rights are socially derived over time, and the particular constellations or “bundles” of rights that obtain in any given society are historical products (Naughton-Treves and Sanderson 1995). Because the use of forest resources along with other natural resources has changed over time in Rwanda, the analysis in this chapter focuses on a historical dimension.

**Evolution of Forest Institutions in Rwanda**

Property rights have evolved throughout the history in response to the growing population and increasing pressure on forest resources. The history of the management of the Nyungwe Forest has gone through 4 distinct periods:

- **Pre-colonial period**

  During the pre-colonial period, the Nyungwe forest as well as other Rwandan natural resources, were managed under a wide range of state and communal tenure arrangements. These tenure arrangements suited to low population densities of pastoral to
sedentary agricultural communities and allowed for migration, translocation and other responses whenever natural resources became degraded.

The customary law recognized land rights obtained in one of three ways: by inheritance through male line, from a chief in return for tribute, and by clearing new land to which no chief had laid claim. Both collective ownership by a lineage or individual ownership by a politician or his client were recognized. These access rights were very secure, respected by all in the community.

The main aspects of land tenure were as follows:

- **Ubukonde**, or clan law, which was enacted by the head of the clan who is the first to clear the forest,

- **Igikingi**, or the right to grazing land given by the king of his chief to pastoral families.

- **Inkungu**, or custom authorizing the local political authority to dispose of abandoned land. The lands were grouped into a sort of land reserve from which the ruler of the time accorded plots to any who required one.

- **Gukeba** was the process of settling families onto grazing land, or on fallow land.

However, due to rising number of people and cattle, vast areas of forest were cleared for farms and grazing lands. In addition poor soils, frequent droughts and diseases in the eastern part of Rwanda, made the NFR the most attractive for expansion (Weber 1989). As a result much of the deforestation took place long before European intervention in 19th century as herders had created a landscape suitable for grazing. Only about 2,000
of Rwanda’s 8,000 km² of original highland rain forest remained at the beginning of the colonial period (Weber 1989).

- Colonial period (Late 19th century -1962)

During the colonial period both German and Belgian colonists ruled through the established mechanism of the Tutsi kingdoms. The colonial administration was based on indirect rule through the king and hill chiefs, who in many instances replaced lineage chiefs as the local authority figure. Local lineages were obliged to surrender uncultivated lands for reallocation by chief to each member of their kin group. Thus individually owned plots replaced collectively owned lands. While the mode of land acquisition was mostly through inheritance, as the land became scarcer, the rules of access and rights of use tended to be exclusive for the vulnerable categories of the population such as separated or divorced women, wives under polygamous arrangements, widows, handicapped etc. This situation resulted in expansion of cultivation onto marginal land traditionally used for rangeland, long fallow and forest.

In response to rapid conversion of mountain forests to pasture land that occurred in the late 1920s, the Belgian authorities adopted the first piece of legislation establishing all remnant forestlands including Nyungwe Forest as reserves (Weber and Vedder 1984). The legislation prohibited clearing for agriculture but recognized community rights to cut and gather dead wood and commercial exploitations of valuable hardwoods. While the colonial government retained the ownership right there were no mechanisms in place to monitor and regulate access to the forest. As a result, the forest was used for a wide range of activities including honey collection, woodcutting, hunting of animals,
goldmining, and small-scale agriculture. According to Fimbel and Kristensen (1994), during 1950s, about 3,000 miners were working in the Nyungwe watershed.

- **Post independence period (1962-1990)**

  The post-independence period witnessed a trend towards centralization of authority over land and forest resources by the governments. The national administration was created by making the Ministry of Agriculture responsible for all forms of agriculture production, Rwandan forestry service and national park service. On the other hand, the post independence period has witnessed a large number foreign institutions ranging from large multilateral/bilateral donor agencies to a variety of non-governmental organizations (NGO’s) interested in natural resources management. Most of these national and international institutions have played key roles in conservation and management of the NFR. The impact of these institutions on the conservation of the NFR is discussed below.

  The land tenure regulations, which had been introduced by the Belgian administration and various Rwanda councils, were recognized as binding after independence by the Rwandan Constitution of 1962 (Article 108) (Reintsma 1981). These laws can be summarized as follows: 1) Lands occupied by the original inhabitants were to remain in their possession, 2) All unoccupied lands belonged to the State, 3) All sales or gifts of lands had to be approved by the Minister of Agriculture and 4) Lands belonging to persons who were not the original inhabitants had to be registered.

  The first post independence institution to manage the NFR was the Ministry of Agriculture. It has been responsible for the promotion of agriculture production and forest management. The ownership right to the NFR was vested in the Forest
Department, a sub-agency under Ministry of Agriculture, who had the responsibility of forest conservation, preservation and development. Since forest conservation was not one of the major priorities of the government during the early years of independence, agriculture policies that were aimed at increasing cash crop production had a direct impact on the NFR. Since tea exports represented the second major source of revenue from the agriculture sector, it was quite natural to expand tea plantations. As a result, sections of NFR were cleared for tea plantations after independence (Weber 1989). In addition Fimbel and Kristensen (1994) recognize that between 1958 and 1979 local farmers reduced the NFR in size from 1,141 km\(^2\) to 971 km\(^2\) through illicit encroachment.

Following the biosphere reserve model (Sayer 1991), in 1984 the Rwandan Department of Forestry developed an action plan for the conservation and management of Rwanda’s mountain forests. The plan envisaged three management regimes for the Nyungwe forest: a core area where only tourism and research would be permitted, multiple use zones where controlled harvesting of forest products would be allowed, and a buffer zone (a belt of exotic tree plantations surrounding the natural forest) with the dual intent of demarcating the forest boundary and generating a steady flow of forest products and revenue (Weber 1989). Four management units were established for implementation of the action plan supported by Swiss and French bilateral aid agencies, the World Bank, and the European Development Fund.

Although buffer zones did a good job of demarcating the boundaries of the NFR, they did not achieve the socioeconomic objective of providing steady flows of forest products and benefits to communities around the reserve. First, the buffer zone was planted on land previously occupied by wooded pasture, native forest, and community
farms. Now local farmers are extremely bitter at the government for having appropriated their land without compensation. Second, it appears that community needs and interests were ignored during the design and implementation of the buffer zone project. The forest department and donor agencies have relied mainly on the promotion of exotic species rather than indigenous species that are more socially acceptable and useful to local people. As a result government and non-government agencies have not been able to effectively enforce state’s property rights against illegal forest users. For example, in the late 1980s, there were many permanent residents within the forest borders and mining centers known as “gold” towns (Kristensen 1992; Fimbel and Kristensen 1994).

In 1988 the Rwandan government adopted a new forestry law (No. 47/1988). The previous forestry legislation was essentially based on an old decree of 18 December 1930 that provided, amongst other things, for the creation of forest reserves and the protection of forest species. The law recognized community rights to cut and gather dead wood and allowed commercial exploitations of valuables hardwoods to Europeans settlers. To change this situation, the new legislation was adopted, which deals with the various components of the forest sector: public domain, community and private forestland. This legislation defines the forest reserve as an “area for the protection of the flora and fauna, in which no cutting is permitted except in the interest of protected plants”. In addition the legislation specifies activities that are prohibited including hunting, fishing, collecting animals, plants or minerals. Scientific studies are allowed by ministerial permit.

In 1988, the ORTPN was given the mandate for enforcement of conservation regulations in the forest, including efforts to control illegal mining, hunting and clearing. The ORTPN is now responsible for the management of national parks, special reserves
and hunting reserves through, forest guards with guns to enforce the rules. Forest guards have power to arrest, search and execute penalties. Since 1988, both WCS and ORTPN have actively engaged in law enforcement, conservation education, ecotourism, and professional training, and scientific research.

Today issues related to intergovernmental agencies’ relationships continue to influence the management of the NFR. Firstly, there is no legal or formal provision that gives responsibility for the management of the NFR to ORTPN. Since the status of Nyungwe is a forest reserve and not a national park, the Forest Department under the forestry law (No. 47/1988) still claims the responsibility over NFR. Because of this ambiguous legislation, the Forest Department has been reluctant to approve the transfer of Nyungwe forest to the ORTPN. This has resulted in frictions and conflicts between government agencies. In addition, the colonial legislation that is still in application in the Ministry of Commerce, Industry and Tourism allows the Department of Mines to deliver permission for mining in forest reserves. This legislation makes the enforcement of conservation regulations difficult; therefore there is a need to adjust all legislations relating to the Nyungwe Forest.

In summary, due to limited resources, lack of support from provincial law enforcement, ambiguous government policies and/ or lack of coordination among public agencies, efforts to control illegal activities such as gold mining and hunting to date have been seriously limited.

- War and post-war period (1991-present)

The last decade of conservation in Rwanda was largely influenced by the war and its consequences at the national level. War has affected the conservation of the NFR in
various ways: first forest institutions have become weak due to the lack of incentives at all levels of the administration to enforce regulations. In addition, the internationally funded projects in each of the four management zones around the NFR were terminated and were never resumed after the genocide due to the prevailing political and economic instability. Second, the post-war government priorities were focused on rehabilitation and resettlement rather than conservation. For example, following the genocide development agencies returned to Rwanda but drastically revised their priorities in the light of post-war needs. For at least 2-3 years almost all assistance was focused on humanitarian relief and no funding went to conservation programs.

The progress made so far, in terms of conserving the NFR is largely due to the tireless efforts of the Wildlife Conservation Society since 1988. Despite the effort to conserve the remnant mountain forests, the decline in the area of the NFR is the result of government policies, population pressure and inadequate capabilities of forest institutions to enforce the rules.

**Towards an Improved Forest Management Regime**

While there is no easy solution to the biodiversity crisis for a country such as Rwanda with a high population density, the long-term viability of protected areas will depend on the support of people who live around them. Previous government policies have been silent on the role of local authorities in the management of forest resources.

During the last decade, community participation has become the centerpiece in the conservation puzzle. This is not to suggest that community participation is a panacea for resource conservation. Many forests have suffered severe degradation at the hands of those highly dependent on nearby forest resources (Gibson and Becker 2000). Therefore, there is a need to understand how local institutions can be effective in managing natural
resources based on site-specific issues. The objective of the following section is not to evaluate but to show the current trend in protected areas management.

Rwanda has embarked on a decentralization of the local government since 1998. The decentralization process aims at ensuring democratic governance, people’s participation in the decision-making process, and accountability. The current local administrative system is a three-tiered system of elected Local councils (LCs) and executives committees – LC1 at the village level, LC2 at the sector or parish level, LC3 at the district level. Each local council includes an executive committee of ten members who have specific responsibilities (e.g. secretary of environment). The LC1 includes all residents in the village. The LC2 contains all executive committee members of LC1 plus its own members. The LC3 includes all LC1 and LC2 executive committees members. While LC1 and LC2 committee members are volunteers, LC3 executive committee members are paid servants of the government.

Following the decentralization process, in 1999 the Nyungwe Forest Conservation Project (PCFN) initiated a new partnership approach with LCs. Under this partnership approach, ORTPN and PCFN work in cooperation with LCs in raising public awareness about conservation issues and in controlling the illegal activities within the NFR. Cyangugu province was selected as a pilot site to test this approach. The logic behind this approach is: 1) Given the size of the NFR (970km$^2$) and the prevailing socioeconomic conditions, the government can not afford to hire forest guards to contain illegal forest users; 2) The experience has shown that even when illegal users are caught, forest rangers or warden need local authority to prosecute or give sanctions and to follow offenders in the village; 3) Because local council officials were elected democratically, it is believed
that they are more worthy in the community than forest officials. Therefore, the partnership with LCs was needed in order to enforce rules and to transfer conservation messages to communities through councils at local levels.

