Ecotourism for sustainable development: Economic valuation of recreational potentials of protected areas in the Congo Basin.

by

Julius Chupezi Tieguhong

Submitted in fulfilment of the academic

requirements for the degree of

Doctor of Philosophy (PhD) in the

Discipline of Forestry,

Faculty of Science and Agriculture

University of KwaZulu-Natal

Pietermaritzburg

2008

ABSTRACT

This study was designed to capture the complexity of man-to-forest relationships in the endangered, world-renowned tropical rain forests of the Congo Basin in Africa. Their biological complexity and integrity have been challenged by human development and new knowledge is urgently needed to save these forests and the people dependent on them. The scope of the study was enormous because of the complexity of the resource, the diversity of forest-dependent people and actors. The major benefit of this research was in accessing and exposing new and quantitative information in remote settlements of the region by applying innovative methodologies and analytical techniques. These included:

1. The definition of forest-dependency based on detailed annual inventories of sources of households' incomes, their statistical ranking and interpretation with logistic regressions, and the Kuznets ratio and Gini coefficients as introduced by the World Bank;
2. critical appraisal of the international parks in the region based on auto-financing principles and tested with contingent valuation and tax maximization techniques, such as Laffer's curves, and leading to the development of new conservation models of financial self-sufficiency and a new formula for practical park management;
3. the critique of poaching by explaining and exposing food insecurities, especially deficient supplies of animal protein and associated malnutrition among the rural poor;
4. assessment of housing inadequacy among forest dwellers and its impact on forest regeneration and resources;
5. clarification of the impacts of timber logging by accessing detailed unpublished information from timber companies;
6. the introduction of survey-based valuation techniques as essential prerequisites to policy formulation and the sustainable management of forests;
7. proposing a flow chart that embraced the resources and stakeholders through the flow of market values and services for further exploration.

Contrary to traditional beliefs; the results showed that both poor and wealthy households are equally dependent on forest resources for their livelihoods with no significant difference in consumed forest products between the 25% higher income earners and the 25% lower income

households. Forests contribute over 57% of wage income in the region and forest-derived income is of a higher total value than any other source, including agriculture. Among forest foods, wild fruit and bushmeat are by far the most important. Therefore, the clearing of forests for agriculture or instituting conservation policies that completely keep local people away from forests will result in constrained access to resources of immense importance to local livelihoods. However, the findings contradict the commonly propagated views that timber harvesting in the region is directly responsible for deforestation, the loss of forest structure and biodiversity. It was shown that the harvesting of saplings and poles for housing may endanger forest regeneration and species composition of forests neighbouring the villages. The desired financing of national parks should be through internally generated revenues, requiring deliberate investments in facilities and infrastructure. The necessity to satisfy the basic needs of the forest-dependent people remains urgent. The complexity of man-to-forest relationships is beyond one study and needs to be further expanded on, in our quest to sustainable forest management based on participatory principles. Such management needs to provide for and be supported by various stakeholders including the local communities, state agencies, donors, NGOs, and commercial conglomerates. Moreover, the need to understand forest values beyond market principles is required in order to translate the concept of sustainable forest management from a theoretical concept in the Congo Basin to one that can reduce conflicts, deforestation, poverty and famine.

PREFACE

The research work described in this thesis was carried out in the Faculty of Science and Agriculture, University of KwaZulu-Natal, Pietermaritzburg from August 2004 to December 2007 under the supervision of Professor Janusz Zwolinski.

These studies represent original work by the author and have not otherwise been submitted in any form for any degree or diploma to any University. Where use has been made of the work of others it is duly acknowledged in the text.

Signed:
Julius Chupezi Tieguhong (Candidate).

Signed:
Professor Janusz Zwolinski (Supervisor).

ACKNOWLEDGEMENTS

Whenever I accomplish a task in the course of the struggle up the rungs of the academic ladder, I always stop to ruminate over how I could have achieved it without the direct and remote support of certain individuals. Such individuals have in one way or another contributed to this study and production of this thesis for which I remain truly grateful.

First, I recall with fondness the encouragement, guidance, insight, patience and painstaking supervision of my promoter, Professor Janusz Zwolinski. He deserves my profound gratitude.

Secondly, I treasure and highly appreciate the field supervision of my research work in Cameroon by Dr Ousseynou Ndoye, formerly working as a senior scientist with the Centre for International Forestry Research (CIFOR) and now with the Food and Agriculture Organisation of the United Nations (FAO) as a regional coordinator of a project on non-wood forest products in Central Africa.

I heartily appreciate the encouragement and insightful advices of Prof. Bruce Campbell, Dr CTS Nair, Dr Adrian Whiteman and Dr Arild Angelsen under the umbrella of the Poverty and Environment Network (PEN) project that enabled me to become one of its pioneer partners and beneficiaries.

Words of encouragement to start this PhD programme came from many individuals including my MSc. thesis supervisor, Professor Philip Kio and Dr Leonard Usongo, the Coordinator of the Jengi Project of the Worldwide Fund for Nature.

I am deeply indebted to Amougou Victor, the Coordinator of CEFAID, a field-based non-governmental organisation that assisted me in all phases of data collection. Also within the framework of data collection, I sincerely thank Mr Mathias Heinze, the principal technical adviser of the German Technical Corporation (GTZ)-Bayanga, who was untiringly helpful in authorising logistics for my research activities in the Dzanga-Ndoki National Park segment of the study area.

I cherish and heartily appreciate a number of friends for their ideas and knowledge that was very valuable in analysing relatively huge datasets, as well as drawing maps using Quantum GIS version 9 and Arc GIS Version 3.0. Among these individuals, I distinguish Guy Paulin Tekombong, Elise Tokou, Eric Kamgnia, Bruno Bokoto, Marieke Sandker and Paolo Cerruti.

My sincere gratitude goes to my enumerators in the field, who were very enthusiastic to work with me, under rain and sun to ensure that I got out of the field with good data. Among them, those that I feel obliged to mention in this thesis include: Didier Nnanga in Koumela, Eloi Djenda Kouatadiba, Gilbert Nzie Ndtoungou, Jean-Louis Kemani, Nasser Bariga and John Ndakwe Mukiawah in Mambele; Anicet S. Lebiangali in Bayanga; Franckline Abedine in Libongo and Aldophe Mbio in Socambo.

I am extremely grateful for the collaboration and warm welcome by the chiefs of the five villages, where I carried out quarterly household surveys for a period lasting up to 12 months. The chiefs were Bonaventure Ndokanda Wandjo, Nicolas Djokou, Jean Pierre Mokoakilli, Robert Melo and Michel Mossaidjambe for Koumela, Libongo, Mambele, Zega and Socambo villages respectively.

I would also like to thank distinguished friends who in difficult moments tirelessly encouraged me morally and materially to continue the pursuit of my dream. These unforgettable friends include: Henry Tarpah, Amy Ickowitz, Raymond Asongwe and Christopher Chi.

I owe the largest debt to all my colleagues at the Centre for International Forestry Research (CIFOR) – Cameroon. Their constant smiles were a regular source of inspiration on tiring days. Special thanks go to the drivers of CIFOR, Ivo Ekane and Martin Ahanda, who under very difficult and risky conditions safely transported me in the field for data collection.

I am grateful to all my family members who continuously supported me for my 32 years of schooling. Most of all, I want to express my gratitude to my mother, brothers and sisters, whose love and belief in me sustained and helped me to believe in myself. This thesis is

dedicated to the memory of my father, Joseph Feteh Tieguhong, whose love remains deeply rooted in my heart for all his support and blessings until his death in 1994. My deepest thanks and gratitude goes to my lovely wife, Marilyn Leila and daughter, Janice Puatwoe Tieguhong for their understanding, encouragement and support during the days of writing this thesis.

I acknowledge, appreciate and thank FORINFO (Projet Formation et Recherche pour l'appui au developppement durable du secteur foret-environement en Afrique Centrale), the International Foundation of Science (IFS) and African Forestry Research Network (AFORNET) for funding all my field research work; and CIFOR and the University of KwaZulu Natal for efficiently managing the use of these funds.

There are many others whose good wishes I was privileged to receive but are too many to mention here. All I can say is that God blesses the visible and invisible hands that have contributed in turning this vision into reality. To God always is the glory.
Amen!

Table of Contents

List of Tables

List of Figures

List of Appendices

LIST OF ACRONYMS AND ABBREVIATIONS

AFORNET : African Forestry Research Network
AFWC : African Forestry and Wildlife Commission
AKR : Absolute Kuznets ratio
AFKR : Absolute Forest Kuznets ratio
ART : African Resources Trust
AWT : Average willingness-to-pay
CAB/PM : Cabinet de Premiere Ministre
CAR : Central African Republic
CARPE : Central African Regional Program for the Environment
CBFP : Congo Basin Forest Partnership
CBO : Community based organization
CFA : Communauté Financière d'Afrique Centrale
FCFA : Franc de la Communauté Financière d'Afrique Centrale
CEFAID : Centre pour l'Education, la Formation et l'Appui aux Initiatives de Développement au Cameroun
CEFDHAC : Conference on the Central African Moist Forest Ecosystems
CI : Conservation International
CIB : Congolais Industriel du Bois
CIFOR : Centre for International Forestry Research
CIRAD : Centrale de Coopération Internationale en Recherche Agronomique pour le Développement
CITES : Convention on International Trade in Endangered Species of Wild Fauna and Flora
COFO : Committee on Forestry
COMIFAC : Forestry Commission of Central Africa
CS : Consumer surplus
CVM : Contingent Valuation Method
DBH : Diameter at breast height
DNNP : Dzanga Ndoki National Park

DRC : Democratic Republic of Congo

ECOFAC : Programme on Conservation and Sustainable Use of Central African Forest Ecosystems

EF : Entrance fee

EFR : Entrance Fee Revenue

FAO : Food and Agriculture Organisation of the United Nations

FMU : Forest management unit

FNNP : FAO/Netherlands Partnership Programme

FORINFO : Projet Formation et Recherche pour l'appui au développement durable du secteur foret environnement en Afrique Centrale.

FUG : Forest user group

GDP : Gross Domestic Product

GIS : Geographical Information Systems

GTZ : German Technical Cooperation

HH : Household

IFS : International Foundation of Science

INAS : National Institute of Statistics

ITTO : International Tropical Timber Organisation

IUCN : World Conservation Union

km : kilometre

km^2 : Square kilometres

KWS : Kenya Wildlife Service

LNP : Lobeke National Park

MDG : Millennium Development Goals

ME : Marginal effect

MED : Minimum exploitable diameter

MINEF : Ministry of Environment and Forestry

MINFOF : Minstry of Forestry and Wildlife

NGOs : Non-governmental organisations

NIDA : National Institute of Development Administration

NNNP : Nouabele-Ndoki National Park

NTFP : Non-timber forest products
NWFP : Non-wood forest products
OCFSA : Organization for Wildlife Conservation in Central Africa
PA : Protected areas
PEN : Poverty Environment Network
RAPAC : Central Africa Protected Areas Network
RC : Republic of Congo
RFKR : Relative forest Kuznets ratio
RKR : Relative Kuznets ratio
SANP : South African National Parks
SD : Standard deviation
SEFAC : Société d'Exploitation Forestière et Agricole du Cameroun
SFM : Sustainable forest management
SPSS : Statistical Package for Social Sciences
TCM : Travel Cost Method
TFR : Takamanda Forest Reserve
TNS : Tri-National de la Sangha (Sangha Tri-national Park)
TV : Television
UNEP : United Nation Environment Programme
UNFF : United Nations Forum on Forests
US$: United States of America dollars
USA : United States of America
USAID : United States Agency International development
WPC : World Park Congress
WTO : World Tourism Organisation
WTP : Willingness-to-pay
WTA : Willingness-to-accept
WCS : Wildlife Conservation Society
WSSD : World Summit on Sustainable Development
WWF : Worldwide Fund for Nature

CHAPTER ONE

INTRODUCTION, OBJECTIVES AND OVERARCHING METHODS

Introduction

For a long time forests were valuated based on the volume of utilisable timber. Their environmental functions have been recognized relatively recently, since the birth of the modern forestry and ecological sciences about 150 years ago. National parks and nature reserves were the first milestones in a quest to protect forests for their beauty, biodiversity and environmental functions. As the human population grows, its impact on forests becomes a growing challenge worldwide, especially so in developing countries.

Natural resources such as forests and wildlife have been superficially protected by delineating borders, policing and introducing laws foreign to the people whose livelihoods have been dependent on these resources for millennia. The concept of a participatory forest management structure has been introduced by scientists and conservationists operating usually far away from the forest-dependent poor. Inaccessible terrains, difficulties to communicate in ethnic languages, and huge cultural and social differences prevent them from defining new forest values by including the real needs of rural communities. Without satisfying these basic needs and without understanding the value of forests beyond the market principles or even the paradigms of environmentalism, the concept of sustainable forest management will remain a theoretical one due to conflicts, continued deforestation and famine. One of these areas requiring urgent actions is found in the heart of Africa.

The Congo Basin (Figure 1.1) is represented by six countries: Cameroon, the Democratic Republic of Congo (DRC), the Central African Republic (CAR), Gabon, the Republic of Congo (RC) and Equatorial Guinea. It covers a total area of 398 265 million hectares, 57.2% of which are covered by forests (FAO, 2005) Timber producing forests cover 58.5% of the total forest area (Nasi *et al.*, 2006). Humid dense forests occur on 137 million ha of which

49.4 million ha (36%) have already been allocated to logging companies by 2004 (Karsenty, 2005). Nasi *et al*. (2006) made higher estimates of 41.5% of the humid dense forest have already been placed within logging concessions.

Being the second largest and the most intact tropical forest complex of the world, these forests have received the special attention of the Member States of the Forestry Commission of Central Africa (COMIFAC) and the international community at large because of the biological diversity and impact they make on the global climate. The total population inhabiting this region is slightly over 78.2 million people giving an average population density of 19.6 inhabitants km^{-2} and a forest area per person of 2.9 ha (FAO, 2005). Population growth rates ranged from 1.3% (CAR) to 2.8% (DRC). In 2003, the proportion of the rural population was 48.6%, 57.3%, 46.5%, 68.4%, 51.9% and 16.2% for Cameroon, the CAR, Congo, the DRC, Equatorial Guinea and Gabon respectively, with a regional average of 62% (FAO, 2005).

Economic indicators such as the Gross Domestic Products (GDP) per capita, the economic growth rates in 2003 were US$ 803 and 4.4%, US$ 325 and -0.8%, US$ 1050 and 3.5%, US$ 107 and 3.0%, US$ 5915 and 16.2%, and US$ 4155 and 3.0% for Cameroon, the CAR, Congo, the DRC, Equatorial Guinea and Gabon, respectively, with an overall regional average of US$ 411 (FAO, 2005).

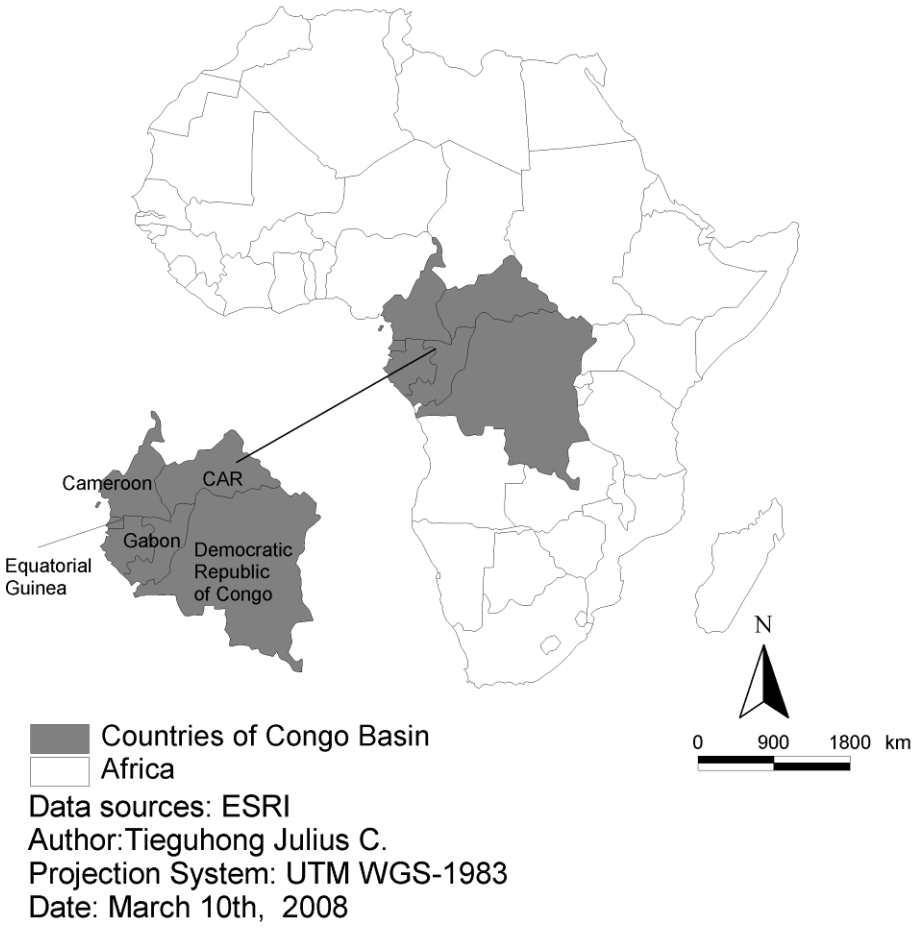

Figure 1.1. Countries of the Congo Basin in Africa.

The six heads of state of the Central African countries signed the Yaounde Declaration on the 17th of March 1999, which committed their countries to the creation of trans-boundary protected areas and to reform the forestry sector to ensure a "sustainable forest management" (COMIFAC, 2005). In December 2000, the ministers in charge of forestry from Cameroon, the CAR and the RC implemented this agreement by signing an accord to establish the Sangha Tri-National Park, known by its French acronym as, 'Trinational de la Sangha' (TNS).

To protect the natural resources on the 28 000 km^2 of land, this agreement aimed at harmonizing forestry laws and putting into place a common management system of anti-poaching measures, ecological monitoring, scientific research, communication and logging controls (Usongo, 2002). The belief guiding this initiative was that the Congo Basin forests and wildlife therein might not be sufficiently protected if the countries sharing the trans-boundary park resources had differing laws governing the management and exploitation of such resources. Therefore, harmonizing forestry policies across the borders was seen as a major step forward in acknowledging that a sub-regional approach could be an effective way of guaranteeing the future of the Congo Basin forests.

In general, the principles of a sustainable forest management system are founded on the balanced considerations of economic, social and ecological dimensions. With regards to the TNS, ecological and ethnographic dimensions have been examined, described and emphasized in various reports, but very little or nothing is known on the socio-economic dimensions. The current economic situation in terms of the present and potential contributions of the surrounding forests and the park resources to the local livelihoods and poverty alleviation is unknown. To fill this gap, in-depth economic valuations of the Congo Basin forest resources, functions and services was deemed necessary. The TNS was selected as a case study, from which some generalisations could be drawn for the management of the protected areas in the Congo Basin.

The TNS comprises of the Lobeke National Park (LNP), the Dzanga-Ndoki National Park (DNNP), the Dzanga-Sangha Special Reserve, and the Nouabale-Ndoki National Park (NNNP) in the respective countries (Figure 1.2).

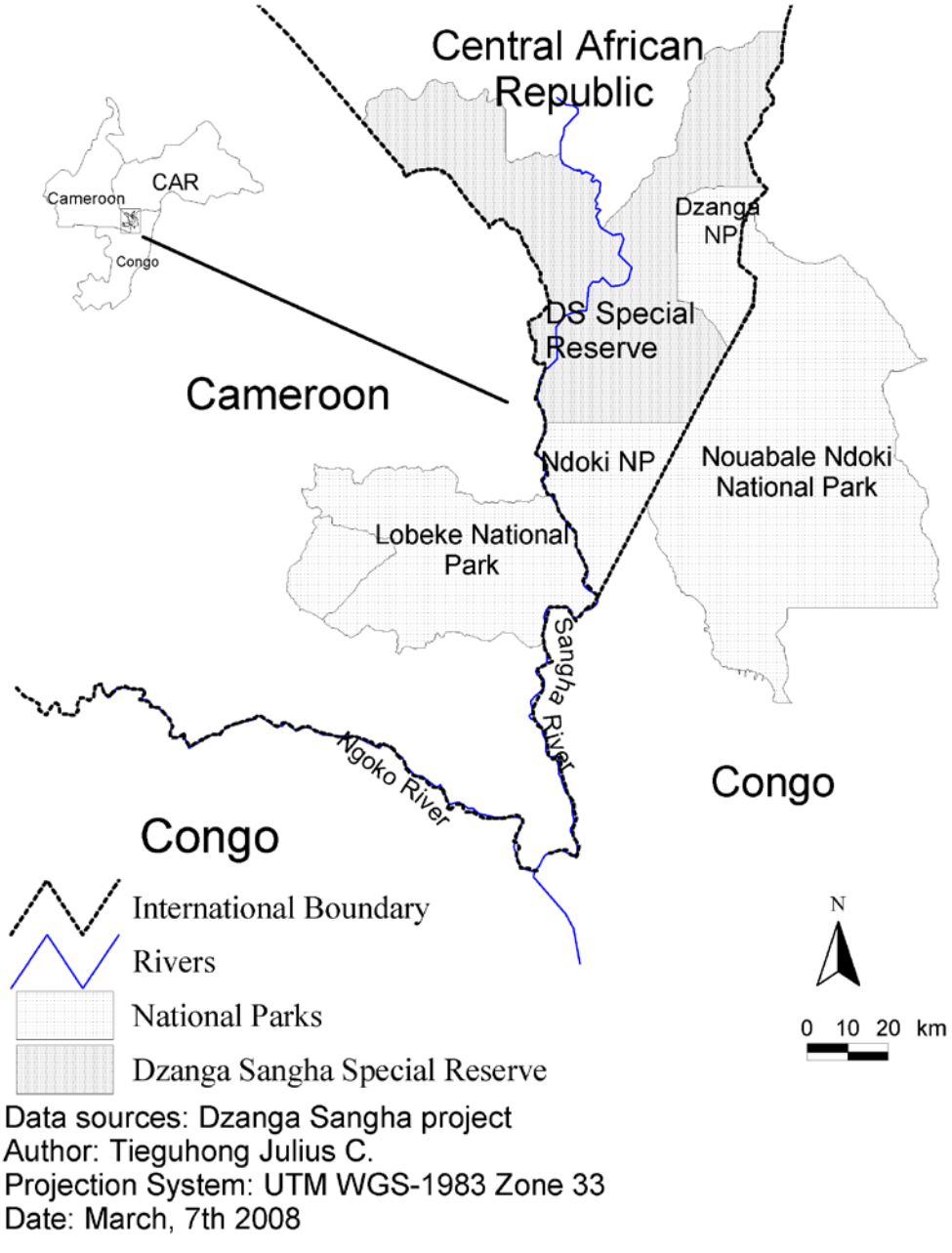

Figure 1.2. The location and composition of the Sangha Tri-National Park (TNS)

The TNS comprises of a core protection zone, where human activities are either forbidden or controlled; and a peripheral zone, where participatory and sustainable uses of wildlife and

forest resources can be practised. The core protection zone of the TNS covers some 7750 km² while the peripheral zone covers about 21 000 km². The latter is divided into various uses by allocating concessions to harvest timber, hunt for trophies or bushmeat, cultivate crops and rare livestock, and establish settlements or other compatible activities. The laws governing the uses of the resources in the TNS are defined by the respective national legislative acts. The section of the Sangha River included in the TNS remains an international boundary and as such is regulated by international laws (Blom, 2001). Beyond the prime need to determine the value of forests for the sustainable livelihoods of forest-dwellers, other reasons for selecting the TNS as a study site included:

- the high political interests expressed by the three governments through the regional processes: the Central African Forests Commission (COMIFAC), Conference on the Central African Moist Forest Ecosystems (CEFDHAC), and the Congo Basin Forest Partnership (CBFP). These are the three regional initiatives by the central African states to show their commitments to implement the resolutions of the Yaounde Declaration with the priority Action Plan enshrined in the Joint Action Plan (Ze Meka, 2002);
- the active presence of many national and international non-governmental organizations: World Wildlife Fund (WWF), German Technical Cooperation (GTZ), Wildlife Conservation Society (WCS), the World Conservation Union (IUCN), Centre for International Forestry Research (CIFOR), the Central Africa Protected Areas Network (RAPAC), Programme on Conservation and Sustainable Use of Central African Forest Ecosystems (ECOFAC), regional governments and local non-governmental organizations (NGOs);
- the pristine nature of the forests with many charismatic species of flora and fauna and the great potential for ecotourism as enshrined in the joint action plan (‘plan de Convergence’) of COMIFAC (COMIFAC, 2005);
- the absence of rigorous economic valuation studies on the forests and the park resources and ecotourism potentials in the region.

Historical context of the TNS

The regional conservation initiatives in the TNS date back to the mid 1980's, when activities began in the south-western CAR (WCS, 1996). The DNNP is made up of two areas, the Dzanga (495 km^2) and the Ndoki (725 km^2), and the Dzanga-Sangha Special Reserve (3159 km^2), which were officially gazetted in 1990. The NNNP (4000 km^2) was gazetted in December 1993 and the LNP (2100 km^2) in March 2001 (Fomete *et al.,* 2005). These parks are rich in forest resources and wildlife, harvested by generations of indigenous communities. The physical features and biological diversity of these three parks are similar and typical of the north-western Congolian lowland forest eco-region (WCS, 1996). They contain important populations of endangered large mammals that travel freely across the frontiers (Usongo, 2002). For these reasons, the tri-national zone is now internationally recognised as an extremely important conservation region. The TNS forms the first project resulting from the agreement between the three countries, and serves as a model for other conservation efforts in the region and even elsewhere in the world (CBFP, 2006).

Threats to the TNS

The Congo Basin is endowed with forest and wildlife resources within its protected areas, which are among the most important economic assets for the region (Tieguhong and Ndoye, 2007), however these resources are under grave threat. The major threats to the TNS include forest logging, poaching, intricate road networks, traditional mining, proliferation of arms and pet trade (MINEF, 2004; Usongo, 2002). Internal risk factors include inefficient management and monitoring structures, poor trans-boundary collaboration, low participation of the local communities, low valorisation and promotion of its attributes and weak decision-making at the level of management. These destructive factors are outlined below:

- Industrial timber extraction in logging concession areas close to the TNS cover more than 35 000 km² of forests. The largest concession (12 000 km²) being issued to CIB located close to the Nouabale-Ndoki National Park. Logging concessions cover more than 40% of the multiple-use area (CBFP, 2006).
- Hunting and bushmeat trade are the leading threats to some charismatic wildlife species such as elephants, chimpanzees and western lowland gorillas. Their populations have been observed to be decreasing due to over-exploitation, extensive

habitat destruction or other environmental disturbances. Bushmeat forms an important source of protein and income to teaming populations in the region (Wilkie *et al*., 2005; Tieguhong and Ndoye, 2004; Usongo, 2002; Wilkie and Carpenter, 1999; Noss, 1998).

- Arms proliferation in association with increased access via logging roads and unprotected borders has also encouraged trade, especially in arms, ammunitions and animal trafficking. Sophisticated military weapons smuggled from the conflict areas in the CAR and the CR increase hunting pressures. Timber truck drivers transport the arms in exchange for bushmeat to various destinations and markets (Usongo, 2002).
- Commercial trade in baby chimpanzees and gorillas is gradually gaining ground within the TNS region. There is a regional network in the sale of pets destined mainly for zoological gardens in Europe and to a lesser extent in the Gulf States. The pets are transported in very inhumane conditions in little wooden cages with poor aeration, stuffed in between the logs on timber trucks. Pet trade of the great apes is quite organized, with intermediary agents working with counterparts in Europe and other destinations where they have been ordered (Usongo, 2002).

From the foregoing understanding it was considered desirable to study the actual and potential economic contributions of forest products and ecotourism (the major forest service) to the local livelihoods in the Congo Basin.

General objectives

The overall objective of this research is to quantify the present and potential contributions of ecotourism and forest resources in protected areas to the local livelihoods in the Congo Basin. The specific objectives include:

- Review of the management of forests and protected areas in the Congo Basin;
- valuate sources of income and determine the forest-household dependency;
- analyse the economics of tourism in the TNS and tourists' willingness-to-pay for park services;
- determine the optimum park entrance fees and set scenarios for auto-financing;
- assess the impact of timber harvesting as well as the harvesting of non-timber forest products;

- analyse the bushmeat trade and the impact of hunting on wildlife;
- develop scenarios that can be used to improve equitable partitioning of benefits as well as the overall conservation of natural resources in the region.

Hypotheses

- Under the current protected areas management system, parks are not losing appreciable revenues.
- Concessionnaires are not going to abandon their forest concessions in the Lobeke region due to the depletion of desirable timber species.
- Local households are not dependent on park resources for income.
- Tourists are not ready to pay higher user fees for using improved quality facilities in the TNS.
- Hunters do not make appreciable incomes from the hushmeat hunting
- The use of poles/saplings as local housing materials is limited

Overarching research methods

- Tourist surveys that involved questionnaires and interviews of national, resident and international tourists to the LNP and the DNNP.
- Household surveys that involved quarterly questionnaire surveys and interviews on the perceptions of household heads in five villages around the LNP on their income portfolios and the possible factors that determined their dependency on forests.
- Housing material and population surveys orchestrated in five villages around the LNP that targeted the classification of the types of housing materials and socio-economic characteristics of households that determined the use of specific materials.
- Institutional consultations were conducted, involving accessing park data and reports on financial management, tourist flows and revenues in the LNP and the DNNP.
- Consultation of business entities notably five logging companies for records of timber species and volumes harvested in 2006 around the LNP.
- Synthesis of literature based on a literature search on this specific subject matter in the Ministries of Tourism, Forestry and Wildlife and Finance in two of the three countries under study. Reviews of published and unpublished reports of active NGOs and other

institutions working in the park area were carried out on visitor and household surveys in the region and beyond. The public use data was collected from protected areas management. Maps and ecological data of the parks were solicited from the park management, NGOs and resource persons.

- Data management involved the use of Microsoft Excel and Access interfaces to input, check and summerise the data. Further analysis involved the exportation of data from Excel or Access to statistical software such as SPSS version-12 and STATA version-8 for analysis. Specialist inputs on statistical methods such as logistic regression and bi-probit analysis were sought from resource persons at the National Institute of Statistics (INAS) in Cameroon.
- Analysis of variance, Student-t and Krustal Wallis tests served to test the differences between the means of parametric and non-parametric variables. Gini coefficients and Kuznets ratio were calculated to test inequalities and the dependence on forest income. Tables, piecharts and bar charts were the major forms of presenting results.

Structure of the thesis

The scope of the study is as enormous, as is the complexity of the resource and the diversity of the forest-dependent people. Therefore, it was decided to synthesise the collected information into thematic chapters. The chapters have been ranked to reflect the study sequences from the most general and descriptive to specialist, detailed and analytical. After introducing the background information, the study matter and its objectives (Chapter 1), the first thematic paper (Chapter 2) is dedicated to an in-depth review of the current management of protected areas in the Congo Basin. The third chapter contains information on the overall income portfolios of households adjoining the TNS as well as the level to which households are dependent on forest-derived income. The fourth chapter is devoted to assessing the potential of ecotourism to finance protected areas in terms of meeting the recurrent costs or total park budgets. The sustainability of logging concessions in the Congo Basin with particular reference to timber species purported to face endangernment in the light of continuous harvesting is tackled in chapter five. The overall issue of the bushmeat markets and the persistence of bushmeat production, consumption and sale are described in the sixth chapter. A succinct analysis on local housing habits especially involving the utilisation of saplings and

poles for constructing primitive houses is conducted in the seventh chapter. Chapter eight is dedicated to possible scenarios of the sustainable financing and manangment of the TNS with major recommendations for the entire national park system in the Congo Basin.

REFERENCES

Blom A. 2001. Ecological and economic impacts of gorilla-based tourism in Dzanga-sangha, Central African Republic. Ph.D Thesis. Department of Environmental Sciences, University of Wageningen, Wageningen, Netherlands. ISNN: 0926-9495.

COMIFAC 2005. Treaty on the conservation and sustainable management of forest ecosystems in Central Africa. The Central African Forests Commission. February. 17 pp.

CBFP (Congo Basin Forest Partnership). 2006. The Forests of the Congo Basin. State of the forest 2006. 256 pp. ISBN: 978907827016.

FAO 2005. State of the World Forests. FAO-Rome. ISBN: 92-5-105187-9. 153 pp.

Fomete T., Falkeberg C.M., Ray V., Klug U., Moye M., and Carr-Dirick B. 2005. Technical Mission to propose a profile for the Sangha Trinational (TNS) Trust Fund. Design and creation process for a turst fund for the TNS. 45 pp.

Karsenty A. 2005. Les concessions forestières en Afrique centrale. Aspects historiques, institutionnels et politiques, du point de vue de la responsabilité des entreprises concessionnaires. Département Forêts du CIRAD, France. 40pp.

MINEF. 2004. A management plan for the Lobeke National Park and its peripheral zone. Yaounde. 2003-2007.

Nasi R, Cassagne B, and Billand A 2006. Forest management in Central Africa: where are we? *International Forestry Review* 8(1): 14-20.

Noss A.J. 1998. The impacts of cable snare hunting on wildlife populations in the forests of the Cental African Republic. *Conservation Biology* 12(2):390-398.

Tieguhong J.C. and Ndoye O. 2007. The impact of timber harvesting in forest concessions on the availability of Non-Wood Forest Products (NWFP) in the Congo Basin. FAO Forest Harvesting Case Study 23. ISBN: 978-92-5-105709-4.

Tieguhong J.C. and Ndoye O. 2004. Wildlife and protected areas management in Central Africa: Major challenges and ways forward. Paper presented at the 5th Conference on Central African Moist Forest Ecosystems (CEFDHAC) in Yaounde, Cameroon. 24-26 May 2004.

Usongo L. 2002. Apes in the Proposed Tri-National de la Sangha Conservation Area. *Gorilla Journal* 25, December 2002.

WCS (Wildlife Conservation Society). 1996. The Lobeke forest, Southeast Cameroon. Summary of activities 1988-1995. Report submitted to WCS, New York.

Wilkie D.S., Starkey M., Abernethy K., Nstame Effa E., Telfer P. and Godoy R. 2005. Role of prices and wealth in consumer demand for bushmeat in Gabon, Central Africa. *Conservation Biology* 19: 268–274.

Wilkie D.S. and Carpenter J. 1999. Bushmeat hunting in the Congo Basin: An assessment of impacts and options for mitigation. *Biodiversity and Conservation* 8: 927 – 955.

Ze Meka E. 2002. Cameroon Minister praises ITTO support for Yaounde Process. 28 June 2002. ITTO Secretariat. http://www.itto.or.jp/inside/current_news/jun28_2002_minister.html

CHAPTER TWO

Review on the management of protected areas in the Congo Basin

Julius Chupezi Tieguhong

Forestry, Faculty of Science & Agriculture, University of KwaZulu-Natal, P Bag X01, Scottsville 3209, South Africa. chupezi@yahoo.co.uk or 204523366@ukzn.ac.za

ABSTRACT

Over 32.7 million ha representing 14.4% of the Congo Basin's forest is under one of the IUCN protected areas categories. This is in line with the year 2000's declaration by most Central African Ministers in charge of forests at the Yaounde Summit to conserve at least 10% of their forests in protected areas. Despite the huge potential economic and environmental benefits of the Congo Basin's forests; this paper argues that their sustainability would depend on three cardinal factors, namely: economic viability, adequate management capacity and political support at the highest level. The paper reviews and examines some critical questions, proposes answers to these questions and draws major lessons from across Africa to support key recommendations on the sustainable management of protected areas in the Congo Basin.

Keywords: Economic viability, Evolving institutions, Management capacity, Policy profile, Yaounde Summit

INTRODUCTION

The Congo Basin comprises six countries including Cameroon, the Central African Republic (CAR), the Republic of Congo (Congo), the Democratic Republic of Congo (DRC), Equatorial Guinea and Gabon (Figure 2.1). The total land area of the Congo Basin is about 398.3 million ha with over 57% of the area covered by forests (FAO, 2005). The forest area per capita is 2.9 ha compared to the global forest area per capita of 0.8 ha. Over 78 million people inhabit this region, out of which 62% are still living in rural areas. The average population growth rate is 2.5% and population densities range from less than 5.2 persons per km^2 in Gabon to 34.4 persons per km^2 in Cameroon (FAO, 2005). The average GDP per capita for the Congo Basin is about US$ 411, although great variations exist among the countries. For example, in the DRC the GDP per capita is US$ 107, while in Gabon and Equatorial Guinea the GDP is US$ 4155 and 5915 per capita, respectively. Apart from Equatorial Guinea with an annual GDP growth rate of just over 16%, the other countries in the Congo Basin experience growth rates of less than 5% percent whilst the Central African Republic is facing a recession with a negative growth of -0.8%. The above statistics show that the Congo Basin is a forest rich region and the people depend on these forests to meet their everyday needs (Tieguhong and Ndoye, 2004; 2007). Despite these vast natural resources the level of poverty is high.

In terms of biological diversity, the Congo Basin contains over 60% of Africa's fauna and flora within the largest remaining contiguous moist tropical forest in Africa (Wilkie *et al*., 2001). Most of this biodiversity resides in protected areas, which have been expanded by African countries in response to the global call for protecting both floral and faunal biodiversity (Lusigi, 2003). New national parks have been established in the Congo Basin over the last two decades and today the total number of national parks in the region stands at 49 out of which 24 were created after 1990 (Table 2.1).

Figure 2.1. Map of Africa showing countries of the Congo Basin.

Table 2.1. Trends in the proclamation of national parks in the Congo Basin (World Database on Protected Areas, 2007).

Country	No. of National Parks		
	Created before 1990	Created after 1990	Total at present
Cameroon	11	3	14
Central African Republic	4	1	5
Republic of Congo	1	3	4
Democratic Republic of Congo	9	0	9
Equatorial Guinea	0	3	3
Gabon	0	14	14
Total	**25**	**24**	**49**

The extent of the protected areas as a proportion of the total forest area for the Congo Basin is about 14.4% (FAO, 2005; Nasi *et al*., 2006). However, conspicuous variations exist among the countries, both in terms of forest proportion and the total area per country (Table 2.2).

Table 2.2. Proportion of protected areas in countries of the Congo Basin.

Country	Total land area (kha)[1]	Forest Area (k ha)[1]	Protected area (ha)[2]	PA as % of total forest area
Cameroon	46 540	23 858	3 227 361	14
Central African Republic	62 297	22 907	5 017 000	22
Republic of Congo	34 150	22 060	3 819 002	17
Democratic Republic of Congo	226 705	135 207	16 141 650	12
Equatorial Guinea	2 805	1 752	552 000	32
Gabon	25 767	21 826	3 955 285	18
Total	398 264	227 610	32 712 298	14.4

[1]FAO, 2005
[2] Nasi *et al*, 2006

The protected areas in the five countries make up over 98.3% of all protected areas in the Congo Basin, with the DRC alone accounting for over 59%. All the countries in the Congo Basin have over 10% of their forests under some form of protection, which is in accordance with their commitments expressed at the Yaounde Summit in 2000. Despite the increasing number of protected areas in the Congo Basin, numerous remaining challenges need to be addressed in order to achieve both the conservation and development objectives governing their creation.

During the celebration of the 5th World Park Congress (WPC) in Durban, South Africa, over 3000 participants voiced a concern and urgent need for action on the management of protected areas for their enormous benefits that should be retained and equitably shared (WPC, 2003). Similar concerns were re-iterated during the 15th Session of the Working Party on the Management of Wildlife and Protected Areas in Africa (African Forestry and Wildlife Commision - AFWC, 2004). These concerns included inadequate institutional arrangements, weak policy profiles for wildlife conservation in the protected areas management, inadequate financial resources, inadequately trained manpower, weaknesses in law enforcement systems, cross-boundary movement, exploitation of wildlife, and unsustainable trade in wildlife products (Tieguhong and Ndoye, 2004).

RESULTS AND DISCUSSIONS

Despite the huge potential for economic and environmental benefits of forests in the Congo Basin; their sustainability depends on three major factors, namely: economic viability, adequate management capacity and political support at the highest level. In this paper only five of the concerns mentioned above are examined:

- improvement of political support,
- advancement of institutional arrangements,
- how to increase human resource capacities,
- improved financial resources,
- enhancement of sustainable bushmeat trade.

Political support for protected areas management

Political support for the management of protected areas can be judged by reviewing (i) the attendance and active participation of government and non-governmental organizations at regional and international meetings, (ii) government budgetary allocations and (iii) the respect of international agreements. An analysis of the attendance of delegates from the Congo Basin to the recent WPC and the AFWC indicated weak political interest and support (Table 2.3).

Table 2.3. Delegates from the Congo Basin to the 5th World Park Congress (WPC) in Durban, South Africa (2003) and to the African Forestry and Wildlife Commissions in 2002, 2004, and 2006 (Source: Lists of participants).

Country	Delegates to WPC 2003		Delegates to the African Forestry and Wildlife Commissions		
	Total	Government	13th Session 2002	14th session 2004	15th Session 2006
Cameroon	25	4	1	1	0
CAR	2	1	3	2	1
Congo	4	1	0	0	3
DRC	8	1	0	0	5
Equatorial Guinea	0	0	1	0	1
Gabon	4	2	4*	0	2
Total	50	9	9	3	12

* There were over 60 observers from Gabon

Out of approximately the 50 delegates from Central Africa that attended the 5th WPC in Durban, nine were from government ministries and the rest from civil society. The "15th Session of the Working Party on the Management of Wildlife and Protected Areas" was attended by 28 delegates, but only one originated from the Congo Basin, specifically from the Central African Republic. Equatorial Guinea is not yet a member of the African Forestry and Wildlife Commission and the International Tropical Timber Organisation (ITTO). Only Cameroon, the Congo, the DRC, and Gabon are members of the Committee on Forestry (COFO). With regards to International Forestry Processes, only a few countries from the Congo Basin are active. For example, the DRC was the only country to summit a national report to the 5th United Nations Forum on Forests (UNFF).

The 15th Session of the AFWC was attended by 106 representatives from 40 member and observer countries and 3 representatives of the United Nations. Observers from the 12 inter-governmental and non-governmental organisations also attended (AFWC, 2006). Of the 46 member countries, 36, including most countries of the Congo Basin, were represented, excepting Cameroon.

Forty nine experts from 20 countries attended the 14th Session of the AFWC in Accra, Ghana in 2004. These included members of the Collaborative Partnership on Forests (CPF) as well as other international, regional and sub-regional organisations (14), members of the private sector

(1) and NGOs (4) (AFWC, 2004). National reports made available to the commission in 2002 were from just 12 countries (Benin, Guinea, Kenya, Mali, Morocco, Niger, Senegal, South Africa and Uganda) including three from the Congo Basin (Cameroon, Central African Republic and Gabon) (AFWC, 2002).

The lesson to be learned from this analysis is that countries that are always present in international forums on wildlife and protected areas have been able to use the knowledge gained to raise the political profiles of protected areas in their countries and therefore better develop their park systems and management. This is true for South Africa, which has always been well represented in all commissions and committees and is today the leading international tourism destination in Africa (Rogerson, 2007). Other countries always well-represented include Ghana and Senegal, each equally championing international tourist arrivals to their parks in West Africa. In addition to the low attendance rates in international and regional conferences, the countries of the Congo Basin suffer from inadequate budgetary allocations (Table 2.4). Budgetary allocations for the management of protected areas have low priorities for the governments of these countries.

Table 2.4. Budget allocations on protected areas (PA) in some African countries (US$) (Wilkie *et al*., 2001; PPP = purchasing power parity, INT$ = international dollar rates).

Country	Government spending				
	PPP (Int$/US$)	**Total (Int$ million PPP)**	**PA (Int$'000 PPP)**	**PA/Total (%)**	**Unit area spending (US$ PPP/km^2)**
Cameroon	1.20	2 676	771	0.03	30
CAR	1.58	3 002	505	0.02	11
DRC	1.90	464	768	0.17	8
Gabon	0.72	1 058	178	0.02	10
Kenya	5.20	14 040	69 685	0.5	2 129
South Africa	1.28	48 640	157 065	0.32	2 725
Zimbabwe	2.70	7830	18 090	0.23	357

Apart from the notion that most countries in the Congo Basin are poor, one reason to explain the low allocations of funds is that no existing studies that can be used to showcase the significance of wildlife resources and their habitats to the economies of these countries (Tieguhong and Ndoye 2004). In some cases where technical information is available, it is not

interpreted into appreciative and understandable statements for local politicians and decision-makers to assimilate and use. The lack of existing information and proper communication results in an underestimation of the importance of wildlife and protected areas within the fiscal sectors of the governments and therefore, the lack of a strong political will to support conservation efforts (Tieguhong and Ndoye, 2004).

One way to improve this situation is by raising the profile of wildlife and national parks through the generation of sound research results on the current and potential economic impact of protected areas on national economies. Small amounts of revenue documented so far from the protected areas are believed to provide little incentive for the central governments to allocate adequate funding for their management (Eagles, 2001).

Evolving institutional arrangements

Previous conservation activities in the Congo Basin had adopted a piecemeal approach whereby each country tried to tackle the problems and challenges facing forest and wildlife management within their national frontiers. This approach did not seemingly yield the desired results as the decline of forests and wildlife accelerated. Due to commonalities in natural conditions, in addition to weak and inappropriate policies of national institutions, a vision towards a regional approach was established. In consequence there has been an evolution of institutions in the Congo Basin towards a joint framework for forest and wildlife management. This became evident in the early 1990's with innovative developments demonstrating the will of forest stakeholders and the state to work together for the benefits of the sustainable use of the regional forest ecosystems in accordance with the political, social, economic, and environmental needs. To date, the following regional initiatives have been instituted as a proof of a greater political commitment and trans-national integration:

- **Conference on Central African Moist Forest Ecosystems (CEFDHAC),** known also as the Brazzaville Process, was created in May 1996. Meeting every two years, it provides a framework for the co-ordination and exchange of experience among stakeholders in the forest sector (governments, the private sector, NGOs, etc.). It has ten member countries (Burundi, Cameroon, Central African Republic, Chad, Congo,

Democratic Republic of the Congo, Equatorial Guinea, Gabon, Rwanda and Sao Tome and Principe). CEFDHAC was an inter-ministerial organ co-ordinating various conservation initiatives in the sub-region but it has been transformed to play a technical role within the present schemes. It reports to the council of ministers of forest.

- **Yaounde Process.** The Yaounde Process also known as the Yaounde Forest Summit was launched in March 1999 as a ground-breaking event that was hosted and chaired by the President of the Republic of Cameroon and co-chaired by His Royal Highness, Prince Phillip of Edinburgh, the President Emeritus of WWF. The summit was held to address common challenges plaguing the conservation and sustainable management of the Central African forests. Notable achievement of the Yaounde Process was the signing of the Yaounde Declaration by seven heads of state (Cameroon, Central African Republic, Chad, Congo, the Democratic Republic of Congo, Equatorial Guinea and Gabon). The declaration was a 12 point resolution aimed at a common understanding of ways to improve forest resource management in the region. The following “12 Points” highlighted the agreement:
    1. creation of trans-boundary protected areas;
    2. development of adequate forest taxation policies;
    3. harmonization of national forest policies;
    4. enhancement of the participation of rural populations in forest management;
    5. enhancement of the participation of economic operators in forest management;
    6. adoption of measures to harmonize forest policies with those of other sectors;
    7. combating poaching;
    8. promotion of industrial wood processing;
    9. promotion of national and regional forums for the exchange of experiences;
    10. adoption of sustainable strategies for financing the forestry sector from internally and externally generated funds;
    11. organisation of further summits dedicated to the conservation and sustainable management of sub-regional forests;

12. revival of the Organization for Wildlife Conservation in Central Africa (OCFSA).

- **Central African Forest Commission (COMIFAC)**, now known as the Council of Ministers, is composed of the ministers in charge of forests. The council of ministers forms the primary authority for decision-making and co-ordination of sub-regional actions and initiatives pertaining to the conservation and sustainable management of the Congo Basin forests in accordance with the resolutions of the Yaounde Process. The first COMIFAC meeting was held in December 2000 and with advice from a preceding meeting of experts (September 2000) where the Joint Plan of Action (known by its French acronym as 'Plan de convergence') was finalised and approved by the ministers. Inscribed in the Joint Plan (2003-2010) are common intervention strategies of the States and partners in the development, conservation and sustainable management of forest ecosystems in Central Africa.

- **Congo Basin Forest Partnership (CBFP)** was launched in Johannesburg, South Africa at the World Summit on Sustainable Development (WSSD), held in September 2002 by the United States of America and South Africa. The CBFP is a Type II partnership, involving voluntary association of multiple stakeholders working to accomplish common objectives (CBFP, 2006). It was formed as an association with memberships of 33 governmental and non-governmental organizations working together to improve the communication and co-ordination of programmes, projects and policies governing the sustainable management of forest ecosystems in the six countries of the Congo Basin. The activities of partnership are organised within the framework of the COMIFAC Joint Plan of Action.

Within the framework of these regional initiatives achievements on wildlife and protected areas management has so far been in the area of drafting and signing protocols on trans-boundary conservation areas. A vivid example was the approval of the Sangha Tri-National Park (TNS) draft protocol on co-coordinating anti-poaching activities in the region by Cameroon, the Republic of Congo and the Central African Republic as well as the ratification of the TNS co-operation agreement in 2005. In addition to these; medium and long-term plans

have been initiated with funding mechanisms established to ensure the successful execution of various regional conservation programmes and overall commitments upheld by governments to pay their dues for the functioning of the COMIFAC Secretariat and other operations. Despite these commitments, which are vivid illustrations of a greater political will to support the sustainable management of protected areas in the region, inadequate human capacities and financial resources at ground level persist.

Capacity to manage wildlife and protected areas

Staff shortages for the management of wildlife and protected areas, as well as low capacities amongst the local communities to effectively participate in the management of conservation areas persist. According to James (1999), Africa's investment in protected areas management is the lowest in the world and the number of staff assigned to manage them is also low, ranging from 8 to 36 and 60 persons per 1000 km^2 in West and Central Africa, Southern and East Africa, respectively. Many participatory approaches and community-based organizations (CBOs) have been developed across Africa to support capacity building amongst the rural communities, including training initiatives for developing more equitable links and improved co-operation with conservation agencies. However, these approaches have not yet achieved the desired results in all the areas because many issues that govern such transitions are poorly understood by both the local communities and the staff managed protected areas (Nelson and Gami, 2003). Many local communities do not yet have the confidence and skills to negotiate with the operational staff and many have not yet developed appropriate representations that are able to do that on their behalf. Moreover, many managers of protected areas are still ill-equipped to understand how to treat communities as partners, rather than as subordinates and they have not been fully exposed to the guidelines on participation and to work in a participatory mode. Many confuse information provision with participation, to the extent that communities become audiences rather than partners in dialogues and negotiations.

From the foregoing understanding, it seems impending that the following issues have to be addressed in order to effectively increase both the local and the professional staff capacities for protected areas management:

1. Capacity building is essential for:
    - community members to gain the necessary skills and understanding of issues in order to enter into equitable dialogues with the government and conservation authorities and to communicate with diverse audiences;
    - staff managing protected areas in order to develop a proper understanding of the practice and benefits of community participation and to establish guidelines with clear standards on service quality, marketing and pricing policies;
    - governmental staff dealing with forest conservation staff to foster improved collaboration with communities, to establish clear job incentives and to encourage the development of new activities in protected areas.
2. Managers of protected areas will need to develop proper incentives for their staff to engage in ongoing dialogue with all stakeholders and to gain a better practical understanding of the modalities of entering into equal dialogue with communities. For this to happen, adequate funding of conservation agencies would be required, implying that management staff needs to continuously adapt their style and language to suit the changing priorities of funding organizations.
3. There is a need to promote community participation and devolution of authority over management regimes to local levels so that communities, helped by professional staff, can become central stakeholders in the development and implementation of plans on management of protected areas.
4. Finally, the link between national parks and universities needs strengthening so as to generate expertise in the specialized area of park management and tourism.

Financial resources for protected areas management

Aside from inadequate budgetary allocations, there is the problem of weak mechanisms for the generation of internal revenues in the absence of business approaches that could ensure financial sufficiency. This weakness is associated with inadequate finance management capacities, leakages in financial flows and poor financial profiles. Overall, this results in a lack of confidence by charities to donate money for protected areas management. There are

over 25 ways to raise revenue for protected areas management which can be classified under three basic categories (Spergel, 2001):

1. annual budgetary allocations by government;
2. grants and donations from individuals, corporations, foundations and international donor agencies, including conservation trust funds and debt-for-nature swaps;
3. fees, conservation taxes, sale of concessions, fines etc.

In most countries of the Congo Basin, government budgetary allocations for protected areas management use a centralized approach that depends upon the money available in the central treasury as well as on various political and lobby group influences (James, 1999). Moreover, revenues generated by park management are submitted to the government's central treasury. However, according to Spergel (2001), such an approach could only be effective when a central government provides sufficient funds. This approach suffers from a number of inefficiencies, such as low user fees, poor fee collection, very weak tourism expertise and "leakages" of tourism income to the private sector. These inefficiencies result in a low cost recovery and inadequate management budgets for protected areas, suggesting that, in combination with other approaches, such as the user payment approach, protected areas budgets could be enhanced.

The user payment approach is instrumental because all protected areas have some level of visitor use and nature-related tourism (ecotourism) has emerged as a major segment of the large tourism sector. For example, wildlife-based tourism alone accounts for over 40% of global, nature-related tourism (USAID, 2001). In Central Africa, this has a great potential for the economic development and local livelihood improvement, considering the presence of many charismatic wildlife species and pristine habitats.

The first step in increasing the current funds for wildlife and protected areas is to examine how funds can be generated internally from visitors and other users (Tegegne, 1999; Lindberg and Johnson, 1994; Binkley and Mendelsohn, 1987). Usually such income sources include entrance fees, concessions, accommodation, equipment rental, food and merchandise sales, licensing of intellectual property rights, and cross-product marketing (Spergel, 2001). A difference in revenues depends on the pricing policy and finance management structure in

place. For example, the wildlife-based tourism industry in Namibia has been triggered by the establishment of conservancies that has led to 30-fold increase in wildlife production values (Eagles, 2001). A suitable benefit-sharing and earmarking are major innovations that have captured the interest and full participation of local communities in protected area management in a number of countries (Mapedza, 2007; Mabugu and Mugoya, 2001).

Business approaches require the management of protected areas to generate higher amounts of money for their budgets from tourist expenditures (Eagles, 2001). The expectations from such an approach include: significant revenue gains from business-based management, increased visitation, more emphasis on client satisfaction, enhanced marketing, independence from government grants and better pricing policies. In this context, the park systems of a number of African countries such as Tanzania's National Parks, the Kenya Wildlife Service (KWS) and the South African National Parks (SANP) Board have adopted park agency management styles that are very similar to corporations or parastatal organisations. These countries are more likely to earn most or all of their operational budgets from tourism. For example, the SANP is successfully using these strategies to make over 80% costs recovery. The success is attributed to proper pricing, marketing and income policies (Tieguhong, 2003).

Other innovative funding approaches include external sources such as those obtained from international conservation funding agencies, corporations, and foundations (Tieguhong, 2003). Donations by individuals have also been seen as a promising way of raising funds for protected area management. "Debt-for-nature-swaps" and conservation trust funds are good avenues but no country in the Congo Basin has benefited from these as yet. The WWF has a long and well-established history of developing innovative conservation finance tools from which Central African countries can draw expertise to consolidate the gains. Important manuals have been written on this issue by WWF and FAO that can be used for capacity building within developing countries (Spergel, 2001).

Therefore, by instituting new management structures with innovative pricing policies and services in Africa, the amount of money for the management of protected areas can be increased (Moye and Carr-Dirick, 2002). Differential fee and market-based mechanisms

should be used in setting appropriate value for various services. A mechanism should be developed for sharing benefits with local communities in exchange for their participation in conservation efforts (Mapedza, 2007). It is also important to note that better and transparent management structures are of critical importance to generate funding in many African countries from various forms of foreign aid.

Sustainability of commercial trade in bushmeat

Wild animals have been hunted throughout time to serve as a source of protein and well-being. In the past, the human population was small and forest-dependent people used simple tools to kill game for their own consumption or to meet social rites. It was a sustainable practice as animal habitats were never degraded and the off-take was in harmony with the natural replacement rates by the animal populations. However, with the increase in human populations and as people are increasingly moving to cities, a large market has emerged for many products that were originally for subsistence consumption (Fa *et al.*, 2003; de Merode *et al.*, 2004; Bennett, 2002). One of such products is wildlife meat (bushmeat) for expanded domestic as well as external markets.

The social, economic and environmental consequences of externally market-driven hunting of bushmeat are different from those of subsistence production with the former often leading to the over-exploitation and depletion of wildlife. This goes well to say that African wildlife and protected areas are under pressure, much of this being blamed on poverty and the need to make a living (Tieguhong and Ndoye, 2004). A major problem is that the actual contribution of wildlife to livelihoods and economic development is difficult to quantify because most bushmeat production is informal and traditional, therefore, not always reflected in national accounting systems. However, CARPE (2001) estimates annual consumption of over one million tonnes of bushmeat (equivalent to about 4 million cattle) in Central Africa.

The commercial sustainability of the bushmeat trade would depend on its economic viability and on control mechanisms that govern the sustainable supply of bushmeat. Wildlife management tools such as bag limits, quotas, as well as open and closed hunting seasons can be used to control hunters. The use of export quotas has become an effective tool for the regulation of international trade in wild fauna and flora, which has ensured that the export of

products from a particular species will not be detrimental to the survival of the species. For such controls, export permits indicate the number of specimens already exported in a current year and the allowable quota for the species concerned. A quota system is set for hunting a specific number of each species of animal and this quota is based on the calculation of the sustainable harvest level of the species.

From the standpoint of international organisations, there is a need to: (i) strengthen the implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) through an Interaction Task Force to combat illegal trafficking of African Wildlife and (ii) to harmonise each country's policies with the roles of treaties and conventions. The CITES Bushmeat working group has established a representation in each nation in Central Africa and is in the process of developing a plan of action. The FAO/Netherlands Partnership Programme (FNPP) was generated bushmeat action plans for Cameroon, the Congo and Gabon (AFWC, 2004).

The difficulties of making actual financial estimates of bushmeat production, consumption and trade, i.e. its contributions to national economies are associated with the poor distinction between subsistence and commercial production of bushmeat as well as with setting appropriate systems of charging fees for bushmeat hunting. In countries such as Ghana, Nigeria, Tanzania, and Zambia permits are issued to different categories of bushmeat hunters but the revenue generated in this way is generally too low to reflect the market value of the bushmeat or the costs of managing the resource and collecting the fees (Tieguhong, 2003). A high and equitable fee system that reflects the value of the bushmeat and management costs can generate an ample amount of money to complement other sources of funds for sustainable management. For instance, a proper control of hunters by a motivated management team and the reflection of the actual value of bushmeat in national accounting systems might gain a greater political support that would attract higher budgetary allocations.

Success stories on the commercialisation of game in some southern African countries provide opportunities for improving wildlife habitats and increasing species diversity in other countries (Muir-Leresche and Nelson, 2000). The control over the use of wildlife has been privatised and instituted as a policy measure to encourage the ranching of highly valued species. For example, in Zimbabwe 53-94% of many desirable species are found on

commercial game farms (Muir-Leresche and Nelson, 2000). This approach has been seen as a viable option to replenish wildlife populations to continuously meet consumer demand for desirable species (AFWC, 2004). Dalal-Clayton (1991) estimated that annual revenues generated from wildlife hunting and tourism were about US$ 200 million and US$ 5 million to the economies of Zimbabwe and Zambia respectively. According to the latter, the huge difference was largely due to a lack of investments and proper wildlife management in Zambia as compared to Zimbabwe. Zambia had a land surface almost twice as large as Zimbabwe and with 32% of its land set aside as national parks and hunting areas, but the possibility of earning much more from wildlife was not realised.

Further information on the bushmeat sector requires more cross-cutting research. This was emphasized during the 14th Session of the Working Party on the Management of Wildlife and Protected Areas in March 2002, whereby item 5 of its report reiterated the need to consider bushmeat as a crucial resource rather than a product, so that its economic and social values are fully reflected in national development plans (AFWC, 2002). However, in most African countries, many scientific and conservation studies on bushmeat have focused on the impact of game hunting on biodiversity, as well as, the sustainability of the resource but with little in-depth considerations on the socio-economic importance of such activities to local household livelihoods. Some research projects have dwelled on the volume and value of bushmeat sold in both local and urban markets while others have concentrated on the estimation of wildlife population densities. Little quantitative data exists on household consumption and income from bushmeat production and trade, and on how such incomes are used in meeting basic household needs. Such needs include paying school fees, meeting household protein needs, ensuring the right of entry to healthcare, gaining access to modern equipment such as television (TV) and radio sets, etc.

CONCLUSION AND RECOMMENDATIONS

The following findings are formulated from this literature review:

1. while protected areas fulfil a number of economic, biological and social functions in the Congo Basin, their long-term values will depend on their economic viability, the political support and the manpower to manage them;

2. improving infrastructure and positive perceptions of safety, security, and accountability are key drivers to attract international financial resources, whether from foreign tourists, donors or private investors. Proper financial management will seemingly stimulate a dynamic workforce, create better infrastructure and sustain improved governance structures. Supplementary sources of funding are necessary but must not be viewed as a replacement to government allocations until such time that the economic indicators show that they are financially self-sustaining;
3. countries in the Congo Basin should make greater conservation efforts and become more active in forestry and wildlife commissions and processes to become informed on the challenges and opportunities in their protected areas management;
4. improving information flow to update governments, businesses and the media should lead to beneficial policies on wildlife and protected areas management. This requires sound research for data generation and dissemination. Whatever technical information is generated, it should be interpreted for political leaders and decision-makers to understand and apply;
5. the development of professional expertise on visitors' needs, service quality, leisure pricing policy, social statistics, park finance generation and management as well as on tourism management, are very important and unique for each protected area system;
6. an eradication of corruption and ensuring efficient financial systems for protected areas in each country are essential. Expertise from WWF and FAO on this issue may be sought;
7. more cross-cutting research on the role of bushmeat in household livelihood portfolios is urgently needed for more pro-development policies in conservation areas.
8. bushmeat hunting is not only important in a conservation context but also in the context of people's livelihoods, household economy and human development.

REFERENCES

AFWC (African Forestry and Wildlife Commission). 2006. Report of the 15th Session of the Working party on the Management of Wildlife and Protected Areas. Maputo, Mozambique. FO: AFWC/2006/REP. 29 March - 01 April 2006. 50 pp.

AFWC (African Forestry and Wildlife Commission). 2004. Report of the 14th Session of the Working party on the Management of Wildlife and Protected Areas. Accra, Ghana. FO: AFWC/2004/REP. 16-18 February 2004. 50 pp.

AFWC (African Forestry and Wildlife Commission). 2002. Report of the 13th Session of the Working party on the Management of Wildlife and Protected Areas. Libreville, Gabon. FO: /AFWC/2002/REP. 25-29 March 2002. FAO. Rome. 50 pp.

Bennett E.L. 2002. Is there a link between wild meat and food security? *Conservation Biology* 16: 590-592.

Binkley C.S. and Mendelsohn R.O. 1987. Recreation User fees, II. An economic analysis. *The Journal of Forestry* 85(5): 31-35.

