SOCIO-ECONOMIC AND ECOLOGICAL IMPLICATIONS OF LOCAL PEOPLE'S USE OF BWINDI FOREST IN SOUTH WESTERN UGANDA

Research · November 2015

DOI: 10.13140/RG.2.1.1545.4161

SOCIO-ECONOMIC AND ECOLOGICAL IMPLICATIONS OF LOCAL PEOPLE'S USE OF BWINDI FOREST IN SOUTH WESTERN UGANDA

ROBERT BITARIHO

MSc (Environmental Sciences and Natural Resource Management),

BSc (Hons), Makerere University, Kampala

A thesis submitted to Mbarara University of Science and Technology in accordance with the requirements for the degree of Doctor of Philosophy (PhD) in the Faculty of Science, Biology Department

January 2013

DECLARATION

I, Robert Bitariho, declare that this thesis has never been submitted for a degree in this or any other university or higher institution of learning. All information contained herein is based on my observations and conclusions unless otherwise stated.

Signed: _____

Date: _____

SUPERVISORS

Associate Professor Gerald Eilu

Department of Forestry, Biodiversity and Tourism,

Makerere University, P.O Box 7062, Kampala, Uganda.

e-mail: gerald.eilu@gmail.com

Signed: _____

Dr. Douglas Sheil.

School of Environmental Science and Management, Southern Cross University. PO Box 157 Lismore NSW 2480, Australia.

Center for International Forestry Research, P.O Box 6596 JKPWB, Jakarta 10065 Indonesia

e-mail: douglassheil@itfc.org, d.sheil@cgiar.org

Signed: _____

ACKNOWLEDGEMENTS

This study was supported with funding from the Bwindi Mgahinga Conservation Trust (BMCT), Rufford small grants fund and the USAID funds through Wildlife Conservation Socieity's WILDWEST project. The Institute of Tropical Forest Conservation (ITFC) supported this study through provision of field equipment, field assistants and the Herbarium technician. ITFC also paid my salary top-ups and registration fees at Mbarara University of Science and Technology (MUST) for five years. MUST kindly waived the tuition fees required for my Phd study and I am grateful.

Technical support, comments and constructive criticisms were provided by my supervisors, Associate Professor Gerald Eilu and Dr Douglas Sheil. Dr Douglas Sheil provided me with immense literature that helped in the shaping up this thesis. The local communities and protected area managers from Bwindi-Mgahinga Conservation Area (BMCA), Queen Elizabeth Conservation Area (QECA), Kibale Conservation Area (KCA), Mt Elgon Conservation Area (MECA) as well as forest reserves of Mabira and Echuya were helpful in this study while carrying out consultative meetings with them. Miriam vanHeist provided useful comments especially for chapters 4 and 5. Various researchers, BMCA Conservation Area Manager (Pontius Ezuma), former Senior Warden In-charge Mgahinga (John Justice Tibesigwa) provided useful comments.

Miriam vanHeist, Desi Tibamanya, Clemencia Akankwasa and Florence Tukamushabe helped organize and provide the necessary logistics (finances, manpower and others). Special thanks go to Robert Barigyira (herbarium technician) and Aurelia Kyalimpa (woman interviewer) for

helping during the village and resource user interviews and the market surveys. Field assistants that helped me in the data collection included Christopher Byaruhanga, Philemon Tumwesigye, Benon Twehikire, Damazo Zoreka, Marius Tumuhangirwe, Edson Nzabarinda, Narsis Owoyesigire, Savio Ngabirano and Peter Mukasa. Special thanks go to the camp-keepers Sigirenda Valentine and Steven Akabway who always prepared our food while camping. Other people who helped in data collection included the former ITFC volunteer researchers Badru Mugerwa (now ITFC staff), Peter Kabano (now MPI staff) and Emmanuel Akampulira (former ITFC staff). Thanks also go to other ITFC and Bwindi park staff who contributed to this study in one way or the other.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Bwindi Impenetrable National Park (hereafter called Bwindi) is an Afromontane forest that has probably existed since the Pleistocene and Holocene times. The forest was first used by Batwa for hunting and wild fruit/yams gathering up to the mid-16th century when Bakiga and Bafumbira agriculturists came and started clearing forest patches for farming. In 1991, Bwindi forest was gazetted a national park and restrictions on forest use by local people were imposed resulting in conflict between park managers and the local people. To mitigate the conflict, park management introduced a Multiple Use Programme (MUP) that involved local people accessing the forest for some livelihood resources such as plants for medicines and basketry.

Under the MUP, local people were allowed access to a few forest resources and not all important livelihoods requirements were granted. Forest resources such as firewood, building poles, bush-meat, fruits, wild fruits, yams and fish were not permitted under the MUP. Despite the several reviews carried out on Bwindi's MUP, the programme has up to now failed to confirm to key definitions of collaborative forest management like elsewhere in other protected areas (PAs) of Uganda. The RUCs in Bwindi meet less frequently than those of other PAs. Local people around Bwindi have lost interest in the RUC meetings and view forest access in Bwindi as being very restrictive. Furthermore, there is less cohesion and cooperation among the RUCs of Bwindi than those from other PAs.

Indeed through village and resource user interviews, this study found out that the most preferred forest resources for the local people around Bwindi were mainly those prohibited by park

management. Also there was a significant difference between the Batwa and the Bakiga, men and women in forest resource preferences. To understand how Bwindi's MUP contributes to local people's livelihoods and income, this study carried out village interviews and market surveys around Bwindi. Results show that there was a significant difference in local people's attitudes on benefits got from the MUP among three categories of parishes (non-multiple use, beekeeping zone and plant harvest zone parishes). Local people involved in the MUP had the most positive attitudes than those not involved. There was a significant difference between the three categories of parishes in mean annual incomes from the sale of forest products. Beekeeping for honey is the most lucrative contributing to a mean annual income of 298,000ushs (114USD) per beekeeper. This study concluded that the MUP has helped contribute a small but important livelihood and income to the forest resource users around Bwindi.

To understand the ecological implications of harvesting the forest resources from Bwindi, a forest survey was carried. Results show that plant stem densities were highest in the harvest zones than in non-harvest zones. Furthermore, non-harvest zones had more large sized individuals than the harvest zones. Annual bark production of *Ocotea usambarensis* tree and annual stem growth rates of *Piper guineense* and *Milletia dura* were not significantly different between the two zones. There was a significant relationship between environmental variables (% tree canopy cover and altitude) and stem densities of most plants. Multiple use guidelines have been proposed by this study to improve Bwindi's MUP.

Chapter One

1 General introduction

1.1 Chronology of conservation approaches

A dominant approach to conservation in the 20th century was the establishment of protected areas (PAs) from which local people were excluded (Hutton *et al.,* 2005; Adams & Hutton, 2007). This model was widely adopted after the creation of Yellowstone and Yosemite National Parks in the United States of America in the late 19th century (Runte, 1990; Adams & Hutton, 2007). This conservation approach was founded on the concept that nature was pristine and should be distinguished and physically separated from human-transformed lands (Hutton *et al,* 2005; Adams & Hutton, 2007). Most PAs that were created then used paramilitary methods to create "pristine" national parks and forest reserves free from human activities using the Yellowstone National Park model. The local people who depended on these PAs for their livelihoods resisted the restrictions imposed on them by the PA managers. This inevitably created conflict between the PA managers and the local people who faced displacements, arrests and killings by the managers to create the "pristine" PAs.

In the 1980s, decentralized, community-based approaches to biodiversity conservation and natural resource management began to spread rapidly, particularly in Southern and Eastern Africa (Scot, 1998; Cunningham, 2001; Hutton *et al,* 2005; Adams & Hutton, 2007). There was a shift in global opinion regarding the management and conservation of natural resources particularly in tropical developing countries. It became widely accepted that strictly policed protected areas or setting aside land for large mammals or spectacular landscapes alone cannot be achieved without the participation of the adjacent local people (Scot, 1998; Cunningham, 2001; Hutton *et al,* 2005;

Adams & Hutton, 2007). Hence, the local resident people who are dependent on the natural resources for survival and therefore suffer the most if the natural resources are degraded were recognized (Scot, 1998; Ghazoul & Sheil, 2010).

During the early 1990s, there was a divide between proponents of community-based approaches to conservation and those advocating a return to the traditional preservationist approaches to biodiversity conservation (Redford *et al.,* 1998; Hutton, *et al.,* 2005; Wilshusen *et al.,* 2002; Sanderson, 2005; Adams & Hutton, 2007; Agrawal & Redford, 2009). Those advocating for preservationist approaches argued that nature is pristine, with complexes of species existing in a natural state and that humanity is a destructive force for these complexes (Kramer *et al.,* 1997; Redford *et al.,* 1998; Struhsaker, 1998; Struhsaker, 1999; Wilshusen *et al.,* 2002; Sanderson, 2005; Adams & Hutton, 2007, Agrawal & Redford, 2009). They argued that the growing human populations are accompanied by increased consumption of natural resources leading to the extinction of many species (Redford *et al.,* 1998; Struhsaker, 1998; Wilshusen *et al.,* 2002; Sanderson, 2005; Agrawal & Redford, 2009).

Struhsaker (1998),Wilshusen *et al.,* (2002) and Sanderson, (2005) stated that the sustainable use of natural resources and biodiversity conservation cannot be attained if based on a bottom-up approach that depends on voluntary compliance. These arguments were compounded by the fact that there is no clearly demonstrable synergy between conservation and other social development goals such as poverty alleviation and economic growth (Adams & Hutton, 2007; Agrawal & Redford, 2009). Advocates of strictly protected "people-free parks' suggest that while community conservation approaches waste scarce conservation resources, PAs can work if they

are strictly protected, well-resourced and properly managed (Redford *et al.,* 1998; Brandon *et al.,* 1998; Struhsaker, 1999; Wilshusen *et al.,* 2002; Naughton-Treves *et al.,* 2005; Balmford *et al.,* 2002; Adams & Hutton, 2007).

A counter-argument against such strict preservationists is that the strategy of setting aside PAs for conservation has inevitable social and economic impacts. The power of good conservation planning lies in the development of protocols that identify categories of both nature and people adjacent to the PAs (Hutton *et al*, 2005; Adams & Hutton, 2007, Agrawal & Redford, 2009). The community-based conservationist approaches state among others that biodiversity conservation is a moral and ethical necessity (Adams & Hutton, 2007, Agrawal & Redford, 2009). In 2006 for example, the Botswana high court ruled that the eviction of Bushmen from central Kalahari Game Reserve by the government was unlawful and unconstitutional and that they had the right to live on their ancestral land inside a designated area of the Reserve (Adams & Hutton, 2007).

Local people suffer direct costs from PA creation through displacements, loss of rights, hazards from crop raiding by wild animals (elephants, buffaloes and primates), labor and opportunity costs of crop defense (from wild animals) and death (Naughton-Treves, 2005; Sekhar, 1998; Woodroffe *et al.,* 2005, Adams & Hutton, 2007; MacKenzie, 2012). Park neighbors can also be exposed to corrupt rent-seeking behavior by PA staff, particularly linked to minor infringement on park boundaries or regulations (Adams & Hutton, 2007).

Biodiversity conservation strategies such as those of protectionists are usually believed to distress the less powerful, politically marginalized and the poor. Tourists and scientists have

conventionally been tolerated in the PAs where the poor and politically less powerful local resource users have been excluded (Adams & Hutton, 2007, Agrawal & Redford, 2009). These and other arguments have led to a rethink in conservation approaches. Many questions have been asked regarding PA conservation and these include: Should local people be involved in PA management? How can local people neighboring PAs be involved in management? How can PAs be conserved and at the same time local people get benefits from them? What works and what does not work? Is there a compromise? These and other questions have attracted several research topics from scientists and are the basis of this thesis.

1.2 IUCN's categorizations of Protected Areas

The International Union for Conservation of Nature (IUCN) has classified PAs into different categories based on management objectives and has repeatedly refined them over years (Ravenel & Redford, 2005). The IUCN PA classification consists of six categories, including those that are exclusionary (category 1) and various others that are inclusive of human activities, such as protected landscapes and reserves intended to maintain flows of products and services for human society (Category VI) (Adams & Hutton, 2007).

In essence, the IUCN categorisation of PAs has resulted in the bridging of the gap between arguments by preservationists and those for local people involvement in PA management. Of interest to this study is category II whose objectives are to protect functioning ecosystems but include substantial use by tourists, including supporting infrastructure and taking into account the needs of indigenous people, including subsistence resource use as long as they do not adversely affect the primary management objective of the PAs (IUCN, 2008; IUCN, 2012). Most

national parks in Uganda including Bwindi Impenetrable National Park fall in this category (IUCN, 2008; IUCN, 2012).

Category VI is of protected areas that contain natural areas where biodiversity conservation is linked with sustainable use of natural resources, which is incompatible with category I. However large category VI protected areas may contain category I areas within their boundaries as part of management zoning (IUCN, 2008; IUCN, 2012). In Uganda, PAs have been zoned using the category VI into strict nature conservation areas (core zones) where no human activity is allowed and areas where human activities can take place that include buffer zones or multiple use zones. The buffer or multiple use zones are usually located at the PA periphery while the core zones are at the centre of the PAs. Category II and VI are of particular interest to this study since they include PAs that neighbour local people and are usually surrounded with a high human population density and inevitably are linked with local people livelihoods

1.3 Protected area resources used by local people

In the past, especially during the 20th century, forest resources played a major role in the culture and life styles of traditional forest users and were extracted at a subsistence level in line with traditional conservation practices (Scot, 1998; Cunningham, 2001; Hutton *et al*, 2005; Adams & Hutton, 2007, Agrawal & Redford, 2009; Ghazoul & Sheil, 2010). Presently, wild plants provide an important source of income to millions of people world-wide (Kaimowitz & Sheil 2007; Ghazoul & Sheil, 2010), sometimes leading to growth in commercial trade of forest resources with large volumes of resources being harvested that result in forest overexploitation (Godoy & Bawa, 1993; Freese, 1997; Vedeld *et al*., 2004; Ticktin, 2004). Other times, forest resources provide a

subsistence source of livelihood for rural local people and therefore provide social benefits that include; bush meat, fish, wild fruits, medicines from wild plants (Kaimowitz & Sheil 2007). Many of the estimated two billion people that lack adequate access to western medicines rely largely on wild and semi-wild plants and animals for much of their treatment (Farnsworth & Soejarto, 1991; Kaimowitz & Sheil 2007; Ghazoul & Sheil, 2010). Therefore tropical forest resources provide both economic and subsistence livelihoods for billions of people worldwide.

The contributions that many forest products make to rural livelihoods, and the fact that non-timber forest products are less ecologically destructive than timber harvesting, have led to the belief that more intensive management of forests could contribute to both development and conservation objectives, and have led to initiatives to expand on their commercial uses (Arnold & Perez, 2001). Controlled harvesting of selected plant resources holds a great potential as a means of integrating natural resource protection with local people use of natural resources in a sustainable manner (Peters, 1994; Cunningham, 2001; Ticktin, 2004).

1.3.1 Forest resource use in Bwindi Impenetrable National Park

Forest resource extraction from Bwindi forest is as old as when local people first lived there. The Batwa who lived in the forest as hunter-gatherers, were probably the first people to use the forest (Kingdon, 1998; Lewis, 2000; chapter 2 of this thesis). Prior to the establishment of Bwindi as a national park, local people adjacent to the forest depended on it for their livelihoods through hunting, honey collection, fruit gathering and collection of weaving, medicinal and house construction plants.

When Bwindi was gazetted a national park in 1991, the people were barred from harvesting forest resources some of which played a crucial role in their livelihoods. Consequently, conflicts arose between park managers and the local people resulting in numerous fires being deliberately set in the forest. For example, in 1991 up to 5% of Bwindi forest was burnt by arsonists (ITFC, 1999). There were also numerous cases of harassment of park staff by local community members (Wild & Mutebi 1996, Wild, 2001). To mitigate these conflicts, Uganda National Parks then (now Uganda Wildlife Authority (UWA), in collaboration with other organisations such as CARE, International Gorilla Conservation Programme (IGCP) and Institute of Tropical Forest Conservation (ITFC), established a collaborative management plan for Bwindi that involved multiple-use and revenue sharing programmes in 1994 (Wild & Mutebi, 1996; ITFC, 1999; Bitariho *et al.,* 2006; Ndangalasi, *et al.,* 2007).

The multiple-use programme (MUP) allows low impact plant harvesting and bee-keeping from specified park areas called Multiple Use Zones (MUZs). Presently 14 out of 24 four parishes around Bwindi Impenetrable National Park (hereafter called Bwindi) benefit from the programme by extracting plants for medicines and weaving as well as carrying out beekeeping at the park periphery (Bitariho *et al.,* 2006; Ndangalasi *et al.,* 2007). Fifty seven plant species are now legally being harvested from Bwindi's multiple use zones by the local people (Davey *et al.,* 2001; Bitariho *et al.,* 2006; Ndangalasi *et al.,* 2007). Other forest resources are restricted for harvest under the MUP. These include plants used for building poles, walking sticks and hoe handles and a liana *Loeseneriella apocynoides* (Welw. ex Oliv.) N.Hallé ex J.Raynal that is used for making tea harvest baskets (Bitariho *et al.,* 2004). Others are wild yams, wild fruits and wild honey for the Batwa (Bitariho, *et al.,* 2004). Despite the ban, some of these resources are illegally harvested by

the local people. Olupot *et al.,* (2009) found evidences of "illegal" harvests of poles, stakes and firewood along the Bwindi park periphery. Cunningham (2001), Wild (2001) and Ndangalasi *et al* (2007) as well reported illegal harvests of L. *apocynoides*, *Smilax anceps* Willd. and bark from *Rytigynia kigeziensis* Verdc. and *Ocotea usambarensis* Engl.

Presently most government programs in Uganda are geared towards prosperity for all, poverty alleviation and the millennium development goals. Local people are being encouraged and helped to be involved in income generating projects to help in the rural economy. The MUP was initiated to encourage domestic use of forest resources only but the changing government's political and economic perspectives necessitated the MUP to be viewed as one of the ways to improve local people livelihoods. This is in line with the resolution of the world's park's congress in 2003 (Durban) that stressed that protected Areas must not exacerbate poverty but rather should reduce and eliminate poverty for the local people adjacent. Indeed some forest products from the MUP are sold in local markets around Bwindi by the local people for income.

1.4 Overall study objective

The major objective was to review Bwindi's MUP and its benefits to the local people. Other specific objectives were to:

1. Investigtate whether Bwindi's MUP has helped initiate local people participation in park management
2. Assess important forest resources for local people from Bwindi
3. Determine socio-economic contributions of Bwindi's MUP to the local people
4. Determine the ecological impacts of harvesting plant resources by local people from Bwindi

5. Recommend guidelines for better implementation of Bwindi's MUP.

1.5 Research questions

This study was guided by the following research questions;

a. Does Bwindi's multiple use programme help initiate participation of local people in park management?
b. What are the most important forest resources for local people around Bwindi?
c. How has the MUP contributed to the socio-economic status of local people around Bwindi?
d. What are the ecological implications of harvesting plant resources from Bwindi?

1.6 Problem statement

Before any kind of plant exploitation begins, it is imperative to carry out plant resource inventories so as to determine the plant stock and mitigate the over-exploitation (Peters, 1994, Cunningham, 2001, Bitariho, *et al.,* 2006). Despite the growing concern over the exploitation of plant resources world-wide, information on the ecological implications of plant resource harvest is available only in few disparate case studies (Boot and Gullison, 1995; Cunningham, 2001; Ticktin, 2004; Bitariho, *et al.,* 2006).There is limited biological information on most plants harvested or needed by the local people from Bwindi forest. There is also lack of data on biomass production, regeneration and mortality rates of most of the plants that are extracted legally and those needed by the local people from Bwindi (Cunningham, 2001; Ticktin, 2004; Bitariho, *et al.* 2006).

Lack of scientific data (such as abundance and distribution) on the illegally harvested plants has often been cited by UWA as the reason resource extraction is not permitted. Cunningham (1992) and some multiple use programme reviewers (Bensted-Smith *et al.,* 1995; Davey *et al.,* 2001; Bitariho *et al.,* 2004) recommended the granting of access to forest resources needed by the Batwa. UWA has however, justifiably used lack of data on the resources as the reason they do not allow to harvest them. What is needed, therefore, is the provision of data on whether these resources can be sustainably harvested. Sustainable harvest of plant resources can be determined through direct measurement of the rate of plant resource extraction and comparing it with the rate of natural replacement (biomass production and recruitment) (Godoy & Bawa, 1993; Peters, 1994; Tuxill & Nabhan, 1998; Cunningham, 2001; Ticktin, 2004; Bitariho *et al.,* 2006).

1.7 Overall Study justification

The People and Plants Project in the mid-1990s to early 2000 supported Masters' students' studies in Bwindi on the density and distribution of some harvested plants such as *Loeseneriella apocynoides, Rytigynia kigeziensis, Smilax anceps* and plants for traditional herbalists (Muhwezi, 1997; Kamatenesi, 1997; Ogwal, 1998 and Kyoshabire, 1998). Olupot (2004) carried out a boundary edge effect study in Bwindi in which he recommended a study on the most harvested and needed plants from Bwindi such as *Marantochloa leucantha* and *Raphia spp*. All these studies, however, do not reflect the general condition of the plant resources being harvested, their conservation status and socio-economic benefits to the local people around Bwindi.

No study has yet examined annual biomass production of the harvested plants in Bwindi, an important aspect in determining plant harvest sustainability. This study built on the work already done by the People and Plants Project and others to determine the socio-economic contributions of the MUP to the local people and also assess the contributions the programme makes towards local people poverty reduction. This study further determined the highly demanded and used plants from Bwindi, their ecological status and biomass production and therefore was able to assess whether the plants being harvested were sustainable.

1.8 Outline and arrangement of thesis

This thesis consists of eight chapters each crafted individually as manuscripts for publishable research papers. The chapters include:

Chapter 1 (this chapter) is a general introduction that includes global debates for PA conservation approaches. Debates for and against excluding local people from the use of PA resources are highlighted. The IUCN categorizations of the PAs and a general description of the importance of forest resources to the local people are explained in this chapter. The chapter also describes the overall objectives, research questions, problem statement and justification of this thesis.

Chapter 2 is a literature review, it provides the historical context of forest use by local people in south west Uganda in general and Bwindi in particular. The chapter describes trends in plant use and how forest dependent Batwa people helped maintain the Afromontane forests in

southwestern Uganda before commercial cutting for timber began in the early 1900s. The chapter also describes how the multiple use programme began in Bwindi and how park authorities have sought to involve local people in park management through establishment of various park/local people committees.

Chapter 3 is a review of how Bwindi's multiple use programme (MUP) has initiated local people participation in Park management. It starts by considering a question; to what degree is the multiple use programme contributing to local people involvement in park management? The MUP is compared with other resource use programmes in other PAs. The chapter concludes that the Bwindi's MUP is less collaborative than other resource use programmes of other PAs in Uganda and gives suggestions on how to improve it to make it more collaborative and efficient.

Chapter 4 provides an assessment of important forest plants needed by the local people from Bwindi forest. The chapter also provides an assessment of how ethnicity and gender influence preferences for forest resources. The most important forest resources for the local people were those prohibited for use by park management.

Chapter 5 describes and determines the socio-economic contribution of the MUP to the local people. The contribution of beekeeping and plant harvests towards rural income are assessed and presented. The chapter ends by discussing how the MUP can advance poverty eradication/reduction around Bwindi.

Chapter 6 presents the ecological implications of harvesting important forest plants from Bwindi. Stem densities, size class distributions and annual biomass production estimates of the important forest plants are given. The relationships between environmental variables (tree canopy cover, altitude and slope) and stem densities of important plants are provided in this chapter. The chapter also highlights the plants under threat of overexploitation.

Chapter 7 gives general recommendations for the improvement of the MUP and others elsewhere. Guidelines for the implementation of the MUP and recommendations for methods to be used for plant offtake assessments are proposed.

Chapter 8 presents an overall discussion, conclusions and recommendations that link up the 7 chapters above.

Reference

Adams, W.M & Hutton, J., 2007. People, Parks and Poverty: Political Ecology and Biodiversity Conservation. *Conservation Society* 5:147-183.

Agrawal, A & Redford, K., 2009. Conservation and Displacement: An Overview, *Conservation Society* 7 (1):1-10.

Arnold, J.E.M and Ruiz M.P., 2001. Can non-timber forest products match tropical forest conservation and development objectives? *Ecological Economics* (3): 437-447.

Balmford, A.,Bruner, A.,Cooper, P.,Costanza, R., Farber,S., Green, R.E., Jenkins, M., Jefferiss, P., Jessamy, V., Madden,J., Munro, K., Myers, N., Naeem, S., Paavola, J., Rayment, M.,Rosendo, S.,Roughgarden, J., Trumper, K & Turner., K., 2002. Economic Reasons for Conserving Wild Nature, *Science* 297: 950-953.

Bensted-Smith, R., Infield, M., Otekat, J. and Thompson-Handler, N. (1995). Review of the multiple-use (resource sharing) programme in Bwindi Impenetrable National Park. A report to CARE-Development Through Conservation Project, Kampala.

Bitariho, R., McNeilage, A., Babaasa, D., Barigyira, R. 2006. Plant harvest impact and sustainability in Bwindi Impenetrable National Park, S.W. Uganda. *African Journal of Ecology* 44: 14-21.

Bitariho, R., Mugyerwa, B., Barigyira, R and Kagoda E. 2004. Local People's Attitudes and new demands since inception of Multiple Use Programme in Bwindi Impenetrable National Park, S. W Uganda, Ruhija, Kabale.

Boot R.G and Gullison., 1995. Approaches to Developing Sustainable Extraction systems for Tropical Forest Products. *Ecological applications* 5(4): 896-903.

Brandon, K., Redford, K.H & Sanderson, S.E., 1998. Parks in Peril: People, Politics and Protected Areas. Island Press for Nature Conservancy, Washington, DC.

Butynski, T.M. 1984. Ecological survey of the Impenetrable (Bwindi) Forest, Uganda and recommendations for its conservation and management. *New York Zoological Society*, Bronx, New York.

Cunningham, A.B. 1992. People, park and plant use: Research and recommendations for multiple-use zones and development alternatives around Bwindi-impenetrable National Park, Uganda. Unpublished report to CARE-International, Kampala, Uganda.

Cunningham, A.B., 2001. Applied Ethnobotany, People, Wild Plant Use and Conservation, WWF, Earthscan Publications Ltd, London.

Davey, C., Peters, C.M, and Byarugaba, D., 2001. Participatory review of the Multiple Use Programme, Bwindi Impenetrable National Park and Mgahinga Gorilla National Park. CARE-Uganda and Uganda Wildlife Authority, Kampala.

Farnsworth, N.R., & Soejarto, D.D., 1991. Global Importance of medicinal plants.In O. Akerle, V. Heywood and H. Synge (eds). The conservation of medicinal plants. Pages 25-51. Cambridge University Press, Cambridge.

Freese, C.H., 1997. Harvesting Wild Species, Implications for Biodiversity Conservation.The Johns Hopkins University Press, 2715 North Charles street,Baltimore, Maryland.

Ghazoul, J & Sheil, D., 2010. Tropical rain forest ecology, diversity, and conservation. Oxford University Press, Great Clarendon Street, Oxford.

Godoy, R. A and Bawa, K.S., 1993. The Economic Value and Sustainable Harvest of Plant and Animals from the Tropical Forest: Assumptions, Hypotheses, and Methods. *Economic Botany* 47(3): 215-219.

Hutton, J., Adams, W.M & Murombedzi, J.C., 2005. Back to the Barriers? Changing Narratives in Biodiversity Conservation. *Forum for Development Studies* 32 (2): 341-370.

ITFC, 1999. The potential supply of weaving and medicinal plant resources in the proposed Kifunjo-Masya Multiple - Use Zone of Bwindi Impenetrable National Park, South-Western Uganda. Unpublished Report, Ruhija, Kabale.

IUCN., 2008. Guidelines for applying protected area management categories Revised guidelines, IUCN, Morges.

IUCN, 2012. IUCN Protected Area Management Categories**,** Guidelines for Applying Protected Area Management Categories, Morges.

Kaimowitz, D & Sheil, D., 2007. Conserving What and for Whom? Why Conservation Should Help Meet Basic Human Needs in the Tropics *Biotropica* 39(5): 567– 574.

Kamatenesi, M. 1997. The Conservation and Utilisation Status of Nyakibazi (Rytigynia spp.) in the Multiple - Use Areas of Bwindi Impenetrable National Park,Uganda. MSc. Thesis, Makerere University, Kampala.

Kingdon, E., 1988. The Twa of Kigezi. Report on fieldwork among the Twa of Kigezi. Unpublished report for Horniman Trust London and Swan Fund, Oxford.

Kramer, R.A., van Schaik, C.P & Johnson, J., (eds). 1997. The last stand: Protected Areas and the defense of tropical Biodiversity. Oxford University Press, New York

Kyoshabire, M. 1998. Medicinal Plants and Herbalists Preferences Around Bwindi Impenetrable Forest, Uganda. Unpublished MSc thesis, Makerere University, Kampala.

Lewis, J., 2000. The Batwa Pygmies of the Great Lakes Region, Minority Rights Group international Report, London.

MacKenzie, C.A., 2012. Trenches like fences make good neighbours: Revenue sharing around Kibale National Park, Uganda. *Journal for Nature Conservation* 20(2): 92-100.

Muhwezi, O, 1997. The Biology, Use and Impact of Harvesting on the Afromontane Liana (*Loeseneriella apocynoides*) in and Around Bwindi Impenetrable National Park, Uganda. MSc. Thesis, Makerere University, Kampala.

Naughton-Treves, L.,Holland, M.B., & Brandon, K., 2005. The Role of Protected Areas in Conserving Biodiversity and Sustaining Local Livelihoods. *Annual Review of Environmental Resources* 30: 219-252.

Ndangalasi, H, Bitariho R, Dovie D. 2007. Harvesting of non-timber forest products and implications for conservation in two montane forests of East Africa, *Biological Conservation* 134 (2): 242-250.

Ogwal, S.F. 1998. A study of Abundance, Utilisation and Management of *Smilax anceps* in Bwindi Impenetrable National Park, S.W Uganda, MSc thesis Makerere University Institute of Environment and Natural Resources, Kampala.

Olupot W (2004). Boundary Edge effects in Bwindi Impenetrable National Park, Unpublished report, ITFC, Ruhija, Kabale

Olupot, W., Barigyira, R., Chapman, C., 2009. The status of anthropogenic threat at the people-park interface of Bwindi Impenetrable National Park, Uganda. *Environmental Conservation* 36 (1): 41–50.

Peters, C.M (1994). Sustainable Harvest of Non - Timber Plant Resources in Tropical Moist Forest: An Ecological Primer. USAID Biodiversity Support Programme, Washington DC.

Ravenel, R.M., & Redford, K.H., 2005. Understanding IUCN Protected Area Categories. *Natural Areas Journal* 25: 381-389.

Redford, K., Brandon, K & Sanderson, S., 1998. Holding Ground. In: *Parks in Peril:People, Politics and Protected Areas,* Pages 455-563, Island Press, for Nature Conservancy, Washington, DC.

Runte, A., 1990. Yosemite: The Embattled Wilderness. University of Nebraska Press,Lincoln.

Sanderson, S., 2005. Poverty and Conservation: The new Century's "peasant question"? *World Development* 33: 323-332.

Scott, P. 1998. From Conflict to Collaboration, People and forests at Mount Elgon, Uganda. International Union for Conservation of Nature and Natural Resources IUCN, Gland and Cambridge.

Sekhar, N.U., 1998. Crop and Livestock depredation caused by wild animals in Protected Area: The case of Sariska Tiger Reserve, Rajasthan, India. *Environmental Conservation* 25: 160-171.

Struhsaker, T.T., 1998. A biologist's Perspective on the Role of Sustainable Harvest in Conservation. *Conservation Biology* 12 (4): 930-932.

Struhsaker, T.T., 1999. Ecology of an African Rain Forest: Logging in Kibale and the Conflict Between Conservation and Exploitation. University Press of Florida, Gainesville.

Ticktin, T., 2004. The ecological implications of harvesting non-timber forest products. *Journal of Applied Ecology* 41: 11-21.

Tuxill, J and Nabhan, G.P. 1998. Plants and protected areas. A guide to In Situ management. WWF, Stanley Thornes publications, Ellenborough house, Wellington street Cheltenham.

Vedeld, P., .Angelsen, A., Sjaastad, E., & Kobugabe, G. B., G., 2004. Counting on the Environment, Forest Incomes and the Rural Poor. Environment Economics Series paper 98. World Bank. Washington DC.

Wild, R.G., 2001. Plants from the Park: Establishing Community Harvesting of Plants as a Conservation Tool at Bwindi Impenetrable and Mgahinga National Parks, Uganda. Unpublished Master of philosophy thesis Department of Botany, University of Capetown, Capetown .

Wild, R, & Mutebi, J., 1996. Conservation Through Community Use of Plant Resources: Establishing Collaborative Management at Bwindi Impenetrable and Mgahinga Gorilla National Parks. People and Plants Working Paper 5. UNESCO, Paris.

Wilshusen, P.R., Brechin, S.R., Fortwangler, C.L. & West, P.C., 2002. Reinventing a Square Wheel: Critique of a Resurgent "Protection Paradigm" in International Biodiversity Conservation. *Society and Natural Resources* 15: 17-40.

Woodroffe, R., Thirgood, S., & Rabinowitz (eds)., 2005. People and Wildlife: Conflict or Coexistence? Cambridge University Press, Cambridge.

Chapter two

2 A History of tropical forest use in South Western Uganda

2.1 Introduction

Tropical rain forests can be divided into five main biogeographical regions: the Americas, Southeast Asia, Africa, Madagascar, and Australia-New Guinea (Ghazoul & Sheil, 2010). Tropical montane forests are a result of millions of years of interplay between evolving species and a changing earth. Africa's tropical moist montane forests have probably existed since Pleistocene and Holocene times about 2.6 million years ago (Butysnki, 1987; Marchant, Taylor & Hamilton, 1997; Ghazoul & Sheil, 2010). The Pleistocene was characterized by extended periods of ice formation (glacial age) with over 30% of the world surface covered in ice (Kingdon, 1990a; Ghazoul & Sheil, 2010). During this period, tropical Africa experienced very severe dry conditions while todays temperate regions remained covered in ice. Most of the tropical Africa lowland forests turned into savannahs and deserts except for the Afromontane forests whose climate remained suitably moist (Kingdon, 1990a; Marchant, Taylor & Hamilton, 1997; Ghazoul & Sheil, 2010).