Although this approach seems to be working, its continuation depends on finding incentives for LCs. Volunteerism may not last long. It should be noted that this process is new and it is difficult to comment on its effectiveness. Further studies will be needed to evaluate the efficiency of this approach and provide recommendations for the government.

**Conclusion**

The foregoing discussion demonstrates that conservation of the NFR is a socioeconomic, environmental and institutional problem. The NFR has been affected not only by the population growth but also by the government’s inability to enforce its rule. Lack of coordination among government agencies and ambiguous property rights are also influencing the conservation of the NFR. Furthermore, this analysis reveals that for the last century property rights structures have been skewed in favor of the state at the expense of local people’s needs and aspirations.

While declaration of decrees can help protect the area from some pressures, far more is needed in most cases, including proper legislation, management plans, staff, equipment, capacity and - perhaps most important of all - the support and co-operation of surrounding communities. As such, the managing authority will need to have good consultative and communication systems, and effective mechanisms which may include incentives, to secure compliance with management objectives. Furthermore, since nature protection is by definition a social and political process (Brenchin 2001), protected areas
managers and conservationists will need to approach the problem in a holistic framework integrating socioeconomic, environmental and institutional issues.

It is evident that the current institutional arrangement needs changes. First, NFR status will need to change in order to prevent confusion over the responsibility of the management between government agencies. Second, it is believed that community involvement in forest management may increase the motivation of individuals to protect the resource due to an enhanced sense of ownership and the anticipated increase in benefits (Banana et al. 2001). Therefore, there is a need to identify institutional arrangements that could ensure equitable distribution of benefits to local communities around the NFR.
CHAPTER 3
FOREST DEPENDENCY AND ITS IMPLICATION FOR THE CONSERVATION OF THE NFR

Introduction

Human dependence upon forests is a multifaceted phenomenon due to the fact that forests provide a diverse stream of benefits to humans (Beckley 1998). Humans depend upon forests directly for timber, non-timber products, and recreational experience and indirectly for things such as air and water quality, biodiversity, carbon sequestration, and other ecological services. Conservation of biodiversity in protected forest areas of developing countries has become complex and challenging because of higher dependency of population on natural resources for agricultural, energy, nutritional, medicinal, and income needs. Rwanda, a country of 26,338 sq km, with approximately 7% of its land surface under protected areas exemplifies many management challenges relating to protected areas. Rwandans depend on protected areas for agricultural land, livestock pasture and fuel wood.

Protected area managers have relied upon law enforcement approaches to resolve problems associated with local people. However, the success is very limited because of lack of recognition to the needs of local communities living around the protected areas (Studsrod and Wegge 1995). It is now widely recognized that the long-term survival of protected areas in developing countries will be jeopardized if needs, aspirations, and attitudes of local peoples are not accounted for (McNeely, 1990; Ghimire and Pimbert 1997). This suggests that understanding the dependency and conservation attitudes of
local people towards protected areas surrounding them is of great importance to formulate new or modify existing conservation strategies.

Several studies have demonstrated the role of forest resources in the economy of forest inhabitants in different parts of the world (Fernandes et al. 1988; Falconer and Arnold 1998; Cavendish 2000, Gunatilake 1996; Gunatilake 1998; Godoy 1993; Hedges and Enters 2000; Reddy and Chakravarty 1999, Barham et al. 1999; Bahuguna 2000; Takasaki et al. 2001). However, very few attempts were conducted to assess the socio-economic determinants of forest dependency (Gunatilake 1998). The objectives of this study are, therefore, to identify the socioeconomic factors determining forest dependency of communities around the NFR; and to assess the impact of dependency on households’ attitudes towards NFR conservation.

**Conceptual Framework of the Study**

In this study the resource use theory provided by Firey (1960) will be used as a framework to guide the study. The theory recognizes three value factors or frame of references- ecological, economic, and ethnological/cultural – that interact with each other and play a role in determining local perception towards a resource system. Social groups differ in their needs and perceptions with respect to a resource so do their attitudes towards resource systems. There is growing empirical evidence in support of the thesis that local people’s support for protected areas depends on the perceived costs and benefits of conservation.

Off-farm employment opportunities, agricultural income, household size, education and incorporation to outside market are found to influence forest dependency (Gunatilake 1998; Hedges and Enters 2000). However, a study by Nepal and Weber (1995) revealed that dependence on protected area resources leads to negative attitudes
towards protection policy. Also Infield (1988) found that poverty leads to negative attitudes towards wildlife protection. Infield (1988) found that benefits from the protected area and a better education result in a more positive attitudes in Natal, South Africa. In addition, Heinen (1993) points out that literacy and rights to collect forest products lead to positive attitudes. However, crop damage and restrictions on grazing and collection of fuel wood were shown to have negative impact on the conservation of Kosi Tappu Wildlife Reserve, Nepal. These results have been supported with other findings from various countries (De Boer and Baquete 1998; Parry and Campbell 1992; Fiallo and Jacobson 1995). In addition, Parry and Campbell (1992) found that crop damage, loss of livestock and greater dependence on wildlife for meat resulted in more negative attitude towards conservation. A study by Gullingham and Lee (1999) points out that gender and wealth influence attitudes. Also, Nepal and Weber (1995) found that landholding size has positive effect on attitude towards the park. Finally, the study of Mehta and Heinen (2001) in Nepal revealed that benefit from tourism, wildlife depredation issue, gender, and education level were significant predictors of local attitudes towards conservation.

Drawing on the literature reviewed, a framework is developed to examine the effects of forest dependency on the conservation of the NFR (Figure 3-1). This framework consists of two models that are interrelated. Household’s socioeconomic and demographic characteristics determine income, the extent of consumption, production and expenses. Forest dependency is driven by households’ socioeconomic and demographic characteristics. Conservation attitudes are influenced by households’ socioeconomic and demographic characteristics and the extent of forest dependency.
Institutions regulate access to resources in protected area and design management strategies that have an impact on communities.

**Figure 3-1: Conceptual framework explaining households’ dependency and attitudes towards conservation**

**Research Design and Data Collection**

**Study Sites and Respondent Selection**

This study was conducted in five villages neighboring the NFR namely Gisakura, Bweyeye, Rangiro, Kitabi and Nshili. The data for the estimation of forest dependency
were collected using a structured questionnaire survey (Appendix A). The selection of sample was done as shown in Figure 3-2. Five districts out of twelve surrounding the NFR were randomly selected. Within each of the five districts one sector contiguous to the forest was randomly selected and within each sector one village was selected randomly. Finally within each village thirty-five households were randomly selected for interview. In total one hundred seventy five households were randomly selected from villages around the NFR. In case the household head was not available during the visit, the next person in the household was interviewed. Stratified sampling method was used to capture the environmental heterogeneity and market opportunities associated with distinct geographic locations to see how they influence forest dependency in villages. Secondly, this was important in ensuring equal chances of selection of households from both high and low income within and between villages around the NFR. In selected villages, names of residents’ households were compiled with the help of local council authorities and thirty-five households were selected from each village. The names of residents’ households were written on pieces of paper and put in a box and with the help of research assistants; respondents’ names were drawn randomly from the box.
Five districts out twelve randomly were selected

From each district one sector was selected randomly from sectors that bordered with NFR (5 sectors in total)

From each sector 1 village was randomly selected (5 villages in total)

From each village 35 households were selected randomly (175 households in total)

**Survey Design**

The survey was divided into three main sections (see Appendix A). Section one included 4 questions about attitudes to environmental issues in general and to the conservation of the NFR in particular. Three questions were open-ended questions while one question was designed to be measured using a 5-point Likert-type scale, with a neutral central category (5 = Most important, 4 = More important, 3 = Important, 2 = Less important and 1 = Least important). At the analysis stage responses were recoded into dummy variables where responses with scores greater to “3” were recoded as “1”
and responses with scores less than or equal to “3” were recoded as “0” based on the assumption that neutral response could indicate a less important issue.

The second section was composed of 12 questions about forest resources use. Respondents were asked to report and quantify all items they collect from the forest, and how much time they spend in getting these items. The value of the resource was calculated as the product of time spent and local wage rates. Where market prices of resources existed, they were used to compute the value of the resources.

The third section dealt with 9 questions covering the respondent’s background. Specifically, they were asked for their education, length of residence in the area, household size and composition and household socio-economic characteristics and productive activities. Respondents were also asked to report the size of the land they own, the main crops they grow, and their crop output. In addition, respondents were asked to list all capital assets they own.

**Administration of the Survey**

Questionnaire was translated in Kinyarwanda and administrated orally. A team of five trained research assistants administered the questionnaire. First, the survey was pre-tested with Nyungwe forest staffs and 25 community members of Gisakura village. After the pre-test minor revisions were made for the questionnaire. The survey was approved by the University of Florida Institute of Research Bureau (Approval Protocol # 2001 - 415) and by the Office Rwandais du Tourisme et Parcs Nationaux).
Estimation of Forest Dependency

Model Specification and Data

The dependent variable, the forest dependency, used in the logit model is a binary variable. The cut off value used to transform the dependent variable represent 40% of the total income. We assumed that households whose forest income represents greater or equal to 40% of the total income are highly dependent, while households whose forest income represents lesser than 40% of the total income is less dependent. Thus, the variable is assigned a value of zero if the household forest dependency is < 0.4 and a value of 1 if the household dependency index is ≥0.4. The binary nature of the dependent variable suggests that a logit model is appropriate. Logistic regression model is a statistical technique in which the probability of a dichotomous outcome (such high dependency and lower dependency) is related to a set of explanatory variables that are hypothesized to influence the outcome.

The model used to estimate forest dependency is specified as follows:

\[
\ln\left(\frac{P_i}{1-P_i}\right) = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \ldots + \beta_k X_{ik}
\]

where subscript \(i\) denotes the \(i\)-th observation in the sample, \(P\) is the probability of the outcome, \(\beta_0\) is the intercept term, and \(\beta_1, \beta_2, \ldots, \beta_k\) are the coefficients associated with each explanatory variable \(X_i, X_2, \ldots, X_k\).

Based on the conceptual framework discussed in the previous section, the impact socioeconomic factors -- age, gender, education, household size, agricultural income, market access, and landholding size—on forest dependency is estimated below. Before

---

1 Another method when the dependent variable is a binary variable is the probit regression model. The logistic function approximates the normal distribution quite well and is analytically convenient (Gujarati 1995).
presenting the results of estimation, a brief description is provided about the variables used in the model.

**Household income**

Household income computation was carried out in the following way:

\[
\text{Household Annual Income} = \sum (\text{FOREST INCOME} + \text{AGRICULTURE INCOME} + \text{RETURN TO WEALTH} + \text{WAGE INCOME})
\] (1)

**Forest income**

Information about forest products collection and selling was obtained from households. Products such as bamboos and wild honey are traded and yield cash while subsistence products such as fuelwood are used for household purposes. Income from commercial products was calculated by multiplying the quantities with market prices. Income on subsistence products was computed based on surrogate prices, where values are inferred from prices of alternatives that are closely related goods. Mines of gold and tantalite constitute another major source of income from the NFR. Income from mining was computed using the local market price per unit of each mineral.

**Agriculture income**

Agriculture included cultivation of both commercial and subsistent crops. Information on crop yields was obtained from individual households through the questionnaire survey. Prices of crops were obtained from local markets. Income from farming was computed by multiplying the annual crop yields with respective prices.