CARPE (Central African Regional Programme for the Environment). 2001. Rich forests, poor countries: Adapting forest conservation to economic realities, CARPE Information Series, No. 10. USAID. Washington D.C.

CBFP (Congo Basin Forest Partnership). 2006. The Forests of the Congo Basin. State of the forest 2006. 256 pp. ISBN: 978907827016.

Dalal-Clayton B. 1991. Wildlife Working for Sustainable Development. GATEKEEPER SERIES No. 9. 9pp.

de Merode E., Homewood K. and Cowlishaw G. 2004. The value of bushmeat and other wild foods to rural households living in extreme poverty in the Democratic Republic of Congo. *Biological Conservation* 118: 573-581.

Eagles P.G.J. 2001. International trends in park tourism. EUROPAC. 43pp.

Fa J.E., Currie D. and Meeuwig J. 2003. Bushmeat and food security in the Congo basin: linkages between wildlife and people's future. *Environmental Conservation* 30: 71-78.

FAO. 2005. State of the World's Forests. FAO. Rome. ISBN: 92-5-105187-9. 153 pp.

James A.N. 1999. Institutional constraints to protected areas funding. Parks: *The International Journal for Protected Area Managers* 9 (2): 15-33.

Lindberg K. and R.L. Johnson. 1994. Estimating demand for ecotourism sites in developing nations. *Trends* 31:10-15.

Lusigi W.J. 2003. The African Protected Areas Initiative (APAI): Enhancing support for protected areas. Open Plenary of Institutions Session. WPC, Durban, South Africa. 7 pp.

Mabugu R. and Mugoya P. 2001. Financing, revenue-sharing and taxation issues in wildlife management areas. Wildlife Division, Ministry of Natural Resources and Tourism, Tanzania. 50 pp.

Mapedza E. 2007. Keeping CAMPFIRE going: Political uncertainty and natural resource management in Zimbabwe. *Gatekeeper Series 133*. IIED. 24 pp.

Moye M. and Carr-Dirick B. 2002. Feasibility study on financing mechanisms for conservation and sustainable management of Central African forests. Summary Report Prepared for the COMIFAC. 22 pp.

Muir-Leresche K. and Nelson R.H. 2000. Private property rights to wildlife: The Southern African Experiment. April. 30 pp.

Nasi R., Cassagne B.; and Billand A. 2006. Forest management in Central Africa: where are we? *International Forestry Review* 8(1): 14-20.

Nelson J. and Gami N. 2003. Enhancing equity in the relationship between protected areas and indigenous and local communities in Central Africa, in the context of global change. Final Report for TILCEPA. 19 pp.

Rogerson C.M. 2007. Reviewing Africa in the global tourism economy. *Development Southern Africa* 24 (3): 361-379.

Spergel B. 2001. Raising revenues for protected areas. A Menu of options. Center for Conservation Finance. World Wildlife Fund. 28pp.

Tegegne G. 1999. Willingness-to-pay for environmental protection: An application of the contingent valuation method (CVM) in Sekota District, Northern Ethiopia. *Ethiopian Journal of Agricultural Economics* 2(1):18-25.

Tieguhong J.C. and Ndoye O. 2007. The impact of timber harvesting in forest concessions on the availability of Non-Wood Forest Products (NWFP) in the Congo Basin. FAO

Forest Harvesting Case Study 23. ISBN: 978-92-5-105709-4.

Tieguhong J.C. and Ndoye O. 2004. Wildlife and protected areas management in Central Africa: Major challenges and ways forward. Paper presented at the 5th Conference on Central African Moist Forest Ecosystems (CEFDHAC) in Yaounde, Cameroon. 24-26 May 2004.

Tieguhong J.C. 2003. Review and Synthesis of fee mechanisms for Non-wood forest products and forest services in Africa. Africa Outlook Studies on Forest Finance. EC-FAO Partnership Programme (2000-2002). Consultancy Report. 59 pp.

USAID. 2001. Amendment 1 USAID/Ghana. Tourism-Led Economic Growth Promotion Programme.
www.usaid.gov/procurement_bus_opp/procurement/annual_pstatements/ghana.html.
Last visited 30 October 2006.

Wilkie S.D. Carpenter J.F. and Zhang Q. 2001. The under-financing of protected areas in the Congo Basin: so many parks and so little willingness-to-pay. *Biodiversity and Conservation* 10: 691-709.

World Database on Protected Areas, 2007. http://sea.unep-wcmc.org/wdbpa
Last visited 21 October 2007.

WPC (World Park Congress) 2003. Outputs of the 5th WPC. 8-17 September. South Africa. 16 pp.

CHAPTER THREE

Household dependency on forests in the Congo Basin

Julius Chupezi Tieguhong

Forestry, Faculty of Science & Agriculture, University of KwaZulu-Natal, P Bag X01, Scottsville 3209, South Africa. chupezi@yahoo.co.uk or 204523366@ukzn.ac.za

ABSTRACT

This study analyzed the average consumption and cash incomes of households living in villages adjoining the Lobeke National Park in Southeast Cameroon with particular focus on the extent to which households in the region were dependent on forest products and services. Possible reasons for the dependency of households on forests were identified and tested using logistic regression. A total of eight income portfolios were found to be the main contributors to the household annual incomes in the studied villages. The variation of total household incomes with regards to income portfolios in the five studied villages showed that forest income was conspicuously contributing to the livelihoods of the people living in the area. Forest income alone contributed 44.44% while the non-forest income sources contributed 55.56% to the total income of all the households surveyed. Significant differences in incomes were observed among households ($p<0.5$) in the studied villages. A major recommendation was that conservation policies need to be overhauled to seriously take into consideration the importance of forest products in the livelihoods of forest peoples.

Keywords: Congo Basin, Conservation and development, Forest dependency, Income portfolios, Policy shifts, Protected areas

INTRODUCTION

In the Congo Basin, national parks and other protected forest landscapes are not uninhabited spaces. People live in and around those ecosystems and depend on them for food, shelter, health and income (Tieguhong and Ndoye, 2007; Ndoye and Tieguhong, 2004; Blom, 2001; Wilkie *et al*., 2001). According to Wollenberg and Nawir (1998), income estimation for people whose livelihoods depend on forests is central to understanding their well-being and forest usage. Many other authors have stressed that the analysis of forest resources used by forest dwellers can provide appropriate insights to their management as well as to developing livelihood strategies for the forest-dependent peoples (Masozera and Alavalapati, 2004; Angelsen and Wunder, 2003; Wunder, 2001; Bahuguna, 2000; Cavendish, 2000; Emerton, 1996; Godoy and Bawa, 1993; Falconer and Arnold, 1989). This suggests that the dependence of local people on the natural environment must not be overlooked in the management of protected areas (Masozera and Alavalapati, 2004). Therefore, factors that determine peoples' needs should be identified, such that innovative strategies can be designed to ensure peoples' well-being and thereby reduce impacts and increase the sustainability of the forests (Masozera and Alavalapati, 2004; Hedge and Enters, 2000; Gunatilake, 1998). For almost all forested and protected areas in the Congo Basin, scientific information to this end remains qualitative or where some quantitative information is provided, the overall income portfolios of the forest-dependent households are not provided. The concept of villagers' income portfolios is based on the fact that in addition to income from forest products they generally rely on other income sources such as agriculture, livestock, fishery, wages, trading, full-time employment, remittances, gifts, government assistance, mortgage payments or yield from sharecropping arrangements (PEN, 2007; Levang *et al.*, 2005; Campbell *et al*., 2002; Bahuguna, 2000; Wollenberg and Nawir, 1998). Coherent economic data showing the extent to which villagers depend on forest resources as compared to other livelihood portfolios is generally lacking. Therefore, this study was geared at filling the information gap by asking the over-arching question: what is the level of forest-dependency in the Congo Basin?

In the past managers of conservation areas applied conventional law enforcement strategies but failed to restrict the local peoples' access to forest resources. Such an approach and

ignorance of the socio-economic needs of the local people, often resulted in conflicts and consequential difficulty in mobilising the communities to collaborate in conservation efforts (Masozera and Alavalapati, 2004; Sayer and Campbell, 2004; Sheil and Wunder, 2002). The information to be generated in this study is needed to make pro-poor development policies for conservation areas in the region, which is in line with the new paradigm of conservation implicit in local development (Chan *et al*., 2007; Garnet *et al.,* 2007; Kaimowitz and Sheil, 2007; Wilkie *et al.,* 2007; Anderson *et al*., 2006; Kuster *et al.,* 2006; Purcell and Brown, 2005; Adams *et al.,* 2004; Angelsen and Wunder, 2003; Brown, 2002; 2003; Wunder, 2001; Faith *et al.,* 1996; Alcorn, 1993). To this, international donors/funding agencies are increasingly more interested in projects that have both developmental and conservation components (Brown, 1998). So far, regional development strategies have been based on guess work due to the lack of sound economic data. The informed policy to bridge human development and conservation strategies would benefit the minorities and forest-dependent poor. Such an approach could provide answers to the concerns of equity and fair play in global attempts to achieving both conservation and development goals as enshrined in the United Nations Millennium Development Goals (MDGs) (Commission for Africa, 2005).

The study was guided by the fact that income is a vital indicator of forest villagers' well-being (Vedeld *et al.,* 2004; Angelsen and Wunder, 2003; Campbell *et al*., 2002; Cavendish, 2000; Campbell and Luckert, 2002; Wunder, 2001). The following terminology is understood in this study as:

- Income is defined as the total revenues less total costs associated with generating these revenues.
- Revenue is usually received in cash from the exchange of forest products in the marketplace but costs are not subtracted (PEN, 2007).
- Gross income is revenue less cash costs and
- Net income is revenue less cash costs and imputed costs such as depreciation, value of unpaid labour or the opportunity costs of inputs (Wollenberg and Nawir, 1998).
- Total income is cash income plus the value of consumed or stored items intended for consumption.

- Income-in-kind is non-cash income such as gifts, food items intended for home consumption or timber intended for home use (PEN, 2007; Wollenberg and Nawir, 1998).

STUDY AREA AND METHODS

Study area

The Lobeke National Park (LNP) forms the western section of the Sangha Trinational Park (TNS) shared by Cameroon, the Republic of Congo (RC) and the Central African Republic (CAR) (Figure 3.1).

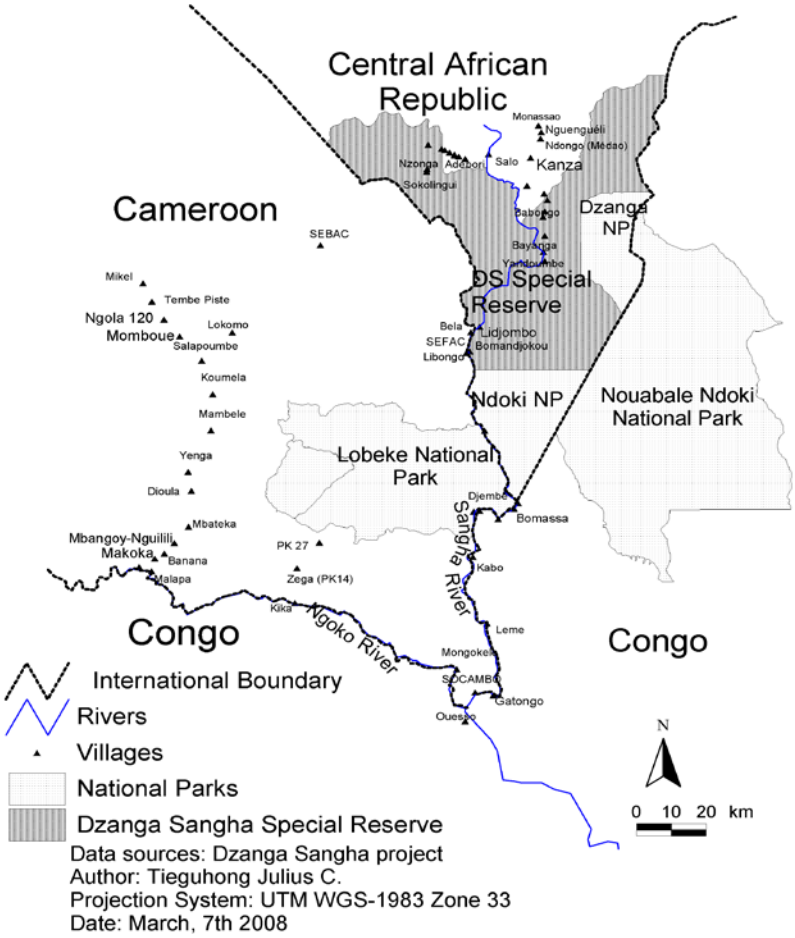

Figure 3.1. National parks in the Tri-National Park (TNS) and the neighbouring Cameroonian study villages (CAR – Central African Republic).

Two dominant indigenous ethnic groups inhabit the humid forest zone of the Congo Basin. These include the Bantus (predominantly farming population) and the pygmies (predominantly forest-centred hunter-gatherers) (Jackson, 2004). Many Pygmy peoples totalling over 500 000 (Jackson, 2004) in the region refer to themselves as ‘people of the forest’ and see themselves as distinct from their settled farming neighbours whom they call ‘village people’ and in some cases patrons (Abega, 1998). The pygmies and Bantus are popularly known as Baka and Bangando/Bakwele in southeast of Cameroon and Ba’aka/Bayaka and Bilos in south-western CAR respectively (Jackson, 2004).

Both in Cameroon and the CAR, the pygmies are known as prior occupants of forest lands and have a distinctive social structure, lifestyle and livelihood strategy intimately dependent on the continued existence of the forest and the maintenance of its ecological functions (Tieguhong and Ndoye, 2007). According to Jackson (2004), pygmies have extensive traditional forest-related knowledge about forest ecology, wildlife, and plants, giving them a holistic view of the forest and themselves as intimately connected and indivisible. However, some socio-cultural differences exist among the pygmies found in Cameroon and those in the Central African Republic, particularly in relation to the ability to go to school, recognition of the monetary value of goods, attitude to farming, self-responsibility and emancipation to take part in decision making, time spent in the forest, ability to speak French, and social relations with Bantus (Table 3.1).

Table 3.1. Socio-cultural differences between pygmies in Cameroon and those in the Central African Republic (Per. Obs.).

Variable	Central African Republic	Cameroon
Education	Find it difficult to send their children to school despite support from the Bayangan project	Voluntary acceptance to send their children to school
Money value	More often abandon their work and therefore difficult to put them on contract	Are more in the job market and more conscious of their job regulations
Agriculture	Prefer to always work for Bantus	Few work for Bantus
Time in forest	More time spent in the forest with specifically long forest holidays (up to 3 months).	Time in the forest reduced and fewer youths have good knowledge of the forest
French language skills	Poor	Good
Representation at meetings	Incapable of defending their interests (Inability to self-expression)	Integrated in society and participate at meetings
Self responsibility	Less, do not ask questions, when the bilos speak	More self-determined, ask questions when Bangandos/Bakweles speak
Marriage with Bantus	Non-existent, they think it is impossible	Few cases existing

Farming peoples also hunt and gather in forests (but to a lesser extent than Pygmy peoples) and consider the forest to be a source of abundance and having spiritual importance. They too have valuable forest knowledge, but they are generally less dependent on forest resources than Pygmy peoples (Tieguhong and Ndoye, 2007). Their customary land ownership is based largely on the transformation of forestland to agricultural lands through slash-and-burn practices (Jackson, 2004, Abega, 1998).

Selection of villages

In total, 14 villages exist outside the LNP but not more than 50 km from the LNP boundary. The villages were stratified by their location from the park boundaries into western villages (Koumela, Mboli, Lopondji, Mambele, Yenga, Mbateka and Nguilili), northern villages (Libongo and Lokomo) and southern villages (Ndjombi, PK-14/Zega, Kika, Mongokele and Socambo). There were no villages to the east of the LNP as the Sangha River forms the boundary with the RC. In two of the strata (west and south), two sample villages were

randomly selected from each. Only one village was randomly selected from the northern stratum for the survey. The five sample villages were: Koumela, Mambele, Libongo, Zega and Socambo. Therefore, household (HH) surveys were only conducted in five villages on the Cameroonian side of the TNS.

Selection of households

In each of the villages mentioned above, a random sample of 22 households was drawn. This gave a total of 110 households in the Lobeke section of the TNS plus one additional household in Mambele, which was not selected but insisted on participating in the study, giving a total of 111 households. After choosing the households, an enumerator was trained and assigned to personally interview the inhabitants of the households in each of the villages, quarterly over a period of 12 months. The introduction phase involved brief explanations of the general topic of the survey and the solicitation of acceptance to complete an in-depth and in-person interview at an agreed time. A tablet of soap was presented as a token of appreciation before beginning the interviews to increase the response rate.

Estimates of household dependency

The aim of the data collected through household surveys was to estimate forest dependency and to identify factors influencing it (Masozera and Alavalapati, 2004). A questionnaire, developed originally in English, was translated into French and administered orally in-person. Respondents were asked to report all items and their quantities collected from the forest, which they sell and consume at household level. Data on the respondent's education, age, duration of residence, household size and other socio-economic information was collected. The respondents were also asked to report their land ownership, crops grown those lands and the outputs thereof (Vedeld *et al.*, 2007; Angelsen and Wunder, 2003; Campbell and Luckert, 2002; Campbell *et al.*, 2002; Luckert and Campbell, 2002; Campbell *et al*., 2000).

Conceptual framework

A conceptual framework for this study was aimed at understanding the distribution of total household income and in-kind values among the different income portfolios in the study area. A model was developed which showed that the total household income of the forest dwellers

could be broadly divided into (i) a proportion of the cash income from selling forests products and non-forest activities (X%) and (ii) a balance of the income (in monetary value) of the home-consumed forest, and non-forest, products (Y%). Therefore, X% was sub-divided into (i) forest products and activities (X_1%) and (ii) non-forest products and activities (X_2%), and the Y% was subdivided into non-forest products cash income (Y_1%) and (ii) forest products cash income (Y_2%). Further sub-divisions divided the forest products and activities (X_1%) to ecotourism income (X_{1a}%) and other forest products and services (X_{1b}%). The sum of X_{1a}%, X_{1b}% and Y_2% gave the total forest income of each household and the sum of X_2% and Y_1% gave the value of non-forest products income for each household (Figure 3.2).

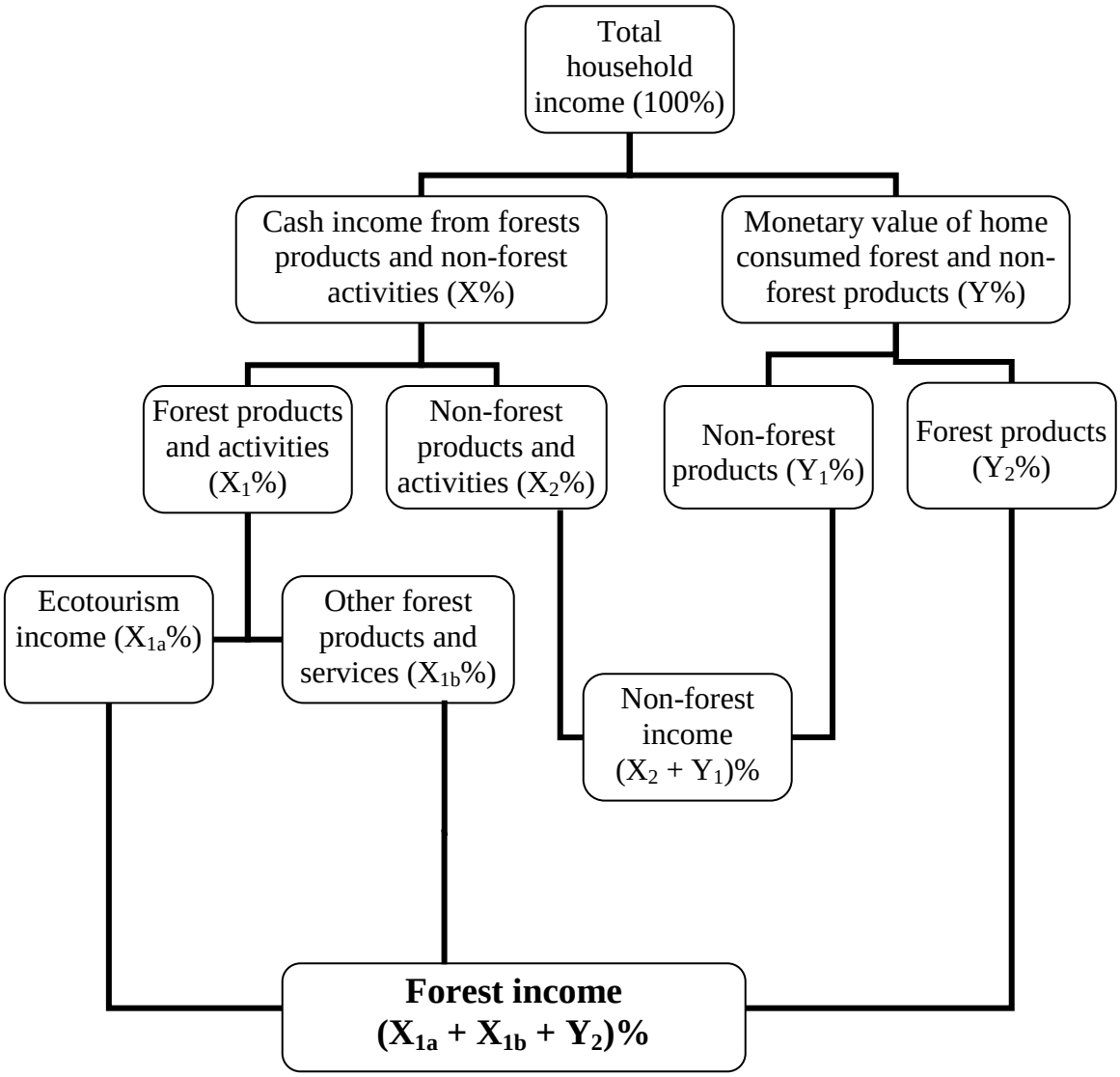

Figure 3.2. Conceptual framework on partitioning income for the households in villages around the Lobeke National Park

Data analysis

Data analysis was conducted in three phases involving data entry, checking and correcting thereof; the calculation of descriptive statistics and finally performing the logistic regression analysis.

Descriptive statistics

Household data was entered into the Microsoft Access interface and after being checked and corrected, it was exported to SPSS and STATA using Stat-Transfer 5.0. Descriptive statistics were calculated by using SPSS version 12.0 and Microsoft Excel 2003. STATA version 8.0 was used for logistic regression analysis. Microsoft Excel 2003 edition was very useful in aggregating the data for presentations such as pie charts and histograms.

Inferential statistics

It was considered important to know if annual household incomes were significantly different across households per income source. It was found that the means of incomes from different sources were heterogeneous, which justified the use of a Kruskal-Wallis level one test in the SPSS version 12.0 interface. This is a non-parametric test; equivalent to a one-factor analysis of variance test. The Kruskal-Wallis test is used when the conditions of homogeneity of variances and normality of distribution of observations are violated (SPSS User Guide, 1999).

Following the Kruskal-Wallis test, it was considered important to find out which villages actually had similar or different mean annual incomes from each other by income source. The Games-Howell test (SPSS version 12.0) was employed. This is a multiple comparison test applicable where the variances of means are heterogeneous (SPSS User Guide, 1999).

Knowing the different sources of income was important for this study. Equally important was the need to find out which income sources were actually contributing to the variation of incomes among the households and the villages. Also it was considered important to find out

the independent socio-economic variables characterising individual households that explained their dependence on specific income sources. In this case, the logistic regression model was employed by using the STATA version 8.0.

Logistic regression - model specification

A household's dependence on the resources of the LNP was calculated as the ratio of the annual income earned from forests (collection of forest products, tourism revenue, labour income from forest companies and the management of the LNP) to the total annual income earned from all other sources (PEN, 2007; Masozera and Alavalapati, 2004; Vedeld *et al*., 2004). The following procedures were used to derive income from the different sources:

Total annual HH income = $\sum$ (Forest income + Agricultural income + Fishing income + Livestock income + Non-forest environmental income + Wage income + Business income + Other sources of income).

Where:

HH = Households in the studied villages

Forest Income = (Forest cash income + Subsistence forest income) - costs

Forest cash income = cash from sale of forest products + wage income from forest-related activities + other revenues from forest-related activities such as compensation from conservation NGOs, loggers and sport hunters.

Subsistence forest income = value of all consumed forest products at household level

Forest household dependency = total annual HH forest income/total annual HH income

In order to apply the logit model, households were dichotomised into those that were highly dependent on forest products and those that were of low dependency on forest resources. For this study it was supposed that a household in any of the studied villages was highly dependent on the forest resources if the proportion of its total forest income was more than 49.09%. This was the mean proportion of the forest income for all the households in the studied villages. The dichotomization of the households into high and low dependencies was important for designing policies and strategies to reduce household dependence on forest products

(Masozera and Alavalapati, 2004; Gujarati, 1995). The model used to estimate the dependency was specified as follows:

$$\text{In}\,[P_i/(1-p_i)] = \beta_0 + \beta_1 X_1 i + \beta_2 X_2 i + \ldots\ldots + \beta_k X_k i$$

where subscript i denotes the i-th observation in the sample, p is the probability of the outcome, β_0 is the intercept term, and β_1, β_2,…., β_k are the coefficients associated with each explanatory variable X_1, X_2……X_k (Masozera and Alavalapati, 2004; Gujarati, 1995). The explanatory variables used to explain household forest dependency were: age of household head, gender, education, ethnic affinity, duration of residence in the village, household size, major crisis faced by a household (e.g. death of income earning member of household, prolonged illness, crop failure), membership of a forest user group, agricultural income, fishing income, livestock income, non-forest wage income such as employment in a public service, landholding size, and other non-forest sources of revenue such as remittances (PEN, 2007; Vedeld *et al*., 2007; Anderson *et al*., 2006; Dewi *et al*., 2005; Masozera and Alavalapati, 2004) (Table 3.2).

Table 3.2: Independent variables and expected impact on household dependency in the Congo Basin (Min=Minimum; Max=Maximum; SD=Standard Deviation)

Explanatory variable	**Measurement**	**Expected impact**
Duration residence (years)	Min=1; Max=60;Mean=18.96;SD=14.73	Positive
Ethnicity	Belong to major ethnic group=1; not=0	Positive
Household size	Min=1; Max=13;Mean=6.24;SD=2.64	Positive
Age of household head	Min=23; Max=71;Mean=46.67;SD=11.50	Positive
Gender of household head	Male=1; Female=2	Positive
Education (years)	Min=0; Max=14;Mean=5.72;SD=3.87	Negative
Total land area owned (ha)	Min=1; Max=14;Mean=3.33;SD=2.52	Negative
Major crisis faced by household	Yes=1; No=0	Positive
Member of FUG	Yes=1; No=0	Positive
Income from fishing (US$)	Min=0; Max=151;Mean=24.47;SD=25.76	Negative
Non-forest environmental income (US$)	Min=0; Max=99;Mean=3.69;SD=15.51	Negative
Non-forest wage income (US$)	Min=0; Max=1110;Mean=52.00;SD=156.05	Negative
Business income (US$)	Min=0; Max=1370;Mean=61.59;SD=185.01	Negative
Agricultural income (US$)	Min=25; Max=925;Mean=135.16;SD=141.85	Negative
Income from livestock (US$)	Min=0;Max=580.80;Mean=75.00;SD=105.31	Negative
Other non-forest income (US$)	Min=0;Max=600.00;Mean=57.47;SD=102.60	Negative

Extrapolations

In order to make estimates on the total value of each of the eight income sources in all villages around the LNP, field research data as well as data from previous studies was used under various assumptions as follows:

- Population of each village: Zega (227), Socambo (249), Koumela (825), Mambele (1153) and Libongo (4032) ;
- number of households in each village, Zega (46), Socambo (55), Koumela (126), Mambele (211) and Libongo (659) ;
- number of households surveyed in each village: Zega (22), Socambo (22), Koumela (22), Mambele (23) and Libongo (22);
- total population of surveyed villages = 6486;
- total number of households in surveyed villages = 1097 ;
- total number of households in all villages around the LNP = 4166.67
- Average household size in sampled villages = 6.24 persons
- total population in all villages (14) around the LNP = 26000 (MINEF, 2004);
- total income from all income portfolios of households in all villages around the Lobeke National Park was estimated in two ways:

  i). assumption that the mean household size of the population in five villages is representative of all households in the region and thus could be used to extrapolate the number of households for the population of all 14 villages;

  ii). assumption that the population of five villages is representative of the entire population of the region and thus the income earned by five villages could be used to estimate the total income of the entire population in the region.
- Income from each income source for all surveyed households in each village was drawn from previous analyses.

Based on the above assumptions and data, the following equations were derived and used in estimating the total income from each income portfolio on the studied villages.

$Total\ income_j = \sum_{i=1}^{5} (Income_{ij} * \frac{NH_i}{n_i})$, equation 1 for five villages

Where:

j denotes the source of income

i denotes the village

$Income_{ij}$ denotes the total income from j's source of the households surveyed in the i village

NH_i denotes the total number of households in the i village

n_i denotes the number of households surveyed in the i village

NH_i/n_i = extrapolation coefficient for five villages

$$Total\ income_j = (\sum_{i=1}^{5}(Income_{ij} * \frac{NH_i}{n_i})) * \frac{TNV}{nvs}, \quad \text{equation 2 for 14 villages}$$

Where:

j , i, and $income_{ij}$ are defined as in equation one.

TNV denotes the total number of villages around the LNP

nvs denotes the number of villages surveyed around the LNP

TNV/nvs = extrapolation coefficient for 14 villages

$$Total\ income_j = (\sum_{i=1}^{5}(Income_{ij} * \frac{NH_i}{n_i})) * \frac{TNH}{tnhs}, \quad \text{equation 3 for 14 villages}$$

Where:

j , i, and $income_{ij}$ are defined as in equation one.

TNH denotes the total number of households in all villages around the LNP

tnhs denotes the number of households in villages surveyed around the LNP

TNH/tnhs = extrapolation coefficient for 14 villages based on the proportionality of households in sampled ones around the LNP

$$Total\ income_j = (\sum_{i=1}^{5}(Income_{ij} * \frac{NH_i}{n_i})) * \frac{TP}{tps}, \text{ equation 4 for 14 villages}$$

Where:

j , i, and $income_{ij}$ are defined as in equation one.

TP denotes the total population in all villages around the LNP

tps denotes the population in villages surveyed around the LNP

TP/tps = extrapolation coefficient for 14 villages based on extrapolating the population in sampled villages to all villages around LNP

By applying the above formulae, the incomes of all households for each income portfolio in the five villages as well as in all the villages around the Lobeke National Park, were estimated.

Simple tests on the role of forest income in different households

Income inequality and distribution

This sub-section suggests other complementary measures of income inequality that can be used in the analysis of forest income dependence (Vedeld *et al*., 2004). These include Gini co-eficients and Kuznets ratios.

Gini Coefficient

The Gini coefficient can be calculated as:

$$G_{AI} = \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} | AI_i - AI_j |}{2n^2\mu}$$

Where n is the sample size and μ is the sample average. So the Gini coefficient for income inequality is simply the relative mean difference between all possible income pairs i and j in the sample. If we construct a new variable "absolute non-forest income", that is, absolute income from all sources other than the forest, such that:

ANI = AI – AFI

then we can calculate a Gini coefficient for absolute incomes excluding forest income:

$$G_{ANI} = \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} | ANI_i - ANI_j |}{2n^2\mu}$$

A comparison of these two Gini coefficients will reveal whether, and to what extent, forest environmental incomes contribute to reducing inequality (Vedeld *et al*., 2004).

Kuznets Ratios

Comparisons of forest income and the dependence between the rich and poor are of interest in general, regardless of the specific nature of the relationship (Vedeld *et al*., 2004; Botha, 2003; Aryal, 2002). The Kuznets ratio is the ratio between the average incomes of the richest 'x'

percent with the poorest 'y' percent (Vedeld *et al.*, 2004). We extend the definitions of Kuznets ratio by distinguishing between the absolute and relative ones, and we also apply them to forest environmental income (Vedeld *et al*., 2004). In the following, the value of the richest 25% and the poorest 25% (Figure 3.3) will be used to calculate Kuznets ratios for "absolute total income", "Absolute forest income" and "relative forest income".

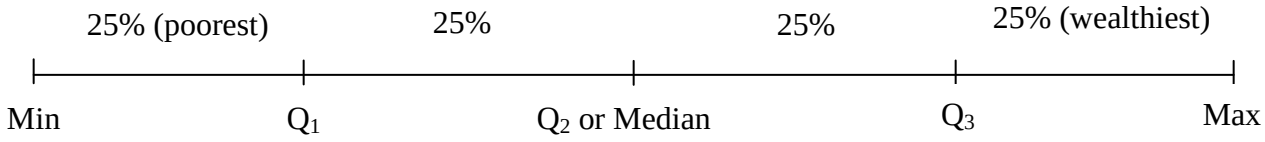

Figure: 3.3. Quartiles of income distribution for the rich and the poor

Min represents the minimum revenue in the distribution considered (absolute total income or Absolute forest environmental income or relative forest environmental income) while Q_1, Q_2, and Q_3 respectively represent quartiles in the order 1, 2 and 3. Lastly, Max represents the maximum revenue in the distribution. Therefore, for a given range of revenues, 25% of households have revenues below Q_1, 50% have revenues between Q_1 and Q_3, and the remaining have revenues above Q_3. This implies that the first 25% with revenues less than Q1 represent the poorest 25% segment needed in the equation. Using the same logic, the last 25% segment represents 25% of the richest households needed for the equation.

The "absolute Kuznets ratio", in terms of total income, can be defined as:

$$AKR = \frac{mean\ AI(wealthiest\ 25\%)}{mean\ AI(poorest\ 25\%)}$$

The correspondent "absolute forest Kuznets ratio" can then be defined as:

$$AFKR = \frac{mean\ AFI(wealthiest\ 25\%)}{mean\ AFI(poorest\ 25\%)}$$

Relative Kuznets ratio specifies the share of mean absolute income attributable to different sources. Taking forests as a source of income, the "Relative forest Kuznets ratio" can be defined as:

$$RFKR = \frac{mean\ RFI(wealthiest\ 25\%)}{mean\ RFI(poorest\ 25\%)}$$

While AFKR measures the ratio of absolute forest income among the wealthy to those of the poor, the RFKR expresses the ratio of dependence among the wealthy to that of the poor. Thus, it is entirely plausible that while the wealthy will have absolute forest incomes exceeding those of the poor (AFKR > 1), the poor will be more dependent on forest environment incomes (RFKR < 1) (Vedeld *et al*., 2004; Cavendish, 2003).

RESULTS AND DISCUSSIONS

Socio-economic characteristics

The data collected in the five villages yielded a total of 111 responses from the household heads most of whom (86.49%) were males. In a population of 6486 people, there were three major ethnic groups were represented by 77.48% of the population while 22.52% of the people belonged to different ethnic origins. Household size varied from one to 13 persons with a mean of 6.24 (standard deviation sd=2.64). The distribution was such that 24.32%, 63.06%, and 12.61% of the households consisted of 1-5, 5-10 and 10-13 persons, respectively. The age of the household heads varied from 23 to 71 years with a mean age of 46.67 years (sd=11.50 years). The most frequent household head age group was 50-60 years (27.93%), followed by 30-40 years (27.03%), while the young (23-30 years) and the old (60-71 years) categories were less frequent (6.31% and 16.22%, respectively). Only 13.51% of households were headed by women. This is associated with a high proportion of married people that are living together in the villages, where traditionally the man remains the head of the household insofar as he is living with his wife. The education level was found to be low in the villages with years of schooling varying from zero (no formal schooling) to 14 years of formal schooling. Mean number of schooling years was 5.72 years (sd=3.87 years).

It was found that 11.71%, 24.32%, 13.51%, 36.04%, 13.51% and 0.90% of the population had no formal education, elementary, primary, secondary, high school, and university (1 year) education, respectively. In terms of marital status, 88.29% of the household heads were married and living together while 7.21%, 3.60% and 0.90% were widows, divorcees and

singles, respectively. The household heads were found to have spent a minimum of 2 years and a maximum of 60 years in the villages with a mean of 18.96 years (sd=14.73 years). The distribution of the years spent by the household heads in the villages showed that only 27.03% of the people belonged to a forest user group (FUG). Members of FUGs believed that membership enhances the possibility of better forest management and more future benefits, increases their access to other benefits, gives them more societal respect as they are regarded as responsible persons, raised social status and increased access to forest products. The non-members (72.97%) explained that members usually belong to ethnic groups other than their own; they doubt the effectiveness of FUGs in managing forests; while others think that belonging to a FUG would restrict their use of forest resources. The analysis of the total land area owned by the households irrespective of their category (forest or agricultural land) showed a variation of 1 to 14 ha, with a mean size of 3.33 ha (sd=2.52 ha). The households in Mambele and Koumela were found to have larger land areas averaging of 3.91 ha and 3.82 ha, respectively.

Income portfolios and their characterisation

Livelihood strategies at household level are based on the use of capital assets (human, social, natural, physical and financial) to improve livelihood outcomes such as income, health and security, food security, access to natural resources, and general well-being (Luckert and Campbell, 2002). Eight income portfolios were found to be important for meeting respondents' daily needs in the form of:

- Forest products harvesting consumption and sale;
- Agriculture involving both food and cash crops production;
- Fishing in rivers and a preliminary start-up in aquaculture;
- Livestock production;
- Collection of non-forest natural products such as gold;
- Employment for wage income;
- Small business enterprises;
- Other sources of income such as gifts, remittances, support from NGOs, government, etc.

The forest income alone contributed US$ 36346.7 (44.44%) while the non-forest income sources contributed US$ 45439.1 (55.56%) to the total income of all the studied households (Table 3.3).

Table 3.3: Forest and non-forest income in studied villages around Lobeke National Park (US$)

Sources of income		Value (US$)	Village					Total (US$)
			Zega	Mambele	Socambo	Koumela	Libongo	
Forest income	Direct forest income	Value	5859.3	6777.7	4832.2	5346.8	3741.5	26557.5
	Forest derived income	Value	20	21.6	119.2	182.4	0	343.2
	Wage forest income	Value	354	1447	419	1659	3375	7254
	Other forest income	Value	0	564	360	1238	30	2192
	Total 1	Value	6233.3	8810.3	5730.4	8426.2	7146.5	36346.7
		%	**46.78**	**42.39**	**55.58**	**39.85**	**44.05**	**44.44**
Non-forest income	Fishing income	Value	726	663	451	279	597	2716
		%	**5.45**	**3.19**	**4.37**	**1.32**	**3.68**	**3.32**
	Non-forest environmental income	Value	409.9	0	0	0	0	409.9
		%	**3.08**	**0.00**	**0.00**	**0.00**	**0.00**	**0.50**
	Non-forest wage income	Value	430	2547	407	959	1428	5771
		%	**3.23**	**12.26**	**3.95**	**4.54**	**8.80**	**7.06**
	Business income	Value	434	2578	719	1477	1628	6836
		%	**3.26**	**12.40**	**6.97**	**6.99**	**10.03**	**8.36**
	Agriculture income	Value	3601.4	2897	2220.5	4002	2282	15002.9
		%	**27.03**	**13.94**	**21.54**	**18.93**	**14.07**	**18.34**
	Livestock income	Value	1105.3	2807.9	783	2486	1142.1	8324.3
		%	**8.29**	**13.51**	**7.59**	**11.76**	**7.04**	**10.18**
	Other non-forest income	Value	385	479	0	3515	2000	6379
		%	**2.89**	**2.30**	**0.00**	**16.62**	**12.33**	**7.80**
	Total 2	Value	7091.6	11971.9	4580.5	12718	9077.1	45439.1
		%	**53.22**	**57.61**	**44.42**	**60.15**	**55.95**	**55.56**
Total		Value	13324.9	20782.2	10310.9	21144.2	16223.6	81785.8
		%	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

As expected, the second most important income portfolio for household income was agriculture, accounting for 18.34% of the total income of all the households surveyed. Livestock, business income, other non-forest income, non-forest wage income and fishing income contributed 10.18%, 8.36%, 7.08%, 7.06% and 3.32% to the total income of all households in the studied villages. Non-forest environmental income was reported to be of

economic importance to households in Zega only, with its overall contribution estimated at only 0.5% for all the households surveyed (Figure 3.4).

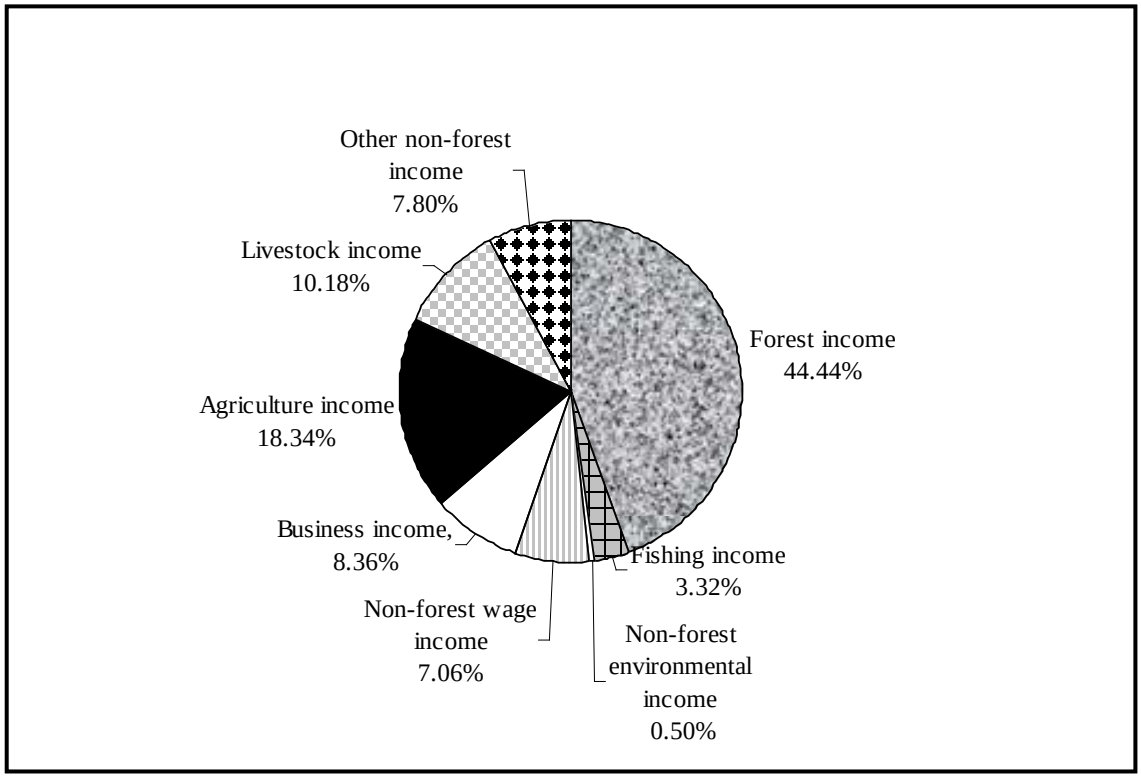

Figure 3.4. Distribution of income portfolios in studied villages around Lobeke National Park

The above results are consistent with the findings of Tchatat (1999) in the Ekom and Mekas villages in the South Province of Cameroon. The latter found that besides agriculture; forest product collection and sale formed 52.4% of income to households 32% from agriculture and the remaining proportion by other diverse economic activities. Sunderland *et al.* (2002) found that 70% (some 15707) of people living in 12 villages around the Takamanda Forest Reserve (TFR), located in the humid forest zone of the Southwest Province of Cameroon were exploiting forest products that represented 39% of their total household incomes. According to Tieguhong and Ndoye (2006) such supplemental incomes play important roles in buying agricultural implements and purchasing basic household needs as well as sending children to school. For further clarification, the sections below give a detailed analysis of each of the household income portfolios.

Income from forest products

Usually forest income includes income from forest products (sold or consumed), payments for forest services, salaries from forest companies, and compensations from NGOs and/or forest companies. In this section only the income from forest products is discussed. There were 14 forest products or product groups found to be commonly harvested, consumed and/or sold by households. The most important ones were considered to be those that mostly contributed to the total income. In this regard, the most important products in term of US$ value were wild fruits (34.54%), bushmeat (25.6%), fuelwood (17.63%), wild vegetables (3.35%), medicinal plants (3.14%), woven products (2.84%), honey (2.64%), nuts (2.60%), poles (2.09), bamboo (1.60%), rattan (1.52%), mushrooms (1.19%), Maranthaceae leaves (0.74%), and roots/tubers (0.53%). The studied households' annual income from forest products varied from US$ 87.80 to US$ 581.40 with a mean of US$ 239.26 (sd = US$ 80.53). There were significant differences in annual incomes from forest products between households in the villages ($P< 0.05$) with households in Mambele having the highest and Libongo the lowest direct incomes from forest products (Appendix 3.1). For the 111 respondents, the total annual income from forest products amounted to US$ 26 557.5, with unequal contributions from the villages: Zega US$ 5859.3, Mambele US$ 6777.7, Socambo US$ 4832.2, Koumela US$ 5023.8 and Libongo US$ 4064.5 (Table 3.4).

Table 3.4. Forest products and household income (US$) in five villages near the Lobeke National Park (Cameroon).

Forest products and values			Village					Total
			Zega	Mambele	Socambo	Koumela	Libongo	
Poles		US$	232.4	109.4	82.6	78	53.4	555.8
		%	**3.97**	**1.61**	**1.71**	**1.55**	**1.31**	**2.09**
Fuelwood/		US$	1050.8	1244.4	740	873.2	773.6	4682
		%	**17.93**	**18.36**	**15.31**	**17.38**	**19.03**	**17.63**
Rattan		US$	95	76	98	84	50	403
		%	**1.62**	**1.12**	**2.03**	**1.67**	**1.23**	**1.52**
Bamboo		US$	209.2	108	25	0	83	425.2
		%	**3.57**	**1.59**	**0.52**	**0**	**2.04**	**1.6**
Wild fruit		US$	1670	2480	1672	1920	1430	9172
		%	**28.5**	**36.59**	**34.6**	**38.22**	**35.18**	**34.54**
Nuts		US$	152	209	170	21	138	690
		%	**2.59**	**3.08**	**3.52**	**0.42**	**3.4**	**2.6**
Mushrooms		US$	101.8	86.7	54	31.8	41.1	315.4
		%	**1.74**	**1.28**	**1.12**	**0.63**	**1.01**	**1.19**
Roots and tubers		US$	43	32	0	18	47	140
		%	**0.73**	**0.47**	**0**	**0.36**	**1.16**	**0.53**
Wild vegetables		US$	226.2	220.2	241.4	137.2	66	891
		%	**3.86**	**3.25**	**5**	**2.73**	**1.62**	**3.35**
Medicinal plants		US$	194.5	267.2	161	139.6	70.4	832.7
		%	**3.32**	**3.94**	**3.33**	**2.78**	**1.73**	**3.14**
Maranthaceae Leaves		US$	71.4	32.6	44.6	26.4	22.6	197.6
		%	**1.22**	**0.48**	**0.92**	**0.53**	**0.56**	**0.74**
Bushmeat	Mammals	US$	1298.2	1534	1249.4	1155	838	6074.6
		%	**22.16**	**22.63**	**25.86**	**22.99**	**20.62**	**22.87**
	Reptiles	US$	0	0	0	12	42	54
		%	**0**	**0**	**0**	**0.24**	**1.03**	**0.2**
	Insect and Worms	US$	34	35	151	318	133	671
		%	**0.58**	**0.52**	**3.12**	**6.33**	**3.27**	**2.53**
	Total Bushmeat	US$	1332.2	1569	1400.4	1485	1013	6799.6
		%	**22.74**	**23.15**	**28.98**	**29.56**	**24.92**	**25.6**
Honey		US$	286	160	0	64	191	701
		%	**4.88**	**2.36**	**0**	**1.27**	**4.7**	**2.64**
Woven Products		US$	194.8	183.2	143.2	145.6	85.4	752.2
		%	**3.32**	**2.7**	**2.96**	**2.9**	**2.1**	**2.84**
Total		US$	5859.3	6777.7	4832.2	5023.8	4064.5	26557.5
		%	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

** Kruskal-Wallis test (p-value=0.000; α=0.05)

Income from agriculture

Thirteen food and cash crops were found to be commonly cultivated in the villages. These crops constituted the source of agricultural income (Table 3.5).

Table 3.5. Household agricultural income in five studied villages near the Lobeke National Park (Cameroon).

Crops		Village					Total
		Zega	Mambele	Socambo	Koumela	Libongo	
Maize	US$	392	340	436	531	255	1954
	%	10.75	11.62	19.38	13.5	10.26	12.82
Cassava	US$	471	1044.4	485.4	416	410	2826.8
	%	12.92	35.71	21.58	10.58	16.49	18.55
Irish potato	US$	0	16	24	0	0	40
	%	0	0.55	1.07	0	0	0.26
Sweet potato	US$	55	31.8	89.2	64	107	347
	%	1.51	1.09	3.96	1.63	4.3	2.28
Cocoyam	US$	564	304	442	510	426	2246
	%	15.47	10.39	19.65	12.97	17.14	14.74
Groundnut	US$	20	136	48	40	24	268
	%	0.55	4.65	2.13	1.02	0.97	1.76
Pear	US$	2	5.6	2	4	0	13.6
	%	0.05	0.19	0.09	0.1	0	0.09
Banana	US$	25.8	44.4	45.2	42.6	39	197
	%	0.71	1.52	2.01	1.08	1.57	1.29
Orange	US$	0	29.4	5.8	0	12	47.2
	%	0	1.01	0.26	0	0.48	0.31
Pawpaw	US$	3	2.6	1.8	0	1	8.4
	%	0.08	0.09	0.08	0	0.04	0.06
Plantain	US$	895	545	510	997	840	3787
	%	24.55	18.63	22.67	25.35	33.79	24.85
Cocoa	US$	1176	360	136	1296	336	3304
	%	32.26	12.31	6.04	32.95	13.52	21.68
Red pepper	US$	42	65.8	24.4	33	36	201.2
	%	1.15	2.25	1.08	0.84	1.45	1.32
Total	**US$**	**3645.8**	**2925**	**2249.8**	**3933.6**	**2486**	**15240.2**
	%	**100**	**100**	**100**	**100**	**100**	**100**

** Kruskal-Wallis test (p-value=0.223; α=0.05)

Five crop plants (plantain, cocoa, cassava, cocoyam and maize) constituted 92.63% of the agricultural income of the respondents. The annual income of households from agriculture varied from US$ 25 to US$ 925 with a mean of US$ 135.16 (sd= US$141.85). The high

dispersion from the mean shows that there was a wide range of activities in the villages such that some households earned an appreciable proportion of their incomes from activities other than agriculture. The total income from agriculture for all households studied amounted to US$ 15240.2. There was no significant difference observed between the villages in terms of the income accrual from agriculture ($p>0.05$) (Appendix 3.1). This could be associated with the simplicity of production systems, absence of large plantations and complete lack of the use of inputs such as fertilizers to boost production.

Income from livestock

Livestock-derived income arose from the production of four livestock species (goats, sheep, pigs and chicken) and animal products (mainly meat and eggs). Chickens were found to be the most important livestock reared by the households as they represented 43.55% of all the income from livestock. This was followed by sheep (22.90%), pigs (17.22%) and goats (16.33%). An annual, individual household income derived from livestock varied from US$ 0.00 to US$ 580.80 (mean 74.99 US$ and sd=105.31 US$) (Table 3.6). There were significant differences ($p<0.05$) in the livestock-derived income between the villages, with the households in Mambele and Koumela earning on average about double the income of the households in Zega, Socambo and Libongo (Appendix 3.2).

Table 3.6. Livestock-derived income (US$) by the studied households in the villages near the Lobeke National Park (Cameroon) (percentage income in brackets).

Livestock	Village					Total
	Zega	Mambele	Socambo	Koumela	Libongo	
Goats	287 (29.35)	620 (24.87)	0 (0.00)	140 (7.12)	100 (9.91)	1147 (16.33)
Sheep	215 (21.98)	804 (32.25)	0 (0.00)	370 (18.83)	220 (21.80)	1609 (22.90)
Pigs	0 (0.00)	320 (12.84)	210 (36.14)	680 (34.61)	0 (0.00)	1210 (17.22)
Chicken	476 (48.67)	749 (30.04)	371 (63.86)	775 (39.44)	689 (68.29)	3060 (43.55)
Total (animals)	978 (100.00)	2493 (100.00)	581 (100.00)	1965 (100.00)	1009 (100.00)	7026 (100.00)
Total (Derived products)	127.3	314.9	202	521	133.1	1298.3
Grand total	1105.3	2807.9	783	2486	1142.1	8324.3

** Kruskal-Wallis test (p-value=0.018; α=0.05)

Income from fishing and aquaculture

This income was derived from five species of freshwater fish and shellfish caught in rivers and streams, as well as from aquaculture, still at its infancy in Libongo. The main income species were catfish (51.40%), common carp (38.48%), shrimps (5.41%), crabs/crayfish (4.05%) and tilapia (0.66%). Annual household income derived from fishing varied from US$0.00 to US$151 (mean=24.47 US$ and sd=25.57 US$) (Table 3.7). The difference between the villages was significant ($p<0.05$) with households in Zega, Libongo and Mambele earning higher incomes from fishing than Socambo and Koumela (Appendix 3.2). This could have been associated with the presence or absence of rivers and fishing culture.

Table 3.7. Fishing and aquaculture income (US$) by the studied households in the villages near the Lobeke National Park (Cameroon) (percentage income in brackets).

Fish/shellfish	Village					Total
	Zega	Mambele	Socambo	Koumela	Libongo	
Catfish	495 (68.18)	267 (40.27)	265 (58.76)	149 (62.08)	220 (34.59)	1396 (51.40)
Common carp	170 (23.42)	326 (49.17)	131 (29.05)	86 (35.83)	332 (52.20)	1045 (38.48)
Shrimps	37 (5.10)	37 (5.58)	27 (5.99)	0 (0.00)	46 (7.23)	147 (5.41)
Crab/crayfish	24 3.31	33 (4.98)	28 (6.21)	5 (2.08)	20 (3.14)	110 (4.05)
Tilapia	0.00 0.00	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	18.00 (2.83)	18.00 (0.66)
Total	726 (100.00)	663 (100.00)	451 (100.00)	240 (100.00)	636 (97.17)	2716 (99.34)

** Kruskal-Wallis test (p-value=0.003; α=0.05)

Income from non-forest natural resources

In the context of this study this income was derived by the extraction of gold and diamonds from the environment. Gold was reported only by the households in Zega as a source of income. Diamonds were reported to be exploited a little further north of the park and beyond the region of this study. Annual incomes from gold mining in Zega varied from US$ 0.00 to US$ 99 (mean=18.63 US$ and sd=31.12 US$). Total income derived from gold for the sampled households was US$ 409.90.

Wage income

Wage income to households was considered as income from forest and non-forest based activities. The forest-based wage income was derived usually from activities such as logging, tourism or transport and the like. The non-forest wage income includes employment in the public service and other non-forestry related jobs. Eight different types of jobs were identified in the studied villages as making the major contributions to household incomes. These included timber-processing (24.62%), forestry-logging (0.58%), forestry-transport (0.14%) and other forestry jobs (30.36%), large-scale agriculture (4.98%), small-scale agriculture (0.93%) transport (3.54%), and trade and marketing (1.52%). The forest-related wage income alone constituted 55.70% of the total household wage income for the studied villages. This is a clear indication on how the income portfolios of the households in this region might be tightened to the forests. The annual household wage income was found to vary significantly from one village to another ($p<0.05$). Mean wage incomes were higher in Mambele (US$ 280.21), Libongo (US$ 250.98) and Koumela (US$ 160.26 than in Zega (US$ 50.29) and Socambo (US$ 56.14) (Appendix 3.3). Overall, the annual household wage income varied from 0.00 to US$ 1110 (mean= US$ 117.34 and sd= US$ 198.58 (Table 3.8).

Table 3.8. Wage income (US$) earned by the studied households in the villages near the Lobeke National Park (Cameroon) (percentage income in brackets).

Type of work and income	Village					Total
	Zega	Mambele	Socambo	Koumela	Libongo	
Small-scale agriculture	0 (0)	68 (1.7)	18 (2.18)	35 (1.45)	0 (0)	121 (0.93)
Large-scale agriculture (commercial)	0 (0)	0 (0)	0 (0)	584 (24.2)	64 (1.28)	648 (4.98)
Forestry-logging	0 (0)	0 (0)	75 (9.08)	0 (0)	0 (0)	75 (0.58)
Forestry- processing	50 (6.38)	0 (0)	0 90)	454 (18.81)	2703 (53.97)	3207 (24.62)
Forestry-transport	0 (0)	0 (0)	18 (2.18)	0 (0)	0 (0)	18 (0.14)
Forestry-other	304 (38.78)	1447 (36.23)	326 (39.47)	1000 (41.44)	877 (17.51)	3954 (30.36)
Transport	0 (0)	0 (0)	281 (34.02)	0 (0)	180 (3.59)	461 (3.54)
Trade and marketing	60 7.65	60 1.5	78 9.44	0 0	0 0	198 1.52
Construction	370 (47.19)	89 (2.23)	0 (0)	0 (0)	0 (0)	459 (3.52)
Mechanical	0 (0)	0 (0)	0 (0)	210 (8.7)	584 (11.66)	794 (6.1)
Total	784 (7.89)	1664 (16.75)	796 (8.01)	2283 (22.98)	4408 (44.37)	9935 100.00

** Kruskal-Wallis test (p-value=0.027; α=0.05)

Business-derived income

Four types of businesses were found to be contributing to annual household incomes: shops and trading posts (48.70%), transport (20.04%), processing and sale of agricultural products (18.80%) and lodging and restaurants (12.46%). These activities were bringing similar incomes with no significant differences ($p>0.05$) between the villages (Appendix 3.3). Household annual business incomes varied from US$ 0.00 to US$ 1370 (mean = US$ 61.59 and sd= US$ 185.01) (Table 3.9).

Table 3.9. Business income (US$) by the studied households in the villages near the Lobeke National Park (Cameroon) (percentage income in brackets).

Type of business	Village					Total
	Zega	Mambele	Socambo	Koumela	Libongo	
Shop/trade	264 (60.83)	640 (24.83)	350 (48.68)	850 (57.55)	1225 (75.25)	3329 (48.70)
Agric. Processing	105 (24.19)	408 (15.83)	369 (51.32)	0 (0.00)	403 (24.75)	1285 (18.80)
Transport	0 (0.00)	1370 (53.14)	0 (0.00)	0 (0.00)	0 (0.00)	1370 (20.04)
Lodging/ Restaurant	65 (14.98)	160 (6.21)	0 (0.00)	627 (42.45)	0 (0.00)	852 (12.46)
Total	434.00 100.00	2578.00 100.00	719.00 100.00	1477.00 100.00	1628.00 100.00	6836.00 100.00

** Kruskal-Wallis test (p-value=0.671; α=0.05)

Other sources of income

Other sources of income included remittances (39.46%) from relatives outside the region, financial and in-kind gifts (33.86%), financial support from the government and non-governmental organisations (NGOs), payments for environmental services such as ecotourism in the park, payments for renting out land and payments from FUG as compensation to leaders. Significant differences were observed between the villages with respect to income from the other sources ($p<0.05$). The Games-Howell test showed that households in Koumela and Libongo had a higher 'other sources of income' average than the other villages (Appendix 3.4). Average contribution of the other sources of income to the annual household income varied from US$ 0.00 to US$ 600 (mean=77.22 US$ and sd=118.19 US$) (Table 3.10).

Table 3.10. Income earned from other sources (US$) by the studied households in the villages near the Lobeke National Park (Cameroon) (percentage income in brackets).

Type of other income		Village					Total
		Zega	Mambele	Socambo	Koumela	Libongo	
Remittances	US$	132	0	0	2270	980	3382
	%	34.29	0.00	0.00	48.53	46.56	39.46
Support from government, NGOs	US$	0	70	90	435	30	625
	%	0.00	6.71	25.00	9.30	1.43	7.29
Gifts/Support from friends and relatives	US$	253	479	0	1125	1045	2902
	%	65.71	45.93	0.00	24.05	49.64	33.86
Payment for forest services	US$	0	494	190	513	0	1197
	%	0.00	47.36	52.78	10.97	0.00	13.97
Payment for renting out land	US$	0	0	0	85	10	95
	%	0.00	0.00	0.00	1.82	0.48	1.11
Payments from FUG	US$	0	0	80	250	40	370
	%	0.00	0.00	22.22	5.34	1.90	4.32
Total	US$	385	1043	360	4678	2105	8571
	%	100.00	100.00	100.00	100.00	100.00	100.00

** Kruskal-Wallis test (p-value=0.000; α=0.05)

Total household income

The total household income can be defined as the total value of goods and services absorbed by a household. Despite the former way [using on cash income) of calculating the total income in conventional market studies, it seems to be deficient compared with the method used in this paper, which takes into account all in-kind incomes and subsistence activities. This is especially true for close-to-nature communities, like those around the Lobeke National Park. The value of household-consumed goods varied from US$ 139.30 to US$ 1066.60 (mean=282.18 US$ and sd=103.46 US$) compared to a household cash income which varied from US$ 51.60 to US$ 4446.60 (mean=634.61 US$ and sd=739.83 US$)(Table 3.11). The implication of these findings is the value of household-consumed goods which represented about 44.6% of the cash income flows to the surveyed households. Adding up the means of the total cash and in-kind incomes, results in a total household income of US$ 916.79. The mean HH cash income of US$ 654 appreciably compares to the national per capita income of US$ 803 (FAO, 2005).

Table 3.11. Mean total cash and consumption incomes (US$) of studied households in five villages near the Lobeke National Park (Cameroon).

Type of income	Village	Number of households	Mean (US$)	Standard Deviation (US$)	Minimum (US$)	Maximum (US$)
Total Consumption	Zega	22	291.89	81.84	166.10	534.80
	Mambele	23	343.47	173.24	201.50	1066.50
	Socambo	22	271.83	52.21	169.20	394.30
	Koumela	22	280.89	58.35	190.40	410.20
	Libongo	22	220.02	58.51	139.30	339.20
	Total	111	282.18	103.46	139.30	1066.50
Total Cash	Zega	22	385.13	393.94	86.80	1799.60
	Mambele	23	868.84	1012.34	184.40	4446.60
	Socambo	22	295.00	490.01	51.60	2347.90
	Koumela	22	813.47	801.35	150.30	3447.00
	Libongo	22	799.96	669.11	185.40	2699.60
	Total	111	634.61	739.83	51.60	4446.60

Forest dependency

Over 1.6 billion people of the world depend heavily on forest resources for their livelihoods, of which 1.2 billion in developing countries use trees on farms to generate food and income (Dubois, 2003). In 2004, the International Fund for Agricultural Development (IFAD) asserted that about 80% of the population in developing countries uses forest products on a daily basis and about 75% of poor people that live in rural areas depend on forests for subsistence (IFAD, 2004). In this study a forest dependency index was calculated as a ratio of forest-derived values to the total values derived by the households from all sources. It was found that household forest dependency varied from 0.1 to 0.82 with a mean of 0.49 and standard deviation of 0.18. The average dependencies were higher in Socambo (0.56) and Zega (0.50) than in Koumela (0.42), Libongo (0.45) and Mambele (0.49). Figure 3.5 shows the forest dependency indices for the studied villages.