The moist Afromontane forests therefore served as refugia for some flora and fauna and the species shifted to high elevations where conditions were suitable (Butysnki, 1987; Kingdon, 1990a; Marchant, Taylor & Hamilton, 1997; Ghazoul & Sheil, 2010). The result was that many of these forests such as those in the Albertine Rift became rich in rare and endemic species (Butysnki, 1987; Kingdon, 1990a; Ghazoul & Sheil, 2010). Subsequently, favorable conditions

enabled species to disperse to lower elevations thereby expanding their present distributional ranges (Hamilton, 1974; Butynski, 1984; Ghazoul & Sheil, 2010). The Albertine Rift forests such as the Bwindi Impenetrable in south western Uganda represents such refugia and is the focus of this paper in which historical trends in tropical forest use by humans in south western Uganda are reviewed. Examining such historical trends is important for understanding the present use patterns of forest resources in Bwindi Impenetrable forest. It is also important to understand the reasons why different management regimes of Bwindi Impenetrable forest have altered the way local people relate to it. This is important for relating past forest use situations with the present to help park managers make right decisions for forest resource use programs for the local people.

2.2 Bwindi Impenetrable Forest

Bwindi Impenetrable forest is located in Southwestern Uganda at the edge of the western Rift Valley (Figure 2.1). The forest touches the western border of the Democratic Republic of Congo and covers three districts of Kabale, Kisoro and Kanungu. The highest point in Bwindi forest is located in the southeast part of the forest in Kabale district at 2607 m a.s.l while the lowest point is at the northwest part of the forest in Kanungu district at 1400 m a.s.l (Butynski, 1984; Howard, 1991; Olupot, 2008; Olupot *et al.,* 2009). The forest lies at the northwestern end of the Rukiga highlands that are associated with upwarpings of the western Rift Valley (Butysnki, 1984; Taylor & Marchant, 1995). The forest has a steep undulating topography, formed from folding of the underlying Precambrian sedimentary rocks into a series of roughly parallel ridges and poorly drained valleys (Taylor & Marchant, 1995).

The soils in Bwindi forest have been described by Leggat & Osmaston (1961) and Butynski (1984) as derived primarily from the Precambrian phyllites of the Karagwe-Ankolean system. These soils have been classified into two types of "non-differentiated humic ferralitic soils of high altitudes" and "non-differentiated ferrallitic soils with dark horizons". The soils are generally tropical red earths overlain with spongy humus with clays occurring under a layer of peat in the swampy valley bottoms (Atlas of Uganda, 1967; Leggat, & Osmaston, 1961). Butynski (1984) observed that Bwindi Impenetrable and its surrounding soils as poor for agriculture; the reason shifting cultivation is practiced there.

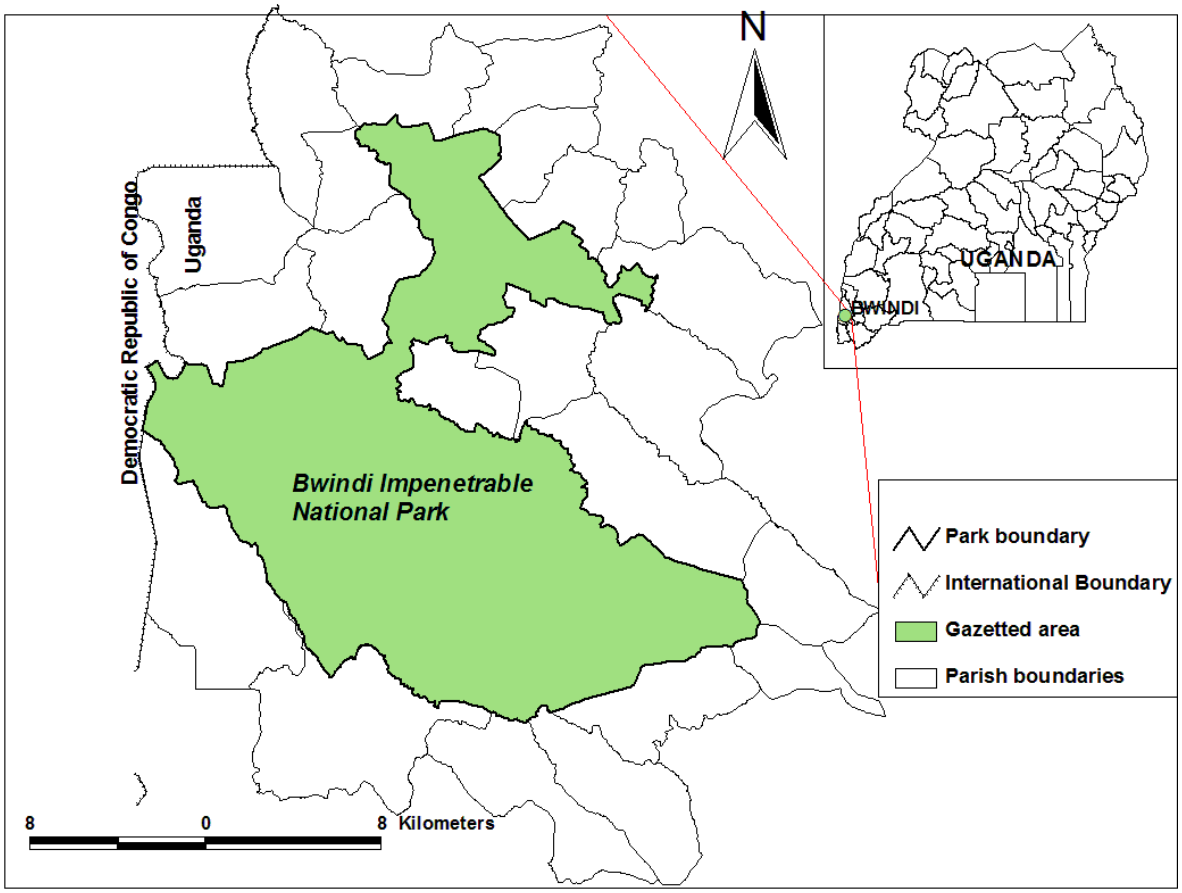


Figure 2.1: Location of Bwindi Impenetrable National Park in Southwest

2.3 First human settlements in southwestern Uganda

The first human settlements in southwest Uganda can only be traced mainly through oral history and pollen data records as there is little Anthropological information documented. Human settlements in southwest Uganda may have coincided with the migrations of the Bantu speaking people from the southern and central parts of Africa into East Africa between 1000-1800AD (Huffman, 1970). Present day southwestern Uganda is occupied by Bantu speaking tribes of Bakiga, Bafumbira (Hutu and Tutsi) and Batwa. Forests in the southwestern Uganda were initially inhabited by Batwa only until the mid-16th century when Bakiga and Bafumbira-Bahutu joined following wars in northern Rwanda (Kingdon, 1990b; Lewis, 2000; Marchant, Taylor & Hamilton, 2000).

The Batwa were nomadic forest hunter-gatherers who occupied areas stretching from montane forests to savannah-forests in western Uganda. These are the present high altitude forests of Bwindi and Mgahinga as well as the lowland forests of Semuliki that are akin to the Congo basin forests. Before the British colonial times, the southwestern parts of Uganda were considered the northern frontier territory of the Rwandan state ruled by Tutsi kings. Oral history describes how the high altitude forests were considered Batwa territories by the Tutsi kings of Rwanda farther south (Kingdon, 1990b). The Batwa paid tribute to the Tutsi kings with ivory and animal skins and helped them fight wars with other tribes of Bakiga and Bafumbira-Hutu (Kingdon, 1990b; Lewis, 2000).

The Batwa, Bakiga/Bafumbira-Hutu and Batutsi clans lived together albeit in a precarious harmony, due to their complimentary livelihoods as hunter-gatherers, agriculturists and

pastoralists respectively. The pastoralist Tutsis were the rulers who demanded tribute in terms of gifts from other tribes. The Bakiga/Bafumbira-Hutu often refused to submit to the Tutsi kings and were considered rebellious. As a result there were intertribal wars between the Bakiga/Bafumbira-Hutu and the Tutsi (Edel, 1957). The rebellious Bakiga-Bafumbira were eventually overwhelmed by a strong force of the Tutsis assisted by Batwa archers in the mid-16th century and therefore migrated farther north into the present day southwestern Uganda (Edel, 1957; Kingdon, 1990b). By about 1750, nine Bakiga/Bafumbira-Hutu clans had settled in Southwestern Uganda to escape the wars with the ruling pastoralists Tutsis (Edel, 1957; Kingdon, 1990b; Lewis, 2000).

The relationship between Batwa and Bakiga/Bafumbira-Hutu varied from place to place and spanned the gamut from hostility to ambivalent tolerance and friendly paternalism (Kingdon, 1990b). While in northern Rwanda there was hostility between them, in the southwestern Uganda, the Bakiga/Bafumbira-Hutu obtained goodwill and cooperation from the Batwa they found. Usually, beer or one or two heads of livestock were sufficient to enlist the Batwa help and cooperation in felling and clearing a patch of forest for agriculture (Kingdon, 1990b).

2.4 First human use of Bwindi Impenetrable Forest

2.4.1 Batwa forest people (hunter-gatherers)

The first humans to use montane forests in southwestern Uganda were probably the Batwa (hunter-gatherers) who probably first occupied the forest around 1000AD (Huffman, 1970). They used the forest for hunting, worshiping and collection of wild honey, wild yams, fruits and

vegetables. The forest was also a source of meat from elephants, antelopes, bushpigs and buffaloes for the Batwa. Leopard and Colobus monkey skins were traded for food, beer and livestock from the Bakiga farmers and Tutsi kings. Other traded forest items by Batwa included ivory and gold which were paid as tribute to the Tutsi kings. The Batwa also collected toll in form of food and beer payments from caravan travelers that passed through the forests (Kingdon, 1988; Kingdon, 1990b; Lewis, 2000).

Batwa also hunted flying squirrels (*Anomalurus derbianus*) as food. The flying squirrels were important in the culture of the Batwa for payment of bride price by the men (Kingdon, 1988). Batwa women occasionally escorted their husbands in hunting expeditions but did not participate in hunting per say; they collected wild vegetables, mushrooms and fruits such as those from *Myrianthus holstii* (Kingdon, 1988). The men and women also collected wild yams (*Dioscorea praehensilis* and *Dioscorea preusii*) and wild honey. Other products obtained from the forests included; vines and lianas for making ropes and medicinal plants which they exchanged for food and beer.

2.4.2 Bakiga and Bafumbira-Hutu agriculturalists

The earliest forest clearance in southwestern Uganda dates back approximately 2200 years before present (B.P) probably caused by low level human impacts of agriculture (Marchant *et al.*, 2000). This coincided with the iron-smelting technology developed between 2500 to 2000 years B.P and taken up by the Bakiga and Bafumbira-Hutu agriculturalists (Phillipson, 1986; Marchant *et al*., 2000). The iron smelting technology was taken up by a few Bakiga clans of Basingola near Bwindi and Baheesi near Lake Bunyonyi (Rugyema-Turyahikayo, 1983; Marchant *et al*., 2000).

The agriculturalists obtained tools for clearing forests from the iron smiths through exchange of food items. They developed methods of agriculture and metalworking which enabled them colonize new areas with widely varying technologies and with increased human population densities than hunting and foraging permitted.

The intertribal and clan wars in northern Rwanda led to a population influx and expansion of iron and agricultural technology which in turn led to increased clearing of forests for agriculture (Edel, 1957; Kingdon, 1990b; Lewis, 2000; Marchant *et al*., 2000). The Bakiga were free nomadic cultivators who practiced shifting cultivation of slash-and-burn in the high altitude forests of southwestern Uganda (Kingdon, 1990b; Edel, 1957). This practice eventually led to encroachment on the Batwa forest territories as the Bakiga/Bafumbira populations increased. The forests started becoming patchy and started decreasing resulting in conflicts of the agriculturalists with the Batwa forest hunter-gatherers (Kingdon, 1990b; Edel, 1957). A series of wars between Bakiga/Bafumbira-Hutus and Batwa archers ensued as such and were only quelled by the British colonial administrators in 1912 (Marchant *et al*., 2000; Lewis, 2000).

The Batwa remained with a few forest patches that survived the agriculturists. Marchant *et al* (2000), note that the Batwa may have been important in the maintenance of the coherence of the montane forests in southwestern Uganda before legislation by colonialists since they defended them from agriculturists. The few forest patches that survived were those the Batwa protected and these may constitute those of the present Bwindi Impenetrable, Mgahinga (Virunga), Echuya and Mafuga/Kirima forests in southwestern Uganda (Marchant *et al.* 2000).

Up until the nineteenth century, forest use was a preserve of Batwa who traded forest resources for food and alcohol with other tribes (Kingdon, 1988; Kingdon, 1990b; Lewis, 2000). Some Bakiga/Bafumbira-Hutus after interactions with their Batwa cohorts learnt skills for hunting and use of the forest (Kingdon, 1988; Kingdon, 1990b). For example some Bakiga clans such as the Bahunde (who intermarried with Batwa) started to hunt, cut trees, and dig for gold, harvest climbers for ropes and baskets and medicinal plants (Kingdon, 1988; Kingdon, 1990b). The Bahunde mainly hunted giant forest hogs, buffaloes and duikers but did not hunt primates and rodents considered a preserve of the Batwa (Namara *et al.*, 2000).

The Bakiga later on introduced new methods of hunting such as using nets and snares (Namara *et al.*, 2000). Animals were driven into the nets with the help of dogs and then speared. This method may have likely contributed to the loss of the giant forest hogs and buffaloes from the present Bwindi Impenetrable forest. The Bakiga-Bafumbira-Hutu forest users came up with a wide diversification of forest use such as woodcarvings for beer boats, shields, musical harps, cups and hoe handles (Namara *et al.,* 2000). Others were making iron smelting bellows (from tree trunks), perfumery and cosmetics using powder from *Carapa grandiflora* seeds for animal skin wear by women, as well as basket and weaving materials from climbing plants (Namara *et al.*, 2000).

2.5 Use of Bwindi forest during colonial and post-colonial times

Prior the gazettement of Bwindi forest (in 1932) by the colonialist, the forest was mainly used for commercial exploitation of timber. The extraction of timber was commissioned by white

missionaries and colonial administrators for building churches, hotels and government buildings. In 1914 there was an increase in commercial exploitation of *Podocarpus milanjianus* for timber exported to Europe for making gun handles/butts (Marchant *et al.,* 2000). The driving force that most determined the forest tree composition then was pitsawing that commenced during the period in 1914 when there was the First World War and later on during the Second World War in 1939 (Marchant *et al.,* 2000).

In 1932 the British colonial government enacted legislation for the gazettement of forest reserves and the Bwindi Impenetrable Forest Reserve was established under the district administration. The aim was to stop encroachment by cultivators and regulate timber exploitation (Leggat & Osmaston, 1961; Butysnki, 1984; Kingdon, 1990b, Lewis, 2000). By that time, cultivation and tree felling had greatly reduced the forest territories of the Batwa hunter-gatherers which greatly increased their dependence on Bakiga/Bafumbira-Hutu farmers for food and land (Lewis, 2000). The traditional ownership of the forest by the Batwa was ignored by the colonialists although they continued to use the forest for hunting and fruit gathering (Lewis, 2000). By 1954, large chunks of Bwindi forest had been cleared by the agriculturalist and timber exploiters (Butynski, 1984; Scott, 1992; Wild, 2001).The most exploited trees for timber then were *Podocarpus milanjianus, Maesopsis eminii, Newtonia buchanani, Symphonia globulifera, Ficalhoa laurifolia, Fagara macrophylla, Entandrophragma* spp and *Chrysophyllum* spp (Leggat, & Osmaston, 1961; Butynski, 1984). Hunting by Batwa and Bakiga was not restricted.

In 1961, a regulative plan for timber exploitation was established by Leggat, & Osmaston (1961) in which exploitation was limited to certain ‘restricted tree species” and forest compartments by

licensed pitsawyers (Butynski, 1984; Wild, 2001). In 1964, the game act established the Bwindi Impenetrable Game Reserve that put restriction on hunting. Permits were now required to hunt game (Butynski, 1984). The forest and game departments employed forest and game guards respectively to stop illegal timber extraction and poaching. The harvesting of other minor forest products was not restricted by the forest and game act (Wild, 2000). The creation of the Bwindi Impenetrable Game Reserve was mainly to protect the endangered mountain gorillas (*Gorilla beringei beringei*), (Butynski, 1984). Permits holders allowed to hunt were mainly the British colonial administrators since Batwa and Bakiga/Bafumbira-Hutus could not afford them. The Batwa and Bakiga/Bafumbira-Hutus only hunted "illegally" as penalties for illegal hunting were not severe enough to deter them and there was low manpower to patrol the forest (Butynski (1984). Butynski (1984) further notes that while the forest and game departments did an excellent job of preventing forest encroachment; they failed to prevent illegal timber extraction and poaching. By mid-1960's the use of forest climbers became restricted to holders of permits issued free by forest guards (Wild, 2000). This was later abused by the forest guards who solicited bribes to issue the permits (Bunengo Eriya-Former forest Guard *personal communication*).

The above historic sequences still have consequences for the present day Bwindi Impenetrable forest management. Whereas the Batwa were not evicted from the forest, the gazettement of the Bwindi forest and game reserves limited their ownership and use of the forest. Restrictions on hunting and climber collections led to increased dependency of the Batwa on Bakiga/Bafumbira-Hutu farmers for food. The Batwa were hence exploited for cheap labor by the agriculturalists Bakiga/Bafumbira (Lewis, 2000). These changes affected to a lesser extent the

Bakiga/Bafumbira-Hutus than the Batwa. Farming was their principal livelihood and the use of the forest was for only supplementary incomes unlike the Batwa who depended on it for survival (Kingdon, 1988).

2.6 Local use of Bwindi forest after gazettement as National Park

The period after Uganda's independence in 1962 was that of political turmoil and dictatorship. Between 1971 and 1984 there were several civil wars and Idi Amin dictatorship. The forests were neglected by the government and there was widespread commercial hunting, timber extraction, forest encroachment and mining by both local people and others from nearby towns (Butynski, 1984; Lewis, 2000; Wild, 2001). The forest and game department's already precarious situation was exacerbated by the political turmoil and dictatorship in Uganda. It is thought that some of the flora and fauna were lost during this period (Butynski, 1984).

This situation improved after a new Government of Yoweri Museveni came into power in 1986. In the same year, the Impenetrable Forest Conservation Project (IFCP) was established with funding from the World Wide Fund for Nature (WWF) to support the Game Department to protect the mountain gorilla, its habitat, and carry out ecological research in Bwindi forest (Wild, 2001). This helped to control illegal activities through more recruitment and motivation of staff to effectively patrol the forest.

Within the same period, other conservation and development organization were formed to strengthen the conservation efforts. These included the International Gorilla Conservation

Programme (IGCP) and CARE's Development Through Conservation (DTC). The IGCP focused on ensuring better conservation efforts of mountain gorillas and their habitats through providing veterinary services for the mountain gorillas. The CARE-DTC project provided support to research of the WWF project (IFCP) and helped initiate local community livelihood projects. It was initiated after an agreement between USAID and WWF in 1988 with the goal of enhancing the environmental quality of life for approximately 86,500 subsistence farmers in southwest Uganda. In 1991, the IFCP project became registered under Mbarara University of Science and Technology as the Institute of Tropical Forest Conservation (ITFC) with the aim of carrying out ecological research, education, monitoring and training and helping ensure Uganda's natural heritage for future generations.

With recommendations from Butynski (1984), ITFC and other local scientists and National park managers such as Prof Frederick Kayanja and Dr Eric Edroma, the Bwindi Impenetrable forest was gazetted a national park in August 1991. This was to strengthen on the efforts of protecting the mountain gorillas and its habitat. The creation of Bwindi as a national park led to restrictions of all human activities within the forest. Traditional forest users were denied access to the forest. The National park recruited and employed paramilitary rangers to patrol the forest and stop human activities within. Conflicts between park managers and the local people soon arose and the people protested the gazettement of the national park. Such conflicts included the numerous fires that were deliberately set up in the forest by the local people, burning up to 5% of the park in 1991 and 1992 (ITFC, 1999). There was also severe harassment of park staff by local people (Butynski, 1984, ITFC, 1999, Wild, 2001). These conflicts also occurred in other newly established national parks in Uganda as well. Despite the paramilitary protection of Bwindi, poaching and pitsawing still

continued on a large scale. The paramilitary rangers could not patrol the entire Bwindi park area ($321km^2$) from such activities.

2.7 The Rio de Janeiro conference and the multiple use programme

When the United Nations Conference on Sustainable Development also known as the "Earth Summit" was held in Rio de Janeiro in Brazil in 1992, there was a global shift in strategies for the management and conservation of natural resources in protected areas. It became widely accepted that paramilitary and preservationist strategies for natural resource protection were ineffective given the socio-economic and cultural climate in which they operated in (Scott, 1998; Cunningham, 2001; Namara, 2006). Hence donor and development agencies such as CARE-DTC thereafter influenced the Uganda National Parks (now Uganda Wildlife Authority-UWA) to change its strategies from that of paramilitary approach to one that focused on the involvement of local people in park management. Thus new strategies such as collaborative forest management, sustainable use of forest resources and equitable sharing of forest resources emerged (CBD, 1993). These strategies were later emphasized and strengthened by the 2003 fifth world park's congress held in Durban. Uganda became a signatory to the CBD on 12th June 1992 and was part of the 2003 world park's congress and was thus obliged to involve local people in protected area management.

The changing political perspectives in 1992 led to Uganda National Parks to integrate sustainable use of forest resources into park management. Bwindi was the first national park to integrate sustainable use of forest resources into park management. In 1994, the Bwindi park management

with facilitation and funding from various stakeholders and donor agencies such as CARE's-DTC, IGCP and ITFC devised and started a collaborative forest management programme called the Multiple Use Programme (MUP). The MUP was set up on the premise that the relationship between park management and local people would be enhanced through access to forest resources for livelihoods, and that illegal activities within the park would stop or reduce (Cunningham, 1992; Multiple use MoU, 1994; Wild, 2001).

"Multiple use" initially referred to multiple land-uses in Bwindi, i.e., biodiversity conservation, tourism and low impact forest resource use. This later evolved to low impact forest resource use only (Wild, 2001). Under the MUP arrangement, specific local people access plants for weaving and medicines and also carry out beekeeping at the park periphery (Wild & Mutebi, 1996; ITFC, 1999; Wild, 2001). The use of the forest by Batwa (e.g. for fruit gathering, wild honey and wild yams collection) were not permitted despite various recommendations (Butynski, 1984; Cunningham, A, 1992; Wild & Mutebi 1996). The MUP activities were furthermore restricted to 20% of the park's area (Wild 2001; Bitariho *et al.,* 2006a). The program started as a pilot scheme in 1994 in the parishes of Mpungu, Rutungunda and Nteko for plant resource extraction and Kitojo, Nyamabare, Kashasha, Nshanjare and Byamihanda for beekeeping and honey collection (Wild & Mutebi, 1996; ITFC, 1999). It was later expanded in 1999 to include seven other plant resource extraction zones for the other parishes around the Park (ITFC, 1999; Bitariho *et al.,* 2006b) see Figure 2.2.

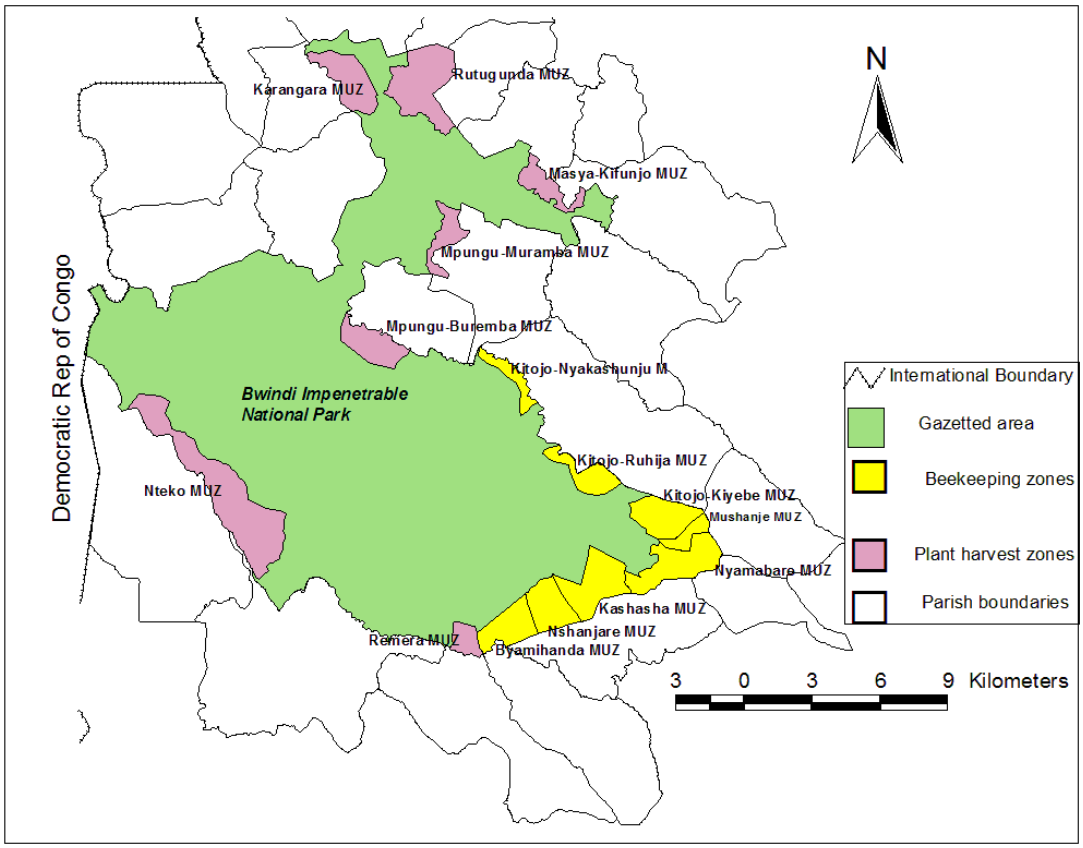


Figure 2.2: Map of Bwindi Impenetrable National Park Multiple Use Zones.

2.8 Strengthening local people's participation in Park management

In the early 1990s, Uganda government adopted a decentralization programme to devolve government responsibilities to local institutions at the district and village levels (Uganda local Government Act, 1997, Namara, 2006). This approach was similarly adopted by the protected areas in Uganda and especially Bwindi with support and funding from CARE-DTC. Bwindi park management established forest resource user committees and Parish Production and Environmental Committees (PPECs) to develop their formal linkages with local government institutions (Namara, 2006). Forest Resource user committees comprised of resource users (plant harvesters and beekeepers) involved in the MUP. The Chairpersons of the forest resource user committees

automatically became members of the PPECs who in turn formed the Community Protected Area Institutions (CPIs) a key decision body that addressed local people interests at the park management level.

The CPI is supported by the community protected area institutions policy of Uganda Wildlife Authority and its members are drawn directly from parish-level local governments and park management (Namara, 2006). When the CARE-DTC programme wound up in the mid-2000s, the PPECs became dysfunctional because they lacked funds and facilitation as there were no established channels to sustain them. Today, the CPIs are no longer active; furthermore the forest resource users are no longer represented at the CPIs. The participation of local people and most especially forest resource users in park management is low and most of their needs are restricted by park management.

Several reviews of the MUP have been carried out aiming at strengthening local people involvement in park management; these include those by Bensted-Smith *et al.* (1995); Davey *et al.* (2001); Bitariho *et al.* (2004) and Tushabomwe-Kazooba & Mbamanya (2005). However, most of the recommendations from the reviews have not been taken up by park management. Only few Batwa have been incorporated in the MUP for restricted quantities of wild yams harvests. Other forest resource access such as wild honey, poles, hoe handles, walking sticks and fishing have not been permitted by Bwindi park management. However, some of these forest resources are sometimes extracted illegally by the local people leading to conflicts with park management (Bitariho *et al.,* 2004; Bitariho *et al.,* 2006b; Namara, 2006). The illegal activities presently observed in Bwindi

are attempts by the local people to attain a forest use and access status they enjoyed in the past before gazettement.

The events described above still have implications in the way Bwindi forest is managed by the present park managers. For example, the present illegal activities (hunting, fishing, and wild honey collection) manifested in Bwindi National park are often blamed on the Batwa and other traditionalists by park rangers. Despite the prohibition by park managers, the local people continue to illegally seek for them disregarding the risks of arrests and fines involved. The former forest hunter-gatherers seem to continually seek the forest user rights they enjoyed before Bwindi was made a national park.

2.9 Conclusions

The history of human settlement and forest resource use in Bwindi shows that for centuries Bwindi forest has been a source of livelihood for the local people. However, the forest has several species of endangered and endemic plants and animals. As such the conservation of Bwindi forest has been highly regarded as paramount by many conservationists and park managers sometimes to the detriment of the adjacent local people. It is nonetheless widely accepted that Bwindi cannot be conserved without involving the adjacent local people.

The need to conserve Bwindi forest and the involvement of local people in park conservation has resulted in the forest undergoing through three stages of metamorphosis: complete local people ownership of the forest (before gazettement), complete local people exclusion (early park

establishment), and controlled/no local people ownership of the forest (when the MUP was established). Attempts by park management to devolve power to the local people under programmes such as PPECs and CPIs have failed because the process has not been done in a transparent and equal manner. The most important local people livelihood requirements for example have not been included in Bwindi's MUP. Most Batwa who depended on the forest for their livelihoods have completely lost out and have ended up leading a destitute life. The Batwa have been ignored in most park management programs yet they were crucial in the protection of the Afromontane forests in southwestern Uganda. It is high time the Bwindi park management involved the Batwa in park management to tap on their skills and knowledge of Bwindi forest.

References

Bensted-Smith, R., Infield, M., Otekat, J. and Thompson-Handler, N., 1995. Review of the multiple-use (resource sharing) programme in Bwindi Impenetrable National Park. A report to CARE-Development Through Conservation Project, Kabale.

Bitariho R, Mugyerwa B, Barigyira R and Kagoda E., 2004. Local people's attitudes and new demands since inception of multiple use programme in Bwindi Impenetrable National Park, S. W Uganda, Unpublished report, Institute of Tropical Forest Conservation, Kabale

Bitariho, R., McNeilage, A., Babaasa, D., and Barigyira, R., 2006a. Plant harvest Impacts and sustainability in Bwindi Impenetrable National Park, S.W. Uganda, *African Journal of Ecology* (44): 14-21.

Bitariho, R., Kagoda, E., Barigyira R.,Amanya, S., Safari., C., 2006b. The potential supply of forest resources demanded by Batwa from Bwindi Impenetrable National Park, S.W Uganda, Unpublished report, Institute of Tropical Forest Conservation, Kabale.

Butynski T.M., 1984. Ecological survey of Impenetrable (Bwindi) Forest, Uganda, and recommendations for its conservation and management. New York Zoological Society Report, New York.

CBD., 1993. Convention on Biological Diversity, www.cbd.int/convention/about.shtml

Cunningham, A.B., 1992. People, park and plant use: Research and recommendations for multiple-use zones and development alternatives around Bwindi-impenetrable National Park, Uganda. Report to CARE-International, Kampala.

Cunningham A. B., 2001. Applied ethnobotany, people, wild plant use and conservation, WWF, Earthscan Publications Ltd, London.

Davey, C., Peters, C.M, and Byarugaba, D., 2001. Participatory review of the Multiple Use Programme, Bwindi Impenetrable National Park and Mgahinga Gorilla National Park. CARE-Uganda and Uganda Wildlife Authority, Kampala.

Edel, M.M., 1957. The Chiga of western Uganda. International African Institute, Oxford University Press, New York.

Ghazoul, J & Sheil, D., 2010. Tropical rain forest ecology, diversity, and conservation. Oxford University Press, Great Clarendon Street, Oxford.

Howard, P.C., 1991. Nature Conservation in Uganda's Tropical Forest Reserves. IUCN, Gland.

Huffman, T.N., 1970. The early Iron Age and the spread of the Bantu, *The South African Archaeological Bulletin*. 25 (97): 3-21.

ITFC., 1999. The potential supply of weaving and medicinal plant resources in the Proposed kifunjo/masya multiple-use zone of Bwindi Impenetrable National Park, S.W Uganda. Unpublished report, Institute of Tropical Forest Conservation, Kabale.

Kingdon, E., 1988. The Twa of Kigezi. Report on fieldwork among the Twa of Kigezi. Unpublished report for Horniman Trust London and Swan Fund, Oxford.

Kingdon, E., 1990b. Caught Between two worlds. Moral problems relating to conservation in South-West Uganda. *International Journal of moral and social studies* 5: 235-250.

Kingdon, J., 1990a. Island Africa. The evolution of Africa's rare animals and plants. Collins publishers, London.

Leggat, G.J and Osmaston, H.A., 1961. Working plan for the Impenetrable Central Forest Reserve, Kigezi district, Western province, Uganda. Uganda forest department, Entebbe.

Lewis, J., 2000. The Batwa Pygmies of the Great lakes region. Minority rights group, London.

Marchant, R, Taylor, D and Hamilton A., 1997. Late Pleistocene and Holocene history at Mubwindi swamp, southwest Uganda. *Quaternary research* 47:316-328.

Marchant, R, Taylor, D & Hamilton A., 2000. Late Holocene fluctuations in the composition of montane forest in the Rukiga highland, Central Africa: a regional reconstruction. In human ecodynamics, Bailey, G, Charles, R, Winder, N (Eds) Oxbow Books, Cambridge.

Multiple use MoU, 1994. Memorundum of Understanding Between Uganda National Park Bwindi Impenetrable National Park and the People of Rutugunda Parish, Kanungu District. An agreement concerning collaborative forest use and management at Bwindi Impenetrable National Park, Kanungu.

Namara, A., Gray M, McNeilage A, 2002. People and Bwindi Forest: A history account as given by local community members. Unpublished report, ITFC, Ruhija, Kabale.

Namara, A., 2006. From Paternalism to real partnership with local communities? Experiences from Bwindi Impenetrable National Park (Uganda). *Africa Development* 31 (2):39-68.

Olupot W., 2008. A variable edge effect on trees of Bwindi Impenetrable National Park, Uganda, and its bearing on measurement parameters. *Biological Conservation* 142 789-797.

Olupot, W, Barigyira, R, & Chapman, C., 2009**.** The status of anthropogenic threat at the people-park interface of Bwindi Impenetrable National Park, Uganda. *Environmental Conservation* 36 (1): 41–50.

Phillipson, D.W., 1986. Life in the Lake Victoria basin. *Nature* 320: 110-111.

Rugyema-Turyahikayo, B., 1983. Philosophy and Traditional Religion of the Bakiga. Literature Bureau, Nairobi.

Scott, P., 1992. Fringe benefits: National Park boundaries as areas for local community utilisation: the case of the Impenetrable (Bwindi) forest. MSc. Thesis, Agricultural University of Norway, Norway.