---

2 The underlying mathematical details for the logistic model are presented in Appendix B.
**Wage income**

Labor earnings from wage employment were calculated by multiplying the number of days worked by the local wage rate for a year. Information on other sources of employment such as salaried jobs and business were collected from individual members.

**Capital asset**

Recent studies have recognized the role of capital asset on the economic life of rural peoples and its influence on natural resource use (Barham et al. 1999; Reardon and Vosti 1995; Takasaki et al. 2000; Takasaki et al. 2001). The annual rate return on the capital (livestock, bicycle, motorcycle etc.) was computed as a product of the price of the asset and the interest rate. For the purpose of this study the interest rate used was 10%.

“Forest dependence index” was calculated as the ratio of income earned from the forest (mining, forest products, labor earning from mining) on the total income earned from various activities (Forest activities, return to wealth, agriculture, and labor).

**Explanatory Variables**

Descriptions of the variables used in the logistic regression analysis, their unit of measurements and their expected relationship with forest dependency are summarized in Table 3-1.

**Education**

Hedge and Enters (2000) show that high-educated people will have greater off-farm employment opportunities than less educated people. In general education opens up diverse and better employment opportunities. As such people tend to move away from subsistence agricultural and gathering activities. Therefore, it is hypothesized that forest dependency is inversely related to the education level of the members of the family.
**Age**

Age may be an important variable in determining forest dependency. Forest dependent activities in protected forests are labor intensive because people have to walk a long distance to reach and search for forest resources. Also forest dependent activities are often prohibited in protected forests, therefore elderly people may not take a risk of going into the forest to do illegal activities. It is hypothesized that forest dependency is inversely related to the age.

**Gender**

Nature collection and use of forest resources depend on the sex of the individual. For example, men carry out activities such as hunting and mining. Collection of wild vegetables and thatching grass are exclusively carried out by women. Cultivation and firewood collection are joint activities. Because forest dependent activities are labor intensive and prohibited in the reserve, men are more likely to take the risk relative to women to enter the forest. Therefore, it is hypothesized that household with males as heads have a greater dependency than households with women as heads.

**Household size**

Families with more labor tend to extract more forest resources (Gutanilake 1998; Hedge and Enters 2000). In general large families require more resources to meet their subsistence needs, therefore have a higher propensity to extract resources from the reserve. In addition, families with more labor can mobilize part of it for forest dependent activities while maintaining the labor supply for village-based activities. It is hypothesized that size of the family is directly related to forest dependency.
Landholding size

Families with more land are likely to earn more income from their own land and therefore depend less on forest resources from the reserve. Thus, land size is expected to be inversely related to forest dependency.

Market access

Access to outside market may affect forest resources extraction in different ways. On one hand, access to markets may open up better employment opportunities thereby making people less dependent on forest resources. On the other hand, market access may facilitate commercialization of forest resources and thus may promote extractive activities. Therefore, it is hard to determine, a priori, the impact of market accessibility on forest dependency. Gunatilake (1998) shows that access to outside markets will reduce forest dependency. Godoy and Bawa (1993) found that indigenous people who live far away from markets can deplete forest resources. In this study it is hypothesized that community’s access to markets reduces forest dependency.

A “market access” index was developed following Gunatilake (1998). Distance to the nearest town, distance to ride a bus, number of buses available per day and availability of other facilities such as school and medical centers were used in developing an index value. Information on these variables was collected at the village level from key informants. Each village was assigned a rank on a scale of 1 to 10 based on the ascending order of market access. For example, the villages with the shortest distance to the nearest town were assigned a rank of 10. Similarly, ranks were assigned for distance to ride a bus and frequency of the bus visits. Villages with more facilities were assigned higher
ranking while village with fewer facilities were assigned a low rank. The average score of all four categories was used as a market access index.

*Agriculture income*

Gunatilake (1998) show that higher agriculture productivity and agriculture income result in less extraction of forest resources. In general, people from farm-dependent villages will depend less on forest resources. It hypothesized that the forest dependency is inversely related to agriculture income.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Variable definition</th>
<th>Expected sign</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DEPENDENCY</strong></td>
<td>(dependent variable measuring forest dependence)</td>
<td>No assigned</td>
</tr>
<tr>
<td><strong>EDUCATION</strong></td>
<td>(respondent's level of education)</td>
<td>Negative</td>
</tr>
<tr>
<td><strong>AGE</strong></td>
<td>(respondent’s age in years)</td>
<td>Negative</td>
</tr>
<tr>
<td><strong>GENDER</strong></td>
<td>(1 if respondent is male, 0 female)</td>
<td>Positive</td>
</tr>
<tr>
<td><strong>LAND</strong></td>
<td>(Land area in ha)</td>
<td>Negative</td>
</tr>
<tr>
<td><strong>TAGRINC</strong></td>
<td>(Total income from agriculture)</td>
<td>Negative</td>
</tr>
<tr>
<td><strong>HHS</strong></td>
<td>Family size of the household</td>
<td>Positive</td>
</tr>
<tr>
<td><strong>MARKET ACCESS</strong></td>
<td>(distance to the nearest town, 10 village with the shortage distance and 1 village with the longest distance)</td>
<td>Negative</td>
</tr>
</tbody>
</table>

**Results and Discussion**

Results of the model explaining forest dependency are given in Table 3-1 and are analyzed in terms of overall significance of the model and the impact of each explanatory variable on forest dependency. The Likelihood Ratio test shows that the regression model is significant with Chi-Square statistics of 40.35. This result indicates that the explanatory
variables included in the model are significantly related to the dependent variable, forest dependency (DEPEND). The explanatory power of the model is given by the model goodness of fit statistics ($R^2$). Since upper bound $R^2$ for binary-choice models is approximately 0.33 (D’Souza et al. 1993) an $R^2$ value of 0.20 suggests that the model has reasonable explanatory power. The results show that the model predictions are correct 89.08% of the time indicating that the explanatory variables allow us to specify the dependent variable, in discrete terms (1, 0), with high degree of accuracy. Therefore, the results can be considered reliable and used for formulating forest conservation policies.

In this model, many explanatory variables have the expected effect on forest dependency. While coefficients on the AGE, TAGRINC and MACCESS are statistically significant at 5%, variable HHS is significant at 10%. The variable AGE shows a negative relationship to the forest dependency. This suggests that younger households are more dependent on forest resources. This may be due to the fact that forest dependent activities in the NFR are illegal and it is risky to undertake them. Youth generally take greater risks relative to older people in the community. Furthermore, with limited off farm economic opportunities, younger households rely more on forest resources to meet their basic needs. A study by Andre and Platteau (1998) in Rwanda notes that younger households are being trapped in poverty due to limited alternative economic opportunities.
The variable TAGRINC shows a negative relationship with forest dependency.

This implies that households with high agriculture income are less dependent on forest
resources. This finding is similar to the finding of Gunatilake (1998) wherein agriculture income was found to have a negative impact on forest dependency in Sinharaja forest community in Sri Lanka. Agriculture constitutes the main source of income for rural Rwandan households and contributes substantially to their income. Therefore, poor households with little income from agriculture may be more dependent on the forest (Cavendish 2000; Godoy 1993; Gunatilake et al. 1993).

Market access (MACCESS) has a negative relationship with forest dependency. When local communities are integrated to outside markets they tend to depend less on forest resources. People living in isolated areas with limited access to external markets and infrastructure facilities are likely to remain poor and will continue to depend on surrounding forest resources. On the other hand, communities closer to town may have a wide range of opportunities such as employment in tea plantations and small businesses. For example, communities who live closer to tea plantations show less dependency to Nyungwe Forest resources because they have access to year round employment. In addition, returns to labor and agriculture may be high in villages closer to the market than those of isolated villages. This result supports the argument of Angelsen and Kaimowitz (1999) that higher rural wage and greater off-farm employment opportunities reduce deforestation.

The variable household size (HHS) has a positive relationship with forest dependency. This suggests that large families tend to depend more on forest resources. Due to higher unemployment in the Nyungwe Forest area, large families mostly rely on forest resources to increase their income or to meet their basic needs. Also, forest activities such as honey collection are labor intensive and therefore larger households are
more likely to undertake these activities. Hedge and Enters (2000) also found the same relationship between household size and income from forest products.

The variables EDUCATION, GENDER and LAND are not statistically significant. The positive coefficient of EDUCATION suggests that formally educated people are more dependent on forest resources. Although this result is somewhat counter intuitive, the reason for this observation may be due to lack of variation in education (see Table 3.2 for descriptive statistics) among households. Also, in the face of limited off-farm opportunities in rural areas, educated people with more knowledge about forest products such as minerals may have greater advantage over illiterate people. The positive coefficient of GENDER demonstrates that male respondents are more dependent on forest resources. The negative coefficient of LAND suggests that respondents with larger landholdings are less dependent on forest resources. This is consistent with the findings of Reardon and Vosti (1995) that in Rwanda, land-poor are also poor in off-farm capital and therefore cannot afford to continue sustainable agriculture. Therefore, land poor will rely more on forest resources to meet their livelihood needs.

The elasticities at the means of explanatory variables are reported in Table 3.3. The elasticity column shows the odds of being high forest dependent in response to a unit change in the mean value of an explanatory variable. For example, a household whose TAGRINC exceeds 232.82 USD per year is approximately 29.6 % more likely to be less dependent on the NFR than those with lower income. Similarly, the MACCESS has an elasticity of 0.739 indicating that households with market access index higher than 6.22 are 73.9 % more likely to be less dependent on the NFR than those who live in rural/remote areas.
Measurement of Conservation Attitude

Model Specification and Data

Attitude is defined as organization of beliefs about an object or situation that influence one’s response to that object (Rokeach 1968). The local community’s conservation attitude is analyzed as a function of forest dependency and a set of socioeconomic factors. Local communities around the NFR expressed their attitudes towards conservation by approving or disapproving several statements. Unlike many variables such as income and age, it is difficult to perceive attitude as a continuous variable. The dependent variable is a binary variable regarding conservation attitude. As noted earlier, the binary nature of the dependent variable suggests that a logit model is appropriate. Logistic regression analysis was used to determine which factors were significant in predicting attitude towards conservation (see Appendix A for details). Gillingham and Phillis (1999) and Mehta and Heinen (2001) used the same technique to assess the relationship between socioeconomic factors and conservation attitude.

The logistic regression model characterizing conservation attitude by the sample households is specified as follows:

\[
\ln\left(\frac{P_i}{(1 - P_i)} \right) = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \cdots + \beta_k X_{ki}
\]

where subscript \(i\) denotes the \(i\)-th observation in the sample, \(P\) is the probability of the outcome, \(\beta_0\) is the intercept term, and \(\beta_1, \beta_2, \ldots, \beta_k\) are the coefficients associated with each explanatory variable \(X_1, X_2, \ldots, X_k\).

Explanatory Variables

Data on household’s attitude and socioeconomic characteristics were collected through survey process (see section on research design and appendix A for details).
Limited access to forest resources (LIMAC)

Since conservation projects place restrictions on the use of forest resources, it is hypothesized that these restrictions may pose problems to households in meeting their forest products needs and therefore influence their attitude. Results from Heinen (1993) show that restrictions on grazing and collection of fuelwood led to negative attitudes in Nepal. Therefore, it is expected that households who perceive that they have limited access to the NFR due to protected area status are likely to develop a negative attitude.

Wildlife cropraiding (CRPRAID)

Mehta and Heinen (2001) show that wildlife damage in the form of crop raiding leads to a negative attitude. Given the widespread wildlife depredation around the NFR and the current ban on hunting or trapping wild animals, it is hypothesized that people who perceive wildlife crop damage is a serious issue would hold negative attitude towards conservation of the NFR.