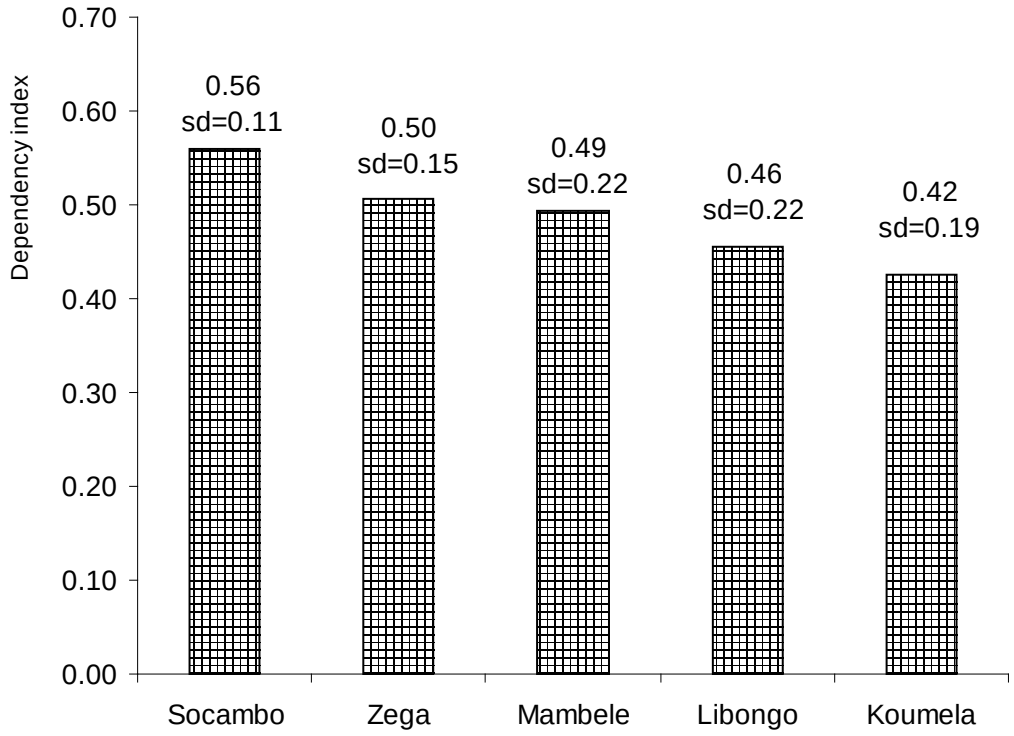

Figure 3.5. Mean forest dependency index by studied villages near the Lobeke National Park in Cameroon (sd = standard deviation).

These results confirmed other findings. Barret *et al*. (2001) remarked that although Africa has been noted as a continent of subsistence farmers, non-farm resources may account for over 40% of an average household income. From the foregoing understanding, development workers in the Congo Basin have to derived food security, household well-being and income generation from a combination of traditional agriculture, forestry and other sources.

Logistic regression of forest dependence

Results of the logistic regression explaining the forest dependency of the households near the LNP are presented in Table 3.10. The likelihood ratio test showed that the regression model is significant. It means that the explanatory variables were well selected and could be used to predict the dependent variable 90.09% correctly. Most of the explanatory variables (education, fish income, non-forest environmental income, non-forest wage income, business income, agricultural income, livestock income, and other non-forest income) had the expected effect on forest dependency. Their coefficients were significant at the 5% level. These coefficients were

negative for such variables as income from fishing, non-forest environmental income, non forest wage income, business income, agricultural income, income from livestock, and other non-forest income, resulting in a significant reduction in forest dependency. For instance, households with a high income from fishing were less dependent on forest resources. Similar interpretations were considered valid for the other significant variables except for the level of education. Education levels were found to be positively related to forest dependency (Table 3.12). This could be explained by the fact that educated villagers had better knowledge of forest products assemblage and marketing skills, and thus could make more income from forest products than their less educated neighbours.

Table 3.12. Results of the logit analysis on the explanatory variables for household forest income portfolio in villages around Lobeke National Park (p – probabilities).

Independent variables	Coefficient	Standard Error	p	Elasticity
Duration residence (years)	0.046	0.030	0.13	0.011
Ethnicity	-0.930	0.972	0.339	-0.226
Household size	0.059	0.157	0.71	0.015
Age of household head	-0.038	0.040	0.34	-0.009
Gender of household head	-1.468	1.023	0.151	-0.327
Education	0.423*	0.150	0.005	0.106
Total land area owned	0.093	0.168	0.581	0.023
Major crisis faced by household	-1.475	0.945	0.119	-0.352
Member of FUG	0.048	0.926	0.959	0.012
Income from fishing	-0.033*	0.014	0.017	-0.008
Non-forest environmental income	-0.053*	0.022	0.014	-0.013
Non-forest wage income	-0.016*	0.007	0.021	-0.004
Business income	-0.015*	0.004	0.001	-0.004
Agricultural income	-0.017*	0.007	0.02	-0.004
Income from livestock	-0.016*	0.005	0.003	-0.004
Other non-forest income	-0.014*	0.005	0.004	-0.003
Constant	6.452*	2.585	0.013	
Log-Likelihood		62.70		
Correct prediction		90.09%		

* Coefficient significant at $p \leq 0.05$

The elasticity indicates that the percentage change in the forest dependency from the mean value is consequential to 1.0% change from the mean value of an explanatory variable. In this case for example, a 1.0% increase in the mean value of the income from fishing (US$24.47) will decrease the probability of forest dependency by about 0.008%, assuming all other

variables remain unchanged. At the same time, a 1.0% increase of the mean agricultural income will decrease the probability of forest-dependency by 0.004%.

Gini coefficients and Kuznets ratio

The Kuznets ratio and Gini coefficients were calculated in the form developed by the World Bank for measuring forest income dependence. In this study the following Gini coefficients were computed: Gini (AI) = 0.37 and Gini (ANI) = 0.53, meaning that the Gini coefficient increases when forest income is excluded. Therefore, without forest resources inequality widens in the region. This conclusion was further verified with the observation of a higher value of absolute Kuznets ratio (AKR = 4.84), than the absolute forest Kuznets ratio (AFKR = 3.16). Then, the relative forest Kuznets ration (RFKR) was calculated as the ratio of the AFKR/AKR = 0.65. This result agrees with the existing empirical results hypothesis of Cavendish (2003; 2000) and the studies of Botha (2003) and Aryal (2002), who found RFKR<1. The result showed that the lower 25% poor were dependent on forest resources for their income than the upper 25% rich. This is so depite the fact that wage related forest activities constituted over 57% of wage income in the region, implying the rate forest wages might not lead people out of the poverty category. Low wage rates could be associated with the remoteness of this study site, characterised by a virtual absence of other commercial/industrial activities that are non-forest related.

Extrapolations

Based on the assumptions, equations and data derived in this paper, the total income from each income portfolio in the studied villages was estimated. For the five studied villages the total income from all income portfolios was US$ 820 676, while the corresponding amount for all fourteen villages around the park ranged from about US$2.3 million to US$ 3.3 million depending on the equation and assumption applied (Table 3.13).

Table 3.13. Extrapolation of total income (US$) from different income portfolios in villages around the Lobeke National Park (LNP) in Cameroon.

Sources of income	Total income for 5 villages Equation 1	Total income for 14 villages Equation 2	Total income first assumption for 14 villages Equation 3	Total income second assumption for 14 villages Equation 4
Direct forest income	237033	663692	900307	950177
Agriculture income	137077	383816	520652	549492
Livestock income	67846	189969	257696	271971
Fishing and aquaculture	29153	81630	110732	116865
Wage income	164010	459227	622948	657455
Business	83580	234025	317459	335044
Other sources of income	101120	283136	384078	405353
Non-environmental income	857	2399	3254	3434
Total	820676	2297893	3117125	3289790

Estimation from equation 2 implied that all villages were homogenous, which in reality was not the case. Moreover, income estimates were based on households and not villages as sample units. Estimates made from equation 3 and 4 were considered more realistic because they had to deal with households (sample units) with direct implications on the number of people that constitute the entire population.

CONCLUSIONS AND RECOMMENDATIONS

The well-being of the households in the Congo Basin depends on the combination of several activities including collection, consumption and commercialisation of forest products, agriculture, livestock rearing, fishing, local and international supports, gifts and remittances, and working-for-wage income. Due to the extensive forest coverage in the Congo Basin, the well-being of humans is inseparable from the conservation of forest biodiversity. Policy shifts are needed based on new mind-sets of conservation and development practitioners. To this, Angelsen and Wunder (2003) asserted that some scientific evidence need to be provided to convince policy makers and development planners that forests play an important role in poverty alleviation and therefore they need to be managed for the well-being of forest-dependent poor.

As pinpointed in this study, the value of the home-consumed goods was at least 44.6% of the total cash value generated by individual households. This means that the role of forests in the livelihoods of forest-dependent communities might be substantially underestimated when using the traditional market approaches such as the production-to-consumption methodologies. This could be explained by the fact that by solely estimating the value of marketed products one neglects potentially marketable- and non-marketed products consumed internally (Wollenberg and Nawir, 1998). The latter two categories could actually be more valuable to some forest-dependent households, especially in remote forested areas. From the results of this study, it could be recommended that the value of subsistence production and consumption should as be taken into account in order to avoid the under-estimation of the value of forest-derived products and related resources to forest-dependent households.

REFERENCES

Abega S.C. 1998. Pygmées baka: Le droit a la différence. Inades Formation. Yaoundé. Université Catholique d'Afrique centrale.

Adams W. M., Aveling R., Brockinton D., Dickson B., Elliott J., Hutton J., Roe D., Vira B. and Wolmer. W. 2004. Biodiversity conservation and the eradication of poverty. *Science.* 306: 1146-49.

Angelsen A. and Wunder, S. 2003. Exploring the forest-poverty link: Key concepts, issues and research implications. Occasional Paper # 40. CIFOR. Bogor, Indonesia. 95 pp.

Alcorn J.B. 1993. Indigenous peoples and conservation. *Conservation Biology*. 7 (2): 424-26.

Anderson J., Benjamin C., Campbell B.M., Tiveau D. 2006. Forests, poverty and equity in Africa: new perspectives on policy and practice. *International Forestry Review* 8(1): 44-53.

Aryal B. 2002. Are trees for the poor? A study from the Budongo Forest, Uganda. Department of Economics and Social Sciences. Agric. University of Norway.

Bahuguna V.K. 2000. Forests in the economy of the rural poor: an estimation of the dependence level. *Ambio* 29: 126-129.

Barret C.B.; Reardon T. and Webb P. 2001. Non-farm cash income diversification and household livelihood strategies in rural Africa: concepts, dynamics and policy implications. *Quarterly Journal of International Agriculture* 31(3): 230-47.

Blom A. 2001. Ecological and economic impacts of gorilla-based tourism in Dzanga-Sangha, Central African Republic. PhD Thesis. University of Wageningen, Wageningen, Netherlands. ISNN: 0926-9495. pp 142-156.

Botha N.B. 2003. Looking for a path out of poverty: the study of Chimaliro Forest Reserve. Malawi. Department of Economics and Social Sciences. Agric. University of Norway.

Brown D. 1998. Participatory biodiversity conservation: rethinking the strategy in the low-tourist potential areas of tropical Africa. *Natural Resource Perspective* 33. Overseas Development Institute. ISSN: 1356-9228. 19 pp.

Brown K. 2003. Integrating conservation and development: A case of institutional misfit. *Frontiers in Ecology and the Environment* 1(9): 479-487.

Brown K. 2002. Innovations for conservation and development. *The Geographical Journal* 168 (1): 6-17.

Campbell B.M. and M.K. Luckert eds. 2002. Uncovering the Hidden Harvest. Valuation Methods for Woodlands and Forest Resources. London. Earthscan. 264 pp.

Campbell B.M., Sayer J., Kozanayi W., Luckert M., Mutamba M. and Zindi C. 2002. Household livelihoods in Semi-Arid Regions: Options and constraints. CIFOR. Bogor, Indonesia. 154 pp.

Campbell B.M., Frost P., Goebel A., Standa-Gunda W., Mukamuri B. and Veeman M. 2000. A conceptual model of woodland use and change in Zimbabwe. *International Tree Crops Journal* 10: 347-366.

Cavendish W. 2003. How do forests support, insure and improve the livelihoods of the rural poor? A research note. CIFOR. Bogor. Indoneisa.

Cavendish W. 2000. Empirical Regularities in the poverty-environment relationship of rural households: Evidence from Zimbabwe. *World Development* 28(11):1979-2000.

Chan K.M.A., Pringle R.M., Ranganathan J., Boggs C.L., Chan Y., Ehrlich P.R., Haff P.K., Helier N.E., Al-khafaji K. and Macmynowski D.P. 2007. When agendas collide: Human welfare and biological conservation. *Conservation Biology* 21 (1): 59-68.

Commission for Africa. 2005. Our Common Interest. Report of the Commission for Africa. March. 462 pp.

Dewi S., Belcher B., Puntodewo A. 2005. Village economic opportunity, forest dependence, and rural livelihoods in East Kalimantan, Indonesia. *World Development* 33(9): 1419–1434. ISSN: 0305-750X.

Dubois O. 2003. Forest-based poverty reduction: A brief review of facts, figures, challenges and possible ways forward. In Oksanen, Pajari and Tuomasjukka (eds.) Forest in Poverty Reduction Strategies: Capturing the potentials. EFI Proceedings No. 47. Pp 65-85.

Emerton L.1996. Valuing the subsistence use of forest products in Oldonyo Orok For. Kenya. Network Paper 19e. ODI.UK.

Faith D.P., Walker P.A., Ive J.R. and Belbin L. 1996. Integrating conservation and forestry production: exploring trade-offs between biodiversity and production in regional land use assessment. *Forest Ecology and Management* 85: 251-261.

Falconer J. and Arnold J.E.M. 1989. Household food security and forestry: an analysis of socio-economic issues. Community Forestry Note 1. FAO, Rome, Italy.

FAO. 2005. State of the World's Forests. FAO. Rome. ISBN: 92-5-105187-9. 153 pp.

Garnet S.T., J. Sayer and J. du Toit. 2007. Improving the effectiveness of interventions to balance conservation and development: a conceptual framework. *Ecology and society* 12(1): 2.

Godoy R.A. and Bawa K.S. 1993. The economic value and sustainable harvest of plants and animals from tropical forests: assumptions, hypothesis and methods. *Economic Botany* 47: 220-223.

Gujarati D. N. 1995. Basic econometrics. McGraw-Hill. New York. ISBN 0-07-025214-9.

Gunatilake H.M. 1998. The role of rural development in protecting tropical rainforests: evidence from Sri Lanka. *Journal of Environment and Management* 53: 273-292.

Hedge R. and Enters T. 2000. Forest products and household economy: case study from Mudumalai Wildlife Sanctuary, Southern India. *Environmental Conservation* 27: 250-259.

IFAD (International Fund for Agricultural Development). 2004. Commerce et développement rural: enjeux et perspectives pour les ruraux pauvres. 31 pp.

Jackson D. 2004. Implementation of international commitments on traditional forest related knowledge: Indigenous peoples' experiences in Central Africa. FPP. 100 pp.

Kaimowitz D. and Sheil D. 2007. Conserving what and for whom? Why conservation should help meet basic human needs in the tropics. *Biotropica* 39(5): 567-574.

Kuster K., Achdiawan R., Belcher B., and Ruiz-Perez. M. 2006. Balancing development and conservation? An assessment of livelihood and environmental outcomes of non-timber forest product trade in Asia, Africa and Latin America. *Ecology and Society* 11(2): 20.

Levang P.E., Dounias E.and Sitorus. S.2005. Out of forest, out of poverty? *Forests, Trees and Livelihoods* 15: 211-36.

Luckert M. K. and Campbell. B. M. 2002. Expanding our conceptual and methodological understanding of the role of trees and forests in rural livelihoods. In Campbell B.M. and M.K. Luckert (eds.): Uncovering the Hidden Harvest: Valuation methods for woodland and forest resources. Earthscan Publication Ltd. London.PP. 228-253.

Masozera M.K. and Alavalapati J.R.R. 2004. Forest dependency and its implication for protected areas management: A case study from Nyungwe Forest Reserve, Rwanda. *Scand.J. For. Res*. 19(Suppl. 4). 85-92. Taylor & Francis ISSN 1400-4089.

Ndoye O. and Tieguhong J.C. 2004. Forest resources and rural livelihoods: The Conflict between timber and Non-timber forest Products in Congo Basin. In *Scand. J. For.* 19(suppl. 4): 36-44.

PEN (Poverty Environment Network). 2007. PEN Technical Guidelines, Version 3, CIFOR. P.36.

Purchell M. and Brown J.C. 2005. Against the local trap: scale and the study of environment and development. *Progress in Development Studies* 5(4): 279-297.

Sayer J. and Campbell B. 2004. The science of sustainable development: local livelihoods and the global environment. Cambridge University Press, Cambridge, UK.

Sheil D. and Wunder S. 2002. The value of tropical forests to local communities: complications, caveats and cautions. *Conservation Biology* 6(2):9

Sheil D., Puri R., Wan M., Basuki I., Van Heist M., Liswanti N., Rachmatika I. and Samsoedin I. 2006. Recognizing local people's priorities for tropical biodiversity. *Ambio* 35(1): 17-24.

SPSS User Guide. 1999. SPSS Base 9.0. User Guide. SPSS Inc. Marketing Department. Chicago. USA. ISBN: 1-56827-832-2. pp. 276-394.

Sunderland T.C.H., Besong S. and Ayeni J.O.S. 2002. Distribution, Utilization and Sustainability of the Non-timber forest products of the Takamanda Forest Reserve, Cameroon. A consultancy report for the Project: "Protection of the forests around Akwaya" (PROFA). 18 pp.

Tchatat, M. 1999. Les Produits Forestiers autres que le Bois d'œuvre (PFAB): place dans l'aménagement durable des forêts denses humides d'Afrique centrale, CIRAD, CIFOR, CARPE, IRAD.

Tieguhong J.C. and Ndoye O. 2007. The impact of timber harvesting in forest concessions on the availability of Non-Wood Forest Products (NWFP) in the Congo Basin. FAO Forest Harvesting Case Study 23. ISBN: 978-92-5-105709-4.

Tieguhong J.C. and Ndoye O. 2006. Transforming subsistence products to propellers of sustainable rural development: Non-timber forest products (NTFPs) production and trade in Cameroon. *Africa-Escaping the Primary Commodities Dilemma*. *African Development Perspective Yearbook Vol. 11*. Unit 1. VERLAG Berlin. Pp. 107-137. ISBN 3-8258-7842-2

Vedeld P., Angelsen A., Bojo J., Sjaastad E., Berg G.K. 2007. Forest environmental incomes and the rural poor. *Forest Policy and Economics* 9: 869–879.

Vedeld P., Angelsen A. Sjaastad E. and Berg G.K. 2004. Counting on the environment: Forest incomes and the rural poor. Environment Department Paper # 98. World Bank. 95 pp.

Wilkie D.S., Morelli G.A., Demmer J., Starkey M., Telfer P. and Steil. M.2007. Parks and people: Assessing the human welfare effects of establishing protected areas for biodiversity conservation. *Conservation Biology* 20(1): 247-49.

Wilkie D.S. Carpenter J.F. and Zhang Q. 2001. The under-financing of protected areas in the Congo Basin: So many parks and so little willingness-to-pay. *Biodiversity and Conservation* 10: 691-709.

Wollenberg E. and Nawir A.S. 1998. Estimating incomes of the people who depend on forests. In Wollenberg, E. and Ingles A. (Eds). Incomes from the Forests. Methods for development and conservation of forest products for local communities. Pp. 157-87.

Wunder S. 2001. Poverty alleviation and tropical forests – what scope for synergies? *World Development* 29 (11): 1817-33.

Appendix 3.1. Comparison of sample means of direct forest and agriculture income in studied villages around the Lobeke National Park (Games-Howell test)

Village(I)	Village(J)	Direct forest income (US$)		Agriculture income (US$)	
		Difference of means (I-J)	p-value	Difference of means (I-J)	p-value
Zega	Mambele	-28.35	0.803	37.74	0.953
	Socambo	46.69	0.300	62.77	0.585
	Koumela	37.98	0.585	-13.16	0.999
	Libongo	81.58*	0.028	54.93	0.700
Mambele	Zega	28.35	0.803	-37.74	0.953
	Socambo	75.04*	0.001	25.02	0.943
	Koumela	66.33*	0.014	-50.91	0.856
	Libongo	109.93*	0.000	17.18	0.986
Socambo	Zega	-46.69	0.300	-62.77	0.585
	Mambele	-75.04*	0.001	-25.02	0.943
	Koumela	-8.71	0.985	-75.93	0.340
	Libongo	34.90	0.305	-7.84	0.934
Koumela	Zega	-37.98	0.585	13.16	0.999
	Mambele	-66.33*	0.014	50.91	0.856
	Socambo	8.71	0.985	75.93	0.340
	Libongo	43.60	0.233	68.09	0.451
Libongo	Zega	-81.58*	0.028	-54.93	0.700
	Mambele	-109.93*	0.000	-17.18	0.986
	Socambo	-34.90	0.305	7.84	0.934
	Koumela	-43.60	0.233	-68.09	0.451

* Difference is significant at $p < 0.05$

Appendix 3.2. Comparison of sample means of fishing and livestock income in studied villages around the Lobeke National Park (Games-Howell test)

Village(I)	Village(J)	Fishing income (US$)		Livestock income (US$)	
		Difference of means (I-J)	p-value	Difference of means (I-J)	p-value
Zega	Mambele	4.17	0.979	-71.84	0.218
	Socambo	12.50	0.347	14.65	0.916
	Koumela	22.09*	0.047	-58.80	0.280
	Libongo	4.09	0.992	-5.63	0.998
Mambele	Zega	-4.17	0.979	71.84	0.218
	Socambo	8.33	0.560	86.49*	0.011
	Koumela	17.92	0.077	13.04	0.998
	Libongo	-0.08	1.000	66.21	0.342
Socambo	Zega	-12.50	0.347	-14.65	0.916
	Mambele	-8.33	0.560	-86.49*	0.011
	Koumela	9.59	0.492	-73.45	0.138
	Libongo	-8.41	0.820	-20.28	0.869
Koumela	Zega	-22.09*	0.047	58.80	0.280
	Mambele	-17.92	0.077	-13.04	0.998
	Socambo	-9.59	0.492	73.45	0.138
	Libongo	-18.00	0.261	53.18	0.449
Libongo	Zega	-4.09	0.992	5.63	0.998
	Mambele	0.08	1.000	-66.21	0.342
	Socambo	8.41	0.820	20.28	0.869
	Koumela	18.00	0.261	-53.18	0.449

* Difference is significant at $p < 0.05$

Appendix 3.3. Comparison of sample means of wage and business income in studied villages around the Lobeke National Park (Games-Howell test)

Village(I)	Village(J)	Wage income (US$)		Business income (US$)	
		Difference of means (I-J)	p-value	Difference of means (I-J)	p-value
Zega	Mambele	-138.02	0.173	-92.36	0.607
	Socambo	-1.91	1.000	-12.95	0.986
	Koumela	-74.05	0.265	-47.41	0.819
	Libongo	-192.00*	0.015	-54.27	0.547
Mambele	Zega	138.02	0.173	92.36	0.607
	Socambo	136.11	0.186	79.41	0.757
	Koumela	63.97	0.877	44.95	0.975
	Libongo	-53.98	0.959	38.09	0.983
Socambo	Zega	1.91	1.000	12.95	0.986
	Mambele	-136.11	0.186	-79.41	0.757
	Koumela	-72.14	0.297	-34.45	0.952
	Libongo	-190.09*	0.016	-41.32	0.840
Koumela	Zega	74.05	0.265	47.41	0.819
	Mambele	-63.97	0.877	-44.95	0.975
	Socambo	72.14	0.297	34.45	0.952
	Libongo	-117.95	0.358	-6.86	1.000
Libongo	Zega	192.00*	0.015	54.27	0.547
	Mambele	53.98	0.959	-38.09	0.983
	Socambo	190.09*	0.016	41.32	0.840
	Koumela	117.95	0.358	6.86	1.000

* Difference is significant at $p < 0.05$

Appendix 3.4. Comparison of sample means of non-environmental and other income in studiedvillages around the Lobeke National Park (Games-Howell test)

Village(I)	Village(J)	Other income (US$)		Non-environmental income (US$)	
		Difference of means (I-J)	p-value	Difference of means (I-J)	p-value
Zega	Mambele	-27.85	0.347	18.63	0.071
	Socambo	1.14	1.000	18.63	0.071
	Koumela	-195.14*	0.000	18.63	0.071
	Libongo	-78.18	0.081	18.63	0.071
Mambele	Zega	27.85	0.347	-18.63	0.071
	Socambo	28.98	0.373	0.00	-
	Koumela	-167.29*	0.000	0.00	-
	Libongo	-50.33	0.494	0.00	-
Socambo	Zega	-1.14	1.000	-18.63	0.071
	Mambele	-28.98	0.373	0.00	-
	Koumela	-196.27*	0.000	0.00	-
	Libongo	-79.32	0.081	0.00	-
Koumela	Zega	195.14*	0.000	-18.63	0.071
	Mambele	167.29*	0.000	0.00	-
	Socambo	196.27*	0.000	0.00	-
	Libongo	116.95	0.055	0.00	-
Libongo	Zega	78.18	0.081	-18.63	0.071
	Mambele	50.33	0.494	0.00	-
	Socambo	79.32	0.081	0.00	-
	Koumela	-116.95	0.055	0.00	-

* Difference is significant at $p < 0.05$

CHAPTER FOUR

Valuation of Ecotourism in the Sangha Tri-National Park in the Congo Basin

Julius Chupezi Tieguhong

Forestry, Faculty of Science & Agriculture, University of KwaZulu-Natal, P Bag X01, Scottsville 3209, South Africa. chupezi@yahoo.co.uk or 204523366@ukzn.ac.za

ABSTRACT

Within its protected areas the Congo Basin is endowed with forest and wildlife resources that cover over 10 percent of the total land area. These forests are among the most important economic assets for the region, but are undergoing threats from indiscriminate logging, destructive land-use practices, and uncontrolled hunting of wildlife. The potentials of such protected areas for ecotourism development can be appreciable when the right systems are put in place. It is believed that well-organized ecotourism can form an ideal way to use the Congo Basin's forests without destroying them, therefore forming the basis of convincing decision-makers of the value of these forests as a propeller of development while standing. However, in the Congo Basin, this potential has not been assessed. Such is the case with the 28000 km^2 Sangha Tri-National park shared by Cameroon, the Congo and Central African Republic.

Overall, national park systems in the Congo Basin are constantly faced with three major difficulties. Firstly, there is the problem of inadequate funding to cover recurrent costs of protecting, managing and investing in park development. Funding by government is usually limited, covering less than 30% of the operating expenses, while international funding sources are generally not sustainable. These deficiencies affect tourist flows and park income generation in the region, rendering it the least developed tourism destination in Africa with arrivals and revenue from tourism remaining practically stagnant in recent decades.

Secondly, most parks in the region do not have good financial management systems in place. Park revenues are not always properly collected and where some collections are made, their accounting is subjected to profound inefficiencies (about 67% of potential revenues from

entrance fees is lost) and an overall lack of records. Deliberate policy initiatives to cost recovery, profit making or generation of local business opportunities through studies on sustainable park pricing mechanisms are woefully lacking. It remains unclear how the fees paid by tourists to visit the parks in the region are related to operational or total costs of managing such areas, or the effectiveness of fee structures to approximate tourists' willingness-to-pay (WTP). An optimistic scenario suggests that in order to circumvent the above-mentioned difficulties, innovative strategies need to be developed to generate more sustainable funding. Concomitantly, efficient fee setting, collection and management systems for all protected areas in the Congo Basin are needed. This study evaluated tourists' willingness-to-pay higher fees and their willingness to prolong their stay in two protected areas in the Congo Basin. It was found that if park facilities were improved, international and national tourists to the Lobeke National Park would be happy to pay an additional US$ 10 each to the current entrance fee. At the Dzanga-Ndoki National Park segment; international, resident and national tourists would possibly pay an additional US$ 30, US$ 20 and US$ 7 respectively. To this end, the efficiency in the current fee setting and management structures were scrutinised and optimum entrance fee levels determined.

Keywords: Contingent valuation method, Ecotourism, Entrance fee, Revenue management, Visitation, Willingness-to-pay

INTRODUCTION

The national park systems in the Congo Basin are constantly faced with three major difficulties (Blom, 2004; 2001; 2000; Wilkie *et al.*, 2001; Wilkie and Carpenter, 1999a; 1999b):

- Firstly, there is the problem of inadequate funding to cover recurrent costs of protecting and managing the park as well as investing in its development (Blom, 2004). Government funding is usually limited, covering less than 30% of operating expenses while international funding sources are generally not sustainable (Wilkie and Carpenter, 1999a). For instance, the management costs (US$/ha) of protected areas in Cameroon, the Central African Republic, Gabon and the Democratic Republic of Congo are 30 US$/ha, 11 US$/ha, 10 US$/ha and 8 US$/ha, respectively. Whereas, for more developed tourist destinations like South Africa, Kenya and Zimbabwe the corresponding spending expenses are 2725 US$/ha, 2129 US$/ha and 357 US$/ha, respectively (Wilkie *et al.*, 2001). This difference is expected to affect the numbers of tourists and the incomes they generate.The statistics provided by the World Tourism Organisation (WTO) confirm that the Congo Basin region is the least developed tourism destination in Africa (Yunis, 2003). Between 1990 and 2000 the average annual growth rate of total international tourist arrivals in Sub-Saharan Africa increased by over 10% from 6.8 million to 17.8 million. In the Congo Basin region however, arrivals remained practically stagnant over the same period and totalled less than 400 000 tourists. In terms of income, annual foreign exchange earnings from tourism expanded at a rate of 9% for Africa and reached US$ 7.1 billion in 2000, while Congo Basin countries experienced zero growth and remained stagnant at US$ 70 million (Yunis, 2003).
- Secondly, there are insufficient economic incentives at local level for protecting parks because other options for making use of park resources usually result in greater local benefits. Sayer *et al.* (2004) confirmed that in circumstances of low visitation and low park budgets, it becomes difficult to maintain extensive protected area systems, with overall confidence tilted towards well-managed forest industry to assure the future of forest biodiversity and economic benefits.

- Thirdly, most parks in the region do not have good financial management systems in place. Park revenues are not always properly collected and where some collections are made, their accounting is subjected to profound inefficiencies and an overall lack of records. Deliberate policy initiatives to cost recovery, profit making or the generation of local business opportunities through studies on sustainable park pricing mechanisms are woefully lacking. It remains unclear how the fees paid by tourists to visit the parks in the region are related to operational or total costs of managing such areas or, as stated by The Nature Conservancy (2005), how effectively fees are structured to approximate tourists' willingness-to-pay (WTP).

Despite the opaque picture and stagnant flow of tourists to the region, Yunis (2003) stipulated that hopes may not be lost because the possibility for improving ecotourism remains very high. His conviction was based on three cardinal factors:

- numerous natural attractions and the unexplored nature of the territories;
- absence of infrastructure that offers investment opportunities in modern ones;
- a relative closeness of the Congo Basin countries for the European tourists.

An optimistic scenario suggests that in order to circumvent the above-mentioned difficulties, innovative strategies need to be developed to generate more sustainable funding. Concomitantly, efficient fee setting, collection and management systems for all protected areas in the Congo Basin are needed. This study was undertaken to evaluate tourists' willingness-to-pay higher fees and to prolong their stay in two protected areas in the Congo Basin. According to Schultz *et al.* (1998), entrance fees to national parks are justifiable for the following salient reasons:

- generate revenues to cover costs and to ensure quality goods and services;
- reduce congestion in overcrowded parks while promoting visitation in less crowded ones through differentiated pricing;
- remove unfair competition with privately owned protected areas due to subsidization;
- promote equity by having direct users pay for parks, while foreign visitors pay higher fees than residents who themselves contribute to the establishment and maintenance of parks through general taxes or forgone opportunity costs.

The first and the fourth reasons are of particular relevance to the countries of the Congo Basin. The objectives of this study were:

- to analyze the market structure of tourists visiting the TNS and their willingness-to-pay for improved park services;
- to quantify the present and potential contributions of ecotourism to the financing of parks;
- to make projections on the number of years and the required number of tourists for studied parks to become auto-financed from entrance fee revenues following improvement of park facilities; and
- to proffer recommendations for improving protected areas management in the region.

The over-arching hypothesis was that under the current protected areas management systems appreciable income is being lost.

METHODS

The hypothetical ideal of this study is that adequate infrastructure, logistics, and park facilities are in place in order to capture profits from tourism. Based on the above understanding, and to make this study of relevance for policy overhauls in the management of protected areas in the Congo Basin, the valuation of ecotourism potential was analysed at three levels. Firstly the willingness of tourists to pay increased park entrance fees was studied by using the contingent valuation method (CVM). Secondly, the determination of an optimum entrance fee, which provided the possibility of estimating the optimum revenue from entrance fees paid by tourists; and thirdly was the analysis of fee revenue collection systems and projection scenarios for park auto-finance.

Study site

Equatorial African Forests are highly significant for the global conservation of biodiversity, whilst at the same time an important economic resource for the nations possessing them. The forest areas of the TNS region harbour some of the highest densities of chimpanzees and gorillas in the Congo Basin. The two great ape species live in this region, the western gorilla, *Gorilla gorilla* and the robust chimpanzee, *Pan troglodytes* (Usongo, 2002). The concentration

of chimpanzee and gorilla populations for the three countries is greater in the protected areas of the TNS than in the buffer zones. Based on some studies, the chimpanzee and gorilla populations within the entire TNS zone are estimated at 1500 and 10 000 individuals, respectively (Usongo, 2002).

Gorillas are strongly attracted by large forest clearings known by the Baka name "bais", where they feed on grasses and sedges. The ‘bais’ possess enormous potential for eco-tourism development, especially if the gorillas can be habituated (Usongo, 2002). In addition, there are large tracks of natural landscapes, pristine forest mosaics and rivers and apart from the former species, there are also forest elephants, forest buffalos, bongos, sitatungas and colobus monkeys. Major threats to the TNS include commercial logging, hunting and bushmeat trade, arms proliferation and pet trade.

Valuation Techniques

In order to standardise some technical terms used in this study several terms need to be specified. These definitions are provided below.

Economic value: the economic value of products or services is measured by a summation of many individual WTPs, which reflects clients’ preferences for the goods. So, an economic valuation in this study is defined as a measure of people’s preferences for environmental goods (Whittington et al,. 1997). For clarity, what is being valued is not the environment but preoples’ preferences for possible changes in a delivery of environmental qualities or services.

Ecotourism: is defined as travel motivated by a need to visit natural ecosystems which in turn promotes conservation, has low visitors’ impact and provides for active socio-economic involvement of local peoples. Ecotourism is distinct from nature tourism because of its emphasis on conservation, education, traveller responsibility and active community participation. Specifically ecotourism possesses the following characteristics:

- conscientious and low impact visitors’ behaviour;
- sensitivity towards and appreciation of local cultures and biodiversity;
- support for local conservation efforts;
- sustainable benefits to local communities;

- Local people's participation in decision-making;
- Educational components for both the traveler and local communities (The Nature Conservancy, 2004).

Ecotourists: individuals who travel to relatively undisturbed or uncontaminated natural areas with the specific objective of studying, admiring, and enjoying the scenery, its wild plants and animals, as well as the cultural manifestations of the region (Eagles *et al.*, 2002).

Entrance fee: a fee to enter a park or protected area, typically higher for foreign tourists (The Nature Conservancy, 2004).

Facilities: human-made structures and improvements in protected areas that support public usage of these areas (The Nature Conservancy, 2004).

Concessionaire: company or individual granted the right to undertake and profit from a specific on-site activity, such as a restaurant or eco-lodge (The Nature Conservancy, 2004).

Concession fee: fee charged to a business providing a service (e.g. lodging) within a protected area.

Fee differential: scale of different fees charged, based upon residential and other criteria; designed to promote equity between disparate income levels, and to maximise revenue of protected areas (The Nature Conservancy, 2004).

Visit: a measurement unit involving a person going into a park or protected area for the purposes mandated for that area (Eagles *et al.*, 2002).

Visitation: the sum of visits during a specific period (Eagles *et al.*, 2002).

Visitor: a person who visits a park or protected area for purposes mandated for the area. A visitor is not paid to be inside the park and does not live permanently in the park (Eagles *et al.*, 2002).

The literature studied showed that various methods may be used to estimate total economic values of environmental goods. The economic values of forest products and services can be categorized into direct and indirect use values, option values and existence values (Mohd Azmi *et al.*, 2002). There are three approaches to determine the value of forest resources and services. These include:

- valuation by using conventional markets (market-based approach)
- valuation by using implicit markets (revealed preference) and

- valuation by using artificial markets (stated preference) (Mohd Azmi *et al.*, 2002).

Valuation by using conventional markets is based on market prices, which can be altered. Some of these methods include production function, market prices and replacement cost methods (ITTO, 2001). However, to determine a forest recreational value, valuation is done by using implicit- and/or artificial markets (Mohd Azmi *et al.*, 2002). In the case of ecotourism valuation, trends in tourist flow and their willingness-to-pay for improved service quality can be estimated by using various valuation tools (Amigues *et al.*, 2002; Eagles *et al.*, 2002; Pieter *et al.*, 2002; Brown, 2001). Since the 1950's many approaches to the valuation of recreational services of protected areas have been tried, but the travel cost method (TCM) and the contingent valuation method (CVM), have gained global importance and application (Hu Mingxing, 1998; Lindberg 2001, Eagles *et al.*, 2000; Hackett, 2000; Israngkura, 1998; Lindberg and Johnson, 1994). However, in this study, the CVM was used because of its overall advantage in terms of simplicity and popularity over the other methods (Mohd Azmi *et al.*, 2002; Hu Mingxing 1998). The advantage of the CVM as a survey approach is that it could be used to estimate both the market and non-market values of goods and services while other valuation methods can not achieve that (Hu Mingxing, 1998). Moreover, the results from CVM are known to be more reliable than from other methods (Pearce, 1993; Farber, 1988). The economic value of recreational benefits can be estimated from the surpluses of visitors to a recreational site. A consumer surplus is the net social benefit that a visitor obtains by visiting a recreational site, which is in excess of the expenditures committed when making a trip to, and recreating, at the site (Mohd Azmi *et al.*, 2002; Hu Mingxing, 1998; Pearce, 1993). Greater elaboration on the CVM method is given in the next section.

Contingent valuation method (CVM)

The contingent valuation method was used to estimate the tourists' willingness-to-pay for improved ecotourism services in the LNP and DNNP. The following sections address how the CVM study was conducted starting with the sampling technique through the CVM design to model specification and implementation to calculate mean, median and optimum WTP for increasing park entrance fees in the LNP and DNNP. The optimum WTP is the entrance fee at which the park system can maximize its revenue.

Sampling technique and Data Collection

Data for this study was collected in the TNS Park that is found in Cameroon, the Central African Republic and the Republic of Congo. The main sources of data were the tourists that visited the park. Fee payment in each section of the park followed a multi-tiered pricing system with different levels of fees paid by national, resident and international tourists. A stratified random sampling technique was used for collecting data from two categories of tourists (national and international) in the Lobeke National Park (LNP) and the three categories (national, international and resident) in Dzanga-Ndoki National Park (DNNP) according to the local fee payment systems. The data collection was restricted to two sections of the TNS park system, notably on the parts located in Cameroon and the CAR, due to budget and time constraints. Tourists were sampled by using a stratified random sampling method whilst the proportion of each category to be surveyed was calculated from previous data kept at park headquarters (Clairin and Brion 1997).

Detailed plan to carry out the CVM

A CVM is different from other valuation methods in that it generates both market and non-market values of resources (Loomis and Ekstrand, 1997; Loomis and Gonzalen-Caban, 1997). A CVM can provide rough value estimates of what would be useful in project development, especially when there is no possibility of employing other valuation methods (ITTO, 2001) and where no market information exists about people's preferences of goods or services. Thus, it is widely used in environmental studies on value changes (Whittington *et al.*, 1997). Respondents are asked direct CVM-structured questions that reveal their WTP, in order to improve or reduce quality changes (Whittington *et al.*, 1997). A market contingent is taken of the service (e.g. an improved view or a better water quality), the institutional context in which it would be provided and the way in which it would be financed (Pearce and Turner, 1990). A CVM creates a hypothetical market for forest recreation. In this case, the attempt was to measure the value of ecotourism by eliciting tourists' WTP higher entrance fees for a repeat visit to the Lobeke and Dzanga-Ndoki National Parks. The tourists were asked to reveal their WTPs for a specified recreational experience following some improvements.

This CVM study involved six major steps (Adamowicz *et al*., 1998; 1997; Whitehead, 2003):

1. setting a realistic hypothetical scenario;
2. setting WTP questions;
3. setting questions on the socio-economic and demographic characteristics of visitors;
4. designing the survey;
5. implementing the survey and
6. compiling the data, analyzing and reporting the results.

Based on the data generated during the survey, the average WTP (hypothetical market price for revisiting the TNS in future) was estimated according to the utility theory of value (Hu Mingxing, 1998). As such, the total recreational value of the TNS was calculated from the mean and median WTP, the current total number as well as the projected future number of tourists following improvements of the infrastructure and services, according to the following formula (Hu Mingxing, 1998):

$$WTP = \sum_{i=1}^{k} AWP_i * (n_i/N) * M$$

Where: WTP-------total WTP for forest recreation by tourists in the TNS per period of time;

AWP_i------WTP of level i;

n_i----------the total number of tourists surveyed whose WTP is AWP_i;

N----------the total number of tourists surveyed

M----------the total number of foreign tourists per period of time.

In this method it is assumed that the number of persons who stated their willingness-to-pay for a service would in fact be the case if the situation were to arise (FAO, 2001; ITTO 2001; Whitehead *et al.,* 2000). There are various elicitation procedures that can be used in constructing such a market and collecting the data. These include direct questioning, a bidding game, payment cards and contingent ranking methods. An example would be to estimate how much people will be willing to pay or to contribute for the sustainable management of forest recreational areas (Yu Ling, 1998). The bidding games method is usually used for surveying the WTP of people for forest recreational services. This can be approached in three different ways:

- Opening a Direct Inquiring Approach. People surveyed are directly questioned about their WTP for a forest recreational service, after describing its attributes to the respondent. The inquirer does not give any limit or hint on the sum the respondent can pay.
- Dichotomous Choice Approach. The inquirer asks directly if the respondent is willing to pay some money for a forest recreational service, and the respondent answers "Yes" or "No". From the number of people who answer “Yes” and those who answer “No”, the WTP of the people is estimated using a statistical model such as the Logit, probit or biprobit models.
- Converging Bidding Games Approach. The inquirer presents a price for a forest recreational service and asks the respondent if he accepts the price. The inquirer raises or brings down the price until the respondent is no longer willing to change the new price, which is considered the highest WTP or the lowest willingness-to-accept (WTA). CVM is basically a survey-based approach (Hu Mingxing, 1998).

CVM Survey design

A questionnaire was designed to conduct a comprehensive survey of tourists visiting the two parts of the Tri-National Park (the LNP and DNNP). It consisted of a number of questions grouped in four sections related to environmental issues, recreational activities, entrance fees and background information on the tourists (De Lopez *et al.* 2001). The questionnaire was administered in-person to increase the chance of the interviewee completing this relatively long survey. Then the double-bounded dichotomous choice contingent valuation method was used to define the value of fees by people who were willing to pay for visits to the Park. A consumers’ surplus (CS) was calculated as a difference between this potential fee and the current fee.

The first part of the survey consisted of a series of questions aimed at obtaining information on the reasons why respondents chose TNS as a destination for their holiday and whether they were first-comers or repeated visitors, so that their individual expectations could be assessed. This first part also involved elicitations on the background information of the respondents, including age, gender, education, country of origin, and country of residence.

The second part examined the main recreational attributes of the landscapes. This part also consisted of eliciting information on why the tourists thought it was a good idea to visit the TNS Park in order to assess their motivation for visiting the parks. Environmental issues were examined as tourists were asked questions about their attitudes towards environmental attributes and to identify major disturbing problems that might be hindering the better provision of recreational services in the parks.

The third part examined the major recreational attributes of the parks including what they liked or disliked most or what they wanted to see but could not. Respondents who were visiting the park for the first time, were asked about their desire for a revisit. The overall grading of the park by tourists and their suggestions on how the park could be improved were elicited in this section.

The fourth part consisted of asking tourists whether they thought it was acceptable to have them pay an increased fee for visiting the park following improvements in park facilities, requiring a yes/no answer, and a WTP amount was elicited from those who replied positively to the payment principle question. These were elicitations on the respondents' willingness-to-pay bids using the contingent valuation method (double-bound dichotomous choice contingent valuation method). Elicitation on the respondents' willingness to pay involved explaining the park attributes to the respondent and setting a hypothetical scenario for improved park infrastructure and facilities.

The exact text of the WTP section was as follows: ‘One of the main characteristics of the Sangha Tri-national Park (TNS) is the presence of many charismatic wild animals, fish and bird species; many bais (natural open clearings in the forest), rivers and pristine forest settings, with great potential for ecotourism development. Alternative activities such as logging, poaching and other development activities threaten this transboundary park. In order to prevent the degradation of the resources and ensure proper management for the benefit of local people and resource conservation, ecotourism is considered a good non-extractive use of the TNS resources. You are probably aware that there is a daily per visitor admission fee to be

able to enter the TNS. Revenues generated through the admission fees are used to cover the costs of park operations as well as finance local development projects. Given that the current fee and total revenue generated per annum cannot meet these important functions; do you think it is acceptable to be asked to pay higher fees per visitor to enter the Park?'

After respondents answered 'yes' or 'no', they were asked to give a reason why they stated their particular answer, especially those who said no. This allowed the linking of expectations, motivations, and WTP responses for each respondent. Those who responded positively were asked what amount in Central African Community (CFA) Francs they would be most willing to pay per person per day to visit the park. The WTP amount was chosen with the current entrance fee as the reference. The current fee was doubled once and then twice with the WTP question repeated each time for each tourist to give responses in a double-bounded dichotomous CVM format.

At the end of the WTP survey, monthly income and final impression of the tourists that visited the parks were also elicited for statistical purposes in this section. Where appropriate, income was elicited in the respondents' national currency (US dollars, English pounds, shillings, Euros) and then converted into CFA Francs. In addition to the information generated during the survey, information from literature reviews was also collected. The data was entered into Microsoft Excel for Windows 2003 and analyzed using Stata version 8 and SPSS (Statistical Package for Social Sciences) version 12 statistical packages. Primary statistics and binary logistic regression analyses were conducted where appropriate.

The original questionnaire was pre-tested by using a sample of 30 respondents to uncover misinterpretations of the questions, ambiguity in response categories and clarity of visual aids such as maps. The cover and first page of the survey form provided the location, history, map and the facilities/resources present in the park. Current financial management and shortfalls were described in the survey questionnaire. Following the suggestion of Loomis and Gonzalen-Caban (1997), the sample size was targeted at not less than 200 tourists and the questionnaire was administered over a period of 12 and 8 months for the LNP and DNNP segments of the TNS respectively. The purpose of this long data collection period was due to

the low visitation in the parks and was done in order to provide sufficient precision of the WTP estimations. The park headquarters, where all tourists register upon entry, served as the sampling site. The payment method was a cash reference to the current entrance fee.

Limits of the CVM method

The CVM has some deficiencies associated with biases emanating from hypothetical survey techniques between the responses and the true WTP by the responder. Empirical studies suggest five types of biases: (i) hypothetical bias associated with the fact that the reaction of a respondent to a hypothetical market environment may be different from a true market situation; (ii) strategic bias associated with the respondent purposefully answering on the high or low side to favour his or her personal interests; (iii) payment instrument bias associated with false responses because the respondent has different emotional reactions to different payment vehicles; (iv) information bias associated with poor expression of WTP because the respondent was not accurately informed of the forest landscape attributes by the inquirer; and (v) starting point bias associated with the starting price being implicitly accepted by the respondent because he or she does not have true experiences of enjoying the forest recreation site as described by the inquirer (Whitehead, 2003; Mohd Azmi *et al.*, 2002; Hu Mingxing, 1998). Despite these biases, the CVM is considered an effective approach for estimating the value of forest recreation because some of the biases can be identified and controlled by taking steps such as improving sampling plan, employing suitable survey manners, asking the right questions, properly describing the hypothetical market and applying the right statistical methods (Hu Mingxing, 1998).

Econometric model specification

After defining the WTP of people for ecotourism, it was important to find factors that explained it. The dependent variables were double-bounded and dichotomous, taking the value of one if a tourist is willing to pay and zero if otherwise. When a qualitative dependant variable is dichotomised (0 or 1), its variance is low and the observed estimated coefficients by a linear regression are not pertinent (Mukherjee *et al.*, 1998). Therefore, linear regression is considered inappropriate and it is usually replaced with logistic regression. For a single-bound dichotomous choice CVM, a simple logit/probit model can be used, but in this study the

double-bound dichotomous choice method was employed. The implication of this was that two dependent variables corresponding to the two bounds for each respondent were estimated simultaneously. According to Meng and Schmidt (1985) the biprobit model is suitable to simultaneously explain or estimate two dependent variables.

The biprobit model

In this study, the two variables were the WTP at 100% more and the WTP at 200% more than the current entrance fee. The objective was to test whether the socio-demographic characteristics of tourists could predict their WTP at a higher entrance fee (De Lopez *et al.* 2001).

Let $Y_{1i}*$ be the first latent variable concerning the WTP 100% more than the current entrance fee. As in every logistic regression, the variable was modelled by its probability. Practically, a tourist will be willing to pay a 100% higher entrance fee, if his latent variable is higher than a limit value c_1.

$$P_i = \text{Prob}(Y_{1i}* = 1) = \text{Prob}\,(\beta_{1i}X_{1i} + \varepsilon_{1i} \geq c_1) \quad (1)$$

$$= \text{Prob}\,(\varepsilon_{1i} \geq c_1 - \beta_{1i}X_{1i}) \quad (2)$$

where c_1 is a limit value stated.

$$= F(c_1 - \beta_{1i}X_{1i}) \quad (3)$$

where the function of repartition F(x) follows a normal centre reduced distribution.

The model is therefore written as follows.

$$Y_{1i}* = \beta i X_{1i} + \varepsilon_1 \quad (4)$$

where:

$$\begin{cases} Y_{1i}* = \text{WTP 100\% more the entrance fee} \\ \beta_{1i} = \textit{Coefficients} \text{ of independant variables} \\ X_{1i} = \text{Socio - demographic characteristics explaining the dependant variable} \\ \varepsilon_{1i} = \textit{Error term} \end{cases}$$

The error term of the model is normally distributed, with a mean equal to zero, a normalised variance equal to one, and is uncorrelated with X_{1i} (Meng and Schmidt, 1985).

The second dependant variable based on a WTP 200% more entrance fee is using the same principle.

Let Y_{2i} *, be the latent variable concerning the WTP_200% more entrance fee. A tourist will be willing to pay 200% more the entrance fee, if his latent variable is higher than a limit value c_2.

P_{2i} =Prob(Y_{2i} * =1) = Prob($\beta_{2i} X_{2i} + \varepsilon_{2i} \geq c_2$) (5)

= Prob ($\varepsilon_{2i} \geq c_2 - \beta_{2i} X_{2i}$) where c_1 is a limit value stated. (6)

= F($c_2 - \beta_{2i} X_{2i}$) where the function of repartition F(x) follows a normal centre reduced distribution.

The model is therefore written as follows.

$$Y_{2i}^* = \beta_{2i} X_{2i} + \varepsilon_{2i} \quad (7)$$

where:

$$\begin{cases} Y_{2i}^* = \text{WTP\_200\% more the entrance fee} \\ \beta_{2i} = \textit{Coefficients} \text{ of independant variables} \\ X_{2i} = \text{Independent variables explaining the dependant variable} \\ \varepsilon_{2i} = \textit{Error term} \end{cases}$$

The error term is normally distributed, with a mean equal to zero, a normalised variance equal to one, and which is uncorrelated with X_{2i} (Meng and Schmidt, 1985).

As the answer on the WTP_200% is endogenous on the WTP_100% more than the current entrance fee, the two errors terms ε_{1i} and ε_{2i} are correlated. This is because WTP_200% more than the current entrance fee is observed only when the WTP_100% is equal to 1. Therefore, the two equations have to be applied simultaneously.

$$\begin{cases} Y_{1i}^* = \beta_{1i} X_{1i} + \varepsilon_{1i} \\ Y_{2i}^* = \beta_{2i} X_{1i} + \varepsilon_{2i} \end{cases} \quad (8)$$

where,

$$\begin{cases} Y_{1i} \text{ and } Y_{2i} = \text{WTP } 100\% \text{ and the WTP200\% more respectively} \\ \beta_{1i} = \textit{Coefficients} \\ X_{1i} \text{ and } X_{2i} = \text{Socio - demographic characteristics explaining the WTP} \\ \varepsilon_{1i} \text{ and } \varepsilon_{2i} = \textit{Error term} \end{cases}$$

ε_{1i} ; ε_{2i}, therefore follow a normal bivariate distribution with a variance equal to one.

ε_{1i} ; $\varepsilon_{2i} \rightarrow$ BVN (0,0,1,1,c)

The coefficients can be estimated by using an ordinary Least Squares Method (OLS) to regress the transformed dependent variables on the explanatory variables or the method of the maximum likelihood of occurence (Mukherjee *et al.,* 1998). The latter method is preferred to the previous one because it produces a better estimation of coefficients (Mukherjee *et al.,* 1998). The coefficients provided by the model are those that maximise the likelihood function, which is stated as follows:

$$LnL(\beta_{1i}, \beta_{2i}, c) = \sum \begin{bmatrix} Y_{1i}Y_{2i} \ln \Phi_2(\beta_{1i}Y_{1i}, \beta_{2i}Y_{2i}) \\ + Y_{1i}(1-Y_{2i}) \ln[\Phi(\beta_{1i}Y_{1i}) - \Phi_2(\beta_{1i}Y_{1i}, \beta_{2i}Y_{2i}; c)] \\ + (1-Y_{1i}) Ln[\Phi(-\beta_{1i}Y_{1i})] \end{bmatrix} \quad (9)$$

where,

Φ_2 and Φ are respectively, densities of the centre and reduced normal bivariate distribution and that of the univariate normal distribution (Meng and Schmidt, 1985). The interpretation of the result of a probit or biprobit model is not the same as the interpretation of a linear regression model (Mukherjee *et al*., 1998).

Interpretation of the result of the biprobit model

After confirming the overall significance of the model, further insights are obtained by interpreting the sign, probability and elasticity linked to each coefficient provided by the model.

For the overall significance of the model, its log-likelihood is compared to the theoretical Chi-square (df= n-1, p=0.05) (where n is the number of independent variables in the model) (Mukherjee *et al*., 1998). When the log-likelihood is higher than the Chi-square, the coefficients are significantly different from zero and the independent variables all well selected (Mukherjee *et al*., 1998). The power of the model is measured by the correct predictive value in percentage, i.e., the percentage of the WTP that has been correctly estimated by the model.

The magnitude of the coefficients does not provide any information in probit and biprobit regressions. It is only their signs that are interpreted. When the coefficient of an independent variable is positive, it means that the variable has positively influenced the probability of the willingness-to-pay more, else, the reverse holds true (Mukherjee *et al*., 1998). Quantitatively, the influence of an independent variable on the probability of a higher WTP is measured by the marginal effect (elasticity). When the independent variable is quantitative, its marginal effect is defined as the variation of the probability of the dependent variable created by a variation in its value (Mukherjee *et al*., 1998). For a qualitative variable it is the difference between the probability of WTP if possessing a certain characteristic and the probability of WTP if not (Mukherjee *et al.*, 1998). Taking as an example the case of the influence of a visitor's age on the WTP, let the reference of the independent variable 'age' be 'old', then:

$$\begin{cases} \text{Age} = 1, \text{ if the tourist is young} \\ \text{Age} = 0, \text{ if the tourist is old} \end{cases}$$

The marginal effect (ME) is the difference between the probability of being young and the WTP more (P_y) and the probability of being old and the WTP more (P_o).

$$ME = P_y - P_o$$

If ME > 0; then $P_y > P_o$, the marginal effect is positive, this means that young tourists are more willing to pay higher entrance fees than their older counterparts (taken as reference, Age = 0). In other words, being young increases the probability of the WTP more by about ME%.

RESULTS AND DISCUSSION

Demographic characteristics of the tourists

Origin

300 tourists visited the LNP in 2006, 237 international and 63 nationals. At the DNNP in the same year, 1042 tourists visited, of which 677 were international, 177 residents and 188 national. Considering the distribution of tourists by the above-mentioned strata, interviews were conducted. Out of the 200 tourists sampled at the LNP, 158 were international while 42 were national tourists. At the DNNP the corresponding numbers were 108, 28 and 30 for international, residents and national tourists respectively. International tourists represented 79% of the LNP's visitors and 65.1% visited the DNNP. National tourists represented 21% and 16.9% of the total number of tourists to the LNP and DNNP, respectively. The balance of 18% of the tourists were resident tourists visiting the DNNP.

Age and, gender, marital status and education level

Most tourists to the LNP and DNNP were of the age range 30 to 50 years, represented by 79.0% and 69.9% of tourists, respectively. The respective proportion of younger tourists, less than 30 years, in LNP and DNNP were 9% and 19%. Tourists older than 60 years represented 5% of the total in both the LNP and DNNP, and they were mostly international tourists. The younger tourists were mostly nationals in the LNP and both nationals and residents in the DNNP, meaning that the national and resident tourists tended to be younger than the international tourists in each park (Appendix 4.1: age). This result could be explained by field observations that older international tourists get younger national companions and friends while visiting parks in the region. Moreover, younger locals are becoming more interested in nature, recreation and conservation due to the advanced schooling and "westernization" of their lifestyles as well as increased environmental awareness in the region.

In terms of gender balance, female tourists were well represented in both parks with respective proportions of 41.5% and 33.3% in the LNP and DNNP. The proportion of international female tourists was slightly higher than for the national female tourists. Over 50% of the tourists were found to be single (unmarried) while divorced and widowed tourists were less

frequent. A similar distribution characterizes the international and national married tourists (Appendix 4.1: Marital status).

In terms of educational levels, all visitors with post-graduate degrees were international tourists. National tourists and the rest of the foreigners mostly had under-graduate degrees, high or secondary school education. Therefore, foreigners tended to have higher educational levels (post-graduate) than national tourists (Appendix 4.1: education).

Country of residence and nationalities

The tourist country of residence was considered very important irrespective of their nationalities. The understanding was that future marketing strategies and communication on products of ecotourism in the Congo Basin should target those countries from which most tourists come. Tourists to the LNP and DNNP came from 26 and 11 countries of residence, respectively. Tourists visiting the DNNP, who reside in the CAR, originated from Spain, Sweden and France. Similarly, tourists to the LNP came from Cameroon, Germany, the USA, France, Spain and Great Britain. Only 1.2% of tourists who reside in Cameroon visited the DNNP while no tourists residing in the CAR were found to visit the LNP. This could be associated with the fact that nationals and foreign residents in the region are fully aware of the similarity of the facilities and attractions in the region (close substitutes) or alternatively there is poor promotion of regional tourism.

Specifically for the international tourists, Germany (17.1%), the USA (15.2), France (12.7%), Spain (9.5%) and Great Britain (8.8%) were the main countries of departure to the LNP. Similarly, for the DNNP, Spain (31.5%), Sweden (24.1%), France (14.8%), the USA (5.6), Norway and Belgium (3.6% each) were the principal provenances of international tourists. Within the African continent, most foreign tourists to the LNP came from Nigeria, Ghana and South Africa (Appendix 4.1: Countries of residence). These countries are undoubtedly having a fast growing ecotourism development in Sub-Saharan Africa (Rogerson, 2007; Yunis, 2004; Eagles *et al*., 2002).

Tourists to the LNP in Cameroon represented a wider range of nationalities (27) than those visiting the DNNP in the CAR (16) (Appendix 4.1: Nationalities). This could be linked to the

fact that Cameroon is a member of both the Francophone and Commonwealth of Nations thus attracting both French and English speaking tourists. There is also the added benefit of the peaceful political climate in Cameroon over the CAR where, in the northern areas, serious insecure situations have persisted since 2003.

Annual income

Tourists visiting the two parks of the TNS were found to have a similar average annual income of US$ 70 329 for the LNP and US$ 69 629 for the DNNP, with standard deviations of US$ 59 039.4 and US$ 52 561.1 for the respective parks. Income distribution in terms of the categories of tourists showed that the mean annual income of the international tourists was almost nine times higher than that of the national tourists in the LNP and four times higher for the national tourists to the DNNP (Table 4.1). The high disparity of income between the national and international tourists gives a great justification for implementing multi-tiered fee pricing systems for the parks of the TNS system (Eagles *et al*., 2002; 2000; Lindberg, 2001; Israngkura, 1998; Lindberg and Hurber Jr., 1998; Lindberg and Johnson, 1994).

Table 4.1. Annual income (US$) of surveyed tourists to the Lobeke and Dzanga-Ndoki National Parks, 2006.

Income (US$)	Lobeke National Park			Dzanga-Ndoki National Park			
	National	International	All	International	National	Resident	All
Mean annual income	9 957.1	86 377.2	70 329.0	88 822.2	22 800.0	44 240.0	69 628.9
Standard deviation	9 000.0	78 000.0	46 800.0	78 000.0	13 500.0	36 000.0	46 800.0

Environmental Awareness

The TNS has gained public attention in relation to national, regional and international conservation actions and policy dialogues undertaken in the last two decades. Based on this, the conservation conscious visitors to the TNS Park were expected to know that the LNP and DNNP were a part of the TNS. Only some national (40.5%) and some international (27.2%) tourists that visited the LNP were aware of that. The numbers for the DNNP were 51.9%, 57.1% and 60% for the international, national and resident tourists respectively (Table 4.2).

These results showed that the DNNP is better advertised than the LNP, which might explain the higher visitation (1042 tourists in 2006) to the former than the latter (300 tourists in 2006).

Table 4.2. Distribution of surveyed tourists to the Lobeke and Dzanga-Ndoki National Parks by environmental awareness, destination and tourist category, 2006.

Aware that the park is part of the TNS	Lobeke National Park			Dzanga-Ndoki National Park			
	National	International	All	International	National	Resident	All
Yes	40.5	27.2	30.0	51.9	57.1	60.0	54.2
No	59.5	72.8	70.0	48.1	42.9	40.0	45.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Moreover, the membership of a conservation organization by tourists visiting the parks of the TNS could serve as another indicator of their environmental consciousness. In this study the differences among the different categories of tourists were glaring with respect to being a member of a conservation organization or not. Overall 34.2% of international tourists visiting the LNP and 22.2% of those to the DNNP were members of conservation organizations. Among the resident tourists in the DNNP, 20% were also members. The national tourists, however, seldom belonged to conservation organizations: 4.8% of them in the LNP and 14.3% in the DNNP. This was indicative of a higher tendency among the national tourists from the CAR in becoming members of conservation organisations compared to their Cameroonian neighbours (Appendix 4.1 Member conservation organisation).