Scott, P., 1998. From Conflict to Collaboration, People and Forests at Mount Elgon, Uganda. IUCN-Eastern Africa Regional Office, Nairobi

Tushabomwe-Kazooba, C, & Mbamanya, H., 2005. Multiple use program in Bwindi Mgahinga Conservation Area (BMCA) – South western Uganda. Unpublished report of a stakeholders' workshop held in White Horse Inn Kabale, A consultancy report for CARE-REPA, Kampala.

Uganda Local Government Act, 1997. Republic of Uganda, Entebbe Government Printer, Entebbe.

Wild, R, & Mutebi, J., 1996. Conservation Through Community Use of Plant Resources: Establishing Collaborative Management at Bwindi Impenetrable and Mgahinga Gorilla National Parks. People and Plants Working Paper 5. UNESCO, Paris.

Wild, R., 2001. Plants from the Park: Establishing community harvesting of plants as a conservation tool at Bwindi Impenetrable and Mgahinga National Parks, Uganda Mphil Thesis, Dept of Botany, University of Capetown.

Chapter Three

3 Does Bwindi's Multiple Use Programme initiate participation of local people in park management?

3.1 Collaborative natural resource management

It is widely accepted that strict and militaristic approaches to management of protected areas (PAs) alone cannot be maintained without the participation of the adjacent local people (Scott, 1998; Cunningham, 2001; Hutton *et al,* 2005; Adams & Hutton, 2007). The local residents who are dependent on the natural resources for survival and suffer most if the natural resources are degraded are among key stakeholders in natural resources protection and conservation (Scott, 1998; Ghazoul & Sheil, 2010).

Often most benefits of protected area conservation accrue elsewhere while the local residents suffer the costs and as a result commonly hold negative attitudes towards the protected areas (Beck, 2000; Harter & Goldman, 2010). Such costs include displacements, hazards from crop raiding by wild animals, labor and opportunity costs of crop defense (from wild animals), physical hazards and death (Naughton-Treves, 1997; Sekhar, 1998; Woodroffe *et al.,* 2005, Adams & Hutton, 2007). It is important to compensate the local people over some of these costs. As such many tropical countries have developed mechanisms of integrating the participation of rural people in park management through systems such as Collaborative Natural Resource Management-CNRM (Sheil & Lawrence, 2004; Borrini-Feyerabend *et al.,* 2007; Garcia & Lescuyer, 2008). The goal of CNRM is to involve the local people in the management of natural resources within the protected areas

(Castro & Nielsen, 2001; Dietz, Ostrom & Stern, 2003; Sheil & Lawrence, 2004; Garcia & Lescuyer, 2008).

Collaborative Natural Resource Management or Collaborative Forest Management (CFM), sometimes referred to as Co-management has been defined differently e.g. Borrini-Feyerabend, 1996; MTWA, 1996; Sumar Singh *et al.*, 1997; IUCN, 1997; Beck, 2000; Castro & Nielsen, 2001; NFA, 2003, Kazoora, 2006, Borrini-Feyerabend *et al.*, 2007; Worah, 2008. In this chapter CFM is defined after Beck, (2000), Borrini-Feyerabend *et al.* (2007) and Worah (2008) as an arrangement where key stakeholders enter into a mutually enforceable agreement that defines their respective roles, responsibilities, returns and rights (4Rs) in the management of a protected area (PA) resource. CFM has also been described under different names such as Joint Forest Management, Community Forestry, Community Based Natural Resource Management, Natural Resource Co-management, Popular Participation and Participatory Forestry Management but all involve the 4Rs already mentioned (Sumar Singh *et al.*, 1997; Borrini-Feyerabend *et al.*, 2007; Worah, 2008).

3.2 When and why should stakeholders be willing to collaborate?

According to Borrini-Feyerabend *et al.*, 2007 and Worah, 2008, collaborative approaches to natural resource management capitalize on two main lessons: first, there exists a variety of interests and concerns at stake for any given set of natural resources, and what meets conservation objectives and benefits on social actors, may harm another, the second lesson is that different social actors possess different and often complementary capacities and comparative advantages to optimally manage a set of natural resources (Borrini-Feyerabend *et al.*, 2007). The

two lessons emphasize and illustrate the need for collaboration among different stakeholders. For example when a ban on extracting plant resources used for medicinal purposes is imposed by natural resource managers, the tourist camp owners may not be adversely affected as a local herbalists. The local people lack the necessary resources needed to tackle threats to ecological problems such as reduction in plant and animal numbers. Also natural resource managers cannot police the entire protected areas alone due to limited resources and lack of local traditional knowledge (Borrini-Feyerabend *et al.,* 2007; Worah, 2008).

Collaborative approaches to natural resource management are therefore helpful where stakeholders acting alone find it difficult to manage the natural resources (Beck, 2000; Castro & Nielsen, 2001; Borrini-Feyerabend *et al.,* 2007). The different stakeholders can broaden their perspectives and join forces to become stronger and more effective natural resource managers (Borrini-Feyerabend *et al.,* 2007). Most CFMs are a result of conflicts between natural resource managers and adjacent local communities (Wild & Mutebi, 1996; Wild, 2000; Castro & Nielsen, 2001). Such conflicts arise from the different opinions by stakeholders on how to manage the natural resources. Hence, CFMs offer substantial promise as a way of dealing with natural resource-based conflicts between local people and state agencies in a participatory manner (Wild & Mutebi, 1996; ITFC, 1999; Wild, 2001; Castro & Nielsen, 2001).

CFM arrangements in Uganda and elsewhere vary with location, management categories and types of protected areas (Castro & Nielsen, 2001; Kazoora, 2006; Worah, 2008). Often this variation is a result of willingness or unwillingness by protected area managers to devolve authority to local people (Beck, 2000; Worah, 2008). The primary objective of Uganda Wildlife

Authority (UWA) for instance is biodiversity conservation while that of the National Forest Authority (NFA) is the liberal economic use of forest resources. The local people around protected areas would like to benefit socially and economically from them for their livelihoods. The reluctance to devolve authority to the local people by protected area managers stems from the fact that they would compromise their management objectives (Worah, 2008).

Conflicts over opinions on how to manage natural resources in protected areas have in the past been experienced in Bwindi Impenetrable National Park (hereafter called Bwindi) and other forest protected areas (PAs) of Uganda such as Kibale Conservation Area (KCA) and Mt Elgon Conservation Area (MECA) when they were gazette national parks in the early 1990's. A CFM arrangement called Multiple Use Program (MUP) was introduced in Bwindi to help mitigate the conflicts (Wild and Mutebi, 1996; Wild, 2001). Other national Parks such as Queen Elizabeth Conservation Area (QECA), KCA, and MECA later introduced similar arrangements referred to as Integrated Resource Use Programmes in the early 2000s.

3.3 Study objectives

The aim of the study was to compare CFM arrangements and local community attitudes from other PAs with those of Bwindi, The specific objectives were to;

i. Assess the influence of resource use committee group size and heterogeneity on group cohesion, governance and organization.
ii. Compare forest resources permitted and prohibited for extraction in Bwindi with those of other PAs**.**

iii. Compare attitudes of local people involved in Bwindi's CFM with those of other involved in CFM of other PAs in Uganda.

iv. Assess and compare methods used to determine resource offtakes in Bwindi with those of other PAs.

3.4 Study justification

Because of the status of Bwindi as a protected area under IUCN category 2 and home to the endangered mountain gorillas (*Gorilla beringei beringei*), not all the livelihood requirements by the local people were included for access in the MUP. Local people around Bwindi continue to demand for bush meat, wild honey, fish, hoe handles, walking sticks, timber and firewood from the park yet they are not legally allowed (Beck, 2000; Bitariho *et al.,* 2004; Namara, 2006). There have been incidences where some of these resources have been illegally harvested by the local people from Bwindi (Bitariho *et al.,* 2004; Namara, 2006; Olupot *et al.,* 2009). Illegal exploitation of forest resources from Bwindi is a form of protestation by the local people against the existing restrictions on resource access (Barrow & Murphree, 2001; Namara, 2006).

In the other PAs of Uganda, extraction of some of these resources such as hoe handles, building poles, walking sticks and firewood is permitted. The differences of the CFM arrangements between Bwindi and other PAs are likely to cause more conflicts between local people and protected area managers. The CFMs arrangement may exacerbate the conflicts if not well managed and synergized. For example, in Bwindi, there is a reported low interest in the MUP by local people because of low benefits from it (Davey *et al.,* 2001; Bitariho *et al.,* 2004; Namara, 2006).

No study has however been carried out to compare and assess resource use programs and local people attitudes in the different PAs of Uganda. This is necessary for evaluating Bwindi's MUP in order to mitigate potential future conflicts. This study compared CFM arrangements of Bwindi with those in other PAs of Uganda thereafter identified lessons and opportunities from other PAs that could be adopted in Bwindi. This study further assessed the influence of resource use committee (RUC) group size and heterogeneity on governance and cohesion of the groups and therefore successful implementation of CFM.

3.5 Methods

3.5.1 Study Area

The study was carried out in 10 protecteda areas (six national parks and four forest reserves) of Uganda that had CFM arrangements. The National parks were; Bwindi, Queen Elizabeth Conservation Area-QECA (includes Rwenzori Mountains National Park-RMNP), Kibale Conservation Area-KCA (includes Semuliki National Park-SNP) and Mt Elgon Conservation Area (MECA). The forest reserves were; Budongo, Echuya, Mabira, and Namatale Forest Reserves. Five of the six national parks (Bwindi, QEPA, RMNP, KNP and SNP) are located in the Albertine Rift in western Uganda while MECA is located in eastern Uganda bordering Kenya. Bundongo and Echuya forests are also located in the Albertine Rift, Mabira forest in central Uganda and Namatale forest in eastern Uganda.

3.5.2 Interviews

Focused group discussions were carried out with Resource Use Committee (RUC) members and PA managers using a semi-structured questionnaire in the six national parks and the four forest reserves mentioned above. The interviews involved a small number of people (fewer than 10) that constituted the administrative structures of the RUCs (Chairman, Secretary, Treasurer and three committee member). The discussions with them focused on protected area management issues, attitudes towards the PAs and PA resource use issues. Attitudes towards the PAs were graded as good, fair, or poor depending on what the RUCs felt was appropriate for local community attitudes (see Appendix for questionnaire checklist). A two-way communication with the interviewee group was encouraged to facilitate the discussions. Thirteen RUCs and 16 PA managers were interviewed from the PAs. The RUC members ranged from 4 to 10 people depending on the PA and RUC (Table 3.1). The RUCs constituted; Chairperson, Vice Chairperson, Secretary, Treasurer and three committee members). In total 66 local people from the 10 PAs were interviewed. The PA managers interviewed were Conservation Area Managers (CAMs), Senior Warden In-charge (SWICs), Community Conservation Wardens (CCWs), Research and Monitoring Wardens (R&MWs) and Community Conservation Rangers (CCRs) from the national parks and forest sector managers from forest reserves (Table 3.1). The semi-structured questionnaires were with open ended questions on CFMs in the different PAs of Uganda (Martin, 1995; Tuxill & Nabhan, 1998).

Table 3.1: Respondents interviewed during focused group discussions

Protected Area	Protected Area managers	Resource use committee members
Queen Elizabeth Conservation Area	CAM, SWIC CCW, WR&M (4)	Kiyanga (4), Katunguru (4) & Kazingo (3) parish RUCs
Kibale Conservation Area	CAM , SWIC, CCR (3)	Bigodi rattan (6), Ngamba parish RUCs (4) & Kayanja fishing group (4)
Bwindi Impenetrable National Park	CCW , CCR (2)	Karangara (4) & Rutugunda (4) parish RUCs
Mabira Central Forest Reserve	CFM specialists, Sector Manager (2)	COFSDA RUC (4)
Mt Elgon Conservation Area	CAM , CCW, CCR (3)	Tangweni (8) & Bunasufwa (10) parish RUCs
Echuya Central Forest Reserve	sector manager (1)	Muko parish RUC (5)
Budongo Forest Reserve	sector manager (1)	KICODA RUC (6)
Total	**16 PA managers**	**66 local people**

CAM = Conservation Area Manager, SWIC= Senior Warden In-charge, CCR= Community Conservation Ranger, WR&M=Warden Research & Monitoring, COFSDA =, Conservation for Sustainable Development Association, KICODA = Kapeeka Integrated Community Development Association

3.5.3 Literature reviews

The following documents documents were reviewed; working CFM agreements (or Memoranda of Understanding-MoUs) of the different PAs, published and unpublished articles on CFMs elsewhere. Legislative framework was also examined and specifically the Uganda National Forestry and Tree planting Act (2003), Uganda Forestry Policy (2001), Uganda Local Government Act (1997) and the Uganda Wildlife Act CAP 2000. CFM agreements reviewed were those of; Kapeeka Integrated Community Development Association (KICODA) of Budongo forest, MoUs for; Ngamba-Burondo parishes of Semliki National Park, Kiyanga, Rwenshama and Katunguru women resource users parishes of QECA, Karangara, Mpungu and Rutugunda parishes of Bwindi and Tangweni and Bunasufwa parishes of MECA.

3.6 Results

3.6.1 Size coverage and legal status of resource use committees

RUCs in all the studied PAs were either village based or parish based (Table 3.2). The RUCs from Bwindi, MECA and ECFR were parish based while those from QECA, KCA, BFR and MFR were village based. Resource use committees in Bwindi met less frequently (twice in a year) while those from other PAs met quiet regularly up to 12 times in a year. In Bwindi, the RUCs are no longer active like in the past and their frequency of holding meetings has tremendously reduced since the MUP began.

All the RUCs from Bwindi pointed out that the level of attendance of executive meetings is irregular and that they have never held an annual general meeting for wider local community consultations. This was not the case with the other RUCs from other PAs where annual general meetings are held to inform larger local community members on issues to do with resource use. According to the RUC members from Bwindi, local people have lost interest in the meetings as they do not see benefits from them.

The RUCs working in the national parks are not legally registered while those working in forest reserves under National Forest Authority (NFA) are legally registered as community based organizations (CBOs) (table 3.2). The RUCs in national parks are informal and only require MoUs with Uganda Wildlife Authority (UWA). NFA deals only with legally registered CBOs while initiating and implementing CFMs.

Table 3.2: Characteristics of CFM arrangement in different PAs of Uganda

	Bwindi	QECA	KCA	MECA	ECFR	MFR	BFR
CFM first signed	1994	2000	2003	2003	2006	2006	2004
PA management	UWA	UWA	UWA	UWA	NFA	NFA	NFA
CFM coverage	Parish	Village	Village	Parish	Parish	Village	Village
Frequency of RUC meetings/year	2	12	4	12	4	12	12
Ever held annual general meetings?	No	Yes	Yes	Yes	Yes	Yes	Yes
Legal status of RUCs	Informal entity (MoUs)	Informal entity (MoUs)	Informal entity (MoUs)	Informal entity (MoUs)	Legal entity (CBO)	Legal entity (CBO)	Legal entity (CBO)
Ethnic composition of RUCs	Heterogeneous	Heterogeneous	Heterogeneous	Homogenous	Heterogeneous	Homogenous	Heterogeneous

QECA= Queen Elizabeth Conservation Area, KCA=Kibale Conservation Area, MECA=Mt Elgon Conservation Area, ECFR=Echuya Central Forest Reserve, MFR=Mabira Forest Reserve, BFR= Budongo Forest Reserve, UWA=Uganda Wildlife Authority, NFA=National Forestry Authority.

3.6.2 Ethnic composition of resource use committees

RUCs under the CFM arrangement in the PAs are either homogeneous or heterogeneous in ethnic composition (Table 3.2). With the exception of RUCs from MFR and MECA, the RUCs in the different PAs of Uganda are heterogeneous. In Bwindi, the RUCs constitute of Batwa, Bakiga and Bafumbira. In QECA, they constitute of Bakonzo, Banyankole and Batoro while in KCA they constitute of the Batoro and Bakiga. The chairpersons RUCs from Bwindi complained that Batwa (the minority group) do not attend RUC meetings and never go with them (Bakiga) to the forest

for resource harvest. The Batwa however say they preferred going to the forest alone because they do not want the Bakiga to learn their traditional forest skills. This was not the case in the homogeneous RUCs of MECA and MFR. The RUCs from MFR constitute of Baganda and those from MECA constitute of either Bagisu or Sabiny.

3.6.3 Resources permitted for extraction from the PAs

Twenty six resources from within the PAs are valued for livelihoods by the local people around the different PAs of Uganda (Table 3.3). Resource use in Bwindi can be considered restrictive compared with other PAs. Six out of the 26 (c. 23%) potential PA resources are permitted for extraction in Bwindi. Other National Parks such as KCA and MECA permit over 69% of the PA resources. Resource use in National Parks is generally more restrictive than in Forest Reserves. The MFR and BFR permit the highest number of valued PA resources (up to 88%) than other PAs. Whereas other PAs allow the extraction of firewood, wild honey, mushrooms, thatching grass, minerals, fishing and cultural sites visits, Bwindi does not (Table 3.3).

Table 3.3: Forest resources permitted for extraction by local people from different PAs:

Local people livelihood requirements	Bwindi	QECA	KCA	MECA	ECFR	MFR	BFR
Weaving plants	P	P	P	P	P	P	P
Medicinal plants	P	P	P	P	P	P	P
Wild yams	N	N	N	N	P	P	P
Mushrooms	N	P	P	P	P	P	P
Wild fruits	N	P	P	P	P	P	P
Wild honey	N	P	P	P	P	P	P
Green vegetables	N	P	P	P	P	P	P
Thatching grass	N	P	P	P	P	P	P
Papyrus	N	P	P	P	P	P	P
Wild coffee	N	N	N	N	N	P	P
Salt leak for animals	N	N	N	N	N	P	P
Ropes (various spp)	N	P	P	P	P	P	P
Bamboo	N	P	P	P	P	N	N
Stakes (bean/meat)	N	P	P	P	P	P	P
Firewood	N	P	P	P	P	P	P
Fish	N	P	P	N	P	P	P
Water	P	P	P	P	P	P	P
Mineral mining	N	P	P	P	P	P	P
Beekeeping	P	P	P	P	P	P	P
Footpaths	P	P	P	P	P	P	P
Hoe handles	N	N	N	N	N	P	P
Walking sticks	N	N	P	P	P	P	P
Cultural sites	N	P	P	P	N	P	P
Wild meat	N	N	N	N	N	N	N
Timber (exotics)	P	N	P	P	P	P	P
Timber (indigenous)	N	N	N	N	N	N	N
Total permitted	**7**	**18**	**20**	**19**	**20**	**23**	**23**
% permitted	**23%**	**69%**	**77%**	**73%**	**77%**	**88%**	**88%**

P= permitted resources for extraction, N = resources not permitted for extraction
QECA= Queen Elizabeth Conservation Area, KCA=Kibale Conservation Area, MECA=Mt Elgon Conservation Area, ECFR=Echuya Central Forest Reserve, MFR=Mabira Forest Reserve, BFR= Budongo Forest Reserve.

3.6.4 Attitudes of local people participating in CFMs

All the RUC members (13 RUCs) reported that they benefited more from participating in the CFM arrangements than those not participating. Joint opinions from RUC members were that the good relationship between park management and the local people adjacent had greatly improved as a result of the CFMs (Table 3.4). Other reported benefits of the CFMs by the RUCs were; source of income from the sale of PA resources, ability of the RUCs to organize themselves for loans from credit and saving institutions as well as the involvement of local people in protection of the PAs. All the PA managers expressed similar opinions. The major challenges expressed by the RUC members were the fear of over-harvesting some resources such as fish from QECA and KCA, low offtakes of some resources like in Bwindi and long durations of negotiating and implementing the CFM agreements.

There were differences between attitudes of local people from Bwindi and the attitudes of those from other PAs regarding resource harvest restrictions (Table 3.5). In Bwindi, local people feel resource access is too restrictive and offtakes for the permitted resources are too low. The RUCs stated that because weaving and medicinal plants harvests were allowed but restrictive, the attitudes of local people towards the park was fair (room for improvement) as table 3.5 shows. When compared to other local people from other Pas, the RUCs from these PA felt that that resource access was not restricted and the attitides of local people towards the PAs was good as table 3.5 shows. Managers from the other PAs assume that the local people will use resources wisely and are able to police themselves without compromising the status of the resources. Only 6 resources are permitted for extraction from Bwindi and of these, only 1 (use of footpaths) is unrestricted unlike in other PAs (Table 3.5). Access to hoe handles, walking sticks, fish and firewood is not

permitted in Bwindi unlike in other PAs. Controls over rights to access PA resources are vested under the management of PA managers in all the PAs of Uganda. All the RUC members interviewed expressed that they would like this status quo to remain since they do not have the skills and resources to manage the PAs themselves.

The most positive attitude towards the PA was manifested by the Mabira Forest Reserve RUC called Conservation for Sustainable Development Association (COFSDA). The COFSDA members were quite happy with the forest offtakes permitted. They felt empowered by the CFM arrangement and participated in resisting the proposed government degazettement of part of Mabira forest into a sugar cane plantation. They are also involved in determining annual resource offtakes and participated in forest patrols and disciplining illegal forest users. The NFA offers COFSDA members first priority when seeking tenders to clear forest boundaries and harvesting boundary trees for timber.

In RMNP and KCA the RUC members reported that most of their livelihood requirements had been given to them. The RUC members of Kazingo parish in RMNP have been empowered to collect and utilize fees from other local people using foot paths in the park. The Bigodi Rattan cane resource user committee of KCA felt they had access to harvest rattan canes that they use to make furniture which they sold for income.

Table 3.4: Summary of attitudes of RUC members towards CFM

CFM Benefits	Challenges	Suggestions for improvements
Improved people/park relations	Overharvesting of some resources that are highly demanded e.g. fish	PA management should facilitate cross visits to other PAs
Provision of source of income and livelihoods from the PAs	Some offtakes are too low and not enough-need more offtakes	Increase offtakes and zones for harvest of PA resources e.g. in Bwindi
Involvement of local people in protection of protected area	Need other income generating projects	PA management should allow timber harvesting
Ability to organize for loan schemes	CFM agreements take long to implement (*takes over 2 years from negotiation to implementation*)	PA management should facilitate them to be able to market some of the harvested PA resource e.g. honey, and baskets

Table 3.5: Comparisons of harvest restrictions and attitudes of local people in the PAs

Resource	Protected area	Access rights	Harvest conditions	Local people attitudes*
Weaving plants	Bwindi	Must obtain permission	Restricted use (conservative offtakes)	Fair
	Other PAs	Must obtain permission	"wise use" (RUCs able to police themselves)	Good
Medicinal plants	Bwindi	Must obtain permission	Restricted use (conservative offtakes)	Fair
	Other PAs	Must obtain permission	"wise use" (RUCs able to police themselves)	Good
Wild yams	Bwindi	Must obtain permission	Restricted use (conservative offtakes)	Fair
	Other PAs	Must obtain permission	"wise use" (RUCs able to police themselves)	Good
Water	Bwindi	Must obtain permission	"wise use" (RUCs able to police themselves)	Good
	Other PAs	Must obtain permission	"wise use" (RUCs able to police themselves)	Good
Beekeeping	Bwindi	Must obtain permission	Restricted use (conservative offtakes)	Fair
	Other PAs	Must obtain permission	"wise use" (RUCs able to police themselves)	Good
Footpaths	Bwindi	No permission needed	"wise use" (RUCs able to police themselves)	Good
	Other PAs	No permission needed	""wise use" (RUCs able to police themselves)	Good
Timber (exotics)	Bwindi	Must obtain permission	Restricted use (conservative offtakes)	Fair
	Other PAs	Must obtain permission	Restricted use (conservative offtakes)	Fair
Others (hoe handles, firewood, fish)	Bwindi	Must obtain permission	Not permitted	Poor
	Other PAs	Must obtain permission	Restricted use (conservative offtakes)	Fair

*The grading (good, fair poor) was from the RUCs perceptions of what they thought was the local people attitudes and depended on the whether resources were restricted or not

3.6.5 PA resource assessment methods and frequency of forest visits

Most PAs in Uganda use a Rapid Vulnerability Assessment (RVA) method to assess resources for local use except Bwindi (Table 3.6). In Bwindi a more technical and scientific method based on random transects and plots is used by the park management. The frequency of forest visits by the local people for resources extraction is in Bwindi differs from that of other PAs (Table 3.6). Bwindi is the only PA that limits harvesting of forest resources by local people to only twice a year (during dry seasons only). All the other PAs allow local people to visit the forest for resources up to 96 times in a year (twice a week).

Unlike in forest reserves, in all national parks resource extraction is recorded by local harvesters. The resource offtakes are recorded by the RUCs themselves and handed over to park authorities for subsequent analysis. The PA managers from Bwindi, QENP, BFR and ECFR expressed worries on the possible resource over-exploitation by local people (Table 3.6). In Bwindi the concern was on the over-exploitation of two plant species of *Loeseneriella apocynoides* and *Marantochloa manii* favored for making baskets. At QEPA the concern was the on the possibility of over-fishing on Lake George. In ECFR the concern was the over-harvesting of bamboo stems (*Arundinaria alpina*) for building poles and making baskets.

Table 3.6: Summary of resource harvest issues in all the PAs of Uganda

	Bwindi	QECA	KCA	MECA	ECFR	MFR	BFR
Assessment method	Plots	RVA	RVA	RVA	RVA	RVA	RVA
Harvest Frequency	2	96	96	96	96	96	96
Offtake recording	Yes	Yes	Yes	Yes	No	No	No
Over exploitation concern	Yes	Yes	No	No	No	Yes	Yes

QECA= Queen Elizabeth Conservation Area, KCA= Kibale Conservation Area, MECA= Mt Elgon Conservation Area, ECFR=Echuya Central Forest Reserve, MFR=Mabira Forest Reserve, RVA = Rapid Vulnerability Assessment method

3.7 Discussion

3.7.1 Group size and frequency of RUC meetings for successful CFM

Success or failures of CFMs can be attributed to governance and organizational structures of Resource User Committees (RUCs) (Scott, 1998; Agrawal & Sanjeev, 1999; Ostrom, 1999; Brett, 2003). Group size is negatively correlated to solving collective-action problems (Ostrom, 1999). Smaller groups are more effective in solving action problems (Chamberlin, 1974; Ostrom, 1999; Agrawal & Sanjeev, 1999; Ostrom, 2000; Brett, 2003). Scholars of user-governed forestry institutions have concluded that success in cohesion and governance is more likely to occur in smaller groups (villages) than in larger groups (sub-counties or parishes) (Ostrom, 1999; Ostrom, 2000; Brett, 2003). This is consistent with this study where RUCs organized at a village level are more organized and cohesive than those organized at the parish level. RUCs organized at large scale units such as sub-counties and parishes like those of Bwindi are too amorphous for local people coherence, organization and governance (Ostrom, 1999; Ostrom, 2000; Brett, 2003).

Often when resource users organize themselves in groups to devise and enforce their own rules, they tend to manage local resources more efficiently and sustainably than when rules are externally imposed on them (Ostrom, 2000). Indeed, it would be ideal to implement CFMs in Bwindi with already existing small scale and traditionally evolved administrative structures of stretcher groups (*ebibiina bye'ngozi*). The stretcher groups are excellent entry points for local community programmes such as health education, social development and income generating activities since they are cohesive and well governed (Ashaba-Magezi, A, *et al.*, 1994; Cunningham, 2001). Bwindi park management has however not used these stretcher groups for CFM implementation because they consider them to be numerous, difficult to monitor and govern compared to the large parish based groups. This is where the problem lies.

Scott (1998) has pointed out that certain schemes aimed at improving human welfare have not been effective because of failure by state organs to recognize the importance of traditionally evolved systems that the local people are accustomed to. State organs normally introduce new systems that they find easy to govern, manage and tax but are too complex for the local people. UWA does not need to invest a lot of time, money and efforts in governing and monitoring these groups if the RUCs are fully involved and empowered in the CFM. Failure by UWA management to recognize the importance of these traditional institutions in implementing the MUP in Bwindi could have contributed to the lack of cohesion and self-governance among the RUCs.

The frequency of RUC meetings are indicators of how active and empowered the local people are in CFM implementations (Ostrom, 2000; Dietz *et al.*, 2003). As this study has shown, village based

RUCs such as those of MFR and MECA meet more frequently and regularly than the parish based ones of Bwindi. Issues discussed in RUC meetings include disciplinary issues of errant members, problems faced while harvesting resources, status of PA resources and socio-economic activities for members. Such issues discussed in RUC meetings may sometimes create arguments and suspicions from members leading to conflicts if the committees are not cohesive and well governed.

The empowerment of local people under CFM can be enhanced and strengthened when RUCs maintain frequent and face-to face meetings. Face-to-face communications among RUCs enhances cooperation and removes suspicions among individuals. Indeed, the RUC meetings maintain a dense social network-sometimes called social capital-that increases the potential for trust, allowing people to express and see emotional reactions to distrust (Ostrom, 2000; Dietz *et al.,* 2003). In agreement with this study, Beck (2000) has noted that RUCs in Bwindi do not hold regular meetings or call annual general meetings to share their decisions or ask for input from large community members. Without the incentives for members to communicate and attend RUC meetings, there is bound to be only few or no meetings as is the case in Bwindi (Ostrom, 2000; Beck, 2000).

3.7.2 Ethnic composition of RUCs for successful CFM

The ethnic composition of RUCs also plays an important role in the way committee members organise and mobilise themselves to extract and conserve PA resources. Ostrom (1999) notes that focusing only on group size as a key factor in determining effective CFMs is not appropriate as other problems related to ethnic composition may arise. Many other variables often change as group size increases (Chamberlin, 1974; Hardin, 1982; Isaac *et al.,* 1993; Ostrom, 1999). It is necessary to consider other factors such as heterogeneity and homogeneity of a population.

Homogeneity is helpful for initiating and sustaining self-governance (Ostrom, 1999). Groups can vary along diverse dimensions including their cultural background, interests and endowments (Baland & Platteau, 1996). If groups with a heterogeneous background have different views about resource access and organization, then achieving self-governance among the RUCs is particularly challenging (Ostrom, 1999). In such a situation it becomes particularly challenging to find a compromise on such views.

In Bwindi, the RUCs are composed of Batwa and Bakiga who have a long history of animosity (Kingdon, 1990; Lewis, 2000). The Bakiga most times despise the Batwa and use them as a source of cheap labor while the Batwa accuse the Bakiga as being responsible for their eviction from Bwindi forest (Kingdon, 1990; Lewis, 2000). Thus in most local community meetings around Bwindi, the Batwa always feel marginalized and never contribute to discussions whenever their Bakiga cohorts are present (Bitariho *et al.,* 2004). All the CFM agreements (multiple use MoUs) around Bwindi are heterogeneous and include Bakiga and Batwa together which is a weakness that contributes to incoherent RUCs and problems to do with their governance. It is important to consider social dynamics of the local people around the PAs when designing resource use agreements.

3.7.3 Legal framework of RUCs for successful CFM

PAs in Uganda are mandated by an act of parliament to be managed by the Uganda Wildlife Authority (UWA) and National Forestry Authority (NFA).The two organizations have defined and implemented the CFMs differently. The working definition of the CFMs in the National Parks and Forest Reserves are different and are based on policies and acts that differ. UWA is guided by the

Uganda Wildlife Act of 2000 while NFA is guided by the Uganda National Forestry and Tree planting Act of 2003.

One out of eleven policy statements in the Uganda Forestry Policy is devoted to collaborative forest management (Uganda Forestry Policy 2004; Kazoora, 2006). The policy underscores the importance of the rights, roles, responsibilities and returns (4Rs) of the different stakeholders (Kazoora, 2006). The Uganda Wildlife Act 2000 on the other hand is silent on the 4Rs of the different stakeholders. The act empowers the executive director to enter into any commercial or collaborative arrangement with any person/s for management of the PA. The Uganda Wildlife Act vests all powers over CFMs to the Executive Director. The Uganda Forestry Policy 2004 is more resolute about the CFM than the Uganda Wildlife Act 2000. This might be the reason the NFA and UWA working definitions of CFM differ.

The RUCs working in the forest reserves are legally registered entities and can sue or be sued (NFA, 2003). Legally registered RUCs are empowered since they have strong negotiating powers when initiating CFM (Sumar Singh *et al.*, 1997; Worah, 2008). The CFM guidelines for the forest reserves stress the importance of dealing with legally registered entities. In National Parks, the RUCs are informal and only involve signing of informal memoranda of understandings (MoUs) with the local people. These MoUs are not legally binding. The most successfully implemented CFM arrangements are those that were originated and implemented by legally registered RUCs (Sumar Singh *et al.*, 1997).

3.7.4 Attitudes of local people towards a successful CFM

Ostrom (2000) and Barrow & Murphree (2001) have noted that the strength of CFM agreement is derived from the level of benefits resource users get and the economic contributions the CFM makes to their livelihoods. Whereas other PAs in Uganda offer a variety of resources to the local people, those offered in Bwindi are limited and restricted. The most preferred forest resources to the local people around Bwindi (firewood, building poles, hoe handles, fish and fruits) are those not permitted for access (Davey *et al.,* 2001; Bitariho *et al.,* 2004; Namara, 2006). The local people however continue harvesting them illegally despite the risks of arrest and fines involved (Namara, 2006). Moreover the annual resource offtakes for the permitted resources are too low to yield tangible benefits (Beck, 2000; Davey *et al.,* 2001; Bitariho *et al.,* 2004).

Incentives are vital for getting people to negotiate and agree to continue participating in a CFM (Ostrom, 2000; Castro & Nielsen, 2001). CFMs must bring about benefits to stakeholders that would not necessarily have been achievable working alone (Beck, 2000; Castro & Nielsen, 2001; Borrini-Feyerabend *et al.,* 2007). The reported loss of interest in Bwindi's MUP by the local people can be attributed to the low tangible benefits the programme offers (Beck, 2000; Davey *et al.,* 2001; Bitariho *et al.,* 2004). Tangible benefits offered by the other PAs in Uganda may have contributed to a more local people positive attitude. This observation is supported by the fact that there is a greater degree of positive attitudes manifested in areas that are involved in the MUP than those not involved (Beck, 2000).

3.7.5 Resource assessment methods for successful CFMs

The methods used for assessing resources from the PAs will determine the type and quantity of resources the local people will harvest. A Rapid vulnerability Assessment (RVA) method was

developed by Tony Cunningham in 1992; it assesses subjectively the abundance and distribution of resources based on knowledge of specialists' resource users and a few subjective forest visits (Wild & Mutebi, 1996; Wong, 2003; Cunningham, 2001). This method has the advantage of involving local people in resource assessment and is not restrictive like the random transect and plot method.