Forest dependency (DEPENDENCY)

Households who are dependent more on extraction of forest resources are unlikely to favor conservation (Nepal and Weber 1995). Restrictions on the use of forest resources may affect their dependency and livelihood. Therefore, it is hypothesized that forest dependency may have a negative effect on attitude towards conservation.

Age

Age may be an important explanatory variable in determining conservation attitude. Elderly people may perceive the NFR as a constraint to their livelihood because of culture and traditions. In that case, AGE may have a negative influence on conservation attitude. Alternatively, if younger people are more dependent on forest
resources because of prevailing socioeconomic conditions, AGE variable may have positive impact on conservation attitude. Fiallo and Jacobson (1995) results show that older inhabitants are less likely to support conservation than younger people.

**Length of residency (LENGTH)**

Long-term residents are more likely to have been adversely affected by restrictions associated with protected area establishment than short-term residents (Newmark et al. 1993). Thus it is hypothesized that length of residency is inversely related to conservation attitude.

**Education**

The level of acceptance of the protected area increases with the education level of residents (Fiallo and Jacobson 1995; Heinen 1993). Educated people are expected to support conservation because they may be more aware of the short and long term benefits of conservation. It is hypothesized that education is positively related to conservation attitude.

**Landholding (LAND)**

Larger landholding size makes people more positive towards conservation. Households with more land are likely to earn more income from their own land and therefore depend less on forest resources. On the other hand landless people who see protection as a limitation to expand or to acquire land may hold a negative attitude towards conservation. Nepal and Weber (1995) show a positive relationship between landholding size and conservation attitude. Thus, it is expected that landholding size will have a positive impact on conservation attitude.
**Buffer zone benefits (BZBEN)**

Households around protected areas may have positive attitudes towards conservation because they perceive benefits from the buffer zone through employment, or because its establishment less affects them than other communities. Perception of the benefits from the buffer zones may lead to positive attitudes towards conservation. Results from Infield (1988); Brown (1991); Fiallo and Jacobson (1995); and Mehta and Heinen (2001) suggest that benefits from a protected area lead to a positive attitude towards conservation. Thus, it hypothesized that people who were not negatively affected by the establishment of the buffer zone plantations around the NFR have positive attitudes towards the NFR.

**Limited food (FOOD)**

Poverty leads to negative attitudes towards wildlife protection (Infield 1988). Maslow’s hierarchy of needs suggest that households that have hard time meeting their lower needs, such as food and shelter, may not care much about conservation. Therefore, it is hypothesized that people who perceive the food shortage as an important problem in their community may hold a negative attitude towards conservation.
Table 3-4: Variable definitions for conservation attitude model.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Variable definitions</th>
<th>Expected sign</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONAT</td>
<td>(dependent variable measuring conservation attitude)</td>
<td>No assigned</td>
</tr>
<tr>
<td>EDUCATION</td>
<td>(respondent’s level of education)</td>
<td>Positive</td>
</tr>
<tr>
<td>AGE</td>
<td>(respondent’s age in years)</td>
<td>±</td>
</tr>
<tr>
<td>LANDLIM</td>
<td>(1 if respondent’s important issue facing the community is land scarcity, 0 otherwise)</td>
<td>Negative</td>
</tr>
<tr>
<td>CRPRAID</td>
<td>(1 if respondent’s important issue facing the community is wildlife depredation, 0 otherwise)</td>
<td>Negative</td>
</tr>
<tr>
<td>FOOD</td>
<td>(1 if respondent’s important issue facing the community is lack of sufficient food, 0 otherwise)</td>
<td>Negative</td>
</tr>
<tr>
<td>LIMAC</td>
<td>(1 if respondent’s important issue facing the community is lack access to forest resources/products, 0 otherwise)</td>
<td>Negative</td>
</tr>
<tr>
<td>BZBEN</td>
<td>(1 if the respondent’s family benefits from the buffer zone plantations, 0 otherwise)</td>
<td>Positive</td>
</tr>
<tr>
<td>DEPENDENCY INDEX</td>
<td>(1 high dependence, 0 otherwise)</td>
<td>Negative</td>
</tr>
<tr>
<td>RESIDENCY</td>
<td>(Respondent’s residency length in years)</td>
<td>Negative</td>
</tr>
</tbody>
</table>

Results and Discussion

In response to questions such as “What kind of impact do the conservation activities have on you? Is it an improvement or a detriment?”, about 58% of respondents held positive attitude toward the NFR conservation program. On average 60% of respondents expressed that they have had problems with animals from the forest, 54% of respondents believed that limited access to forest resources is the most important issue facing their community, 89% believe that land scarcity is an important issue in their community, 91% perceived the lack of sufficient food as an important issue in the community and only 35% reported that their families benefit from the buffer zones plantations (Table 3-5). Since collection of forest products in the NFR is prohibited, few respondents reported that they collected resources from the forest.
The estimated coefficients from this model are presented in Table 3-6. The $R^2$ value (Maddala = 0.114), the likelihood ratio test statistic (chi-square value = 21.20), and the percentage of correct predictions (68.97%) suggest the model has limited explanatory power. However, Gujarati (1995) suggests that $R^2$ as a measure of goodness fit is not well suited for the dichotomous dependent variable models.

Table 3-5: Variable definition and descriptive statistics for attitude model.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>Std.Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONAT</td>
<td>0.58</td>
<td>0.49</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>EDUCATION</td>
<td>2.12</td>
<td>2.63</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>AGE</td>
<td>44.89</td>
<td>13.71</td>
<td>19</td>
<td>80</td>
</tr>
<tr>
<td>LANDLIM</td>
<td>0.89</td>
<td>0.30</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>CRPRAID</td>
<td>0.60</td>
<td>0.49</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>LIMAC</td>
<td>0.54</td>
<td>0.49</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>BZIBEN</td>
<td>0.35</td>
<td>0.48</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>DEPENDENCY INDEX</td>
<td>0.10</td>
<td>0.26</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>LIMFOOD</td>
<td>0.91</td>
<td>0.28</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>RESIDENCY</td>
<td>31.08</td>
<td>16.85</td>
<td>0</td>
<td>80</td>
</tr>
</tbody>
</table>

Overall, the majority of the variables had expected signs. Coefficients on BZBEN and LIMAC are statistically significant at $p<0.05$. The variable forest dependency (DEPENDENCY) is negative and statistically significant at $P<0.1$ suggesting that households with high level of dependency are more likely to hold negative attitudes towards the conservation of the NFR. This is consistent with Nepal and Weber (1995)
finding that people who are dependent on protected areas for their livelihood are unlikely to support conservation efforts.

The variable representing buffer zone benefits (BZBEN) is positive and highly significant, suggesting that families who realize benefits from the buffer zone plantations have more positive attitudes towards the NFR. The establishment of buffer zones has affected communities around the NFR differently. On one hand, people who live close to tea plantations with off-farm economic opportunities have positive attitudes because buffer zone plantations provide them with fuel-wood. In addition communities around tea plantations have not been expropriated by the government during the establishment of the buffer zone. On the other hand, people who live far away from tea plantations without economic alternatives perceive the buffer zone primarily as a limitation for the expansion of their agriculture into the reserve. Some people are against the buffer zone plantations because the government has expropriated their land in order to establish the plantations.

The variable representing limited access to forest (LIMAC) shows a negative relationship with conservation attitude. This suggests that households who perceive restrictions on the use of the forest as a concern hold a negative attitude. In the face of widespread poverty and limited economic opportunities in rural areas, it is quite natural that restrictions on the use of forests and other natural resources will lead to a negative attitude. Similar situations have been noted in other protected areas of developing countries. For example, Fiallo and Jacobson (1995) found that people who perceive personal benefits from Machalilla National Park in Ecuador held positive attitudes towards it than those who believed that the park affects them negatively. Meihta and
Heinen (2001) also found a positive relationship between tourism benefit and households’ attitude towards conservation in Nepal.

Table 3-6: Regression results showing determinants of conservation attitude.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficients</th>
<th>Standard Error</th>
<th>Elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGE</td>
<td>.0109</td>
<td>.012</td>
<td>0.201</td>
</tr>
<tr>
<td>BZBEN</td>
<td>1.049**</td>
<td>.367</td>
<td>0.153</td>
</tr>
<tr>
<td>LIMAC</td>
<td>-.778**</td>
<td>.348</td>
<td>-0.172</td>
</tr>
<tr>
<td>DEPENDENCY</td>
<td>-1.065*</td>
<td>.609</td>
<td>-0.040</td>
</tr>
<tr>
<td>EDUCATION</td>
<td>.061</td>
<td>.067</td>
<td>0.053</td>
</tr>
<tr>
<td>LANDLIM</td>
<td>-.278</td>
<td>.580</td>
<td>0.102</td>
</tr>
<tr>
<td>CRPRAID</td>
<td>-.343</td>
<td>.344</td>
<td>-0.084</td>
</tr>
<tr>
<td>RESIDENCY</td>
<td>.005</td>
<td>.009</td>
<td>0.067</td>
</tr>
<tr>
<td>FOOD</td>
<td>-.307</td>
<td>.651</td>
<td>-0.115</td>
</tr>
<tr>
<td>CONSTANT</td>
<td>.460</td>
<td>966</td>
<td>0.188</td>
</tr>
</tbody>
</table>

Maddala R²: 0.114  
Correct prediction: 68.97%  
LR test: 21.20

The variable limited land (LANDLIM) shows a negative relationship with conservation attitude. This result suggests that landless households perceive conservation programs as a limitation to meet their subsistence needs and therefore are likely to hold a negative attitude. The same result was observed in Nepal by Nepal and Weber (1995). Crop raiding (CRPRAID) has shown to have a negative relationship with conservation attitude but it is not statistically significant. This result suggests that people who suffer...
with wildlife depredation hold a negative attitude towards the conservation of the NFR. Given the scale of wildlife damage in the midst of widespread poverty it is likely that people-animal conflicts will result in less favorable attitude. This is consistent with other studies (Parry and Campbell 1992; Heinen 1993 and Mehta and Heinen 2001) that found a negative relationship between wildlife depredation and conservation attitude.

The variables age and education are not statistically significant but show positive relationship with conservation attitude. These results suggest that older people are more likely to hold favorable attitude towards conservation. This is explained by the fact that younger households with limited economic opportunities are more affected by restrictions associated with the NFR management. This result is in contradiction with findings from Ecuador and Tanzania where older inhabitants were less likely to support the park than younger households (Newmark 1993; Fiallo and Jacobson 1995). However, the positive relationship between the level of education and conservation attitude support the findings of Heinen (1993); Fiallo and Jacobson (1995); and Mehta and Heinen (2001).

The variable residency length (RESIDENCY) is positive but not significant. This suggests that short-term stay is more likely to hold negative attitudes towards NFR. This is explained by the fact that short-term residents are younger and landless. Therefore, they depend on forest resources to meet their livelihood needs. These results are in contradiction with the findings of Newmark et al. (1993) and Fiallo and Jacobson (1995) that long-term residents hold negative attitude than short-term residents. The variable limited food (FOOD) shows a negative relationship with conservation attitudes suggesting that people who cannot afford to meet their basic needs such as food are unlikely to appreciate conservation of the NFR. This is because it limits their ability to
collect food and other forest products. Infield (1988) found similar results that poverty leads to needs which results in negativity toward setting land aside for wildlife protection.