Visit Characteristics and Organization

The characteristics of a tourist's trip included its organisation, party composition, duration of visits, group size and means of transportation. Tourists' trips were found to be self-organised or organised by tour operators. The latter organised 74% and 57.8% of the trips to the LNP and the DNNP, respectively. More specifically, 75.9% and 66.7% of international and national tourists to the LNP had their trips organised by tour operators. The numbers for the DNNP were 66.7%, 71.4% and 13.3% for international, national and resident tourists respectively (Table 4.3: trip organisation). The analysis of the organisation of the trips was considered

important in gauging the overall image of the TNS Park as a tourist destination in the global tourism market.

Regardless of the tourist category, most tourists to the LNP (67%) and the DNNP (57.8%) came in groups of friends. Tourists visiting alone represented only 11.5% of visitors to the LNP and 18.1% of those to the DNNP. Despite the comparative advantage of tourists traveling in groups of friends in sharing certain costs and reducing their total expenditure, solitary tourists could have a different comparative advantage in having more flexibility in their itineraries and could easily make use of simpler forms of transportation such as motorbikes. The proportion of solitary tourists was higher at the DNNP than at the LNP. Despite the fact that 60% of the resident tourists were married, none of them was found to visit the DNNP with his/her family, about 87% of them visited the park with friends or accompanied a filming crew (Table 4.3: Party composition). This suggests that the TNS Park system formed a good venue for friends to meet for business matters rather than a typical holiday or recreational family destination.

Table 4.3. Trip organization and party composition of of a sample of tourists to the Lobeke and Dzanga-Ndoki National Park (%), 2006

Variables		Lobeke National Park			Dzanga-Ndoki National Park			
		National	International	All	International	National	Resident	All
Trip organisation	By tour operator	66.7	75.9	74	66.7	71.4	13.3	57.8
	Self organised	33.3	24.1	26	33.3	28.6	86.7	42.2
	Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Party composition	Friends	66.7	67.1	67	42.6	85.7	86.7	57.8
	Alone	21.4	8.9	11.5	24.1	7.1	6.7	18.1
	Family	9.5	12.7	12	13	0	0	8.4
	Filming crew	0	1.3	1	1.9	0	6.7	2.4
	Travel agency	2.4	10.1	8.5	18.5	7.1	0	13.3
	Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**

The mean size of a tourist group visiting the LNP and the DNNP were accordingly 4.7 and 5.2 persons (Table 4.4). Specifically, the mean group sizes were 4.1 and 4.9 persons for national and international tourists in the LNP while in the DNNP 4.1, 7.6 and 6.5 average person-

groups were found for the international, national and residents tourists, respectively. Again the high average group size could be explained by the fact that bigger groups of tourists could share some costs, thereby reducing the total expenditure, e.g. on transportation, as well as being able to reduce the risks associated with individual trips to forested areas.

The mean duration of the visitors' stay in the two countries showed that tourists generally stay longer in Cameroon than in the CAR: international tourists spent a mean of 9.1 days in Cameroon and 7.9 days in the CAR. However, tourists stayed longer in the DNNP than in the LNP. Moreover, the proportion of time spent in the parks in comparison to the total duration spent in the relevant countries ranged from 60.5% time spent in the DNNP and only 36.7% in the LNP (Table 4.4). There are two possible reasons for this disparity. The first is that in Cameroon there are a wider variety of sites to visit from the south to the north of the country but it is only the southern section of the CAR that is enjoying some level of political stability. The northern parts of the latter, where some well-developed parks are located have suffered from the stigma of political instability since 2003. Secondly, the facilities provided at the DNNP are far better than those available at the LNP (Blom, 2004). With better facilities, tourists would be more likely to enjoy their stay and by so doing spend more time within the countries/parks (Eagles *et al.*, 2002).

Table 4.4. Mean group sizes of a sample of tourists and duration of stay in the Lobeke and Dzanga-Ndoki National Parks (sd= standard deviation), 2006.

Variables	Lobeke National Park			Dzanga-Ndoki National Park			
	National	International	All	International	National	Resident	All
Mean Group size	4.1 sd=2.6	4.9 sd=3.4	4.7 sd=3.3	4.2 sd=3.3	7.6 sd=2.5	6.5 sd=3.3	5.2 sd=3.4
Mean duration of entire trip (days)	11.17 sd=6.55	16.8 sd=8.3	15.6 sd=8.3	14.6 sd=5.0	9.8 sd=3.9	8.9 sd=2.5	12.7 sd=5.1
Mean duration in a country (days)	8.3 sd=4.2	9.1 sd=4.9	9.0 sd=4.8	7.9 sd=2.57	7.9 sd=2.9	8.6 sd=1.9	8.1 sd=2.5
Mean duration in a park (days)	3.4 sd=2.0	3.3 sd=1.9	3.3 sd=1.9	5.0 sd=1.7	4.5 sd=2.3	5.1 sd=1.9	4.9 sd=1.9
% of entire duration spent in the country	74.6	54.4	57.7	54.4	80.7	96.6	63.8
% of entire duration spent in the park	30.4	19.7	21.2	34.1	46.0	57.3	38.6
% of duration in Cameroon spent in the park	40.8	36.1	36.7	62.7	57.0	59.3	60.5

As expected, the mean durations of stay for international and resident tourists were found to be higher than that of the national tourists. International tourists visiting the LNP and the DNNP had average trip duration of 17 and 15 days, respectively. This could be explained by the additional days spent in international travel as well as the relatively higher purchasing power of international and resident tourists' budgets over the national tourists' budgets. The high purchasing power is undoubtedly associated with higher incomes that offered the former more aptitude to support the high cost of longer trips.

Observations of the proportions of tourists' entire trip durations spent in the parks showed that the TNS is a great and potentially enjoyable tourist destination. This can be confirmed by the fact that international tourists spent 21.1% and 38.6% of their entire trip durations at the LNP and the DNNP, respectively. National tourism policy-making bodies could take this seriously as one of the indicators that national tourism policies may follow and try to increase investments to improve the development of ecotourism in the TNS.

Type of transportation

Tourists were found to use different means of transport to reach the parks. Rented cars were found to be the most common transportation type and represented 70% and 47% for the LNP and the DNNP visitors, respectively. The use of private vehicles was the second most popular mode of transportation. Private cars were less frequently used in the LNP (21%) than in the DNNP (36.1%). This could be explained by the bad state of the roads used to reach the parks, which require four-wheel drive vehicles. Majority of tourists were oversea visitors with little access to private cars, thus most of them used retal cars. Rented private planes were not used to reach the LNP but for the DNNP 11% of international tourists arrived by this method. Bus services were used by 8.0% of the tourists coming to the LNP, but in the DNNP just 1.2% of tourists used this means of transport. Undoubtedly, the bad state of the roads played a role in the low rate of tourists using bus services. For instance, from Bayanga (the DNNP headquarters) to Bangui (political capital and location of the international airport) the distance is about 700 km but it takes 2 days of a difficult journey to go through.

Bad roads are a great obstacle to the development of tourism. Generally tourists consider accessibility as one of the most important points while planning their trips (Eagles *et al.*, 2000). Therefore, the information on the absence of good roads from the airport to the national parks in the Congo Basin discouraged tourists or made them choose similar parks elsewhere. Wehiong (2005) and Koyo (2004) reiterated that tourism development in the Congo Basin is hampered by inadequate infrastructure and poor communication with regards to networking within and among the countries. For instance, out of 220 000 km of roads in the five countries of the region (Cameroon, Congo, Gabon, CAR and DRC) only 8 700 km (3.95%) are tarred or are all-weathered roads (Koyo, 2004).

Tourists' interests in visiting the TNS

Tourists' interests motivate them in choosing the TNS Park as a destination for their visits. Wildlife, Pygmy culture and the rainforest were the major features that were of great interest to 70.9%, 58.8% and 33.7% of the tourists visiting the LNP as well as 63.9%, 55.4% and 50.6% of the tourists in the DNNP, respectively. Research interests brought 8.0% and 31.3%

of the tourists to the LNP and the DNNP, respectively. 72% of international tourists were particularly interested in the park wildlife. The interests of the local tourists were more widespread than those of the international tourists (Table 4.5).

Table 4.5. Distribution of a sample of tourists (%) by their group and interests in the Lobeke National Park (LNP) and the Dzanga-Ndoki National Park (DNNP), 2006.

Features of interest	LNP			DNNP			
	National	International	All	International	National	Resident	All
Wildlife	63.4	72.8	70.9	72.2	35.7	60.0	63.9
Pygmy culture	53.7	60.1	58.8	64.8	28.6	46.7	55.4
Research	14.6	6.3	8.0	33.3	14.3	40.0	31.3
Geology	36.6	27.8	29.6	13.0	14.3	13.3	13.3
Rainforest	36.6	32.9	33.7	57.4	21.4	53.3	50.6
Climate	14.6	10.1	11.1	18.5	14.3	13.3	16.9
Camping	2.4	5.7	5.0	3.7	0.0	0.0	2.4
Park issues	7.3	3.8	4.5	14.8	14.3	6.7	13.3
Ethics	7.3	8.9	8.5	11.1	7.1	13.3	10.8

Apart from tourists having individual interests in specific activities, upon arrival, they participated in diverse activities. Tourists to the LNP engaged in nature observation (83.5%), wildlife photography (44.2%) hiking (31.5%) and bird watching (26.5%) whilst relaxing and boating were the two activities that a lesser number of tourists participated in (17% in the LNP and 10% in the DNNP). The tendency of tourists to participate in any given activity was more or less similar across the national and international tourists in the LNP. In the DNNP, the major activities that tourists participated in, included nature observation (72.3%), wildlife photography (72.3%), relaxing (22.9%), camping (20.5%) and bird watching (12.0%). Hiking (4.8%) and fishing (4.8%) were found to be of lesser interest to tourists in the latter (Figure 4.1). It could be concluded that most tourists to the two parks of the TNS primarily participated in wildlife photography and nature observation while participation in other activities was more varied according to the tourist category.

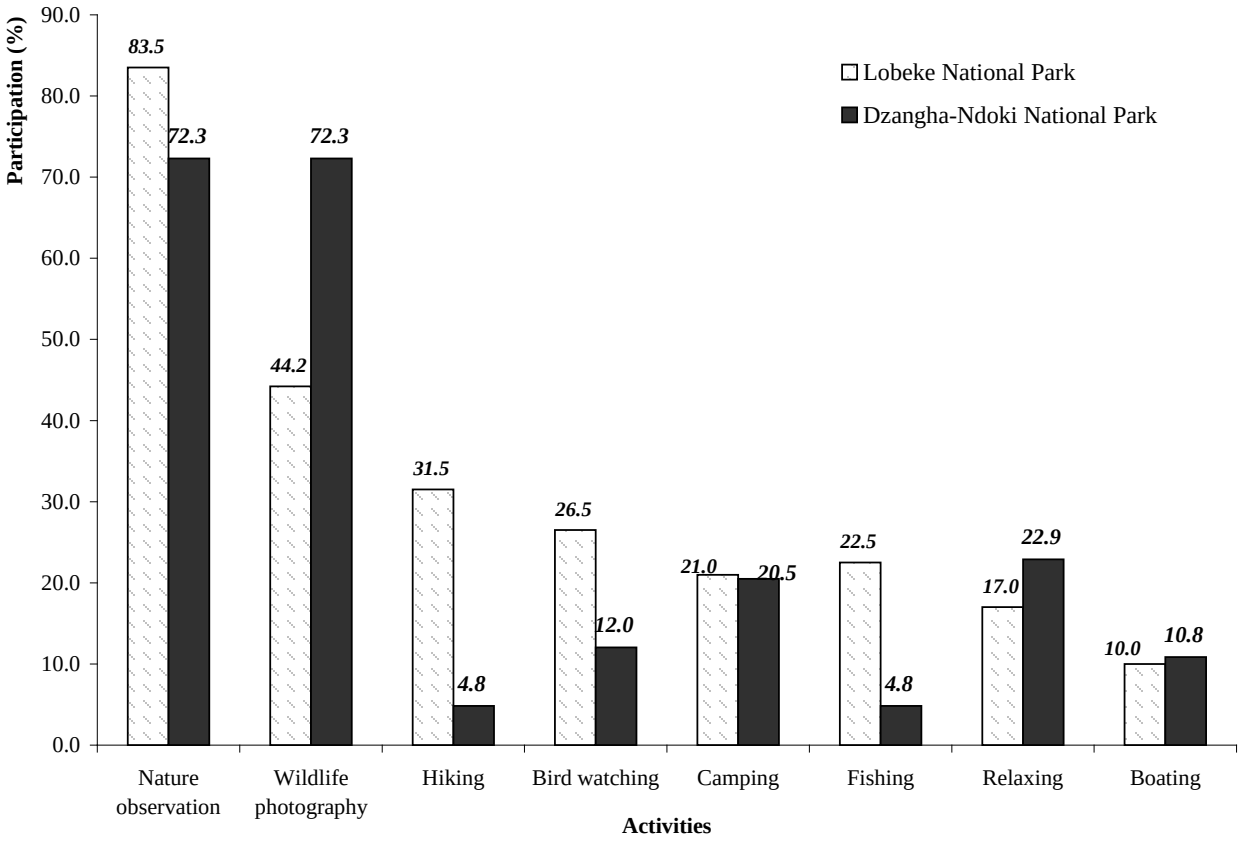

Figure 4.1. Surveyed tourists' participation in various activities in Lobeke and Dzanga-Ndoki National Parks

Tourists' satisfaction or dissatisfaction

Only 9.0% of tourists to the LNP and 13.3% to the DNNP were re-visiting, while the rest were first-timers (Table 4.6).

Table 4.6. Repeat visitors to the Lobeke and Dzanga-Ndoki National Parks (%).

Previous visit to Park	Lobeke National Park			Dzanga-Ndoki National Park			
	National	International	All	International	National	Resident	All
Yes	7.1	9.5	9.0	14.8	21.4	0	13.3
No	92.9	90.5	91.0	85.2	78.6	100.0	86.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Appreciation of the current entrance fees (EF)

In appreciating the current level of EF to the parks, tourists stated whether they were appropriate; low, high or too high. 52.3% and 72.3% of tourists to the LNP and the DNNP, respectively, stated that giving the current status of the parks, the entrance fees were appropriate. In this same sequence 33% and 8.4% thought the current EF was low while 3.0% and 4.8% thought it was high (Figure 4. 2). The policy implication of this result is that if park facilities and infrastructure at the parks are not appreciably improved, the current EF should be maintained. Any further increase may not be welcome by the majority of tourists, unless the park features are unique (Lindberg, 2001).

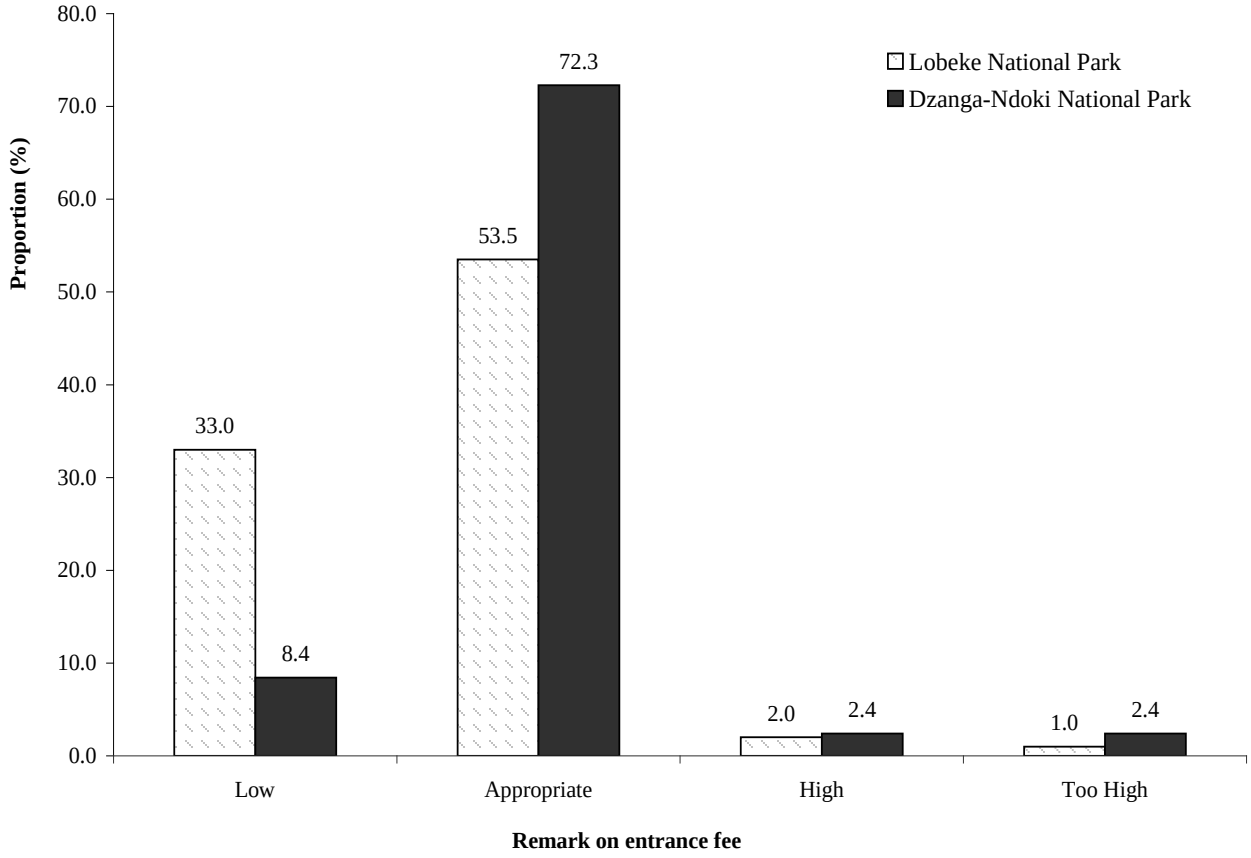

Figure 4.2. Appreciation of entrance fee by tourists in Lobeke and Dzanga-Ndoki National Parks.

Park grades as perceived by tourists

When tourists were asked about the quality of facilities and infrastructure available in the parks most of them graded the LNP on the low (<50%) to average (50-60%) categories while the DNNP tended to be graded on the average to high (61-75%) quality category of parks (Figure 4.3).

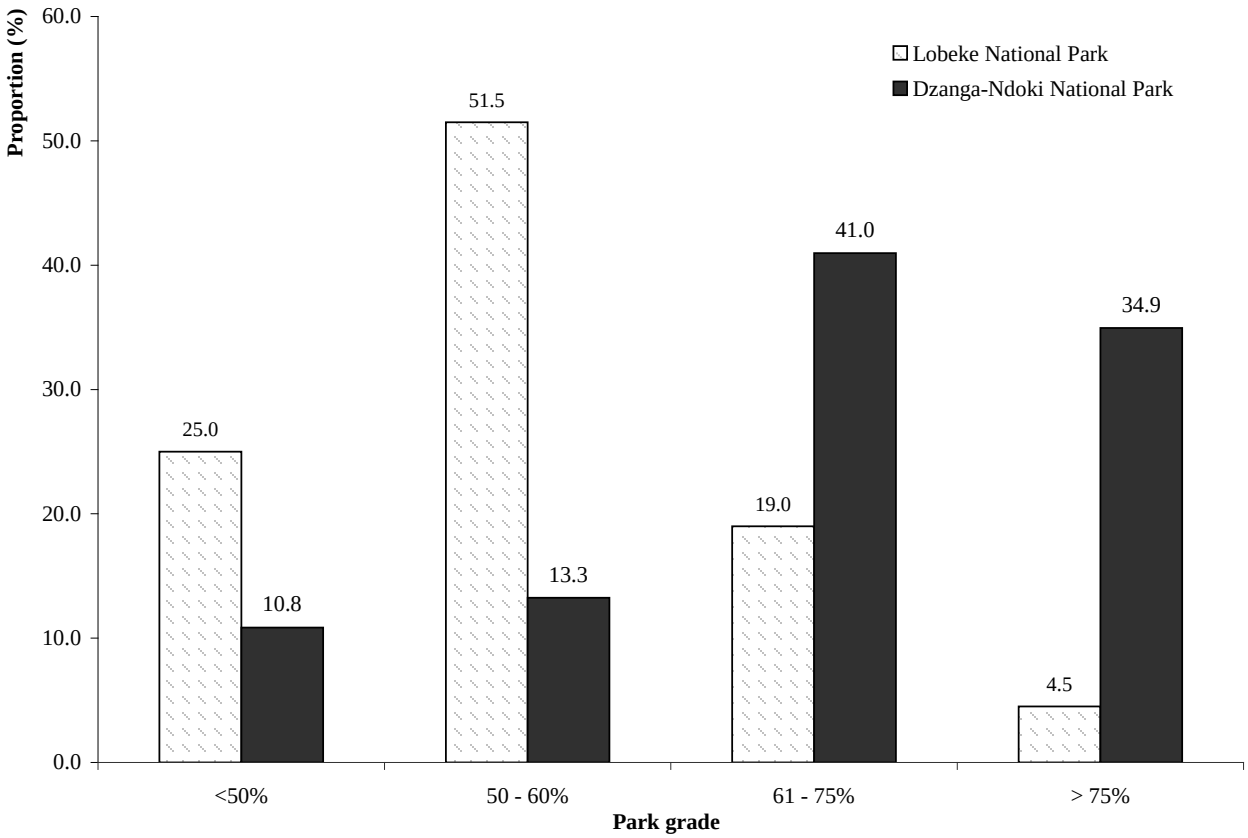

Figure 4.3. Park grades given by tourists visiting Lobeke and Dzanga-Ndoki National Parks

The grading of the parks into categories of low or high quality by tourists could be of importance to park managers to find out the strength and weaknesses of their facilities and services, as well as to plan for improvement.

Strengths of the parks as perceived by tourists

Tourists liked seven features of the LNP and four of the DNNP. The most appreciative features of the LNP included wildlife (19%), nature observation (17%) climate (15%) and the rainforest (10%). The rainforest of the latter was particularly more appreciated by international

tourists than by their national counterparts. As for the DNNP, tourists mostly appreciated wildlife (81.6%) and the warm reception by villagers (2.6%). Attractions in the LNP were found to be potentially more diverse and eye-catching to the tourists compared with the DNNP. However, and expectedly, 33.5% (LNP) and 13.2% (DNNP) of tourists stated that there was nothing they liked in the parks (Table 4.7).

Table 4.7. Features that tourists liked most about Lobeke and Dzanga-Ndoki National Parks (%).

Features	Lobeke National Park			Dzanga-Ndoki National Park			
	National	International	All	International	National	Resident	All
Climate	21.4	13.3	15.0	0	0	0	0
Wildlife	19.0	19.0	19.0	80.0	78.6	91.7	81.6
Nature	14.3	17.7	17.0	2.0	0	0	1.3
Rain forest	4.8	11.4	10.0	0	0	0	0
Warm village reception	4.8	0.6	1.5	4.0	0	0	2.6
Camping	2.4	1.3	1.5	0	0	0	0
Biodiversity	7.1	3.2	4.0	2.0	0	0	1.3
Nothing	26.2	33.5	32.0	12.0	21.4	8.3	13.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Apart from asking tourists questions about what they liked most during their visits to the two parks of the TNS, it was important to ask them what they thought was special or unique about the parks, highlights of what they considered rare and beautiful during their stay. The highlights indicated by the tourists in the LNP were: the rainforest (22.5%), wildlife richness (9.0%), high density of gorillas (4.0%), climate (3.0%), rural Pygmies' culture (3.0%) and buffalos (0.5%). In the DNNP the highlights were more obvious and included: wildlife richness (36.3%), a high density of gorillas (28.8%), the rainforest (16.3%) and a high density of elephants (12.5%) (Figure 4.4).

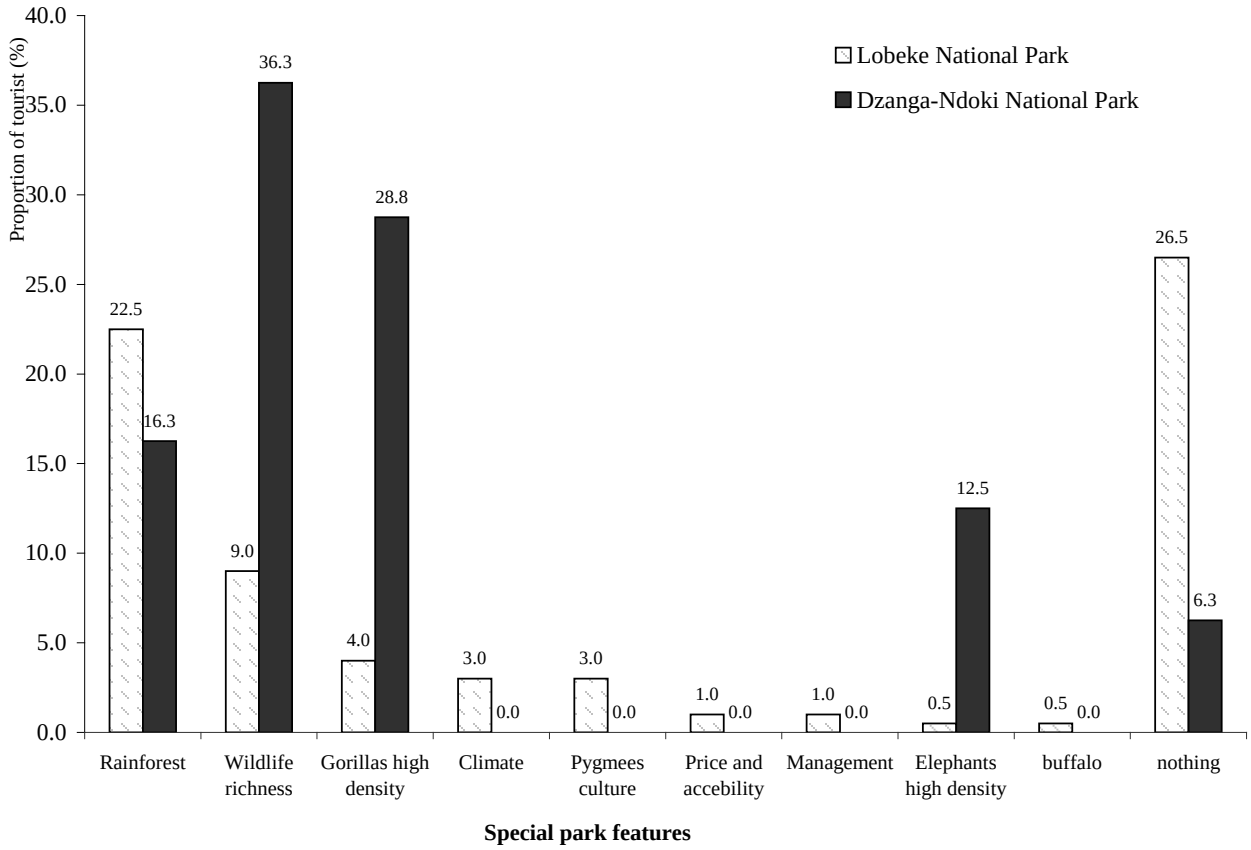

Figure 4.4. Special features identified by surveyed tourists in Lobeke and Dzanga-Ndoki National Parks

The result presented in Figure 4.4 showed that more tourists appreciated the wildlife found in the DNNP than in the LNP. Overall both DNNP and LNP were well-appreciated as only 6.3% and 26.5% of tourists, respectively, found nothing special about them. However, the result suggests higher dissatisfaction with LNP.

Weaknesses of the LNP and DNNP as perceived by tourists

As discussed in the preceding paragraphs, some tourists were not fully satisfied with the state of the parks as destinations for enjoyable recreation. One way to identify this discontent was by asking tourists about what they expected to see but could not during their trips. About 43.0% of tourists to the LNP said that they did not see what they expected to see, while in the DNNP the proportion of unsatisfied tourists was much lower (24.1%). These opinions were however, different among national, international and resident tourists (Table 4.8). This could

have been due to their various preferences, motives of visits and experiences (Eagles *et al.,* 2002; Eagles, 1997).

Table 4.8. Tourists that did not see all expected features and obstacles for not seeing them at Lobeke and Dzanga-Ndoki National Park (%).

Expected features seen/ not seen and obstacles thereto	Lobeke National Park			Dzanga-Ndoki National Park			
	National	International	All	International	National	Resident	All
Seen	38.1	44.3	43	16.7	35.7	40	24.1
Not Seen	61.9	55.7	57	83.3	64.3	60	75.9
Not found expected features	18.2	38.5	34	50	0	20	26.7
Time of the trip was short	9.1	20.5	18	33.3	100	20	46.7
Weather/rain/clouds	18.2	15.4	16	0	0	0	0
Poor organisation	27.3	5.1	10	0	0	0	0
Too expensive	0	0	0	16.7	0	60	26.7
Bad road	9.1	7.7	8	0	0	0	0
Not well directed	0	7.7	6	0	0	0	0
Poor site features	9.1	2.6	4	0	0	0	0
Noise by guides/porters	9.1	2.6	4	0	0	0	0
Total	100	100	100	100	100	100	100

With regards to the obstacles that might have hindered tourists from seeing expected park features, 34% and 26.7% of tourists to the LNP and the DNNP respectively felt that the expected features were simply not available. Others thought that there were really some obstacles that hindered them from seeing expected features. Such obstacles at the LNP included short duration of their trips (18%), bad weather conditions (16%), poor organization (10%), bad roads (8%) poor directions (6%) poor sites and noisy porters or guides (4.0%) each. In the DNNP, there were only two obstacles including short duration of the trips (46.7%) and expensive rates for accessing the desired features (26.7%). The latter obstacle was obvious for some tourists that wished to visit habituated gorillas at Bai Hokou, whereby a special user fee (four times the park entrance fee) is levied.

Another way to elicit discontent among tourists was to ask them directly about what they disliked most during their visits. At the LNP tourists gave the following reasons: a lack of

information on the weather conditions at night as well as muddy roads (25.7%), lack of facilities and poor management (23%), safety concerns (21.6%), bad roads (20.3%), lack of authentic receipts for the fees paid and corruption (6.8%), and the inability to see animals for various reasons (2.7%). At the DNNP bad roads commanded the highest discontent among 43.9% of the tourists. Tourists were also found to be unhappy with the lack of information, inability to see expected animals, poor attention to safety concerns, lack of facilities and poor management (Table 4.9). In fact most of the unpleasant issues raised by tourists were found in both parks, apart from corruption and lack of financial management that was peculiar to the LNP. The lack of authentic receipts was seen by most tourists as unbelievably obnoxious. As expected, poor financial management is in disaccord with the first principle of ecotourism (Eagles *et al.,* 2002; Eagles, 1997). This principle emphasizes that ecotourism should lead to conservation and local economic benefits but if the money paid by tourists is taken by individuals and put into private pockets, the main objectives of collecting fees would be hampered.

Table 4.9. Park aspects that tourists disliked in Lobeke and Dzanga-Ndoki National Parks (%).

Aspects disliked in the park	Lobeke National Park			Dzanga-Ndoki National Park			
	National	International	All	International	National	Resident	All
Inability to see animals [few animals]	0	3.5	2.7	34.6	16.7	0	24.4
Lack of receipt and corruption	5.9	7.0	6.8	0	0	0	0
Bad roads	35.3	15.8	20.3	38.5	16.7	77.8	43.9
Lack of information (Climate, mud)	17.6	28.1	25.7	3.8	16.7	11.1	7.3
Safety concerns	17.6	22.8	21.6	11.5	33.3	11.1	14.6
Lack of facilities and poor management	23.5	22.8	23	11.5	16.7	0	9.8
Total	100	100	100	100	100	100	100

Gauging discontentment expressed by tourists

Tourists were asked (i) as to whether would they be willing to make a repeat visit to the area and (ii) if they could recommend the parks to other people for a visit. In the case of negative responses they were asked to state the reasons. Overall, an appreciable proportion of tourists were willing to return to the LNP (44%) and the DNNP (43.4%). Specifically, 39.9% and 38.9% of international tourists were willing to return to the two parks, respectively. Also among the international tourists, the respective proportion of tourists not certain about making a repeat visit in future were 40.5% and 33.3 % for the LNP and the DNNP. The majority of national or resident tourists was more certain about returning (59.5% at the LNP; 57.1% and 46.7% for national and resident tourists respectively at the DNNP) or at least were hesitant in their responses about returning to the parks (19% at the LNP; 28.6% and 26.7% for national and resident tourists respectively at the DNNP) (Table 4.10).

Table 4.10. Tourists' willingness to return to the parks and the reasons given by those not willing to return to Lobeke and Dzanga-Ndoki National Parks (%).

Return and reasons	Lobeke National Park			Dzanga-Ndoki National Park			
	National	International	All	International	National	Resident	All
Return to park	59.5	39.9	44	38.9	57.1	46.7	43.4
Perhaps	19	40.5	36	33.3	28.6	26.7	31.3
Not return	21.4	19.6	20	27.8	14.3	26.7	25.3
Poor management/ organisation	14.3	26.1	23.3	0	0	0	0
Bad state of the park	42.9	30.4	33.3	0	0	0	0
Needs of discovering new areas	0	30.4	23.3	0	0	0	0
Not enough animals found	0	8.7	6.7	0	0	0	0
Poor roads and infrastructure	42.9	4.3	13.3	100	0	75	66.7
Police annoying	0	0	0	0	100	25	33.3
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

The national and resident tourists were more certain about making repeat visits to the parks in future than the international tourists, which could be explained by the smaller scope of attractions available to the former group. The high cost of air-tickets paid by international tourists could also explain the reluctance of making repeat visits to the region. The policy implications are that tourism should be promoted at a national level to increase repeat visits among the national and resident tourists. As observed in Table 4.10 various pertinent reasons

were raised by tourists for their decision of not making repeat visits in future. Five reasons were raised for the LNP and two for the DNNP. Reasons for not returning to the LNP included: bad state of the park (33.3%), poor management and organisation (23.3%), poor roads and infrastructure (13.3%), not having seen enough animals (6.7%) and a need to see new attractions (23.3%). As for the tourists not making repeat visits to the DNNP, 66.7% of them complained about the state of the roads while 33.3% said that the police controls were annoying because they could not distinguish between genuine tourists and other clandestine or unlawful types of travellers.

The overall responses were encouraging. Tourists were generally positive about recommending the two parks as tourists' destinations as 81.5% and 93.5% would recommend the LNP and the DNNP, respectively (Table 4.11).

Table 4.11. Reasons for reluctance in recommending the Lobeke and Dzanga-Ndoki National Parks (%).

Recommend the park and reasons for not recommending	Lobeke National Park			Dzanga-Ndoki National Park			
	National	International	All	International	National	Resident	All
Recommend	83.3	81.0	81.5	94.0	100.0	84.6	93.5
Perhaps	0	0	0	2.0	0	7.7	2.6
Not recommend	16.7	19.0	18.5	4.0	0	7.7	3.9
Poor management/ organisation	40	17.6	22.7	0	0	0	0
Bad state of the park	20	35.3	31.8	0	0	0	0
Not enough animal found	0	23.5	18.2	0	0	0	0
Poor road and infrastructure	40	23.5	27.3	100	0	0	0
Total	100	100	100	100	0	0	0

For the 18.5% of the tourists that said they could not recommend the LNP to another person as a recreational site, four reasons were elicited for their decisions: poor management and organization (22.7%), (ii) bad state of the park (31.8%), (iii) not enough animals seen (18.2%),

and (iv) poor roads and infrastructure (27.3%). As for the DNNP, the main reason was the bad state of the roads that makes access to the park very difficult.

Tourist suggestions for park improvement

In order to understand tourists' perceptions to make the experience of visitors to the parks more enjoyable, they were asked to make propositions as well as give advice that could help in quality improvements in the future. Seven cross-cutting propositions were made to improve the LNP and the DNNP (Figure 4.5).

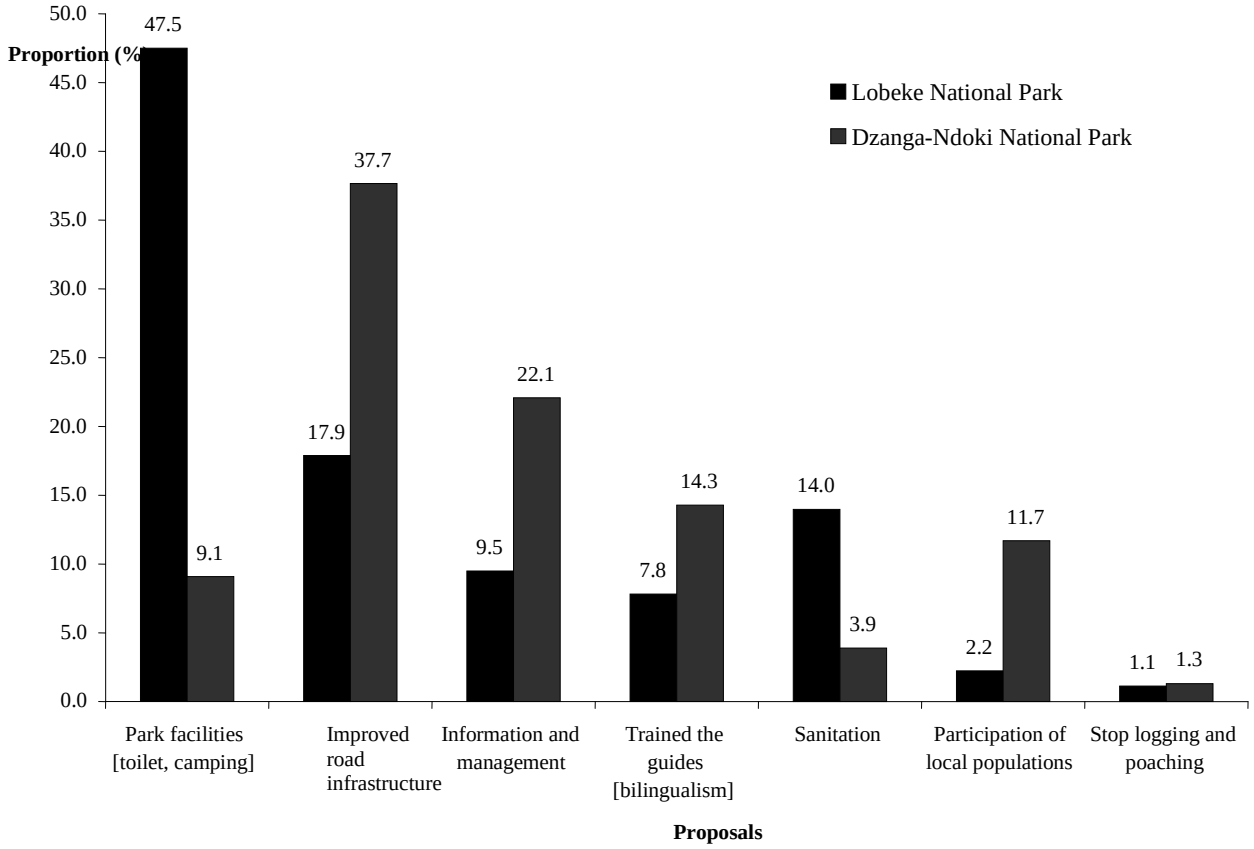

Figure 4.5. Tourist proposals for improving services in the Lobeke and Dzanga-Ndoki National Parks (%).

As observed in Figure 4.5, the most urgent issues for the LNP included park facilities like toilets, portable water sources (47.5%), roads (17.9%), sanitation (14%), information and management (9.5%) and training of bilingual guides (7.8%). As for the DNNP the issues that need attention include: improving roads (37.7%), information and management (22.1%),

training of bilingual guides (14.3%), participation by local populations (11.7%), park facilities (9.1%) and sanitation (3.9%). The participation of local populations was seen less frequently as a serious problem at the LNP (2.2%) because local youths are employed as porters for long walks (7-9 km) to reach watchtowers (miradors). Tourists (1.1% for the LNP and 1.3% for the DNNP) also viewed the issues of logging and poaching around parks as requiring urgent attention.

When tourists were asked about the best advice they could give to park management for future improvements on park recreational attributes, a shopping list of 17 specific lines of action were given for the LNP and seven for the DNNP (Table 4.12).

Table 4.12. Advice of tourists to improve the Lobeke and Dzanga-Ndoki National Parks (%).

Advices	Relative frequencies (%)	
	Lobeke National Park	Dzanga-Ndoki National Park
Improve roads and bridges	15.1	23.5
Provide good park/area information	3.5	5.9
Demonstrate transparent management of funds	6.0	2.9
Improve organisation and management	8.8	8.8
Train guides	8.1	2.9
Reduce police controls and extortions	4.9	52.9
Reduce poaching	1.4	2.9
Provide good accommodation	6.0	0.0
Reduce the traffic of rented cars on the roads	0.7	0.0
Introduce a communication network	2.1	0.0
Build toilets	3.9	0.0
Improve restaurants	4.2	0.0
Build good camp areas	3.5	0.0
Improve the watchtowers	6.7	0.0
Install water supplies	3.9	0.0
Improve sanitation	8.1	0.0
Improve all other park facilities	13.3	0.0
Total	**100.0**	**100.0**

Past and present situation in the parks

Among the repeat visitors to the LNP, 100% and 33.3% of national and international tourists, respectively, thought that there were only negative changes between the current and the past

situation of the park. Among the national tourists, half declared that the eco-guards were more disgruntled and the rest of them stated that park access is becoming too difficult. The international tourists (40%) declared that the watchtowers were in ruins, 40% commented on the problem of bad roads and the rest complained about the decrease of the number of animals in the LNP. However, at the DNNP, 71.4% international tourists thought that there were positive changes between their past and current visits. They appreciated the habituation of gorillas (80%) and the rest found that there were more animals in the park. 28.6% of the international repeat tourists felt that park access is becoming more difficult. All the national tourists found that they were no changes in the DNNP Park. There were no resident repeat visitors to comment on the past and actual situation of the DNNP (Table 4.13).

Table 4.13. Perceptions on changes by repeat visitors to the Lobeke and Dzanga-Ndoki National Parks (%).

Changes observed in the park	Lobeke National Park			Dzanga-Ndoki National Park			
	National	International	All	International	National	Resident	All
Negative changes	**100**	**33.3**	**38.9**	**28.6**	**0.0**	**0.0**	**20.0**
Mirador Platform	0.0	40.0	28.6	0.0	0.0	0.0	0.0
Ecoguardes	50.0	0.0	14.3	0.0	0.0	0.0	0.0
Access becoming difficult	50.0	40.0	42.9	100.0	0.0	0.0	100.0
Less animals seen	0.0	20.0	14.3	0.0	0.0	0.0	0.0
Positive changes	**0.0**	**0.0**	**0.0**	**71.4**	**0.0**	**0.0**	**50.0**
Gorillas habituation	0.0	0.0	0.0	80.0	0.0	0.0	80.0
More animals at saline	0.0	0.0	0.0	20.0	0.0	0.0	20.0
No changes	**0.0**	**66.7**	**61.1**	**0.0**	**100.0**	**0.0**	**30.0**
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**0.0**	**100.0**

Mobility of tourists within the TNS region and beyond

Tourists do not normally have one destination in their travelling plans. Most tourists visiting the TNS area were found to have one or more other destinations within the region or beyond. Some tourists had the TNS parks as their primary destinations, while others did not. If tourists' facilities in the TNS region had become more appealing and enjoyable perhaps they would

stay longer without opting to go elsewhere. The TNS was a primary destination for 42.5% of tourists for the LNP and 56.6% to the DNNP. For 48.5% and 36.1 % of the tourists visiting the LNP and the DNNP, respectively, these parks were just one of the several destinations in their travel plan. However, 9.0% and 7.2% of tourists that visited the LNP and the DNNP, respectively, did not have them in their original travel plans at all (Figure 4.6).

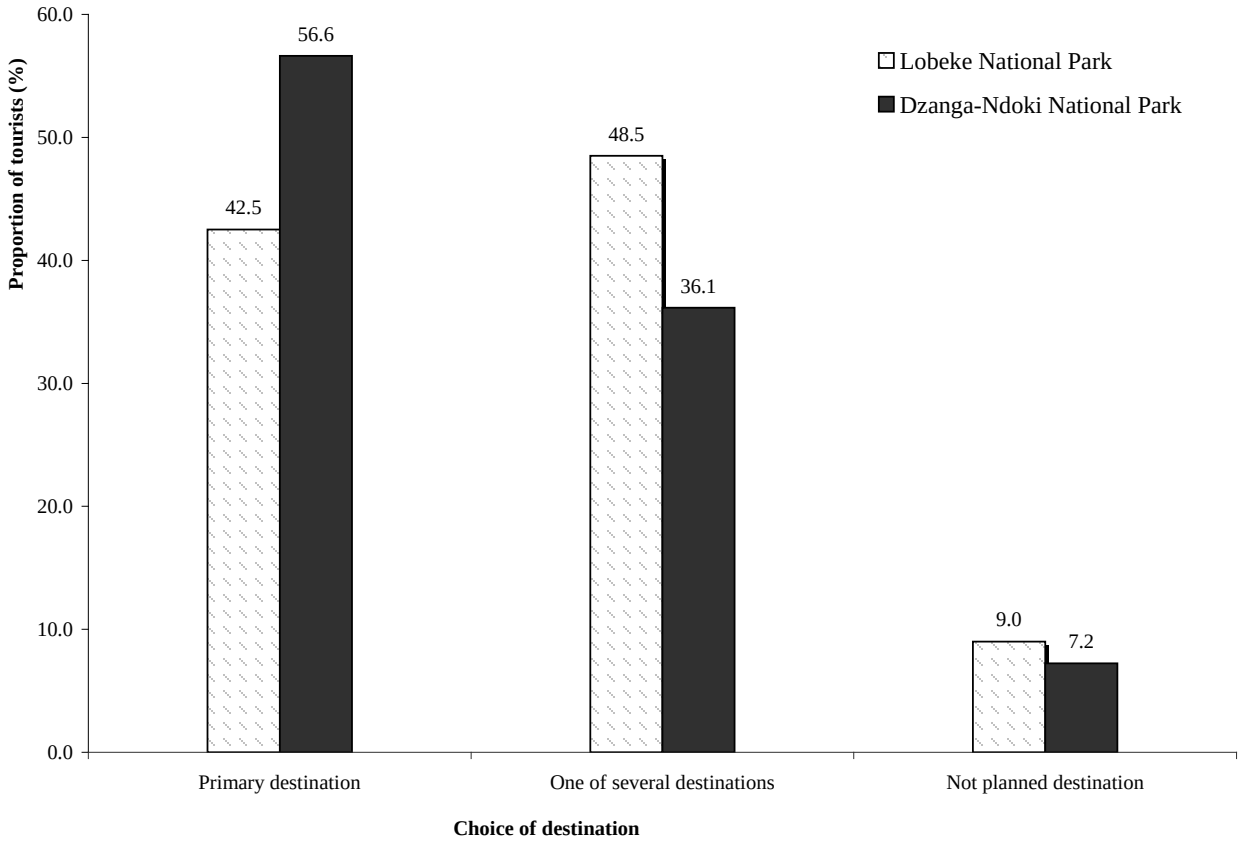

Figure 4.6. Tourists' choices of a park destination (Lobeke National Park; Dzanga-Ndoki National Park)

Within the TNS park system, 26% of tourists visiting the LNP were found to also visit the DNNP and only 7.2% that visited the DNNP also visited the LNP. In addition 25.3% and 9.5% of visitors to the DNNP and the LNP respectively, visited the NNNP in the Republic of Congo (Figure 4.7). This could be associated with better park facilities available at the DNNP. However, the flow of tourists from the NNNP to the other two parks of the TNS was not studied.

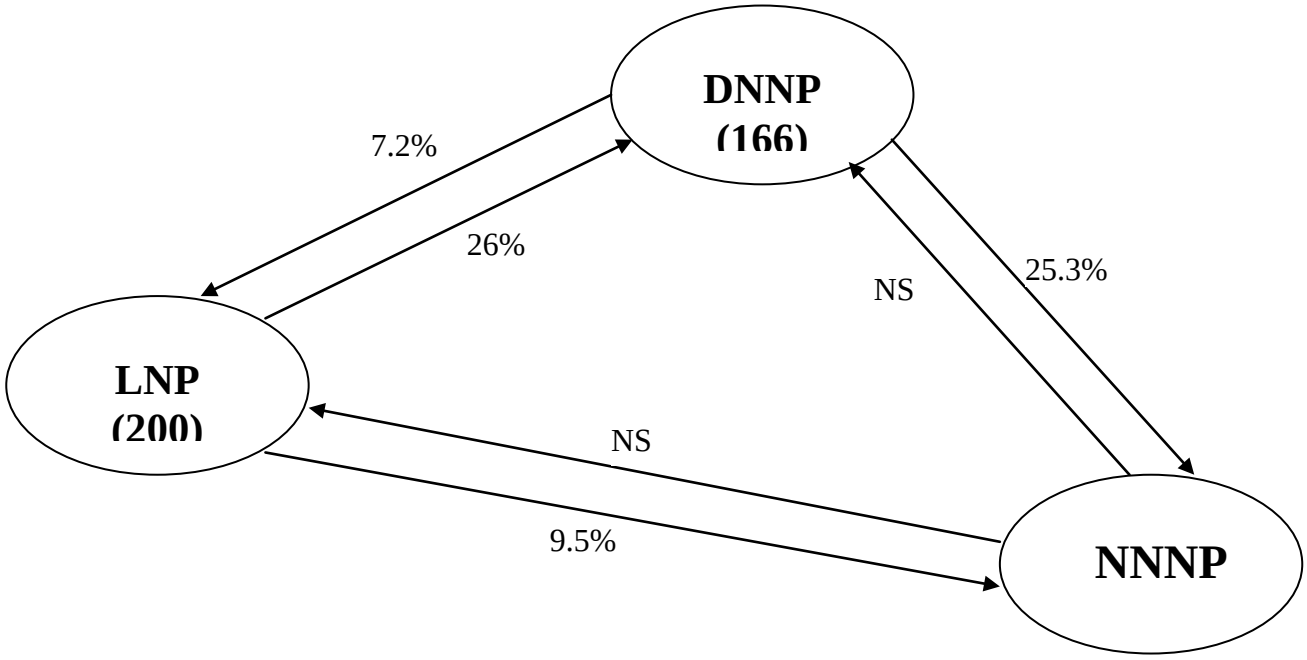

Figure 4.7. Dynamics (mobility) of tourists within the TNS region (LNP=Lobeke National park; DNNP=Dzanga-Ndoki National Park; NNNP=Nouabale-Ndoki National Park; NS=Not Studied).

It was also found that apart from visits to the three parks of the TNS, tourists also visited other parks and recreational areas in Cameroon. Some tourists visiting the LNP also visited the Waza National Park (12.5%), the Korup National Park (10.0%), the Dja Biosphere Reserve (4.0%), Kribi beach/town (3%) and many other sites in Cameroon. However, 66.1% of the visitors to the DNNP had no other destinations within the CAR in their plans. Only 1.2% of the tourists that visited the DNNP went also to the Waza National Park in Cameroon (Table 4.14). The singular reason as mentioned by the tourists for their low mobility in the CAR was insecurity in the northern section of the country, where other interesting parks are located.

Table 4.14. Tourists from the Lobeke (LNP) and Dzanga-Ndoki National Parks (DNNP) visiting other destinations within the region (%).

Destinations	Other destinations within the region visited by tourists from LNP	Other destinations within the region visited by tourists from DNNP
Other destination	**81.5**	**33.7**
DNNP	26.0	NA
Waza	12.5	1.2
Korup	10.0	0
NNNP	9.5	25.3
Dja	4.0	0
Kribi	3.0	0
North Cameroon	2.5	0
Foumban	2.5	0
Ejagan Lake	2.5	0
Menchum	1.5	0
Mount Cameroon	1.5	0
Nki	1.5	0
Manengouba	1.5	0
Benoue	0.5	0
Limbe	0.5	0
Rumpi	0.5	0
Kumbo	0.5	0
West Cameroon	0.5	0
Campo	0.5	0
LNP	NA	7.2
No other destination	**18.5**	**66.3**
Total	100.0	100.0

Aside from visiting other sites within the countries where the TNS is located, 49.5% of the LNP tourists and 38.4% of the DNNP tourists also visited eighteen and six other countries, respectively (Table 4.15).

Table 4.15. Tourists to the Lobeke (LNP) and Dzanga-Ndoki National Parks (DNNP) visiting other countries (%).

Countries	Relative frequencies for tourists to the LNP	Relative frequencies for tourists to the DNNP
Other country	**49.5**	**38.4**
CAR	24.5	0.0
Congo Brazzaville	8.5	25.2
Togo	3.0	0
Kenya	2.0	0
Mali	2.0	0
Gabon	1.5	0
France	1.0	0
Cote d'Ivoire	1.0	0
Switzerland	1.0	0
Chad	1.0	0
DRC	0.5	0
Uganda	0.5	0
Equatorial Guinea	0.5	0
Morocco	0.5	1.2
Ghana	0.5	1.2
Senegal	0.5	1.2
Sudan	0.5	0
Benin	0.5	0
Uganda	-	2.4
Cameroon	NA	7.2
No other country	**50.5**	**61.6**
Total	100	100

ESTIMATION OF WILLINGNESS-TO-PAY MORE AND WILLINGNESS-TO-STAY LONGER IN THE TNS

In this study it was supposed that for the parks within the TNS to receive maximum revenues from entrance fees, efforts have to be made to ensure that tourists pay their optimum entrance fee as well that they stay as long as possible within the parks. In the case of tourists rejecting higher fees and longer stays, elicit reasons for a lack of willingness to pay or to stay longer in the parks had to be defined.

Willingness to stay longer in parks

The results showed that if conditions in the parks were improved, tourists would stay for an average of 1.9 days longer in the LNP and 1.5 days longer in the DNNP (Table 4.16).

Table 4.16. Tourists' willingness to stay longer (by tourist category) in Lobeke and Dzanga-Ndoki National Parks (days) (sd=standard deviation).

More days	Lobeke National Park			Dzanga-Ndoki National Park			
	National	International	All	International	National	Resident	All
Mean	1.8	1.9	1.9	1.2	2.0	2.4	1.5
Sd	1.2	1.2	1.2	1.4	1.4	1.2	1.4

It was found that if park conditions and facilities would be improved, all categories of tourists would extend their stay in the parks. Specifically, for international tourists (financially, the most attractive category of tourists), the number of additional days that they would stay if conditions were improved was higher in the LNP than in the DNNP. This could be explained by the fact that they had lesser problems in the DNNP than in the LNP, where they wanted to see more animals and they could not enjoy park facilities.

WTP higher entrance fees in the LNP and DNNP

The WTP higher EF by tourists visiting the parks were elicited by asking tourists directly if they were willing to pay an additional amount of money to the current fee assuming the current conditions of the parks were to be improved. Irrespective of the category of tourists, 84.5% of them in the LNP and 75.9% in the DNNP were willing to pay higher EF following an improvement of the recreational facilities in the parks. Apart from the resident tourists in

the DNNP, who were not willing to pay increased fees to the park, the other categories of tourists were actually willing to accept the fees increased after significant improvements in park facilities and infrastructure. Up to 85.7% and 78.6% of the national tourists in the LNP and the DNNP, respectively, were willing to accept the increased EF (Table 4.17).

Table 4.17. Tourists willing to pay more for recreation in Lobeke and Dzanga-Ndoki National Parks (%).

WTP more	Lobeke National Park			Dzanga Ndoki National Park			
	National	International	All	International	National	Resident	All
Yes	85.7	84.2	84.5	81.5	78.6	53.3	75.9
No	14.3	15.8	15.5	18.5	21.4	46.7	24.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

It could be concluded from the above results that national tourists are willing to see national parks improved for better recreational activities and that they are ready to contribute financially for it. So, when putting in place a policy on ecotourism development in the parks, the government could seriously consider the possible contribution of national ecotourism markets.

Estimates of WTP Using Dichotomous choice CVM

Qualitative information on the WTP higher fees was considered insufficient to justify policy changes on the fee system in the parks. It was therefore considered important to make quantitative estimates on the actual amount of money that tourists would be willing to pay if park facilities and infrastructure were to be improved. To do this, the use of the dichotomous choice contingent (CVM) was employed.

The WTP of a higher EF per person per day was found to be dependent on the category of EF paid by each respondent. Using a doubled-bounded CVM, the estimated mean amounts that each category of tourist could pay as EF were computed. As indicated in Table 4.18, international tourists offered the highest WTP amounts as EF into the parks. This could be justified by the fact that international tourists come from afar with well-calculated budgets to

spend for recreation. This could also be linked to the latter's higher income levels as compared with the national and resident tourists.

Table 4.18. Mean willingness-to-pay of tourists per person per day in Lobeke and Dzanga-Ndoki National Parks following improved park facilities (WTP=Willingness-to-pay; CVM=contingent valuation method).

Mean WTP	Lobeke National Park		Dzanga-Ndoki National Park		
	International	National	International	National	Resident
Mean WTP CVM (US$)	**18.65**	**9.95**	**53.6**	**4.9**	**29.3**
Mean WTP CVM (CFAF)	9325	4975	26806	2464	14667

Table 4.18 shows that in the DNNP, the mean WTP was US$ 53.6 for international tourists, US$ 29.3 for resident tourists and US$ 4.9 for national tourists. As for the LNP the mean WTP amounts were US$ 18.65 and US$ 9.95 for international and national tourists, respectively. The mean WTP estimates indicate that a higher EF could be implemented, following improvements in park infrastructure, facilities and services. Foreign visitors value the DNNP more than the LNP, while the opposite is true among the local visitors because the DNNP offers better services/facilities at present.

Consumer surplus

A consumer surplus (CS) is the difference between what a consumer is willing to pay for a good or service and what he or she actually pays when buying it (Boxall and Beckley, 2002). Desaigues and Point (1993) defined consumer surplus as the economic measure of surplus satisfaction - the excess of price that a consumer would be willing to pay for a product or service. In this case, it is an amount of money that a tourist can pay in addition to the current EF for visiting a site. As indicated in Table 4.19, the CS for each category of tourists per day at the LNP and the DNNP was calculated as the difference between the mean WTP and the current entrance fee.

Table 4.19. Consumer surplus (US$) for tourists visiting Lobeke and Dzanga-Ndoki National Parks)

Consumer surplus	Lobeke National Park		Dzanga-Ndoki National Park		
	International	National	International	National	Resident
Current entrance fee (US$)	10	4	30	3	20
Mean Willingness-to-pay (US$)	18.65	9.95	53.6	4.9	29.3
Consumer surplus (mean willingness-to-pay – Current entrance fee)	**8.65**	**5.95**	**23.6**	**1.9**	**9.3**

Overall, it is concluded from the study that tourists, irrespective of their category, were willing to pay an increased fee following pertinent improvements in the condition of the parks. What remained to be confirmed was to determine whether or not the WTP amount expressed by tourists could actually be justified by their socio-demographic characteristics. To test this, further analysis was conducted to identify more of the determinants of the WTP. Some of these characteristics included: gender, education level, age, nationality, country of residence, annual income, marital status and membership to a conservation organisation.

Socio-demographic factors influencing WTP

Dichotomous outcomes known as 'bounds,' requiring 'Yes' or 'No' responses were defined for different levels of fees to gauge tourists' WTP higher EF following improvements in park facilities and services. The two bounds of EF for national and international tourists to the LNP were US$ 4 and US$ 8, and US$ 10 and US$ 20 respectively. As for the DNNP, the two bounds were US$ 3 and US$ 6, US$ 20 and US$ 40, and US$ 30 and US$ 60 for national, resident and international tourists, respectively.

Among the national tourists to the LNP, 92.9% and 71.3% of females were willing to pay US$4 and US$8 respectively. These proportions were slightly higher than those of the male tourists (81.5% and 66.7%) for the respective two fee levels. The proportion of married tourists willing to pay higher EF for the two bounds (85.7% and 83.3% respectively) were slightly higher than those of singles (82.8% and 66.7% in that order) at each bound. A higher education level of the national tourists negatively influenced the WTP higher EF for each bound. Tourists with a primary education were all willing to pay US$4 more for the EF and

80% among them were willing to pay US$8 more for the EF. These proportions were 87.5% and 66.7%, respectively, for the tourists with secondary education, and 80% and 66.7% for the tourists possessing university degrees or an equivalent. The distribution of the national tourists by their age and the WTP at the two bounds of the EF showed that the probability of a higher WTP increased slightly with age. The proportion of tourists that were members of conservation organisations and willing to pay a higher EF were lower (50% and 0.0% for the two bounds respectively) than for the tourists that were not members of such organizations (87.2% and 70.3% respectively). As expected, the percentage of tourists willing to pay higher fees increased with their annual income (Table 4.20).

Table 4.20. Socio-economic characteristics of tourists visiting the Lobeke National Park and their willingness-to-pay (WTP) higher entrance fees (%).

Characteristics	Lobeke National Park			
	National tourists		International tourists	
	%WTP_US$4	%WTP_US$8	%WTP_US$10	%WTP_US$20
Gender				
Female	92.9	71.4	87.0	30.0
Male	81.5	66.7	82.2	28.5
Marital status				
Single	82.8	66.7	79.7	78.8
Married	85.7	83.3	84.2	64.9
Divorced	100.0	75.0	100.0	55.6
Widowed	100.0	-	100.0	80.0
Education Level				
Post graduate degree	-	-	84.0	56.0
Diploma/degree from university or equivalent	80.0	66.7	87.2	70.9
secondary/high school education	87.5	66.7	79.6	79.7
Primary education	100.0	80.0	-	-
No formal education	-	-	100.0	50.0
Membership of a conservation organisation				
Member	50.0	-	85.2	16.7
Not member	87.2	70.3	83.8	34.2
Age				
[20; 30[	85.7	42.9	81.8	7.7
[30; 40[	84.6	78.3	76.6	30.9
[40; 50[	100.0	66.7	95.2	30.6
[50; 60[	100.0	100.0	84.6	15.4
>60	-	-	66.7	44.4
Annual income (US$)				
[0;10 000[	82.9	68.8	66.7	16.7
[10 000; 20 000[	100.0	75.0	85.7	0
[20 000; 40 000[	100.0	-	62.5	18.8
[40 000; 60 000[	-	-	81.3	3.1
[60 000; 80 000[	-	-	75.8	21.2
[80 000; 100 000[	100.0	100.0	100.0	57.1
[100 000; 150 000[	-	-	92.0	44.0
>150 000	-	-	100.0	64.0
General	**85.4**	**68.4**	**84.3**	**26.7**

As expected, the percentage of international tourists willing to pay higher EF increased with annual income. For tourists whose annual incomes were under US$ 10 000, 66.7% were willing to pay US$10 more EF. This proportion was generally increasing with annual income and approaches 100% for tourists with more than US$80 000 per annum. Being a member of a

conservation organisation did not positively influence the WTP more EF in the LNP. In fact, the percentage of members of conservation organisations willing to pay US$10 more EF was quite the same as those for non-members (85.2% and 83.8% respectively). Concerning the WTP US$20 more EF, 34.2% of non-members were willing to pay while only 16.7% of members to conservation organisations were willing to pay.

WTP of international, national and resident tourists at the DNNP.