Most useful plants in PAs are clumped and sparsely distributed and are therefore more likely to be missed by the random transects and plots. The local people such as those around Bwindi do not understand the random transect and plot methods and feel the method is too restrictive and misses plants they consider to be abundant (Davey *et al.,* 2001; Bitariho *et al.,* 2004). The method used in Bwindi might cause conflicts with the local people in future since they feel it limits on the amount of resources to harvest.

Both methods have been criticized by local people, park managers and scientists a like (Hall & Bawa, 1993, Godoy & Bawa, 1993, Peters, 1994, Cunningham, 2001, Ticktin, 2004, Feinsinger 1997; ITFC, 1999). Some scientists and ethnobotanists feel the RVA method is not robust enough and that it does not generate baseline data for future studies (Hall & Bawa, 1993, Godoy & Bawa, 1993, Peters, 1994, Ticktin, 2004). There is therefore a need to develop a method that caters for the concerns of local people while at the same time considering those of conservationist (Davey *et al.,* 2001). An improved version of the RVA method for forest resource assessment would therefore be desirable (see chapter 7).

3.8 Conclusion

This study has shown that Bwindi's MUP has not initiated increased participation of local people in park management like was originally planned. Collaborative approaches in Uganda's PAs encompass several "models" a long a spectrum that ranges from a lesser collaboration and participation of local people in PA management (Bwindi's MUP) to a greater collaboration and participation of local people in PA management (MFR situation).

The organisation structures of the RUCs and types of benefits derived from the park by the local people are the main reasons for why the local people are participating less in Bwindi. The RUCs in Bwindi are neither coherent, cooperative nor are they well governed. As such Bwindi's MUP is not a true Collaborative Forest Management because it does not fully involve and empower local people at its initiation, implementation and monitoring stages. When compared to other PAs, Bwindi's multiple use programme has benefited the local people less and the RUCs are not empowered and are less motivated to participate in PA management. Important forest resources to the local people were not considered while negotiating access rights in Bwindi.

The lack of cohesion, cooperation and self-governance of the RUC members in Bwindi may be because of the way the committees are organized. The RUCs are too large and heterogeneous for cohesion, cooperation and self-policing to occur. The most important forest resources for the local people are those prohibited and this has led to their disinterest in the MUP. Lack of interest in Bwindi's MUP by the local people has in turn contributed to irregular and in most cases no RUC meetings, an important aspect for group cohesion and cooperation. Because of the PA resource assessment method adapted in Bwindi, the resources permitted by park management are restrictive

and this has led to local people having negative attitudes towards park management. Perhaps policies and laws governing forest reserves and national parks may have contributed to the different ways the two institutions manage resource access programmes. These need to be synergized for successful implementation of CFM arrangements in Uganda as all the two institutions have programs that aim at local people participation in PA management.

3.9 Recommendations

As this study has shown, the most effective and efficient RUCs are those organized at small scales such as those at a village level. Therefore, for Bwindi's MUP to be efficient and effective, RUCs must be organized and based on the village stretcher groups (ebibiina by'engozi) that are well governed, cohesive and self-policed. These may be supervised by large parish based RUCs. The village stretcher groups are small but effective in implementation of social programmes for the local people; the parish based groups may provide only a supervisory role to the village based ones. The village based resource use groups will also act independently of the parish based ones when going to the forest for resource harvest and when holding meetings.

Ethnic composition also plays an important role in the way RUCs cooperate and organize themselves for PA resource collection and management. In Bwindi, the Batwa should be helped form their own separate resource user groups (like the village based ones above). The Batwa resource use groups should also act as a sub-committee of the parish ones as above. TheBatwa and Bakiga have different interests and skills in forest use and therefore should not be combined together for resource use.

For greater participation of local people in PA management, then resources from the PA must offer tangible benefits to them. It would therefore be desirable for UWA not to restrict forest resource harvest frequency to only twice in a year. This should be increased upwards to at least six times in a year so that local people are able to get more tangible benefits from the park. This will help increase on local people appreciation of the MUP and therefore positive attitudes towards park management. Also Bwindi's MUP should permit access to other forest resources important to the local people such as fish, wild yams, vegetables, mushrooms, fruits and wild honey as long as their harvest sustainability can be guaranteed through assessments and harvest impact monitoring.

A local people involving method for PA resource assessment that is cheaper and easier to manage should be used for PA resource assessments in Bwindi. Experiences of how this is done in other National Parks such as Rwenzori, Kibale and Mt Elgon should be sought. A workable method such as use of the Rapid Vulnerability Assessment (RVA) should be explored for Bwindi (see chapter 7). The RVA involves local people participation in PA resource assessment and is not restrictive like the random transect/plot methods. The RVA is therefore more likely to increase on local people participation in PA management.

The present plant harvest annual offtakes of 1% based on available plant stock that is used in Bwindi is too low and should be increased. Several studies carried out in Bwindi have shown that present plant harvests offtakes (were done at conservative offtake quotas) are sustainable. This is likely to increase on more local people participation and appreciation of the MUP. Also

more local people participation will be increased of other parishes such as Bujengwe and Rubimbwa not benefiting from the MUP were included to benefit.

On-farm substitution/planting of some forest resources important to the local people around Bwindi should be encouraged as a future MUP strategy and could be taken up by the developmental organizations such as Bwindi trust and CARE working around Bwindi.

There is need to design new MoU formats for Bwindi resource use that spells out the different roles, rights, responsibilities and returns of stakeholders involved. For example what roles do park and local people have on the management of resources within the park? What are the penalties for the offenders of the MoUs and what are the benefits of abiding by the MoUs for all stakeholders. These questions should all be ably answered by the newly designed MoUs

References

Adams, W.M & Hutton, J., 2007. People, Parks and Poverty: Political Ecology and Biodiversity Conservation. *Conservation Society* 5:147-183.

Agrawal & Sanjeev., 1999. Group size and collective action: Third-party monitoring in common-pool resources. Department of political science, Yale University, 124 prospect street, Rotterdam.

Ashaba-Magezi, A, Kaharuza, F, Barton, T., 1994. Peasant Survival Strategy: A case Study of Engozi as a means of Health Transport in Kigezi, Uganda. Unpublished report Child Health and Development Centre, Makerere University, Kampala.

Baland, J.M & Platteau, J.P., 1996. Halting degradation of natural resources. Is there a role for rural communities? Clarendon Press, Oxford.

Barrow, E & Murphree, M., 2001.'Community conservation. From concept to practice' In D.Hulme and M. Murphree, eds., *African Wildlife and Livelihoods. The promise and Performance of community conservation*, James Currey, Oxford

Beck, P., 2000. Collaboration and Credible Commitments: Experiments with Collaborative Resource Management in Uganda. Unpublished report prepared for delivery at the 2000 meeting of the international association for the society of common property. School of public and environmental affairs, Indiana University, Bloomington.

Bitariho, R., Mugyerwa, B., Barigyira, R & Kagoda E., 2004. Local People's Attitudes and New Demands since inception of Multiple Use Programme in Bwindi Impenetrable National

Park, S. W Uganda. Unpublished report. Institute of Tropical Forest Conservation, Ruhija, Kabale

Borrini-Feyerabend, G., Pimbert, M., Farvar, M.T., Kothari, A & Renard, Y., 2007. Sharing Power: A global guide to collaborative management of natural resources. Earthscan Publications limited, London.

Borrini-Feyerabend, G., Farvar, Nguingiri, T., Ndangang, V., 1996. Co-management of Natural Resources. GTZ and IUCN, Kas-parek, Heidelberg.

Brett, E.A., 2003. Participation and accountability in development management. *Journal of Development Studies* 40 (2):1-29.

Castro, A.P & Nielsen, E., 2001. Indigenous people and co-management: Implications for conflict management, *Environmental Science and Policy* 4:229-239.

Chamberlin, J., 1974. Provision of collective goods as a function of group size. *American Political Science Review*, 68:707-16.

Cunningham, A.B., 1992. People, park and plant use: Research and recommendations for multiple-use zones and development alternatives around Bwindi-impenetrable National Park, Uganda. Report to CARE-International, Kampala.

Cunningham A B., 2001. Applied Ethnobotany, People, Wild Plant Use and Conservation, WWF, Earthscan Publications limited, London.

Davey, C., Peters, C.M, & Byarugaba, D., 2001. Participatory review of the Multiple Use Programme, Bwindi Impenetrable National Park and Mgahinga Gorilla National Park. CARE-Uganda and Uganda Wildlife Authority, Kampala.

Dietz, T, Ostrom, E, Stern, P.C., 2003. The struggle to govern the commons: Tragedy of the commons? *Science Review* volume 302, www.sceincemag.org

Feinsinger, P., 1997. Utilised Species Monitoring, Unpublished DTC consultancy report and provisional plan for the multiple-use programme of Bwindi Impenetrable National Park. Institute of Tropical Forest Conservation, Ruhija, Kabale

Garcia, CA & Lescuyer, G., 2008. Monitoring, indicators and community based forest management in the tropics: pretexts or red herrings? *Biodiversity Conservation* (17): 1303-1317.

Ghazoul, J & Sheil, D., 2010. Tropical rain forest ecology, diversity, and conservation. Oxford University Press, Great Clarendon Street, Oxford.

Godoy, R. A., & Bawa, K.S., 1993. The Economic value and sustainable harvest of plant and animals from the tropical forest: Assumptions, hypotheses, and methods. *Economic Botany* 47(3):215-219.

Hall, P & Bawa, K., 1993. Methods to assess the impact of extraction of Non-timber tropical forest products on plant populations, *Economic Botany.* 47, 234-245.

Hardin, R., 1982. Collective action. John Hopkins University Press, Baltimore.

Harter, J., & Goldman, A., 2010. Local responses to a forest park in western Uganda: alternate narratives on fortress conservation, *Oryx*, 45 (1), 60-68

Hutton, J., Adams, W.M & Murombedzi, J.C., 2005. Back to the Barriers? Changing Narratives in Biodiversity Conservation. *Forum for Development Studies* 32 (2): 341-370.

Isaac, R.M., Walker, J. & Williams, A., 1993. Group size and the voluntary Provision of public goods: experimental evidence utilizing large groups. *Journal of Public Economics* 54:1-36.

ITFC, 1999. The potential supply of weaving and medicinal plant resources in the proposed kifunjo/masya multiple-use zone of Bwindi Impenetrable National Park, S.W Uganda. Unpublished report, Institute of Tropical Forest Conservation, Ruhija, Kabale.

Kazoora, C., 2006. Lessons on opportunities for Collaborative Resource Management in Mt Elgon Ecosystem. Unpublished report, Sustainable Development Centre, Makerere University, Kampala.

Kingdon, E., 1990. Caught Between two worlds. Moral problems relating to conservation in South-West Uganda. *International Journal of Moral and Social Studies* 5: 235-250.

Lewis, J., 2000. The Batwa Pygmies of the Great lakes region. Minority rights group, London.

Martin, G.J., 1995. Ethnobotany: A Methods Manual. Chapman and Hall, London.

Namara, A., 2006. From Paternalism to real partnership with local communities? Experiences from Bwindi Impenetrable National Park (Uganda). *Africa Development* 31 (2):39-68.

Naughton-Treves, L. Holland, M.B., & Brandon, K., 2005. The Role of Protected Areas in Conserving Biodiversity and Sustaining Local Livelihoods. *Annual Review of Environmental Resources* 30: 219-252.

Ndangalasi, H, Bitariho R, Dovie D. 2007. Harvesting of non-timber forest products and implications for conservation in two montane forests of East Africa, *Biological Conservation* 134 (2), 242-250.

NFA, 2003. Guidelines for implementing Collaborative Forest Management in Uganda, National Forestry Authority, Kampala.

Olupot, W., Barigyira, R., Chapman, C., 2009. The status of anthropogenic threat at The people-park interface of Bwindi Impenetrable National Park, Uganda. *Environmental Conservation* 36 (1): 41–50.

Ostrom E., 1999. Self-Governance and Forest Resources. Occasional paper no.20 CIFOR, Indonesia. http://www.cgiar.org/cifor

Ostrom, E., 2000. Collective Action and Evolution of Social Norms, *Journal of Economic Perspectives* 14 (3):137-158.

Peters, C., 1994. Sustainable Harvest of Non - Timber Plant Resources in Tropical Moist Forest: An Ecological Primer. USAID Biodiversity Support Programme, Washington D.C

Samar Singh, Avenash Datta, Anil Bakshi, Arvind Khare, Sushil Saigal, & Navin Kapoor, 1997. Participatory Forest Management in West Bengal, India. In Harvesting Wild Species, Implications for biodiversity conservation by Freese CH. The John Hopkins University Press, Baltimore, Maryland, London

Scott, J.C., 1998. Seeing like a State. How certain Schemes to improve the human condition have failed. Yale University Press, New Haven and London.

Sekhar, N.U., 1998. Crop and Livestock depredation caused by wild animals in Protected Area: The case of Sariska Tiger Reserve, Rajasthan, India. *Environmental Conservation* 25: 160-171.

Sheil, D & Lawrence A., 2004. Tropical biologists, local people and conservation: New opportunities for collaboration. *Trends in Ecology* 19:634-638.

Ticktin, T., 2004. The ecological implications of harvesting non-timber forest Products, *Journal of Applied Ecology*, 41: 11-21.

Tuxill, J & Nabhan, G., 1998. Plants and Protected Areas. A guide to In Situ management. WWF, Stanley Thornes Publications, Ellenborough house, Wellington street Cheltenham.

Uganda Local Government Act, 1997. Republic of Uganda, Entebbe Government Printer, Entebbe

Uganda Forestry Policy, 2001. Republic of Uganda, Ministry of water, lands and Environment, Kampala

Uganda Wildlife Act, 2000. Chapter 200, The Uganda Wildlife Act, CAP 200. 4245- 4310

Wild, R., 2001. Plants from the Park: Establishing Community Harvesting of Plants as a Conservation Tool at Bwindi Impenetrable and Mgahinga National Parks, Uganda. Unpublished Master of philosophy thesis Department of Botany, University of Capetown, Capetown.

Wild, R., & Mutebi, J.,1996. Conservation Through Community Use of Plant Resources: Establishing Collaborative Management at Bwindi Impenetrable And Mgahinga Gorilla National Parks. People and Plants Working Paper 5. UNESCO, Paris.

Wong, J., 2003. Recommendations for resource assessment for collaborative forest management in Uganda. SC/08/2002. Report to the EDF/Uganda Forest Department: Forest resources management and conservation programme, Kampala

Worah S., 2008. Participatory management of forests and protected areas, a trainer's manual. Regional community forestry center (RECOFTC), Bangkok.

Woodroffe, R., Thirgood, S., & Rabinowitz (eds)., 2005. People and Wildlife: Conflict or Coexistence? Cambridge University Press, Cambridge.

Appendix

Questionnaire for Resource user committee members and PA managers

1. Name of the Protected area:……..

2. Status of interviewee (PA manager, Local community member):……

3. Date resource use agreement was signed/When forest resources started to be harvested…….

4. Type of resources harvested (*medicinal/weaving plants, beekeeping, wild honey, bamboo stems, green vegetables, mushrooms, fruits, tubers, firewood, tree poles, etc)*

5. Frequency of forest visits (harvest) per year:……..

6. Record offtakes?? How??.....

7. Issues to do with ownership of forest (who owns the forest?):……..

8. Products? Usufruct rights? Traditional/Current?:……..

9. Are there resources you would want to be harvested but not allowed?? (*Community*)……

……..

10. Are there resources PA managers are concerned about that are being over-harvested (*PA managers*):……

…….

11. Are there resources community members are concerned about that are being over-harvested (community):……

…….

12. Frequency of forest use committee (or similar) meetings? Who calls these and who attends? What types of decisions are made?:……...

13. Punitive measures?? (Who is responsible? how are punitives decided-on paper or actual cultural norms, any examples, what had happened, problems?):……

……

14. What role do communities play in developing, applying and modifying RU agreements?:……

…….

15. Who are the signatories?:……

16. How are RU agreements negotiated?-Process:…….

17. Size of the area under the RU agreements, number of people (Parish/village based?):…….

18. Are there migrants/outsiders? What is their role?-Any fears about them?:…….

19. Number of people in the RU agreement:…….

20. Homogeneity of the group?? Shared interest of the group, anyone excluded?? (marginalized e.g Batwa):…….

21. Does anybody cheat? How what happens?:……

22. How much time every month/year do you spend working on the agreement (meetings, discussions, and letters, dealing with visits)? Is it worth it?.....

.....

23. Do you trust the other parties in the agreements (list?

Why/not?)……

24. What are the main benefits and problems with the current system? (Ask the dfferent stakeholders to address these from both their own perspective and from the perspective of the other stakeholders

involved)?.....

.....

25. Do you think resource use is more or less likely to be sustainable as a result of the current agreement? Why? What are the main

threats?.....

.....

26. If all controls were removed what would

happen?.....

.....

27. If all harvests inside the PA were prohibited what would

happen?.....

.....

28. Suggestions on improvement of current

system……

……

29. What is the traditional management of resource use

sustainability……

……

30. How are conflicts managed within and outside the group (S/H conflict resolutions) can these be solved?

Examples……

……..

THANK YOU FOR YOUR TIME

Chapter four

4 What resources do local people need from protected areas? A case study of Bwindi's Multiple Use Programme

4.1 Tropical forest resources for local people

Tropical forests have resources that can be classified into timber as well as non-timber forest products. The forests have relatively high species diversity that includes many valuable plants and animals scattered in the forests often at low densities and susceptible to over-exploitation (Peters, 1994; Ndangalasi *et al*., 2007; Ghazoul & Sheil, 2010). People have exploited these forest resources for ages sometimes causing extinction of species therein (Newton, 2007). Millions of people world-wide, many of them poor derive their livelihoods from wild tropical plants and animals (Ticktin, 2004). In the past, attention to forests was focused mainly on the extraction of timber for commercial and subsistence use (Scott, 1998; Cunningham, 2001; Ticktin, 2004 see also chapter 6). Extraction of non-timber forest products (NTFPs) were not considered important by conservationists then (Scott, 1998; Cunningham, 2001; Ticktin, 2004). Improved technologies for timber exploitation that came with industrialization resulted in tropical forests being overexploited. This soon became a concern to conservationists, triggering the need for ways to sustainably manage them. As such, most tropical forests were gazetted protected areas (national parks and forest reserves) to help mitigate this overexploitation.

The importance of NTFPs for local people in the tropics and the relatively small ecological impact of their exploitation has raised high expectations for their potential to contribute to tropical forest conservation (Ros-Tonen, 2000; Newton, 2007). This approach was based on the premise that forests can be conserved if rural people gain some direct economic benefits from harvesting NTFPs

(Newton, 2007). NTFPs comprise of diverse products such as bush meat, starch foods, nuts, spices, leaves for wrapping food, medicinal herbs, vines/lianas for handicrafts, small wood for tools, firewood, fibres, ornamental plants, essential oils, latex for rubber, wild honey and rattans among others (de Beer & Mcdermott, 1996; Ros-Tonen, 2000). With the promulgation of wildlife acts and other protected area acts, access to some of these NTFPs became restricted and prohibited in some cases causing deteriorating relationships between protected area managers and the local people (Cunningham, 2001; Bidhan Kanti Das, 2005; Newton, 2007). Rural poverty exacerbates the need for access to natural resources in protected areas and increases public conflict with protected-area management. A prerequisite for the long-term sustainability of parks and protected areas is therefore public involvement and support for the conservation of natural resources (Elba & Jacobson, 1995).

4.2 Forest use in Bwindi Impenetrable National Park

For centuries, Bwindi forest was a source of livelihood for local people who had unrestricted access to forest resources. When Bwindi was gazzetted a national park in 1991, the local people were stopped from accessing the forest resources. This sparked off conflict between local people and park managers resulting in the local people burning parts of the forest. There were numerous cases of severe harassment of park staff by the local people (Wild & Mutebi, 1996; ITFC, 1999; Wild 2001). To mitigate the conflict, Bwindi Impenetrable National Park (hereafter called Bwindi) management in collaboration with other stakeholders established a multiple use programme (MUP) in 1994 (ITFC, 1999; Wild 2001, see also chapter 2 &3). The MUP allows specific and regulated plant harvesting by the local people from park peripheral areas called multiple use zones (MUZs). In some areas, the MUP also allows bee-keeping for honey by local

people at the park periphery (Wild & Mutebi, 1996; Wild 2001; Cunningham, 2001; Bitariho, *et al.,* 2006). Presently fourteen parishes benefit from the programme (Bitariho, *et al.,* 2006; Ndangalasi, *et al.,* 2007).

Although Bwindi's MUP allows limited access to some park resources, it prohibits access to others. These include bush meat, timber, poles, walking sticks, fruits, wild yams, vegetables, mushrooms, wild honey and firewood. The logic behind prohibiting access to these resources is that they cannot be sustainably harvested without compromising the conservation values of the forest and most especially as a habitat for the red listed mountain gorillas (*Gorilla beringei beringei*).

Eighteen years later, the local people still prefer those prohibited forest resources and continue to harvest them illegally (Bensted-Smith *et al.,* 1995; Davey *et al.,* 2001; Bitariho *et al.,* 2004; Tushabomwe-Kazooba & Mbamanya 2005; Namara, 2006; Olupot *et al.,* 2009). For example, Olupot *et al.,* (2009) observed illegal tree stem cutting for poles, hoe handles and walking sticks along the Bwindi park periphery. The Batwa have always requested for wild yams, wild fruits and wild honey from Bwindi but have never been allowed to access them (Cunningham, 1996; Bitariho *et al.,* 2004). Bwindi park staff has often blamed the origin of forest fires on illegal wild honey harvests by Batwa (Bitariho *et al.,* 2004).

4.3 Study objectives

The aim of this study was to assess the forest resources that are considered most important by people around Bwindi. The specific objectives were to:

i) Determine the forest resources most preferred by the local people from Bwindi.

ii) Assess the influence of ethnicity and gender on forest resource preferences.

iii) Determine commonly made products from the forest resources and their ingredients

iv) Assess views of resource users regarding the status of harvested forest resources.

4.4 Study hypotheses

The following null hypotheses were tested:

i) Differences in the types of forest resources preferred by Batwa and Bakiga were tested using a null hypothesis **H_0, that: There is no significant difference between Batwa and Bakiga in forest resources preferences**

ii)) Differences in the types of forest resource preferred by men and women were tested using a null hypothesis **H_0, that: There is no significant difference between men and women in forest resources preferences.**

4.5 Study Justification

Lack of scientific information on prohibited but important forest resources for the local people has often been cited by Bwindi park management as one of the main reasons they do not allow their access. Studies on plant use in Bwindi have mainly focused on plant resources that are legally harvested under the MUP and have ignored others especially those prohibited (e.g. Muhwezi, 1997; Kamatenesi, 1997; Ogwal, 1998; Kyoshabire, 1998; Olupot, 2004). This study assessed all forest resources the local people prefer including those prohibited by park management. The study has provided information on why local people continue risking arrests and fines to harvest the prohibited forest resources. The study was guided by the following research questions; what are the most preferred forest resources for the local people around Bwindi? How does gender and ethnicity influence forest resource preference and use? What are the major forest products made by local people? And how do resource users view the status of forest resources in Bwindi? No study has yet been carried out in Bwindi to answer those questions to help Bwindi park management, local people and conservationists in the management of the MUP.

4.6 Methods

4.6.1 Study Area

The study was carried out in eight parishes bordering Bwindi an Afromontane forest located in south-western Uganda The parishes were; Bujengwe, Buremba, Karangara, Kashasha, Kitojo, Mushanje, Rutugunda and Southernward (Figure 4.1). The smallest unit of administration in the Uganda local government structure is a “village” and several villages constitute a “parish” (Uganda local government Act, 1997).The Bwindi park management works directly with parishes when signing Memoranda of Understandings (MoUs) with the local people regarding

plant resource access. This study was therefore based on the parish administrative units of local government structures.

Two of the parishes were non-MUZs (Bujengwe and Mushanje), four were plant use MUZs (Buremba, Karangara, Rutugunda and Southernward) and two were beekeeping MUZs (Kashasha and Kitojo). Households interviewed in all the parishes were those directly adjacent to Bwindi within 1-2km radius also called “frontline households. The major ethnic groups in the parishes around Bwindi are Bakiga, Bafumbira and Batwa. The Bakiga and Bafumbura are mainly agriculturalists while Batwa are former forest hunter gatherers (Kidd, 2008; Chapter 2 this thesis). The Batwa are the minority of the tribes constitute of 3,000 people in Kanungu, Kabale and Kisoro (Kidd, 2008). This study covered households that had Bakiga and Batwa for some parishes and Bakiga only for others.

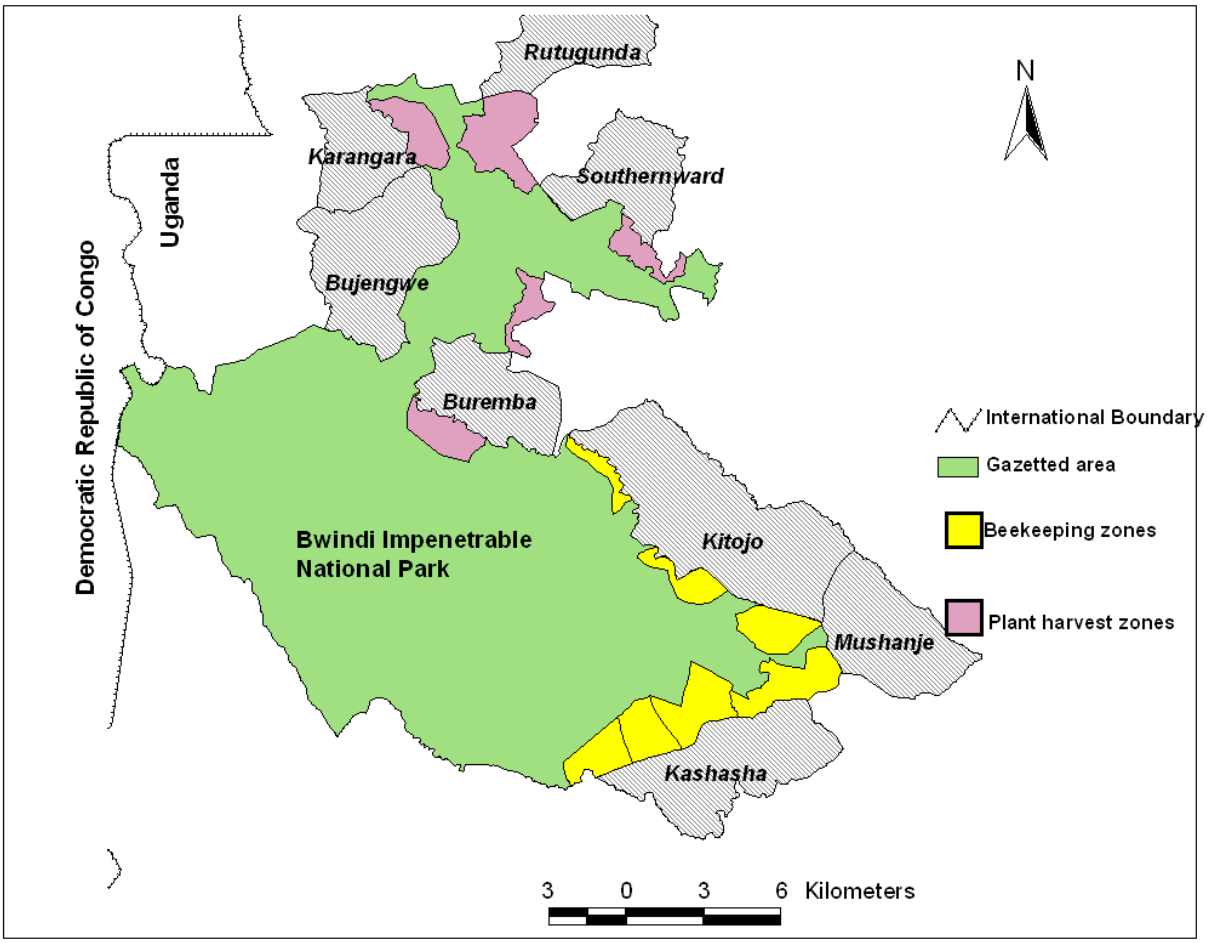


Figure 4.1: Map showing the study parishes around Bwindi.

4.6.2 Village interviews

The National population census household lists kept by local council officials were used to select respondents. A similar approach was used by Eilu *et al*, (2004). Questionnaires were randomly issued to 390 household heads and their spouses. The randomization procedure was by assigning numbers of households per parish on pieces of papers and placing the paper notes in a hat. These were then shuffled before picking out the households for interviewing from the hat. Household heads and their spouses were interviewed only if found at or near their homes at the time of interviews following Eilu *et al* (2004) and Eilu *et al* (2007) methods. Information recorded from

respondents included age, sex, ethnicity and names of forest resources preferred. The men and women were interviewed separately by a woman interviewer assistant. A total of 42 Batwa households and 348 Bakiga households were covered. The number of respondents varied between parishes and depended among others on the presence of respondents. A semi-structured questionnaire with open ended questions was used for the interviews (Tuxill & Nabhan, 1998).

4.6.3 Resource user interviews

Households with specialist forest resource users e.g. herbalists, basket makers and beekeepers were identified from the village interviews and selected for resource user interviews (Ndangalasi, 2004; Eilu *et al*, 2007). From each of the three categories of parishes above, one parish was randomly selected for resource user interviews (making total of three parishes). The randomization procedure was as above by assigning numbers of parishes on pieces of papers and placing the paper notes in three different hats per category. These were then shuffled before picking out one parish each for resource user interviews from the hat. The parishes interviewed were Bujengwe for non-MUZ, Kashasha for the beekeeping MUZ and Buremba for the plant harvest MUZ parishes. A total of 104 resource users were interviewed from all the three parishes. Information sought from the resource users included; forest resources used, types of products made, number of products made per year, source of raw materials and ingredients used and perceptions of resource users on the status of the plants used (See Plate 4.1). The interviews were also followed with transect walks into the forest to identify the plants used (Ndangalasi, 2004; Eilu *et al.,* 2007). Plant specimens were collected, assigned local names and identified at the Institute of Tropical Forest Conservation field herbarium in Ruhija, Kabale.

Plate 4.1 Interviewing a Mutwa resource user from Buremba parish in Mpungu sub-county

4.6.5 Data analysis

4.6.5.1 Important forest resources for local people

A list of the six most preferred forest resources from Bwindi mentioned by Batwa and Bakiga was generated in order of preference using ANTHROPAC computer software for Smith's Saliency test. This test is a calculation that accounts for frequency of mention and is weighted for list position (Smith, 1993). The Smith's saliency test for the six most preferred forest resources from Bwindi was calculated separately for the multiple use zones, non-multiple use zones and beekeeping zones parishes. The values were then converted into percentages of the most frequently mentioned forest resources.

4.6.5.2 Influence of ethnicity and gender on forest resource use

The household' interview data were grouped according to; non-multiple use zone parishes, beekeeping zone parishes and plant use zone parishes. The differences/similarities in types of forest resources preferred by the Batwa and Bakiga as well as men and women was tested for significance using Clarke (1988, 1993)'s formula of:

$$R = \frac{r_b - r_w}{n\,(n-1)/4}$$

where **R** is the Smith's Saliency test, r_b, r_w are the means of the ranked similarity between and within groups respectively and **n** is the total number of samples. R scales from +1 to -1. +1 indicates that all the most similar samples are within the same groups. R = 0 occurs if the high and low similarities are perfectly mixed and bear no relationship to the group. A value of -1 indicates that the most similar samples are all outside of the groups (Clarke, 1993).

The differences between Batwa and Bakiga as well as men and women in the types of forest resources preferred was further summarized using a hierarchical agglomerative cluster analysis based on Ward's method of linking the groups (Digby & Kempton, 1987; Clarke, 1993; Jongman *et al.,* 1995). The data were analyzed in a Community Analysis Package (CAP version 4.1.3).

4.6.5.3 Commonly made forest products and their ingredients

Specialist resource users' data were prepared and analyzed in Microsoft Excel 2010 spreadsheets. The data was summarized in form of percentages and graphs.

4.7 Results

4.7.1 Important forest resources for local people

The most preferred forest resources for local people from plant harvest zone parishes in descending order were; *Smilax anceps* Willd.(for baskets and winnowing trays), timber (various species), *Milletia dura* (Dunn) tool handles (for walking sticks and hoe handles), *Ocotea usambarensis* Engl. (bark for medicinal purposes), *Dracaena laxissima* Engl. (for winnowing trays and baskets) and firewood (Table 4.1). Of these resources, timber, tool handles and firewood are not permitted for extraction from the forest. For those in the beekeeping zones, the most preferred forest resources were bamboo stems (for baskets), *S. anceps*, *Rytigynia kigeziensis* Verdc.(bark for medicinal), timber, *O. usambarensis*, bamboo rhizomes for planting and *M. dura* tool handles in descending order. Those from the non-multiple use zones, the most preferred forest resources were; bamboo rhizomes, timber, *S. anceps*, *M. dura* tool handles, *D. laxissima*, *Prunus africana* (Hook.f.) Kalkman (bark for medicinal) and bamboo stems in descending order. For the Batwa, the most preferred forest resources in descending order were; bush meat, wild yams (*Dioscorea praehensilis* Benth.

and *Dioscorea preusii* Pax), wild honey, *S. anceps*, fish, firewood and *R. kigeziensis*. With the exception of *R. kigeziensis*, all Batwa forest resources preferred by Batwa are not permitted for extraction from Bwindi forest.