**Conclusion**

Understanding community dependency is critical for designing conservation strategies. This study reveals that community dependency on the NFR is driven by many factors. The results show that agriculture income and access to outside markets will reduce forest dependency. Also, younger households and larger families are more dependent on forest resources. In addition, people living in isolated areas with poor infrastructure are likely to be more dependent on the Nyungwe forest Reserve. Consequently, in the face of social and economic problems, rural poverty will exacerbate the need for access to natural resources in the NFR and increase the conflicts with the NFR management. Therefore, policy measures that aim at increasing agriculture income and generating off-farm employment opportunities for rural communities are needed to reduce forest dependency and enhance biodiversity conservation. This study shows that (1) forest dependency and (2) limited access to forest resources (3) lack of benefits from the reserve and its buffer zone, are the major factors that hinder the positive attitude toward the conservation of the NFR.

During the last decade, protected area managers, donors and non-governmental organizations have relied on the development of conservation education programs and ecotourism projects in the NFR. However, for households around the NFR who struggle to meet their basic livelihood needs, educational programs may have less impact in enlisting their cooperation towards conservation. The results suggest that any conservation programs relating to the NFR must consider the socio-economic characteristics of communities around the forest. There is a growing recognition for the
CBC approach to address the socioeconomic needs of rural communities around protected areas. In the next chapter I will assess the potential for a CBC approach to manage the NFR.
CHAPTER 4
ASSESSING THE POTENTIAL FOR COMMUNITY BASED CONSERVATION APPROACH TO MANAGE THE NYUNGWE FOREST RESERVE

Introduction

The continuous loss of biodiversity in tropical forests has led to the creation of protected areas in many developing countries. Conventional management strategies such as the “fences and fines approach,” which prohibits human use of resources in protected areas, have failed to conserve biodiversity in the tropics (Wells et al. 1992). Failures may be more pronounced in places where communities are more dependent on protected areas for their subsistence needs. However, community-based conservation (CBC), an approach that recognizes the basic needs of people who live in and around the protected areas, is thought to provide solutions to biodiversity conservation (Western et al. 1994; Gibson and Marks 1995). Following Uphoff (1998), we refer to the CBC approach as efforts that involve local people as an integral part of natural resource management by engaging their ideas, experiences, values, and capabilities and seeking means to benefit participating communities. The above definition presumes that biodiversity conservation will succeed only if local communities participate in protected area management and in return receive sufficient benefits (Gibson and Marks 1995). Also, CBC is thought to address the inherent weakness of the conventional strategy wherein local communities bear more costs and reap fewer benefits of protected areas management, relative to external communities. Furthermore, factors such as limited resources to pursue “fences and fines” approaches, increasing appreciation for decentralized decision making, and
growing recognition of the rights of local communities to resources (Gibson and Marks 1995; Lewis and Carter 1993; Murombedzi 1998; Salafsky and Wollenberg 2000) provide impetus for CBC. Although some are skeptical about the potential of this concept in achieving the goals of conserving natural resources and enhancing the well-being of local communities (Wells et al. 1992; Barrett and Arcese 1995; Gibson and Mark 1995; Hackel 1999; Kellert et al. 2000; Songorwa et al. 2000), it is appealing and support for implementation is increasing (Western and Wright 1994; McNeely and Pitt 1985). Furthermore, past research suggests that the effectiveness of CBC depends largely on socioeconomic factors of communities and biophysical attributes of the natural resource. This implies that if CBC plans that were developed under certain conditions are transferred into different set of conditions, their success becomes more unpredictable. Therefore, it is critical to assess the potential of CBC as perceived by various stakeholders.

This study assesses the potential of CBC to manage the Nyungwe Forest Reserve (NFR), Rwanda. Specifically, we apply strengths, weaknesses, opportunities and threats (SWOT) in combination with Analytical Hierarchy Process (AHP) to assess the perceptions of representatives from local communities, a government agency, and an environmental organization about the application of the CBC approach to the NFR. While SWOT analyzes perceptions that determine potential success or failure of an approach or plan (Weihrich 1982; Kotler 1994; Smith 1999), AHP measures the relative importance of those perceptions (Saaty 1977, 1982, 1993; Zahedi 1986; Wind 1987). AHP, as a decision-making tool, has been widely used to assess forest management planning (Mendoza and Sprouse 1989; Kuusipalo and Kangas 1994), to integrate
biodiversity protection with forest management planning (Kangas and Kuusipalo 1993), to develop resource management plans for national parks (Peterson et al. 1994), to monitor resources in national parks (Schmoldt et al. 1994), and to design a buffer zone for a nature reserve (Li et al. 1999). More recently, Kurtilla et al. (2000) applied SWOT-AHP to examine the potential of forest certification in private forest management.

SWOT-AHP Methodology

Although SWOT analysis was introduced as a part of a strategic planning process, it is now extensively used independently in public and private business decision-making (Weihrich 1982; Kotler 1994; Smith 1999). This approach helps planners identify factors (i.e., strengths, weaknesses, opportunities, and threats) related to a decision and enables planners to match external opportunities and threats with internal strengths and weaknesses. In conventional SWOT analysis, the magnitude of SWOT factors is not quantified to determine the effect of each factor on the proposed plan or strategy. One can overcome this problem by using the AHP method, which assigns relative priority to each factor through pair-wise comparison and uses an ordered structure to derive ratio scales (Zahedi 1986; Wind 1987; Saaty 1993).

Following Kurtilla et al. (2000), we explain SWOT-AHP analysis in three steps. The first step is to identify possible positive and negative factors relating to the proposed strategy or decision (see Table 4-1 for the list of SWOT factors relating to CBC). It is suggested that less than 10 factors are included within each SWOT group so that the number of pair-wise comparisons is manageable. Pair-wise comparison of factors within each SWOT group is the second step (see Figure 4-1 for a portion of the questionnaire indicating the pair-wise comparison). Determining the relative importance of two strength factors, for example, is central in this step. This procedure must be repeated
separately for all SWOT factors. From these pair-wise comparisons, a priority value for each factor within each SWOT group is computed using the eigenvalue method (see Appendix D for details). Next, the factor with the highest priority value under each SWOT group should be brought forward for further comparisons. The third step involves pair-wise comparison of these four factors that are brought forward and computation of priority values for each factor. In order to differentiate these priority values from those computed under step 2, these values are often described as scaling factors. Scaling factors and priority values are used to calculate the overall priority of each factor as shown below:

\[
\text{Overall priority of factor } ij = (\text{priority value of } ij) \times (\text{scaling factor of group } j)
\]

Where \( j = 4 \) (strength, weakness, opportunity, and threat). The overall priority scores of all factors across groups sum to one and they indicate the relative importance of each factor.

**Survey Design and Data Collection**

In June 2001, we organized a three-day stakeholders meeting in Gisakura, a semi-urban center near the Nyungwe Forest, Rwanda, to generate required data for SWOT-AHP analysis. There were 11 people (excluding two researchers) representing three stakeholder groups—5 people from local communities, 3 people from the ORTPN, and three people from the WCS. In order to get representative views from all stakeholders, caution was exercised in the participant selection process. For community representatives, criteria for selection were based on the ability of an individual to express community views in a group, knowledge of Nyungwe Forest conservation issues, and formal leadership at the grass roots level. Consistent with the representative democracy principle, we selected one member from each of five different Local Councils.
Representatives of communities were contacted two weeks before the actual meeting at which time the purpose of our research was explained to them. As pointed out earlier, the ORTPN and the WCS are responsible for undertaking and coordinating conservation efforts in the Nyungwe Forest. Out of the three ORTPN representatives, one was from the national headquarters (Kigali), one was the Warden of the Nyungwe Forest, and the other was a field staff member. Selected representatives of WCS were knowledgeable and experienced about Nyungwe Forest conservation programs and the socioeconomic situation of local communities. Among WCS representatives, one was the project director, and the two others were the conservation education officer and a field staff member respectively.

We conducted a brainstorming session with participants and generated an exhaustive list of SWOT factors relating to the CBC approach to the NFR. The factors listed were further reviewed, deliberated, and aggregated. For example, factors such as income generation and employment opportunity were aggregated as additional source of income (Table 4-1). This process yielded 3 strengths, 4 weaknesses, 4 opportunities, and 4 threats.
Table 4-1: SWOT factors relating to CBC approach

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Opportunities</th>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>S1: Additional source of income.</strong></td>
<td><strong>O1: Better community-agency relationship.</strong></td>
<td><strong>T1: Biodiversity loss.</strong></td>
</tr>
<tr>
<td>- Income generation</td>
<td>- Relations between communities and agencies would improve</td>
<td>- Wildlife and habitats may suffer</td>
</tr>
<tr>
<td>- Employment opportunities</td>
<td>- Profit sharing</td>
<td>- Potential negative impacts on tourism</td>
</tr>
<tr>
<td><strong>S2: Management benefits.</strong></td>
<td><strong>O2: Reduction of poverty.</strong></td>
<td><strong>T2: Potential collapse of CBNRM.</strong></td>
</tr>
<tr>
<td>- Reduction of management cost</td>
<td>- Socioeconomic improvement of communities</td>
<td>- Potential conflicts within and between communities</td>
</tr>
<tr>
<td><strong>S3: Favorable institutional set up.</strong></td>
<td><strong>O3: Improved community awareness.</strong></td>
<td><strong>T3: Uncertainty associated with high level decisions.</strong></td>
</tr>
<tr>
<td>- Existing decentralization process helps succeed CBNRM</td>
<td>- Promotes equality in distribution of income</td>
<td>- Limited influence of communities/agencies in high level decision making</td>
</tr>
<tr>
<td>- Existing government policies and CBNRM are similar</td>
<td><strong>O4: Additional future benefits.</strong></td>
<td>- Limited influence of field staff over high level decisions</td>
</tr>
<tr>
<td></td>
<td>- Increasing understanding of the importance of forest</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Rural-urban exodus might drop</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- CBNRM may lead to overall buffer zone management by communities</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Leads to sustainable forests</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Improvement in forest protection</td>
<td></td>
</tr>
</tbody>
</table>

The SWOT factors listed in Table 4-1 were used to develop a survey questionnaire for pair-wise comparison. The survey questionnaire included a rating scale...
of one to nine to weigh each factor relative to the other (Figure 4-1). Groups of respondents were asked to deliberate and evaluate the SWOT factors in pairs and indicate if both factors are equally important or one is more important than the other. However, the survey questionnaire was administered to the three stakeholder groups separately. In Figure 4.1, if the response was “3” on the right side, it implies that the strength that is listed on the right side of the questionnaire is three times more important than the strength listed on the left side.

1. Compare STRENGTH A to STRENGTH B, and circle one appropriate number:

Figure 4-1: An example of a pair-wise comparison between strength factors

Unlike many statistical analyses, SWOT-AHP analysis is not designed to estimate central tendencies of variables. On the contrary, SWOT-AHP approach focuses on in-depth analysis of stakeholders’ preferences (Kurtilla et al. 2000). As facilitators, we ensured that no one individual dominated in assigning the relative weights within each group. If there was a difference in individual choices within the group, members were asked to explain their viewpoint, convince other members in the group, and come to a consensus. This approach assumes that members within each stakeholder group are homogeneous. This assumption is not unrealistic because members in a group or an agency generally endorse an issue or action collectively. We assisted each stakeholder group separately in filling out the questionnaire by explaining the process of pair-wise comparisons in order to avoid ambiguities and inconsistency in selecting the choices.