Contrary to the LNP, national male tourists to DNNP were more willing to pay than females. All male tourists were willing to pay US$3 higher EF and 75% were willing to pay US$6 higher EF. Married tourists were more likely to pay higher EF than singles. The proportion of tourists willing to pay higher EF was found to increase with annual income. Older national tourists at the DNNP appeared to be a little less willing to pay higher EF than younger ones. For international tourists, the proportion of tourists willing to pay US$30 higher EF increased with annual income. For the two bounds, the proportions of tourists willing to pay more generally increased with age. The proportions of members of conservation organisations willing to pay higher EF were higher than those of non-members. For the WTP US$30 higher EF, the proportion of male international tourists was higher than those of females. But for the WTP US$ 60 more EF, the situation was not the same as female international tourists were more willing to pay than males. According to marital status, married tourists were more willing to pay than singles for the two bounds. With regards to the resident WTP US$40, annual income did not really positively influence the proportion of tourists willing to pay that additional EF. There was no great difference between the proportion of younger resident tourists willing to pay US$20 higher EF and those of tourists older than 40 years (50%). The proportion of single resident tourists willing to pay (83.3%) was higher than those that were married (33.3%) (Table 4.21).

Table 4.21. Socio-economic characteristics of tourists to Dzanga-Ndoki National Park and their Willingness-to pay (WTP) more (%)

Characteristics	Dzanga-Ndoki National Park					
	National tourists		International tourists		Resident tourists	
	WTP US$3	WTP US$6	WTP US$30	WTP US$60	WTP US$20	WTP US$40
Gender						
Female	70.0	50	65.0	50	55.6	11.1
Male	100.0	75	75.0	33.3	50.0	28.6
Marital status						
Single	75.0	60	58.6	41.2	83.3	42.9
Married	100.0	50	76.0	52.6	33.3	-
Divorced	-	-	100.0	-	-	-
Widowed	-	-	-	44.7	-	-
Education Level						
Post graduate degree	-	-	52.9	77.8	50.0	-
Secondary/high school education	100.0	50	60.0	50	83.3	16.7
Primary education	100.0	100	100.0	25	20.0	33.3
No formal education	-	-	-	-	50.0	-
Diploma/degree from university or equivalent	66.7	42.9	76.0	31.6	-	-
Member of a conservation organisation						
Member	100.0	100	84.6	72.7	84.6	-
Not member	75.0	50	62.8	33.3	62.8	23.1
Age						
[20; 30[	100.0	66.7	62.5	20.0	75.0	20.0
[30; 40[	100.0	57.1	61.9	38.5	42.9	14.3
[40; 50[	75.0	50.0	77.8	42.9	50.0	25.0
[50; 60[	-	-	60.0	100.0	-	-
>60	-	-	75.0	66.7	-	-
Annual income (US$)						
[0;10000[	80	40	-	-	25	-
[10 000; 20 000[	100	75	-	-	100	100.0
[20 000; 40 000[	100	100	31.3	12.5	50	-
[40 000; 60 000[	-	-	90.9	16.7	100	-
[60 000; 80 000[	-	-	100.0	-	66.7	33.3
[80 000; 100 000[	-	-	100.0	53.8	-	-
[100 000; 150 000[	-	-	-	-	-	-
>150 000	-	-	100.0	71.4	100	-
General	**78.6**	**58.3**	**69.8**	**44.7**	**53.3**	**18.8**

Biprobit model of the willingness-to-pay

The independent variables chosen were the socio-demographics characteristics of tourists. In order to simplify the model results and render them more relevant to policy-making, all the qualitative variables were dichotomized as follows:

age: (i) young and (ii) old (>40 years);

gender: (i) males and (ii) females;
marital status: (i) single and (ii) married, divorced and widowed;
membership of conservation organizations: (i) member and (ii) non-member;
education level: (i) standard and medium and (ii) high;
annual income: as a quantitative variable, not dichotomized;
connectivity: (i) frequent visitor and (ii) first-time visitor;
destination choice: (i) planned and (ii) incidental;
trip organization: (i) self-organized and (ii) agent-organized;
other destinations: (i) multiple destinations and (ii) singular destinations;
awareness of TNS organization: (i) aware and (ii) not aware.
The second category of each characteristic served as a reference in the model.

The presentation of these econometric results involved the following:

- the observation of the correlation matrix,
- the observation of the signs and probabilities of coefficients provided by the model, and
- the interpretation of the marginal effects of each independent variable.

Correlation results: the LNP tourists

A correlation matrix for the international and national tourists showed that some of the independent variables were auto-correlated. In a situation where two variables were strongly correlated one was dropped off before the model was run. In a situation where two variables were slightly correlated an individual decision was made to keep the two variables or to drop one of them. The biprobit models for international tourists to the LNP was therefore estimated by using the following variables: annual income, marital status, age, gender, frequent/first-time visitor, member of conservation organisations, “party composition”, education level, other destination, trip organisation and destination choice. The selection of variables used in the model designed for the national tourists follows the same logic as for international tourists. The biprobit model for national tourists to the LNP was estimated by using four selected variables (annual income, party composition, “frequent visitor to the LNP,” and ‘destination choice’ (Table 4.22).

Table 4.22. Correlation (*) of independent variables for the tourists visiting the Lobeke National Park (S- variables selected for biprobit models).

	International tourists												**National tourists**											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
1.Marital status	S												-											
2.Other destination		S											*	-										
3. Age			S												-									
4. Education level				S												-								
5. Trip organisation					S												-							
6. Destination choice						S									*	*	*	S						
7. Awareness of the LNP as part of the TNS							-						*	*					-					
8. Frequent visitor							*	S												S				
9. Party composition									S							*					S			
10. Member to conservation organisation										S						*	*		*	*		-		
11. Gender									*		S			*		*				*			-	
12. Annual income	*		*									S				*								S

Biprobit model: the Lobeke National Park

The biprobit model of the WTP by the international tourists visiting the LNP was significant at the level of 5%, because its log-likelihood of 138.2 was higher than the theoretical Chi-square of 33.5 ($df = 22$; $\alpha = 0.05$), Various explanatory variables were selected for the different WTP models (Table 4.22). For international tourists WTP US$10, 'annual income' was the only significant variable at the level of 5% (Table 4.23). It was positively linked ($\beta = 0.0012$; $p < 0.001$) to the higher WTP. This result could be explained by the fact that 84.7% of the international tourists were willing to pay an additional US$10 to the current EF regardless of their socio-demographic characteristics. For international tourists WTP US$20, four variables were significantly correlated at 5% level of statistical confidence. Marital status ($\beta = -0.575$; $p < 0.05$), was negatively linked to the WTP a higher EF, meaning that married tourists were characterised by a higher probability of WTP higher EF than their single counterparts. This could be explained by the fact that married tourists have a future responsibility of caring more about posterity; the future of their children than singles. "Member of conservation organisations" was also negatively linked to the WTP US$20 ($\beta = -1.005$; $p < 0.05$). This could be explained by two observations: 48.1% of the members of conservation organisations thought that the current park EF was appropriate. All the re-visiting tourists, members of conservation organisations, stated that despite the EFR having been collected before, there were no positive changes in the park, the watchtowers and other park facilities were in ruins. This could have been the reason why they were less willing to pay a higher EF, believing that such payments would not serve to increase park investments. Also an annual income was positively linked ($\beta = 0.0006$; $p < 0.05$) to the WTP US$20, meaning that the higher the annual income of an international tourist the higher the probability of his or her WTP an additional US$ 20 EF. The variable on having been to the park before was significantly and negatively linked to the WTP US$20 ($\beta = -0.940$; $p < 0.05$). Re-visiting international tourists were not willing to pay an additional US$20 because they did not see any positive improvements in the park (Table 4.23).

Table 4.23. Results of the biprobit models for willingness to pay (WTP) additional dollars (US$) as entrance fees by the foreign and national tourists at the Lobeke National Park (β – coefficients, p – significance, Chi-square).

Independent variables	International tourists				National tourists			
	intWTP US$10		IntWTP_US$20		natWTP_US$4		natWTP_US$8	
	Coef. (β)	P	Coef. (β)	P	Coef. (β)	P	Coef. (β)	P
Marital status	-0.053	0.817	-0.575	0.004				
Other destination	0.394	0.129	-0.237	0.289				
Age	0.012	0.968	-0.606	0.127				
Education level	-0.533	0.125	-0.156	0.577				
Trip organisation	0.113	0.720	0.379	0.162				
Destination choice	0.166	0.540	-0.093	0.685	1.184	0.026	0.920	0.009
Frequent visitor	-0.277	0.487	-0.940	0.040	-2.407	0.001	-8.190	0.000
Party composition	-0.040	0.938	-0.338	0.440	5.896	0.000	0.057	0.916
Member of conservation organisations	0.131	0.624	-1.005	0.000				
Gender	0.221	0.461	-0.188	0.476				
Annual income	0.0012	0.001	0.0006	0.001	0.0001	0.0430	0.001	0.5140
Log-likelihood	138.2				55.8			
Prob>Chi	0.00002				0.000			

The biprobit model tested for the national tourists showed that both models, one developed for the WTP an extra US$4 and US$8 were significant but different sets of independent variables were significant in these models. When an additional US$4 was asked for the EF, tourists revisiting the park were less inclined to pay extra entrance fees compared to the first-time visitors. ‘The ‘primary destination’, ‘trip organisation’, ‘party composition’ and annual income were all positively impacting on the WTP extra US$4. The national tourists who organised their own trips specifically to visit the LNP were more willing to pay the higher EF due the fact that when a trip was organised by an agency the total trip cost was higher and tourists did not want to spend additional money. The same principle applied to the higher income earners and the solitary national tourists who could afford to pay the higher EF than those paying entry fees for their friends or families. When the WTP additional US$ was

analysed only the tourists whose 'primary destination' was the LNP and those who travelled alone were prepared to pay US$8 more.

Marginal effects

In this study, the marginal effects defined the influence of the independent variables on the probability of the WTP of higher EFs. Among the international visitors, the variables that most decreased the probability were: 'memberships of conservation organisations' (by -28.1%), re-visiting tourists (by -23%), and unmarried tourists (by -18.9%). The higher the annual income of an international tourist, the (slightly) higher was his/her probability of WTP more (Table 4.24).

Table 4.24. Marginal effect of the independent variables on international and national tourists willingness-to-pay to visit the Lobeke National Park

Variables	International tourists	National tourists
Marital status	- 0.189	
Other destination	- 0.063	
Age	- 0.177	
Education level	- 0.056	
Trip organisation	0.113	
Destination choice	- 0.031	0.353
Frequent visitor to the LNP	- 0.230	-0.746
Member of conservation organisations	- 0.281	
Party composition	- 0.07	0.023
Gender	- 0.073	
Annual income	0.000002	0.000003

The probability of the WTP higher EF by the national tourists was mostly influenced by four variables (Table 4.24): their primary destination (by 35.3%), solitary visitors (by 2.3%) and revisiting tourists (by -74.6%). These results provide insights for park management to strategise fees and the selling of tour packages. Efforts should be made to ensure that the Park is the first destination to be visited. Management should also make deliberate efforts to ensure that every year a reasonable portion of the EFR is allocated to the development of park facilities and infrastructure. This would give a positive impression to tourists (Eagles, 1997).

Correlation results: for the DNNP

The correlation matrices for international, national and resident tourists showed that there was significant correlation between certain socio-economic variables. In each case, when strong correlation was observed the second variable was removed from the model. When two variables were weakly correlated, both of them were retained in the model. A variable that was correlated to more than two others was in itself removed from the model. Variables selected and used to run the biprobit model for international tourists were annual income, age education level, marital status, trip organisation, destination choice, and “frequent visitor”. With regard to national tourists, the same procedure was followed to select variables that were later used in the biprobit model: education level, annual income, trip organisation and destination choice. Variables retained for the biprobit model for resident tourists were: annual income, marital status, trip organisation, and “member of conservation organisations” (Table 4.25).

Table 4.25. Correlation (*) of independent variables for the tourists visiting the Dzanga-Ndoki National Park (S- variables selected for biprobit models).

	International tourists												**National tourists**												**Resident tourists**											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
1.Marital status	S												-												S											
2.Other destination		-												-												-										
3. Age	*		S												-												-									
4. Education level				S											*	S									*		*	-								
5. Trip organisation					S												S												-							
6. Destination choice						S												S									*		*	S						
7. Awareness of LNP as a part of TNS							-								*		*		-										*		-					
8. Frequent visitor							*	S					*			*	*	*		-												-				
9. Party composition		*							-												-												-			
10. Member to conservation organisation				*				*		-								*	*			-					*	*					S			
11. Gender						*					-					*							-				*			*				*	-	
12. Annual income											*	S	*									*		S			*								*	S

Biprobit model for the DNNP

Statistically significant ($p<0.05$) variables that determined the WTP higher entry fees by the international tourists were: age, trip organisation, "Frequent visitor to the DNNP" and annual income. The biprobit model obtained for the WTP an additional US$30 and US$60 was significant as the log-likelihood of 162.0 was higher than the theoretical Chi square of 23.7 ($df = 14$; $\alpha = 0.05$) (Table 4.26). Tourists that were less willing to pay the additional US$30 included young tourists, and tourists that self-organised their trips. Self-organised tourists have less flexibility with their money because they individually cover all charges (insurance, hiring of vehicles) and are sensitive to overspending. Overspending was also preventing young tourists from declaring their support for additional entry fees. Contrary to what was observed at the LNP, frequent visitors had positively appreciated the changes that occurred in the DNNP and were therefore willing to pay more. They could have assumed that previous EFR were properly used by the park authorities to improve the recreational attributes of the park. Annual income was also positively linked to the WTP the additional US$30 for the EF. This was in accordance to what was expected. In the model testing the WTP an additional US$60, the significant variables were similar but 'trip organisation' was excluded while 'marital status' was included. Married tourists, older tourists and tourists with a higher income were more willing to pay the US$60 higher EF. The model obtained for the national tourists was significant ($p<0.05$) as the log-likelihood of 112.6 was higher than the theoretical Chi square of 15.5 ($df = 8$; $\alpha = 0.05$) (Table 4.26). The national tourists visiting the Park alone tended to be more willing to pay the US$3 higher EF than the tourists who were organised by tour operators. This could be explained by the fact that when national tourists had paid a tour operator they were no longer expecting to pay an additional fee. This implies that the park may gain additional income if it advertises its operations to attract more solitary self-organised tourists than those organised by tour operators. No variable was significant in the model used to explain the additional US$6 (Table 4.26).

Table 4.26. Results of the biprobit models of willingness to pay (WTP) additional dollars (US$) as an entrance fee by foreign, resident and national tourists at the Dzanga-Ndoki National Park (β – coefficients, p – significance, Chi-square).

Independent variables	International tourists				National tourists				Resident tourists			
	intWTPUS$30		intWTPUS$60		natWTPUS$3		natWTPUS$6		resWTPUS$20		resWTPUS$40	
	Coef. (β)	P|	Coef. (β)	P	Coef. (β)	P|	Coef. (β)	P|	Coef. (β)	P	Coef. (β)	P|
Age	-0.971	0.001	-0.718	0.023								
Education level	-0.45	0.187	-0.247	0.412	0.325	0.26	-0.242	0.39				
Marital status	-0.379	0.255	-0.768	0.004					1.478	0.000	0.798	0.028
Member of conservation organisations									-1.098	0.03	-6.363	0.98
Trip organisation	-1.045	0.011	-0.048	0.886	0.857	0.017	0.244	0.462	-0.807	0.019	-1.214	0.001
Destination choice	0.364	0.324	-0.267	0.411	-0.384	0.26	-0.384	0.26				
Frequent visitor	1.157	0.025	1.075	0.009								
Annual income	0.000025	0.000	0.00001	0.041	-0.000006	0.277	-0.000006	0.277	0.00001	0.015	0.000002	0.701
Log-likelihood	162				112.6				98.3			
Prob > chi2	0.000				0.0132				0.000			

As for the resident tourists, the log-likelihood of the biprobit model was 98.3, far higher than the theoretical Chi square of 21.02 (df = 12; α = 0.05), meaning that coefficients were significantly different from zero and the model was significant at 5% (Table 4.26). Members of conservation organisations and self-organised tourists were less willing to pay the US$20 more for the EF. Tourists who were more willing to pay the US$20 higher entry fees included single resident tourists and the tourists with higher annual incomes. This could be explained by the fact that both groups of tourists can afford higher fees: while the single resident tourists usually come to a park accompanied by international tourists. Both groups come with higher budgets, in particular single female tourists as well as non-members of conservation organisations, were more likely to pay an additional US$20 EF to enter the park than the other tourists. However, when the proposed additional entry fees were increased to US$40, only the single tourists were prepared to pay more. Similarly, the self-organised tourists were less willing to pay than the tourists organised by tour operators. This could be explained by the fact that resident tourists already have a full knowledge of the pros and cons of different park systems.

Table 4.27 shows the influence of each of the significant variables on the probability of the WTP more for the international, national and resident tourists visiting the DNNP. Younger international tourists (less than 40 years old) decreased the probability of the WTP by 24% more compared to the older tourists. A similar impact was created by single tourists who decreased this probability by 28.3%. However, a probability of the WTP the additional EF was increased by the tourists revisiting the park (by 40.9%) and the higher income earners. The national tourists, who organise their own trips, increased the probability of the WTP a higher EF by 9.2%. As mentioned earlier park managers should be more sensitive to these facts when advertising their recreational facilities and to raise more awareness among prospective individual national tourists.

Table 4.27. Marginal effect of independent variables on tourists' willingness-to-pay to visit the Dzanga Ndoki National Park.

Independent variables	International	National	Resident
Age	-0.249		
Education level	-0.093	-0.091	
Marital status	-0.283		0.044
Trip organisation	-0.017	0.092	-0.133
Member of conservation organisation			-0.193
Destination choice	-0.099	-0.140	
Frequent visitor	0.409		
Annual income	0.000002	-0.000002	0.0000001

Being a resident tourist and a member of a conservation organisation decreased the probability of the WTP a higher EF by about 19.3%. Also this probability was decreased (by 13.4%) when the resident tourists organised their own trips as compared to those that allowed tour operators to organise their trips. Single resident tourists increased the probability of the WTP higher EF by 4.4%. A higher annual income of resident tourists also had a slight positive influence on the probability of them paying higher EF.

OPTIMUM ENTRANCE FEE REVENUE AND SELF-FINANCE FOR THE LNP AND THE DNNP

The efficiency of the forest recreational markets and financial management in the TNS Park involves:

- determination of the optimum EF;
- consumer surplus at current and potential fees;
- comparison of the current fee collection and management system with a potential one; and
- estimation of the number of years and tourists needed for the park to become self-financed.

Optimum entrance fees

As the tourists want to improve their satisfaction from visits to the parks, so to do park managers want to maximise their profits. For the poorly visited parks in the Congo Basin, the

costs of managing tourists' pressures on the environment may not be substantially increasing with increasing numbers of tourists (ART, 1998). This makes it possible to undermine possible extra costs in calculating maximum revenue associated with the optimum EF as visitation increases.

Revenues from the increasing EF could be considered as a tax paid by tourists to enter the park. Therefore, the optimum EFs for tourists in the LNP and the DNNP were calculated by using the tax maximisation technique of Arthur Laffer reported by Lecaillon and Pondaven (1998). Laffer stated that by increasing a tax rate, tax collectors can increase their revenue but only until a certain optimum tax rate is reached. After that optimum value, the revenue decreases because of tax evasions or a relocation of businesses (Lecaillon and Pondaven, 1998). The Laffer's curve, showing the optimum tax rate, was first introduced by Arthur B. Laffer as showing the relationship between the tax rates and tax revenues collected by governments (Lecaillon and Pondaven, 1998). Figure 4.8 shows an example of the Laffer's Curve, which suggests that as taxes increase from low levels, the corresponding tax revenues collected by the government also increase. It also shows that tax rates increasing after a certain point (R*) would cause people not to work as hard or not at all, thereby reducing tax revenue. Eventually, if tax rates reached 100% (the far right of the curve), then all people would choose not to work because everything they earned would go to the government. It would be better to set taxes at a point R*, at which maximum taxes can be collected while people would continue to work hard.

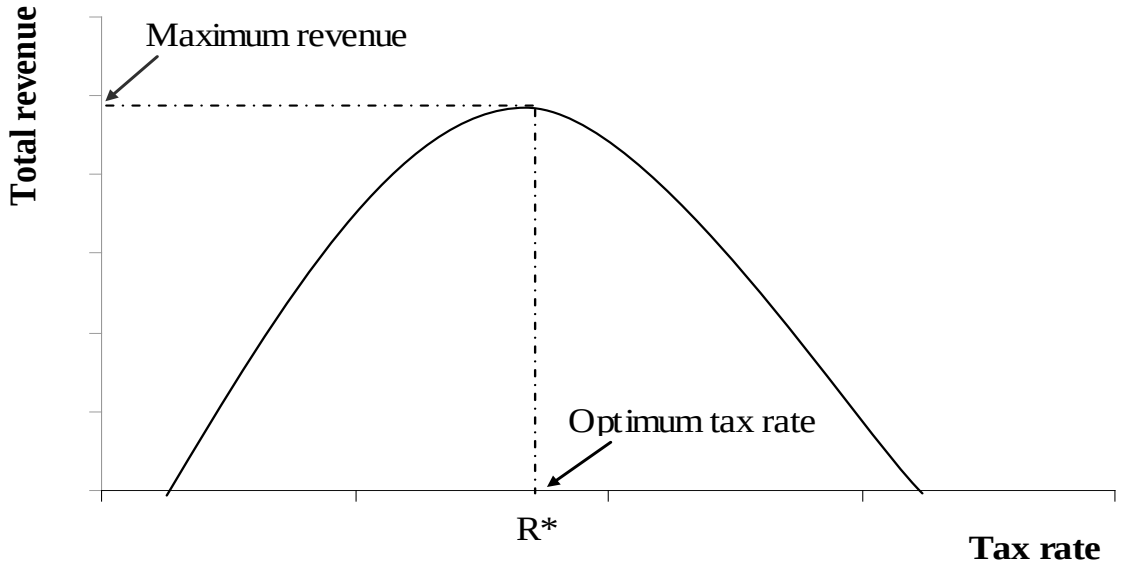

Figure 4.8. "Laffer's Curve" showing the variation of tax revenue with changes in tax rates.

The same theory was applied to the EF in this study. Similarly to the tax case, when a park EF increases its revenue it can only do so up to a certain optimum value. Thereafter, any further increase of the EF will result in decreasing revenue because tourists will become discouraged or will look for substitute parks. With the response of each category of tourists concerning their WTP amount, Laffer's Curves (total park EFR against EF) for the LNP and the DNNP parks were drawn and the optimum EF determined. The EF corresponding to the maximum revenue of the park ($EFR=EF_i*N_i$) was considered as the optimum entrance fee (EF*). Therefore, from the Laffer curve and for each category of tourists, the EF corresponding to the maximum EFR was considered as the optimum fee. The number of tourists (N_i) willing to pay each EF was determined from their 'willingness to pay' responses.

$$N_i = \sum_{j}^{N} A^i{}_j \qquad \text{Where,} \qquad A^i{}_j = \begin{cases} 1 & \text{if the } WTP^i{}_j \geq EF_i \\ 0 & \text{if the } WTP^i{}_j < EF_i \end{cases}$$

Where:

i = type of tourist (International, national or resident)

j = a given tourist

$A^i{}_j$ = dummy variable allocated to the j^{th} tourist of i^{th} type

N_i = the number of tourists willing to pay the entrance fee EF_i

N = total number of tourists

$WTP^i{}_j$ = Willingness to pay of the j^{th} tourist of i^{th} type

The park EF revenue at the peak of each curve is:

$$EFR = EF_i \cdot N_i$$

Cartesian curves were plotted with the EFR (y-axis) and the entrance fee (x-axis) from which the optimum entrance fee (EF*) was determined for each category of tourists. Schultz et al. (1998) calls the curves logistic WTP curves that can also be used to predict changes in the WTP (and number of visitors) associated with proposed changes in the park EF.

This is in accordance with Laffer who stated that there is no equation that permits the estimation of the optimum tax but that it could be done only by using graphical observations (Lecaillon and Pondaven, 1998). For each category of tourists and parks, the results are shown in Figures 4.9-13.

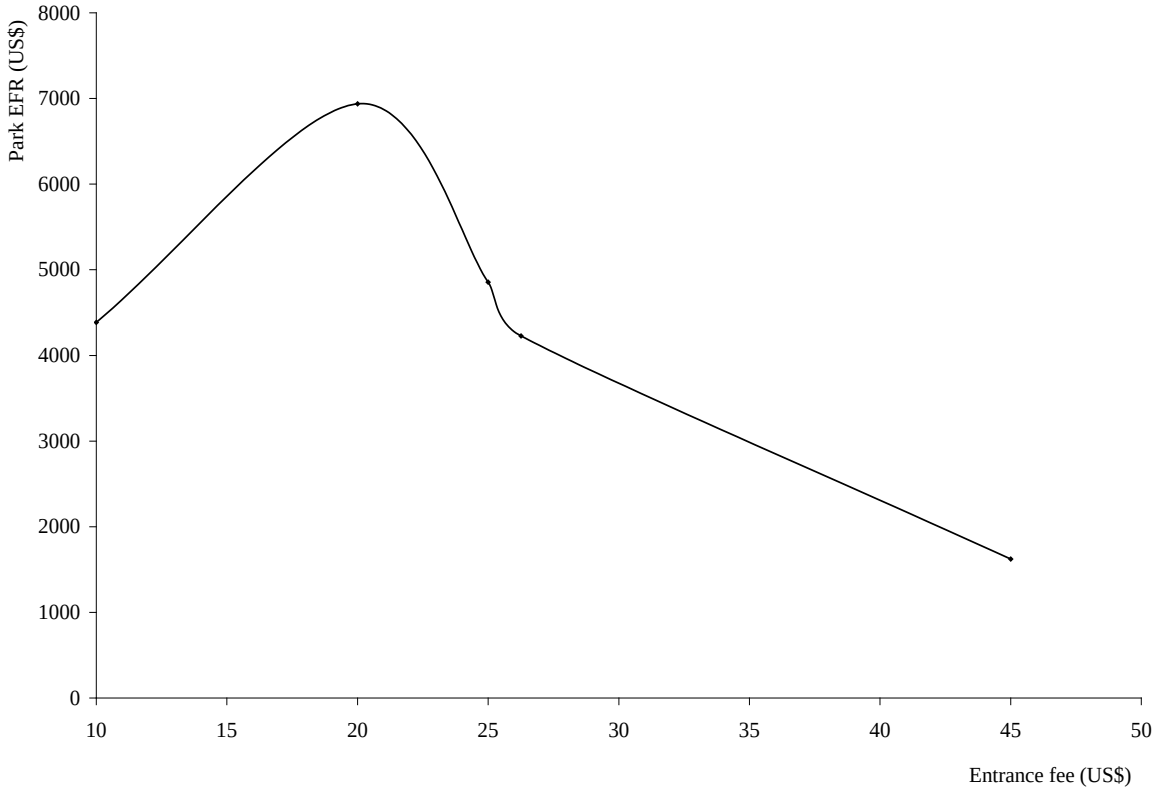

Figure 4.9. Optimum park entrance fee for international tourists in the Lobeke National Park

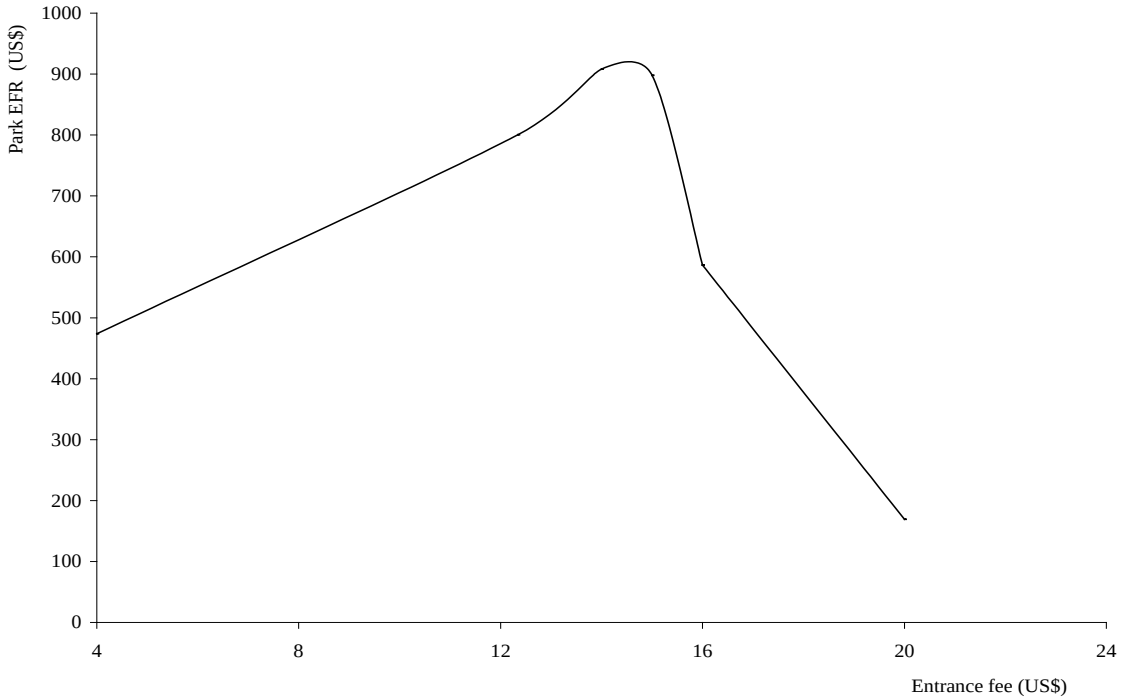

Figure 4.10. Optimum park entrance fee for national tourists in the Lobeke National Park

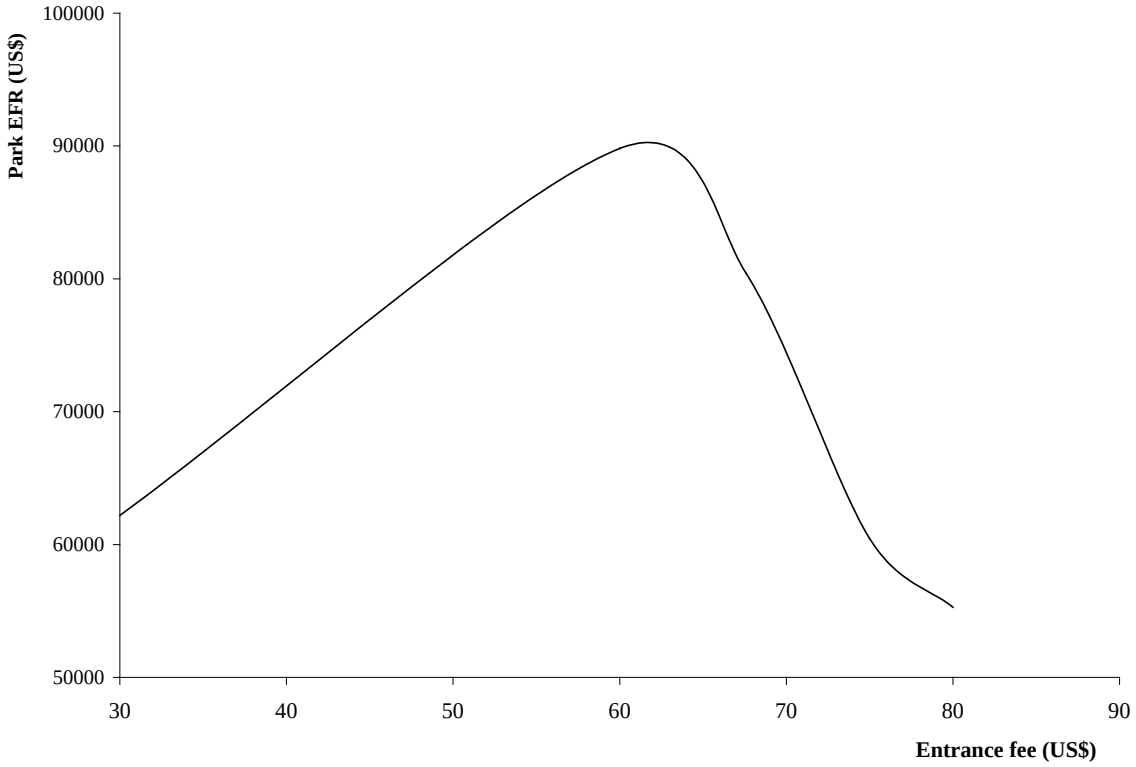

Figure 4.11. Optimum entrance fee of international tourists in the Dzanga-Ndoki National Park

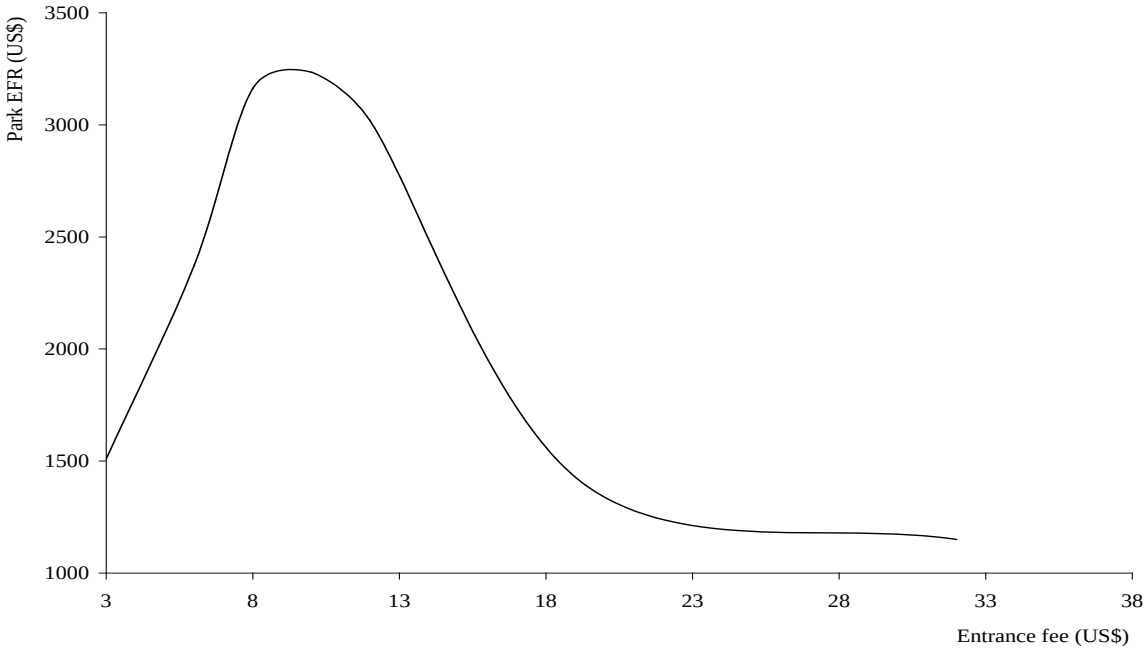

Figure 4.12. Optimum park entrance fee for national tourists at Dzanga-Ndoki National Park

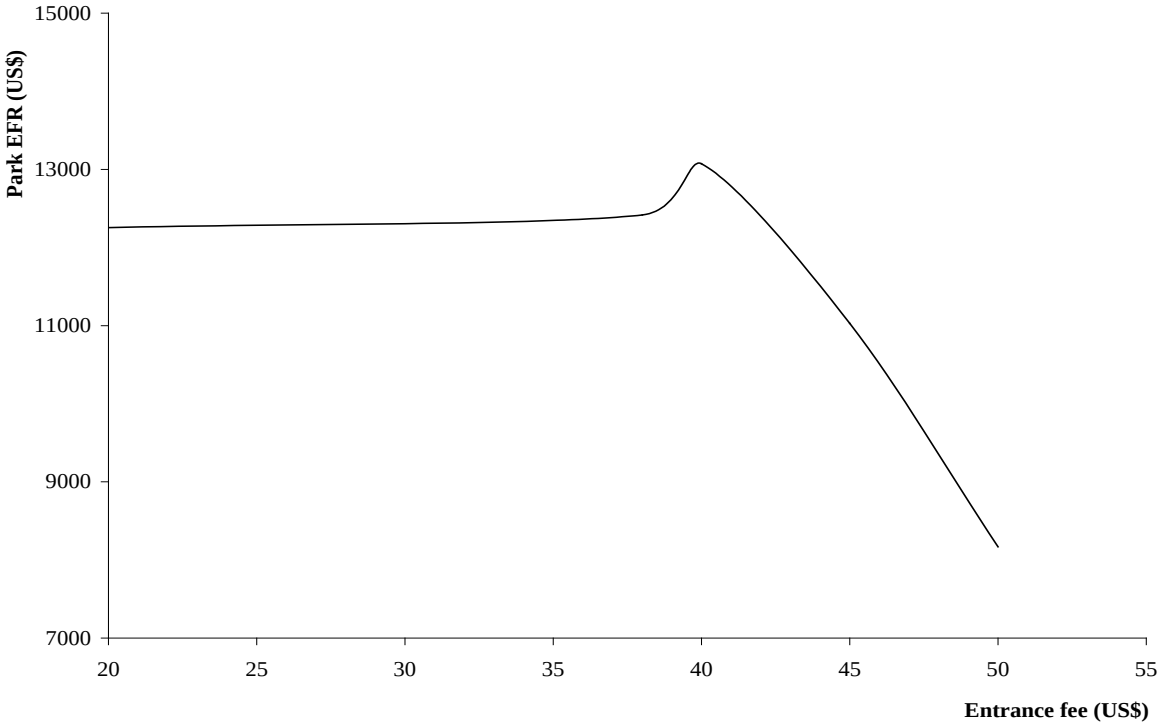

Figure 4.13. Optimum park entrance fee for resident tourists in the Dzanga-Ndoki National Park.

From the preceding curves, the optimum entrance fees to the LNP for international and national tourists were found to be US$ 20 and US$ 14, respectively. As for international, national and resident visitors to the DNNP, the corresponding amounts were US$ 60, US$ 10 and US$ 40, respectively.

Adjusted consumer surplus

If the EF is considered as having been increased up to its optimum, then the adjusted consumer surplus (CS**) is the difference between the optimum EF and the current EF. This consumer surplus is a little higher than the normal consumer surplus (CS*) estimated from the CVM analysis. The management of the LNP would generate higher revenues by getting an extra US$ 10 per international and national tourist per day if the park infrastructure and facilities were improved to meet the expectations of the tourists. In the same vein, the DNNP would stand to benefit a daily extra of US$ 30, US$ 7 and US$ 20 per international, national and resident tourist respectively (Table 4.28). For this to be realised, some level of investments, transparent fee collection and management systems as well as enabling policy changes within the region may be required.

Table 4.28. Optimum entrance fee (EF) and consumer surplus (CS) for tourists visiting the Lobeke and Dzanga-Ndoki National Parks (CVM – contingent valuation method, WTP – willingness-to-pay).

Fees and consumer surplus	Lobeke National Park		Dzanga-Ndoki National Park		
	International	National	International	National	Resident
Current fee (US$)	10	4	30	3	20
Mean WTP CVM (US$)	18.65	9.95	53.6	4.9	29.3
Optimum EF (US$)	20	14	60	10	40
Consumer surplus (CS*)	8.65	5.95	23.6	1.9	9.3
Consumer surplus (CS**)	10	10	30	7	20

* Mean WTP – Current fee
** Optimum entrance fee – Current fee

This study is very relevant for the TNS in particular and the other parks in the Congo Basin at large. The results stress for challenging actions which are achievable as shown in other regions of the world. For example Brown (2001) reported that the WTP studies conducted in 1996 in Costa Rican protected areas showed that the EF between US$1 and US$6 were not the optimal fees for revenue generation. Both, nationals and foreigners were willing to pay double for entering the parks. Those studies gave the opportunity to use more appropriate fee setting in Costa Rican protected areas that led to greater revenues and the rendering of better services (Brown, 2001).

Comparison between the current and potential EFR

It was considered important not only to look at how much more revenue can be generated but also how the current revenue is collected and managed as it is believed that an efficient revenue management is key to park development. Therefore, this study examined the current fee collection and reporting systems in the LNP and the DNNP for the identification of possible loopholes and making propositions on how to block or eliminate them. To achieve this, two objectives were pursued:

1. Estimating total EFR at the current EF and potential revenue at the mean and optimum EF.
2. Measurement of possible financial losses due to the lack of proper fee collection and management.

Considering the total number of tourists in 2006 and the mean duration of their visit, it was found that in each park there was a difference between the park EFR declared in the account and the estimated current EFR. In the LNP, the amount of the EFR recorded in 2002 was 600 000 CFAF (US$1280) (MINEF, 2004); in 2004-2006, no records were available and estimates were made based on an annual revenue increase of 1.4%, resulting in an EFR of 640 000 CFAF for the year 2006. In the DNNP, available records included the number of tourists and their distribution by categories, and revenue sources. The EFR was 10 569 000 CFAF (US$ 21138) in 2006. This amount was collected from 1042 tourists, (678 international, 188 resident and 176 national tourists).

By using the estimates from this study on the mean duration (days) spent in the park by each category of tourist, some disparities were observed between the recorded revenues and the

expected ones. For example, by assuming that each tourist spent only one day in the DNNP, instead of the average- over 3 day-visit, the supposed revenue was 12 217 450 CFAF (US$24 435) or 15.6% more than the reported amount by the park officials. As for the LNP, if each tourist spent only one day instead of the approximate 2.0 days inside the park, the supposed park EFR was US$ 2622 or 105% more than the officially reported EFR for 2006. Considering the estimated mean duration (days) spent in each park by tourists, the EFR for the LNP became 2 596 800 CFAF (US$ 5193.6) in LNP and 37 024 771.4 CFAF (US$ 74 049.5) in DNNP (Table 4.29).

Table 4.29. The estimation of the current park Entrance Fee Revenues (EFR) for one day and the average visit stay by various categories of tourists in the Lobeke (LNP) and Dzanga-Ndoki National (DNNP) Parks in 2006 (EF- entrance fee per person and day, CFAF- Central African Monetary Community Francs).

Visit place & duration	Category of tourist	EF (US$)	Days inside the park (days)	Number of tourists	EFR (US$)	EFR (CFAF)
DNNP 1 day	International	30	1	678	20 350	10 175 130
	Resident	3	1	188	563	281 340
	National	20	1	176	3 522	1 760 980
	Total DNNP			1042	**24 435**	**12 217450**
LNP 1 day	International	10	1	237	2 370	1 185 000
	National	4	1	63	252	126 000
	Total LNP		1	300	**2 622**	**1 311 000**
DNNP mean days	International	30	3.1	678	62150	31 075 000
	Resident	3	3.3	188	1 842.4	921 200
	National	20	2.9	176	10 057.1	502 8571.4
	Total DNNP			1042	**74 049.5**	**3 702 4771.4**
LNP mean days	International	10	2	237	4 740	2 370 000
	National	4	1.8	63	453.6	226 800
	Total LNP			300	**5 193.6**	**2 596 800**

Giving these estimates their credibility, the supposed EFR for the DNNP should be 2.5 times more than the current amount recorded. As for the LNP, the supposed EFR is 3.05 times more than the recorded amount. It remains uncertain if the unaccounted amount of money results

from a poor recording of finances of the parks or a corrupt fee collection system. In trying to justify the gap between the field estimation and the park records, it became glaring that there were some poor collections of the EF, errors in the reporting and mismanagement of the EFR. Specifically possible reasons for the disparity between the official records and the estimates made in this study could be associated with poor collection of the EF caused by the fact that friends of the park staff and government functionaries entered the park without paying. This was reported by the employees of the DNNP. In other cases payments went directly into individual pockets or fees were not collected at all with some tourists entering the park without paying. In conclusion it can be said that the management of the LNP and the DNNP had serious problems with their financial operations, which at the current EF and inefficient accounting make them to loose over two-thirds (75.3% and 71.4% for LNP and DNNP respectively) of their potential EFR.

Gap between the current EFR and the optimum EFR

Assuming that an efficient collection system and management are put in place in each of the parks, it would be possible to realise a reasonable proportion of the park budgets from the EFR. With an efficient fee collection system in place and visits prolonged by the 300 tourists as estimated in this study, an additional US$ 3578.3 can be earned by the management of the LNP every year. If the consumer surplus at the optimum EF is absorbed by properly managing the park, an additional US$ 2987.2 could be realised. This implies that with efficient EF collection, management and pricing, the LNP can realise an additional annual EFR of US$ 6565.5 (Table 4.30).

In the DNNP, an additional US$ 54 806.7 could be realised per annum if an efficient fee collection system was put in place. An additional US$ 30 178.04 could be realised if the recreational facilities and infrastructure of the park are improved to attract tourists willing to pay the optimum EF. In total, at the current visitation rate, the DNNP would be able to make an additional US$ 84 984.8 per annum by following efficient fee collection, management and pricing systems (Table 4.30).

Table 4.30. Overall gap in entrance fee revenues (EFR) in the Lobeke National Park (LNP) and the Dzanga-Ndoki National Park (DNNP)

EFR	LNP (US$)		DNNP (US$)		
	International tourists	National tourists	International tourists	National tourists	Resident tourists
Current park EFR**	4384.5	473.8	62181.4	1509.41	12253.9
Optimum park EFR	6937.5	908	89817.5	3234.45	13070.8
Declared Park EFR	1280		21138		
CS	2987.2		30178.04		
Irregularity	3578.3		54806.7		
Overall gap (Irregularity+ CS)	6565.5		84984.8		

** Assuming regular payments

Self-financing activities from the EFR at the LNP and the DNNP

No coherent study has been carried out in the Congo Basin to define if the national parks can be self-financed by revenues from the EF. Therefore the objective here is to estimate the number of tourists and the number of years required for the parks to be auto-financed by their EFR. Two levels of finance were considered, firstly, financing only the recurrent costs of the parks and secondly, financing the total parks budgets.

Estimations of self-financing are made at the current status of the parks as well as for the parks with improved park facilities and infrastructure that can stimulate a higher level of visitation by tourists. In Eastern and Southern Africa an average budget in protected areas is estimated at US$257/km^2. In the Congo Basin, the amount for proper management was estimated at US$250/km^2 (MINEF, 2004). This latter amount was used to estimate the total budget for the DNNP at US$1 142 500 or US$ 640 000 for the LNP (MINEF, 2004).

The recurrent cost of a park is the amount of money used annually to cover operating expenses. For the two parks, recurrent costs were estimated by using the following equation developed by the African Resources Trust (ART, 1998).

$Cr = US\$50 \cdot \left(1 + \frac{2}{A} + \frac{3}{\sqrt{A}}\right)$ Where, Cr represents the recurrent costs and A is the total park area in km^2.

The investment cost is the difference between the total budget and the recurrent costs. This money is usually used for the renewal and increase of park assets. Based on the above information, the recurrent costs and the total annual budget for the LNP and the DNNP were estimated as shown in Table 4.31.

Table 4.31. Recurrent costs and total budgets of the Lobeke and Dzanga-Ndoki National Parks.

Variables	Lobeke National Park	Dzanga-Ndoki National Park
Area (km^2)	2180	4570
ART estimate C_r* (US$)	430 472	649 163
Investment (US$)	209 528	493 337
Total budget** (US$)	640 000	1 142 500

*(ART, 1998)
** (MINEF, 2004)

Number of tourists and time required for self-financing

The estimation of the number of years (N*) needed for the park to arrive at the balanced budget was calculated by using the following formulae:

Let N be the total number of tourists;
i is the type of tourist: 1 = international, 2 = national; 3 = resident;
N_i is the number of i type of tourists;
α_i is the proportion of i type of tourists;

$$N_i = \alpha_i \cdot N \qquad (11)$$

The contribution of a tourist to park EFR is given by:

$$c_i = EF_i \cdot d_i \qquad (12)$$

Where:

$\begin{cases} d_i \text{ is the mean duration inside the park by i type of tourists} \\ EF_i \text{ is the entrance fee paid by i type of tourists} \end{cases}$

The aggregate contribution (total entrance fee revenue) of all the tourists is given by the following formula:

$$C = \sum_{i=1}^{3} N_i \cdot c_i \qquad (13)$$

by substituting N_i and c_i with eq. 1 and eq. 2 gives:

$$= \sum_{i=1}^{3} \alpha_i \cdot N \cdot EF_i \cdot d_i$$

$$= N \cdot \sum_{i=1}^{3} \alpha_i \cdot EF_i \cdot d_i \qquad (14)$$

Let N* be the total number of tourists needed for the EFR to be equal to the park budget or recurrent cost (B). Then, when the contribution C is equal to B then N is equal to N*.

$$N^* = \frac{B}{\sum_{i=1}^{3} \alpha_i \cdot d_i \cdot EF_i} \qquad (15)$$

This number of tourists can be reached after a number of years (t*) and at a certain growth rate (r). The t* was derived from the following formula:

$$N^* = N_0 \cdot (1+r)^{t^*} \qquad (16)$$

Taking the Logarithm of both sides, we have:

$$t^* = \frac{\mathrm{Ln}\left(\frac{N^*}{N_0}\right)}{\mathrm{Ln}(1+r)} \qquad (17)$$

By substituting equation (15) into (17), the estimated number of years (t*) needed for the park to be auto-financed by its EFR is obtained:

$$t^* = \frac{\mathrm{Ln}\left(\dfrac{B}{\dfrac{\sum \alpha_i \cdot d_i \cdot EF_i}{\mathrm{N_o}}}\right)}{\mathrm{Ln}(1+\mathrm{r})} \qquad (18)$$

By applying formulae (15) and (18), it is possible to estimate the number of tourists and the time required for the LNP and DNNP park systems to become auto-financed by the EFR. To achieve this, eight scenarios, each for three possible growth rates of tourists in each park, were explored at two levels of the EFR and two possible self-financing arrangements. This gave a combination of 24 scenarios.

The following annual growth rates in visitor numbers were considered in this study:

- current growth rate of 1.44% as estimated from the park data
- General growth rate of 5% due to improved park facilities to match the 5% annual growth rate in global tourism (Yunis, 2004);
- African growth rate of 10%, due to improved park facilities and publicity to match the 10% annual increase of tourism growth in Africa (WTO, 2005).

The two entrance fee levels included:

- current entrance fee with existing structures for the national, resident and international tourists;
- optimum entrance fee as elicited from the WTP estimates in this study.

Another important variable considered was the duration (days) of the visits to be either:

- current mean days as the mean number of days spent by tourists surveyed in this study or
- potential mean days, including the additional days that tourists would be willing to stay if park facilities and infrastructure were improved.

Self-financing arrangements considered, included the possibility of the EFR covering:

- only the recurrent costs;
- the total park budgets (recurrent and investment costs).

Based on the above considerations eight financial arrangements were used to calculate the number of years and the corresponding number of tourists required to meet one or all of the self-financing scenarios. These scenarios were:

i). EFR covering recurrent costs at the current fee and mean days in the park;
ii). EFR covering recurrent costs at the current fee and potential days;
iii). EFR covering recurrent costs at optimum fee and current mean days in the park;
iv). EFR covering recurrent costs at optimum fee and potential mean days;
v). EFR covering total park budget at current fee and mean days in the park;
vi). EFR covering total park budget at current fee and potential mean days in the park;
vii). EFR covering total park budget at optimum fee and current mean days in the park;
viii). EFR covering total park budget (optimum fee and potential mean days in the park.

The results are provided in Table 4.32.

Table 4.32. Scenarios for auto-financing the Lobeke and Dzanga-Ndoki National Parks from entrance fee revenue (EFR)

Scenarios			Lobeke National Park				Dzanga-Ndoki National Park				
Growth rate (%)	Costs	Fees and days	International Tourists	National tourists	Total number of tourists	No. of years	International tourists	National tourists	Resident tourists	Total number of tourists	No. of years
1.44	Recurrent cost	I	21000	5582	26582	314	5798	1505	1603	8907	150
		II	10155	2699	12854	263	3995	1037	1105	6137	124
		III	9784	2601	12385	260	2861	743	791	4395	101
		IV	4750	1263	6013	210	1967	511	544	3022	74
	Total budget	V	31221	8299	39520	341	10205	2649	2822	15676	190
		VI	15097	4013	19111	291	7031	1825	1944	10801	164
		VII	14547	3867	18413	288	5036	1307	1392	7735	140
		VIII	7062	1877	8940	237	3462	899	957	5318	114
5	Recurrent cost	I	21000	5582	26582	92	5798	1505	1603	8907	44
		II	10155	2699	12854	77	3995	1037	1105	6137	36
		III	9784	2601	12385	76	2861	743	791	4395	29
		IV	4750	1263	6013	61	1967	511	544	3022	22
	Total budget	V	31221	8299	39520	100	10205	2649	2822	15676	56
		VI	15097	4013	19111	85	7031	1825	1944	10801	48
		VII	14547	3867	18413	84	5036	1307	1392	7735	41
		VIII	7062	1877	8940	70	3462	899	957	5318	33
10	Recurrent cost	I	21000	5582	26582	47	5798	1505	1603	8907	23
		II	10155	2699	12854	39	3995	1037	1105	6137	19
		III	9784	2601	12385	39	2861	743	791	4395	15
		IV	4750	1263	6013	31	1967	511	544	3022	11
	Total budget	V	31221	8299	39520	51	10205	2649	2822	15676	28
		VI	15097	4013	19111	44	7031	1825	1944	10801	25
		VII	14547	3867	18413	43	5036	1307	1392	7735	21
		VIII	7062	1877	8940	36	3462	899	957	5318	17

The results presented in Table 4.32 show that irrespective of the additional number of days and the increase in the EF to the optimum levels, it would take over a century for the parks to realise their recurrent costs or total park budgets from the EFR if no investments are made to stimulate an annual increase in tourists numbers by 5- to 10%. This confirms the earlier pessimistic assertions of Wilkie and Carpenter (1999a) and Blom (2000; 2004) that self-finance of the parks from tourism in the Congo Basin was a distant dream under the contemporary socio-economic constraints. The best scenarios for the park system would be to invest in developing park facilities and infrastructure that would stimulate a greater interest among tourists that could pay the optimum EF and stay longer in the park. By following better planning and investments in the DNNP, the recurrent costs and budget could be self financed in 11 and 17 years, respectively, or in 31 years for the recurrent costs and 36 years for the budget in the LNP.

In the LNP, it will require an annual growth rate of 10% of the number of tourists paying the optimum EF (US$ 20 for the internationals and US$ 14 for the nationals) and their visits extended to the potential mean duration of 5.2 days for the international tourists and 5.3 days for the national tourists to cover only the recurrent costs from the EFR in 31 years,. This translates to a total of 6013 (4750 international and 1263 national) tourists. To self-fund the entire park budget in 36 years, will require 8940 (7062 international and 1877 national) tourists.

As for the DNNP, 11 years would be required to cover recurrent costs from the EFR following an annual growth rate in visitation of 10%, with tourists paying the optimum EF of US$ 60, US$ 10 and US$ 40 for the international, national and resident tourists, respectively, and extending their staying up to the potential duration of 6.5 days, 6.0 days and 6.6 days for the international, national and resident tourists, respectively. To achieve this, 3022 tourists are required (1967 international, 511 national and 544 resident tourists). It will take a minimum of 17 years with a visitation growth rate of 10%, and a total of 5318 tourists (3462 international, 899 national and 957 resident tourists) to cover the entire park budget from the EFR. Despite the fact that these scenarios may look too optimistic, they are achievable in the TNS park system. Such optimism is rooted on three principles:

Firstly, it is documented that if park conditions and facilities are improved, the number of tourists will increase more rapidly than hitherto (Eagles *et al.*, 2002). In recent years, this has been experienced in Costa Rica, Belize and Ghana following greater political commitments and investments in developing ecotourism (Eagles *et al.*, 2002; USAID 2001; Schultz *et al*., 1998). For example, an investment of US$ 10 million in ecotourism development in and around the Kakum National Park in Ghana increased visitation from 700 in 1990 to 80 000 in 1999 (Eagles *et al.*, 2002). According to Eagles *et al.* (2002), the success of the Kakum Project was associated with four factors: a well-conceived government initiative, the United State Agency for International Development (USAID) provided significant and long-term financial support, Conservation International (CI) provided consistent and high-quality technical planning and direction and the country had a stable political environment and expanding economy during the project period. Another lesson was learnt from Madagascar (where tourism is the country's second largest foreign exchange earner) is that targeted investments in tourism infrastructure and facilities lead to a more than equivalent increase in revenues (Vieta, 1999). Kenya and South Africa have invested heavily in ecotourism and today they have the highest level of tourist arrivals and receipts in Africa (Vieta, 1999). Outside Africa, many success stories exist too. In the Galapagos National Park in Ecuador, there were fewer than 5000 visitors in 1970 but by 1999 the number of tourists had increased to over 66 000, the increase in tourism was concomitant with the increase in infrastructure (The Nature Conservancy, 2001). In Costa Rica, park EF was US$1 for both, nationals and foreigners, generating up to US$1 million annually in the 1980s. In the 1990s, park funding from international sources was curbed and the park agency raised the park EF to US$15 (with advanced booking fees of US$10 and US$ 5.25 for bulk booking and travel agents, respectively). Although visitation decreased, revenues in the first nine months of 1995 were four times the amount earned in the whole of 1994 (Brown, 2001).

Secondly, tourism associated with protected areas is a fast growing segment of the economies of many countries with a major comparative advantage for developing countries in terms of cultural heritage, natural wildlife, climate and attractive unspoiled remote rural areas (Yunis, 2004). In West and Central Africa, Ghana seems to lead in the understanding of tourism demands and markets. With a greater investment in tourism facilities and infrastructure, Ghana

is enjoying an overall annual tourism growth rate of 12%, resulting in tourism being the third largest foreign exchange earner for the country, after gold and cocoa (USAID, 2001). Before the Rwandan emergency in the 1980s, tourism in that country was providing over US$ 10 million in annual revenue, mainly associated with mountain gorilla viewing (Brown, 1998).

Thirdly, ecotourism accounted for 20% of the total international tourism and this percentage is growing. The number of protected areas is also increasing in the Congo Basin, therefore so too could the revenue from ecotourism (Brown, 1998). According to the CBFP (2006), tourism development within the protected areas should be supported because not only does it contribute to the national economies, but it can also improve the perception on these protected areas and attenuate certain conflicts with neighbouring populations. UNEP (2006) content that ecotourism can serve as a powerful incentive to protect natural resources.

CONCLUSIONS AND RECOMMENDATIONS

Tourism and especially ecotourism is a unique way of natural resource utilization which integrates the three pillars of sustainability: biological, economic and social, if properly structured and implemented. On the economic side, protected areas require investments for development and conservation. The over-arching question is: where would the money come from to fill the investment gaps? According to Sayer et al. (2004), the protected areas in the Congo Basin are almost entirely dependent on international funding. While such funding is generally not sustainable, national capacities to cover financial deficits are, not only limited, but also uncertain (Wilkie et al., 2001). Ecotourism has been observed to bring appreciable economic resources that benefit park management systems in many developing countries, including the examples of Costa Rica, Kenya, South Africa, Belize and Ghana. These countries have succeeded in promoting ecotourism in their park systems through professionally competent national park agencies.

An optimistic scenario for protected areas in the Congo Basin suggests that in order to circumvent funding and management difficulties, innovative strategies need to be developed for more sustainable outcomes. This study evaluated a willingness-to-pay higher entrance fees by tourists and their willingness to stay longer in two protected areas in the Congo Basin, the

Lobeke National Park and the Dzanga-Ndoki National Park. A vivid description of the socio-economic characteristics of the tourists, their trip characteristics, preferences, pros and cons of recreational experiences and suggestions for future improvements were analyzed. The past and present situations of the parks were elicited from the perceptions of the re-visiting tourists and the overall mobility of the tourists within the region and beyond was investigated. The study clarified how the visitation fees paid by tourists to the parks in the region, were related to the operational and total costs of managing such areas, and how closely the envisaged entry fee increases might agree with the tourists' willingness-to-pay. A double-bounded dichotomous choice contingent valuation method was used to estimate the willingness-to-pay for improved recreational services in the parks. Mean and optimum entrance fees were estimated and the consumer surplus for each category of the tourists was calculated. A synthesis of the differences between the current and potential park revenue was provided with an overall emphasis on fee collection and management shortcomings.

The high expectations of ecotourism to meet the social needs of local people through poverty reduction and the conservation goal of sustaining biodiversity are achievable in the Congo Basin. This is rooted on well documented evidence in other parks of the world, the high recreational potentials of the region, the rapid expansion of ecotourism in the global tourism market, the increasing number of protected areas in the region, and the need to promote conservation and development in protected areas.

Based on the above understanding, the establishment of national park management agencies is recommended in each country of the Congo Basin. The park agencies would serve as a foundation for good financial management systems because such agencies are usually manned by competent staff. The roles of the proposed financial management systems would entail proper fee collection, park management and pricing. The benefits of efficient fee setting, collection and management systems for all protected areas in the Congo Basin could be surprising in revealing the self-finance of park activities. This study ignored all other sources of park revenue (lodging, donations, restaurants, shops) but it was believed that the existence of the competent park agencies would maximise revenue generation from such sources.

REFERENCES

Adamowicz W., Boxall P., Williams M. and Louviere J. 1998. Stated Preference approaches for measuring passive use values: Choice Experiments and Contingent Valuation. *American Journal of Agricultural Economics* 80:64-75.

Adamowicz W.L., Swait J., Boxall P.C., Louviere J. and Williams M. 1997. Perceptions versus objective measures of environmental quality in combined revealed and stated preference models of environmental valuation. *Journal of Environmental Economics and Management* 32: 65-84.

Adamowicz W, Louviere J and Williams M. 1994. Combining stated and revealed preference methods for valuing environmental amenities *Journal of Environmental Economics and Management* 26: 271-292.

Amigues J.P., Boulatoff C., Desaigues B., Gauthier C. and Keith J.E. 2002. The benefits and costs of riparian analysis habitat preservation: a willingness to accept/willingness to pay contingent valuation approach. *Ecological economics* 43 (9): 17-31.

ART (African Resources Trust). 1998. Costs of conserving protected areas in Southern Africa. African Resources Trust. Harare. Zimbabwe. Fact sheet 6:1-2.

Batastini J., Eaton C. and Dusenberry D. 2002. Ecotourism as an Economic Development Strategy Economic Growth Promotion Program. http://www2.montana.edu/scapalbo/presentation3.ppt
Last visited May 2007

Benitez B.S. 2001. Visitor use fees and concession systems in protected areas: Galapagos National Park Case Study. Ecotourism program Technical Report Series Number 3. The Nature Conservancy. www.conserveonline.org/2001/06/s/BenitezMayedit;internal&action=cs.plain.action.
Last visited May 2007

Binkley C.S. and Mendelsohn R.O. 1987. Recreation User fees, II. An economic analysis. The *Journal of Forestry* 85(5):31-35.

Blom A. 2004. An estimate of the costs of an effective system of protected areas in the Niger Delta – Congo Basin Forest region. *Biodiversity and Conservation* 13: 2661-2678.

Blom A. 2001. Ecological and economic impacts of gorilla-based tourism in Dzanga-Sangha, Central African Republic. PhD Thesis. Department of Environmental Sciences, University of Wageningen, Wageningen, Netherlands. ISNN: 0926-9495. pp 142-156.

Blom A. 2000. The monetary impact of tourism on protected area management and the local economy in Dzanga-Sangha (Central African Republic). *Journal of Sustainable Tourism* 8:175-189.

Boxall P.C and Beckley T. 2000. An introduction to approaches and issues for measuring non-market values in developing countries. Campbell B.M and Luckert M.K (eds.): Uncovering the hidden harvest. Valuation methods for woodland and forest resources. PP. 103-40.

Brown C.R. 2001. Visitor Use fees in protected areas: Synthesis of the North American, Costa Rican and Belizean Experience. The Nature Conservancy Report Series Number 2. www.conserveonline.org/2001/06/s/CORYFNL;internal&action=cs.plain.action. Last visited 11/10/2006.