Table 4.1: Preferred forest resources by the local people from Bwindi (n = 390 respondents)

Parish Category	Resources permitted for extraction	% frequency of mention	Resources prohibited for extraction	% frequency of mention
Plant use zones	*Smilax anceps*	87%	Timber (various species)	85%
(n= 135	*Ocotea usambarensis*	67%	*Milletia dura* tool handles	74%
households)	*Dracaena laxissima*	59%	Firewood	57%
	Piper guineense	56%	Bush meat (various)	46%
	Monanthothaxis littoralis	35%	Fish	46%
	Rytigynia kigeziensis	26%	*Loeseneriella apocynoides*	33%
Beekeeping	*Smilax anceps*	100%	Bamboo stems	100%
zones (n = 116	*Rytigynia kigeziensis*	91%	Timber (various species)	85%
households)	*Ocotea usambarensis*	64%	*Faurea saligna* tree trunks	54%
	Bamboo rhizomes	52%	*Milletia dura* tool handles	54%
	Salacia elegans	43%	Firewood	43%
	Dracaena laxissima	38%	Pine park boundary trees	37%
Non-multiple	Bamboo rhizomes	100%	Timber (various species)	92%
use zones	*Smilax anceps*	75%	*Milletia dura* tool handles	58%
(n = 97	*Dracaena laxissima*	57%	Bamboo stems	50%
households)	*Prunus Africana*	55%	*Loeseneriella apocynoides*	35%
	Ocotea usambarensis	45%	Firewood	33%
	Rytigynia kigeziensis	40%	Bush meat (various)	28%
Batwa	*Dioscorea praehensilis*	100%	Bush meat (various)	100%
Communities	*Smilax anceps*	86%	*Dioscorea preusii*	94%
(n= 42	*Rytigynia kigeziensis*	62%	Wild honey	81%
households)	*Ocotea usambarensis*	47%	Fish	80%
	Marantochloa leucantha	40%	Firewood	69%
	Piper guineense	39%	*Loeseneriella apocynoides*	65%

4.7.2 Influence of ethnicity on forest resource use

The Batwa and Bakiga ethnic groups preferred different types of forest resources in the study parishes of Bujengwe, Buremba and Rutugunda, and this difference was significant (Clarke's rank test, $R = 0.43$, $P<0.05$, Clarke's rank test $R = 0.25$, $P<0.05$ and Clarke's rank test, $R = 0.44$, $P <0.05$ respectively). Three distinct categories of important forest resources were recognized; those preferred by Batwa only (B), those preferred by Bakiga only (M) and those preferred by both Batwa and Bakiga (Figures 4.2, 4.3 & 4.4). Most forest resources preferred by the Batwa were different from those preferred by the Bakiga as figures 4.2 shows. The Batwa exclusively preferred *D. praehensilis*, *D. preusii* (wild yams), fish and wild honey from stingless bees while the Bakiga exclusively preferred *M. dura* tool handles (walking sticks and hoe handles), timber and wood from *Faurea saligna* Harv.and *Polyscias fulva* (Hiern) Harms for beehives. There was an overlap in preference for medicinal plants such as *Piper guineense*, *R. kigeziensis*, *O. usambarensis* and *P. africana* by both ethnic groups (Figures 4.3 & 4.4).

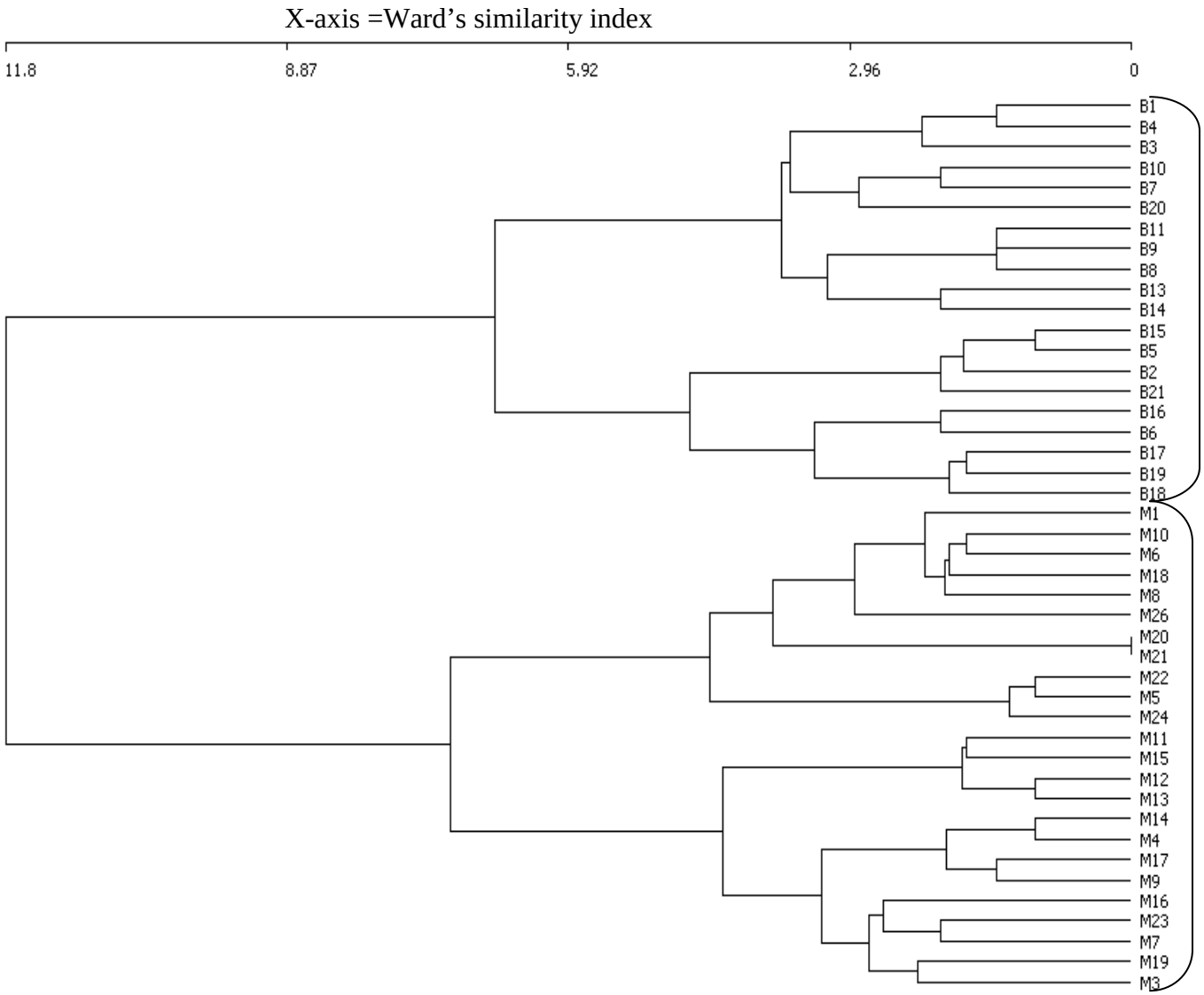


Figure 4.2: Dendrogram of forest resources preferred by Batwa (B1-B21) and Bakiga (M1-M24) in Rutugunda Parish.

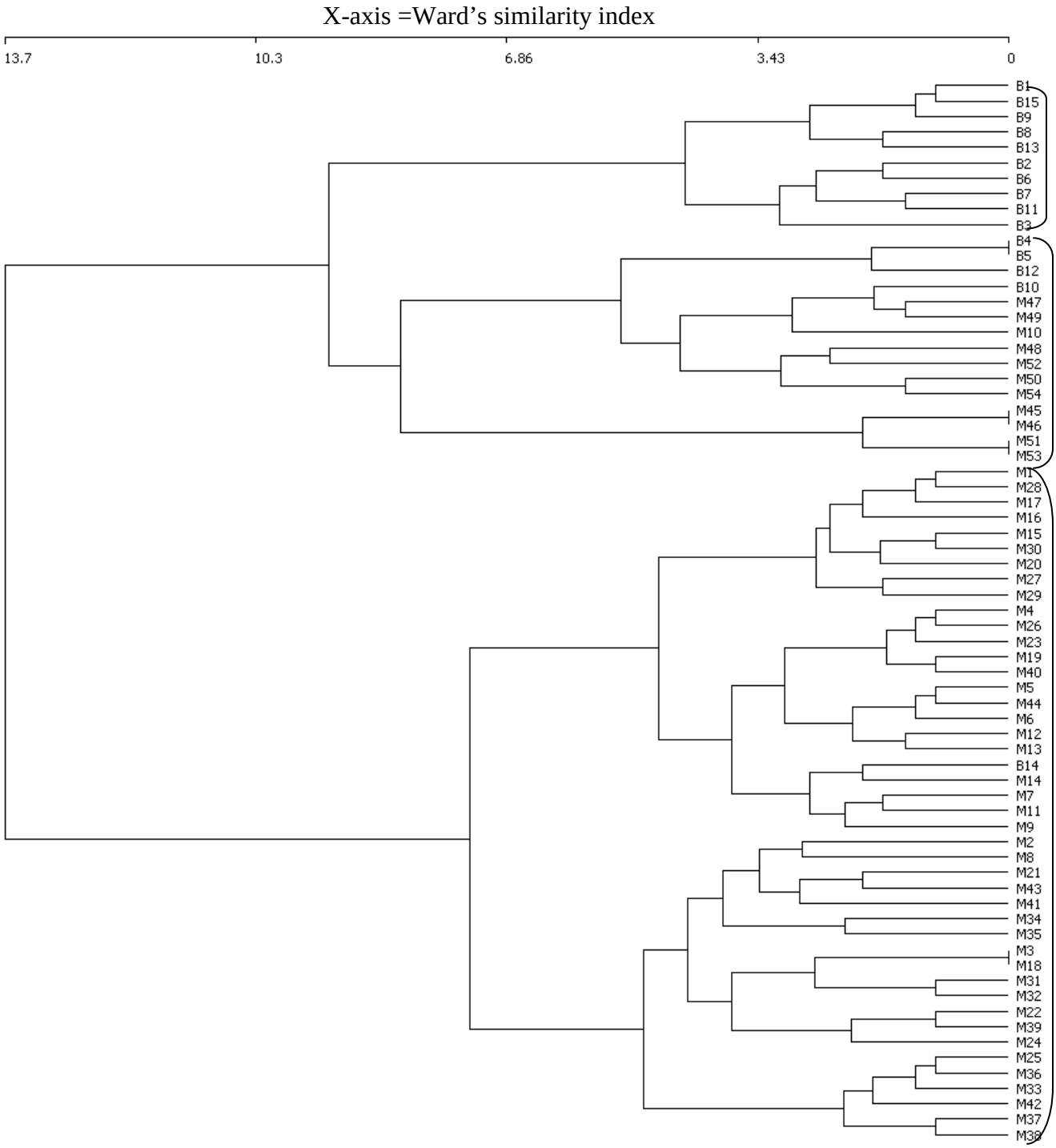


Figure 4.3: Dendrogram of forest resources preferred by Batwa (B1-B15) and Bakiga (M1-M44) in Bujengwe Parish.

X-axis =Ward's similarity index

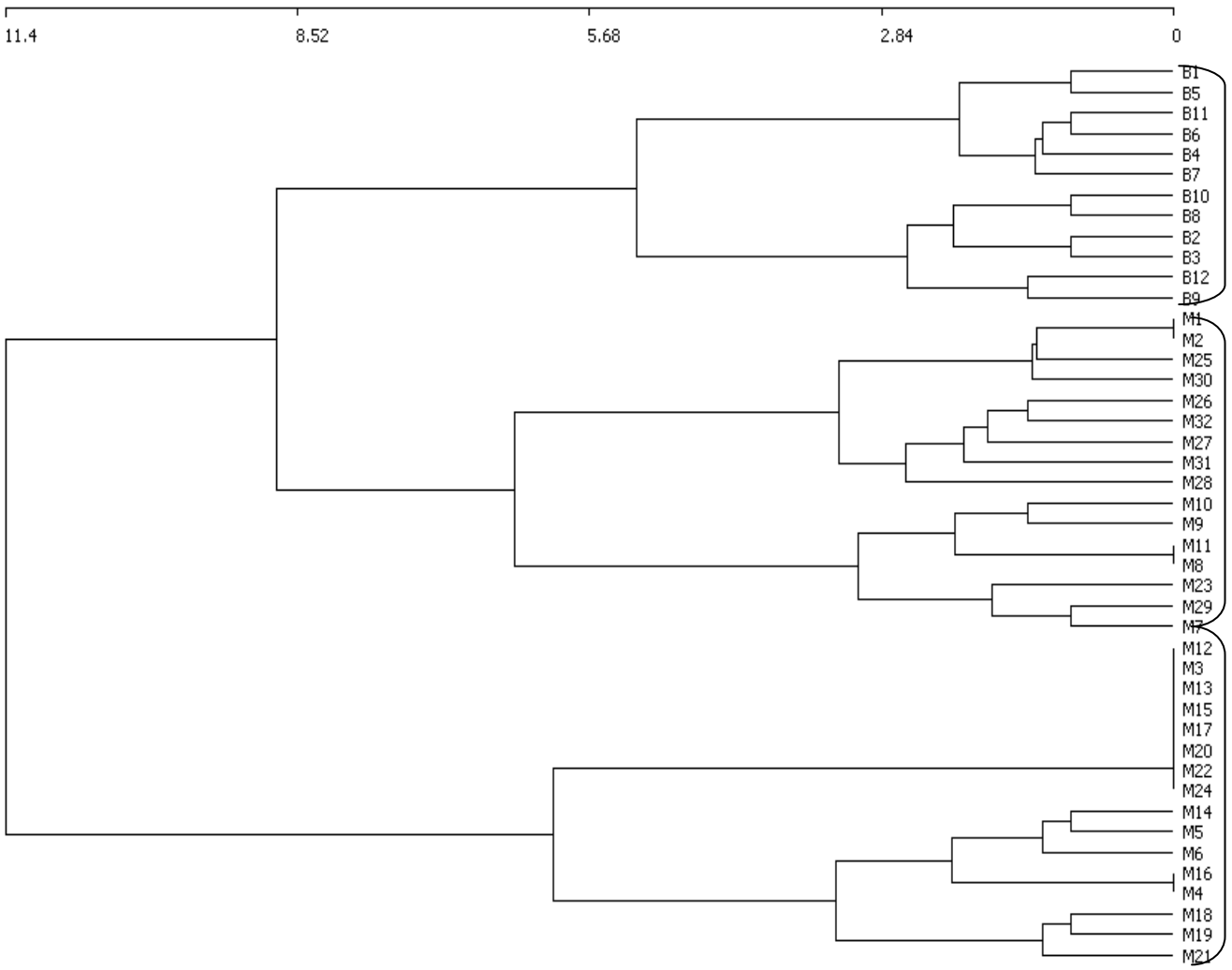


Figure 4.4 Dendrogram of forest resources preferred by Batwa (B1-B12) and Bakiga (M1-M24) in Buremba Parish.

4.7.3 Influence of gender on forest resource use

Among the Bakiga ethnic group, there was a significant difference between men and women in forest resources preferences in all the study parishes (i.e. Rutugunda, Buremba, Southernward and Karangara), (Clarke's rank test, R = 0.31, P<0.05, Clarke's rank test, R = 0.43, P<0.05, Clarke's rank test, R = 0.44, P-value <0.05, Clarke's rank test, R = 0.32, P< 0.05 respectively). However, among the Batwa ethnic group, there was no significant difference between men and women in forest resources preferences (i.e. Bujengwe, Buremba, Rutugunda,) (Clarke's rank test, R = 0.91, P>0.05, Clarke's rank test, R = 0.98, P>0.05 and Clarke's rank test, R = 0.89, P>0.05 respectively). All Batwa men and women preferred wild yams, fish and wild honey as pointed out above.

Among the Bakiga ethnic group, three categories of important forest resources are recognized; those preferred by women only (F), those preferred by men only (M) and those preferred by both women and men (Figures 4.5, 4.6, 4.7 & 4.8). The Bakiga women exclusively preferred firewood, *Marantochloa manii*, (Benth.) Milne-Redh. *M. purpurea*, (Ridl.) Milne-Redh. *M. leucantha* (K.Schum.) Milne-Redh.and *Raphia farinifera* Gaertn.) Hyl.(see also Plate 2*)*. Forest resources exclusively preferred by the men were; *S. anceps, D. laxissima, Monanthothaxis littoralis* (Bagsh. & Baker f.) Verdc., *Uvaria angolensis* Welw. ex Oliv. timber and walking sticks made from *M. dura* (see also Plate 3*)*. Medicinal plants such as *O. usambarensis, R. kigeziensis* and *Piper guineens*e were preferred by both women and men (figures 4.5 and 4.7).

X-axis =Ward's similarity index

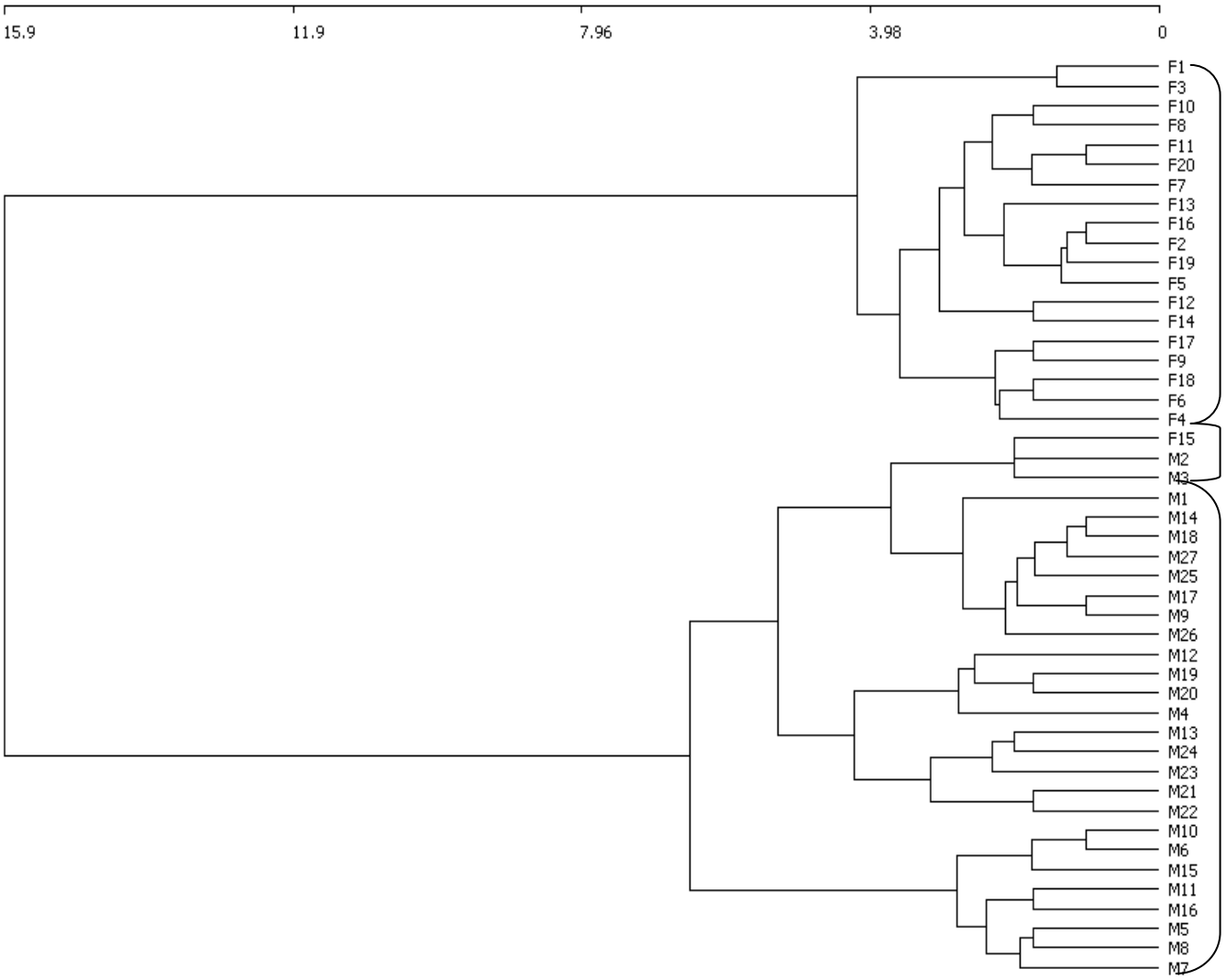


Figure 4.5: Dendrogram of forest resources preferred by women (**F1-F19**) and men (**M1-27**) in Rutugunda Parish.

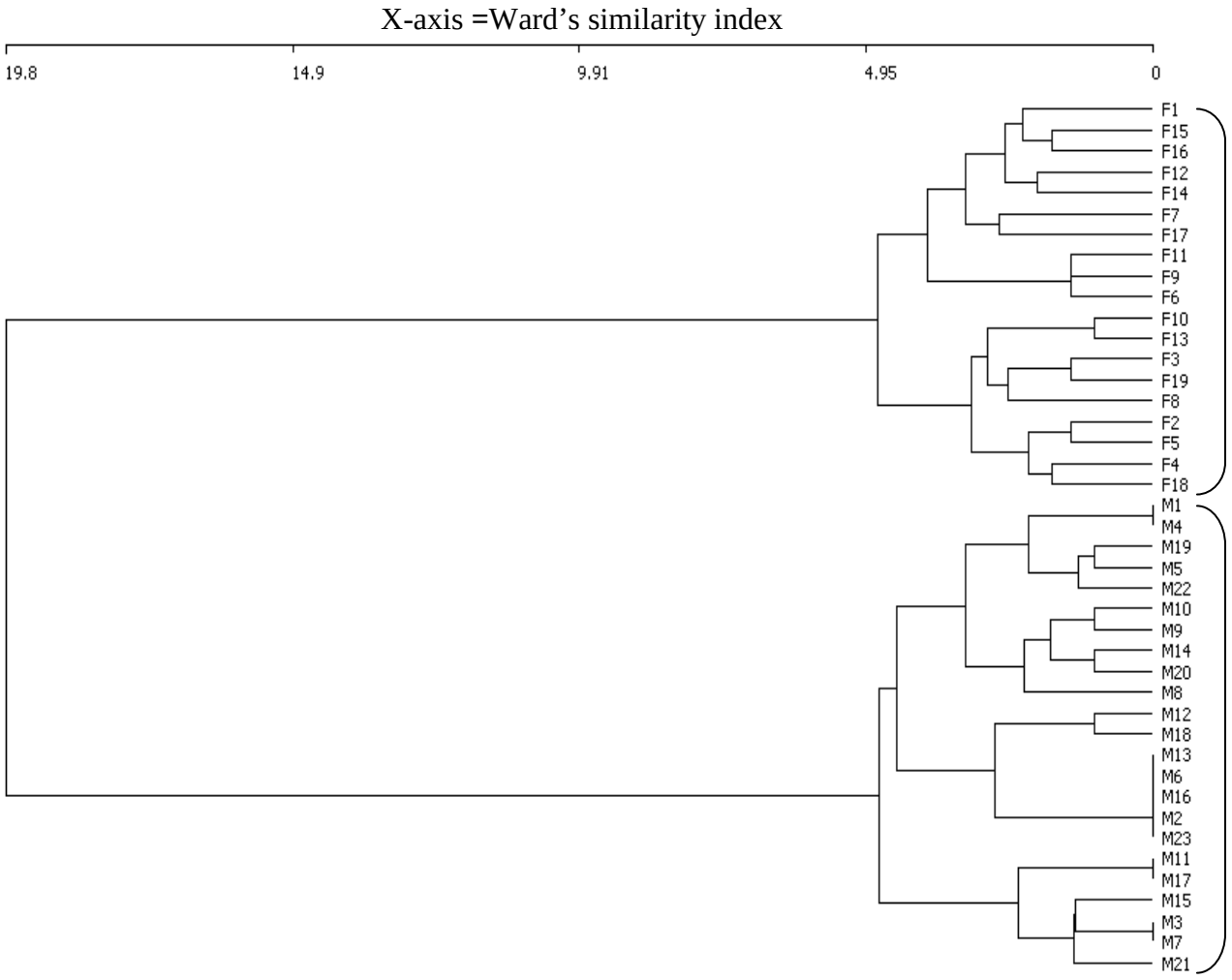


Figure 4.6: Dendrogram of forest resources preferred by women (F1-F19) and men (M1-M22) in Buremba Parish.

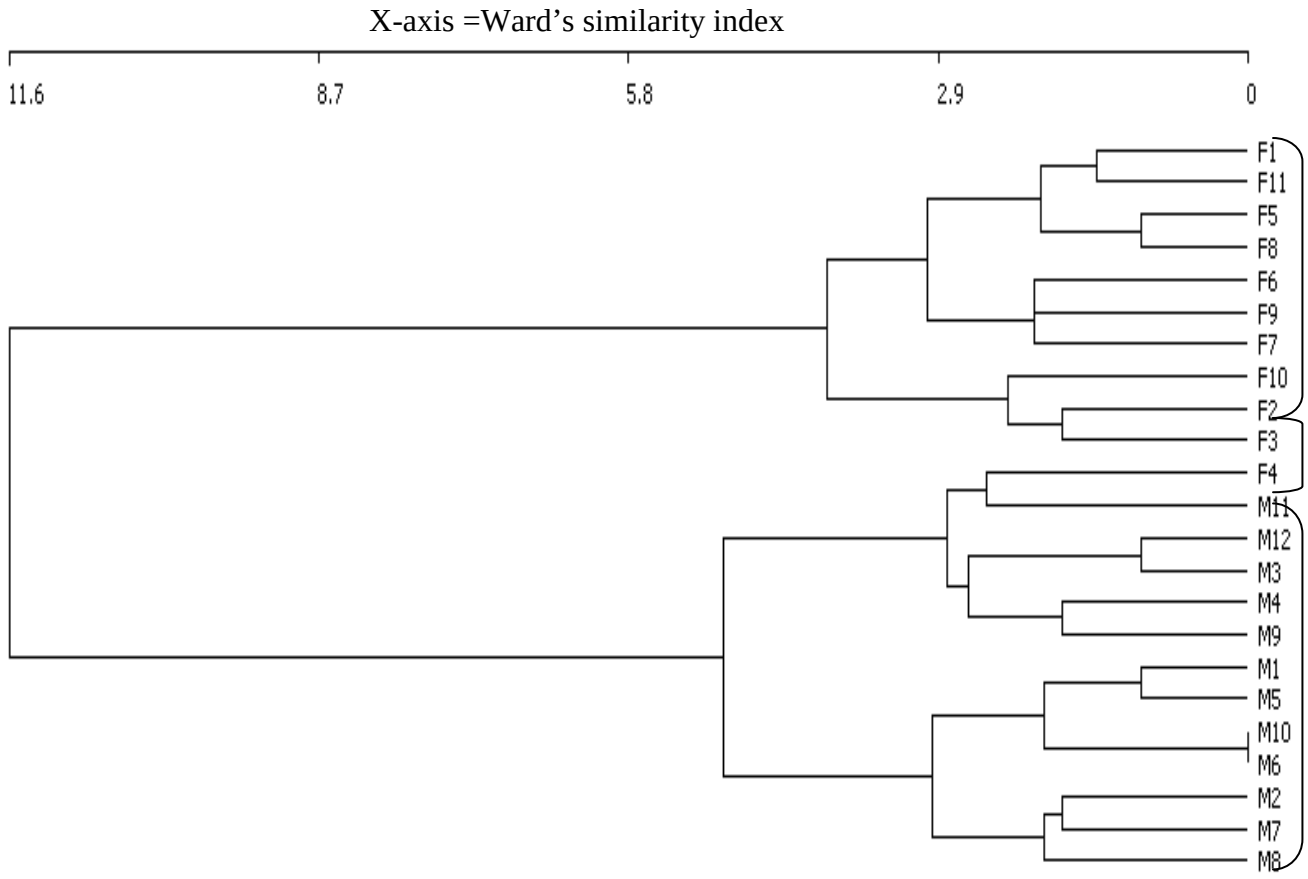


Figure 4.7: Dendrogram of forest resources preferred by women (**F1-F11**) and men (**M1-11**) in Southernward Parish.

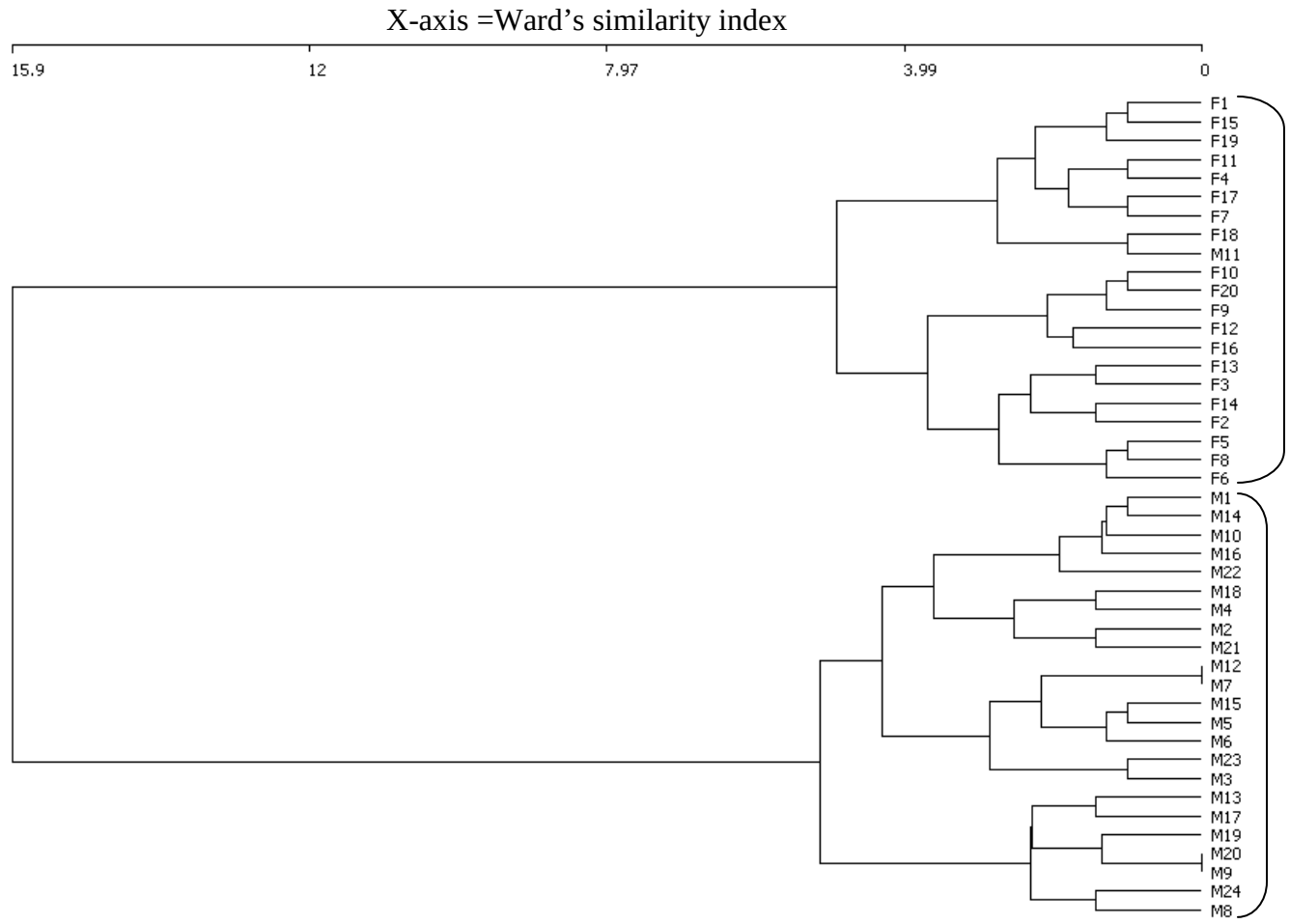


Figure 4.8: Dendrogram of forest resources preferred by women (F1-20) and men (M1-M22) in Karangara Parish.

Plate 4.2 Women resource users harvesting *Maranthochloa manii* from Bwindi forest

Plate 4.3 A man after harvesting *Smilax anceps* vines from Bwindi forest

4.7.4 Major products made/extracted from the forest

The main products made from the forest resources include; baskets and winnowing trays. Resource users also extracted medicine from plants and honey from beekeeping (Table 4.2). Plants commonly used by the resource users from the plant harvest MUZ parishes include; *S. anceps, D. laxissima and Marantochloa spp* for baskets and winnowing trays. Others were; *R. kigeziensis, O. usambarensis* and *P. guineense* for medicine (Table 4.2). Resource users from the non-MUZ parish collected wild plants from woodlots outside Bwindi and used other alternatives such as dry banana fibers, *Triumfetta brachyceras* K.Schum, *Eleucine indica* **(L.)** and *Plantago palmata* Hook.f for making baskets. The number of forest products made by each resource user varied from parish to parish and depended on the category of parish. For example, resource users in the plant harvest MUZ had a variety of plant species to make products more than those from the non-MUZ parish (Table 4.2). The Plant harvest MUZ parish used 10 different plant species while the non-MUZ parish used only 3. The beekeeping MUZ parish extracted only honey from the forest. Therefore resource users from the plant harvest zones made more forest products than those from other categories of parishes.

Table 4.2: Major forest products made by resource users around Bwindi

Parish/number of resource users interviewed	Plant/forest resource used	Finished products	Average number of finished products per resource user/year (±SD)
Buremba- Plant harvest MUZs (30 resource users)	*Smilax anceps, Dracaena laxissima, Monanthothaxis littoralis* (n=16 users)	Winnowing trays	11.8±7.6
	Smilax anceps (n= 18 users)	Big baskets	9.4±3.4
	Marantochloa manii (n=11 users)	Small baskets	8.7±2.3
	Marantochloa purpurea (n=12 users)	Small baskets	4.8±2.5
	Raphia farinifera (n =11 users)	Small baskets	5.8±0.4
	Rytigynia kigeziensis (n=28 users)	Handfuls of bark	2.2±1.3
	Ocotea usambarensis (n=20users)	Handfuls of bark	1.8±0.9
	Piper guineense (n=15 users)	Handfuls of root	1.9±0.8
Kashasha-Beekeeping MUZs (40 beekeepers)	Beekeeping (40 beekeepers)	Kilograms of honey	59.6±14
Bujengwe-Non-MUZs (34 resource users)	Banana fibres (n=17 users)	Small baskets	5.6±3.8
	Plantago palmata (n=50users)	Small baskets	7.1±3.1
	Triumfetta brachyceras (n=32users)	Winnowing trays	4.5±3.2
	Eleucine indica (n=60users)	Small baskets	7.5±3.0

4.7.5 Resource users' views on the status of forest resources

Up to 54% of resource users in the plant harvest parishes reported that forest resources in Bwindi were declining but 43% think are still abundant (Figure 4.9). Resources thought to be on a decline included; *Loeseneriella apocynoides,* (Welw. ex Oliv.) N.Hallé ex J.Raynal, *M. manii, M. purpurea* and *R. farinifera*, those thought to be abundant included*; S. anceps, D. laxissima, Monanthothaxis littoralis, R. kigeziensis* and *O. usambarensis.* The decline in forest resources was explained to be a result of overharvesting by illegal harvesters and the limited size of the permitted MUZ. In the beekeeping zone, 85% of beekeepers stated that the annual honey output

has been declining over the years as a result of application of fertilizers and chemicals in nearby local community gardens and chimpanzees destroying their beehives (Figure 4.9).