Following the procedure detailed earlier, the responses of each stakeholder group were used to estimate a priority value for each factor within each SWOT group. The
factor that scored the highest priority value within each SWOT group was brought forward, and respondents were asked again to perform pair-wise comparisons. The data obtained from these pair-wise comparisons were used to estimate scale factors for each SWOT group. Scale factors were further used to calculate overall priority scores for each factor within each SWOT group. Throughout our analysis, consistency ratios are maintained below 0.1 and we used Expert Choice computer software to analyze data (Expert Choice 2001).

**Results and Discussion**

The results of SWOT-AHP are presented both in tabular (Table 4-2) and graphical formats (Figure 4-3 and 4-5). Since the overall priority scores add up to one, the overall priority score of each factor can be interpreted as the weight of each factor on the proposed CBC. The overall priority score of each factor, which is computed as a product of its factor priority and group priority scores, indicates its relative importance in decision-making. Also, the overall priority scores of strength or opportunity factors are to be interpreted as favorable towards the proposed decision and the overall priority scores of weakness and threat factors as unfavorable. For example, overall priority scores of 0.572 and 0.127 (column 5 of Table 4-2) indicate that strengths and opportunities of CBC would account, respectively, for about 57% and 13% support for CBC from the community group. With this understanding, we will proceed further interpret and understand the perceptions of all stakeholder groups. The priority scores reported in columns 2-4 of Table 4-2 indicate the relative importance of each factor within each SWOT group. For example, a priority value of 0.627 reported in the second column of Table 4-2 indicates that community members think that additional source of income (S1) alone accounts for about 63% in the total of strength of CBC.
Table 4-2: SWOT factors and their priority and overall priority scores

<table>
<thead>
<tr>
<th>SWOT groups</th>
<th>Factors priority scores</th>
<th>Overall priority scores</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Community</td>
<td>ORTPN</td>
</tr>
<tr>
<td>Strengths</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S1</td>
<td>0.627</td>
<td>0.674</td>
</tr>
<tr>
<td>S2</td>
<td>0.094</td>
<td>0.226</td>
</tr>
<tr>
<td>S3</td>
<td>0.28</td>
<td>0.101</td>
</tr>
<tr>
<td></td>
<td>0.572</td>
<td>0.289</td>
</tr>
<tr>
<td>Weaknesses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W1</td>
<td>0.096</td>
<td>0.096</td>
</tr>
<tr>
<td>W2</td>
<td>0.55</td>
<td>0.55</td>
</tr>
<tr>
<td>W3</td>
<td>0.053</td>
<td>0.053</td>
</tr>
<tr>
<td>W4</td>
<td>0.301</td>
<td>0.301</td>
</tr>
<tr>
<td></td>
<td>0.24</td>
<td>0.061</td>
</tr>
<tr>
<td>Opportunities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>O1</td>
<td>0.054</td>
<td>0.301</td>
</tr>
<tr>
<td>O2</td>
<td>0.558</td>
<td>0.539</td>
</tr>
<tr>
<td>O3</td>
<td>0.289</td>
<td>0.104</td>
</tr>
<tr>
<td>O4</td>
<td>0.102</td>
<td>0.057</td>
</tr>
<tr>
<td></td>
<td>0.127</td>
<td>0.113</td>
</tr>
<tr>
<td>Threats</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T1</td>
<td>0.627</td>
<td>0.234</td>
</tr>
<tr>
<td>T2</td>
<td>0.094</td>
<td>0.081</td>
</tr>
<tr>
<td>T3</td>
<td>0.28</td>
<td>0.685</td>
</tr>
</tbody>
</table>

Note: Figures in bold are factors of each SWOT group

Community representatives’ perceptions

The overall priority scores reported in column 5 of Table 4.2 provide valuable information about community members’ perspectives toward CBC. The scores reveal that additional source of income (S1) is the dominant strength of CBC and reduction of
poverty (O2) is a major opportunity factor. In the face of widespread poverty in communities around the NFR, community representatives thought CBC would be a potential strategy in providing additional income and in improving the well-being of communities. The most serious weakness, as perceived by community members, is limited awareness about conservation and development activities (W2). This may be because many rural people have a low level of education and resource conservation issues are so complex. Communities around the NFR may not have adequate capacities to manage forest resources efficiently. Among threats, this group perceives that biodiversity loss (T1) is the most significant negative factor of CBC.

Figure 4-3 presents a more intuitive explanation about the perceptions of community members relating to the CBC. While the length of lines in the top two quadrants indicates the weight of positive factors (strengths and opportunities), those in the bottom two quadrants reflect the weight of negative factors associated with CBC. This suggests that, from community members’ perspective, positive factors with a weight of approximately 0.7 would outweigh the negative factors. This result is consistent with other findings, which indicate that community members and policy makers generally perceive CBC programs as effective means of generating socioeconomic benefits to locals and conserving wildlife (Western et al. 1994 as reported in Songorwa et al. 2000). Kellert et al. (2000) also found similar results from case studies in Nepal and Kenya.
Figure 4-3: Overall priority scores of SWOT factors for community members

**Government agency (ORTPN) members’ perceptions**

Figure 4-4 presents the perceptions of ORTPN members relating to the CBC. This stakeholder group perceives that negative factors associated with the CBC approach would outweigh its positive factors. The overall priority score of threats (0.536) reported in column 6 of Table 4-2 indicates that this group has significant concerns about the applicability of CBC to the NFR. In particular, this group believes that the uncertainty associated with high level decision-making (T3) might pose challenges to the implementation of CBC. For example, if changes in the government and administration result in changes in the CBC approach (say a reduction in the benefit share of the community), there will be conflicts between local communities and the implementing agency. This is a legitimate concern for the ORTPN because changes in government institutions and their policies are frequent in Rwanda. In addition, the ORTPN members
strongly feel that there is not enough institutional capability to implement CBC, and if anything goes wrong in its implementation they will have to face the public at frontline.

![Graph showing ORTPN preferences for CBC]

Figure 4-4: ORTPN preferences for CBC

Furthermore, local government agencies and communities have limited influence in decision-making processes because of the existing top-down management approach where politics rather than science play a key role in decision-making. Limited trust and tainted relationships between communities and the implementing agency would hinder the success of CBC. ORTPN members’ perceptions are consistent with observations of Fiallo and Jacobson (1995) that poor relations between community members and the park staffs in Ecuador were largely due to the top-down management approach. Although this group thinks that negative factors associated with CBC have more weight, it perceives that CBC has potential positive features. In particular, they think that CBC would provide additional income (S1) and help reduce poverty in local communities (O2).
WCS members’ perceptions

Figure 4-5 presents the perceptions of WCS members relating to CBC in the NFR. The perceptions of this group are similar to the members of ORTPN. Members of WCS perceive that negative factors associated with the CBC approach are even more serious.

![Figure 4-5: WCS preferences for CBC](image)

The overall priority scores of weaknesses and threats (0.529 and 0.262) reported in column 7 of Table 4.2 indicate that the negative factors as perceived by this group would account for about 80% weight in the decision making. In other words, this groups thinks that the positive aspects of CBC within the NFR are only about 20%.

In particular, this group believes that the limited control of government agency (W4) as a result of CBC would be a major weakness. Members of WCS think that decentralization of power to local communities may weaken the conservation capabilities of the government agency. Furthermore, this group also perceives that community access to the
NFR and tourism activities that are likely to be permitted under the CBC approach would pose a serious threat to the biodiversity in the NFR. The weight of positive factors as perceived by this group is very limited.

**Conclusion**

The Nyungwe Forest plays many key ecological roles at the local, national and global level. However, conservation of this forest is becoming increasingly complex due to changes in the demographic and socioeconomic condition of local communities. Finding a sound management strategy that integrates community well-being and conservation of this unique forest ecosystem is of paramount importance. There is a growing recognition for the CBC approach to address this type of situation. Our SWOT-AHP analysis of CBC demonstrates that there is little consensus among members of the local community, ORTPN, and WCS about the potential of CBC in the context of Nyungwe. Community members indicate that the positive factors associated with CBC outweigh its negative factors. The converse is true with respect to the government agency and the WCS. This suggests that the CBC approach may not be a panacea to manage protected areas across the world. Biophysical features of the resource, socioeconomic characteristics of communities, and institutional features of the region/nation influence the applicability of CBC. In the context of the NFR, there is no consensus among three stakeholder groups about the potential of the CBC approach. Unless the perceptions of stakeholder groups are reconciled, it is not advisable to undertake this approach.

Although communities’ support and participation is a major determinant for the success of CBC, perceptions of the other two stakeholder groups indicate that the existing socio-economic milieu might pose significant challenges to the success of CBC. In the context of a human-dominated ecosystem such as the Nyungwe Forest, this may be
particularly true. As a first step, key concerns or problems expressed by stakeholder groups must be investigated further and efforts must be made to address them on a priority basis. For example, the uncertainty associated with future government policies must be dealt with. Furthermore, intensive training and awareness programs relating to CBC and establishment of mechanisms of control and monitoring of communities’ actions would reduce the concerns raised by the ORTPN and the WCS. Also, government policies should expand the existing decentralization process on the forestry sector by devolving authority to government agencies and communities. Since the biodiversity in the NFR is sensitive, one cannot afford to make any mistakes even in the process of learning about new management. Therefore, we suggest that, after addressing the key concerns of stakeholder groups, the CBC approach must be tried on a small site covering only a few communities. Drawing on the lessons learned from such a pilot study, required changes can be made and applied at a larger scale. While results presented here reflect Nyungwe Forest stakeholders’ preferences, our sample was limited to selected people in each group. Therefore, caution should be taken while using these findings in a broader context.
CHAPTER 5
SUMMARY AND POLICY IMPLICATIONS

In many African countries several problems threaten the biodiversity in protected areas. Rwanda, with the most biologically rich lower mountain rainforests, has become the focus of many conservation efforts. Conservation of these biologically rich ecosystems is becoming complex because of higher dependency of local communities on these ecosystems. There is growing awareness among conservation professionals that community development and resource conservation are intertwined.

In the face of this situation, community based conservation (CBC), which focus on involving local people in managing forest resources and providing them with benefits of management is thought to provide an effective strategy for conservation. However, this strategy is often emulated without consideration of specific geographical, ecological, cultural and socioeconomic contexts in which conservation strategies are implemented. The research questions addressed in this study were derived from the issues of community dependency and the potential for CBC in the context of the NFR.

First, the role of institutions in the conservation and management of the NFR was analyzed. The analysis reveals that the conservation of the NFR is both socioeconomic, environmental and institutional problem. The conservation of the NFR has to be approached in a holistic framework by integrating socioeconomic, environmental and institutional aspects. Furthermore, the analysis suggests that there is a need to strengthen partnership between local communities, through local councils, and the management agency of the NFR.
The results of the analysis of forest dependency indicate that agriculture income and access to outside market, age, and household size influence household dependency on the NFR. In addition, the study reveals that local attitudes towards conservation are influenced by forest dependency on forest resources, benefits from the buffer zones, and the access to resources in the reserve. This demonstrates that conservation is linked to economic development of rural communities, and supports Maslow’s hierarchy of needs theory. Households near the reserve who have hard time to meet their basic survival needs are unlikely to care for conservation.