Brown D. 1998. Participatory biodiversity conservation: rethinking the strategy in the low tourist potential areas of tropical Africa. Natural Resource Perspective, number 33. Overseas Development Institute. ISSN: 1356-9228. 19pp.

CBFP (Congo Basin Forest Partnership). 2006. The Forests of the Congo Basin. State of the forest. COMIFAC. 256 pp.

Clairin R. and Brion P. 1997. Manuel de sondage. Applications aux pays en voie de développement. Paris, 2e edition. Centre Français sur la population et le développement. 108pp. ISBN: 2-87762-109-X.

De Lopez T.T., Vibol K., Proeung S., Dareth P., Thea S., Sarina C., Song S., Chantha V., Vandy N., Bunly L. and Sinoeum C. 2001. Policy options for Cambodia's Ream National Park: A stakeholder and economic analysis. www.eepsea.org/publications/research1/Thanak-fultxt.doc. Last visited 10/12/06.

Desaigues B. and Point P. 1993. Economie du patrimoine naturel, la valorisation des benefices de protection de l'environnement. Economica. Paris. ISBN 2-7172-25150. 317pp.

Eagles P.F.J. 1997. International ecotourism management: Using Australia and Africa as case studies. Paper prepared for the IUCN World Commission on Protected Areas, Protected

areas in the 21st Century: From Islands to Networks. Albany Australia. 23-29 November. 30 pp.

Eagles P.F.J., McCool S. F. and Haynes C.D. 2002. Financial aspects of tourism in protected areas. In: Sustainable Tourism in Protected Areas: Guidelines for Planning and Management. A. Phillips (Ed.). PP.119-142. htpp://159.189.176.141/xml/BestPractices/TBP-3.pdf

Eagles P.F.J., Mclean D. and Stabler M.J. 2000. Estimating the tourism volume and value in parks and protected areas in Canada and the USA. *The George Wright Forum.* 17(3): 62-82. www.georgewright.org/173eagles.pdf

FAO. 2005. State of the World's Forests. FAO. Rome. ISBN: 92-5-105187-9. 153 pp.

Farber S. 1988. The value of coastal wetlands for recreation: An application of TCM and CVMs. Journal of Environmental Management 26: 299-312.

Hackett C.S. 2000. The recreational economic value of the Eastern Trinity Alps Wilderness. http://www.hunboldt.edu/~envecon_423/trinityAlps.html. Last visited 27/03/07.

Harvey J. 1991. Intermediate economics. Fifth edition. Macmillan.London. 605pp.

Hu Mingxing. 1998. Review on several methods for evaluating forest recreation. In: Forest environmental value accounting. Hou Yuanzhao, Zhang Ying and Li Yumin (Eds.) ITTO PD 39/98 Rev.2 (M). Pp. 103-111.

Israngkura A. 1998. Environmental valuation: an entrance fee system for national parks in Thailand. The School of Development Economics, National Institute of Development Administration (NIDA), Serethai Road, Bangkapi, Bangkok 10240, Thailand.

ITTO. 2001. A model project for cost analysis to achieve sustainable forest management. PD 31/95 Rev.3(F). Vol. I . Synthesis Report. Japan. Pp. 19-22.

Koyo J.P. 2004. Coordinating forest sector development in Central Africa. Unasylva 218(55): 34-38.

Lecaillon J. and Pondaven C. 1998. Analyse micro-economique, Theories economiques. Editions CUJAS. 332 pp.

Li Yide. 1998. Tropical forest resources of Guangdong Province. In: Tropical forest environmental resources of China. Hou Yuanzhao, Yu Ling and Wang Hogfeng (Eds.) IITO PD 39/98 Rev.2(M). pp. 70-92.

Lindberg K. 2001. Protected area visitor fees. Overview. 6 August Version. www.ecotourism.org/pdf/proareafees_country.pdf. Last visited 24/11/06.

Lindberg K. and Johnson R.L. 1994. Estimating demand for ecotourism sites in developing nations. *Trends* 31: 10-15.

Lindberg K. and Huber Jr R.M. 1998. Economic Issues in ecotourism Management. In: Lindberg K. and D.E. Hawkins (Eds.). Ecotourism: A Guide for Planners and Managers. Volume 1. The Ecotourism Society. Bennington, Vermont, USA. Pp. 87-117.

Loomis J.B. and Gonzalez-Caban A. 1997. How certain are visitors of their economic values of river recreation: An evaluation using Repeated Questioning and Revealed Preference. *Water Resources Research* 33:1187-1193.

Loomis J.B. and Ekstrand E. 1997. Economic benefits of a critical habitat for the Mexican Spotted Owl: A Scope Test using a Multiple-Bounded Contingent Valuation Survey. *Journal of Agricultural and Resource Economics* 22: 356-366.

Meng C. and Schmidt P. 1985. On the Cost of Partial Observability in Bivariate Probit Models. *International Economic Review* 26 (1): 71-86.

MINEF. 2004. A management plan for the Lobeke National Park and its peripheral zone. 2003-2007.

Mohd Azim M.I., Awang A.G. Noor, Mohd Shahwahid H.O., Salleh M., Abdul Rahim N. and Ahmad Fauzi P. 2002. Methods for valuation of NTFPs and environmental services. In N. Abdul Rahim (ed.) a model project for cost analysis to achieve sustainable Forest management. volume II, Main report. Pp 115-166.

Mukherjee C., White H and Wuyts M. 1998. Econometrics and data analysis for developing countries. Routledge London ISBN-0415-09400-3. 496 pp.

Pearce D.W. 1993. Economic valuation and the natural world. Earthscan Publication. London.

Pieter J.H. Van Beukering, Herman S. Caesar J. and Marco A. J. 2002. Economic valuation of the Leuser National Park on Sumatra, Indonesia. *Ecological Economics* 44 (2003): 43-62

Rogerson C.M. 2007. Reviewing Africa in the global tourism economy. *Development Southern Africa* 24 (3): 361-379.

Rutenberg H.J. 1992. Rainforest supply price: a tool for evaluating rainforest conservation expenditures. *Ecological Economics* 6: 57-78.

Sayer J.A. Ndikumagenge C. Campbell B. and Usongo L. 2004. Wildlife, loggers and livelihoods in the Congo Basin. Maginis and J.A. Sayer (eds.): Forests in landscapes. Earthscan. PP 115-127.

Schultz S., Pinazzo J. and Cifuentes M. 1998. Opportunities and limitations of contingent valuation surveys to determine national park entrance fees: evidence from Costa Rica. *Environment and Development Economics* 3: 131-149.

Tegegne G. 1999. Willingness-to-pay for environmental protection: An application of contingent valuation method (CVM) in Sekota District, Northern Ethiopia. *Ethiopian Journal of Agricultural Economics* 2(1):18-25.

The Nature Conservancy. 2001. Sustainable finance for protected areas: Visitor use fees and concession systems in protected areas. Galapagos National Park, Ecuador. Tourism and Protected Areas Publication series. USAID. 23 pp.

The Nature Conservancy. 2004. Sustainable finance for protected areas: Tourism-based user fees. From the conservation Finance Guide: A project of the conservation Finance Alliance. 33pp.

The Nature Conservancy. 2005. Sustainable finance for protected areas: Visitor Donations. Islas del Golfo Reserve, Mexico. Tourism and Protected Areas Publication series. USAID. 25pp.

UNEP (United Nations Environment Programme). 2006. African Development Outlook 2: Our Environment, Our Wealth. Tourism and recreation. Pp. 88-90.

USAID (The United States Agency for International Development). 2001. AMENDMENT 1 USAID/GHANA TOURISM-LED Economic Growth Promotion Program. http:/www.usaid.gov/procurement_bus_opp/procurement/annual_pstatements/ghana.html Last visited 12/03/07.

Usongo L. 2002. Apes in the Proposed Tri-National de la Sangha Conservation Area. *Gorilla Journal* 25: 4-9.

Usongo. L. 2000. Conservation Status of Arboreal Primates, Lobéké Forest, SE Cameroon. *Primate Conservation* 18: 66-68.

Vieta F.E. 1999. Ecotourism propels development. But social acceptance depends on economic opportunities for local communities. Africa Recovery United Nations. http://www.un.org/ecosocdev/geninfo/afrec/vol13no1/tourism.htm Last visited 19/02/07.

Wehiong S.M. 2005. Bilan et analyse des experiences de partenariat en gestion forestiere dans le bassin du Congo. IUCN-BRAC. 191 pp.

Whitehead J.C., Williams C.B. and Hoban T.L. 2000. Willingness to Pay for Research and Extension Programs, paper prepared for the Southern Agricultural Economics Association Annual Meetings, January.

Whitehead J.C. 2003. Improving willingness to pay estimates for quality improvements through joint estimation with quality perceptions. Appalachian State University. 26 pp.

Whittington D. Pearce and Moran 1997. Economic values and the environment in the developing world. ISBN-10: 1858985005. Edward Edgar London. 167pp

Wilkie D.S. and Carpenter J.F. 1999a. Can nature tourism help finance protected areas in the Congo Basin? *Orynx* 33: 332-338.

Wilkie D.S. and Carpenter J.F. 1999b. The potential role of safari hunting as a source of revenue for protected areas in the Congo Basin. *Orynx* 33. 339-345.

Wilkie D.S. Carpenter J.F. and Zhang Q. 2001. The under-financing of protected areas in the Congo Basin: So many parks and so little willingness-to-pay. *Biodiversity and Conservation* 10: 691-709.

World Tourism Organisation (WTO). 2006. Third year of sustainable growth. *UNWTO World Tourism Barometer* 4(3): 1-8.

World Tourism Organisation (WTO). 2005. World Tourism market Trends 2004. Africa. World Tourism Organisation, Madrid.

Yu Ling., 1998. Overall introduction to China's Tropical Forest Environmental resources. In: Tropical forest environmental resources of China. Hou Yuanzhao, Yu Ling and Wang Hogfeng (Eds.). IITO PD39/98 Rev.2(M). Pp. 3-33.

Yunis E. 2003. Sustainable Development of Tourism: Remarks at a symposium on natural resource conservation & economic development in the Congo Basin: The Role of Ecotourism. WTO. February 21. http://www.state.gov/g/oes/rls/rm/2003/25826.htm Last visited 03/012/06

Yunis E. 2004. Sustainable tourism and poverty alleviation. Presentation at World Bank – ABCDE Conference – Europe. Brussels. 10 May. 7 pp.

Appendix 4.1. Other descriptive results (%) for the Lobeke and Dzanga-Ndoki National Parks

Socio-demographic characteristics		Lobeke National Park			Dzanga-Ndoki National Park			
		National	International	All	International	National	Resident	All
Age	[20; 30[	17.1	6.9	9.0	16.7	21.4	26.7	19.3
	[30; 40[	63.4	40.3	45.0	35.2	50.0	46.7	39.8
	[40;50[	14.6	39.0	34.0	31.5	28.6	26.7	30.1
	[50;60[	2.4	8.2	7.0	9.3	0	0	6.0
	> 60	2.4	5.7	5.0	7.4	0	0	4.8
	Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Gender	Female	33.3	43.7	41.5	29.6	28.6	40.0	31.3
	Male	66.7	56.3	58.5	70.4	71.4	60.0	68.7
	Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Marital status	Single	69.0	50.0	54.0	53.7	85.7	40.0	56.6
	Married	19.0	35.4	32.0	42.6	14.3	60.0	41.0
	Divorced	9.5	11.4	11.0	3.7	0	0	2.4
	Widowed	2.4	3.2	3.0	0	0	0	0
	Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Education level	Post graduate degree	0	15.8	12.5	31.5	0	13.3	22.9
	Diploma/degree from university	50.0	48.7	49.0	42.6	64.3	40.0	45.8
	Secondary/high school education	38.1	34.2	35.0	20.4	14.3	33.3	21.7
	Primary education	11.9	0	2.5	5.6	21.4	13.3	9.6
	No formal education	0	1.3	1.0	0	0	0	0
	Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Member of conservation organisation	Yes	4.8	34.2	28.0	22.2	14.3	20.0	20.5
	No	95.2	65.8	72.0	77.8	85.7	80.0	79.5
	Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Country living	Cameroon	97.6	5.7	25	1.9	0	0	1.2
	CAR	0	0	0	1.9	85.7	100.0	33.7
	France	0	12.7	10	14.8	0	0	9.6
	USA	0	15.2	12	5.6	0	0	3.6
	Germany	0	17.1	13.5	3.7	0	0	2.4
	Spain	0	9.5	7.5	31.5	7.1	0	21.7
	Great Britain	0	8.2	6.5	1.9	0	0	1.2
	Sweden	0	0	0	24.1	0	0	15.7
	Belgium	0	2.5	2	5.6	0	0	3.6
	Norway	0	0	0	5.6	0	0	3.6
	Poland	0	4.4	3.5	0	0	0	0
	Netherlands	0	3.8	3	0	0	0	0
	Switzerland	0	2.5	2	0	0	0	0
	Nigeria	0	2.5	2	0	0	0	0
	Canada	0	1.3	1	3.7	7.1	0	3.6
	Italy	0	2.5	2	0	0	0	0

	Ghana	2.4	0	0.5	0	0	0	0
	South Africa	0	1.9	1.5	0	0	0	0
	Japan	0	1.9	1.5	0	0	0	0
	Togol	0	1.3	1	0	0	0	0
	Tanzania	0	1.3	1	0	0	0	0
	Chad	0	1.3	1	0	0	0	0
	Israel	0	0.6	0.5	0	0	0	0
	Peru	0	0.6	0.5	0	0	0	0
	Morocco	0	0.6	0.5	0	0	0	0
	Niger	0	0.6	0.5	0	0	0	0
	Senegal	0	0.6	0.5	0	0	0	0
	China	0	0.6	0.5	0	0	0	0
	Malia	0	0.6	0.5	0	0	0	0
	Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Nationality	Cameroonian	97.6	5.1	24.5	1.9	0	6.7	2.4
	Centrafrican	0	0	0	0	85.7	0	14.5
	German	0	17.1	13.5	3.7	0	0	2.4
	American	0	15.2	12.0	7.4	0	33.3	10.8
	French	0	12.0	9.5	13.0	0	26.7	13.3
	Spanish	0	9.5	7.5	31.5	7.1	0	21.7
	English	0	7.6	6.0	1.9	0	0	1.2
	Swedish	0	0.6	0.5	20.4	0	13.3	15.7
	Dutch	0	4.4	3.5	0	0	0	0
	Belgian	0	3.2	2.5	5.6	0	0	3.6
	Togolese	0	1.3	1.0	0	0	0	0
	Swiss	0	1.9	1.5	5.6	0	0	3.6
	Moroccan	0	0.6	0.5	0	0	0	0
	Polish	0	5.7	4.5	0	0	0	0
	South African	0	1.9	1.5	0	0	0	0
	Nigerien	0	0.6	0.5	0	0	0	0
	Ghanaian	2.4	0	0.5	0	0	0	0
	Tanzanian	0	1.3	1.0	0	0	0	0
	Italian	0	2.5	2.0	0	0	0	0
	Canadian	0	1.3	1.0	0	7.1	6.7	2.4
	Japanese	0	1.9	1.5	0	0	0	0
	Nigerian	0	1.9	1.5	0	0	0	0
	Norwegian	0	0	0	5.6	0	0	3.6
	Senegalese	0	0.6	0.5	0	0	0	0
	Chadian	0	1.3	1.0	0	0	0	0
	Danish	0	0	0	1.9	0	0	1.2
	Israeli	0	0.6	0.5	0	0	0	0
	Peruvian	0	0.6	0.5	0	0	0	0
	Russian	0	0	0	0	0	6.7	1.2
	Liberian	0	0	0	0	0	6.7	1.2
	Chinese	0	0.6	0.5	1.9	0	0	1.2
	Malian	0	0.6	0.5	0	0	0	0
	Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**

CHAPTER FIVE

Sustaining timber production in the Congo Basin a case study of the Lobeke National Park, East Province of Cameroon

Julius Chupezi Tieguhong

Forestry, Faculty of Science & Agriculture, University of KwaZulu-Natal, P Bag X01, Scottsville 3209, South Africa. Chupezi@yahoo.co.uk or 204523366@ukzn.ac.za

ABSTRACT

Timber production is a business of vital importance to the economies of Central African countries. Tree harvesting affects the vegetation structure and the floristic composition of the forest. There is a general fear raised by a conventional wisdom about the depletion of desired timber trees in the Congo Basin and the miss-functioning of the forest associated with logging. This fear is shared by timber companies that are worried about the possible shortages of timber and the prospective closures of their saw mills. Out of the 18 timber species harvested around the Lobeke National Park area, one has been already listed as an endangered species in 1992 and four other species belonging to the genus Entandrophragma are in the “vulnerable” category. This study cross-examined and analyzed the harvesting data available for five forest management units. The results showed that the utilizable tree species are not endangered and that there is no real risk of closing the timber business due to a shortage of commercially valuable timber species in the regional forests.

Keywords: rain forest, deforestation, sustainable forest use, timber species

INTRODUCTION

The six countries of the Congo Basin (Cameroon, the Democratic Republic of Congo (DRC), Central African Republic (CAR), Gabon, the Republic of Congo (RC) and Equatorial Guinea) harbour 137 million ha of humid dense forest (FAO, 2005), the second largest area of tropical rainforest in the world after the Amazon forests. By 2004, concessions were already allocated to logging companies to harvest 49.4 million ha (36%) of this forest (Karsenty, 2005). However, different countries allocated different portions of their forest areas to harvesting (Tieguhong and Ndoye, 2007). Cameroon, the RC, Gabon, the CAR and Equatorial Guinea have 45%, 77%, 80%, 86% and 93% of their humid dense forest within logging concessions, respectively (Karsenty, 2005). The DRC has 16 million ha of its humid forest within logging concessions, representing 18% of the country's entire humid forest or 32% of the total concession area in the Congo Basin (Minnemeyer, 2002). The above statistics suggest that forest harvesting forms a major land use in the Congo Basin's forests, one that needs closer examination.

Logging in the Congo Basin dates back to colonial times but in recent decades, timber companies have been blamed for being one of the main drivers of the rapid rate of deforestation, forest fragmentation and degradation in the region (van Gemerden, 2004; Archard *et al*., 2002; Laurence, 1999). Given the high level of forest biodiversity and its global impact on world climates by storing up to 36.815 billion tonnes of carbon (FAO, 2007) there has been a quest to check logging operations in the forests of the region. According to Tieguhong and Ndoye (2007), this need has received special attention from the member states of the Forestry Commission of Central Africa (COMIFAC) and from the international community. Such interests have provoked many questions related to the sustainability of timber operations in the region as well as their future economic impacts on both local and national economies (Nasi *et al.,* 2006). In addition to these are the needs of conserving a large proportion of these forests within protected areas or negotiating for conservation concessions. Putting aside issues related to sustainability, the timber sector remains one of the main economic contributors to local and national economies in the region (Ruiz-Perez *et al.,* 2005). The logging sector contributes 10-15% of the regional gross domestic product (GDP) and remains a major source of government revenue, foreign exchange and employment (Collomb,

2003). It contributes up to 18% to the GDP of the CAR (Demarquez and Petrucci, 2005) and 20% to the foreign exchange earnings of Cameroon (MINFOF, 2005). According to the Congo Basin Forest Partnership (2006) the forests of the Congo Basin are of global environmental values and require global attention for its management and conservation. Hotly disputed issues focus on the scale of benefits and costs of logging, concession arrangements, delineation of protected areas, and conservation concession propaganda, and how sustainable are current arrangements. Despite all these reflections on sustainability and economic underpinnings, logging is continuing and seems unchallenged as an economic pillar of the region in the foreseeable future.

On a regional scale, the most prevalent are logging concessions as logging affects the vegetation structure and the floristic composition of the forest by triggering many disturbances (Tieguhong and Ndoye, 2007; Hall *et al.,* 2003; Veenendaal *et al*., 1996). General fear of species depletion in the Congo Basin has been raised by conventional wisdom as well as the possibility of timber companies closing up their mills following the depletion of desired timber trees (Hall *et al.*, 2003). These concerns put the issue of sustainability into context. Among the timber species exploited in the Lobeke National Park area, *Pericopsis elata* is listed under Appendix II of the Convention on International Trade in Endangered Species of Fauna and Flora (CITES, 2003). Scientific evidence suggests that four other species belonging to the genus *Entandrophragma* (African mahoganies) are in a vulnerable category (Hall *et al.,* 2003).

The overall objectives of this study were to cross-examine and analyze the field data on forest utilization available for logging concessions in five forest management units (FMUs) and to expose some realities revolving around the issue of the endangered and popular timber species exploited in the region around the Lobeke National Park (LNP), East Province of Cameroon. The overriding principle was to mobilise the information to all stakeholders involved in implementing or designing management tools that could enhance the positive effects and minimize the negative impacts of logging on the forest. The specific aim was to further test the prognosis put forward by Hall *et al.* (2003) that:

(i) ‘the forests of the Congo Basin would disappear in the next few decades if logging continues’, and

(ii) ‘if selective logging does not adequately regenerate *Entandrophragma* spp., loggers will quit the region after having mined the forest.’

METHODS

Study site

Cameroon has a total surface area of 46.5 million ha and is divided into ten administrative provinces: Centre, Littoral, East, South, West, Southwest, Northwest, Adamaoua, North and Far North. Tropical timber production comes mostly from six of the 10 provinces (Centre, Littoral, East, South, Southwest and West). This study was carried out in three logging companies who own concessions to harvest five FMUs located around the Lobeke National Park (LNP). The LNP is situated between latitude $2^{o}05'$-$2^{o}30'$N and longitude $15^{o}33'$-$16^{o}11'$E covering an area of 217 854 ha. Administratively, the LNP is located in the Moloundou Sub-division (1.56 million ha), the Boumba and Ngoko Divisions (3.041 million ha) within the East Province of Cameroon. The East Province covers 23.44% of the surface area of Cameroon and is often referred to as the main reserve of timber resources in the country with an average contribution of 60.8% of the total volume of the total national timber production between 1998 and 2005 (MINEFI, 2006). The LNP and its surrounding forests are rich in plant resources and wildlife, which have supported generations of indigenous communities. Six recreational hunting zones superimposed on the five forest concessions form the peripheral zone of the LNP. The forest logging concessions cover a total area of 354 928 ha (Figure 5.1).

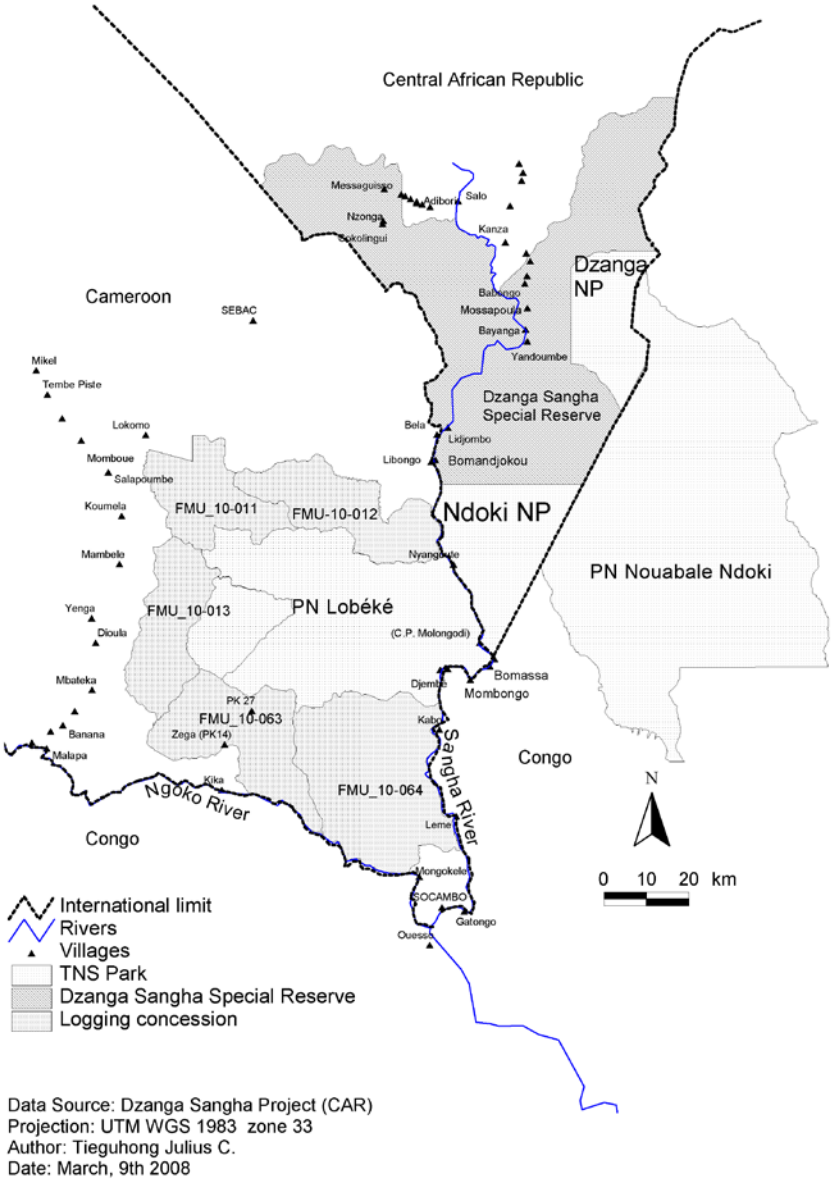

Figure 5.1. Location of the Lobeke National Park and adjoining logging concession areas in Cameroon.

The climate of the region is continental and equatorial, with bimodal rainfall patterns and four seasons, namely: one big rainy season (September to November), one small rainy season (March to June), one big dry season (December to February) and one small dry season (July to August) (MINEF, 2004). The mean annual is 1600 mm in the Sub-Divisional capital, Moloundou (standard deviation = 100 mm). The temperature averages 25.4^{o}C with little

seasonal variation. However, relative humidity varies from a minimum of 60% to a maximum of 98% (MINEF, 2004).

The local people include the Baka Pygmies, the Bangando, and the Bakwele as well as several immigrant people of various ethnic origins. The estimated human population in 2004 was about 26 000 people, 12 000 in the villages and 14 000 people in the three logging towns (Kika, Libongo and Lokomo) (MINEF, 2004). The main human activities in the region include timber extraction, exploitation of non-timber products, fishing, artisan gold mining and bushmeat hunting. Another important future of the Lobeke National Park is that it is a part of the 28 000 km^2 trans-boundary park, known as the Sangha Tri-National Park (TNS). The Sangha River forms the eastern boundary of the LNP and is shared with the Dzanga-Ndoki National Park (DNNP) in the Central African Republic and the Nouabele-Ndoki National Park (NNNP) in the Republic of Congo. Animals move across the river to either of the parks, which instigated the need for a common management system within the framework of transboundary park management systems. Major threats to the LNP have been identified as timber exploitation, poaching, intricate road networks, traditional mining and parrot capture. Adverse internal factors include inefficient management and monitoring structures, poor transboundary collaboration, low participation by local communities, low valorisation and promotion of park attributes and weak decision-making (MINEF, 2004).

Data collection and analysis

Data for this paper was collected by executing field visits to three logging companies in charge of five FMUs located around the LNP. For each FMU, the following information was collected:

1. number and volume of standing trees inventoried for harvesting;
2. actual numbers and volumes for each tree species harvested in 2006;
3. remaining trees after the harvesting in 2006.

Quantitative data was entered into an MS Excel file and analyzed by using descriptive statistics. Literature reviews were conducted for insight on forest policies, management tools,

legislative and institutional arrangements governing the timber sector in the Congo Basin at large and Cameroon in particular.

RESULTS AND DISCUSSION

Forest resources in Cameroon

Cameroon has over 21.2 million ha of forests representing over 45% of the country's area (FAO, 2007). There are over 5.05 million ha of undisturbed forests while production forests make up 64% of the permanent forest domain, representing over 40% of the surface area of the southern part of Cameroon. Production forests are sub-divided into FMUs and today Cameroon has 110 FMU and 13 council forests covering 7 081 965 ha and 364 452 ha respectively (Abena, 2007). Despite this huge forest potential in Cameroon, the question that remains unanswered is whether such forests are being managed in a sustainable manner. It is over 20 years today that the international community put pressure and assisted Cameroon in looking at the problems related to sustainable forest management (SFM), including overall knowledge on the state of forest resources. A national inventory programme was established and sponsored by the Canadian co-operation in seven phases. Four of the phases were achieved in the 1980s covering a block of 14 million ha of moist, tropical forests in the southern part of the country. This inventory was based on tree species of 40 cm in diameter and above. The estimated exploitable timber volume was 1.517 billion m^3 and potentially over 2.6 billion m^3 from 600 exploitable trees species. A higher volume of over 6.5 billion m^3 was estimated based on a basal area for all trees over 20 cm in diameter (Abena, 2007). To date, 300 species of trees are exploited for commercial purposes in Cameroon, with only about 60 species being exploited on a regular basis.

Forest policy, institutional and legislative arrangements in Cameroon

Over the last four decades, the forestry sector of Cameroon has witnessed profound governing reforms of institutional and legislative arrangements (MINEF, 1994; 1995). Some of these reforms included:

- The Forestry Ordinance No. 73/18 of May 1973;
- The Forestry Law of 1981;
- The creation of the Ministry of Environment and Forestry in 1992;

- The adoption of the new Forestry Law in 1994;
- The elaboration and publication of a forest policy document in 1995;
- Institutional reform and re-organisation of the forestry sector in 2002;
- The creation of the Ministry of Forestry and Wildlife in 2004.

These reforms have evolved in concert with the resolutions of the Rio Summit of 1992. Moreover, the 1999 Heads of States Summit known as the Yaounde Declaration also reinforced the sub-regional integration, especially with the signing of the joint action plan by member countries.

The 1994 Forestry Law (94/01) classified the national forest estate into two categories of forests: permanent and non-permanent forest domains (MINEF, 1994; 1995). The permanent domain is composed of state forests, belonging to the state and council forests, belonging to councils. The non-permanent domain is governed by several temporary uses and access rights such as community forests, sales of standing volumes and the different forms of individual cutting permits or exploitation authorisations. Decree 95/531 differentiates forestry exploitation into four types, the two most important being forest concession made up of one or several forest management units (FMU) and the sales of standing volumes (SSV) of trees (Tieguhong and Ndoye, 2007). A forest concession is supposed to have a maximum of 200 000 hectares attributed for a period of fifteen (renewable) years. The sale of a standing volume results in one year of exploitation, twice renewable, but within a forest area limited to 2500 ha (Egbe, 2005).

Principles of concessions

With regards to policy tools governing concessions in Cameroon, the average size of a concession in the latter is about 68 000 ha. Minimum Exploitable Diameters (MED) are defined according to the timber species with due observance of key silvicultural variables. Species are classified into four categories: exceptional category, category I, category II and category III. The exceptional category is made up of only five timber species tagged as exceptional in their MED for timber in Cameroon, fixed at 100 cm. Among these species present are: sidong (*Gossweilerodendron balsamiferum*), Assamala or Afromosia (*Pericopsis elata*), iroko (*Melicia excelsa*), moabi (*Baillonnella toxisperma*) and sapelli (*Entandrophragma cylindricum*). Category I is made up of species whose MED is 80 cm. Examples of species in this category include acajou (*Khaya spp*.), ayous (*Triplochiton scleroxylon*), bilinga (*Nauclea diderrichii*), bubinga (*Guibourtia spp.*), doussie (Afzelia spp), kossipo (*Entandrophragma condollei*), sipo (*Entandrophragma utile*), tiama (*Entandrophragma angolense*) and so on. Category II species have minimum felling diameters of 60 cm while those in Category III have MED's of 50 cm.

The number of species exploited in Cameroon is limited, with the top six timber species (*Triplochiton scleroxylon, Entandrophragma cylindricum, Lophira alata, Erythropleum ivorense, Terminalia superba* and *Melicia excelsa*) in 2002/2003 constituting 80% of the total volume exploited. *Triplochiton scleroxylon* and *Entandrophragma cylindricum*, constituted over 90% of 2005's total timber production for ALPICAM, a logging company located in the southern part of the Lobeke National Park (Tieguhong and Ndoye, 2007). These observations are comparable to what is obtainable in other countries in the Congo Basin. For instance, in the CAR, the most notable timber species exploited included *Entandrophragma cylindricum, Triplochiton scleroxylon* and *Melicia excelsa* that together constituted 79% of the total timber volume exploited by all logging companies within its frontiers in 2003 (Tieguhong and Ndoye, 2007). Despite these exigencies, three policy tools and one control strategy mechanism govern the management of concessions in Cameroon: provisional convention, management plans, final convention and the forest and wildlife control strategy (Vandenhaute and Heuse, 2006).

Timber species harvested in the Lobeke region

The common timber species found in the region are listed in Table 5.1. There were 44 approved exploitable timber species in the forests of the Lobeke region, with only 18 (40.9%) harvested in 2006 (Table 5.2). The most exploited was *Triplochiton scleroxylon* represented by 85.5% of the total allowable volume, seconded by *Entandrophragma cylindricum* (7.81%), *Erythrophleum ivorense* (2.90%), *Pericopsis elata* (2.2%) while the remaining 14 exploited species represented only 1.59% of the total allowable volume. In total 6343 trees were exploited from the five FMUs studied, giving a total volume of 120 517.04 m^3 or 62.6% of the declared utilizable volume for 2006 (Table 5.2). Apart from species exploited in the Lobeke region, there were 26 other exploitable species that were approved for harvesting in management plans but that timber companies generally did not exploit for technical and economic reasons. The exploitation of these species by timber companies could increase the commercial variety of timber species in the region.

Table 5.1. The most common utilizable timber trees species in the study area.

Scientific name	Common name
Afzelia pachyloba	Doussie
Albizia ferruginea	Latandza
Alstonia bonnei	Emien
Amphimas ferrugineus	Lati/Edjil
Aningeria ultissama	Aningre
Anopysis klaineana	Bodioa
Autranella congolensis	Mukulungu
Baillonnella toxisperma	Moabi
Bombax buonopozense	Fromager
Canarium schweinfurthii	Aiele/Abel
Celtis zenkeiri	Diana Z
Detarium macrocarpum	Mambode/Amouk
Entadrophragma condollei	Kossipo
Entadrophragma cylindricum	Sapelli
Entandrophragma angolensis	Tiama
Entandrophragma utile	Sipo
Eribroma oblonga	Eyong
Erythrophleum ivorense	Tali
Gambeya Africana	Longhi/Abam
Gilbertiodendron deweuvrii	Limbali
Gossweilerodendron balsamiferum	Sidong
Guarea cedrata	Bosse clair
Guarea thompsonii	Bosse Fonce
Guibourtia spp.	Bubinga
Khaya anthotheca	Acajou Blanc
Khaya spp.	Acajou
Klainedoxa gabonensis	Eveuss
Lannea welwitschii	Kumbi
Lophira alata	Azobe
Lovoa trichilioides	Dibetou
Mansonia altissima	Bete
Melicia excelsa	Iroko
Milletia laurentii	Wengue
Mitragina ciliata	Bahia
Nauclea diderrichii	Bilinga
Nesogordonia papaverifera	Kotibe
Ongokea gore	Angueuk
Pericopsis elata	Assamala
Piptadeniastrum africanum	Dabema
Ptelopsis hylodendron	Osanga/Sikong
Pterocarpus soyauxii	Padouk Rouge
Pterygota macrocarpa	Koto
Pycnanthus angolensis	Ilomba
Staudtia kamerunensis	Niove
Stemonocoleus micranthus	Esson
Swartzia fistuloides	Poa rosa
Terminalia superba	Frake
Triplochiton scleroxylon	Ayous

Table 5.2. Volume (m^3) of timber by tree species harvested around the Lobeke National Park in 2006.

Scientific name	Forest Management Unit					Total volume Harvested
	10011	**10012**	**10013**	**10063**	**10064**	
Khaya anthotheca	-	292.905	83.534		679.682	1056.121 (0.88%)*
Guarea cedrata	68.820	66.330	-	-	199.228	334.378 (0.28%)*
Lovoa trichilioides	-	28.017	-	-	40.323	68.34 (0.06%)*
Entadrophragma candollei	154.154	381.838	14.944	-	297.713	848.649 (0.70%)*
Entadrophragma cylindricum	1069.328	3928.713	269.263	547.636	3594.471	9409.411 (7.81%)*
Erythrophleum ivorense	1322.750	1455.170	-	29.196	1141.347	3948.463 (2.90%)*
Triplochiton sceleroxylon	944.495	18925.612	12741.827	29917.278	40510.502	103039.71 (85.5%)*
Mansonia altissima	-	9.067	-		0	9.067 (0.01) *
Melicia excelsa	-	65.190	176.202	100.656	273.079	615.127 (0.51%)*
Entandrophragma utile	-	132.283	17.218	-	247.428	396.929 (0.33%)*
Entandrophragma angolensis	-	80.446	-	-	192.769	273.215 (0.23%)*
Pterocarpus soyauxii	1.260	125.575	-	-	245.399	372.234 (0.31%)*
Pericopsis elata	91.700	713.136	-	13.788	1833.473	2652.097 (2.2%)*
Amphimas ferrugineus		45.863	-	-	85.112	130.975 (0.11%)*
Terminalia superba	137.981	-	-	-	26.906	164.887 (0.14%)*
Eribroma oblonga	19.042	-	-	-	-	19.042 (0.02%)*
Gambeya Africana	0.760	-	-	-	-	0.760 (0.00) *
Aningeria ultissama	-	-	-	122.920	-	122.920 (0.10%)*
Total	3865 (26.83%)**	26250.145 (71.69%)**	13302.988 (45.74%)**	30731.474 (75.40%)**	49367.432 (68.87%)**	120517.04 (62.60%)**

* = percentage of total volume harvested, ** = percentage of declared volume harvested

Declared, harvested and residual trees

On average, only 51.1% of the total number of trees declared for harvesting was removed in 2006. Some of the various reasons for this include the fact that they are: easily discernible in the field, included the respect of national forest management norms, and specifications in the forest management plans (all FMUs had approved management plans), and the exclusion of ecological sensitive areas from harvesting. The observations made during this study showed that, depending on the species, between 30% and 95% of mature trees declared for harvesting were left standing. Only three (*Triplochiton sceleroxylon*, *Entadrophragma cylindricum* and *Entadrophragma angolensis*) of the eighteen timber species were found to have more than 200 trees harvested in the five FMUs in 2006 (Table 5.3).

Table 5.3. Numbers of trees by species declared for harvesting, harvested and remaining standing, in the five forest management units (Southeast of Cameroon) in 2006.

Scientific name	Total harvestable trees	Total trees harvested		Total trees remaining	
		number	%	number	%
Triplochiton sceleroxylon	7144	5000	70.0	2144	30.0
Pericopsis elata	358	178	49.7	180	50.3
Melicia excelsa	77	30	39.0	47	61.0
Entandrophragma angolensis	47	17	36.2	30	63.8
Khaya anthotheca	222	79	35.6	143	64.4
Entadrophragma cylindricum	1678	480	28.6	1198	71.4
Erythrophleum ivorense	1611	396	24.6	1215	75.4
Entadrophragma candollei	172	40	23.3	132	76.7
Mansonia altissima	5	1	20.0	4	80.0
Gambeya Africana	5	1	20.0	4	80.0
Entandrophragma utile	82	15	18.3	67	81.7
Guarea cedrata	160	27	16.9	133	83.1
Terminalia superba	231	28	12.1	203	87.9
Pterocarpus soyauxii	266	26	9.8	240	90.2
Lovoa trichilioides	55	5	9.1	50	90.9
Aningeria ultissama	134	12	9.0	122	91.0
Amphimas ferrugineus	118	6	5.1	112	94.9
Eribroma oblonga	42	2	4.8	40	95.2
Total	12407	6343	**51.1**	6065	48.9

The harvesting of the 18 declared timber species had the structure shown in Figure 5.2. The harvesting structure plots showed that the number of trees harvested was generally proportional to the number of trees declared for harvesting. This relationship was further

tested for all the 18 harvested species with a regression analysis shown in Figure 5.3, which confirmed a linear trend in the relationship between the numbers of trees declared for harvesting and those actually harvested.

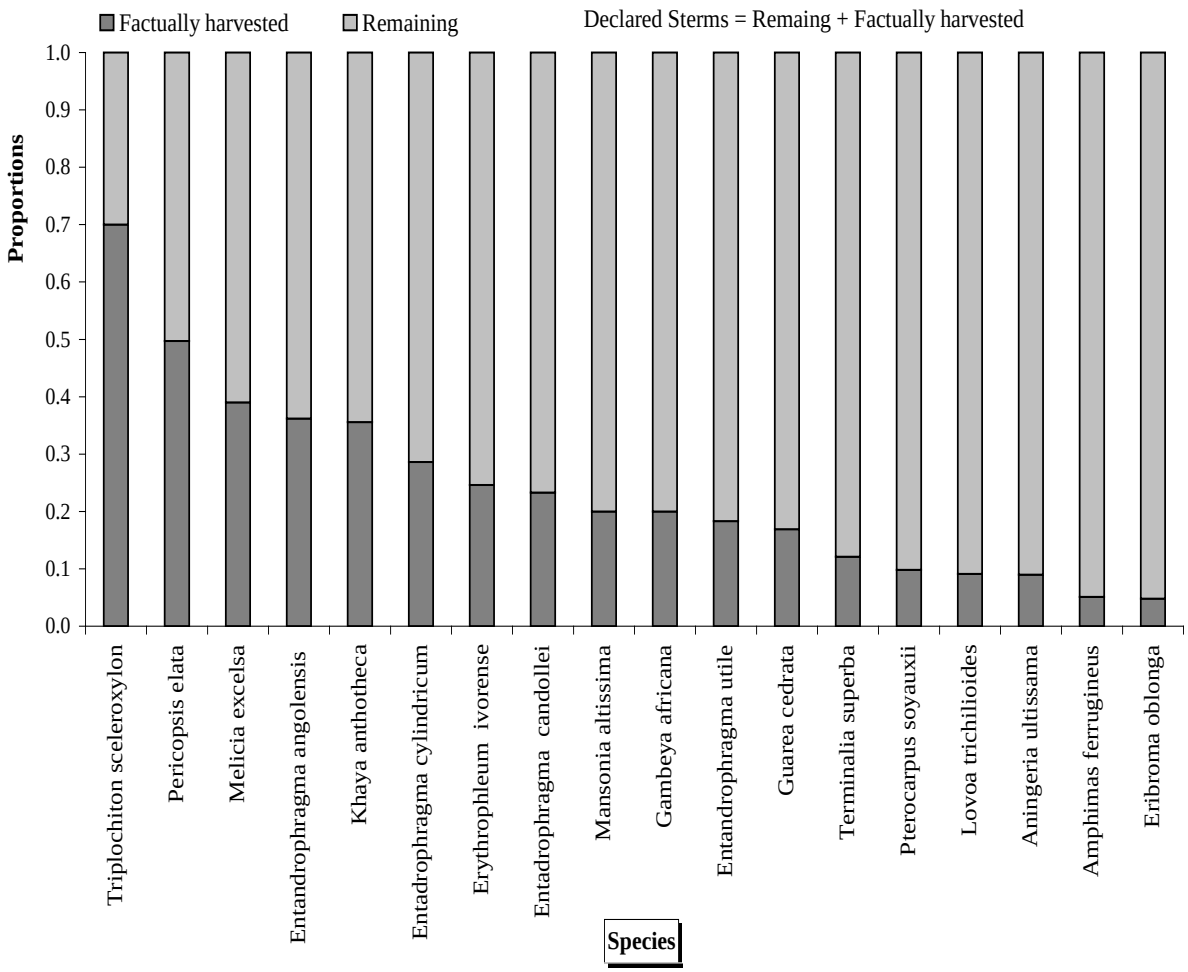

Figure 5.2. Exploitation structure of the 18 popular timber species in five Forest Management Units, Southeast of Cameroon in 2006.

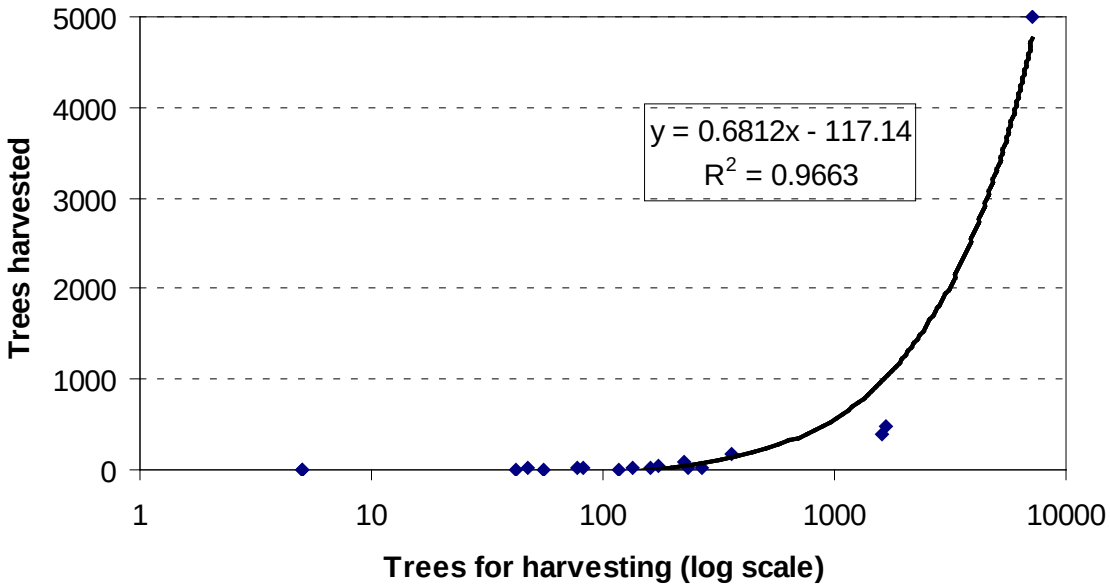

Figure 5.3. A linear relationship between the numbers of trees declared for harvesting and actually harvested in the Forest Management Units, Southeast of Cameroon in 2006.

Ranking species by market demand

All 18 species exploited in the study area were grouped into four categories based on the percentage harvest of the declared tree numbers:

i. over 50% (one species),
ii. between 30-50% (four species),
iii. between 10-30% (eight species),
iv. less than 10% (five species).

Among the 18 timber species exploited in the study area, only *Triplochiton sceleroxylon* was harvested above 50% of its declared numbers. It was the most demanded species: from as many as 7144 trees declared as harvestable, 5000 trees were cut giving a harvested proportion of 70% of the declared stems in 2006.

Four species were observed to be harvested in the region between 30% and 50% of the declared tree numbers. These species were further divided into two groups: those of high densities per ha (rapidly regenerating) and those of low densities per ha. In addition to *Triplochiton* that had a very high density per ha, other species of high densities with over 250 stems declared per harvesting unit in 2006 included *Pterocarpus soyauxii, Pericopsis elata,*

Erythrophleum ivorense and *Entadrophragma cylindricum* in an increasing order. *Pericopsis elata* was the fourth species in terms of density, but the second in terms of the harvested ratio with 49.7% of its declared stems being harvested. *Melicia excelsa, Entandrophragma angolensis* and *Khaya anthotheca* were observed to respecively have 39.0%, 36.2% and 35.6% of their declared trees harvested. At the same time, however, these species were observed to have low densities in the forest.

Timber species classified within the third category were *Entadrophragma cylindricum, Erythrophleum ivorense, Entadrophragma candollei, Entandrophragma utile, Guarea cedrata* and *Terminalia superba* with between 10-30% of their declared mature stems being exploited. *Entadrophragma cylindricum* was the second most declared species in the forest with harvestable stems numbering 1678 of which only 28.6% were harvested. About 71% the declared stems were left unexploited. Of the 1611 mature trees of *Erythrophleum ivorense* and 172 of *Entandrophragma condollei* only 24.6% and 23.3%, respectively, were harvested in 2006.

Out of the five harvestable trees of *Gambeya africana* only one was harvested; while four were left as seed trees or because of their location in ecologically sensitive areas. A similar observation was made for *Entandrophragma utile Guarea cedrata* and *Terminalia superb*, both of which had also less than 20% of the declared mature trees exploited. Furthermore, five species were observed to have less than 10% of their declared stems harvested with over 90% left standing for the next rotation of 30 years. These species included *Pterocarpus soyauxii, Lovoa trichilioides, Aningeria ultissama, Amphimas ferrugineus* and *Eribroma oblonga.*

Biological and economic sustainability

In terms of sustainability, various studies have shown that sustainable timber production from the permanent forest domain of Cameroon could be well above 1.5 million m^3 per annum (CERNA, 2002). This study found that in the study area, the total volume exploited in 2006 represented only 62.60% of the authorised volume while 37.4% was carried over to the next rotation for reasons such as respect of national logging norms and avoidance of ecologically sensitive areas. There were, however, variations among the FMUs with the following percentage of the yields quotas obtained in the various FMUs:

FMU 10011 - 26.83%,
EMU 10012 - 71.69%,
EMU 10013 - 45.74%,
EMU 10063 - 75.40%,
EMU 10064 - 68.87%.

More stringent research is needed to prove this analysis otherwise, especially in terms of how field data is recorded at gantries and sawmill yards and how verifications of logging damage and log recovery rates are determined.

According to Karsenty and Gourlet-Fleury (2006), sustained yield in the forests of the Congo Basin would require a 22% and 53% decrease in the felling intensities of *Entadrophragma cylindricum* and *Triplochiton scleroxylon* respectively to allow for the exploitation of the less commercialised species. Contemporary economic and ecological arguments may not agree to this assertion because of two reasons:

- firstly, these species are light demanding (pioneers) and they regenerate rapidly only under open canopy conditions and therefore have a comparative advantage to thrive under repeated logging regimes (van Germenden 2004). For the same ecological reasons, *Triplochiton scleroxylon* is known to be a pioneer species with abundant recruitment, fast growth rate and high response to solar radiation following canopy openings in natural forests (Veenendaal et al., 1996; Hawthorne, 1995; White, 1983). The bi-modal rainfall pattern is a typical climatic characteristic of the study area and according to Hawthorne (1995) it is very favourable for the growth of the latter;
- secondly, the commercial operators are making money from a smaller number of species. Expanding the commercial band of species would imply additional costs in terms of handling the species at sawmills, packaging for exports and searching for additional market opportunities for diverse products. Within the influence of contemporary circumstances of logging companies and bad road infrastructure in the region, the suggestion of Karsenty and Gourlet-Fleury (2006) might not be practical to be implemented in the nearest future. Therefore, given that *Triplochiton scleroxylon*

regenerates well in logged forests and prefers a two-peak rainfall pattern, a reduction of exploitation rates from 86 to 53% as suggested by Karsenty and Gourlet-Fleury (2006) may be inappropriate from both economic and ecological standpoints.

Melicia excelsa, *Entandrophragma angolensis* and *Khaya anthotheca* were observed to have low densities per ha. According to Hall *et al.* (2003), such low densities could be associated with a shift in canopy dominance from shade intolerant (light demanding) to shade tolerant (non-light demanding) species because highly selective logging does not sufficiently open up canopies for the former species to adequately advance their regeneration and recruitment. However, given that 61–64% of their stems are left standing, it coud be said that these species are not endangered. Over 61% of mature trees left standing should form good seed trees for natural regeneration to take place, especially under the national concession policy of a 30-year rotation before repetitive harvesting.

With regards to the performance of loggers, logging companies in the study area were generally observed to follow the norms of sustainable management in forests under their concessions, showing a special respect for rare and endangered species, ecologically sensitive areas and national norms. For example, the management of FMU 10063 was observed to manage 98.7% of its forest concession for production including ecologically sensitive areas (6%) while 1.3% was kept aside for the protection of unique and diverse plants and animals. Ecologically sensitive areas included swamps, river banks, natural clearings and elephant corridors. Overall, specific national forest management norms were scrupulously followed. National norms require 30 year logging rotations of annual exploitation units. Timber species were exploited within the norms governing the minimum exploitable diameters (MED). Research carried out by Ngniado and Chendjou (2006) in two of the forest management units in the region (including FMU 10064) concluded that no tree of diameter lower than the MED was harvested. Another important national norm protects rare species from being harvested, when they do not re-occur at least once per km^2. Records in FMU 10063 showed that 19 timber species were in this category and none of them was observed to be among those harvested in the study area. National forest management norms specify that species of low densities of less than one per km^2 are forbidden from exploitation and should be protected.

In this light, out-cries of the depletion of desirable timber species associated with timber logging could be far from reality or could be treated as rhetoric. Other factors, direct or indirect may be contributing to the depletion of timber species and not just the timber concession system currently operating in the region. For instance, particular attention was given to *Pericopsis elata* during this study because it is listed in CITES Appendix II and considered endangered in Cameroon (CITES, 2003). This highly valued and commercialised timber species was found in reasonable numbers in the study area. *Pericopsis elata* is a non-pioneer light demanding species that survives for some time under the shade but requires more light to develop from a seedling into a sapling (Hawthorne, 1995). Observations from this study showed that 358 trees of *Pericopsis elata* (volume 5149 m^3) were approved for exploitation in the study area but only 178 trees (volume of 2652.097 m^3) were harvested, representing only 2.8% of all the trees exploited in the area in 2006. This implies that 180 approved trees (volume 2494.903 m^3) where left unexploited. The relatively high proportion of declared mature trees that were left unexploited in various annual logging units could have positive implications on the ecological sustainability of the species and the forest ecosystem in general.

There were differences in the composition of dominant timber species in different countries of the Congo Basin, suggesting that any generalisation on their endangerment across the region could be flawed. For instance, in the Central African Republic, *Entandrophragma* spp. (African mahoganies) represented 42% (by volume) of all timber species exploited in that country in 2003. For the Bayanga Wood Company (SBB) located in the southwestern part of the same country and contiguous with the Cameroonian forest north of the Lobeke National Park, African mahoganies represented 50.62% of all the exploited timber species in 2003. *Triplochiton scleroxylon* represented 30% and 39.02% of all the species harvested in the CAR and SBB (Tieguhong and Ndoye, 2007). In Cameroon, African mahoganies and ayous respectively represented 19.28% and 30.03% of the total harvested timber volume (SGS, 1997). In the study area, *Entandrophragma* spp. and *Triplochiton scleroxylon* yielded 9.06% and 85.5% of the timber volume. These numbers showed a relatively low utilization of the African mahoganies in the study area as compared to *Triplochiton scleroxylon*.

Without doubt, the pride of the region possessing the specific timber resources can be sustained by applying the concepts of sustainable forest management and by reducing the impact of logging (FAO, 2004). According to Ruiz-Perez *et al*. (2006), this could involve greater efforts geared at encouraging logging companies to improve their standards of corporate responsibility and at the same time removing the constraints that discourage their better performance. However, the above analysis suggests that other factors (site factors, natural disturbances, damage by herbivores) could explain the abundance or scarcity of certain timber species in various regions in the Congo Basin and not just the logging pressures (Lawrence, 2003; Veenendaal *et al*., 1996). The growth of the desirable light-demanding timber species such as *Triplochiton scleroxylon* and the *Entandrophragma* spp should be promoted. Hall *et al*. (2003) suggested that a better approach to manage timber concessions in a sustainable way could imply the employment of an adaptive management approach based on increased species selection and canopy disturbance. Contrary to this view, Freris and Laschefski (2001) cautioned that silvicultural techniques adopted to encourage the growth of commercially lucrative species might result in ancient ecosystems being transformed into semi-natural land use systems. However, more research may be required to confirm existing empirical results.

CONCLUSIONS AND RECOMMENDATIONS

Timber companies in the Congo Basin are becoming less likely to impact negatively on sustainable forest management in their search for a sustainable business. Such lessons were learnt by the devastaton caused in the forests of West African countries. Some of the companies moved on to other parts of the world including the Congo Basin. The unruly attitudes may today be considered as historic because of overall international consciousness and evolving market instruments that decry unethical behaviours in tropical forests. Corporate business norms are nowadays respected by logging companies more than they were 30 years ago because of the upsurge of the civil society organisations and the global recognition of the values of the world's forests as reservoirs of biodiversity and carbon. In the Congo Basin and in the study area in particular logging companies are in for a profitable and long-term

business, they are increasing their investments, installing modern machines, hiring experienced foresters and training new ones.

From the data generated in this study it is clear that no species should be labelled as highly endangered due to logging pressures. This is true even for species that remain at low densities. Criticising timber companies for endangering the desirable timber species through logging operations is erroneous at least in the study area. Such assertions should be treated with caution at the policy level. The watch words for action by concessionaires reside in continuously making efforts to improve the logging techniques, to respect national harvesting norms and to scrupulously follow management plans and guidelines. Efforts should be made on promoting proper forest management and silviculture rather than on imaginative endangerment of species and possible economic losses to national and local stakeholders. Unfortunately regional governments are not reacting fast enough in the right direction despite there being a need for more political consciousness and action.

Even if the current rate of timber exploitation in the region is sustainable it may become unsustainable in future. This may occur when the natural regeneration and recruitment cannot catch up with log removals in the Congo Basin's forests. This is relevant in the light of increasing global demand for tropical logs. Countries in the region have to take this problem seriously and set limits to furnishing timber from natural forests. However, in order to benefit from such economic opportunities, they have to make deliberate efforts to invest in increasing timber supply from other niches. Added to the responsible role of the logging companies is the comparative advantage that Cameroon and other countries in the Congo Basin may have in enhancing the regeneration of their most desirable timber species. This could primarily involve planting or seeding those desirable timber species in areas were natural climatic conditions favour their rapid growth. Such trees may for example include *Triplochiton scleroxylon, Pericopsis elata* and the *Entandrophragma* spp. that favour the bi-modal rainfall patterns in the East Province of Cameroon. Given that these species are light-demanding with favourable growth in open canopy conditions, they could be useful for on-farm, out-grower schemes. Deliberate forest policy measures in this direction could be very rewarding to both the local and national economies given that the regional populations are increasing with

consequential expanding farmlands. Such measures should also be welcome by conservation organizations and logging companies alike as accessible stands of commercial timber species would reduce pressures on the old growth indigenous forests and the costs of log harvesting and transportation to processing mills.

REFERENCES

Abena J.C. 2007. Bref aperçu du secteur forestier Camerounais. Point sur la mise en œuvre du programme de travail de l'année 2007 de la direction des Forets. MINFOF. 16 pp.

Archard F., Eva H.D., Stibig H.J., Mayaux P., Gallego J., Richards T. and Mallingreau J.P. 2002. Determination of deforestation rates in the World's tropical forests. *Science* 297: 999-1002.

CERNA. 2002. Etude en vue de la définition d'une politique sectorielle de transformation et de valorisation du bois au Cameroun. MINEF-AFD, Yaoundé, Cameroun. 49 pp.

CITES. 2003. Review of significant trade in *Pericopsis elata*. PC14. Doc. 9.2.2. Annex 3. pp. 77-91.

Collomb J-G. 2003. Logging policy and practices. CARPE. 3pp. http://carpe.umd.edu/Resources/Themes/results.asp?ThemeID=1. Cited January 2008.

CBFP (Congo Basin Forest Partnership). 2006. The Forests of the Congo Basin. State of the forest 2006. 256 pp. ISBN: 978907827016.

Demarquez B. and Petrucci Y. 2005. Projet d'Appui a la réalisation des plans d'Amenagement Forestiers – PARPAF et PARPAF-Bis – Convention CCF 1106 Y01 et CCF 300101 U. Etude de fiscalité pour une seconde phase. TEREA. 86 pp.

Egbe A.H. 2005. Ministre des Forêts et de la Faune de la République du Cameroun http://www.minef.cm/Home/Le%20Ministre/Message%20du%20Ministre.htm Cited 15/03/06.

FAO 2007. State of the World's Forest. FAO-Rome. ISBN: 978-92-5-105586-1. 144 pp.

FAO 2005. State of the World Forests. FAO-Rome. ISBN: 92-5-105187-9. 153 pp.

FAO 2004. Regional Code of Practice for reduced-impact harvesting in tropical moist forests of West and Central Africa. Rome. 138 pp.

Freris N. and Laschefski K. 2001. Seeing the wood from the trees. *The Ecologist*. 31: 6.

Hall J.S., Harris D.J., Medjibe V. and Ashton P.M.S. 2003. The effects of selective logging on forest structure and tree species composition in a Central African forest: implications for management of conservation areas. *Forest Ecology and Management* 183(1-3): 249-264.

Hawthorne W.D. 1995. *Ecological profiles of Ghanaian forest trees.* Oxford Forestry Institute: Oxford. 345 pp.

Karsenty A. 2005. Les concessions forestières en Afrique centrale. Aspects historiques, institutionnels et politiques, du point de vue de la responsabilité des entreprises concessionnaires. Département Forêts du CIRAD, France. 40pp.

Karsenty A. and Gourlet-Fleury S. 2006. Assessing Sustainability of Logging Practices in the Congo Basin's Managed Forests: the Issue of Commercial Species Recovery. *Ecology and Society* 11 (1): 26. http://www.ecologyandsociety.org/vol11/iss1/art26/

Lawrence D. 2003. The response of tropical tree seedlings to nutrient supply: meta-analysis for understanding a changing tropical landscape. *Journal of Tropical Ecology* 19: 239-250.

Laurence W.F. 1999. Reflections on the tropical deforestation crisis. *Biological Conservation* 91: 109-117.

MINEF (Ministry of Environment and Forestry). 1994. Law No 94/01 0f January 1994 to lay down forestry, wildlife and fisheries regulations. Yaounde, Cameroon. 57 pp

MINEF (Ministry of Environment and Forestry). 1995. Decree of Implementation No 95/531/PM of 23 August 1995, stating the conditions for the implementation of forest regulations. Yaounde, Cameroon. 68 pp.

MINEF (Ministry of Environment and Forestry). 2004. A management plan for Lobeke National Park and its peripheral zone, 2003-2007. Yaounde. 81pp.

MINEFI 2006. Annuaire statistique du Cameroun. Institut National de la statistique. Yaounde. Pp. 256–269.

MINFOF 2005. National strategy for forest and wildlife control in Cameroon. Yaounde 31 pp.

Minnemeyer S.2002. Analysis of Access to Central Africa's Rainforest. Global Forest Watch, World Resources Institute, Washington, DC. ISBN 1-56973-518-2.

Nasi R., Cassagne B. and Billand A. 2006. Forest management in Central Africa: where are we? *International Forestry Review* 8(1): 14-20.

Ngniado A.W. and Chendjou C. 2006. Evaluation des degats d'exploitation dans les UFAs 10008 et 10064. WWF. Yokadouma. 26pp.

Ruiz-Perez M., Ezzine de Blas D., Nasi R., Sayer J., Karsenty A., Sassen M., Angoue C., Gami N., Ndoye O., Ngono G., Nguinguiri J.C, Nzala D., Toirambe B. and Yalibanda Y. 2006. Socio-economic constraints, environmental impacts and drivers of change in the Congo Basin as perceived by logging companies. *Environmental Conservation* 33(4): 316-324.

Ruiz-Perez M., Ezzine de Blas D., Nasi R., Sayer J., Sassen M., Angoue C. Gami N., Ndoye O., Ngono G., Nguinguiri J.C., Nzala D., Toirambe B. and Yalibanda Y. 2005. Logging in the Congo Basin. A multi-country characterisation of timber companies. *Forest ecology and Management*. 214 (1-3):221-236.

SGS. 1997. Log exports, Cameroon, January to September 1996-97. ATIBT Newsletter No. 4/97. Paris.

Tieguhong J.C. and Ndoye O. 2007. The impact of timber harvesting in forest concessions on the availability of Non-Wood Forest Products (NWFP) in the Congo Basin. FAO Forest Harvesting Case Study 23. ISBN: 978-92-5-105709-4.