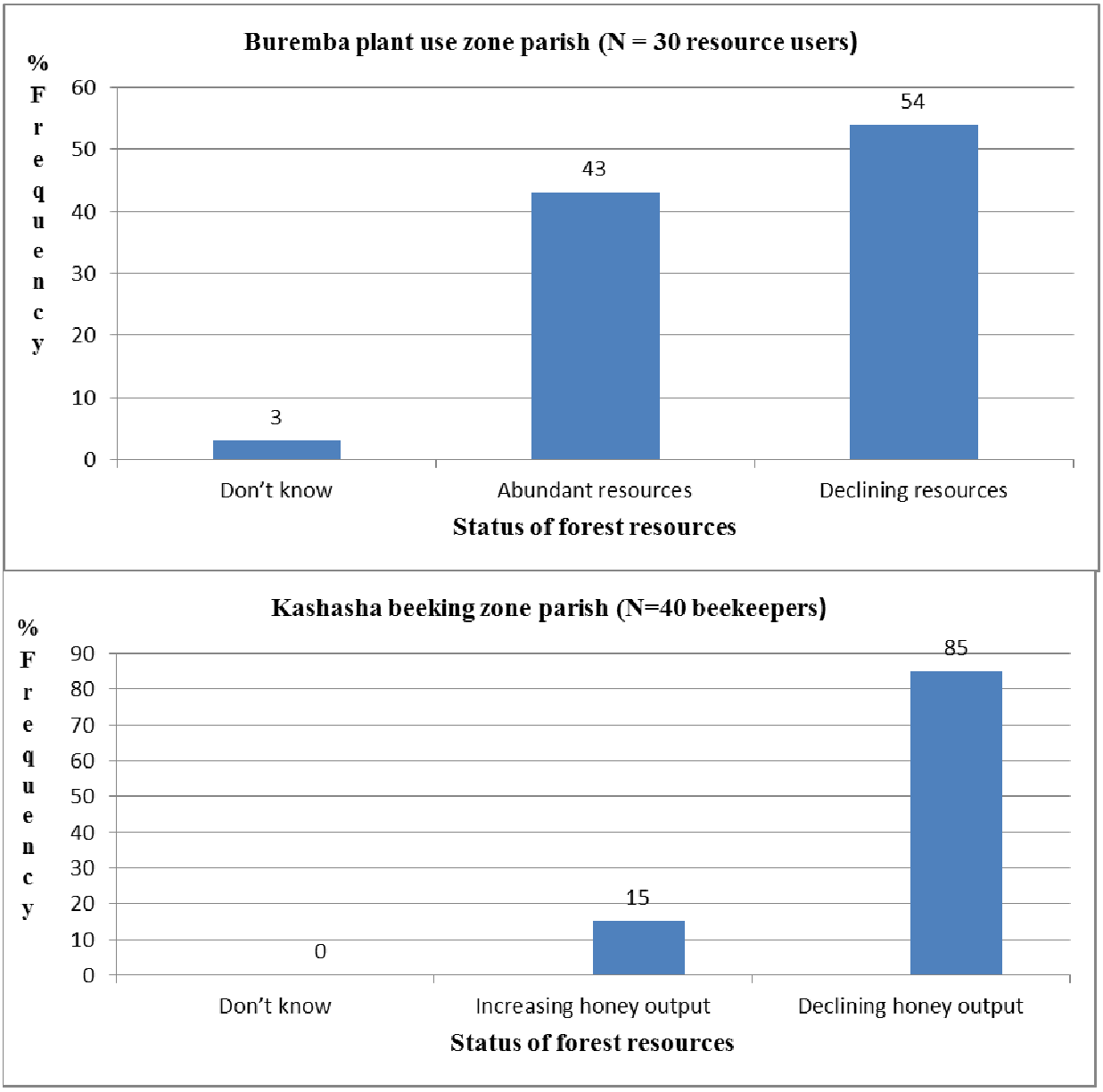


Figure 4.9 Status of forest resources in Bwindi as perceived by forest resource users

4.8 Discussions

4.8.1 Important forest resources for local people

Studies elsewhere in Nepal and Kalimantan (Indonesia, Borneo) have shown that the forest resources most preferred by local people were firewood and timber (Kanel & Shrestha, 2001; Ghazoul & Sheil, 2010; Shova & Hubacek, 2010). Previous studies around Bwindi such as those by Scott (1992); Cunningham (1996); Davey *et al.,* (2001); Bitariho *et al.,* (2004) and Namara, (2006) have shown that forest resources most preferred by the local people around Bwindi were those prohibited under the MUP. These included; food resources (fish, fruits, bush meat, vegetables and wild yams), firewood, poles and timber. The forest resources are considered a source of livelihood and income by the local people. Hence, despite the harvest prohibition, local people continue illegally harvesting them disregarding the risks of arrests and fines involved (Namara, 2006; Shova & Hubacek, 2010). Evidence of such illegal harvests has been reported by Olupot *et al.,* (2009) who observed pole and stake cuttings used for making walking sticks and hoe handles and firewood collection at the Bwindis park periphery. Some onsets of fires in Bwindi have often been attributed to illegal wild honey harvests by Batwa (Kasangaki *et al*, 2001).

The findings of this study are consistent with others carried out by Cunningham (1992), Scott (1992), Wild & Mutebi (1996), Cunningham (2001) and Muhwezi *et al.* (2009) showing that the most popular plants for basket weaving were; *S. anceps*, *D. laxissima*, *Monanthothaxis littoralis, L. apocynoides, Marantochloa manii* and *M. purpurea,* and for medicinal purposes were; *P. guineense, O. usambarensis, P. africana* and *R. kigeziensis*. The four medicinal plants are used for the treatment of stomach upsets and intestinal worms in children (Bitariho *et al.*, 2006). Scott (1992) also recorded that the most favored tree for tool handles and walking sticks in Bwindi was

the *M. dura*. Therefore as this study shows, overtime, little has changed in terms of forest resources local people consider important to them.

4.8.2 Influence of ethnicity and gender on preferences of forest resources

Several authors have pointed out that preferences for forest resources and the degree of reliance on forest products is influenced by ethnicity and gender (Kainer & Duryea, 1992; Cunningham, 2001; Stagegaard *et al*., 2002; Babulo *et al.,* 2008; Illukpitiya & Yanagida, 2008). Lacuna-Richman, **(**2003) on the contrary stated that ethnicity did not influence preferences of forest resources but rather economic gains from the sale of the resources. While it is true that economic gains from sale of forest resources influences preferences for forest resources, this study is in agreement with the view that ethnicity and gender also influence preferences for forest resources.

Historic differences in forest use between Batwa and Bakiga could explain the different preferences for forest resources by the two ethnic groups. The Batwa are former hunter-gatherers who used the forest for their livelihoods by harvesting wild yams and wild honey and hunted animals for bush meat before Bwindi became a national park (Cunningham, 1996; Bitariho *et al.,* 2004; Byarugaba *et al.,* 2006). The Bakiga are agriculturalists who used the forest as an alternative source of livelihood for timber, weaving and medicinal plants. This is the scenario reflected in the current preferences of forest resources by the two different ethnic groups.

Forest resources preferred by the Batwa have never been included in Bwindi's MUP even after recommendations from various researchers (Cunningham, 1992; Bensted-Smith *et al.,* 1995; Davey *et al.,* 2001; Bitariho *et al.,* 2004). When Bwindi's MUP was reviewed in 2008, a few Batwa were included in the programme but were not allowed to harvest the forest resources

valued by them. Batwa have pointed out during several consultation meetings that they have been marginalized by the MUP in favor of the Bakiga and this has been confirmed by this study (Bitariho *et al.*, 2004; Christensen, 2009).

The differences between forest resources preferred by Bakiga men and women could be derived from their traditional and cultural roles in a society. In a traditional Bakiga household, tasks are divided among the different sexes and most men and women have a rough knowledge of all important tasks specific to their own sex (Edel, 1957; Hegner, 2000). Women weave small baskets used for food and grains storage (Cunningham, 2001; Christensen, 2009). These baskets are made from *Marantochloa manii, M. purpurea* and *R. farinifera* hence most preferred by the women. The women are responsible for cooking and therefore it is not surprising that they preferred to collect firewood from the forest (Edel, 1957; Nagbrahmam & Sambrani, 1983; Hegner, 2000; Arnold & Perez, 2001; Kanel & Shrestha, 2001; Sarin, 2009).

On the other hand, men value resources used for constructing houses and granaries made from *Monanthothaxis littoralis*) and for making crop harvest baskets (made from *S. anceps* and *D. laxissima),* tool handles (from *Milletia dura*), for carpentry and iron working (Edel, 1957). They also are make winnowing trays made from *S. anceps, M. littoralis* and *D. laxissima* andcarry out beekeeping for honey. Therefore, when planning for forest resource use programs in protected areas, gender and ethnicity is an important component to be considered.

4.8.3 Major products made and status of harvested forest resources

The difference in the number of products made by resource users is probably caused by differences in availability of forest resources and the demand for the products. Resource users

from plant harvest MUZs access raw materials from the forest more easily than those from the non-MUZs. The non-MUZ parishes depend on village woodlots owned by a few individuals for the forest resources and therefore lack adequate raw materials for making products for sell and home use.

Researchers such as Cunningham (1992); Cunningham, (1996); Bitariho *et al* (2006); Langbroek (2010); Stas (2010) have noted that populations of some harvested plant species such as *S. anceps, D. laxissima*, *R. kigeziensis* and *O. usambarensis* are stable in Bwindi. This is in agreement with observations of the local resource harvesters. The declining plant populations mentioned by resource users of *Marantochloa manii, M.purpurea* and *R. farinifera*, are those used by women for weaving small baskets sold to tourists. The tourism industry around Bwindi could therefore have caused the decline of those plants. Also resource users are in agreement with Ndangalasi *et al* (2007); Muhwezi *et al.*, (2009); Kasangaki *et al.* (2012) that *L. apocynoides* is declining in Bwindi. The *L. apocynoides* is under threat of overexploitation by tea basket makers.

4.9 Conclusions

The most important forest resources preferred by for local people around Bwindi are those prohibited by park management. Such resources are a source of income and livelihoods to the local people; they include bush meat, timber, tool handles, poles, wild yams, vegetables and fruits. There are other highly valued forest resources that are used for making baskets and crafts for sale to tourists and in local markets. These include *Marantochloa manii, M. purpurea* and *R. farinifera* that are declining due to overexploitation as observed by resource users.

Ethnicity and gender influence the preferences for forest resources by local people around Bwindi. Forest resources important to the Batwa and Bakiga, men and women differ because of the traditional roles each group plays in a community and household respectively. Resources desired by Batwa are those that they traditional used when they lived in the forest while those preferred by the women are those that they have traditionally used for carrying out household chores.

Commonly made forest products around Bwindi such as baskets and winnowing trays were those that had available raw materials such as *Smilax anceps* from both Bwindi and village woodlots. The resource users feel that these raw materials are not threatened with overexploitation since they respond to harvests by vigorously sprouting.

4.10 Recommendations

Development programmes around Bwindi should be geared towards establishing alternatives for those important forest resources to the local people (bush meat, timber and tool handles) that are not permitted under Bwindi's MUP; this will curtail their illegal extractions from the forest. Focus on provision of Livestock (pigs, goats and cattle) to individual households around Bwindi especially the poorest and agroforestry in households should be a priority. The agroforestry programmes are likely to reduce illegal extraction of forest resources from Bwindi for timber and tool handles if handled efficiently. Some of these programmes have already been introduced but are not the main focus of these development organizations.

A study in Bwindi on bush meat demand and reasons for bush meat hunting should be carried out on order to understand the social dynamics involved in bush meant hunting. It has been

observed by some park rangers and local leaders around Bwindi that bush meat hunting has some traditional and cultural roles in a local community. They think that some hunters seek for game meat to appease their traditional gods. These are some of the aspects that should be investigated by the study.

There is a need to expand the MUP to other parishes around Bwindi that are not benefiting from the programme. Parishes such as Bujengwe, Rubuguri, Rubimbwa and Bushura could be included in the MUP. These parishes benefit little from park programmes such as tourism and revenue sharing and therefore may likely have negative attitudes towards the park. When this is achieved, then park benefits to the local people will be amplified leading to improved attitudes and therefore less illegal activities.

There is a need to have separate MUP Memoranda of Understanding for the Batwa different from the Bakiga in order to cater for their forest interests. Forest resources preferred by the Batwa are different from those of Bakiga as the study shows, and forest resource harvest may differ in seasons and type within the two ethnic groups e.g. wild honey and wild yams collection.

Some of the forest resources such as wild honey and wild yam collections by Batwa should be included in the MUP as long as their harvest sustainability can be guaranteed. The MUP should also aim at including other forest resources such as wild fruits, vegetables, mushrooms and fish. The harvest sustainability of these forest resources should be investigated through research studies.

References

Arnold, J.E.M, & Perez, R.M., 2001. Can non-timber forest products match tropical forest conservation and development objectives (analysis), *Ecological Economics* 39; 437- 447.

Babulo, B, Muys, B, Nega, F, Tollens, E, Nyssen, J, Deckers, J, Mathijs, E., 2008. Household Livelihood strategies and forest dependence in the highlands of Tigray, Northern Ethiopia, *Agricultural Systems* 98: 147-155.

Bensted-Smith, R., Infield, M., Otekat, J. and Thompson-Handler, N., 1995. Review of the multiple-use (resource sharing) programme in Bwindi Impenetrable National Park. A report to CARE-Development Through Conservation Project, Kabale.

Bidhan Kanti Das, 2005. Role of Non-Timber Forest Products among forest villages in a Protected Area of West Bengal. *Journal of Human Ecology* 18(2): 129-136.

Bitariho, R., McNeilage, A., Babaasa, D., Barigyira, R., 2006. Plant harvest impact and sustainability in Bwindi Impenetrable National Park, S.W. Uganda. *African Journal of Ecology* 44: 14-21.

Bitariho, R., Mugyerwa, B., Barigyira, R and Kagoda E., 2004. Local People's Attitudes and New Demands since inception of Multiple Use Programme in Bwindi Impenetrable National Park, S. W Uganda, Unpublished report, Institute of Tropical Forest Conservation, Ruhija, Kabale.

Byarugaba, D., Ndemere P & Midgley, J., 2006. The vulnerability and resilience of *Dioscorea* species in utilized and nonutilized zones of Bwindi Impenetrable National Park, *African Journal of Ecology* 45: 258–264.

Christensen, T., 2009. An assessment of the benefits of the multiple use programme of Bwindi Impenetrable National Park. Msc thesis report for the University of Aarhus, Aarhus.

Clarke, K. R., 1988. Detecting change in benthic community structure. 131-142 in R. Oger (ed.) Proceedings of invited papers, 14th international biometric conference, Namour.

Clarke, K. R. 1993., Non-parametric multivariate analyses of changes in community structure. *Australia Journal of Ecology* 18: 117-143.

Cunningham, A.B., 1992. People, park and plant use: Research and recommendations for multiple-use zones and development alternatives around Bwindi-impenetrable National Park, Uganda. Report to CARE-International, Kampala.

Cunningham, A.B., 1996. People, Park and Plant Use, Recommendations for multiple use zones and development alternatives around Bwindi Impenetrable National Park, Uganda. A report for people and plants initiative, division of ecological sciences, UNESCO, 7 place de fontenoy, Paris.

Cunningham, A.B., 2001. Applied Ethnobotany, People, Wild Plant Use and Conservation, WWF, Earthscan Publications Ltd, London, N1 9JN.

Davey, C., Peters, C.M, and Byarugaba, D., 2001. Participatory review of the Multiple Use Programme, Bwindi Impenetrable National Park and Mgahinga Gorilla National Park. CARE-Uganda and Uganda Wildlife Authority, Kampala.

de Beer, J.H, McDermott, M.J,.1996. The economic value of non-timber forest products in Southeast Asia, 2nd Revised edition, IUCN, Amsterdam.

Digby, P.G.N & Kempton, R.A. 1987. Multivariate Analysis of Ecological Communities, Population and Community Series, Chapman & Hall, London.

Edel, M.M., 1957. The Chiga of western Uganda. International African Institute, Oxford University Press, New York, Toronto.

Elba, A.F & Jacobson, S.K, 1995. Local Communities and Protected Areas: Attitudes of Rural Residents Towards Conservation and Machalilla National Park, Ecuador. *Environmental Conservation* 22: 241-249.

Eilu, G, & Bukenya, Z., 2004. Local use of climbing plants of Budongo Forest Reserve, Western Uganda. *Journal of Ethnobiology* (24): 2

Eilu, G, Oriekot, J & Tushabe, H., 2007. Conservation of indigenous plants outside Protected areas in Tororo District, eastern, Uganda. *Journal of African Ecology* 45 (Suppl. 3): 73–78

Ghazoul, J & Sheil, D., 2010. Tropical rain forest ecology, diversity, and conservation. Oxford University Press, Great Clarendon Street, Oxford.

Hegner, A.B., 2000. The empowerment of women in Kigezi- Changes in gender relations in rural Uganda. Unpbl Master's thesis in political science, Depart of political science, University of Aarhus, Aarhus.

Illukptiya, P., & Yanagida, J.F., 2008. Role of income diversification in protecting natural forests: Evidence from rural households in forest margins of Sri Lanka. *Agroforestry Systems* (74): 51-62

ITFC, 1999. The potential supply of weaving and medicinal plant resources in the proposed Kifunjo-Masya Multiple - Use Zone of Bwindi Impenetrable National Park, South-Western Uganda. Unpublished Report, Ruhija, Kabale.

Jongman, R.H.G, Ter Braak, C.J.F & Van Tongeren, O.F.R., 1995. Data Analysis in Community and Landscape Ecology, Cambridge University Press, Cambridge

Kainer, A.K & Duryea,M.L., 1992. Tapping Women's Knowledge: Plant resource use in Extractive reserves, Acre, Brazil, *Economic Botany*,46 (4):408-425

Kamatenesi, M., 1997. The Conservation and Utilisation Status of Nyakibazi (Rytigynia spp.) in the Multiple - Use Areas of Bwindi Impenetrable National Park, Uganda. MSc. Thesis,Makerere University, Kampala.

Kanel, K.R & Shrestha, K., 2001**.** Tropical Secondary Forests in Nepal and their importance to local people, *Journal of Tropical Forest Science* 13(4): 691–704

Kasangaki, A., Babaasa, D., Bitariho, R. and Mugiri, G., 2001. A survey of burnt areas in Bwindi and Mgahinga National Parks, Southwest Uganda: The fires of 2000. Institute of Tropical Forest Conservation-Ecological Monitoring Programme, Ruhija, Kabale.

Kasangaki, A, Bitariho, R, Shaw, P, Robbins, M & McNeilage, A (2012). Long-term ecological and socio-economic changes in and around Bwindi Impenetrable National Park, south-western Uganda: in The ecological Impact of long-term changes in Africa's Rift Valley, Plumptre, A (ed) Nova Science Publishers, Inc, New York.

Kidd, C., 2008. Development discourse and the Batwa of south west Uganda, Representing the 'Other': Presenting the 'Self'. A Phd thesis for the Department of Sociology, Anthropology and Applied Social Sciences, University of Glasgow, Scotland.

Kyoshabire, M., 1998. Medicinal Plants and Herbalist Preference around Bwindi Impenetrable Forest,Uganda.Unpublished MSc thesis, Makerere University, Kampala.

Lacuna-Richman, C**.** 2003. Ethnicity and the Utilization of Non-Wood Forest Products: Findings from three Philippine Villages. *Silva Fennica* 37(1): 129–148.

Langbroek, E., 2010. Analysing the impacts of bark harvest on *Rytigynia kigeziensis* in Bwindi Impenetrable National Park, Uganda. Unpbl Msc thesis MSc Environmental Biology, Ecology & natural resources management, Utrecht University, Utrecht.

Muhwezi, O., 1997. The Biology, Use and Impact of Harvesting on the Afromontane Liana (*Loeseneriella apocynoides*) in and Around Bwindi Impenetrable National Park, Uganda, MSc. Thesis, Makerere University, Kampala.

Muhwezi, O, Cunningham, A.B & Bukenya- Ziraba, R.., 2009. Lianas and Livelihoods:The Role of Fibrous Forest Plants in Food Security and Society around Bwindi Impenetrable National Park, Uganda, *Economic Botany* 20 (10): 1-13

Nagbrahmam, D & Sambrani, S., 1983. Women's Drudgery in Firewood Collection, *E*conomic and Political Weekly *18(½): 33+35-38*

Namara, A., 2006. From Paternalism to real partnership with local communities? Experiences from Bwindi Impenetrable National Park (Uganda). *Africa Development* 31 (2):39-68

Ndangalasi, H, Bitariho R, Dovie D., 2007. Harvesting of non-timber forest products and Implications for conservation in two montane forests of East Africa, *Biological Conservation* 134: (2), 242-250.

Newton, A.C., 2007.Conservation of Tree Species through Sustainable Use: How Can it be Achieved in Practice? *Oryx* 42 (2): 195-205.

Ogwal, S.F. 1998. A study of Abundance, Utilisation and Management of *Smilax anceps* in Bwindi Impenetrable National Park, S.W Uganda, MSc thesis Makerere University Institute of Environment and Natural Resources, Kampala.

Olupot, W., 2004. Boundary Edge effects in Bwindi Impenetrable National Park, Unpublished report, ITFC, Ruhija, Kabale

Olupot, W, Barigyira, R, & Chapman, C., 2009**.** The status of anthropogenic threat at the people-park interface of Bwindi Impenetrable National Park, Uganda. *Environmental Conservation* 36 (1): 41–50

Peters, C.M., 1994. Sustainable Harvest of Non - Timber Plant Resources in Tropical Moist Forest: An Ecological Primer. USAID Biodiversity Support Programme, Washington D.C.

Ros-Tonen, M.A.F. 2000. The Role of Non-Timber Forest Products in Sustainable Tropical Forest management. *Springer-Verlag* 58: 196-201

Sarin, M, 2009. Regenerating India's Forests: Reconciling Gender Equity with Joint Forest Management, *Institute of Development Studies bulletin* 26 (1): 83-91

Scott, J.C., 1998. Seeing like a State. How Certain Schemes to Improve the Human Condition have Failed. Yale University Press, New Haven and London.

Scott, P., 1992. Fringe benefits: National Park boundaries as areas for local community utilisation: the case of the Impenetrable (Bwindi) forest. MSc. Thesis, Agricultural University of Norway, A°s, Akershus-Oslo.

Shova, T & Hubacek, K, 2010. Drivers of illegal resource extraction: An analysis of Bardia National Park, Nepal, *Journal of Environmental management* 92(2011): 156-164.

Smith, J.J., 1993. Using ANTHROPAC 3.5 and a Spreadsheet to compute a free-list salience index. *Cultural Anthropology Methods Journal* 5 (3): 1-3.

Stagegaard, J., Sorensen, M., & Kvist, L.P., 2002. Estimations of the importance of plant Resources extracted by inhabitants of Peruvian Amazon flood plains. *Perspectives in plant ecology, evolution and sytematics,* 5(2): 103-122

Stas, S., 2010. Assessing the impacts of bark harvest on *Ocotea usambarensis* in Bwindi Impenetrable National Park, Uganda, Unpublished Msc thesis MSc Environmental Biology, Ecology & natural resources management, Utrecht University, Utrecht.

Tushabomwe-Kazooba, C, & Mbamanya, H., 2005. Multiple use program in Bwindi-Mgahinga Conservation Area (BMCA) – South western Uganda. Unpbl report of a stakeholders' workshop held in White Horse Inn Kabale, A consultancy report for CARE-REPA, Kampala.

Ticktin, T., 2004. The ecological implications of harvesting non-timber forest products. *Journal of Applied Ecology,* 41: 11-21.

Tuxill, J & Nabhan, G.P., 1998. Plants and protected areas. A guide to In Situ management. WWF, Stanley Thornes publications, Ellenborough house,Wellington street Cheltenham.

Uganda Local Government Act, 1997. Republic of Uganda, Entebbe Government Printer, Entebbe

Wild, R, & Mutebi, J., 1996. Conservation Through Community Use of Plant Resources: Establishing Collaborative Management at Bwindi Impenetrable and Mgahinga Gorilla National Parks. People and Plants Working Paper 5.UNESCO, Paris.

Chapter five

5. Forest income and rural livelihoods: A case study of Bwindi's Multiple Use Programme

5.1 Benefits and costs to local people neighboring tropical forests

More than 25% of the world's population (about 1.6 billion people) relies on forest resources for livelihoods, 75% of them living in extreme poverty and lacking the basic necessities for a decent life (Freese, 1997; Arnold & Perez, 2001; World Bank, 2001; Ticktin, 2004; Vedeld *et al.,* 2004; FAO, 2006; Kaimowitz & Sheil, 2007; Babulo *et al*., 2008; Ghazoul & Sheil, 2010). To them, forest resources are not just objects of admiration, but essential elements of a daily life. While most of them grow crops and raise animals, they in addition depend on wild resources obtained through hunting, gathering, and fishing as alternative livelihoods (Kaimowitz & Sheil, 2007).

Over two-thirds of 600 million people in Africa rely on forest products, either in form of subsistence uses or cash incomes (Timko *et al.,* 2010). Income diversification is a distinguishing feature as a risk-reducing strategy for most people in the tropics (Ellis, 2000; Vedeld *et al.,* 2004; Kaimowitz & Sheil, 2007). Hundreds of tropical forest species are a source of proteins, vitamins, income and social status for the local people in the tropics (Freese, 1997; Vedeld *et al.* 2004; FAO, 2006; Kaimowitz & Sheil, 2007). Despite the benefits from tropical forests, local people neighboring protected forests are the ones who suffer the costs of crop raiding by wild animals and labor and opportunity costs of crop defense from the wild animals (Adams & Hutton, 2007; MacKenzie, 2012).

5.2 Forest conservation and poverty alleviation

The Convention on Biological Diversity, the Millennium Development Goals (MDGs) and other international agreements explicitly connect conservation to poverty alleviation (Sachs *et al.,* 2009; Turner *et al.,* 2012). There is a general expectation that conservation actions should benefit human well-being, help secure livelihoods, and pose little risk to the poor (WCED, 1987; Newton, 2007; Turner *et al.,* 2012). When world governments signed the Millennium Declaration in 2000, they committed themselves to halving the number of people living in extreme poverty by 2015 (FAO, 2006). Two of the eight MDGs are geared towards the eradication of poverty and hunger and environmental sustainability. The 5th world's park's congress held in South Africa in 2003 stressed the importance of protected areas in the reduction of poverty among rural poor people (WPC, 2003; Adams & Hutton, 2007; Sachs *et al.,* 2009; Turner *et al.,* 2012).

In Sub-Saharan Africa, almost 90% of rural people live below the poverty line (earn less than $1/day) and rely on forest resources for their livelihoods (Timko *et al.,* 2010). As such most tropics have shifted attention to protected area forests to alleviate rural local people from poverty. Newton (2007) argues that the integration of conservation and poverty is not an option but an imperative. The link between forests to rural livelihoods presents tropical forests with both an opportunity and challenge for achieving conservation and development goals (Timko *et al.,* 2010). There are however no clearly demonstrable synergies between conservation and poverty alleviation and economic growth as pointed out by Adams & Hutton, (2007); Newton, (2007); Agrawal & Redford, (2009). It is thought by some authors such as Brandon (1998) and Agrawal & Redford, (2009) that poverty cannot be linked with protected area conservation since

each is detrimental to the other. Brandon (1998) for example suggests that Protected Areas have unfairly been made to be responsible for "curing' structural problems such as poverty and resource allocation, a problem perhaps caused by external factors such as economies of poor countries.

What is important is to find a balance between conservation of these forest resources and available opportunities for the improvement of rural local people's livelihoods through sustainable use of PA resources (Peters, 1994; Arnold & Perez, 2001; Cunningham, 2001; Newton, 2007; Adams & Hutton, 2007).

5.3 Poverty alleviation around Bwindi Impenetrable National Park

The Uganda government's priority programs are now geared towards prosperity for all and poverty alleviation particularly among the rural poor (NRM manifesto, 2006). These priority programs include access to goods and services, modernization of agriculture and poverty reduction. With financial aid from the World Bank, the Uganda government has introduced programmes such as Poverty Eradication Action Plan (PEAP), Poverty Action Fund (PAF) and the National Agricultural Advisory Services (NAADS) in order to improve on the rural local people's income. These programmes aim at tapping the various opportunities and resources available in rural communities and forests to improve livelihoods of the rural poor people.

In Bwindi Impenetrable National Park (hereafter called Bwindi), an Integrated Conservation and Development Programme (ICDP) that involves multiple use programme (MUP), tourism development, revenue sharing, community and agriculture development projects was introduced in

1994 to help local people benefit socio-economically from the park (Baker, 2004; Christensen, 2009; Blomley *et al.*, 2010). The MUP was started with the aim of allowing local people access medicinal and basketry weaving plants and beekeeping (see also chapters 1, 2, 3 & 4). Already local people around Bwindi have taken up this opportunity and are benefiting from the MUP by selling forest products in local markets and tourists areas (Cunningham, 2001; Wild, 2001; Ndangalasi, *et al.*, 2007; Christensen, 2009). The MUP provides an alternative source of income to the rural local people adjacent Bwindi.

5.4 Study objectives

The aim of the study was to evaluate the contribution of the MUP to the socio-economic status of the local people neighboring Bwindi. The specific objectives were to:

i) Assess important sources of income and livelihood for the local people

ii) Assess perceptions/attitudes of local people on the benefits of the MUP

iii) Determine and compare annual incomes of local people involved in the MUP activities with those not involved

iv) Determine the socio-economic contribution of the MUP to local people and the potential of commercialization of forest resources from Bwindi

v) Assess important forest products, origin of raw materials and the seasonality of forest products in local markets

vi) Assess the types of vendors involved in sale and value chain of the forest products

5.5 Study hypotheses

1. Differences among the three categories of parishes on perceived benefits of the MUP by local people were tested using the null hypothesis; **H_o = There is no significant differences among the three categories of parishes on local people's perceptions of the benefits of the MUP**.

2. Differences among the three categories of parishes on the socio-economic income of resource users were tested using the null hypothesis; **H_o = There is no significant difference among the three categories of parishes on annual incomes of resource users from the sale of forest products.**

3 Differences between local markets' seasons on the number of forest products sold were tested using the null hypothesis; **H_o = There is no significant difference among local markets' seasons on the number of forest products sold**.

5.6 Study Justification

When the MUP was first introduced in Bwindi in 1994, forest resource access was restricted to only subsistence use and sale of forest products for cash was not permitted (Christensen, 2009; Multiple Use MoUs). However, the restriction was not effective since the local people utilized opportunities offered by local markets for forest products sale as a source of income (Cunningham, 2001; Wild, 2001; Ndangalasi, *et al.*, 2007; Christensen, 2009). Despite the various studies carried out on Bwindi's MUP (e.g. Cunningham, 2001; Wild, 2001; Ndangalasi, *et al.*, 2007; Christensen, 2009), little is known about the extent to which the MUP can alleviate

poverty for the rural poor people around Bwindi. Synergies and tradeoffs of conservation related programmes and poverty alleviation that could lead to the economic growth of a country are unclear (Adams & Hutton, 2007; Agrawal & Redford, 2009). Little is known on ways to capitalize on the untapped potential of the MUP to eradicate poverty or mitigate its effects. It is important to clearly understand the socio-economic contribution that non-timber forest products make to rural livelihoods in order to craft policies, appropriate interventions and encourage business ventures that safeguard forest assets (Timko *et al.*, 2010).This study therefore assessed the socio-economic contributions of Bwindi's MUP and specifically determined the most important MUP activity that can alleviate poverty among the local people near Bwindi.

5.7 Methods

5.7.1 Study Area

The study was carried out in eight parishes bordering Bwindi in south-western Uganda, namely; Bujengwe, Buremba, Karangara, Kashasha, Kitojo, Mushanje, Rutugunda and Southernward (Figure 5.1). Bwindi park management works directly with parishes when signing Memoranda of Understandings (MoUs) with the local people regarding plant resource access for establishing multiple use zones (MUZs). This study was therefore based on the parish administrative units of local government structures. The smallest unit of administration in the Uganda local government structure is a "village" and several villages constitute a "parish" (Uganda local government Act, 1997). Two of the parishes were non-MUZs (Bujengwe and Mushanje), four were plant use MUZs (Buremba, Karangara, Rutugunda and Southernward) and two were beekeeping MUZs (Kashasha and Kitojo). Households interviewed in all the parishes were those directly adjacent to Bwindi within 1-2km radius also called "frontline households" by Bwindi park management. The

major economic activities in those parishes are farming for food and cash crops such as tea and coffee. The south-western part of Uganda can be described as a peasantry society.

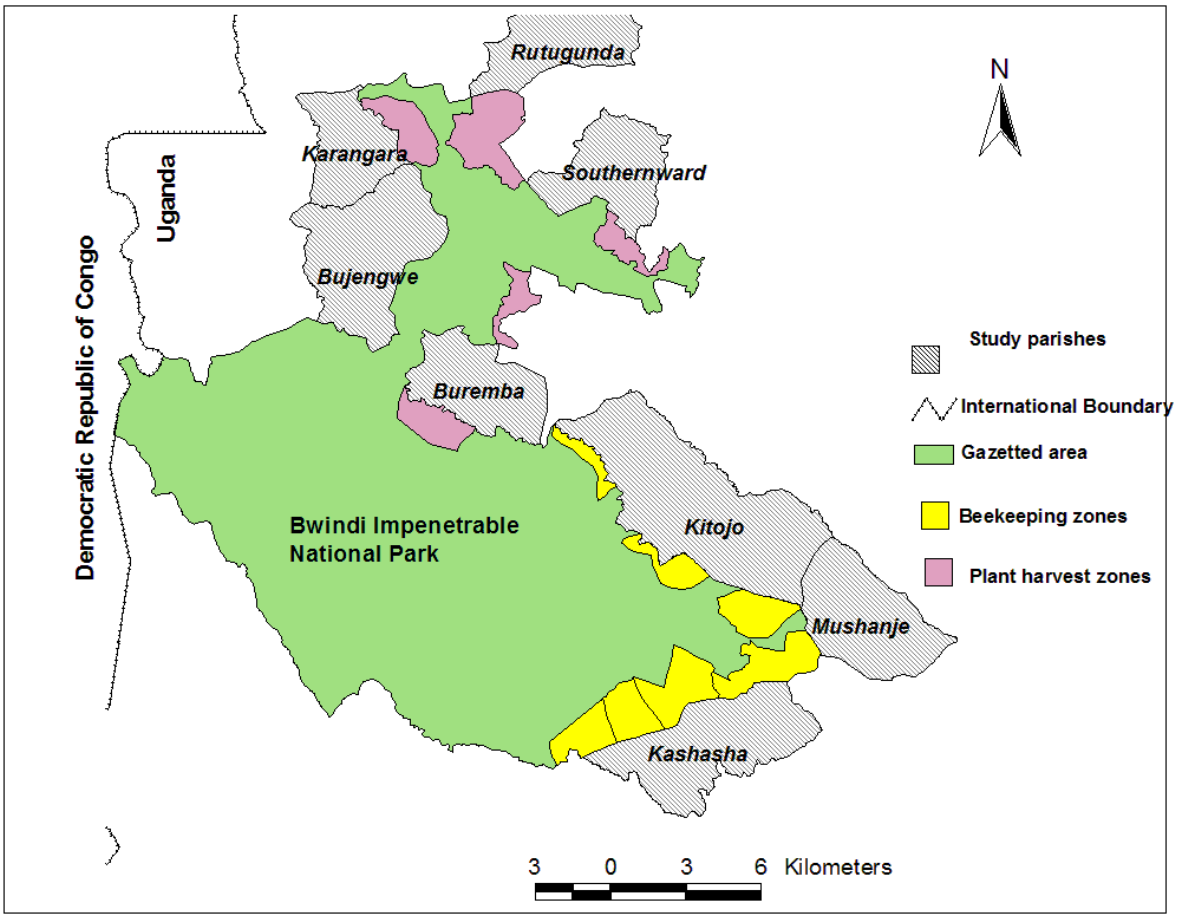


Figure 5.1: Map showing the study parishes around Bwindi.