While environmental education programs have been embraced by conservation organizations and government agencies as strategies to achieve conservation goals in Rwanda during the last decades, they have limited effect because they do not address the socioeconomic needs of communities around the NFR. For households around the NFR, who struggle to meet their basic livelihood needs, educational programs may be less effective in enlisting their cooperation towards conservation. This finding suggests that any conservation program relating to the NFR must consider the socio-economic characteristics of communities around the forest. Therefore, policy measures that aim at increasing agriculture income and generating off-farm employment opportunities for rural communities are needed to reduce forest dependency and enhance biodiversity conservation. Finding a sound management strategy that integrates community well-being and conservation of the NFR is imperative. The results of this study revealed that communities closer to tea plantations are realizing benefits in the form of stable employment and as a result are less dependent on the NFR Therefore, there is a need to assess the socioeconomic and ecological impacts of replacing the pine plantations buffer
zone with tea interspersed with indigenous trees and to identify institutional arrangements that could ensure equitable distribution of benefits to local communities around the NFR.

The SWOT-AHP analysis indicates that there is little consensus among members of local communities, ORTPN, and the WCS in the NFR about applicability of the CBC approach in the context of the NFR. Community members indicate that the positive factors associated with CBC outweigh its negative factors but perceptions of other two stakeholder groups indicate that the existing socioeconomic milieu might pose significant challenges to the success of CBC. This suggests that if CBC is to be implemented decision-makers should address the key concerns of different stakeholders on a priority basis.

Economic incentives are imperative for nature conservation, particularly in remote and ill-monitored regions where a weak presence of protected areas officials hinders conservation regulations. Given the potential of a growing tourism industry in the NFR, ORTPN and conservation organizations should conduct more thorough financial and economic appraisals of the potential value of tourism. A better understanding of the monetary value of the NFR will provide insightful information to assist in the decision making process.
APPENDIX A
HOUSEHOLD SURVEY QUESTIONNAIRES

Introduction

The School of Forest Resources and Conservation at the University of Florida is conducting an independent research study about the Nyungwe Forest Reserve, Rwanda. In order to understand forest dependence of local people, research assistants are conducting face-to-face interviews with households around the Forest. The households are randomly selected, in order to get representative data from various communities around the Forest.

You have been randomly selected from this community to be a respondent. Privacy is a key principle of this survey. There are no wrong or right answers, and most importantly candid and honest answers are the most useful. If you have any questions about this survey, please feel free to contact either of the following offices: the Nyungwe Forest Conservation Project, or the Rwandan National Park Services (ORTPN).

Village:
Date and time:
Name of respondent: Age:_______ Sex:_____ 
Occupation (List all): ---------------------------

1. How many people are living in your household?

<table>
<thead>
<tr>
<th>Names</th>
<th>Age</th>
<th>Sex</th>
<th>Education</th>
<th>Occupation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Section I. Attitude Questions

1. For how many years have you lived in this area?
2. For how many years have you owned a property in this area?
3. Rank the following issues or problems currently facing your community in order of 5 (most important) to 1 (least important).

<table>
<thead>
<tr>
<th>Problems</th>
<th>Most important (5)</th>
<th>More Important (4)</th>
<th>Important (3)</th>
<th>Somewhat important (2)</th>
<th>Least important (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limited land</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Limited food</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Wild animal damage to crops</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Lack of access to forest resources/products</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

Other

4. Please tell us what kind of impact do the conservation activities have on you? Is it an improvement or a detriment?

5. Does your family benefit from the buffer zone plantations? ___ Yes, ___ No

Section II. Resource use

1. Do you ever go into the PA? ___ Yes /No (if no, go to # 2, if yes go to # 3)

2. If NO why don't you ever go there? (then go to # 4)
   a) Fear of rangers   b) Fear of animals   c) No interest   d) No time
   e) Too far   d) Other - specify

3. If YES, why do you go there?
   a) Health related   b) Hunting   c) Building materials   d) Firewood
   e) Grazing   f) Mining   f) Worship
   g) Others - specify

4. Of the items you collect from the PA: how many working hours do you spend per trip, including time of travel to and from? ___________________________

5. How many trips do you do per week? ________________________

6. What amount of items do you collect per trip? ________________________
7. How many people from your household collect items from the PA?


<table>
<thead>
<tr>
<th>Item</th>
<th>Hours / trip</th>
<th>Trips / week</th>
<th>Amount / trip</th>
<th>Total / month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firewood</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Building materials</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Handcraft materials</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Honey</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hunting</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medicinal plants</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grazing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water for domestic use</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minerals (gold, coltan)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

8. Are the forest products collected for the market or household consumption? If for the market, what quantity of the product is sold?

9. How many ours do you walk to reach the market?

10. Are you currently gainfully working for this PA? Yes / No (if No go to # 12)
    If Yes what is your wage rate? (Monthly, daily, piece-meal)

11. Do you benefit from the tourism industry of this PA? Yes / No [if No go to # 12]
    If Yes please specify in which way
    a) Sell handcrafts
    b) Act as a tour guide / porter
    c) Others – specify

12. What is your income from this business per month?______________________

Section III. Socio-demographic Questions

1. How big is the size of the land that is under control of your household (ha)?

2. What main crops do you grow and what was the average production (kg) last season?

<table>
<thead>
<tr>
<th>Crop</th>
<th>Bananas</th>
<th>Coffee</th>
<th>Cassava</th>
<th>Potatoes</th>
<th>Beans</th>
<th>Tea</th>
<th>Wheat</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount (kg)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3. For each crop, find out if the crop is produced for the market or for the household consumption? If for the market, what quantity of the production is sold?

<table>
<thead>
<tr>
<th>Crop</th>
<th>Household consumption</th>
<th>Market (quantity)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Banana</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This area has been known because of many swidden fields in the forest during the last 2 years,

4. Do you have a suidden field in the forest?

5. What was the size of your swidden field in the previous season, 1999-2000 (ha)?

6. What is the size of your swidden fields this season, 2001 (ha)? Did you clear the forest for your field? If NOT why?

7. What are the main sources of cash income for your household?

   a) Sale of farm produce (specify which crops or animal products)
   b) Sale of household labor (specify where sold, and if male or female)
   c) Remittances from - a daughter/ son / relative-specify
   d) Petty trade (specify type of trade and who in the household does it)

   Others (specify)

Wealth and Assets:

8. Please indicate ownership of the following assets and year that the asset was purchased (for livestock, indicate numbers owned):

<table>
<thead>
<tr>
<th>Items</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bicycle</td>
<td></td>
</tr>
<tr>
<td>Motorcycle</td>
<td></td>
</tr>
<tr>
<td>Radio</td>
<td></td>
</tr>
<tr>
<td>Chickens</td>
<td></td>
</tr>
<tr>
<td>Pigs</td>
<td></td>
</tr>
<tr>
<td>Goats</td>
<td></td>
</tr>
<tr>
<td>Cows</td>
<td></td>
</tr>
<tr>
<td>Land with tree plantation (ha)</td>
<td></td>
</tr>
<tr>
<td>Land without tree plantation (ha)</td>
<td></td>
</tr>
</tbody>
</table>

10. What is the last year of education you have completed?
APPENDIX B
MATHEMATICAL DETAILS OF LOGISTIC REGRESSION

Logistic regression model is derived as follows:

\[ P_i = \text{Prob} (Y_i = 1) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 X_{1i} + \Lambda + \beta K X_{Ki})}} = \frac{e^{(\beta_0 + \beta_1 X_{1i} + \Lambda + \beta K X_{Ki})}}{1 + e^{(\beta_0 + \beta_1 X_{1i} + \Lambda + \beta K X_{Ki})}} \quad (A1) \]

Similarly,

\[ \text{Prob} (Y_i = 0) = 1 - \text{Prob} (Y_i = 1) = \frac{1}{1 + e^{(\beta_0 + \beta_1 X_{1i} + \Lambda + \beta K X_{Ki})}} \quad (A2) \]

Dividing (A1) by (A2) we get

\[ \frac{\text{Pr}ob(Y_i = 1)}{\text{Pr}ob(Y_i = 0)} = \frac{P_i}{1 - P_i} = \frac{e^{(\beta_0 + \beta_1 X_{1i} + \Lambda + \beta K X_{Ki})}}{1 + e^{(\beta_0 + \beta_1 X_{1i} + \Lambda + \beta K X_{Ki})}} \quad (A3) \]

where \( P_i \) is the probability that \( Y_i \) takes the value 1 and then \( (1 - P_i) \) is the probability that \( Y \) is 0 and \( e \) the exponential constant.

Taking natural log in both sides of Eq. (A3) we get

\[ L_i = \ln[P_i/(1 - P_i)] = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \ldots + \beta_K X_{Ki} \]

Thus, \( L_i \) is linear in \( x_i \) as well as in \( \beta \), an estimable logit regression model (Gujarati 1995).
APPENDIX C
MATHEMATICAL DETAILS OF PAIREWISE COMPARISON

Information derived from pair-wise comparisons can be represented as a reciprocal matrix of weights, where the assigned relative weight enters into the matrix as an element $a_{ij}$ and reciprocal of the entry $1/a_{ij}$ goes to the opposite side of the main diagonal.

$$A = (a_{ij}) = \begin{bmatrix} w_1/w_1 & w_1/w_2 & \ldots & w_1/w_n \\ w_2/w_1 & w_2/w_2 & \ldots & \vdots \\ \vdots & \vdots & \ddots & \vdots \\ w_n/w_1 & w_n/w_2 & \ldots & w_n/w_n \end{bmatrix}.$$  \tag{1}

Where rows indicate ratios of weights of each factor with respect to all others. In the matrix, when $i = j$, $a_{ij} = 1$, i.e., the main diagonal elements of matrix is $A$. When we multiply matrix $A$ by the transpose of the vector of weights, $w$, we get the resulting vector $nw$ (equation 2).

$$Aw = nw, \quad \text{where, } w = (w_1, w_2, \ldots, w_n)^T.$$  \tag{2}

Equation 2 can be rewritten as

$$(A-nI)w = 0$$  \tag{3}

where $n$ is the largest eigenfactor, $\lambda_{max}$, or trace of matrix $A$. Saaty (1977) demonstrated that $\lambda_{max} = n$ is a necessary and sufficient condition for consistency. Inconsistency may arise when $\lambda_{max}$ deviates from $n$ due to inconsistent responses in pair-wise comparisons. Therefore, the matrix $A$ should be tested for consistency using the formula

$$CI = (\lambda_{max} - n)/(n-1)$$  \tag{4}

$$CR = CI/RI$$  \tag{5}
Where CI is the consistency index, RI is random index (RI) generated for a random matrix of order n, and CR is the consistency ratio (Saaty 1993; Mawapanga and Debertin 1996). The general rule is that CR ≤ 0.1 should be maintained for the matrix to be consistent. Homogeneity of factors within each group, smaller number of factors within each group, and better understanding of the decision problem can improve the consistency index (Saaty 1993).
APPENDIX D
WORKSHOP PROGRAM


Facilitators: Michel MASOZERA and Dr Janaki ALAVALAPATI

- Introductions of participants
- Overview of Nyungwe Forest Reserve Management and Community Based Conservation (CBC).
- Strengths, Weaknesses, Opportunities and Threats of Community Based Conservation (CBC): Brain storming session
- Design SWOT Questionnaire I
- Administration of the questionnaire to participants.
- Pair wise comparison, analysis, and determining one key Strength, Weakness, Opportunity, and Threats.
- Design SWOT questionnaire II.
- Final Analysis of SWOT factor.
APPENDIX E
BRAINSTORMING

**Strengths.**

1. Income generation
2. Employment opportunities
3. Reduction of management cost
4. Existing decentralization helps succeed CBC
5. Existing government policies and CBC policies are similar

   A. Additional source of income 1 and 2
   B. Management benefits 4
   C. Favorable institutional set up 5 and 6

**Opportunities.**

1. Improvement of relations between communities and agencies
2. Socioeconomic improvement of communities
3. Understanding the importance of forest will increase
4. Promotes equality in distribution of income
5. Rural-urban exodus might drop
6. CBC may lead to overall buffer zone management by communities
7. Leads to sustainable forests
8. Reduction of poverty
9. Profit sharing
10. Improvement in forest protection.