Vandenhaute M. and Heuse E. 2006. Aménagement forestier Traçabilité du bois et Certification: Etat des lieux des progrès enregistrés au Cameroun. GTZ. Yaoundé. 71pp.

van Germerden B.S. 2004. Disturbance, diversity and distributions in Central African rain forest. Ph.D thesis. Department of Environmental Sciences. Wageningen University, the Netherlands. ISBN 90-5808-966-5. 200 pp.

Veenendaal E.M, Swaine M.D., Lecha R.T., Walsh M.F., Abebrese I.K., Owusu-Afriyie K. 1996. Responses of West African Forest Tree seedlings to irradiance and soil fertility. *Functional ecology* 10(4): 501-11.

White F. 1983. *The Vegetation of Africa.* A descriptive memoir to accompany the UNESCO/AETFAT/UNSO vegetation map of Africa. Paris:UNESCO. pp.356.

CHAPTER SIX

Supplies of bushmeat for livelihoods in logging towns in the Congo Basin

Tieguhong Julius Chupezi

Forestry, Faculty of Science & Agriculture, University of KwaZulu-Natal, P Bag X01, Scottsville 3209, South Africa. Chupezi@yahoo.co.uk or 204523366@ukzn.ac.za

ABSTRACT

The focus of this study is on the importance of bushmeat to the economies of 99 hunting households in two logging towns in the northern sector of Lobeke National Park, East Province of Cameroon. In the logging towns, bushmeat was the major source of daily animal protein. An estimated 37 960 wild animals are killed each year or 104 animals per day in this region. In general, 62% of the hunted animals were sold for cash income while 38% were consumed by hunters and their families. An annual gross income from the bushmeat to hunters was estimated at 234 058 548 CFA Francs (US$ 469 117) while gross revenue from 11 other income generating activities accessed by the hunters was only 4.5% of the income from hunting. Various costs represented 69.4% of the gross hunting revenues. Average hunting income was twice higher than the income of a junior technician and about the same as that of a senior technician working at SEFAC (logging company). The income of hunters at the higher end of the income range was comparable to those of mid-career SEFAC managers and far higher than the basic salaries of most senior government officers. Such a lucrative business provides economic incentives to hunting despite all the suppressive measures. Moreover, the importance of a large bushmeat market is rarely detected and seriously taken into account when designing conservation policies aimed at protecting wildlife and fighting against poaching. The recommendations resulting from this study stress the need of empathetic approaches that favour more deliberate development and conservation policies while dealing with bushmeat issues in the logging towns of the Congo Basin.

Keywords: game, food security, hunting, poaching, wildlife conservation

INTRODUCTION

With due recognition to the fact that African tropical rainforests are of great global conservation priority because of their unique and high biological diversity, it has been well-documented that these forests are adversely affected by human activities resulting in fragmentation, degradation and loss of forest cover (FAO, 2007; Bennett *et al*., 2006). This is primarily due to activities such as timber logging, agriculture, mining and game hunting to meet diverse economic and social needs. Game hunting for meat, generally known as bushmeat, has long been a staple for rural livelihoods in many parts of the world, including villages in and around the Lobeke National Park (LNP) in the East Province of Cameroon. During the 14th Session of the Working Party on the Management of Wildlife and Protected Areas in March 2002, item 5 on the report reiterated the need to consider bushmeat as a crucial resource rather than a product, so that its economic and social values are fully reflected in national development plans (AFWC, 2002). However, in most African countries, research and conservation focused on the impact of bushmeat hunting on biodiversity and resource sustainability (Lwanga, 2006; Rowcliffe *et al*., 2003; Auzel and Wilkie, 2000; Bowen-Jones, 1999; Muchaal and Ngandjui, 1999; Wilkie and Carpenter, 1999; Ntiamou-Baidu, 1997; Freese, 1996; Usongo and Curran, 1996) but not on the socio-economic importance of such activities to local household livelihoods (Damania *et al.*, 2005; de Merode *et al*., 2004; Bennett and Rao, 2002; Bennett *et al*., 2002; Davies, 2002; UDRSS/VALEURS, 2002; Bahuguna, 2000). Some research dwelled on the volume and value of bushmeat marketed in both local and urban markets (Wilkie *et al.*, 2005; Makazi, 2004; Mendelshon *et al.*, 2003; Fa *et al*., 2000; Ngandjui and Blanc, 2000; Ambrose-Oji, 1997; Usongo and Curran, 1996) or concentrated on the estimation of wildlife population densities (Rovero and Marshall, 2004; Eggert *et al*., 2003; Waltert *et al*., 2001). Little information exists on the number of carcasses, their mass and value of the animals captured by hunting households (Makazi, 2004; Ngueguim, 2001; Fa *et al*., 2002; Akwah, 1999; Noss, 1998). Furthermore, no clear understanding exists on the consumption and trade chains of the bushmeat to meet daily protein needs. The household economic value of bushmeat needs to be properly understood in order to target appropriate policies that can support the dual objectives of nature conservation and human development.

Several researchers argued that traditional forest hunting was probably sustainable in the past because of low human population densities, simple hunting technologies and subsistence-oriented consumption (Bennett *et al.,* 2006). However, whatever the trend was in the past, the contemporary situation in the Congo Basin is a transition from subsistence to commercial hunting that in most cases has resulted in over-hunting with over 60% of hunted animals in the region being exploited unsustainably (Fa *et al*., 2002) due to human population growth, modernisation of hunting techniques, greater accessibility to remote forest areas. This is made possible by industrial logging, slash-and-burn farming and the overall expansion of road infrastructure (Laurance *et al.,* 2006; Fa *et al*., 2005; Barnes, 2002; Wilkie & Carpenter, 1999; Noss, 1998; Barnes and Lahm, 1997). This has provoked many confusing debates within conservation and development spheres on-bushmeat production, consumption and trade in different parts of the world. In the last three decades, such debates have resulted in a number of confrontations between local hunters and conservation organisations. However, to date no clear policy statements or actions have been undertaken to arrive at a win-win outcome, where the basic needs of the hunters and their families are met alongside the conservation objectives of sustaining the existence of targeted animal species. Instead, suppressive measures have been used involving hiring eco-guards, policing the forests and markets, seizing ammunition and hunting equipment as well as the imprisonment of illegal hunters. Despite these measures being implemented, the required results have not been yielded and therefore more stringent anti-poaching steps are being established and additional financial resources are being allocated to regional processes, such as the Central African Forest Commission's Joint Plan of Action. Commercial hunting, tagged by conservation supporters as poaching as opposed to indigenous hunting for consumption, has been viewed as the major driver to bushmeat sustainability problems. In some cases the patronage of poaching by urban elites and administrators has been blamed as a weakness in enforcing anti-poaching regulations. All these problems have caused, what has now been coined a "bushmeat crisis," and are viewed with mixed feelings by both the local people and workers for conservation or development (Bennett *et al*., 2006; Laurance *et al.,* 2006; Wilkie *et al*., 2005).

Some development workers blame the lack of viable alternatives to bushmeat on failing conservation strategies (Laurance *et al.,* 2006). According to Fa *et al.* (2003) and Bennett *et al*.

(2006) the high dependence on bushmeat protein is associated with the fact that most countries do not produce sufficient amounts of non-bushmeat protein to feed their populations. This is truly observed in and around logging towns, where domestic animals, the alternative source of protein, are viewed by most people as delicacies and most often eaten only on festive days such as Christmas and New Year. Therefore, Fa *et al*. (2003) warn that the continuous reliance on bushmeat as a source of animal protein for teaming forest-dependent populations can drive the extinction of many species, thus adding to the misery of the forest-dependent poor. The role of alternative sources of income and animal protein would require deliberate policy overhauls within conservation and development agencies (Brown, 2003; Bennett, 2002; Davies, 2002). This cannot happen without sufficiently reliable data on household consumption and income from bushmeat. Therefore, this study is aimed at providing key information to re-examine the bushmeat situation in this area.

Study objectives

In the past, the surveys of bushmeat production and trade failed to include data on household consumption and income, making it rather impossible to understand the importance of bushmeat as a major resource for poor rural households. Although hunting for bushmeat has been a major conservation issue, it is not only important in the conservation context but primarily in the context of peoples' livelihoods (de Merode *et al.*, 2004). According to Fa and Garcia Yuste (2001) many hunters complement their income with the sale of bushmeat, suggesting the significance of using wildlife as a source of income for the local populations. This means that local livelihoods are tied to bushmeat hunting (Bennett, 2002; Fa *et al.*, 2003), which could contribute to their economic upliftment if managed for sustainability and transparently integrated into the general household economy (Albrechtsen *et al*., 2006; Brown, 2003). Such integration would complement other activities like farming, fishing, the gathering of non-timber forest products and so on (Mendelshon *et al.*, 2003; Ntiamoa-Baidu, 1997).

This study examines the economics of poaching and its persistence despite all the suppressive measures around logging towns in the Congo Basin. Within the above background, the general objective of the study was to examine the role of bushmeat hunting within the household economy with the following specific objectives:

1. assess the value of bushmeat from hunting to local household economies, both for home consumption and for sale;
2. extrapolate the role of bushmeat to household protein needs and income in two logging towns around the Lobeke National Park;
3. proffer recommendations for bushmeat policy shifts in logging towns that can promote both development and conservation outcomes whilst tackling the bushmeat crisis.

METHODS

Study area

Libongo and Bela are logging conglomerations with burgeoning populations of over 6000 inhabitants. They are located near the northern borders of the Lobeke National Park (LNP) in the East Province of Cameroon. These are typical logging towns and accumulations of people from different ethnic backgrounds, working or searching for jobs in an Italian logging company Société d'Exploitation Forestière et Agricole du Cameroun (SEFAC). Typical characteristics of logging towns in the Congo Basin are that they are located in forested regions, mostly several kilometres away from administrative centers with formal economic activities central to logging. Aside from logging, other activities of these towns are either informal or are poorly supported and monitored by the existing infrastructures and administrative systems.

In June 1998, the government of Cameroon declared the Lobeke National Park as a "Gift to the Earth". Final gazattement took place on the 19th of March 2001 under Decree No. 2001/107/CAB/PM. The LNP has a surface area of 217 854 ha with buffer zones composed of six community and trophy hunting zones that are superimposed on five logging concessions, covering a total area of 354 928 ha. The park is situated between latitude 2^{o}05'-2^{o}30'N and longitude 15^{o}33'-16^{o}11'E. Administratively, the LNP is entirely located in the Moloundou sub-division, Boumba and Ngoko division of the East Province of Cameroon. This park is rich in forest resources and wildlife on which depend generations of indigenous communities. The local people include the Baka Pygmies, Bangandos and Bakweles as well as a diversity of immigrant people. Human activities in the region include timber extraction, exploitation of non-timber resources, fishing, hunting and small businesses. The major stakeholders in this area are local communities, representatives of administrative and municipal authorities, delegates from the Ministry of Forests and Wildlife (MINFOF) as well as representatives from the Worldwide Fund for Nature (WWF) and the German Technical Cooperation (GTZ).

The biological richness of the region is characterised by a great variety of animals such as forest elephants, western lowland gorillas, chimpanzees, bongos, duikers, sitatungas, forest buffaloes, and many species of birds, including the famous African grey parrot. There are 764

plant and 45 mammal species, excluding rodents (MINEF, 2004). Another important feature of the LNP is that it is part of a trans-boundary park, known as the Sangha Tri-National Park (TNS). This Tri-National Park comprises the protected areas of the Lobeke National Park in Cameroon, the Dzanga-Ndoki National Park (DNNP) in the Central African Republic and Nouabale-Ndoki National Park (NNNP) in the Republic of Congo, covering a total surface area of about 28 000 km^2. The Sangha River forms the eastern boundary of the LNP and is shared with the DNNP and NNNP. Animals move across the river to either of the parks, which instigated the need for a common management system.

Data collection and analysis

This research is based on household and user-group surveys conducted with the use of structured questionnaires and other qualitative methods such as rapid rural appraisal and participatory rural appraisal tools. The applied methods were focused on group interviews and key informants to elicit information from hunters on their activities in Libongo and Bela. Local research assistants were employed to collect information over a period of 10 days in the two logging towns, although confidence on the anonymous nature of this study was built for more than 18 months by regular visits proving no threat to illegal hunting. Such trust was required to capture sensitive information about hunting tools and methods, types and quantities of the hunted animals, and the bushmeat trade. Socio-economic variables sought included- location, hunters' sex and age, ethnic background, marital status, education, household size, cash income from non-hunting activities, the five-ordered most hunted species, quantities of bushmeat hunted per week, quantities of bushmeat sold or consumed, average price and mass of each species, and average weekly income.

Research on bushmeat is generally known to be sensitive to garner hunters' participation due to their fear of being criminalized. In the study area, such fears were obvious among hunters which made them wary about giving details on the number of animals per species they hunt. Some willing hunters did not know or could not remember exactly the distribution of hunts by species. Others were merely afraid to furnish quantitative information. In order to elicit relevant information from the hunters, the best option was to make an estimation of the distribution of animals hunted per species based on hunters' statements. Then, weighted

averages were calculated for each species of the animals reported by the hunters among the most hunted animals. Five most commonly hunted animals were ranked by each hunter, by allocating scores ranging from five to one, five being the most frequently and one the least frequently hunted species. These scores added to a maximum score of 15 attributed by each hunter to the five most frequently hunted animals. Therefore, coefficients defining the ranking of the hunted species were α_1=5/15; α_2 =4/15; α_3 =3/15; α_4 = 2/15 and α_5 =1/15 for the first, second, third, fourth and fifth most hunted species, respectively. In order to estimate the rate (R^j) at which each species (j) was hunted in the region, the relative frequencies of hunters that provided the same ranking were multiplied by the respective coefficients according to the following formula:

$$R^j = \sum_{i=1}^{5} \alpha_i \cdot \frac{n^j{}_i}{N} \qquad (6.1)$$

where:

j - species
N=99 the total number of hunters
$n^j{}_i$ - number of hunters that stated *j* as their *i* most hunted species
α_i - coefficient linked to *i* rank
R^j- rate of j species.

With the rate for hunting each species in the study area approximated using (6.1), it became possible to estimate the number of animals hunted per species by multiplying respective rates by the total number of animals hunted:

$$H^j = R^j \cdot H \qquad (6.2)$$

where

H^j = number of j species of animal hunted per year
R^j = rate of j species of animal hunted
H = total number of animals hunted in the region per year.

Two approaches were used to estimate an average income generated by hunters. In the first approach the estimated average income excluded all the costs incurred by the hunters. The costs of items were found to be highly variable among the hunters and therefore difficult to measure. In some cases no obvious cost was discernible because family labour and the use of

ropes from the forest were considered costless to the hunters (assumes that the opportunity cost of family members' time is zero). In the second approach the total number of animals hunted per species and the corresponding market prices of whole carcasses were used to estimate the total annual income. This second estimate included all the costs in the gross annual revenue. The revenue obtained from the first method was subtracted from that obtained in the second method to get the total annual cost of hunting operations. Cost/benefit estimates were made on a weekly basis and extrapolated per month or per annum as many hunters could not remember their activities for longer than two weeks.

Microsoft Excel was used to enter the data and the SPSS statistical package was used to analyze it. T-tests were conducted to find if there were any differences between the income of full-time and part-time hunters. In order to find out the incentive for hunting specific animals, a correlation analysis was carried out to find out if the revenue earned by hunters was associated with the number of animals hunted or their mass, or both. The extrapolation of the number of animals, bushmeat mass and total revenue earned by the bushmeat hunters in the Lobeke National Park area was conducted by using the following formula:

$$NH_{14} = \frac{NH_2 \cdot P_{14}}{P_2}$$

where

NH_{14} – Annual total number of animals hunted in 14 villages around the LNP

NH_2 – Annual total number of animals hunted in the two villages surveyed

P_{14} – Total population of the 14 villages around the LNP

P_2 - Total population of the two villages surveyed.

The assumption was that all villages in the region could be considered homogenous in terms of bushmeat consumption, hunting habits and unit prices. The implication of such homogeneity was that the total bushmeat consumed was positively linked to the total population of the area. The local currency was valued at the following rates: one United States dollar was equivalent to 500 CFAF and one Euro cost 656 CFAF. Apart from household surveys some information was gathered from earlier studies on bushmeat trade and local consumption to buttress current findings (Bennett *et al*., 2006; Laurance *et al.,* 2006; Wilkie *et*

al., 2005; de Merode *et al.*, 2004; Makazi, 2004; Fa *et al.*, 2003; Ngueguim 2001; Wilkie and Carpenter 1999; Noss 1998).

Logistic regression

For policy reasons, it was considered imperative to understand the factors that drive hunters towards bushmeat hunting as a pertinent income generating activity and to distinguish between those that earn low or high incomes from the said activity. This was defined in terms of low and high bushmeat income earners giving a dichotomous outcome; such that target policy reforms could readdress the factors that enable such hunts and, thus, reduce hunting intensity. The cut off monthly hunting revenue between low and high income earners was 23 500 CFAF (US$ 47), the minimum salary rate authorised by the national law (Loi N^{o}. 92/007 of Cameroon (Code du Travail au Cameroun, 1992). Hunters that earned less than the cut off amount were classified as low bushmeat income earners while those above the cut of point were considered at the high end. Giving this classification, 45.5% and 55.5% of the hunters were of the low and high bushmeat hunting revenue spectra respectively. The logit model was applied in the Statistical Package for Social Sciences (SPSS) Version 12 in the Microsoft Windows 2003 interface in order to establish the links between independent variables and the probability of the dependent variable taking the value 0 or 1 (Mukherjee *et al.*, 1998). The dependent variable in this case was bushmeat income earners dichotomised into low (0) and high (1) outcomes (Masozera and Alavalapati, 2004; Gujarati, 1995).

The model used to determine the factors that explain hunters' revenues was specified as follows:

$$\mathbf{Ln}\ [\mathbf{P_i/(1-P_i)}] = \beta_1 \mathbf{X}_1 + \beta_2 \mathbf{X}_2 + \beta_3 \mathbf{X}_3 + \ldots + \beta_n \mathbf{X}_n + \varepsilon_i \qquad (6.3)$$

Where:

P_i is the probability for a bushmeat hunter to earn a high revenue from hunting

$X_1, X_2, X_3 \ldots X_n$ are the independent variables

$\beta_1, \beta_2, \beta_3 \ldots \beta_n$ are coefficients associated with each independent variables

ε_i is the error term

Subscript n denotes the number of independent variables

Subscript i denotes the i^{th} bushmeat hunter in the sample

The explanatory variables used to explain the differences in hunters' revenues were: age of hunter, education, ethnic affinity, time input into hunting, number of years as hunter, household size, other income sources and marital status. Theoretical relationships between each explanatory variable and its impact on the income of bushmeat hunters are described as follows:

i. Ethnic group - ethnicity can determine the rate of hunting due to different hunting experiences. Hunters were of different ethnic backgrounds that could have attracted different hunting techniques with varying efficiencies. Therefore, the expected sign in the logit model can be positive or negative depending on the efficiency of hunting techniques employed;

ii. Years in hunting - number of years in hunting experience can influence hunting revenues positively, assuming that a more experienced hunter could have more tools and knowledge than beginners. Thus the expected sign in the logit model is positive.

iii. Age of hunters in years – Older hunters are expected to have more experience than younger ones, thus, the expected sign in the model is positive. However, older hunters could also have less physical strength, thus less efficient hunters. It could be said that hunting ability will increase with experience but at a declining rate due to elements of age.

iv. Time in activity – full-time hunters are expected to have more revenue from hunting than part-timers, thus, time input into hunting activity is expected to have positive influence on hunters' revenues.

v. Other sources of revenue – other income-generating activities such as farming, fishing, formal employment, trading, and the collection of non-timber forest products are expected to influence hunting income negatively. On the contrary, other revenue sources could provide liquidity needed to engage in hunting (e.g. purchase of wires, payment of helpers etc)

vi. Education level – education helps in knowing things beyond the confines of the immediate environment, meaning highly educated persons are expected to appreciate hunting techniques within and beyond their villages. Therefore, education is expected to influence hunting revenue positively.

vii. Marital status – married people have at least one additional mouth to feed and therefore would have to put greater energy into hunting, thus, generating higher revenue than singles. The expected sign is positive. Moreover, a married hunter probably spends relatively less time on tasks such as fuel and water collection and probably more time for income generating activities such as hunting, farming and wage employment.

viii. Household size – hunters with bigger households could be influenced in the same way as described for ‘married’ marital status.

RESULTS AND DISCUSSIONS

Socio-economic profile of hunters

It was found that there were 99 active hunters in the two loging towns, 45 in Bela and 54 in Libongo. Most of the hunters (68.7%) were found to be part-time hunters while for 31.3% hunting is a fulltime activity. In terms of education, about 57% of the hunters had never attended any school while 33.3%, 7.0% and 3.0% had some primary, secondary and nursery education, respectively. The hunters were from twelve ethnic backgrounds including Baka Pygmies (46.5%), Kako (14.1%), Yanguere (13.1%), Bimou (12.1%), Bangando (4.2%), Vonvon (2.0%), Eton/Ewondo (2.0%), Gbaya (2.0%), Congolese (1.0%), Bakwele (1.0%), Badjoue (1.0%) and Maka (1.0%). The indigenous people (Baka, Bangando and Bakwele) represented 51.7% of the hunters while 47.3% came from other parts of the country and 1.0% from outside the country. This observation contrast with what Makazi (2004) observed near the southern borders of the Lobeke National Park area, where most of the over 200 commercial hunters were immigrants from other parts of the country.In terms of age, 31.3%, 41.4%, 20.2% and 7.1% of the hunters were 15-30 years, 31-40 years, 41-50 years and over 50 years old, respectively. The mean hunting age was 33 years, minimum (min) =17, maximum (max) = 56 and standard deviation (sd) = 9.3. Overall 64.7% of the hunters were married, (5.4% had two wives). Household size varied from 1 to 18 persons (mean=4.1, sd=3.1). There were 409 people living in these hunting households, 241 of them being children. The mean number of children per household was 2.4 (min=0, max=15, sd=2.8). With regards to the sources of capital for financing hunting operations, 87.9% of hunters self-financed their operations, 10.1% had sponsors in the towns and 1.0% each either borrowed money or got an external sponsor to purchase hunting tools. Hunters that are sponsored usually share the proceeds from hunting with their sponsors and in some cases the latter take a larger share.

Hunting experience

The years of hunting experience for most hunters varied from 3 years to 35 years, with a mean of 14.3 years (sd=7.3). This result suggested that hunting was an old practice for most hunters in Bela and Libongo. One anonymous hunter vividly put it in these words: ‘‘*Hunting has not started now, it is an ancient practice. In the past there was no gun to shoot, our fathers and*

forefathers used to dig holes like graves, construct fences around and rush animals into them. That was the way they used to get their animals. All types of animals used to fall inside the holes and were killed and taken to the village, presented to our leaders, who usually called all village members to divide the meat equally. There was no trade and no money exchange involved. Hunting for money started with the arrival of the Germans, who introduced the use of wires for snares and guns for shooting without missing. Nowadays we still use the guns and wires to kill animals. The tradition of presenting bushmeat to our leaders has virtually died away unless for selected species for indigenous people but with the outsiders this tradition has died off. The price of bushmeat has increased with the creation of roads and the installation of the timber company that has given rise to more clients and increased demand. Hunting activities are complementary to other activities, especially farming and the collection of other forest products. Hunting is more intense during off-farm seasons and is more consistent because of the fluctuating prices of agricultural products as well as the high costs of establishing a plantation of agricultural crops for a reasonable income. Other sources of income aside from bushmeat are not available and I have been hunting for over 30 years to feed myself and my family. What else can be more lucrative and rewarding to me than hunting? Perhaps, I still need to find. However, hunting is becoming more limited now because most people are being harassed by conservation people and more time is being given to the establishment of farmlands. To some people hunting is more like a transition activity after farm products mature but some of us are still full-time hunters and the benefits keep life going albeit the high risks, warnings and empty promises. Most products are sold in rural markets both at night and in the early hours of the day but some buyers come from towns. To stop hunting completely and do nothing else productive or more rewarding is the same as telling you to abandon your job and go back and meet your father but do nothing else. Can you abandon your profession and go back home and do nothing else? How would you live, your children, your wife and other dependents?”

Numbers and values of hunted animals

According to the hunters interviewed in Bela and Libongo, the number of animals hunted per person per week varies from 2 to 25 animals (mean=7.4, sd=4.1). This gives a total of 730 animals hunted per week or 37 970 animals hunted annually by all the hunters interviewed. This number varies from a minimum of 104 animals to a maximum of 1300 (mean=383.3, sd=215.4). In Bifa, a village in the South Province of Cameroon, Ngueguim (2001) found that on average a hunter captured at least three animals per week totaling 156 animals per annum. In the Dzanga Sangha Forest Reserve region of the Central African Republic, Noss (1995) estimated that people using cable snares hunted 10 552 animals per annum for the 2500 inhabitants of Bayanga, this excluded about 40% of animals hunted and sold locally.

The animals hunted by the Libongo and Bela hunters are either sold (62%) or consumed by the hunting households and given out as gifts (32%). In terms of cash value, the weekly incomes of hunters varied from 1000 CFAF to 35 000 CFAF (mean=8530, sd=6488). Annual cash incomes of hunters varied from 52 000 CFAF to 1 820 000 CFAF (mean=444 000, sd=337 000 CFAF (Table 6.1). The total annual cash income was estimated at 44 million CFAF for the 99 hunters interviewed. A total value of bushmeat was 71.6 million CFAF per annum when the value of the bushmeat utilized by the hunting households was included. This value excludes all costs incurred by hunters in hunting expeditions.

Table 6.1. Estimated annual value (CFAF) of bushmeat and number of animals hunted by the 99 hunters interviewed in Bela and Libongo (Cameroon) in 2007 (sd - standard deviation, min - minimum, max - maximum value).

Specification	Per hunter				Total for all 99 hunters
	Mean	sd	min.	max.	
Number of animals hunted	383.4	215.4	104	1300	37 960
Number of animals sold	237.4	174.1	52	1040	23 504
Number of animals consumed	145.5	75.0	0	416	14 404
Cash income from sold meat (CFA F)	443576	337 363	52 000	1 820 000	43 914 000
Value of consumed meat (CFA F)	279 000	166 121	0	866 667	27 621 038
Total value of meat	723 206	437 127	78 000	2 340 000	71 597 438

As depicted in Table 6.1, when the value of consumed bushmeat is taken into account, the hunters are making an average of 723 206 CFAF per annum (min=78 000, max=2 340 000, sd=437 127). This means that the total annual value of bushmeat consumed or given out as gifts by those 99 hunting households is about 28 million CFAF or an average of 279 000 CFAF per hunter.

The cash income per hunter from bushmeat in Bifa (a village in the southern part of Cameroon) averaged 5343 CFA Francs per week or 277 836 CFAF per annum (Ngueguim 2001). In the southern section of the Lobeke National Park, the annual income of a hunter averaged 608 000 CFAF (Makazi, 2004). On a national level, Infield (1988) estimated an annual income of 350 000 CFAF and 360 000 CFAF per hunter for Cameroon and the Central African Republic, respectively. Noss (1998) reported that snare hunters trapping within the Dzanga-Sangha special forest reserve in southwestern Central African Republic earn 200 000 - 350 000 CFAF per year. The obvious conclusion from these estimates is that annual hunting revenue per hunter generally exceeds the national per capita income for most countries in the Congo Basin, except for Gabon and Equatorial Guinea.

Outside Cameroon, estimates of consumed bushmeat mass are provided, for example, by Townsend (2000) who showed that in Latin America the average daily consumption of bushmeat was 59.6 g per person. According to Fa *et al*. (2003), the current bushmeat protein supply may range from 30 g person^{-1} day^{-1} in the Democratic Republic of Congo to 180 g person^{-1} day^{-1} in Gabon. In the Malaysian state of Sarawak, 67% of Kelabits' (indiginous people) meals contain bushmeat, forming the main source of protein (Bennett *et al.*, 2000).

A comparison between full-time and part-time hunters showed that they earned significantly different annual incomes of 908 155 CFAF and 638 892 CFAF, respectively. Such revenues were earned by killing 515 and 324 animals annually by full and part-time hunters respectively (Table 6. 2).

Table 6.2. Mean revenues (CFAF) and numbers of animals captured by full and part-time hunters in Bela and Libongo (Cameroon) in 2007 (sd = standard deviation).

Variable	Part time	Full time	Combined
Revenue	638 891.7 (sd=394 704.4)	908 154.8 (sd=474 130.4)	723 206.4
Animal numbers	323.5 (sd=145.9)	515.0 (sd=279.2)	383.4343

A t-test showed that there were significant differences between the revenues of full-time and part-time hunters (df=97, |t|=2.95, p= 0.004). The difference between full-time and part time hunters in the mean number of animals captured was also significant (df= 97; |t|= 4.49; p<0.001). It is also important to note that there was no significant differences in the proportions of animals consumed and sold by the two types of hunters (df=97, |t|= 1.18, p=0.239). This result shows that part-time hunters have similar motives as full-time hunters, i.e. to make additional income by selling bushmeat. This is unexpected as part-time hunters were thought to hunt mainly for own consumption.

Species, mass and value of hunted animals

Eighteen (18) animal species were found to be regularly hunted in Libongo and Bela with a total annual count of 37 960 animals or 104 animals killed per day by 99 hunters. Therefore an estimated total of 576 264 animals were killed by the 99 hunters over their mean hunting experience of 14 years. Individual hunters hunted between 416 to 35 100 animals (mean=5821, sd=5435) over the same period. Great variations were observed on the number of animals per species. Based on the reports by the hunters on their most hunted animals, a weighted average coefficient was calculated for each of the species resulting in the rating provided in Table 6.3.

Table 6.3. Weighted rating of the 18 most hunted species of animals near Bela and Libongo (Cameroon) in 2007.

Latin name	Local name	1st hunted	2nd hunted	3rd hunted	4th hunted	5th hunted	index
Cephalophus monticola	blue duiker (lievre)	0.2626	0.3131	0.1919	0.0707	0.0909	0.225
Atherurus africanus	porcupine	0.1111	0.2626	0.2727	0.1515	0.0606	0.186
Cephalophus callipygus	Peter's duiker (Birch)	0.3131	0.1010	0.1313	0.0606	0.0404	0.168
Tragelaphus euryceros	antelope (bongo)	0.1010	0.0606	0.0202	0.1212	0.1414	0.079
Manis spp	pangolin	0.0404	0.0606	0.1010	0.1212	0.1515	0.076
Tragelaphus spekei	sitatunga	0.0707	0.0202	0.0909	0.0707	0.1010	0.063
Hylochoerus meinertzhageni	giant forest hog	0.0606	0.0707	0.0505	0.0707	0.0505	0.062
Thryonomys swinderianus	grasscutter	0.0101	0.0606	0.0202	0.0707	0.0808	0.038
Cercocebus spp.	monkeys	0.0101	0.0000	0.0303	0.1212	0.1111	0.033
Cricetomys gambianus	giant rat	0.0000	0.0101	0.0606	0.0808	0.0202	0.027
Crocodylus niloticus	crocodile	0.0202	0.0202	0.0101	0.0303	0.0000	0.018
Hyemoschus aquaticus	water chevrotin	0.0000	0.0000	0.0101	0.0202	0.0404	0.007
Felis aurata	golden cat	0.0000	0.0101	0.0101	0.0000	0.0202	0.006
Guttera plumifera	guinea fowl	0.0000	0.0000	0.0000	0.0101	0.0606	0.005
Syncerus caffer nanus	forest buffalo	0.0000	0.0101	0.0000	0.0000	0.0000	0.003
Gorilla gorilla	gorillas	0.0000	0.0000	0.0000	0.0000	0.0101	0.001
Atilax paludinosus	marsh mongoose	0.0000	0.0000	0.0000	0.0000	0.0101	0.001
Python sebae	python (boa)	0.0000	0.0000	0.0000	0.0000	0.0101	0.001
Total		**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.000**

The weighted ratings may imply that out of say 1000 animals hunted, 225 would be blue duikers, 186 porcupines, 168 Peter's duiker, 79 bongo antelopes, 76 pangolins, 63 sitatunga, 62 giant forest hogs, 38 grasscutters, 33 monkeys, 27 giant rats, 18 crocodiles, 7 water chevrotins, 6 golden cats, 5 guinea fowls, 3 forest buffalos, and one each of gorillas, marsh mongoose and python. The observed high frequency of duikers confirms the results from the neighbouring Bayanga (Central African Republic) that 74.6% of the animals captured with net snares were the blue duikers and 22.8% of other species, including porcupines and other duiker species (Noss, 1998). Fa and Garcia Yuste (2001) found similar results during their

surveys in Monte Mitra, Equatorial Guinea. In this case the most hunted species was the blue duiker (21.6% or 658 carcasses), followed by the porcupine (20.3%). A surprising result of that study was the high frequency of grasscutters being captured in the tropical rainforest as grasscutters are mostly savannah species that enjoy a thick herbaceous layer of vegetation. Their high frequency could serve as an indicator to potential changes in the ecology of the region, possibly caused by deforestation. Opening up canopies allows more light to reach the forest floor and this promotes the growth of a thick undergrowth of herbaceous vegetation containing grass species.

The ranking of the species hunted in Bela and Libongo areas was different when bushmeat mass or values were taken into account (Table 6.4). This approach is new in the relevant studies except for the study by Fa and Garcia Yuste (2001) that made some estimates of the body mass for various hunted species.

Table 6.4. Ranking of hunted species by numbers, bushmeat mass and value in Bela and Libongo (Cameroon) in 2007 (figures in parenthesis represent the ranks).

Species	Annual animal numbers	Average mass (kg) per Animal	Annual bushmeat mass (kg)	Average price/ animal (CFAF)	Average price (CFAF) per kg of bushmeat	Total annual bushmeat value (CFAF)
Blue duiker (lievre)	8538 (1)	4	34151 (4)	2000	500	17075609 (5)
Porcupine	7055 (2)	2.5	17638 (7)	2000	800	14110384 (6)
Peter's duiker (birch)	6391 (3)	8	51125 (2)	6000	750	38343434 (2)
Antelope (bongo)	3016 (4)	80	241308 (1)	25000	313	75408754 (1)
Pangolin	2889 (5)	2.5	7221 (10)	2000	800	5777077 (8)
Sitatunga	2403 (6)	18	43251 (3)	10000	556	24028552 (4)
Giant forest hog	2352 (7)	15	35276 (5)	12000	800	28220768 (3)
Grasscutter	1457 (8)	2.5	3643 (11)	2500	1000	3642626 (11)
Monkeys	1253 (9)	6	7515 (9)	4000	667	5010209 (10)
Giant rat	1022 (10)	0.5	511 (18)	500	1000	511246 (14)
Crocodile	690 (11)	40	27607 (6)	20000	500	13803636 (7)
Water chevrotin	281 (12)	5	1406 (13)	5000	1000	1405926 (12)
Golden cat	230 (13)	5	1150 (14)	3000	600	690182 (13)
Guinea fowl	204 (14)	0.5	102 (16)	800	1600	163599 (17)
Forest buffalo	102 (15)	100	10225 (8)	50000	500	5112458 (9)
Gorillas	26 (16)	75	1917 (12)	18000	240	460121 (15)
Marsh mongoose (renard)	26 (17)	1.5	38 (17)	1500	1000	38343 (18)
Python (boa)	26 (18)	8	204 (15)	10000	1250	255623 (16)
Total	**37 960**	**-**	**484 290**	**-**	**-**	**234 058 548**

It is clear that the ranking of species varies depending on a characteristic used. In terms of numbers blue duiker is followed by porcupine, Peter's duiker, antelope and pangolin are the most commonly hunted animals. The largest total bushmeat mass is obtained by hunting antelope and then Peter's duiker, sitatunga, blue duiker and the giant forest hog. The same species deliver the highest total annual value but in the following order: antelope, Peter's duiker, the giant forest hog, sitatunga and blue duiker. The most valuable animals on a bushmeat unit mass basis are guinea fowl, python, grasscutter, giant rat, water chevrotin and marsh mongoose (Table 6.4). These observations suggest that the importance of the game in providing bushmeat or income to the households' economies is a function of animal numbers, mass and price. One or all of these factors, in addition to species vulnerability to hunting methods, can explain hunting pressures. Generally, some of the most hunted animals such as the bongo antelopes are hunted not just for the meat but also as trophies, for which trophy hunters in Cameroon pay 1 000 000 CFAF, the same rate as for hunting elephants and lions. For other species, the ease to hunt duikers or to capture smaller mammals such as the porcupines and pangolins with wire/rope snares are technical incentives to consider in hunting preferences.

In order to find out which of the variables (number or mass) contributed most to the annual revenues of hunters, correlation analysis was conducted. There was only a weak correlation between the total revenue and the number of animals hunted per species (r=0.452). However, the revenues earned by hunters were found to be highly correlated to the mass of the hunted animals (r=0.943) as the total bushmeat mass is a combination of animal size and their numbers. This shows that hunters are more motivated to hunt animals of high body mass than numerous but smaller animals. This may explain the high hunting pressures on bongo antelopes. The high frequency of capturing blue duikers might be more associated with the relative ease of capturing them with cable snares rather than because of their value (Noss, 1998).

The relationship between the average animal mass and the bulk bushmeat price (Figure 6.2 top) showed that the value of animals generally increases with their mass as larger animals provide larger quantities of food ($R^2 = 0.9476$). Almost 95% of the variation in animal prizes

can be explained with the average animal mass by fitting a power function. On the other hand, the larger animals are worth less on a per kilogram basis (Figure 6.2 bottom). That is, the unit price of a kilogram of bushmeat decreases with the total mass of the animal hunted (R^2 = *0.6333*). In this case a power function can explain only 63% of the variation. The reason for that is uncertain and probably results from the lack of refrigeration and a need to sell a large bulk of bushmeat at once. It is also possible that some smaller animals are delicacies and preferred for their taste by the buyers who pay a better price per kilogram.

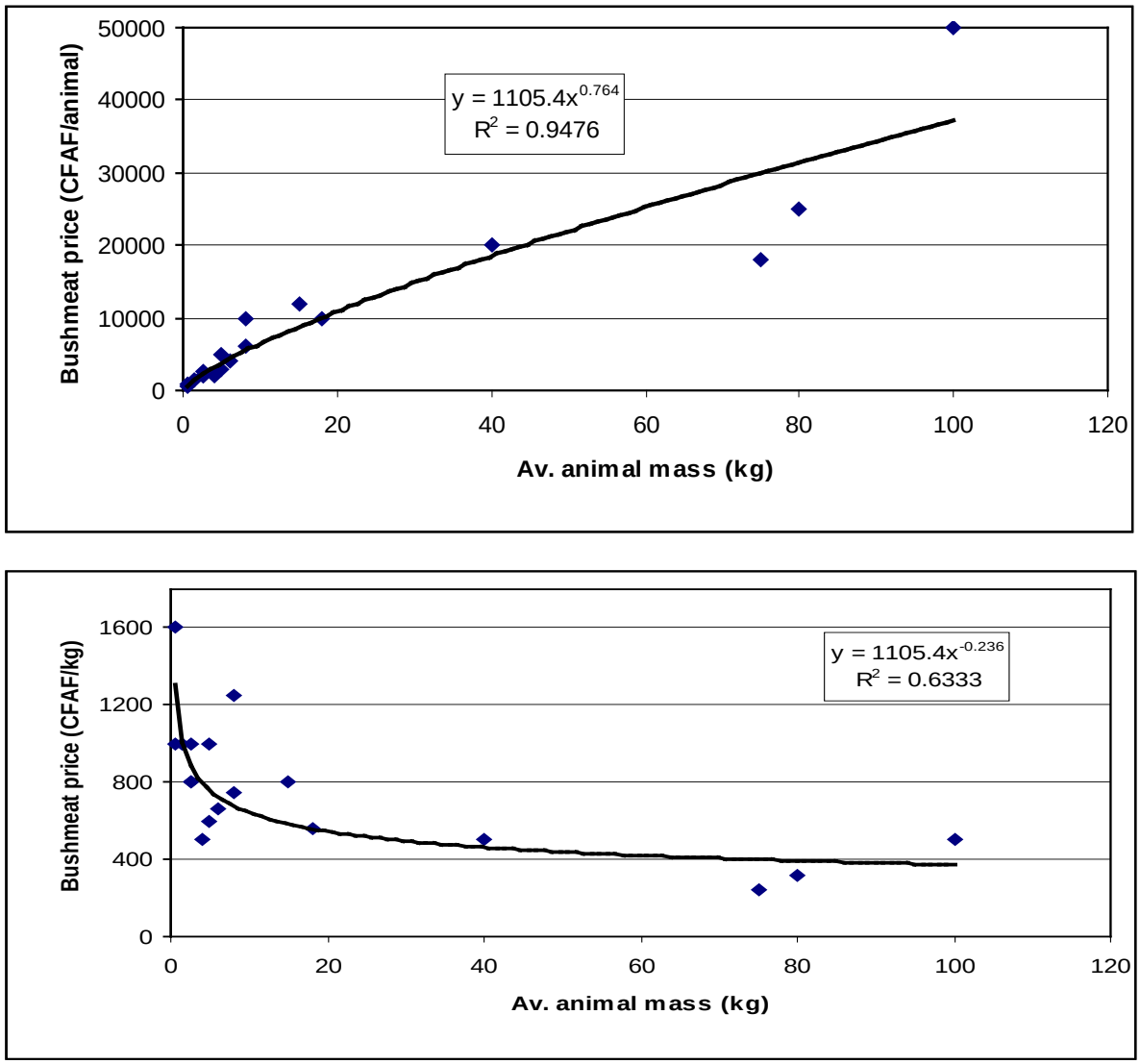

Figure 6.2. Trends in the relationships between (i) the average animal mass and the bulk bushmeat price (top) and (ii) the average animal mass and its unit (kg) bushmeat price (bottom) in Bela and Libongo (Cameroon) in 2007.

Despite the fact that that there was a positive relationship between the number of hunted animals and their total value (Figure 6.3 top), there is a lot (33%) of unexplained variation due to differences in the animal mass and price per kilogram of the hunted species.

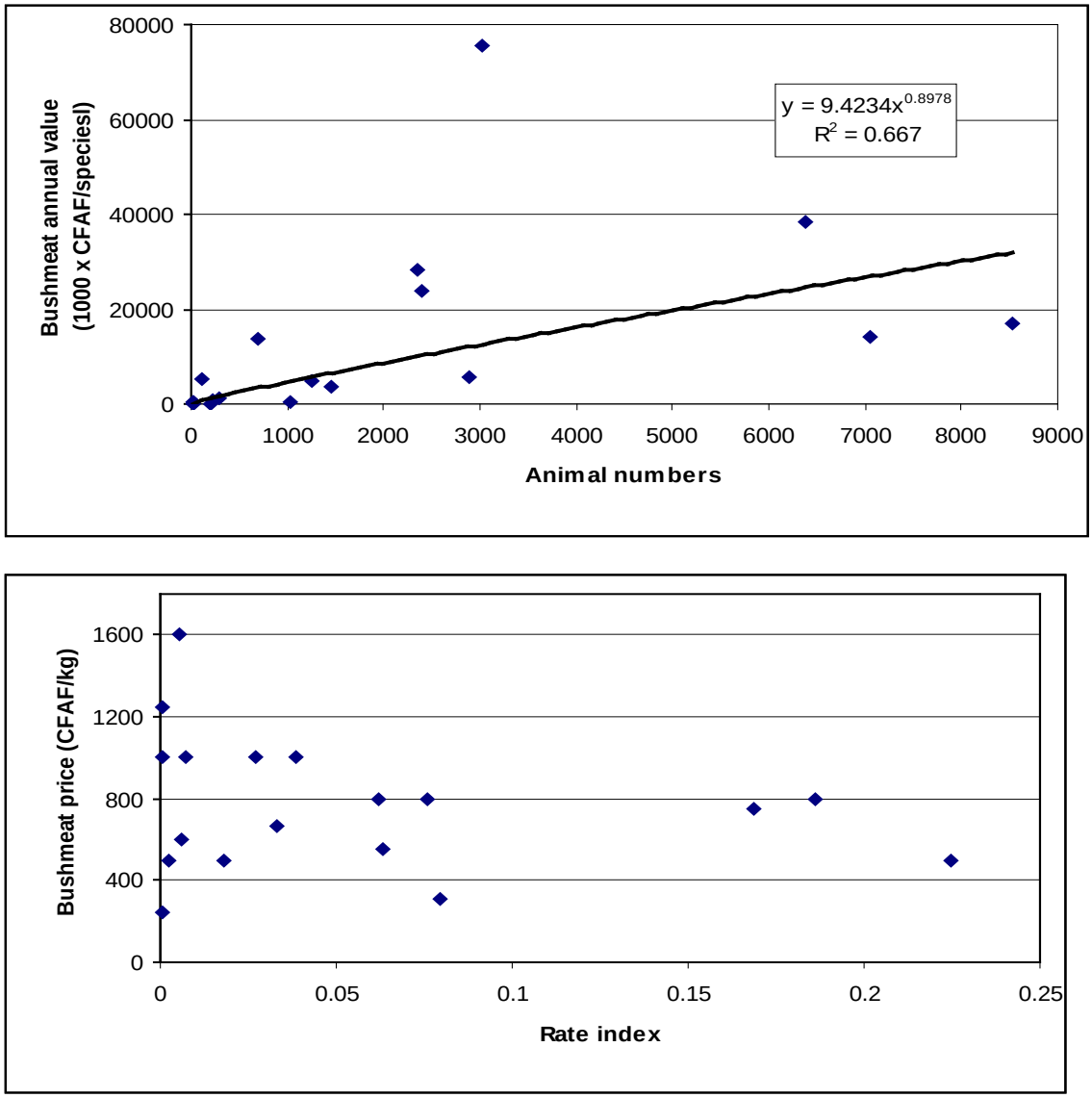

Figure 6.3. Relationships between (i) the number of all animals hunted and their (total) bushmeat value (top), and between (ii) hunters' rate index and the price of bushmeat per killogram (bottom) in Bela and Libongo (Cameroon) in 2007.

The hunters' rating of the hunted species was not associated with the bushmeat price on a per kilogramme basis (Figure 6.3 top) as there was no relationship between their ratings and the bushmeat unit price. The most hunted animals were priced at an average level while there is a

large price range for the less frequently hunted species. This may indicate an opportunistic nature of the hunts which may be more dependent on animal population densities rather then their value per kilogramme. The “random” nature of hunting may be a preferred phenomenon from a sustainability view point as unlikely hunters will persist in finding less common species by declining to hunt the easiest species to find. On the other hand, any attempt to regulate species populations by selective culling may be resisted by the opportunistic bushmeat hunters. It must be emphasized that proper game management may enhance ecosystem capacity. A better understanding of the biology and ecology of the game and the needs of the hunting communities is essential.

Indicated in Table 6.4, over 484 tons of bushmeat, valued at over 234 million CFAF are hunted each year in Bela and Libongo only. This amount includes all the costs incurred by the hunters. Although in terms of numbers, the bongo antelope does not feature as the first most hunted animal, it becomes the most hunted species in terms of the total mass and value estimated at 241.3 tons and 75.4 million CFAF, respectively (Figures 6.4 and 6.5).

If in just two logging towns, over 484 tons of bushmeat are harvested per year for consumption and trade, it could be argued that the total annual harvest of bushmeat, defined to be between one and five million tons in the Afrotropical region, could be a substantial under-estimate (Wilkie and Carpenter, 1999; Fa *et al*., 2002). The estimates of bushmeat consumption in the Congo Basin by Nasi (2007) seem to be more realistic:

Cameroon	78 077 tons
Democratic Republic of Congo	1 067 873 tons
Republic of Congo	16 325 tons
Central African Republic	12 976 tons
Equatorial Guinea	9 762 tons
Gabon	11 381 tons.

Libongo and Bela harbour a total population of about 6000 inhabitants and the total population of the 14 villages around Lobeke National Park was estimated at 26 000 people (MINEF, 2004). The extrapolation of the bushmeat supplies from Bela and Libongo to the whole LNP region is provided in Table 6.5.

Table 6.5. Extrapolation of the number and mass of hunted animals and the bushmeat revenue from Bela and Libongo to the 14 villages around the Lobeke National Park (LNP) in Cameroon.

Region	Population	Number of animals	Mass (kg)	Revenue (CFAF)
Bela/Libongo	6000	37960	484 290	234 058 548
Lobeke National Park area	26000	164493	2 098 590	1 014 253 708

Moreover, the estimate made for Bela and Libongo did not include other less frequently captured animal species, which, according to Fa *et al*. (2003), could furnish appreciable quantities of bushmeat. Within this group are some reptiles and birds as well as meat from elephants and other protected animals that were not mentioned by hunters, suggesting that the estimates made in this study could also have suffered from an underestimation.

Hunting methods

Four combinations of three hunting methods were used by the Libongo and Bela hunters. Some used only guns (1.0%) or wire traps (41.4%) as single hunting methods (Table 6.6). Other hunters used a combination of guns and wire traps (27.3%) or wire and rope traps (30.3%). No hunter used only rope traps as required by the wildlife law in Cameroon. Ropes are natural materials gathered from the forest, usually lianas or climbers with relatively high strength used locally for setting traps in the place of metallic wires.

Table 6.6. Hunting methods, number of hunters and weekly number of animals hunted in Bela and Libongo (Cameroon) in 2007.

Hunting method	Hunters		Animals	
	Number	Percentage	Number/week	Percentage
Guns	1	1.0	8	1.1
Guns and wire traps	27	27.3	264	36.2
Wire traps	41	41.4	275	37.7
Wire and rope traps	30	30.3	183	25.1
Total	99	100.0	730	100.0

The most popular hunting method was by using wire traps. However the most effective hunting technique involved a combination of guns and wire traps. This method yielded on

average 9.8 animals hunted per week compared to 6.1 animals a week for the least effective methods (wire and rope traps). Rope traps are less effective because they usually loose their strength after a few weeks of use. Guns are expensive and not many hunters can afford to stay in the forest at night to use guns when many animals are active.

The legal implications of hunting were studied by Eves (2002) who defined various types of venison; in this context:

- bushmeat is considered to be illegally derived from wildlife, by hunting either, (i) through the use of illegal hunting methods (snares, unregistered guns, etc.), (ii) killing endangered, threatened or protected species, (iii) in protected or excluded areas, or (iv) for trade or commercial gains;
- game meat is defined as legally obtained in commercial (private or communal) operations that are regulated and controlled, where monitoring of the wildlife populations and habitat is carried out, and where trade is legally conducted by authorized agents and controls;
- wild meat is that meat which is derived mainly for subsistence and local trade only by using legal means and conducted by individuals with legal rights to hunt animals officially specified for culling.

According to the above definitions, all the meat investigated during this study must be classified as bushmeat. Therefore, all the hunters from Bela and Libongo are unlawful because their guns are unregistered, they use illegal hunting techniques and all the hunters sell some of the bushmeat for income to feed their families. Given that in reality there is no substitute to bushmeat in the area, the ethical side of the current hunting regulations remains to be questioned unless the legal status of bushmeat can be redefined. This is a moral question driven by the quest for government's responsibility and their sense of empathy to ensure that the protein needs of the people in the region, including the 6000 people in Bela and Libongo, can be met in other ways.

Hunting costs

The total annual costs of hunting operations in Bela and Libongo were calculated by subtracting the money retained from hunting, i.e. 71.6 million CFAF from the gross revenue of 234 million CFAF. Therefore the cost of all hunting operations was estimated at 162.4 million CFAF representing 69.4% of the total annual gross revenue. This high operational cost for hunters is not surprising. Hunters make at least 15 trips to the forest per month, after every two days. During these trips they incur substantial costs of labour for seasoning meat in the forest, long distance transportation from and to hunting sites, purchase of wires, guns, food and other accessories. The latter include pots for cooking in the forest, machetes, polythene bags, tents, rubber shoes and so on. Apart from these operational costs, there are other sporadic costs that might actually reduce their income. Such costs include: the seizing of bushmeat by conservation and law enforcement officers, waste of meat (decay) associated with poor drying or the ill-health of hunters, theft of bushmeat from hiding places associated with the clandestine nature of the business and money used in bribing eco-guards once they are apprehended to be set free or for payments of informal taxes to some forest officers to get protection and information on anti-poaching strategies. Poor salary structures of conservation agents and government officials render most of them vulnerable to bribes, either in kind with bushmeat or in cash. Some resilient hunters move around with appreciable sums of money in their pockets when going hunting. If they are apprehended by one or two eco-guards, they bribe them immediately and they are set free. It becomes difficult to bribe when the eco-guards are many or are escorted by their supervisors for joint anti-poaching patrols and in the presence of some drivers that are loyal to the senior management of conservation organisations. The varying and informal ways these costs are incurred make them difficult to measure when using conventional research methods. Despite the overall high proportion of the costs, the revenue earned by a hunter remains appreciable under the contemporary socio-economic circumstances in Cameroon.

From the above analysis, it is clear that the average income (72232 CFAF) earned by a hunter is twice as high as the average income of a labourer (35 000 CFAF) or almost equal to the salary of a senior technician (80 000 CFAF) working at the SEFAC sawmill or an eco-guard working for conservation and development organizations such as the Worldwide Fund for

Nature and the German Technical Cooperation. For the local people without professional education and employment, hunting provides for their needs at an economic level roughly equal to those of their employed neighbours. This simple comparative analysis suggests a high financial incentive to hunt and therefore meet daily needs. The incentive to hunt is embedded in the economic benefits derived therefrom, despite the official suppressive measures taken against poaching.

Revenue sources alternative to hunting

Eleven income generating activities were reported by most (71.7%) hunters as giving them additional income (Table 6.7). More stringent hunters (28.3%) believed that there was no visible source of income aside hunting.

Table 6.7. Other sources of revenue for hunters in Bela and Kibongo (Cameroon) in 2007

Categories	Monthly mean (CFAF)	Standard deviation (CFAF)	Number of hunters	Monthly aggregate (CFAF)	Annual aggregate (CFAF)
Work at SEFAC	50 000	24 833	7	350 000	4 200 000
NTFP gathering	5 375	2 744	28	150 500	1 806 000
Livestock	12 625	6 802	8	101 000	1 212 000
Agriculture	5 143	2 797	14	72 000	864 000
Small business/trade	20 000	8 660	3	60 000	720 000
Fishing	9 750	7 320	4	39 000	468 000
Carpentary	30 000	.	1	30 000	360 000
Sawmill waste collection/sale	11 000	1 414	2	22 000	264 000
Barbing	20 000	0	1	20 000	240 000
Shoe mending	15 000	0	1	15 000	180 000
Fuelwood collection/sale	6 500	2 121	2	13 000	156 000
No alternative	-	-	28	-	-
Total	-	-	99	872 500	10 470 000

Some hunters believed that alternative activities such as agriculture were capital intensive and the amount of capital required for starting alternative commercial activities remained beyond the financial means of a typical village hunter. According to Messer (2000), measures on providing alternatives to poaching need to be addressed at the level of policy-making on wildlife management and conservation. Some hunters, when asked about their job preferences, often opted for a job in a logging company or any other formal job because hunting activities need their constant presence in the forest, which in most cases they found difficult and risky.

Regression results

The model on the revenue of hunters was significant with a log likelihood ratio (LR) of 111.0 which was higher than the Chi-square of 24.2 ($df = 10; \alpha = 0.05$). The explanatory power of the model was high as indicated by the goodness of fit statistics ($R^2 = 0.3$). Three variables (education level, marital status and other sources of revenue) had slight positive influence on hunting revenues, while years of hunting and household size had slight negative influences. Three variables significantly explained the determinants of hunters' revenues: age, time in activity, and ethnic group; all in conformity with the expected signs (Table 6.8)

Table 6.8: Results of the logit analysis on the determinants of hunting revenues for hunters in Bela and Libongo, Southeast of Cameroon (β – coefficient; SE – standard error; df – degrees of freedom; p – probabilities; OR – odds ratios).

Independent variables	β	SE	df	p	Odds Ratio
Education level			2	0.54	
No formal education	0.824	1.271	1	0.52	2.28
Primary education	0.076	1.140	1	0.95	1.08
Marital status	0.963	0.722	1	0.18	2.62
Other sources of revenue	0.000	0.000	1	0.21	1.00
Time in activity	1.202	0.558	1	0.03	3.01
Age	0.155	0.079	1	0.05	1.17
Ethnic group			2	0.05	
Other Cameroonians	1.322	0.578	1	0.02	3.75
Bangando /Bakwele	1.818	1.296	1	0.16	6.16
Year hunting	-0.165	0.093	1	0.08	0.85
Household size	-0.070	0.124	1	0.58	0.93
Constant	-3.455	2.235	1	0.12	0.03
Correct prediction			64.3		
R^2			0.3		
Log likelihood			111.045		

Time in activity (β = 1.202; $p \leq 0.05$; OR = 3.0) was positively linked to the revenue from hunting, with full-time hunters having as much as a three times higher probability to earn higher income than part-timers. Age (β = 0.155; $p \leq 0.05$; OR=1.2), was related to hunting revenue, meaning that age increased the probability of yielding a higher revenue from hunting. Ethnic group also determined the probability of an increased revenue from hunting. Other Cameroonians (β = 1.322; $p \leq 0.05$; OR = 3.75) were characterised by a 3.7 higher probability to earn higher income from hunting than indigenous people (Baka and Bangando/Bakwele). This could be explained by the fact that outsiders are more business oriented in their hunting activities than local people. The model, therefore, demonstrated that olderfull-time hunters from other part of Cameroon were most likely to earn higher revenue from bush meat hunting activities than others.

CONCLUSION AND RECOMMENDATIONS

Bushmeat supplies have always been an important component of the dietary intake of millions of people in the tropics, especially of forest-dependent people such as the Pygmies and other indigenous people in the Congo Basin. Not only are there high economic incentives for poaching but also bushmeat supplied by poachers is the only source of protein in rural and remote areas. Hunters find new ways to contravening or circumvent conservation policies and strategies to sustain their activities. The bushmeat discourse for the Congo Basin and any other region in the world has often failed to address the protein needs of the truly bushmeat-dependent populations with the consequent depletion of the most sought-after wild animals, despite all suppressive measures by conservation and government agencies.

These errors have to be corrected in the Congo Basin as regional governments are making strong commitments to ensure sustainable forest and wildlife management. They are assisted by regional processes, such as the Central African Forests Commission (COMIFAC), a joint action plan on anti-poaching strategies, established to reduce poaching and to ensure the conservation of wild animals. The use of empathy by policy makers and conservation agencies towards the animal protein shortages in rural areas is strongly recommended. This study showed that any suppressive measures which are impregnated with shortfalls might never yield desired results unless alternative protein sources and adequate income generating activities are provided to the rural poor. Alternative protein sources could include chicken, fish, mutton, beef as well as goat meat and efforts should be made for their local production. This strategy could reduce poaching and enhance the conservation of animal populations in the forest.

Given the economic and dietary incentives of hunting in logging towns in the Congo Basin, there is a need for more research to guide further social and environmental developments on the following topics:

1) design cost-effective commercial activities that hunters could get involved in, to reduce their dependency on poaching;
2) develop local technologies and schemes for commercial meat production and supplies at prices compatible to bushmeat prices;
3) determine an understanding of financial compensations that can enable hunters to abandon hunting at the financial cost compatible to the cost of suppressive, anti-poaching measures;
4) establish hunter associations responsible for a sustainable and environmentally sound game management, for regulated and legal hunting and sell off the culled animals to be commercially processed and distributed;
5) develop forestry-based game farms for the local supply of meat and trophy hunting.

REFERENCES

African Forestry and Wildlife Commission (AFWC). 2002. Report of the thirteenth Session. Libreville, Gabon. 25-29 March. FAO. Rome. P.3.

Akwah G.N. 1999. Les Bangando de la foret de Lobeke: Maîtrise de l'espace forestier et vécu quotidien des mutations socio-économiques. CED. Yaoundé. 51 pp.

Albrechtsen L., Fa J.E., Barry B. and Macdonald D.W. 2006. Contrasts in availability and consumption of animal protein in Bioko Island, West Africa: the role of bushmeat. *Environmental Conservation* 32 (4): 340–348

Ambrose-Oji B. 1997. Valuing forest products from Mount Cameroon. In African rainforests and the conservation of biodiversity: Proceedings of the Limbe Conference. Ed. S. Doolan, Oxford: Earthwatch Europe. pp. 140-150.

Auzel P. and Wilkie D. 2000. Wildlife use in northern Congo: Hunting in a commercial logging concession. In J.R. Robinson and E.L. Bennett (eds.): Hunting for sustainability in tropical forests. New York: Columbia University Press. pp 413-426.

Bahuguna, V.K. 2000. Forests in the economy of the rural poor: An estimation of the dependency level. *Ambio*, 29 (3):126-129.

Barnes R.F.W. 2002. The bushmeat boom and burst in West and Central Africa. *Oryx* 36: 382-388.

Barnes R. F. W. and Lahm S. 1997. An ecological perspective on human densities in Central African forests. *Journal of Applied Ecology 34:245-260*.

Bennett E. L. 2002. Is there a link between wild meat and food security? *Conservation Biology* 16: 590-592.

Bennett, E.L. and Rao M. 2002. Wild meat consumption in Asian tropical forest countries: is this a glimpse of the future for Africa? In: Mainka S and Trivedi M (eds.). Occasional Paper of the IUCN Species Survival Commission No. 24. pp. 39-44.

Bennett E., Eves H., Robinson J. and Wilkie D. 2002. Why is eating bushmeat a biodiversity crisis. *Conservation in Practice* 3 (2): 28–29.

Bennett E.L., Blencowe E., Brandon K., Brown D., Burn R.W., Cowlishaw G., Davies G., Dublin H., Fa J.E., Milner-Gulland E.J., Robinson J.G., Rowcliffe J.M., Underwood F.M. and Wilkie D.S. 2006. Hunting for Consensus: Reconciling Bushmeat Harvest,

Conservation, and Development Policy in West and Central Africa. *Conservation Biology* 21 (3): 884–887.

Bennett E.L., Nyaoi A.J. and Sompud J. 2000. Saving Borneo's bacon: the sustainability of hunting in Sarawak and Sabah. In J.G. Robinson and E.L. Bennett (eds.), Hunting for sustainability in tropical forests. Pp. 305-324. Columbia University Press, New York, USA.

Bowen-Jones E. 1999. A review of the commercial bushmeat trade with emphasis on Central/West Africa and the great apes. *African Primates* 3(1-2): 1-42.

Brown D. 2003. Bushmeat and poverty alleviation: implications for development policy. ODI Wildlife Policy Briefing Number 2. London: Overseas Development Institute. 4 pp.

Code de Travail du Cameroun. 1992. Loi No. 92/007 du Août 1992 portant Code du Travail fixant le salaire minimum a 23514 FCFA.

Damania R, Milner-Gulland E.J and Crookes D.J. 2005. A Bioeconomic Analysis of Bushmeat Hunting. Proceedings: *Biological Sciences*. Vol. 272. No. 1560/February 07: 259-266. www.bioecon.ucl.ac.uk/Kings papers/Milner-Gulland.pdf. Accessed 10/05/05.

Davies G. 2002. Bushmeat and international development. *Conservation Biology* 16(3): 580-583.

de Merode E., Homewood K. and Cowlishaw G. 2004. The value of bushmeat and other wild foods to rural households living in extreme poverty in the Democratic Republic of Congo. *Biological Conservation* 118: 573-581.