5.7.2 Village interviews

A total of 390 household heads and their spouses were interviewed from eight parishes using a semi-structured questionnaire with open ended questions. Household census lists maintained by local council officials were used to select respondents for interviews following Eilu *et al* (2004).

Questionnaires were randomly issued to the 390 household heads and their spouses by assigning numbers of households per parish on pieces of papers and placing the paper notes in a hat. The pieces of paper were then shuffled before picking out the households for interviewing. Household heads and/or their spouses interviewed were those found at or near their homes following Eilu *et al* (2004) and Eilu *et al* (2007) methods. If household heads were absent at the time of interviews, no interviews would be carried out as this would bias the data. Information sought from the respondents was; name of household head, age, perceived benefits of the MUP and sources of livelihood following Tuxill & Nabhan (1998) methods.

5.7.3 Resource user interviews

Households with specialist forest resource users e.g. herbalists, basket makers and beekeepers were identified from the village interviews and selected for resource user interviews. A total of 104 resource users were interviewed (34 from Bujengwe, 40 from Kashasha and 30 from Buremba parishes). One parish was randomly selected from each of the three categories of parishes for resource user interviews (making total of three parishes). Bujengwe parish represented the non-multiple use zone category, Kashasha parish the beekeeping zone category and Buremba parish the plant harvest zone category. The interviews were in form of semi-structured questionnaires focusing on; products made, number of products made per year, whether products are used for domestic use only or sold and the cost if sold.

5.7.4 Market surveys

Ten local markets bordering Bwindi were surveyed using the method recommended by Cunningham, (2001) and Martin (1995) of identifying the most important forest resources sold there. The surveyed markets were Kihihi, town council, Butogota, Kanyantorogo and Kyeijanga

(Kanungu district), Nteko, Kisoro town council and Rubuguri (Kisoro district) and Muko and Karukara (Kabale district). A Semi-structured questionnaire with open ended questions was administered to forest products vendors in the markets. Information sought from the vendors included; products sold, raw materials used for the products, source of raw materials, number of products for sale and their costs following recommendations of Cunningham (2001) and Martin (1995). Opportunistic purchases of forest products were carried out to determine the price ranges following Martin (1995). The market surveys were repeated after six months during the months of March 2009, July 2009 and March 2010 for two years in three major markets of Muko, Kisoro and Butogota to assess seasonality of the forest products.

5.7.5 Data analysis

5.7.5.1 Village interviews

Data from the village and resource user interviews and market surveys were analyzed using a computer program **Systat version 10.2** (SYSTAT software Inc., 2002). A Chi-square goodness of fit test was used to test for differences in the perceptions of local people on the MUP, differences in annual incomes of resource users and differences in the number of products sold in five major markets for the different study seasons. The Chi-square goodness-of-fit test is appropriate and was used to test whether differences existed between the observed and the expected (Siegel & Castellan, 1988).

5.8 Results

5.8.1 Source of income for local people

Most interviewed households around Bwindi depended on the sale of both agricultural products (food stuffs and cash crops) and forest products for their daily income (Table 5.1). None of the

households depended exclusively on the sale of either forest or agricultural products alone. Household heads that were employed did not depend on sale of agriculture or forest produce. Generally, few household heads were employed (self or by others) except those from Southernward (35%), Buremba (27%), Bujengwe (19%) and Kitojo (16%) parishes. The Southernward parish is located near Kanungu town and some of the household heads were employed as either shop attendants, owned kiosks or were casual laborers. In Buremba and Bujengwe parishes some of the household heads worked in a nearby tea factory of Kayonza, owned kiosks or worked as casual laborers on tea plantations. In Kitojo parish some of the household heads were employed as field assistants, rangers and porters at the Institute of Tropical Forest Conservation and Uganda Wildlife Authority. Over 65% of all household heads around Bwindi had no formal or informal employments but depended on the sale of agricultural and forest products for their livelihoods (Table 5.1). The highest number of household heads that depended on sale of agricultural and forest products were from Mushanje and Kashasha parishes (95% and 93% respectively) while the least were from Southernward parish (65%).

Table 5.1 Primary source of income for local people around Bwindi

		Employed (formal /informal)		Sells both agricultural & forest produce		Sells forest products only		Sells agricultural produce only		Total households
		#	%	#	%	#	%	#	%	
Non-MUZs	Bujengwe	13	19	56	81	0	0	0	0	69
	Mushanje	2	5	37	95	0	0	0	0	39
Beekeeping	Kashasha	5	7	64	93	0	0	0	0	69
	Kitojo	8	16	42	84	0	0	0	0	50
Plant use	Rutugunda	7	15	39	85	0	0	0	0	46
	Buremba	12	27	32	73	0	0	0	0	44
	Karangara	7	16	37	84	0	0	0	0	44
	Southernward	8	35	15	65	0	0	0	0	23
Total households interviewed										384

5.8.2 Attitudes of local people on benefits of the Multiple Use Programme

Respondents from the three categories of parishes (non-multiple use, beekeeping and plant harvest parishes) differed in attitudes of the benefits from the MUP (Goodness of fit, $\chi^2 = 272$, df 6, $P < 0.05$). Respondents from the MUP parishes said that they benefited by being able to purchase forest products cheaply from specialist, are able sell forest products for income and access plants for medicinal and basketry use (Table 5.2). Households involved in beekeeping and plant use activities generally appreciated the programme than those not involved. For example, 98% and 97% of households from beekeeping parishes of Kitojo and Kashasha reported that they got benefits from the MUP through sale of honey compared to only 13% and 25% from Bujengwe and Mushanje respectively (non-multiple use zone parishes) as table 2 shows. Households from beekeeping zone parishes appreciated the MUP benefits the most followed by those from the plant harvest parishes (Table 5.2). In the beekeeping zones income is obtained through selling honey while the consumers of honey also purchase it cheaply from beekeepers.

Table 5.2: Local people's attitudes about the benefits of the multiple use programme

Category	Parish	Reported benefits of the multiple use programme								Total
		Buys products cheaply		Source of income		Total benefit		No benefits		
		Number	%	number	%	number	%	number	%	
Non-MUZ	Bujengwe	9	13	0	0	9	**13**	60	**87**	69
	Mushanje	10	26	0	0	10	**25**	29	**75**	39
Beekeeping	Kashasha	29	42	38	55	67	**97**	2	**3**	69
	Kitojo	22	44	27	54	49	**98**	1	**2**	50
Plant use	Rutugunda	23	50	20	43	43	**93**	3	**7**	46
	Buremba	20	46	12	28	32	**73**	3	**7**	44
	Karangara	25	56	12	35	37	**85**	2	**5**	44
	Southernward	13	56	8	35	21	**91**	2	**9**	23
				Total						384

5.8.3 Annual income of resource users from the sale of forest products

Annual incomes obtained by resource users from the sale of forest products significantly differed between the three categories of parishes (Goodness of fit, χ^2 = 94,598, df 6, P< 0.05). Resources users in the beekeeping zone parishes generally earned the highest with a mean annual income of 298,000ushs (114USD) for each beekeeper. The makers of small baskets from *Marantochloa spp* followed with a mean annual income of 39, 150ushs (15USD) per basket maker from the plant harvest zones. Resource users from the non-multiple use zones earned the least (Table 5.3). The major income generating activities in the MUP therefore were from sell of honey and *Marantochloa spp* small baskets while the sale of *Triumfetta brachyceras* K.Schum. winnowing trays in the non-multiple use zones were the least. Income from medicinal plants could not be determined in monetary terms because payment was in form of gifts or presents locally called obuterakishaka (Table 5.3). The local people in need of the medicines usually paid resource users

for the efforts used in searching for the medicinal herbs using other forms of payment such as local brew, food stuffs or household items.

Table 5.3: Annual income generated from the sale of forest products by resource users in Bwindi

Parish/number of resource user interviewed	Forest resource (or equivalent from village farms) used	Products made	Average number of products made per resource user/year (±SD)	Reported price per item (ushs)	Mean annual income per product made (ushs)
Buremba (30 resource users)	*Smilax anceps, Dracaena laxissima, Monanthothaxis littoralis*	Winnowing trays	11.8±7.6	2500/=	29,500/=
	Smilax anceps	Big baskets	9.4±3.4	3000/=	28,200/=
	Marantochloa manii	Small baskets	8.7±2.3	4500/=	39,150/=
	Marantochloa purpurea	Small baskets	4.8±2.5	4500/=	21,600/=
	Raphia farinifera	Small baskets	5.8±0.4	3500/=	20,300/=
	Rytigynia kigeziensis	Handfuls of bark	2.2±0	Gift	NA
	Ocotea usambarensis	Handfuls of bark	1.8±0	Gift	NA
	Piper guineense	Handfuls of root	1.9±0	Gift	NA
Kashasha (40 beekeepers)	Beekeeping	Kilograms of honey	59.6±23	5000/=	298,000/=
Bujengwe (34 resource users)	Banana fibres	Small baskets	6.3±4.9	1500/=	9,450/=
	Plantago palmate	Small baskets	7.1±3.1	2000/=	14,200/=
	Triumfetta macrophylla	Winnowing trays	2±0	1500/=	3,000/=
	Eleusine indica	Small baskets	7.1±3.1	2000/=	14,200/=

NA= Not applicable, Resource users from non-MUZs parishes got resources from village farms or woodlots

5.8.3 Forest products sold in local markets and origin of raw materials

The major forest products sold in the local markets around Bwindi were; big and small baskets (plate 1), tea harvest baskets, winnowing trays and hoe handles (Table 5.4). The highest numbers of forest products found sold in the local markets were small baskets (made out of *Marantochloa manii*, (Benth.) Milne-Redh., *M. purpurea* (Ridl.) Milne-Redh.and *Raphia farinifera* (Gaertn.) Hyl.) in Butogota market (678 baskets) and *Smilax anceps* Willd winnowing trays in Kisoro market (427 baskets). Others were *Arundinaria alpina* (K.Schum.) C.S.Chao & Renvoize big baskets in Karukara and Muko markets (392 and 223 baskets respectively). The least number of forest products sold were *Loeseneriella apocynoides* (Welw. ex Oliv.) N.Hallé ex J.Raynal tea harvest baskets in Butogota market (Table 5.4). The most commonly used forest plants were; *S. anceps*, *Dracaena laxissima* Engl., *Phoenix reclinata* Jacq., *A. alpina*, *Monanthotaxis littoralis* (Bagsh. & Baker f.) Verdc., *Marantochloa manii*, *M. purpurea*, *R. farinifera* and *L. apocynoiedes*. Tree species such as *Albizia grandibracteata* Taub. and *Markhamia lutea* (Benth.) K.Schum., were also commonly used (Table 5.4 & Plate 5.1). According to the forest product vendors, the origin of plants used for the products were mainly from Bwindi and Echuya forest and also included those from village woodlots outside Bwindi. Some plants such as *S. anceps*, *D. laxissima*, *M. littoralis*, *Marantochoa manii*, *M. purpurea* and *L. apocynoiedes* were exclusively derived from Bwindi while bamboo was mainly obtained from Echuya forest. Other plants such as *P. reclinata, A. grandibracteata* and *M. lutea* were mainly extracted from village woodlots as table 5.4 shows.

Table 5.4: Forest products sold in local markets around Bwindi and origin of raw materials used

Market name	Forest products sold	Raw materials used	Reported origin of raw materials	Number of vendors	Number of products
Kihihi	Big baskets	*Smilax anceps, Dracaena laxissima, Monanthothaxis littoralis,*(mixed)	Bwindi forest	1	14
	Big baskets	Bamboo, *Triumfetta macrophylla,*(mixed)	Echuya forest	1	37
	Winnowing trays	*Smilax anceps, Dracaena laxissima, Monanthothaxis littoralis,*(mixed)	Bwindi forest	1	16
	Hoe handles	*Albizia grandibracteata, Markhamia lutea,*(mixed)	Village woodlots	1	23
Kisoro	Big baskets	Bamboo, *Triumfetta macrophylla,*(mixed)	Echuya forest	6	185
	Winnowing trays	*Smilax anceps, Dracaena laxissima, Monanthothaxis littoralis,*(mixed)	Village woodlots	10	427
Butogota	Small Baskets	*Marantochloa manii, Plantago palmata, Marantochloa purpurea,*(mixed)	Bwindi forest	10	678
	Big baskets	*Smilax anceps*	Bwindi forest	2	20
	Tea harvest baskets	*Phoenix reclinata*	Village woodlots	1	68
	Tea harvest baskets	*Loeseneriella apocynoides*	Bwindi forest	1	2
	Trays	*Smilax anceps, Dracaena laxissima, Monanthothaxis littoralis,*(mixed)	Bwindi forest	3	21
	Chicken trap basket	*Phoenix reclinata*	Village woodlots	1	2
Karukara	Big baskets	Bamboo, *Triumfetta macrophylla,*(mixed)	Echuya forest	6	223
	Winnowing trays	Bamboo, *Triumfetta macrophylla,*(mixed)	Echuya forest	2	9
	Hoe handles	*Markhamia lutea*	Village woodlots	5	203
Muko	Winnowing trays	*Smilax anceps, Dracaena laxissima, Monanthothaxis littoralis,*(mixed)	Bwindi forest	3	52
	Big baskets	Bamboo, *Triumfetta macrophylla,*(mixed)	Echuya forest	10	392

Plate 1: A big and small basket being sold in a local market around Bwindi

5.8.4 Types of vendors of forest product in local markets

The number of vendors of forest products varied from market to market and depended on the types of products sold. The highest number of vendors encountered was 10 and these sold winnowing trays in Kisoro market, small baskets in Butogota and big baskets in Muko markets (Table 5.4). Only one vendor was encountered in Kihihi and Butogota markets selling big baskets, hoe handles, tea harvest baskets and chicken trap houses.

Two types of vendors in local markets around Bwindi were encountered; the forest resource user vendors (who make and sell the products themselves) and “middle men/women” vendors (who buy and resale the products). The former constituted the highest percentage of forest products

vendors in all the local markets and over different seasons (over 57%) as table 5 shows. Also the number of forest product vendors varied over the different seasons (Table 5.5). The highest number of forest resource user vendors was encountered in March 2009 (69%), dropping slightly to 57% in July 2009 and the lowest in March 2010. This trend was the same for the "middle men/women" vendors who were more in March 2009 and less in March 2010.

Table 5.5: Types and number of forest product vendors in local markets around Bwindi

Vendor type	Number of vendors					
	March 09		July 09		March 10	
	Number	%	Number	%	Number	%
"Middle men/women"	22	31%	21	43%	16	41%
Resource users	48	69%	28	57%	23	59%

Plate 5.1 Forest products being sold in Kihihi market (*S. anceps* winnowing trays and *A. grandibracteata* and *M. lutea* hoe handles)

5.8.5 Seasonality of forest products sold in local markets

The number forest products sold in major markets around Bwindi were significantly different between the different market survey seasons (Goodness of fit, χ^2 = 36, df, 10, P value < 0.05 for Butogota market, χ^2 = 934.6, df 10, P value < 0.05 for Kisoro market and χ^2 = 117.7, df 10, P value < 0.05 for Muko market). Each market had different forest products sold but winnowing trays and big baskets were common to all the markets (Table 5.6). The Butogota market had the highest number of different types of forest products compared to the rest. The highest number of forest products was sold in July (a dry season) in all the markets followed by March 2009 and March 2010 the least.

Table 5.6: Seasonality and numbers of forest products sold in local markets around Bwindi

Forest products	Markets/seasons								
	Butogota			Kisoro			Muko		
	March 2009	July 2009	March 2010	March 2009	July 2009	March 2010	March 2009	July 2009	March 2010
Big baskets	20	185	0	185	75	17	392	394	174
Winnowing trays	40	427	12	427	969	98	0	16	6
Small baskets	8	44	0	44	33	27	0	0	0
Tea baskets	68	77	39	0	0	0	0	0	0
Hoe handles	15	20	0	0	0	0	0	0	0
Serving spoons	0	10	0	0	0	0	0	0	0
Total forest products	151	763	51	656	1,077	142	392	410	180

5.9 Discussion

5.9.1 Source of income and income diversification for local people

In a rural economy such as the tropics, poor households tend to rely on forest resources as sources of income and safety net (Babulo *et al*., 2008; Pattanayak & Sills, 2001; Arnold & Perez, 2001; FAO, 2006; Timko *et al.*, 2010; Ghazoul & Sheil, 2010; Debela *et al*., 2012). This is the reason why over 65% of households around Bwindi depended on sell of both agricultural and forest produce for a living. Debela *et al* (2012) reported similar results showing that over 65% of rural households in Uganda depended on forest resources for a living. While most of them grow crops and raise animals, they to a large extent still depend on wild forest resources (Kaimowitz & Sheil, 2007; Debela *et al*., 2012). Pattanayak & Sills, (2001) have observed that forest foraging is positively correlated with both agricultural shocks and expected agricultural risks. Indeed, Illukptiya & Yanagida (2008) and Debela *et al* (2012) observed that rural households tend to diversify their source of income as a strategy of insuring themselves against catastrophes

such as droughts, floods and famines and to help them maintain a sustainable livelihood. Most households around Bwindi therefore diversified their incomes through the sale of agricultural and forest products as well as having formal and informal employments. Although this study did not assess total household income of local people around Bwindi, it is apparent that local people around Bwindi depend on both agricultural and forest produce sale among others. Future studies are recommended to determine the contribution of forest products to total household income.

Another survival strategy used by the local people around Bwindi is the collection of wild yams such as *Dioscorea praehensilis* and wild fruits such as *Myrianthus holstii* from the forest during famines when they experience prolonged droughts and floods as reported by Cunningham (1996). Bwindi forest provides some form of insurance to the rural poor people in cases of catastrophes that result in famines (Cunningham, 1996; Arnold & Perez, 2001; Pattanayak & Sills, 2001; Ghazoul & Sheil, 2010). Babulo *et al* (2008) and Debela *et al* (2012) reported that many rural households use forests as a safety net since the forests are the most available alternatives to them and are limited by other alternatives for survival. Forest foraging is the most available alternative to most rural poor people in the tropics even when they do not entirely depend on forests for their livelihoods as the results show. Local people around Bwindi have ranked farming and tea planting as the most source of income followed by access to forest resources for timber, craft materials and honey (Christensen, 2009).

5.9.2 Attitudes of local people on protected area benefits

Attitudes of local people towards the conservation of protected areas (PAs) are influenced by perceived economic benefits from them and the social costs they incur from being PA neighbors (Naughton-Treves, 1997; Sekhar, 1998; Yuan *et al.,* 2003; Baker, 2004; Woodroffe *et al.,* 2005;

Balint, 2006; Adams & Hutton, 2007; Balikoowa, 2008; Garcia and Lescuyer, 2008; Christensen, 2009; Blomley *et al.,* 2010; MacKenzie, 2012). The willingness of local people to appreciate and cooperate with park management is thus dependent on the level of benefits derived from it and the economic contribution the park makes towards their livelihoods (Barrow & Murphree 2001; Balikoowa, 2008; MacKenzie, 2012). Local people adjacent PAs are the ones who suffer costs from displacements, hazards from crop raiding animals, labor and opportunity costs of crop defense and physical hazards and death from the animals and are therefore likely to have negative attitudes towards the PAs (Naughton-Treves, 1997; Sekhar, 1998; Woodroffe *et al.,* 2005, Adams & Hutton, 2007; Balikoowa, 2008; MacKenzie, 2012 see also chapter 1).

Bwindi's MUP benefits in tandem with other park benefits such as tourism, revenue sharing and employment should be seen by the local people to at least partially off-set the costs suffered by them if they are to have positive attitudes towards the park (Balikoowa, 2008; Blomley *et al.,* 2010; MacKenzie, 2012). As such, parishes around Bwindi that are involved in the MUP and also have tourism and revenue sharing programs are most likely to have the most positive attitudes. Indeed as this study shows, local people from the MUP parishes were more appreciative of the PA economic benefits than those not involved. These parishes are also involved in tourism and revenue sharing park programs around Bwindi (Balikoowa, 2008). The MUP will therefore impact positively on local people's attitudes when they get direct benefits and other park management benefits.

According to Baker, (2004) and Blomley *et al.,* (2010), the MUP is one of the strongest factors that have improved local people's attitudes towards Bwindi park management. Despite the costs

suffered from crop-raiding animals, local people involved in the MUP value the importance of conserving Bwindi forest more than those not involved. They see the MUP together with other development programmes as providing tradeoffs for the costs suffered from crop-raiding animals as observed by Baker, (2004) and Blomley *et al.,* (2010).

5.9.3 The Multiple Use Programme and poverty alleviation

In achieving the aims of the convention on biological diversity and the millennium development goals, there is an explicit connection between conservation and poverty alleviation (Newton, 2007; Turner *et al.,* 2012). Although this link is not sometimes clearly synergized as stated by Brandon (1998); Adams & Hutton (2007) and Agrawal & Redford, (2009), rural economies can be boosted through use of forest resources in a sustainable manner (Vedeld *et al.,* 2004; Newton, 2007; Kaimowitz & Sheil, 2007; Turner *et al.,* 2012). Vedeld *et al* (2004) estimated that an average household in Southern Africa and Asia earned about 678usds per year which represented an average of 22% of total household forest income, but these average incomes could be raised to 57% if maximized through marketing and resource mobilizations (Turner *et al.,* 2012). This is a substantial amount that can help improve rural household incomes in developing countries such as Uganda.

In agreement with this study, Blomley *et al.* (2010) noted that beekeeping for honey in Bwindi offers a better monetary value for the local people than the other forest resource use activities. However, annual incomes of local people around Bwindi are quite low when compared to rural households' incomes elsewhere (Vedeld *et al.,* 2004). The average annual income from the sale of honey per household in Bwindi was just 114USD.These incomes are low and well below the United Nations Millennium Development Goal (MDG) of poverty eradication/reduction (FAO,

2006). Annual incomes from the beekeeping activity in Bwindi can be increased if colony multiplication and use of modern beehives are adopted (Bogale, 2009; Berhane, 2010). Presently the Bwindi beekeepers use traditional beehives (tree logs) that are not efficient at maximizing honey production by the bees.

Benefits from the extraction of non-timber forest products are influenced by the governing institutions that restrict or enable their access (Timko *et al.,* 2010). This is the case in Bwindi as well. Harvesting plant for basketry is restricted to twice a year and offtakes have been limited by the Uganda Wildlife Authority (UWA). This leads to lesser income for the local people around Bwindi when compared to others elsewhere. The MUP needs to be strengthened and synergized with other park management programs (tourism development, revenue sharing, community and agriculture development projects) in order to attain the goal of poverty alleviation/reduction for the rural poor people (Baker, 2004; Christensen, 2009; Blomley *et al.,* 2010).

Like elsewhere in Indonesia as reported by Wollenberg & Ingles, (1998), in Bwindi, the medicinal plants uses generate income-in-kind from administering medicinal plants to other local people. The traditional herbalists in are highly respected and socially occupy a high status in the local community administrative structures which is a motivation for their participation the MUP (Christensen, 2009).

5.9.4 Potential for commercialization of forest products in Bwindi

Commercialization of forest resources can exacerbate rather than reduce the pressures that cause their overexploitation. Commercialization of forest resources does not necessarily provide

opportunities for development of the rural poor people adjacent protected areas (Arnold & Perez, 2001; Newton, 2007). Forest resource users are often people with low income, few market skills and lack the technology to extract forest resources for commercial use. Forest products sold in the markets around Bwindi vary in number, types and seasons and this is an indication of the level of demand or availability and therefore potential to be commercialized. According to Martin (1995) and Cunningham (2001), if the demand for forest products is high, then the resource users will take advantage of the demand to maximize their incomes through availing more forest products (as long as supply of raw materials is guaranteed) in the local markets. Therefore more forest products will be available in most markets and market seasons. This study has shown that apart from the big baskets made out of bamboo (*A. alpina*), other forest products were uncommon in all the markets and seasons implying a low level of demand and therefore less potential for commercialization.

Forest product vendors were generally few (ranging from 1 to 10 per product) and resource user vendors were more common than the "middle men/women" vendors. This is also an indication of the low level potential for commercialization of the Bwindi forest resources. There would have been many more "middle men/women" vendors than the forest resource user vendors in the trade if forest products around Bwindi had a high potential for commercialization (Martin, 1995; Cunningham, 2001). Large quantities of forest products sold in local markets and being transported to neighboring big towns provides further evidences of commercialization of forest products as noted by Cunningham (2001). This situation was not observed in Bwindi and in nearby towns around Bwindi. The only forest product seen being transported in large quantities

were the *A. alpina* big baskets. The bamboo is under threat from commercialization and the raw materials come from Echuya forest reserve as observed by Bitariho & McNeilage (2007).

From the results therefore, forest products sold in local markets around Bwindi are at a subsistence level and provide only alternative sources of income to the immediate forest resource users. Arnold & Perez, (2001) recommended the diversification of income generating activities and use of alternative forest products that are not under threat of overexploitation. Some of the forest resources that are not yet under threat of exploitation in Bwindi include; *S. anceps, D. laxissima* and *P. reclinata* (used for making baskets and winnowing trays). These are vigorous sprouting plants that respond positively after harvesting (Cunningham, 1996) and could be promoted further as alternatives to those likely to be commercialized such as *L. apocynoides* and *Marantochloa manii* as reported in chapter 6.

5.9.5 Influence of seasons on forest products sold in local markets

The reliance on non-timber forest products in general vary depending on the season and accompanying household needs (Martin, 1995; Cunningham, 2001; Timko *et al.*, 2010). Some forest products are seasonal in the local markets because the crops or forest materials can only be gathered at certain times of the year (Timko *et al.*, 2010). The most common forest products sold in local markets near Bwindi were big baskets, tea harvest baskets, small baskets (endiiro), winnowing trays and hoe handles. These were the same products common amongst the forest resource users. Most forest products sold in local markets were abundant in the month of July because forest resource harvest in Bwindi is restricted to that month. The month of July is also a harvest season for most crops such as maize, millet sorghum and beans which likely increases on the demand of winnowing trays and baskets during that month.

5.10 Conclusions

Income diversification is one strategy the rural poor people living around Bwindi have adapted as a safety net to overcome agricultural productivity shocks and others to guarantee their livelihoods. Such diversifications include use of forest resources as an alternative source of income and where possible seeking employment from Bwindi park. The MUP, one of Bwindi's park management programmes contributes a small but important income to the local people. Beekeeping for honey collection is the most lucrative of the MUP activities for the local people around Bwindi.

The MUP has helped improve attitudes of local people towards the park with the few benefits they get from it. However the local people attitudes could improve further if the MUP benefits were increased as seen from the positive atttiutdes of the local people involved in the MUP compared with those not involved. Nevertheless, with its restrictions, the MUP alone cannot alleviate poverty among the local people nor compensate for costs incurred from the crop raiding animals around Bwindi. Perhaps to achieve this, park management needs to reconsider some of the restrictions imposed on the MUP and also synergize the MUP with other park management programs such as tourism development and revenue sharing.

Because of restrictions of the MUP, sale of forest products in the markets around Bwindi is still at a subsistence level since primary forest user vendors were more than the middle men vendors. However potential for commercialization of some of the forest resources exists such as those made from *Loeseneriella apocynoides*. Furthermore, combining the MUP activities of both beekeeping and plant harvests rather than only one offers a better opportunity for poverty

alleviation among the rural poor people. The MUP is an important component of the Integrated Conservation and Development Programs (ICDP) strategy that can help contribute to rural income and livelihoods if strengthened and synergized. Therefore in aiming to achieve the MDG target of eradication of poverty and environmental sustainability, government through park management and other partners needs to strengthen and synergize the ICDP strategies.

5.11 Recommendations

In order to amplify the local benefits of the MUP, some parishes such as Bujengwe, Mushanje, Rubuguri and Rubimbwa that do not currently benefit from the programme need to be included. This will help reduce the costs associated with crop raiding and therefore induce more positive attitudes of the local people around Bwindi. Care should be taken however not to put pressure on the Bwindi forest by first assessing if such areas can sustainably supply the needed plant resources to the local people.

It may be more fruitful to help the rural local people around Bwindi move into other more rewarding fields of endeavor such as livestock rearing, poultry and farming (decoupling) than seeking to raise forest resource productivity for increased income (Arnold & Perez, 2001). Therefore income generating activities such as poultry, piggery and fruit growing already carried out by the development organizations around Bwindi should be continued but the target should be the poorest in the local communities. Such activities together with the MUP will help towards poverty alleviation among the rural poor people around Bwindi. The Developmental organizations such as CARE and Bwindi Mgahinga Conservation Trust's (BMCT) priorities should be focused on such projects important for individual household livelihoods and income.

The individual targeted projects will more likely help in poverty reduction than the common good projects.

Beekeeping for honey should be encouraged in all the MUP parishes since it provides the highest income to the local people and has less stress on the forest. Impacts associated with fires from beekeeping can be reduced by enforcing the use of fire smokers rather than 'live fires' for honey collection. In order to maximise the socio-economic benefits from the MUP, then the beekeeping activity should be combined with the plant harvest activity. This is already the practice in the south-eastern part of Bwindi.

There is a need of development organizations operating around Bwindi to help the Bwindi beekeepers to maximize honey production through provision of modern beehives and access to technologies of colony multiplication and therefore increase on their annual incomes. Also a need to add value to some of the forest products being sold in the local markets is needed in order to improve on the products marketability. Such value additions could be in forms of branding baskets sold to tourists and other local markets. The developmental organizations such as CARE and BMCT could help acquire specialists in forest products branding to train the resource users around Bwindi in branding their products.

There is a need to strengthen and consolidate other ICDP strategies such as tourism development, revenue sharing, community projects and agricultural development together with the MUP in order to help the rural local people reduce and eradicate poverty. Such programmes should be refocused to also benefit the poorest people living around Bwindi. For example the

gorilla levy and revenue sharing money should be channeled to benefit the rural local people that incur the costs of being neighbors to Bwindi. Such monies could be used for problem animal/human wildlife conflict management and resolution instead of building schools and hospitals; that are responsibilities of the government.

References

Adams, W.M & Hutton, J., 2007. People, Parks and Poverty: Political Ecology and Biodiversity Conservation. *Conservation Society* 5:147-183.

Agrawal, A & Redford, K., 2009. Conservation and Displacement: An Overview, *Conservation Society* 7 (1): 1-10.

Arnold, J.E.M, & Perez, R.M., 2001. Can non-timber forest products match tropical forest conservation and development objectives (analysis), *Ecological economics* 39; 437- 447.

Babulo, B, Muys, B, Nega, F, Tollens, E, Nyssen, J, Deckers, J, Mathijs, E, 2008. Household Livelihood strategies and forest dependence in the highlands of Tigray, Northern Ethiopia, *Agricultural Systems* 98: 147-155.

Baker, J., 2004. Evaluating Conservation Policy: Integrated Conservation and Development in Bwindi Impenetrable National Park, Uganda. A Phd thesis to the Durrell Institute of Conservation and Ecology, University of Kent, Canterbury.

Balikoowa, K., 2008. Impacts of Bwindi Impenetrable National Park on local people's livelihoods, Unpublished MSc thesis, Department of International Environment and Development Studies, Norwegian University of Life Sciences (UMB), Oslo

Balint, P., 2006. Improving community-based conservation near protected Areas: the importance Of development variables. *Environmental Management* 38:137-148.

Barrow, E & Murphree, M., 2001.'Community conservation. From concept to practice' In D.Hulme and M. Murphree, eds., *African Wildlife and Livelihoods. The promise and Performance of community conservation*, James Currey, Oxford.

Berhane, M.G, 2010. Socio-Economic Analysis of Market Oriented Beekeeping in Atsbi Wemberta District of Eastern Zone, Tigray Region, Unpublished MA Thesis, Department of Management College of Business and Economics, Mekelle University, Mekelle, Ethiopia

Bogale, S., 2009. Indigenous knowledge and its relevance for sustainable beekeeping development: a case study in the Highlands of Southeast Ethiopia. *Livestock Research for Rural Development* 21 (11): 184-197.

Bitariho, R & Mcneilage A, 2007. Population structure of montane bamboo and causes of its decline in Echuya Central Forest Reserve, South West Uganda, *African Journal of Ecology* 46: 325-332.

Blomley, T., Namara, A., McNeilage, A., Franks, P., Rainer, H., Donaldson, A., Malpas, R., Olupot, W., Baker, J., Sandbrook, C., Bitariho, R. and Infield, M., 2010 Development and gorillas? Assessing fifteen years of integrated conservation and development in south-western Uganda, Natural Resource Issues No. 23. IIED, London

Brandon, K., 1998. Perils to Parks: The social context of threats. In: Parks in Peril: People, Politics and Protected Areas (eds. Brandon, K, Redford, K.H & Sanderson), pages 415-439. Island Press, for Nature Conservancy, Washington D.C.

Christensen, T., 2009. An assessment of the benefits of the multiple use programme of Bwindi Impenetrable National Park. Msc thesis report for the University of Aarhus, Aarhus.

Cunningham, A.B., 1996. People, Park and Plant Use, Recommendations for multiple use zones and development alternatives around Bwindi Impenetrable National Park, Uganda. A report for people and plants initiative, division of ecological sciences, UNESCO, 7 place de fontenoy, Paris.

Cunningham, A.B., 2001. Applied Ethnobotany, People, Wild Plant Use and Conservation, WWF, Earthscan Publications Ltd, London.

Debela, B, Shively, G, Angelsen, A & Wik, M., 2012. Economic Shocks, Diversification, and Forest Use in Uganda, *Land Economics* 88 (1): 139–154.

Ellis, F., 2000. Rural Livelihoods and Diversity in Developing Countries. Oxford University Press, Oxford.

Eilu, G, & Bukenya, Z., 2004. Local use of climbing plants of Budongo Forest Reserve, western Uganda. *Journal of Ethnobiology* (24): 2

Eilu, G, Oriekot, J & Tushabe, H., 2007. Conservation of indigenous plants outside protected areas in Tororo District, eastern, Uganda. *Journal of African Ecology* 45 (Suppl. 3): 73–78

FAO., 2006. Better forestry, less poverty, a practitioner's guide. Food and Agriculture Organization of the United Nations, FAO forestry paper 149, Rome.