   A. Better community-agency relationship 1 and 9
   B. Reduction of poverty 2, 4 and 8
   C. Improved community awareness 3
   D. Additional future benefits 5,6,7 and 10

**Weaknesses.**

1. Lack of uniformity in forestry activities
2. Insufficient income from forest products
3. Low level perception about conservation
4. Weak control from government agencies
5. Wide spread poverty
6. Limited skills in conservation and development
7. Unfavorable traditions
8. Limited access to markets

   A. Limited income generation 1, 2, 5 and 8
   B. Limited awareness about conservation and development activities 3 and 6
   C. Unfavorable traditions 7
   D. Limited control by government agencies on community actions 4

**Threats.**

1. Biodiversity loss
2. Potential conflicts within and between communities
3. Limited influence of communities/ agencies in high level decision making
4. Communities may go out of control and consequent collapse of CBC
5. Potential negative impacts on tourism

   A. Biodiversity loss 1 and 5
   B. Potential collapse of CBC 2 and 4
   C. Uncertain high level decisions 3.
APPENDIX F
SWOT SURVEYS

SWOT SURVEY I

STRENGTHS:
A. Additional source of income
   - additional income generation
   - additional employment opportunities
B. Management benefits
   - reduction of management costs
C. Favorable institutional setup
   - existing decentralization helps succeed CBC
   - existing government policies and CBC principles are similar

1. Compare STRENGTH A to STRENGTH B, and circle one appropriate number:

2. Compare STRENGTH A to STRENGTH C, and circle one appropriate number:

3. Compare STRENGTH B to STRENGTH C, and circle one appropriate number:
WEAKNESSES:

A. Limited income generation
   - lack of uniformity in forestry activities
   - insufficient income from forest products
   - wide-spread poverty among communities
   - limited access to markets

B. Limited awareness about conservation and development activities
   - low level of perception about conservation
   - limited skills in conservation and development

C. Unfavorable traditions
   - unfavorable traditions like hunting and wood carving may continue

D. Limited control by government agencies on community actions
   - weak control of government agencies on community actions

1. Compare WEAKNESS A to WEAKNESS B, and circle one appropriate number:

WEAKNESS A: Limited income generation
WEAKNESS B: Limited awareness about conservation and development activities

2. Compare WEAKNESS A to WEAKNESS C, and circle one appropriate number:

WEAKNESS A: Limited income generation
WEAKNESS C: Unfavorable traditions

3. Compare WEAKNESS A to WEAKNESS D, and circle one appropriate number:

WEAKNESS A: Limited income generation
WEAKNESS D: Limited control by government agencies on community actions

4. Compare WEAKNESS B to WEAKNESS C, and circle one appropriate number:

WEAKNESS B: Limited awareness about conservation and development activities
WEAKNESS C: Unfavorable traditions

5. Compare WEAKNESS B to WEAKNESS D, and circle one appropriate number:

WEAKNESS B: Limited awareness about conservation and development activities
WEAKNESS D: Limited control by government agencies on community actions

6. Compare WEAKNESS C to WEAKNESS D, and circle one appropriate number:

WEAKNESS C: Unfavorable traditions
WEAKNESS D: Limited control by government agencies on community actions
### OPPORTUNITIES

**A. Better community-agency relationship**
- improvement of relations between communities and agencies
- profit sharing between communities and agencies

**B. Reduction of poverty**
- socioeconomic improvement of communities
- promotes equality in distribution of income
- reduction of poverty

**C. Improved community awareness**
- understanding the importance of forests will improve

**D. Additional future benefits**
- rural-urban migration might drop
- CBC may lead to buffer zone management
- improvement in forest protection
- leads to sustainable forests

1. Compare OPPORTUNITY A to OPPORTUNITY B, and circle one appropriate number:

   **OPPORTUNITY A:** Better community-agency relationship
   **OPPORTUNITY B:** Reduction of poverty

2. Compare OPPORTUNITY A to OPPORTUNITY C, and circle one appropriate number:

   **OPPORTUNITY A:** Better community-agency relationship
   **OPPORTUNITY C:** Improved community awareness

3. Compare OPPORTUNITY A to OPPORTUNITY D, and circle one appropriate number:

   **OPPORTUNITY A:** Better community-agency relationship
   **OPPORTUNITY D:** Additional future benefits

4. Compare OPPORTUNITY B to OPPORTUNITY C, and circle one appropriate number:

   **OPPORTUNITY B:** Reduction of poverty
   **OPPORTUNITY C:** Improved community awareness

5. Compare OPPORTUNITY B to OPPORTUNITY D, and circle one appropriate number:

   **OPPORTUNITY B:** Reduction of poverty
   **OPPORTUNITY D:** Additional future benefits

6. Compare OPPORTUNITY C to OPPORTUNITY D, and circle one appropriate number:

   **OPPORTUNITY C:** Improved community awareness
   **OPPORTUNITY D:** Additional future benefits
THREATS:
A. Biodiversity loss
   - loss of biodiversity due to CBC
   - potential negative impacts on tourism
B. Potential collapse of CBC
   - potential conflicts within and between communities
   - communities may go out of control and CBC may collapse
C. Uncertain high-level decisions
   - limited influence of communities and agencies in high-level decision making

1. Compare THREAT A to THREAT B, and circle one appropriate number:

   THREAT A: Biodiversity loss
   THREAT B: Potential collapse of CBC

2. Compare THREAT A to THREAT C, and circle one appropriate number:

   THREAT A: Biodiversity loss
   THREAT C: Uncertain high-level decisions

3. Compare THREAT B to THREAT C, and circle one appropriate number:

   THREAT B: Potential collapse of CBC
   THREAT C: Uncertain high-level decisions
**SWOT SURVEY 2 - COMMUNITY**

### STRENGTHS

- **Additional source of income**
  - additional income generation
  - additional employment generation

### WEAKNESSES

- Limited awareness about conservation and development activities
  - low level of perception about conservation
  - limited skills in conservation and development

### OPPORTUNITIES

- Reduction of poverty
  - socioeconomic improvement of communities
  - promotes equality in distribution of income
  - reduction of poverty

### THREATS

- Biodiversity loss
  - loss of biodiversity due to CBC
  - potential negative impacts on tourism

### Compare STRENGTH to WEAKNESS

<table>
<thead>
<tr>
<th>STRENGTH: Additional source of income</th>
<th>WEAKNESS: Limited awareness about conservation and development activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8</td>
<td></td>
</tr>
</tbody>
</table>

### Compare STRENGTH to OPPORTUNITY

<table>
<thead>
<tr>
<th>STRENGTH: Additional source of income</th>
<th>OPPORTUNITY: Reduction of poverty</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8</td>
<td></td>
</tr>
</tbody>
</table>

### Compare STRENGTH to THREAT

<table>
<thead>
<tr>
<th>STRENGTH: Additional source of income</th>
<th>THREAT: Biodiversity loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8</td>
<td></td>
</tr>
</tbody>
</table>

### Compare WEAKNESS to OPPORTUNITY

<table>
<thead>
<tr>
<th>WEAKNESS: Limited awareness about conservation and development activities</th>
<th>OPPORTUNITY: Reduction of poverty</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8</td>
<td></td>
</tr>
</tbody>
</table>

### Compare WEAKNESS to THREAT

<table>
<thead>
<tr>
<th>WEAKNESS: Limited awareness about conservation and development activities</th>
<th>THREAT: Biodiversity loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8</td>
<td></td>
</tr>
</tbody>
</table>

### Compare OPPORTUNITY to THREAT

<table>
<thead>
<tr>
<th>OPPORTUNITY: Reduction of poverty</th>
<th>THREAT: Biodiversity loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8</td>
<td></td>
</tr>
</tbody>
</table>
### SWOT SURVEY 2 - ORTPN

<table>
<thead>
<tr>
<th>S. Additional source of income</th>
</tr>
</thead>
<tbody>
<tr>
<td>- additional income generation</td>
</tr>
<tr>
<td>- additional employment generation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>W. Limited awareness about conservation and development activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>- low level of perception about conservation</td>
</tr>
<tr>
<td>- limited skills in conservation and development</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>O. Reduction of poverty</th>
</tr>
</thead>
<tbody>
<tr>
<td>- socioeconomic improvement of communities</td>
</tr>
<tr>
<td>- promotes equality in distribution of income</td>
</tr>
<tr>
<td>- reduction of poverty</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>T. Uncertain high-level decisions</th>
</tr>
</thead>
<tbody>
<tr>
<td>- limited influence of communities and agencies in high-level decision making</td>
</tr>
</tbody>
</table>

1. Compare STRENGTH to WEAKNESS and circle one appropriate number:

<table>
<thead>
<tr>
<th>STRENGTH: Additional source of income</th>
</tr>
</thead>
<tbody>
<tr>
<td>--------------------------------------</td>
</tr>
</tbody>
</table>

2. Compare STRENGTH to OPPORTUNITY and circle one appropriate number:

<table>
<thead>
<tr>
<th>STRENGTH: Additional source of income</th>
</tr>
</thead>
<tbody>
<tr>
<td>--------------------------------------</td>
</tr>
</tbody>
</table>

3. Compare STRENGTH to THREAT and circle one appropriate number:

<table>
<thead>
<tr>
<th>STRENGTH: Additional source of income</th>
</tr>
</thead>
<tbody>
<tr>
<td>--------------------------------------</td>
</tr>
</tbody>
</table>

4. Compare WEAKNESS to OPPORTUNITY and circle one appropriate number:

<table>
<thead>
<tr>
<th>WEAKNESS: Limited awareness about conservation and development activities</th>
</tr>
</thead>
</table>

5. Compare WEAKNESS to THREAT and circle one appropriate number:

<table>
<thead>
<tr>
<th>WEAKNESS: Limited awareness about conservation and development activities</th>
</tr>
</thead>
</table>

6. Compare OPPORTUNITY to THREAT and circle one appropriate number:

<table>
<thead>
<tr>
<th>OPPORTUNITY: Reduction of poverty</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>THREAT: Uncertain high-level decisions</th>
</tr>
</thead>
</table>

### MORE

9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8

### MORE

9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8

### MORE

9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8

### MORE

9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8

### MORE

9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8

### MORE

9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8

### MORE

9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8

### MORE

9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8
LIST OF REFERENCES


Capistrano, A.D. 1994. Tropical forest depletion and changing macroeconomy. In K. Brown and D.W. Pearce, editors. The causes of tropical deforestation: The
economic and statistical analysis of factors giving rise to the loss of the tropical forests. Vancouver: UBC Press.


Cortner, H.J., M.G. Wallace, S. Burke and M.A. Moote. Institutions matter: the need to address the institutional challenges of ecosystem management. Landscape and Urban Planning 40:159-166


BIOGRAPHICAL SKETCH

Michel K. Masozera was born and raised in the Democratic Republic of Congo (DRC) the former Zaire. Growing up in the middle of the Congo rainforest instilled a sense of pride and appreciation for conservation. Upon graduation from the University of Kisangani with the degree in biological sciences, he returned to his home country, Rwanda, in 1994 after the genocide. He worked for four years for the Wildlife Conservation Society (WCS) in Rwanda as Director of the Nyungwe Forest Conservation Project (PCFN). He joined the University of Florida in 2000, and he hopes to continue working in the conservation field.