Eggert L.S., Eggert, J.A. and Woodruff D.S. 2003. Estimating population sizes for elusive animals: the forest elephants of Kakum National Park, Ghana. *Mol. Ecol.* 12: 1389–1402.

Eves H.E. 2002. Antelopes in Africa: bushmeat, game meat and wild meat – a question of sustainability. In: Mainka S. and Trivedi M. (eds.). Occasional Paper of the IUCN Species Survival Commission No. 24. pp. 73-84.

Fa J.E., Ryan S. and Bell D.J. 2005. Hunting vulnerability, ecological characteristics and harvest rates of bushmeat species in Afrotropical forests. *Biological Conservation* 121: 167–176.

Fa J.E., Peres C.A. and Meuuwig J. 2002. Bushmeat exploitation in tropical forests: an intercontinental comparison. *Conservation Biology* 16 (1): 232-241.

Fa J.E., Currie D. and Meeuwig J. 2003. Bushmeat and food security in the Congo basin: linkages between wildlife and people's future. *Environmental Conservation* 30(1):71-78.

Fa J.E. and Garcia Yuste J.E.. 2001. Commercial bushmeat hunting in the Monte-Mitra Forests, Equatorial Guinea: extent and impact. *Animal Biodiversity and conservation* 24 (1):31-52.

Fa, J.E., Garcia Yuste, J.E. and Castelo, R. 2000. Bushmeat markets on Bioko Island as a measure of hunting pressure. *Conservation Biology* 14: 1602–1613.

FAO. 2007. State of the World's Forests 2007. Rome. ISBN: 978-92-5-105586-1.144pp.

Freese C. 1996. The commercial and consumptive use of wild species: managing it for the benefit of biodiversity. WWF-US and WWF International. Washington, D.C. USA.

Gujarati D. N. 1995. Basic econometrics. McGraw-Hill. New York. ISBN 0-07-025214-9.

Infield M. 1988. hunting, trapping, fishing in villages within and on the periphery of the Korup national Park. Publication No. 3206/A96. WWF International, Gland. 122 pp.

Laurance W. F., Croes B. M., Tchignoumba L., Lahm S. A.. Alonso A., Lee M. E., Campbell P. and Ondzeano C. 2006. Impacts of Roads and Hunting on Central African Rainforest Mammals. *Conservation Biology* 20 (4): 1251–1261.

Lwanga J. S. 2006. The influence of forest variation and possible effects of poaching on duiker abundance at Ngogo, Kibale National Park, Uganda *Afr. J. Ecol*. 44: 209–218.

Makazi, L. C. 2004. Evaluation of the channels of commercialisation of bushmeat trade around Socambo Lobeke National Park. A consultancy report to WWF Southeast Project. May. 32pp.

Masozera M.K. and Alavalapati J.R.R. 2004. Forest dependency and its implication for protected areas management: A case study from Nyungwe Forest Reserve, Rwanda. *Scand.J. For. Res*. 19(Suppl. 4). 85-92. Taylor & Francis ISSN 1400-4089.

Mendelshon S., Cowlishaw G. and Rowcliffe J.M. 2003 Anatomy of a bushmeat commodity chain in Takoradi, Ghana. *The Journal of Peasant Studies* 31: 73-100.

Messer K. 2000. The Poacher's Dilemma: The Economics of Poaching and Enforcement. *Endangered Species UPDATE* 17 (3): 1-7.

MINEF (Ministry of Environment and Forestry). 2004. A management plan for Lobeke National Park and its peripheral zone, 2003-2007. Yaounde. 81pp.

Muchaal P. K. and Ngandjui G. 1999. Impact of village hunting on wildlife populations in the western Dja Reserve, Cameroon. *Conservation Biology* 13(2): 385-396.

Mukherjee C., White H and Wuyts M. 1998. Econometrics and data analysis for developing countries. Routledge London ISBN-0415-09400-3. 496 pp.

Nasi R. 2007. Overview of CIFOR and CIRAD activities in the Congo Basin and their relevance to a partnership with the FAO. Presentation at FAO. Rome. June. 21 slides.

Ngandjui G. and Blanc C.P. 2000. Effects of hunting on mammalian populations in the western sector of Dja Reserve (Southern Cameroon). *Game and Wildlife Science* 17(2): 93-113.

Ngueguim J.R. 2001. Etude de la chasse villageoise dans l'unité technique opérationnelle Campo-Ma'an: Cas du secteur Bifa. Rapport Final. 21 pp.

Noss A.J. 1998. The impacts of cable snare hunting on wildlife populations in the forests of the Cental African Republic. *Conservation Biology* 12(2):390-398.

Noss A.J. 1995. Duikers, cables and nets: a cultural ecology of hunting in a central African forest. Ph.D. thesis, University of Florida, Gainesville: 416 pp.

Ntiamoa-Baidu, Y. 1997. Wildlife and food security in Africa. FAO Conservation Guide 33. Rome. Italy. 117 pp.

Rovero F. and Marshall A.R. 2004. Estimating the abundance of forest antelopes by line transect techniques: a case from the Udzungwa Mountains, Tanzania. *Biological Conservation* 17(2): 267-277.

Rowcliffe, J.M., Cowlishaw, G.C. and Long, J. 2003 A Model of Human Hunting Impacts in Multi-Prey Communities. *Journal of Applied Ecology* 40, 872-89.

Townsend W. 2000. The sustainability of subsistence hunting by the Siriono Indians of Bolivia. In J.G. Robison and E.L. Bennett (eds.): Hunting for sustainability in tropical forests. Pp. 267-281. Columbia University Press, New York, USA.

UDRSS/VALEURS, 2002. The Economic Value of Wild Resources in Senegal: A preliminary evaluation of non-timber forest products, game and freshwater fisheries. Projet: Utilisation Durable des Ressources Sauvages au Sénégal / Valorisation des Espèces pour une Utilisation durable des Ressources Sauvages au Sénégal. Synthesis Report. 76 pp.

Usongo L. and Curran B. 1996. Le commerce de la viande de chasse au sud-est du Cameroun dans la région tri nationale. *African primates* 2 (1):3

Waltert, L.M., Faber K., von Loebenstein K. and Mühlenberg M. 2001. Community-based wildlife population assessment in the Korup Project Area, SW Cameroon. ETFRN NEWS 32: NTFPs. http://www.etfrn.org/etfrn/newsletter/nl32_oip.html#wildlife Last visited 21/10/07.

Wilkie D.S. and Carpenter J. 1999. Bushmeat hunting in the Congo Basin: An assessment of impacts and options for mitigation. *Biodiversity and Conservation* 8: 927 – 955.

Wilkie D.S., Starkey M., Abernethy K., Nstame Effa E., Telfer P. and Godoy R. 2005. Role of prices and wealth in consumer demand for bushmeat in Gabon, Central Africa. *Conservation Biology* 19: 268–274.

CHAPTER SEVEN

The socio-economics of using poles for housing construction in the Congo Basin

Tieguhong Julius Chupezi
Forestry Programme, Faculty of Science & Agriculture, University of KwaZulu-Natal, P Bag X01, Scottsville 3209, South Africa. Chupezi@yahoo.co.uk or 204523366@ukzn.ac.za

ABSTRACT

Increasingly, poor people in sub-Saharan Africa are affected by three dimensions of poverty-hunger, thirst and living without a decent shelter. This study focused on the latter dimension and examined the use of housing materials in villages surrounding the Lobeke National Park (LNP) in the Eastern Province of Cameroon. In total 1980 houses were surveyed, of which 1343, 602, 19, 14 and 2 were built with planks, saplings and poles, tree bark and thatch, respectively. The houses were roofed with thatch (1715), (corrugated zinc sheets (225) or leaves (40). Variations were observed among ethnic groups regarding their preference of housing materials. Further analysis concentrated on houses built with poles harvested from indigenous forests and their negative impact on the structure and value of the forests in future. This study revealed six categories of houses built with varying quantities of poles and thatch. In total, villagers used 132 189 poles and 36 878 thatch components (palm stalks) to build 602 houses in five villages. The number of young trees harvested for the poles was estimated to be several times higher than the number of trees harvested by the timber companies in 2006. This is particularly destructive as wooden houses are short-lived due to the hot and humid climate as well as no protection of wood from harmful insects and fungi. Therefore, a repetitive harvesting of poles for house renovations needs to be conducted every 15 years or less. The magnitude of harvesting impacts on forest biodiversity and structure is expected to be higher in the forest areas neighbouring villages due to a shortage of transportation means. In these areas mature stand composition can be seriously changed, thus, compromising the conservation principles and the value of forests for ecotourism, biodiversity or timber production. Due to a rapidly increasing population, there is an urgent need to empower the local communities to improve their housing habits by promoting building materials alternative to young trees harvested from the indigenous forests.

Key words: deforestation, forest conservation, housing materials, poverty, Pygmies, tropical forests

INTRODUCTION

Inadequate housing is a big challenge in the rural areas of the developing world that clearly needs urgent actions. Over 3 billion people live in such areas, 1.5 billion of them on less than US$2 a day. In the tropics alone, forests and woodlands provide housing materials for over 800 million rural poor people (World Bank, 2007). In the rainforests of Africa over 500 000 indigenous people live in very poor quality houses, whereby they face multiple threats to their lives including poor health and security standards (Forest Peoples Programme, 2005).

The Congo Basin forests cover 228 million ha, making this the second largest area of tropical rainforest after the Amazonian region (FAO, 2005). This forest straddles six countries in differing proportions, these being Cameroon (11.8%), the Central African Republic (3.4%), the Republic of Congo (12.4%), the Democratic Republic of Congo (53.4%), Equatorial Guinea (1.3%) and Gabon (17.7%) (Congo Basin Forest Partnership, 2006). About 18.5 million ha or 10.2% of the Congo Basin forests are classified as national parks or other protected areas (Congo Basin Forest Partnership, 2006). Over 78.2 million people live in the Congo Basin (2003), resulting in an average population density of 19.6 inhabitants km^{-2} and Gross Domestic Products (GDP) of US$ 411 per capita. About 62% of the population lives in rural areas, where people depend on forest resources to meet their daily needs for revenue, food, health and shelter (FAO, 2005). With an annual growth rate of 2.5%, the Congo Basin's population might double in less than 30 years with possible negative effects on the natural resources of the region they depend on. This suggests that urgent actions are required by governments, development and conservation organisations, and local authorities in order to reduce forest-dependencies of the growing population in the region. Such actions, if implemented, would contribute to the continuous existence of the admirable forests of the Congo Basin.

So far, no studies have been conducted in the Congo Basin to show the magnitude of natural resource utilisation for housing. In some of the previous studies authors dwelled on the identification and characterisation of local housing materials with little attention paid to their actual quantity (FAO, 1987; Profizi, 1983; Motte, 1982; Pelissier, 1980). Moreover in these studies, no attempts were made to examine the socio-economic circumstances and

environmental consequences of harvesting materials from indigenous forests for building temporary shelters that are generally dingy, squalid, short-lived and unsafe for humans. This clear deficiency has been addressed in this study which attempts to quantify the local needs for traditional building materials in villages surrounding the Lobeke National Park in the Eastern Province of Cameroon. It is anticipated that the results will lead to policy reflections and actions for improving housing qualities and the improved conservation of forests in the Congo Basin at the same time.

METHODS

Study area

The Sangha Tri-National Park (TNS) is located at the heart of the Congo Basin and consists of the Lobeke National Park (LNP) in the south-eastern corner of Cameroon, the Dzanga-Ndoki National Park (DNNP) in the Central African Republic (CAR) and the Nouabele-Ndoki National Park (NNNP) in the Republic of Congo. The TNS covers 28 000 km^2 including a 21 000 km^2 peripheral zone comprising logging concessions, trophy hunting and communal hunting zones, agro-forestry areas and other activities of the local people (Figure 7.1). On the LNP side of the TNS, there are six hunting zones superimposed within five logging concessions, covering a total area of 354 928 ha. In June 1998, the government of Cameroon declared the LNP as a "Gift to the Earth," covering an area of 217 854 ha. The park is rich in forest resources and wildlife on which generations of indigenous communities have depended for centuries and millennia. Among the 14 villages surrounding the LNP, five (Libongo, Koumela, Mambele, Zega, Socambo) were randomly selected for the survey of housing and construction materials (Figure 7.2). In 2004, the total estimated human population for the entire study area was about 26 000 people: 12 000 living in rural villages and 14 000 people living in three adjoining logging towns (Kika, Libongo and Lokomo)(MINEF, 2004). The local people include the Baka Pygmies, the Bangando and the Bakwelle as well as a number of immigrant people. Human activities in the region include timber extraction, non-timber resource exploitation, hunting, subsistence agriculture and construction of houses. The biological value of the region is characterized by a great variety of animals such as forest elephants (*Loxodonta africana cyclotis*), western lowland gorillas (*Gorilla gorilla*), chimpanzees (*Pan troglodytes*), bongos (*Tragelaphus euryceros*), duikers (*Cephalophus spp.*),

sitatungas (*Tragelaphus spekei*), forest buffaloes (*Syncerus caffer nanus*), and numerous species of birds including the African grey parrot (*Psittacus erithacus*) (MINEF, 2004). There are 764 plant and 45 mammal species, excluding rodents (MINEF, 2004). Major stakeholders in this area are local communities, administrative and municipal authorities, delegates from the Ministry of Forestry and Wildlife (MINFOF), and representatives from the Worldwide Fund for Nature (WWF) and the German Technical Cooperation (GTZ).

Figure 7.1. A satellite view of the Congo Basin near the Tri-National Park showing deforestation scares and the encroachment of settlements along the river near Bomassa (Google-Earth: www.google.co.za).

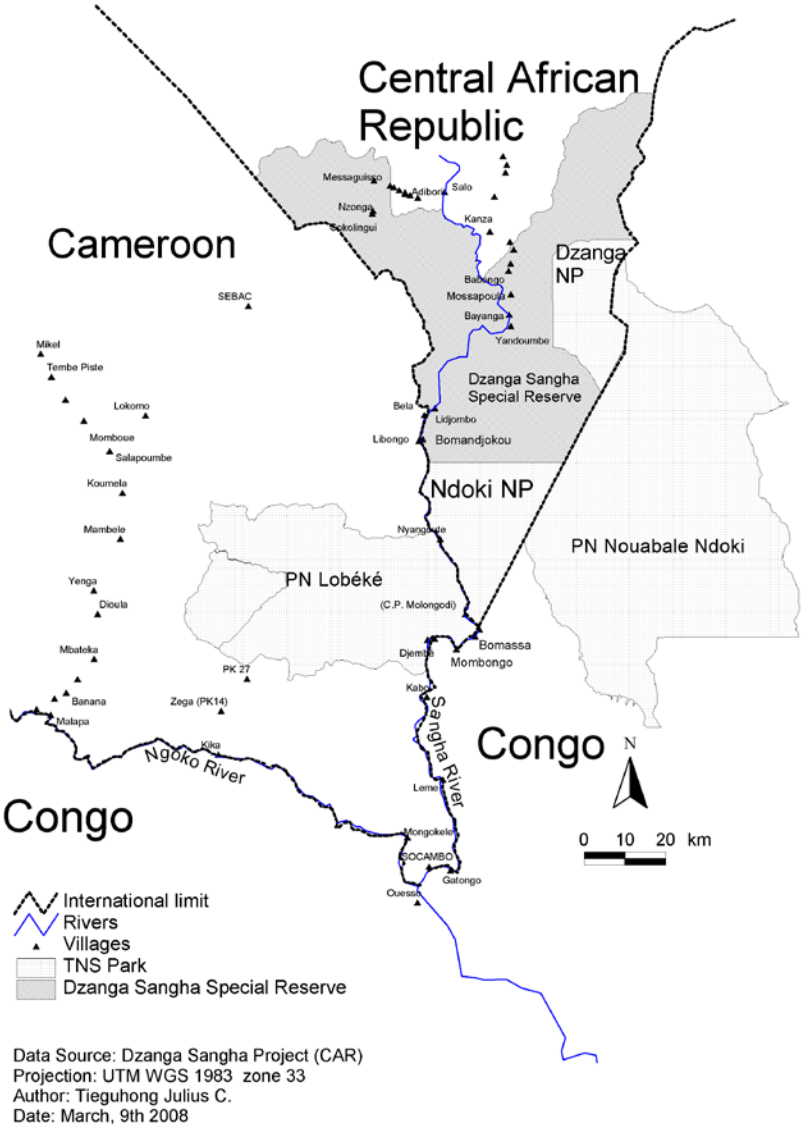

Figure 7.2. Map of the Tri-National Park, showing study villages around the Lobeke National Park.

Data collection and analysis

Stratified random sampling was applied to collect data in the study area. The fourteen villages neighbouring the Lobeke National Park were stratified into two groups comprising (a) three logging towns with sawmills and (b) 11 rural villages without sawmills. For the first stratum one town was randomly selected and for the second, four villages were randomly selected. This gave a total of five villages for the survey with households constituting the basic survey

units. A village census approach (small survey of all households in selected villages) was employed to get key demographic information and specific data on housing materials (Poverty Environment Network, 2006). This also served to introduce inhabitants to the research project and to explain the goals of a more detailed household survey. Data collection tools included a structured questionnaire of twelve questions, focus group interviews, field observations and literature search. The structured questionnaire included variables such as village name, ethnic groups of inhabitants, household head, gender, number of wives/husbands, number of children and their sex, household size, types of building materials and types of roofing materials. Data was entered into excel sheets, checked and analyzed using a pivot table for descriptive statistics and chi-square tests. In-depth statistical analyses were carried out by using econometric models in order to get the differences and similarities among villages in terms of housing habits. This study also focused on providing the determinants of the choices of one category of housing material over another. This was realized by using logit models as the dependent variables were qualitative and dichotomous. Logit models make links between independent variables and the probability of the dependent variable taking the value 0 or 1 (Mukherjee *et al*., 1998). The logit models were applied in the Statistical Package for Social Sciences (SPSS) Version 12 in the Microsoft Windows 2003 interface.

Logit models

In the econometric models, the dependent variables consisted of the specific types of building or roofing material used by individual households. Each dependent variable was dichotomised into binary choice questions of either using a specific material for building houses (Yes) or not using that material (No). It was supposed that the use of a specific building or roofing material could be explained by social factors like village type, household's ethnic group, social status (size and number of houses owned), etc. After running the logit model, significant variables were considered as the determinants (source of motivation) to use specific types of housing and/or roofing materials. The formulation of the model for each housing or roofing material is shown below.

Let $\boldsymbol{j}$, be the building material factor taking values 1 to 5 (1 for poles, 2 for planks, 3 for leaves, 4 for bark, and 5 for thatch) and the $\boldsymbol{k}$ be the roofing material taking values 1 to 3 (1 for

corrugated zinc sheets, 2 for leaves, and 3 for thatch). The equations of the logit models for each housing or roofing material are provided below:

$$Ln\left(P_i^{\ j}/(1-P_i^{\ j})\right)=\alpha_1 X_1+\alpha_2 X_2+\alpha_3 X_3+\alpha_4 X_4+\alpha_5 X_5+\varepsilon_i$$

$$Ln\left(P_i^{\ k}/(1-P_i^{\ k})\right)=\beta_1 X_1+\beta_2 X_2+\beta_3 X_3+\beta_4 X_4+\beta_5 X_5+\varepsilon_t$$

where:

P_i^j is the probability for a household i to use the housing material j

α_i are coefficients whose values and signs determine the influence of variables on the preference for housing material

P_i^k is the probability for a household to use the roofing material k

β_i are coefficients whose values and signs determine the influence of variables on the preference for roofing mater

X_i are expected independent variables

ε_i is the error term

Subscript i denotes the i observation in the sample

In these types of models, the interpretation of results is made with the signs of the observed coefficients and the Odds ratios (ORs) (Desjardins, 2005). OR is the ratio of the odds defined with respect to the dependent variable (dichotomous variable) at different values of explanatory variables (Mukherjee *et al*., 1998). An odds ratio greater than one indicates an increasing probability to use a specific type of building/roofing material. The converse holds true for an odds ratio less than one.

Definition of dependent variables

The dependent variables refer to various types of construction materials described below:

i. Poles - tree stems or their sections, obtained by harvesting young trees with stem diameters of 32 cm or less at 1.3 m above ground (dbh). This definition includes saplings which are usually of a dbh less than 20 cm in diameter. Saplings and poles are potential mature trees and thus represent good candidates for future recruitment and the regeneration of forests (Nwoboshi, 1982);

ii. Planks - primary processed timber, which, in this study, are mainly residuals of sawnwood produced at sawmills. These are sometimes given to local people free of charge for the construction of their houses. Materials commonly used include slabs, off-cuts and deformed planks;

iii. Leaves - harvested from plants belonging to the *Maranthaceae* family which are used mostly by the Baka Pygmies to build houses locally known as Mungulus;

iv. Bark - is the outer layer of tree stems, limbs and twigs of woody plants;

v. Thatch - woven or netted products from raffia palm petioles usually 2-3 m long, used as roofing material with a lifespan of less than three years;

vi. Zinc - a common metallic product used in the form of corrugated sheets for roofing houses. It is far more expensive than local roofing materials.

Theoretical relationships between each explanatory variable and its impact on a choice of construction materials are described as follows:

i. Village (rural village or small town) - considered to be the lowest administrative unit in the region, under the auspices of a village leader called Chief (PEN, 2006). It was supposed that the village of residence of a given household head could be linked to the likelihood of using specific housing and roofing materials available in the area as the types of houses found in the villages are linked to the general level of their development. Thus, the expected sign of influence in the logit model can be positive or negative;

ii. Ethnic group - ethnicity can determine the type of housing material used due to different social experiences. The study area is composed of people from multi-ethnic

backgrounds. Therefore the expected sign in the logit model can be positive or negative depending on social preferences;

iii. Household size varied from 1 to 29 persons with a mean of 5.91 persons and standard deviation of 3.06 persons. Household size was 6.1 persons per household in Libongo and 5.81 in the other villages. It was supposed that bigger households could be associated with more permanent structures because more free labour can be provided. A positive sign was expected;

iv. Population structure and gender records showed that females headed only 4.5% of households whilst 95.5% were headed by males. The sex of the household head could positively influence the housing and roofing quality because male headed households could have higher physical energy exertion to enter the forest and harvest the best available local materials. The expected sign should be positive. Almost 65% of the people were classified as “youth” with almost an equal proportion of boys and girls;

v. Number of houses owned per household varied from one to eight with a mean of 1.8 houses and standard deviation of 0.89 houses. The number of houses owned by a household could positively influence the material used for housing. The number of houses is an indication of wealth, which could positively influence the type of housing material used.

Identifying and estimating the number of poles

With regards to identifying and classifying the different species of trees used, indigenous knowledge was indispensable and the local names in Bangando/Baka dialects were registered. These names were cross-checked with the help of forest technicians and an available checklist of plants for the region (Tieguhong and Ndoye, 2007).

A random sample of 36 houses constructed with poles was used to research the amount of building materials. The number of poles and thatch components was counted in each of the 36 houses. The number of rooms per house was also recorded. This led to the classification of

houses by their size (number of rooms) and the amount of construction and roofing materials. This data was later extrapolated into all of the 14 villages in the region. Three methods were employed to extrapolate the total number of poles used for building houses in the 14 villages around the LNP.

The first method was based on extrapolating the number of poles used in the five villages surveyed, to all of the 14 villages in the region according to the formula below:

$$TS_{14} = \frac{TS_5 \cdot 14}{5}$$

where

TS_{14} = Total number of poles used as housing material in 14 villages around the LNP

TS_5 = Total number of poles used as housing material in the 5 villages surveyed.

The assumption was that all the villages had homogenous structures, which in reality was not the case. The 14 villages had different structures as they were divided into logging towns with sawmills and rural villages without sawmills.

The second method was based on extrapolating the number of poles used by the population of the five villages for the whole population of all the 14 villages according to the formula below:

$$TS_{14} = \frac{TS_5 \cdot P_{14}}{P_5}$$

where

TS_{14} – Total number of poles used as housing material in 14 villages around the LNP

TS_5 – Total number of poles used as housing material in the 5 villages surveyed

P_{14} – Total population of the 14 villages around the LNP

P_5 = Total population of the 5 villages surveyed

The assumption was that the village population size was directly and significantly linked to the number of houses constructed. However, the villages had different demographic characteristics with the logging towns having a higher average household size than the rural villages. Moreover, the proportion of pole houses in the logging towns was far lower than in the rural villages.

The third method involved taking into account (i) population size, (ii) village structures (rural villages or logging towns) and (iii) a range of social characteristics in each type of village such as household size, number of houses per household and percentage of pole houses.

The equations of the third method are specified as follows:

$$TS_{14} = \sum_{i=1}^{2} NHS_i * ASpH_i \qquad \textit{where} \begin{cases} THo_i = P_i / AHsize_i \\ TH_i = THo_i * ANHpHo_i \\ NHS_i = TH_i * \%SH_i \end{cases}$$

where:

i denotes the type of village (i = 1 denotes logging towns; i = 2 denotes rural villages)
TS_{14} = Total number of poles used in the 14 villages
NHS = Total number of houses with poles used for building houses in the 5 villages surveyed
P = Population of the 14 villages
ASpH = Average number of poles used per house built
AHsize = Average household size
%SH = Percentage of houses with poles
THo = Total number of households
ANHpHo = Average number of houses per household

RESULTS

Distribution of population, houses and building materials

The total population of the five villages surveyed was 6486 inhabitants, belonging to 37 ethnic origins in Cameroon and 3 foreign nationalities. This ethnic diversity was integrated into four major groups to facilitate the analysis. These groups were: Bangando, Baka Pygmies, non-indigenous Cameroonians and foreigners representing 19%, 28.3%, 51.8 and 0.9% of the population, respectively (Table 7.1).

Table 7.1. Distribution of population by ethnic groups and villages in the study area in 2006.

Ethnic groups	Koumela	Libongo	Mambele	Socambo	Zega	Total	%
Bangando[1]	266	366	483	76	43	1234	19.0
Baka Pygmies	381	733	528	43	150	1835	28.3
Non-indigenous[2]	174	2898	129	122	34	3357	51.8
Foreigners[3]	4	35	13	8	0	60	0.9
Total	825	4032	1153	249	227	6486	100.0
%	12.7	62.2	17.8	3.8	3.5	100.0	

[1] Bangando group comprised the Bangando and Bakwele.
[2] Non-indigenous Cameroonians included Abakoum, Anglophones (Bantu people form the northwest and southwest provinces of Cameroon), Badjoue, Bafia, Bakoko, Bamileke, Bamoun, Banen, Banvele, Bassa, Gbaya, Beti (Ewondo, Bulu), Bikele, Bobilis, Bokare, Djem, Douala, Essele, Haoussa, Kako, Kepere, Konabembe, Kako, Kepere, Konabembe, Maka, Mbang, Mbimo, Mezime, Mponpong, Ngoumba, Pol, Yabassi, Yambassa, Yanguere and Yebekolo.
[3] Foreigners were mainly from Congo, Senegal and Mali.

Libongo was found to be the most populated village with 62.2% of the total population, followed by Mambele (17.8%), Koumela (12.7%), Socambo (3.8%) and Zega (3.5%). A chi-square test showed that the ethnic background was highly statistically dependent (df= 12, χ^2= 2019, $p < 0.001$) on the village (location).

The household size varied from one to 29 persons with a mean of 9.91 persons and a standard deviation of 3.06. The number of houses owned per household varied from one to eight with a mean of 1.8 houses and a standard deviation of 0.89. The number of wives per household varied from none for single men to five for some married men with a mean of 1.1 wives and a standard deviation of 0.54. The number of children varied from 0 to 13. The overall population was particularly youthful with 64.5% youths (less than 18 years of age) of which 33.1% were boys and 31.4% girls. The mean number of boys and girls per household were 1.97 (standard deviation = 1.79) and 1.84 (standard deviation = 1.74), respectively, giving a sex ratio of 1.07 for the study villages.

A total of 1980 houses were surveyed. The Bangando, Baka Pygmies, non-indigenous Cameroonians and foreigners owned 18.1%, 28.0%, 53.0% and 1.0% of the houses, respectively. In terms of the distribution of houses in the villages, Koumela, Libongo, Mambele, Socambo and Zega had 14.5%, 61.9%, 16.0%, 4.2% and 3.3% of the houses respectively (Table 7.2).

Table 7.2. Distribution of houses by ethnic groups and villages in the study area in 2006.

Ethnic groups	Koumela	Libongo	Mambele	Socambo	Zega	Total	%
Bangando	86	102	134	25	11	358	18.1
Baka Pygmies	131	240	125	14	44	554	28.0
Non-indigenous	70	874	52	42	11	1049	53.0
Foreigners	1	9	6	3	0	19	1.0
Total	288	1225	317	84	66	1980	100
% of all	14.5	61.9	16.0	4.2	3.3	100	

Five types of building materials were recorded in the study area: poles, planks, leaves, thatch and bark were used for constructing 30.4%, 67.8%, 1.0%, 0.1% and 0.7% of the houses, respectively (Table 7.3).

Table 7.3. Distribution of houses by type of building materials and ethnic groups in the study area in 2006.

Ethnic groups	poles	planks	leaves	thatch	bark	Total	%
Bangando	164	190	2	0	2	358	18.1
Baka Pygmies	330	197	14	2	11	554	28.0
Non-indigenous	105	940	3	0	1	1049	53.0
Foreigners	3	16	0	0	0	19	1.0
Total	602	1343	19	2	14	1980	100
% of all	30.4	67.8	1.0	0.1	0.7	100	

In a sample of 1980 houses in five villages around the LNP, 1343 houses were built with planks from sawmills, 602 with poles, 19 with *Thaumatococcus daniellii* leaves of (*Maranthaceae*) popularly known as Mungulus, two with thatching materials and 14 with tree bark. Most of the houses built with planks were found in Libongo, a logging town where people make use of sawmill residues such as slabs, waste wood and off-cuts for construction. The proportion of houses built with poles was 30.4% (602 out of 1980) in all of the five villages surveyed. Over 92% of houses in Libongo (a logging town) were built with planks. In the other four villages less than 29.2% of the houses were constructed with planks. Poles and other local materials, such as leaves and bark, accounted for 70.8% of houses in those villages (Koumela, Mambele, Socambo and Zega). The proportion of houses built with poles in four villages excluding Libongo was 66.8% (505 pole houses out of a total of 756 houses). Pole houses represented only 7.9% of the houses in Libongo. A chi-square test showed that the

non-indigenous inhabitants used far more sawmill off-cuts (956 houses) than the forest building materials (112 houses) while the opposite was true for the indigenous people. The differences between the two groups were highly significant (df=12, χ^2= 542, p<0.001). The distribution of houses by ethnic groups and roof material types is shown Table 7.4.

Table 7.4. Distribution of houses by types of roofing materials and ethnic groups in the study area in 2006.

Ethnic groups	Zinc	Thatch	Leaves	Total	%
Bangando	52	303	3	358	18.0
Baka Pygmies	52	470	30	552	27.9
Non-indigenous	109	935	7	1051	53.1
Foreigners	12	7	0	19	1.0
Total	225	1715	40	1980	100
% of all	11.4	86.6	2.0	100	

As shown in Table 7.4, among the 1980 study houses 225 (11.4%), 1715 (86.6%) and 40 (2.0%) houses were roofed with zinc, thatch and leaves of *Maranthaceae*, respectively. A chi-square test showed that people from different ethnic backgrounds had significantly different preferences (df= 6, χ^2= 101.4, p<0.001) of roofing materials. This was further tested by using the logit analysis.

Choice of building materials: the logit analysis

The variable gender was excluded from the logit models as there were no significant ($p \geq 0.05$) preferences of building materials used by males or females. No models were tested for bark or thatch as house building materials because 99% of the respondents rejected their use for building houses. Therefore, three models were tested for house building materials (planks, poles and leaves) and three others for roofing materials (zinc, thatch and leaves). For each of these, dichotomous response variables were cross-classified in multidimensional contingency tables with explanatory variables. The explanatory variables were: location (village name), ethnicity, gender, household size and number of houses per household. Table 7.5 provides results of the logit analysis.

Table 7.5. Results of the logit analysis on preference of building materials in the study area in 2006 (α, β – coefficients, p – probabilities, OR – odds ratios).

Independent variables	House Building Materials									Roofing Materials								
	Planks			Poles			Leaves			Zinc			Thatch			Leaves		
	β	p	OR	β	p	OR	β	p	OR	β	p	OR	β	p	OR	β	p	OR
Village		0.000			0.000			0.000			0.000			0.005			0.000	
Mambele	0.771	0.040	2.16	-0.14	0.682	0.87	-2.04	0.001	3496	1.02	0.023	2.78	-0.19	0.589	0.82	-2.30	0.000	0.10
Libongo	3.09	0.000	22.0	-2.67	0.000	0.07	-3.40	0.000	0.033	-0.20	0.650	0.82	0.55	0.118	1.73	-2.45	0.000	0.09
Zega	-1.98	0.008	0.14	0.61	0.251	1.84	-19.7	0.997	0.003	-19.1	0.997	0.00	19.9	0.997	457	-20.6	0.997	0.00
Koumela	-1.04	0.020	0.35	0.86	0.038	2.35	-2.09	0.006	0.008	-0.27	0.610	0.76	1.01	0.040	2.74	-2.62	0.001	0.07
Gender	0.831	0.061	2.30	-0.30	0.432	0.74	-18.2	0.997	0.279	0.42	0.299	1.52	-0.04	0.936	0.97	-18.0	0.997	0.00
Ethnic group		0.000			0.000			0.001			0.000			0.031			0.000	
Bangando	-1.29	0.096	0.28	1.22	0.100	3.38	-3.05	0.001	0.005	-2.33	0.000	0.10	1.07	0.010	2.92	-1.81	0.048	0.16
Baka	-2.84	0.000	0.06	2.51	0.001	12.2	-1.45	0.017	13280	-2.54	0.000	0.08	0.83	0.026	2.29	0.44	0.465	1.55
Pygmies	-0.08	0.917	0.92	0.15	0.841	1.16	-3.24	0.001	0.082	-2.26	0.000	0.10	1.10	0.004	3.00	-1.47	0.039	0.23
Other Cam	0.40	0.002	1.50	-0.07	0.030	0.94	0.54	0.000	0.000	0.057	0.597	1.06	0.47	0.001	1.59	-0.45	0.174	0.64
House numbers	0.10	0.004	1.10	0.22	0.034	1.25	-0.11	0.013	1.510	0.039	0.177	1.04	-0.05	0.085	0.95	-0.01	0.903	0.99
Household size	-0.60	0.455	0.55	-0.68	0.374	0.51	-19.7	0.998	0.000	-0.01	0.988	0.99	-1.50	0.018	0.22	-18.7	0.998	0.00

When the use of poles was analysed, the logit model explained 60% ($R^2 = 0.6$) of the variance of using that material for building houses. This meant that the explanatory variables were strongly linked to the dependent variable (use of poles). The log-likelihood (*LR = 798.1*) was far higher than the theoretical Chi-square of 18.3 (*df =10; α =0.05*), meaning that the model was significant at the 5% level. The model had a high predictive power of 83.1%. Four social variables: village location (or name), ethnic group, household size and number of houses owned by individual households significantly determined the likelihood of using poles for building houses. The model demonstrated that people living in Koumela and originating from the Baka ethnic group, with many children (β = 0.22) and possessing a few houses are the most likely ones to use poles for house building. Households in Libongo have 6.9% less probability to choose poles as housing material than households of Socambo. On the other hand, households of Koumela have a 2.35% higher probability of having a pole house than those of Socambo. Ethnic groups were significantly and positively linked to the probability of having a pole house. Baka Pygmies were most likely to use poles for building their houses with a 12.23% higher probability than for example foreigners.

The model on the use of planks was also significant with the log likelihood ratio (LR) of 687.2 which was higher than the Chi-square of 18.3 (*df=10; α =0.05*). The explanatory power of the model was high as indicated by the goodness of fit statistics ($R^2 = 0.657$). Therefore, the explanatory variables predicted 84% of the variance. The model demonstrated that people living in Libongo or Mambele, with a high household size and more than one house were most likely to use planks to build their houses (Table 7.5). Those living at Zega and Koumela coming from Baka were less likely to use planks as building materials.

For using leaves as building materials, the model explained 96% ($R^2 = 0.96$) of the variance of the dependant variable. The model was significant, as the log likelihood ratio of 138.6 was higher than the theoretical Chi-square of 18.3 (*df=10; α =0.05*). The model demonstrated that people living in Libongo, Mambele or Koumela, coming from the Bangando ethnic group with a small household size were less likely to use leaves as building materials, while people belonging to the Baka ethnic group opted for leaves as a construction material (Table 7.5).

The model on the use of zinc as roofing material explained 64% ($R^2 = 0.64$) of the variance of the dependant variable. The model was significant as the log likelihood of 797.21 was by far higher than the theoretical Chi-square of 18.3 ($df=10; \alpha =0.05$). The model demonstrated that people living in Mambele ($p>0.05$) were more likely to use the zinc as roofing material. Household from the Baka, Bangando and the non-indigenous Cameroonian were less likely to use zinc as a roofing material (Table 7.5).

Using leaves as a roofing material was explained in 92% ($R^2 = 0.92$). The observed log likelihood of 236 was greater than the theoretical Chi-square of 18.3 ($df =10; \alpha =0.05$). The model showed that the people living in Mambele, Libongo or Koumela, originating from the Bangando or non indigenous Cameroonian ethnic groups were less likely to use leaves as roofing materials (Table 7.5). Therefore, the only obvious ethnic group with a high likelihood to use leaves as roofing materials were the Baka Pygmies.

Thatch analysis yielded a model which explained 64% ($R^2 = 0.64$) of the variance of the dependant variable with a log likelihood of 800 compared to the theoretical Chi-square of 18.3 ($df =10; \alpha =0.05$). The model demonstrated that people living in Koumela, coming from Bangando, Baka, and non-indigenous Cameroonians were more likely to use thatch as roofing materials. This likelihood was observed to increase with an increasing number of owned houses (Table 7.5).

A summary of the results of the logit analysis with regards to the likelihood of using specific building materials by inhabitants of the villages is shown in Table 7.6.

Table 7.6. A summary on building material preferences by various villages in the study area in 2006 ("-" is the likelihood lower than the reference, "=" the likelihood and the reference are equal, "+" the likelihood higher than the reference, "++" is the highest likelihood).

Object type	Building materials	Koumela	Libongo	Mambele	Zega	Socambo
Housing	Poles	++	-	=	=	=
	Planks	-	++	+	=	=
	Leaves	=	-	=	=	=
Roofing	Zinc	=	=	++	=	=
	Leaves	-	-	-	+	++
	Thatch	++	+	=	=	=

Assessing the local needs for poles

A description of "traditional" housing materials can be found in some botanical studies (Profizi, 1983; FAO, 1987). The information on the plant species that are used and the methods of house construction can also be found in anthropological studies (Pelissier, 1980; Motte, 1982; FAO, 1987). Some interesting information can be gleaned from socio-economic studies and surveys which recorded housing types usually as indicators of wealth (Gartlan, 1987). However, no information was published on the quantities of materials used for house construction in the Congo Basin.

The focus of this study, therefore, was on the quantities of building materials used to build the 602 study houses which were constructed by using poles of various tree species and roofed with thatch. In the assessment of these housing materials a total of 36 randomly identified houses were examined in greater detail. The 36 houses were classified into six size categories based on different requirements for the number of poles and the amount of thatch required for their construction:

Category 1: 17 six-bedroom houses made of 350 poles and 90 thatch components;
Category 2: 34 five-bedroom houses 300 poles and 80 thatch components;
Category 3: 67 four-bedroom houses 280 poles and 70 thatch components;
Category 4: 100 three-bedroom houses 254 poles and 62 thatch components;
Category 5: 167 two-bedroom houses 242 poles and 60 thatch components;
Category 6: 217 one-bedroom houses 145 poles and 54 thatch components.

By extrapolating the data collected from the 36 sample houses, it was found that 132 189 poles and 36 878 thatch components of 3 982 824 raffia palm petioles (*Raphia* spp.) were used to

build the 602 study houses popularly known as poto-poto houses (Table 7.7). Such houses have a life span varying from five years for non-durable poles to fifteen years for poles extracted from slower decomposing tree species. House durability also depends on the regular replacing of decayed thatch-roofs, usually every 2-3 years. Desirable stem characteristics for poles required by the villagers were: straightness, strength, bifurcation above 2.0 m height and high natural durability. Durability was reported as the most important characteristic for selecting an admirable species of trees.

Table 7.7. Characteristics of the 602 houses built with poles and the required amount of material components found around the Lobeke National Park (Cameroon).

No of bedrooms in a house	No. of houses per category	No. of poles per house in each category	Total no. of poles	No. of thatch per house in each category	Total no. of thatch components	Total no of palm petioles
6	17	350	5 950	90	1 530	165 240
5	34	300	10 200	80	2 720	293 760
4	67	280	18 760	70	4 690	506 520
3	100	254	25 400	62	6 200	669 600
2	167	242	40 414	60	10 020	1 082 160
1	217	145	31 465	54	11 718	1 265 544
Total	602	-	132 189	-	36 878	3 982 824

These numbers when projected for the 14 villages surrounding the Lobeke National Park show the impact of housing habits on the regeneration of the Congo Basin forests. The third method of the three methods proposed gave the most realistic results because it took into consideration the structure of the villages, the distribution of the house types and the population distribution and its housing habits. This method showed that 614 389 poles were used, compared to the usage of 369 988 and 529 695 poles defined within the first and second method, respectively. A repetitive harvesting of such high numbers of poles for building houses in and around the protected areas in Cameroon alone could have serious environmental impacts on forest regeneration and its composition, especially with the growing population in the region.

Moreover, the continuous use of poles for housing might also have implications for getting desirable timber species by timber companies. Timber harvesting and sales are the economic pillars of many countries in the region. Logging companies exploited the five forest

management units surrounding the LNP. In 2006 a total of 6343 trees where harvested in the region representing a volume of 120 517 m^3 or averaging 19 m^3 per tree (Table 7.8).

Table 7.8. Forest management units (FMU), number of trees and timber volume harvested around the Lobeke National Park (Cameroon) in 2006.

FMU	Number of trees	Timber volume (m^3)
10012	1 190	26 250
10064	2 469	46 367
10011	279	3 865
10013	669	13 303
10063	1 736	30 732
Total	6 343	120 517

In economic terms, poles and thatch components are collected locally at low cash cost compared to substitutes such as cement blocks and zinc roofing. Using bricks made of compacted clay was resisted for economic reasons. The unit prices of a pole and a 3.0 m long thatch were US$ 0.2 and US$ 0.4, respectively. This means that the construction of the 602 poto-poto houses could cost the inhabitants of the study villages US$ 26 439 for getting the poles and US$ 14 751 for the thatching materials. These estimated costs did not include the cost of other materials such as twines and rattan used for cross-fastening the poles or the labour of owners and their friends helping with the construction work.

DISCUSSION

In the study area, the Bangando and the Baka Pygmies are the indigenous people while the other groups are immigrants (MINEF, 2004). The indigenous people represented 47.3% of the population, while the immigrants represented 52.7%. This result compares well with the other estimates of 50% indigenous people and 50% immigrants (MINEF, 2004). The influx of immigrants is associated with numerous economic activities, such as logging, mining, sport hunting, tourism, pet-trading and poaching, that generally require some capital investment, specialised skills and knowledge. These qualities are generally lacking among the indigenous people due to lack of education. Apart from Koumela that is 12 km away from the a secondary school in Salapoumbe, the other villages are between 70 to 230 km away from the nearest secondary schools. Rural schools usually have poor infrastructure and staffing. The nearest

high school is in the regional capital some 150 km from Koumela and 400 km from Socambo. The nearest university is in the capital city of Yaounde, some 800-1000 km from the study villages.

Primary schooling, which is common in the region, can not enable the indigenous people to compete with the non-indigenous people for salaried jobs. Therefore they remain unemployed or are employed for menial jobs of lower pay that cannot pull them out of poverty or enable them to send their children to higher educational centres in distant places. Added to the above is the fact that funding allocated to village communities, such as shares of revenues from logging companies or sport-hunting concessions, are not equitably shared among the ethnic groups therefore the minorities get little or nothing to improve their standards of living. According to Jackson (2004) the local dominant groups in terms of education and charisma are able to capture forest taxes and tourism revenues and are the main beneficiaries. The immigrants enter the region with modern ideas on capital accumulation, lobbying, business skills and a higher sense of security. The absence of moving out of their own surroundings makes it impossible for most of the indigenous people to understand the benefits of economic independence and living in decent and safe houses. The local people are somehow emotionally attached to forests to get materials for building shelters, good or bad in the sight of on-lookers. It may also be observed that historically the Baka Pygmies dwelled on barter and exchanged with the other ethnic groups (Jackson, 2004) and only recently have they been introduced to the cash economy with a saving culture that is required for capital accumulation and investments for development ends. The above assertions are shared by the UN Committee on Economic, Social and Cultural Rights with concluding remarks that ethnic minorities such as the Baka Pygmies are severely marginalized in the areas of employment, health and education, and are usually considered socially inferior. Consequently they are deprived of full integration into society in terms of their economic, social and cultural rights (Forest Peoples Programme, 2005).

The circumstances that entangle the indigenous people in poverty seem to have direct implications on the state of their housing. These people build their houses with poles and roof them with thatch and leaves while the immigrants possess 90% of the houses built with planks.

The major characteristics of the Bangando are that in addition to hunting and gathering, they possess a farming culture while the Baka Pygmies are more forest dependent. The Bangando are also dominant over the Baka Pygmies in terms of a higher political consciousness and power relations controlling the local economy (Jackson, 2004). This is also reflected in their housing, which is much more advanced, compared to the Baka who still build houses known as 'mungulus,' built by using leaves. Any policy conceived to discourage the local people from using poles for building houses should target the population of Koumela. Lessons drawn in Koumela should be used for possible applications in other villages. In the short term, logging companies could distribute sawmill residue, such as planks and slabs, to distant villages because the use of planks replaces the use of poles. Such an effort would have both development and conservation benefits, securing quality trees for future harvesting in the mid term.

In this paper, the assessment of building materials was mainly done for poles and thatch. The main reason for selecting poles as building materials was the understanding that poles are potentially mature trees with greater economic and environmental future benefits. In economic terms some of the saplings are of the highly sought-after timber species. Examples include: *Triplochiton scleroxylon* (ayous) *Mansonia altissima* (bete), *Entandrophragma utile* (mboyo), *Milicia excelsa* (iroko), *Staudtia kamerunensis* (malanga), *Diospyros iturensis* (babango), *Celtis adolfi friderici* (kakala). A frequent harvesting of such trees at their juvenile stages reduces their contributions to the future stocks of valuable merchantable trees in the Congo Basin. Aside from the timber value, the ecological value of saplings that are allowed to grow into mature trees cannot be overemphasized. This is relevant in the light of the global understanding of the role of forests in carbon sequestration and maintenance of tropical biodiversity. Allowing saplings to grow to maturity would imply less deforestation, forest degradation and fragmentation. According to FAO, (2005), primary forests are lost or modified at the rate of 6.0 million ha per year through deforestation or selective logging, and that about 20% of emissions of greenhouse gases that contribute to global warming are caused by deforestation. Estimates by the World Bank (2007) showed that one hectare of intact rainforest stores 500 tons of carbon dioxide. With the price per stored ton averaging US$ 20 in European markets the forest carbon reserves are worth US$ 10 000 per ha or US$ 2 280

billion when recalculated for the total forest area of 228 million ha in the Congo Basin. Thus by assuming a 100 yr rotation cycle, an annual sustainable value benefit from the CO_2 storage can be estimated at US$ 22.8 billion in the region.

If the status-quo of housing habits and the increasing population trends remain unchanged, then the future impact of cutting saplings for building houses could become devastating for the Congo Basin's forests. To reverse this situation requires more integrated actions by ecologists, economists and development agencies. Alternative materials for building houses in the Congo Basin could include bricks made of compacted clay by using moulders. If every household in the five villages studied is provided with one moulder, it would cost about US$ 500 000 for 2000 households or US$ 1 107 500 for the fourteen villages around the Lobeke National Park. With regard to roofing materials, subsidies could be provided to get more durable materials. Alternatively to brick houses, wooden construction materials could be produced in fast growing timber plantations of desirable tree species. A serviceable life of wood could be prolonged by preservation treatments. This option would add value to the carbon storage initiatives and could be co-financed by development agencies. This scenario could be implemented if the G8 member nations are truly determined to assist developing countries in reducing emissions from deforestation (G8 Summit, 2007).

CONCLUSION AND RECOMMENDATIONS

According to Poore and Thang (2000), poverty remains the greatest threat to tropical forests and the key element for their protection lies in ensuring that their management remains profitable to all concerned. To what extent has this advice been taken into consideration by the tropical forest management in Africa? Increasing numbers of poor people in sub-Saharan Africa are still being affected by the three dimensions of poverty- such as hunger, thirst and living without a decent shelter (Commission for Africa, 2005). This research dwelled on the latter dimension of poverty and examined the environmental, social and developmental impacts in the villages bordering the Lobeke National Park, East Province of Cameroon. The state of housing was exceptionally poor and the indigenous populations depended on building materials harvested from indigenous forests. Forest villages generally lack basic infrastructure and services while the indigenous populations are generally marginalized. As the population

increases, its impact on the indigenous forests will worsen making their further use unsustainable. Squalid tropical forest housing is seen as a product of failed conservation policies, under-funding and neglect by the overall political will. Policy changes and implementation are needed to improve housing qualities and the general living conditions of the forest-dependent poor.

This improvement could be achieved in the following ways:

- develop and promote more durable building materials including treated wood;
- establish plantations of desirable species of trees for house construction;
- promote using building blocks manufactured from compacted clay;
- re-distribute sawmill residues for common benefits.

Without stringent actions to improve the livelihoods of the people in the Congo Basin in a way that would reduce outright forest-dependency, the rich forest resources of this region might be lost in the foreseeable future. One way of reducing forest-dependency would be to provide better housing for the poor. If alternative construction materials are not provided then the poor will continue harvesting saplings for constructing houses, causing forest fragmentation and degradation. A better understanding of the use of local housing materials should be obtained through further research on:

- the abundance and availability of building materials in the forest;
- the impact of sapling harvesting on the regeneration of desired forest species;
- the need for local building materials at a regional level (Congo Basin at large);
- selection, breeding, silviculture and management of desired species of trees in forest plantations;
- the effects of gender, age, main occupation and distance to forests, on the choice of building materials.

REFERENCES

Commission for Africa. 2005. Our Common Interest. Report of the Commission for Africa. March. 462 pp.

CBFP (Congo Basin Forest Partnership). 2006. The Forests of the Congo Basin. State of the forest. 256 pp. ISBN: 978907827016.

Desjardins J. 2005. L'analyse de régression logistique. *Tutorial in Quantitative Methods for Psychology* 1(1): 35-41

FAO. 2005. State of the World's Forests 2005. FAO. Rome.

FAO. 1987. Forestry for local community development. FAO Forestry paper 7. Rome. Pp 33-51.

Forest Peoples Programme. 2005. Indigenous Peoples and the United Nations Human Rights Treaty Bodies: A Compilation of Treaty Body Jurisprudence 1993–2004. 290. pp.

G8 Summit. 2007. Growth and responsibility in the world economy. Summit Declaration (7 June 2007). 37 pp.

Gartlan S. 1987. Korup regional management plan: conservation and development in the Ndian Division of Cameroon. World Wide Fund for Nature (WWF) and Earth Life, Godalming, England (mimeograph).

Google-Earth. nd. A satellite view of the Congo Basin near the Tri-National Park showing deforestation scares and the encroachment of settlements along the river near Bomassa www.google.co.za.

Jackson D. 2004. Implementation of international commitments on traditional forest-related knowledge: Indigenous peoples' experiences in Central Africa. FPP. 100 pp.

MINEF. 2004. Plan d'Aménagement du Parc National de Lobeke. 81pp.

Motte E. 1982. Les plantes chez les pygmées Aka et les Monzombo de Lobaye (Centre Afrique): étude ethnobotanique comparative chez les chasseurs-cueilleurs et les

pêcheurs-cultivateurs dans un même milieu végétal. Société d'Etudes Linguistiques et Anthropologiques de France (SELAF), Paris, France.

Mukherjee C., White H. and Wuyts M. 1998. Econometrics and data analysis for developing countries. Mosley P (Ed.) Routledge. New York. 496 pp.

Pelissier P. 1980. L'arbre dans les paysages agraires de l'Afrique Noire. Cahiers d'ORSTOM, Série Sciences Humaines 17(3r4):127-137. ORSTOM, Paris, France.

PEN (Poverty Environment Network). 2006. PEN Technical Guidelines, Version 2, CIFOR. March 2006. P.36.

Poore D. and Thang H.C. 2000. Review of progress towards the Year 2000 Objective. ITTO. Yokohama.

Profizi J-P. 1983. Les palmiers raphia du sud Benin: utilisations actuelles et potentielles. Notes Africaines 178.

Tieguhong J.C. and Ndoye O. 2007. The impact of timber harvesting in forest concessions on the availability of Non-Wood Forest Products (NWFP) in the Congo Basin. FAO Forest Harvesting Case Study 23. ISBN: 978-92-5-105709-4.

World Bank. 2007. At loggerheads? Agricultural expansion, poverty reduction and environment in the tropical forests. Kenneth M. Chomitz., Piet Buys, Giacomo de Luca, Timothy S. Thomas and S.Wertz-Kanounnikoff (Eds.) 308 pp.

CHAPTER EIGHT

CONCLUSIONS AND RECOMMENDATIONS

Good research especially at a doctoral level is expected to advance the scientific knowledge for the betterment of the existing real world and its quality of life. Despite the widely recognised suffering of poor people in many developing regions (such as in central Africa); little is known about the complexities of the socio-economic situations and the dependencies of local people on the natural resources surrounding them. The environmental crisis resulting predominantly from economic growth in the developed world is amplified by the plundering of natural resources by the rich as well as the poor. Nowadays, it is commonly recognised that forests are central to sustaining life on Earth and also in supporting the livelihoods of forest-dependent communities. The conflict between the needs of the growing rural populations and the conservation desires of protecting the remaining forests is escalating, resulting in an annual loss of millions of hectares of forests in Africa alone while hundreds of millions deteriorate due to man-induced fires and exploitation. International declarations and agreements, though very promising, bring little comfort to the rural poor whose very existence is threatened. Cabinet meetings, as dedicated as they can be, are equally ineffective as planning and management require information and the information allowing the integration of the conservation and development goals is missing.

In this study, an approach has been adopted of gathering and analysing information from the contemporary forests and national parks and their management in the Congo Basin as well as identifying and analysing the socio-economic and environmental aspects critical for the sustainable development of the region. The underlying objective is to inform and advise the

key actors responsible for policy development and management of the forests and national parks.

The complexities of forest resources, their use and management in the Sangha Tri-National Park are beyond one study's content. This complexity has been summarised in one model (Figure 8.1) exposed into distinct components with possible linkages, but they require more detailed research results before informed policies and their implementation can take place. In this illustrative model, the vertical bars present the flow of cash, goods and services between the resources such as the forests and national parks (top horizontal bars) and stakeholders (bottom horizontal bars) in the region. The circled fields represent non-permanent stakeholders such as the donors and NGOs that are presently very active in providing financial and technical supports but that could, in the long run, be excluded from the model. Dotted lines around planted forests emphasize an important dimension that is currently missing in the overall management of forest resources in the region but that holds great potentials for future options towards sustainability. Thicker black lines emphasis current values and actions that need to be increased. Centrally located in the model is the park's management, supposedly playing the role of an agency to implement the actions and policies proposed by the stakeholders. It is also expected to carry out research, the results of which are needed to inform the stakeholders about the benefits of appropriate actions and policies. Research is considered of fundamental importance to an efficient park management, which is currently weak and needs strengthening.

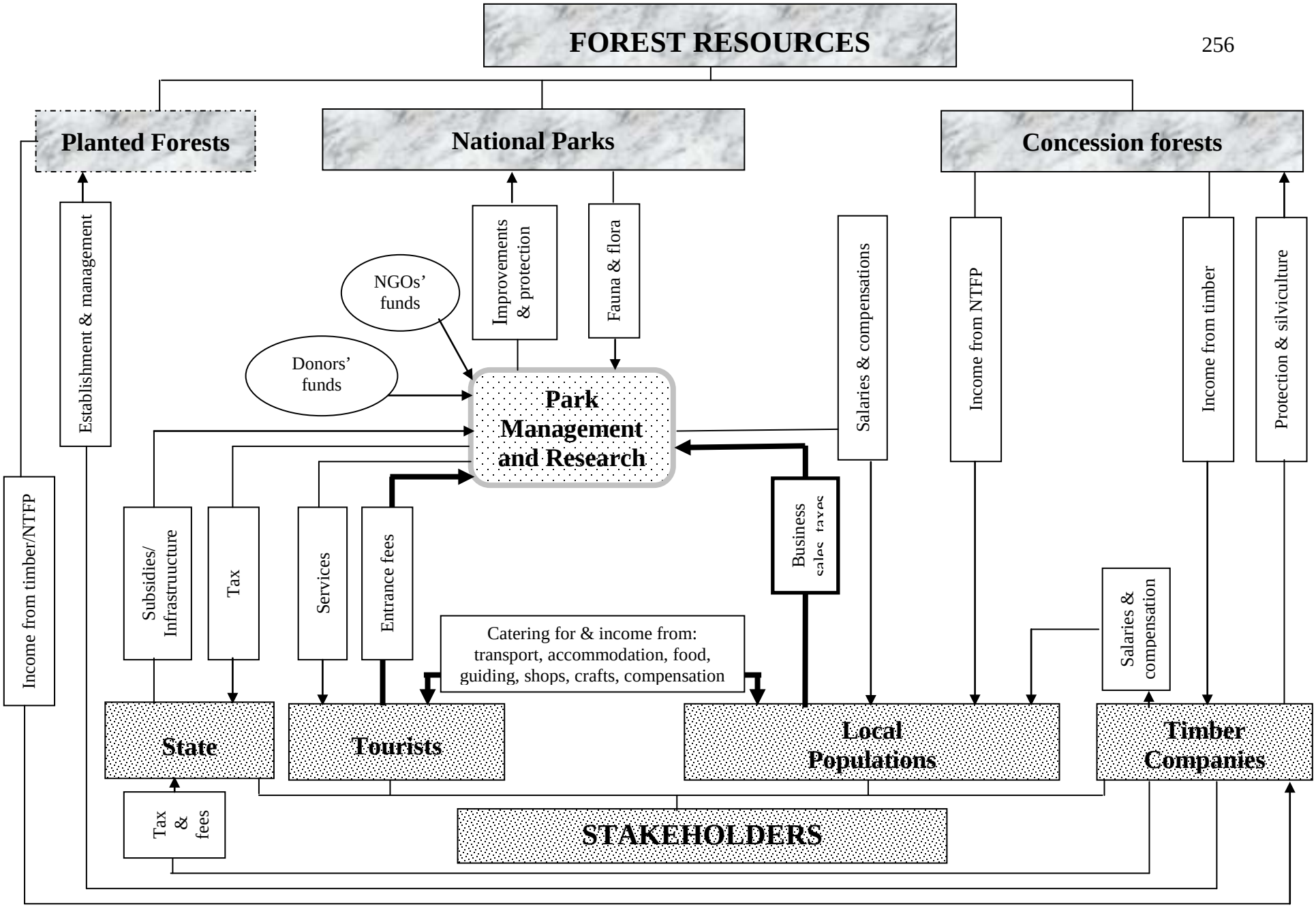

Figure 8.1. Illustrative model of forest and national park management complexities in the Sangha Tri-National Park.

This model shows that forest resources in the region should be managed under three regimes:

(i) commercial, which includes concessions for timber harvesting and trophy hunting as well as plantations for the production of desired forest commodities;

(ii) environmental- for protected areas such as national parks and game reserves;

(iii) community- in which a participatory forest management is practised to supplement the livelihoods of forest-dependent communities with a variety of forest products and uses including building materials, fuelwood, food, medicine and others.

To date the latter regime is poorly developed, despite the livelihoods of millions of people depending on it. The same conclusion is reached regarding the establishment of planted forests as timber plantations cover only 286 200 ha or 0.1% of the total forest area of the Congo Basin (FAO, 2005). Despite the fact that concession forests and national parks respectively represent 36% and 14.4% of the total forest area of the region; their management needs substantial improvements (Karsenty, 2005; Nasi *et al.*, 2006). Considering the huge potentials of natural forest resources and the complex array of stakeholders, the management challenges are expectedly enormous for the realisation of the triangular objectives of ecological, economic and social sustainability. Management needs to provide for and be supported by various stakeholders, including the state, donors, NGOs, commercial conglomerations and local populations.

This model, in tandem with the presented results, provides for actions that should be taken in order to see the management of national parks and forests in the Congo Basin improved in a quest for their economic, social and ecological sustainability. With particular reference to the Tri-National Park complex, it makes the difference between what can be considered the contemporary situation and a desired one. For instance, the contemporary situation of the park financing involves funds originating from the state subventions, and supported by the donors in addition to NGOs contributions. Funds from these sources are mostly used directly for the conservation ends but with a low or no integration with actions of the local populations that, for example, would divert them from poaching and illegal extraction of forest products. Such conflicting interests have been observed in many disappointing projects and programmes that exclude funding to replace forest dependencies with alternative benefits supporting the livelihoods of the rural communities (Sunderland *et al.*, 2008; GEF, 2006; Wilkie *et al.*, 2006;

Schmidt-Soltau, 2004). According to the Global Environment Facility (GEF), the recognition of local benefits forms an essential means of generating and sustaining intended global benefits (GEF, 2006).

On the other hand the ideal way of financing the parks, should be through internally generated revenues- entrance fees, user fees, revenue from catering and other services and activities. This would require sound research results for efficient planning, efficient park pricing and reliable revenue collection systems. This research has shown that investments have to be made to improve tourist facilities to attract tourists from various backgrounds and that the benefits have to trickle down to local populations to distract them from 'illegal' activities. In this light, the roles of stakeholders (park managers, the state, tourists, local communities and business entities) have to be defined and included in the management system to ensure mutual beneficial partnerships that sustain the resources and benefit local development.

REFERENCES

FAO 2005. State of the World Forests. FAO-Rome. ISBN: 92-5-105187-9. 153 pp.

GEF (Global Environment Facility). 2006. The role of local benefits in global environmental programs. GEF Evaluation Office. Evaluation Report No. 30. ISBN: 1-933992-01-8. pp. 3-10.

Karsenty A. 2005. Les concessions forestières en Afrique centrale. Aspects historiques, institutionnels et politiques, du point de vue de la responsabilité des entreprises concessionnaires. Département Forêts du CIRAD, France. 40pp.

Nasi R., Cassagne B.; Billand A. 2006. Forest management in Central Africa: where are we? *International Forestry Review* 8(1): 14-20.

Schmidt-Soltau K. 2004. The cost of rainforest conservation: local responses towards integrated conservation and development projects in Cameroon. *Journal of Contemporary African Studies* 22(1): 93-117.

Sunderland T.C.H., Ehringhaus C. and Campbell B. M. 2008. Comment. Conservation and development in tropical forest landscapes: a time to face the trade-offs. *Environmental Conservation* 34 (4): 276-279.

Wilkie D.S., Morelli G., Demmer J. Starkey M. Telfer P., and Steil M. 2006. Parks and people: assessing the human welfare effects of establishing protected areas for biodiversity conservation. *Conservation Biology* 20(1): 247-249.