Freese, C.H., 1997. Harvesting Wild Species, Implications for Biodiversity Conservation. The Johns Hopkins University Press, 2715 North Charles street, Baltimore, Maryland.

Garcia, CA and Lescuyer, G., 2008. Monitoring, indicators and community based forest management in the tropics: pretexts orred herrings?. *Biodiversity Conservation* (17): 1303-1317

Ghazoul, J & Sheil, D, 2010. Tropical rain forest ecology, diversity, and conservation. Oxford University Press, Great Clarendon Street, Oxford.

Illukptiya, P., & Yanagida, J.F., 2008. Role of income diversification in protecting natural forests: Evidence from rural households in forest margins of Sri Lanka. *Agroforestry Systems* (74):51-62.

Kaimowitz, D & Sheil, D., 2007. Conserving What and for Whom? Why Conservation Should Help Meet Basic Human Needs in the Tropics, *Biotropica* 39(5): 567–574.

MacKenzie, C.A., 2012. Trenches like fences make good neighbours: Revenue sharing around Kibale National Park, Uganda. *Journal for Nature Conservation,* 20(2):92-100

Martin, G.J., 1995. Ethnobotany: A Methods Manual. Chapman and Hall, London.

Naughton-Treves, L.,Holland, M.B., & Brandon, K., 2005. The Role of Protected Areas in Conserving Biodiversity and Sustaining Local Livelihoods. *Annual Review of Environmental Resources* 30: 219-252.

Ndangalasi, H, Bitariho R, Dovie D. 2007. Harvesting of non-timber forest products and implications for conservation in two montane forests of East Africa, *Biological Conservation*, 134 (2), 242-250.

Ndangalasi, H., 2004. Implications of utilization of non-timber forest products in mountain ecosystems; a case study of Uzungwa scarp and Njerera forest reserves, Tanzania. Unpublished Phd thesis, University of Dar es Salaam, Dar es Salaam.

Newton, A.C., 2007.Conservation of Tree Species through Sustainable Use: How Can it be Achieved in Practice? *Oryx*, 42 (2) 195-205.

NRM manifesto, 2006. National Resistance Movement Organization manifesto for 2006 campaigns, Kampala.

Pattanayak, S.K & Sills E.N., 2001. Do tropical forests provide natural insurance? The microeconomics of non-timber forest product collection in the Brazilian Amazon. *Land Economics,* 77 (4):595-612.

Peters, C.M, 1994. Sustainable Harvest of Non - Timber Plant Resources in Tropical Moist Forest: An Ecological Primer. USAID Biodiversity Support Programme, Washington D.C.

Sachs, J.D., Baillie, J.E.M., Sutherland, W.J., Armsworth, P.R.,Ash, N., Beddington, J, Blackburn, J.T.M., Collen, B., Gardinner, B., Gaston, K.J., Charles, H., Godfray, J., Green, R.E., Harvey, P.H., House, B., Knapp, S., Kumpel, N.F., Macdonald, D.W., Mace, G.M., Mallet, J.,Mathews, A., May, R.M., Petchey, O., Purvis, A., Roe, D., Safi, K., Turner, K., Walpole, M. Watson, R., and Jones, K.E., 2009. Biodiversity Conservation and the Millennium Development Goals. *Science* 325:1502-1503.

Sekhar, N.U., 1998. Crop and Livestock depredation caused by wild animals in Protected Area: The case of Sariska Tiger Reserve, Rajasthan, India. *Environmental Conservation* 25: 160-171.

Siegel, S & Castellan, J.N., 1988. Nonparametric Statistics for Behavioral Sceinces (2nd edition). McGraw-Hill Book Company, Newyork.

Ticktin, T., 2004. The ecological implications of harvesting non-timber forest products. *Journal of Applied Ecology*, 41: 11-21.

Timko, J.A., Waeber, P.O., & Kozak, R.A., 2010. The Socio-Economic Contribution of Non-Timber Forest Products to Rural Livelihoods in Sub-Saharan Africa: Knowledge gaps and new directions. *International Forestry Review*, 12 (3): 284-294.

Turner, W.T., Brandon, K., Brooks, T.M., Gascon, C, Gibbs, H.K., Lawrence, K.S., Mittermeier,

R.A & Selig, E.R., 2012. Global Biodiversity Conservation and the Alleviation of Poverty. *Bioscience* 62: 85-92.

Tuxill,J and Nabhan, G.P. 1998. Plants and protected areas. A guide to In Situ management. WWF, Stanley Thornes publications, Ellenborough house, Wellington street, Cheltenham.

Vedeld, P., .Angelsen, A., Sjaastad, E., & Kobugabe, G. B., G., 2004. Counting on The Environment, Forest Incomes and the Rural Poor. Environment Economics Series paper 98. World Bank. Washington DC.

[WCED] United Nations World Commission on Environment and Development. 1987. Our Common Future. Oxford University Press.

Wild, R.G., 2001. Plants from the Park: Establishing Community Harvesting of Plants as a Conservation Tool at Bwindi Impenetrable and Mgahinga National Parks, Uganda. Unpublished Master of philosophy thesis Department of Botany, University of Capetown, Capetown.

WPC, 2003. World Parks Congress recommendations. Report for the Vth IUCN World Parks Congress, Durban.

Wollenberg, E & Ingles, A., (1998) ed. Incomes from the forest; Methods for the development And conservation of forest products for local communities. Center for International Forestry Research, Bogor.

World Bank**.,** 2001. A revised forest strategy for the World Bank Group. Draft. Washington, DC.

Woodroffe, R., Thirgood, S., & Rabinowitz (eds)., 2005. People and Wildlife: Conflict or Coexistence? Cambridge University Press, Cambridge.

Yuan W, James P, Hodgson K, Hutchinson SM, Shi C., 2003. Development of Sustainability indicators by communities in China: a case study if Chongming County, Shanghai. *Journal of Environmental management* 68:253-261.

Chapter six

6. Ecological Implications of Harvesting Plant Resources from Bwindi Impenetrable National Park

6.1 Important plants from tropical forests

Tropical forests have many useful plants that have been exploited by humans for thousands of years (Peters, 1994; Ticktin, 2004; Ndangalasi *et al*., 2007; Ghazoul & Sheil, 2010). Before Non-Timber Forest Products' (NTFPs) utilization in tropical forests gained prominence, attention to forest conservation was mainly focused on sustainable extraction of timber for commercial purposes. NTFPs were considered a "nuisance" by some foresters as they thought some of them such as lianas and climbers suppressed timber tree production (Scott, 1998). The foresters then were interested in systematically removing the lianas and climbers to help the growth of forest trees for timber (Scott, 1998; Cunningham, 2001; Ticktin, 2004). The need for utilization of NTFPs and contribution to forest ecology was seldom considered important.

Recently during the past two decades, NTFPs such as seeds, flowers, fruits, leaves, roots, bark, latex, resins and others have gained increased attention to tropical forest conservation (Cunningham, 2001;Ticktin, 2004; Riviera & Mayer, 2008). This paradigm shift was caused by the increased roles NTFPs played in the livelihoods of people locally and globally sometimes resulting in commercial trade of the NTFPs. This trade of the NTFPs has resulted in increased volumes of plants being extracted from tropical forests sometimes leading to overexploitation (Cunningham, 2001; Ticktin, 2004; Ghazoul & Sheil, 2010). It is estimated for example that between 4,000 and

6,000 tropical forest plants are traded for income world-wide (Iqbal, 1993, Ticktin, 2004, Riviera & Mayer, 2008; Ghazoul & Sheil, 2010).

The promotion of extraction of NTFPs from protected areas (PAs) is based on the assumption that the PAs must offer incentives to local people and as such help to reduce on threats to the PAs from illegal logging, conversion to farming and cattle grazing (Ticktin, 2004; Newton, 2007; Agrawal & Redford, 2009; Blomley *et al.,* 2010). There is increasing recognition that the local people suffer costs of PA establishment through displacement, crop damage and harm from animals (Woodroffe *et al.,* 2005, Adams & Hutton, 2007, see also chapter 1 and 5). Achieving conservation in the PAs becomes difficult if the local people resent the PAs due to the costs they incur. The local people to fully participate in PA management need meaningful benefits/incentives from them and less PA costs incurred to them (Agrawal & Gibson, 1999; Hutton, *et al*, 2005; Adams & Hutton, 2007; Newton, 2007; Agrawal & Redford, 2009; Blomley *et al.,* 2010). The challenge however is that few economic benefits from trade in NTFPs go directly to the local poor people involved in the NTFP extraction. In most cases, to the local people, PA conservation costs outweigh the benefits (Agrawal & Gibson, 1999; Arnold & Perez, 2001; Newton, 2007; Riviera & Mayer, 2008, see also chapter 5). Most forest resource users in the tropics have low incomes, are not skilled at marketing NTFPs and lack the technology to extract forest resources for trade (Newton, 2007; Riviera & Mayer, 2008). If sustainable extraction of NTFPs is to be achieved, then funds accruing from NTFP trade must trickle down to the rural local people involved and the local people's attitudes towards the PAs must be improved though benefit sharing programs (Newton, 2007; Agrawal & Redford, 2009; Blomley *et al.*, 2010).

6.2 Ecological implications of plant resource harvests

It is often stated that the harvest of NTFPs generally has lesser ecological impacts when compared to timber harvesting (Peters, 1994; Cunningham, 2001; Ghazoul & Sheil, 2010); however, the harvest of some of these NTFPs such as forest plants may alter the plants' biological processes at many levels. The harvest impacts may be manifested in the physiology and vital rates of individual plants; changing the demographic and genetic patterns of harvested plants and altering the plants' community and ecosystem-level processes (Hall & Bawa, 1993; Ticktin, 2004; Ghimire *et al*., 2008). The most direct impact is the alteration of the survival, growth and reproduction rates of harvested individuals. Changes in these vital rates can in turn influence the structure and dynamics of the harvested plant populations (Ticktin, 2004; Ghimire *et al*., 2008). Impacts of plant harvesting at the ecosystem level are complex and difficult to model and study, often requiring time and effort as well as the consideration of large special units (Hall & Bawa, 1993). This is because ecosystems are complex systems that are influenced by many factors that interplay. Indeed most studies have focused on the effect of plant harvesting on individual plants and their populations rather than on ecosystem impacts and this study does not deviate from them considering the time, labor and funds constraints.

Impacts of plant harvests can also be assessed through comparing the survival, growth and reproduction of individual plants subjected to different harvesting intensities and then comparing harvested populations with un-harvested populations (Hall & Bawa, 1993; Ticktin, 2004; Ghimire *et al*., 2008; Sampaio *et al.*, 2008). The ecological sustainability of harvested plants can be assessed through directly measuring the rate of extraction and comparing it with the rate of natural replacement as reported by Godoy & Bawa (1993); Hall & Bawa, (1993) and Peters, (1994).

Natural replacements are assessed by studying regeneration (stem densities), annual biomass production (yields) and mortality rates of the harvested plants. Stem densities have a direct effect on the demand and supply of harvestable plants and are assessed through counting individual plants and comparing them in harvested and un-harvested populations (Hall & Bawa, 1993; Peters, 1994; Peters, 1996; Tuxil & Nabhan, 1998; Cunningham, 2001; Bitariho *et al.,* 2006). Furthermore, biomass production of harvested plants may be affected by the plant nutrients relocations from reproduction to healing the 'wounds' created from harvesting impacts. These are assessed through yield studies and then comparing harvested and un-harvested populations (Haig & Westoby, 1988; Hall & Bawa, 1993; Peters, 1994; Boot & Gullison, 1995; Peters, 1996; Bitariho *et al.,* 2006).

The comparisons of harvested and un-harvested plant populations is not enough to determine plant harvest sustainability as it assumes a static environment which is seldom the case (Boot & Gullison,1995; Pfab & Witkowski, 2000). Studying plant harvest plots for at least 10 years is recommended to satisfactorily determine sustainable harvest of the plants using transition matrix population models (Boot & Gullison, 1995; Pfab & Witkowski, 2000). These models use plant population growth rate (λ) to determine harvest sustainability (Boot & Gullison 1995; Caswell 2001; Freckleton *et al.,* 2003; Zuidema, *et al.,* 2007; Ghimire *et al*., 2008; Binh, 2009). Using plant population growth rate (λ) is conceptually sound, but also has drawbacks as it takes long to study (about 10 years) and is strongly affected by variation in vital rates (growth, survival, and reproduction) and is uncertainty in their estimations (Pfab & Witkowski, 2000; Wisdom *et al.* 2000, Zuidema & Franco 2001; Freckleton *et al.,* 2003). Standard matrix models also assume

that the fate of harvested individuals is independent of their past and that the harvested individuals do not vary with density which is seldom the case (Freckleton *et al.,* 2003).

In the present study, plant stem density, size class distribution and biomass production of the harvested plants are used as the basis for determining plant harvest sustainability because of constraints of time and funds constraints required for using transition matrix models. This study used the definition for sustainable plant harvests as that defined by Struhsaker, (1998) and Pfab & Scholes (2003); that sustainable plant harvest is the extraction of plant resources at levels low enough to ensure long-term survival of the plants so that similar levels of extraction can occur indefinitely.

6.3 Forest use by local people adjacent Bwindi Impenetrable National Park

For centuries, Bwindi Impenetrable National Park (hereafter called Bwindi) has been a source of livelihood for the local people adjacent. The forest was a source of protein from bush meat, fish, and plants for food, basket weaving, medicines and house construction. The forest was also a source of hardwood timber for domestic and commercial purposes.

Before gazettement of Bwindi forest in the colonial times, the major use of the forest was for commercial exploitation of timber. Timber from the Bwindi was commissioned by white missionaries and colonial administrators for building churches, hotels and government buildings (Chapter 2). The driving force that determined forest composition then was pitsawing which commenced during 1914 in the First World War and continued to the Second World War in 1939 (Marchant *et al.,* 2000). There was a marked increase in commercial exploitation of *Podocarpus*

milanjianus tree for timber which was exported to Europe for making gun handles/butts. Bwindi forest was also heavily logged for other timber tree species resulting in over 60% of the forest being heavily disturbed (Howard, 1991; Scott, 1992; Babaasa *et al*, 2004).

After Bwindi was gazetted a national park in 1991, forest use became restricted to NTFPs for medicines and basketry and beekeeping at the park periphery in multiple use zones (MUZs) (see chapter 1, 2 3, 4 & 5). Presently 57 plant species are harvested by the local people around Bwindi for medicinal and basketry use (Wild & Mutebi, 1996; Davey *et al.*, 2001; Bitariho *et al..*, 2006; Ndangalasi *et al.,* 2007). Other forest plants are extracted illegally for building poles, walking sticks and hoe handles (Olupot *et al.,* 2009a, see also chapter 4). These include species such as *Milletia dura* (Dunn) and *Vepris nobilis* (Delile) Mziray (synonymy *Teclea nobilis*) (chapter 4).

6.4 Study objectives

The general objective of the study was to assess impacts of harvesting important plants from Bwindi forest by local people. The specific objectives were to:

i) Assess environmental differences between harvest and non-harvest zones.

ii) Determine and compare stem densities and size class distributions of eleven important plants for local people in harvest and non-harvest zones.

iii) Determine and compare annual biomass production (yield) of three most important forest plants for local people in harvest and non-harvest zones.

iv) Assess the effects of environmental variables (% tree canopy, altitude and % slope) on stem densities of the most important plants for local people.

6.5 Study hypotheses

1. Differences in environmental variables (% tree canopy cover, elevation and % slope) between harvest and non-harvest zones were tested using the null hypothesis **H_o, that there were no significant differences in environmental variables between harvest and non-harvest zones.**

2. Differences in plant stem densities between harvest and non-harvest zones were tested using the null hypothesis **H_o, that there was no significant difference in plant stem densities between harvest and non-harvest zones** (Siegel & Castellan, 1988; Botha *et al*, 2004; Ndangalasi *et al.,* 2007). The assumption made was that plant harvest zones are more disturbed than non-harvest zones. Plant harvest zones are often frequented by harvesters (about 120 people per harvest zone in a year) than non-harvest zones (Ndangalasi *et al.,* 2007; Bwindi Multiple use MoUs).

3. Differences in size class distribution of important forest plants between harvest and non-plant harvest zones were tested using the null hypothesis **H_o, that there was no significant difference in plant size class distributions between harvest and non-harvest zones** (Siegel & Castellan, 1988; Botha *et al.,* 2004; Ndangalasi *et al.,* 2007). The assumptions made here were like those above of stem density distribution.

4. Influence of environmental variables (altitude, slope % and % tree canopy cover) on stem densities of important forest plants were tested using the null hypothesis **H_o, that there were no significant relationships between the environmental variables (altitude, slope percentage**

and tree canopy cover) and plant stem densities. The assumptions made here were like those above of stem density distribution.

5**.** Differences in annual biomass productions (yields) of important forest plants between harvest and non-harvest zones were tested using the null hypothesis **Ho, that there is no significant difference in plants' annual biomass productions (yields) between harvest and non-harvest zones.** The assumptions made here were like those above of stem density distribution

6.6 Study Justification

Presently, one major constraint to managed plant harvesting in a tropical forest is limited knowledge on the plants being harvested and their response to disturbance (Cunningham, 2001; Binh, 2009). Tropical forest plant harvests may affect the density, distribution, biomass production and regeneration potential of the harvested plants (Peters, 1994; Freese, 1997; Cunningham, 2001; Ticktin, 2004). Despite the growing concern of the overexploitation of plant resources world-wide, information on the ecological implications of plant resource harvest is available only in few disparate case studies (Boot & Gullison, 1995; Cunningham, 2001; Ticktin, 2004; Bitariho *et al.*, 2006).There is limited quantitative baseline data on abundance, distribution and biomass production of most harvested plants in Bwindi to serve as a benchmark for setting harvesting quotas and for rigorous monitoring of harvested plants (Feinsinger, 1997; ITFC, 1999; Bitariho *et al.*, 2006). This is a serious drawback to good forest management and any attempt to exploit forest resources in such a scenario has the potential to be plagued by destructive harvesting, over-exploitation and the attendant negative ecological impacts in the forest (Peters, 1996; Cunningham, 2001). If the role of

wild plants in providing a range of basic needs is to be maintained, then resource management for sustainable harvesting rather than over-exploitation should take place.

There is limited biological information available on most of the plants being harvested or needed by the local people from Bwindi. Few studies on plant harvest impacts have been carried out in Bwindi e.g. Bitariho *et al.* (2006); Ndangalasi *et al.* (2007); Olupot *et al.* (2009b) and Stas (2011). Olupot *et al.* (2009b) studied useful plants' abundance but did not carry out yield studies and size class distributions of the useful plants and neither did they assess the impacts of environmental variables on the useful plants. Furthermore, Olupot *et al.* (2009b) did not compare differences in useful plants' parameters between harvest and non-harvest zones yet this is an important aspect for determining plant harvest impacts as noted by Hall & Bawa, (1993); Ticktin, (2004); Ghimire *et al.* (2008) and Sampaio *et al.* (2008). Bitariho *et al.* (2006); Ndangalasi *et al.* (2007) and Stas (2011) compared the harvest and non-harvest zones but focused only on three legally harvested species of *Ocotea usambarensis*, *Rytigynia kigeziensis* and *Loeseneriella apocynoides*. With the exception of the later, no negative harvest impacts have yet been reported by the studies. This study, therefore, determined the ecological status and harvest impacts of the most important plants for the local people around Bwindi by assessing the plants' abundance, distribution, biomass production and impact of environmental variables on their population dynamics.

6.7 Methods

6.7.1 Study area

The study was conducted in Bwindi an Afromontane forest in the south- western Uganda, located at the edge of the western rift valley. Bwindi was established a national Park by the act of parliament in August 1991 and is among the few remaining "islands" of the Central African rain forest refugia of the Pleistocene times (Butysnki, 1987; Marchant *et al*., 1997). The forest has an area of 331 km² and lies along latitude 0°53' South to 1°8' South and longitude 29°35' East to 29°50' East of Greenwich (Butynski, 1984). Bwindi has two rainy and dry season peaks with annual precipitation ranges of between 1130 mm and 2390 mm and overall temperature ranges of 14°C minimum and 20°C maximum (Butynski, 1984; Bitariho *et al.,* 2000). The altitudinal range in Bwindi ranges from 1200m a.s.l in the northern sector to 2607m a.s.l in the southern sector at Rwamanyonyi hill (Butynski, 1984; Howard, 1991; Olupot, 2008; Olupot *et al.,* 2009a). Bwindi is surrounded by one of the highest human population density in Uganda of 500 people/km^2 (Uganda population census data, 2002). This study involved forest surveys in eight parishes bordering Bwindi. The parishes were stratified into harvest zones (where plant harvests are permitted) and non-harvest zones (where plant harvests are not permitted). The plant harvest zone were; Buremba, Karangara, Rutugunda and Southernward while the non-plant harvest zones were; Bujengwe, Kitojo, Kashasha and Mushanje (Figure 6.1).

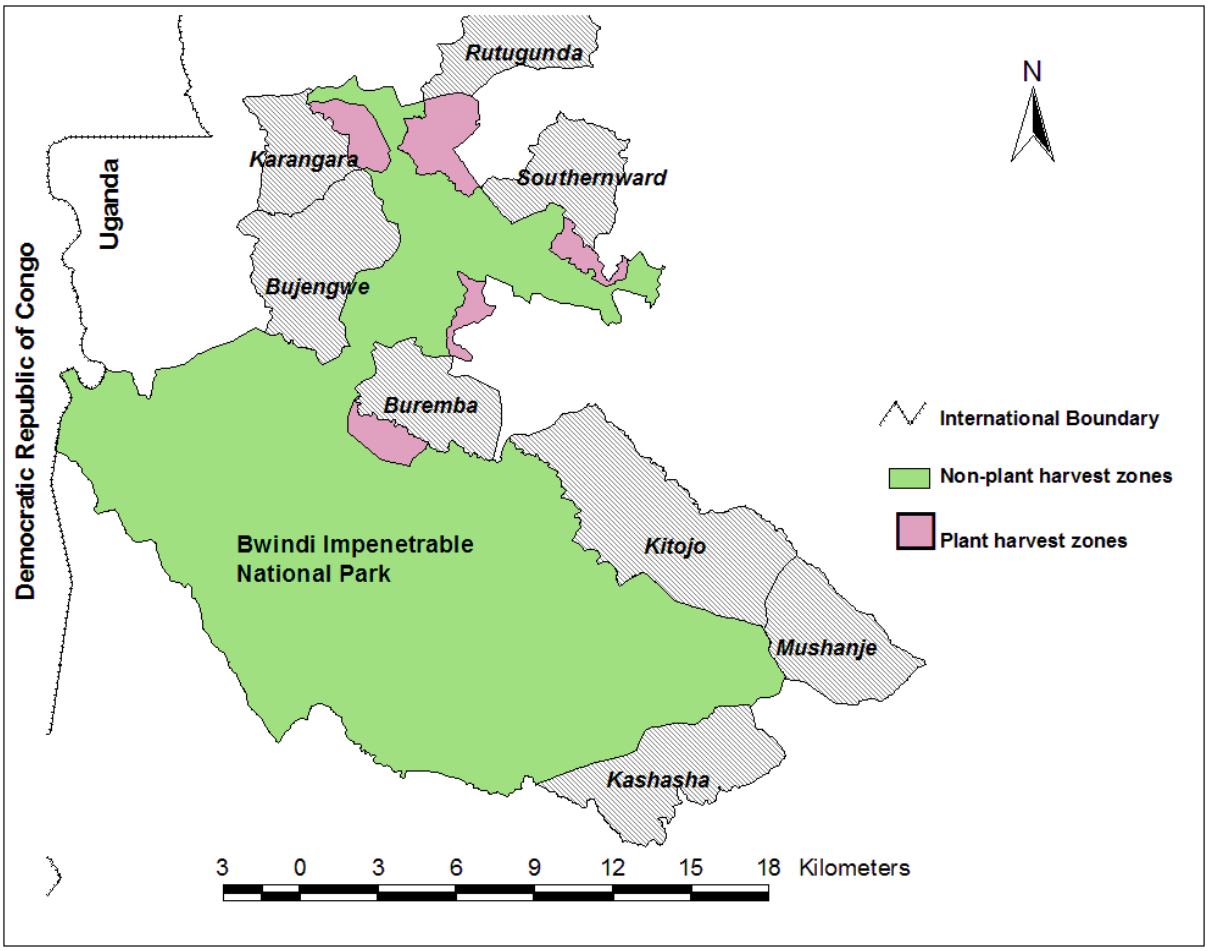


Figure 6.1: Map of forest areas adjacent Bwindi parishes where the study was carried out.

6.7.2 Forest survey sampling design

A stratified random sampling of harvest zones and non- harvest zones was used to assess important plants (Clarke, 1986; Alder & Synnott, 1992; Jongman *et al.*, 1995). The randomization procedure was by first laying a coordinate grid on top of a map of Bwindi and then selecting coordinates of transect locations at random using pieces of paper placed in a hat (Tuxil &Nabhan, 1998). This design was used to compare the population dynamics of plants in the harvest and "non- harvest zones' (Hall & Bawa, 1993; Boot & Gullison, 1995; Botha *et al*, 2004; Byarugaba *et al*, 2006;

Ndangalasi *et al*, 2007). Three belt transects were randomly established (10 m wide and 1 km long), running from the forest edge into the interior to assess important trees (those higly valued by local people as shown in chapter 4). The randomization was as described above. According to Hall & Bawa (1993), the three belt transects for each parish are sufficient to provide a fairly good block replicated sample. Each transect was divided into 1 m x 1 km plots (subdivided into subplots of 1 m x 2 m) to assess tree seedlings. A total of 24 belt transects were established in the whole study area. Belt transects are suitable for surveys over long distances as they account best for heterogeneity of the forest (Hall & Bawa, 1993; Jongman *et al.,* 1995; Feinsinger, 1997; Hladik & Dounias, 1993, Tuxill & Nabhan, 1998, Ndangalasi *et al.,* 2007).

Nested square quadrats of different sizes were also established at every 100 m interval along the transects to assess shrubs and climbers following Hall & Bawa (1993);Tuxill & Nabhan (1998);Musimami & Mcneilage (2003); Byarugaba *et al* (2006) and Ndangalasi *et al* (2007) methods. Shrubs and lianas (woody climbers) were assessed in plot of 10 m x 10 m sizes while herbaceous climbers (vines) were assessed in plots of 5 m x 5 m sizes following Clarke (1986); Hall & Bawa, (1993) and Ndangalasi *et al* (2007) methods. The seedlings and saplings of the plants were enumerated in the respective plot sizes.

6.7.2.1 Plant stem density and size class distribution assessments

For trees, poles and shrubs, stems rooted in the plots were measured for diameters at breast height (dbh) at 1.3 m height. Measurement for the dbh was determined from recommendations of Alder & Synnott (1992) and Cunningham (2001) especially for multi-stemmed and forked plants.

Sprouts, coppices or multi-stemmed individuals were counted as separate plants (Cunningham, 2001, Botha *et al.,* 2004).

For the climbing plants such as lianas and vines, diameters were measured at the base of the stems (basal diameters). Lianas were considered as large, woody bare-stemmed climbers while vines were the predominantly herbaceous, leafy smaller climbers (Hegarty & Caballe, 1991). In cases where the stems of climbers and shrubs were formed by clonal extensions of adults, they were treated as separate individuals.

6.7.2.2 General habitat description

Habitat characteristics such as altitude above sea level (elevation), slope % and over-storey density (% tree canopy cover) were recorded for each plot. Altitude was recorded using an altimeter; slope % using a clinometer and over-storey density using a spherical densitometer following recommendations of Hall & Bawa (1993) and Cunningham (2001).

6.7.2.3 Biomass production (yield) assessments

Three representative sample plants from the eleven most important plants were randomly selected (after plot establishment) and measured for bark thickness and stem growth rates following the methods of Peters (1994); Peters (1996); Cunningham, (2001) and Bitariho *et al* (2006). The randomization procedure was as described above. The basic objective of yield studies is to provide a reasonable estimate of the quantity of resource produced by a given species in a particular habitat (Peters, 1994; Peters (1996). Bark thickness was measured using a bark gauge at DBH with four separate measurements taken around the tree trunk to get a mean bark thickness per tree following methods of Kamatenesi (1997); Cunningham (2001) and

Bitariho *et al* (2006). The basal diameters were measured using vernier calipers (Peters, 1994; Cunningham, 2001; Bitariho *et al.,* 2006). The species selected were *Ocotea usambarensis* Engl for bark thickness (harvested for bark), *Piper guineense* Schumach. & Thonn. and *Milletia dura* (Dunn) for stem growth rates (harvested for root tubers/stems and stems respectively). The *P. guineense* roots and stems are used to treat intestinal worms' infestation in children while and *M.dura* stems are used for making tool handles. The plants were permanently marked with paint, metal tags and flagging tapes for subsequent measurements that was repeated after one year.

6.7.4 Data analysis

6.7.4.1 Environmental differences between harvest and non-harvest zones

Differences in harvest and non-harvest zones were assessed using environmental variables of % tree canopy cover, altitude and slope percentage. The environmental variables in harvest zones were compared with those of the non-harvest zones and statistically tested using a Wilcoxon test for any differences (Hall & Bawa, 1993, Boot & Gullison, 1995; Siegel & Castellan, 1988; Botha *et al*, 2004; Ndangalasi *et al.,* 2007). The Wilcoxon test was performed using Systat 10.2 computer software.

6.7.4.2 Stem density and abundance of the plants

Data on stem densities of important plants from the four harvest zone parishes (Buremba, Karangara, Rutugunda and Southernward) were pooled together as no significant differences were detected between the parishes (Chi- square text, $P>0.05$) following Binh (2009). The same procedure was repeated for the non-harvest zones parishes of Bujengwe, Kashasha, Kitojo and Mushanje. Stem density was used as a measure of abundance of the important plants and was calculated as an average number of individuals per ha (Peters, 1994; ITFC, 1999; Wong, 2003).

Stem density of the eleven important plants in harvest zones was compared with those from non-harvest zones and statistically tested using Chi-square (χ^2) for any differences (Hall & Bawa, 1993, Boot & Gullison, 1995; Botha *et al*, 2004; Ndangalasi *et al.*, 2007). The Chi-square (χ^2) statistical analysis was performed using Systat 10.2 and Excel 2010.

Stem density per hectare = $\frac{\{\text{Total number of individual plant stems}\}}{\text{Total number of plots x plot area in hectares}}$

6.7.4.3 Plants' size class distributions

Diameter data from the four harvest zone parishes were pooled together as no significant differences were detected between the parishes (Wilcoxon test, P>0.05) following Binh (2009). The same procedure was also done for the non-harvest zones parishes. Diameter at breast height and basal diameters were used as a measure of size class distribution of the different useful plants. The size class distribution of the most important plants in harvest zones were compared with those from non-harvest zones and statistically tested using a Wilcoxon test for any differences following Hall & Bawa, (1993); Boot & Gullison, (1995); Siegel & Castellan (1988); Botha *et al* (2004) and Ndangalasi *et al.* (2007). The Wilcoxon test was performed using Systat 10.2 computer software and Excel 2010.

6.7.4.4 Annual biomass production of the plants

Yield data (annual biomass production) from the four harvest zones parishes was pooled together as no significant differences were detected between the parishes (Wilcoxon test, P>0.05) following Binh (2009). The same procedure was repeated for the non-harvest zones parishes. Bark yields were calculated for *O. usambarensis* that is harvested for bark while annual stems growth rates were calculated for *P. guineense* and *M. dura* plants that are harvested for roots/stems and stems

respectively. *O.usambarensis*, annual yields were calculated using the amount of bark produced per year by the tree while for *P. guineense* and *M. dura* plants, annual yields were calculated using stem growth rates of the two plants.

Resource users normally harvest bark from *O. usambarensis* tree up to a maximum height of 2 m up the tree trunk (Kamatenesi, 1997; Cunningham, 2001; Bitariho *et al.,* 2006). Therefore bark mass production of trees were calculated up to a height of 2 m. The calculations of total bark mass were based on a formula by Schonau (1972) in Cunningham 2001 and used by Kamatenesi (1997); Cunningham (2001) and Bitariho *et al.,* 2006:

Log BM (Kg) = 1.87253 (Log d) = 0.72118 (Log h) + 0.152919 (BT) – 0.11767 (BT x Log D) + 0.037728 (BT x Log h) – 2.04586.

Where BM = Bark mass, d =diameter (cm), h = height (cm) = 200cm, BT = Bark thickness (cm)

Bark mass of the *O. usambarensis* was then plotted against the different size classes of the plants on a scatterplot to produce yield curves as recommended by Peters (1994) and Peters (1996). Annual bark yields of *O. usambarensis* in the harvest zones were then compared with those in the non- harvest zones and tested for significance using a Wilcoxon test following Hall & Bawa (1993), Boot & Gullison, (1995); Siegel & Castellan (1988); Botha *et al* (2004) and Ndangalasi *et al.* (2007). The Wilcoxon test was performed using Systat 10.2 computer software.

Stem growth rates of *P. guineense* and *M. dura* were calculated from the two annual measurements of basal diameter increments made to get annual stem growth rates for each plant's diameter. The basal diameters were then plotted against the annual stem growth rates on a

scatterplot to produce yield curves as recommended by Peters (1994) and Peters (1996). Stem growth rates of the two plants in the harvest zone were compared with those from the non-harvest zone and tested for significance using a Wilcoxon test (Hall & Bawa, 1993, Boot & Gullison, 1995; Siegel & Castellan, 1988; Botha *et al.*, 2004; Ndangalasi *et al.*, 2007).

6.7.4.5 Effects of environmental variables on plant stem densities

Analysis of the influence of environmental variables (altitude, slope % and % tree canopy cover) on plant stem densities was carried out using least-squares regression (Jongman *et al.*, 1995; Zar, 1996). The stem density data were first transformed using the equation X^1 = Square root (X + 0.5) (where X is stem density) to cater for the many zero counts in the data in order to conform to a Poisson distribution (Jongman *et al.*, 1995; Zar, 1996). The transformed data was then tested using a Kolmogorov-Smirnov test (KS) goodness of fit to see if it conforms to a Poisson distribution (Botha *et al.*, 2004). When confirmed, then the stem density data was plotted against the environmental variables and then the regression analysis tested using analysis of variance (ANOVA) in Systat 10.2 computer program (Jongman *et al.*, 1995; Bewick *et al.*, 2003).

6.8 Results

6.8.1 Environmental differences between harvest and non-harvest zones

Harvest and non- harvest zones were significantly different in tree canopy cover and elevation distribution ($z = 8.91$, p value< 0.05 and $z = 9.39$, p value< 0.05 respectively, Wilcoxon's test). However harvest and non-harvest zones were not significantly different in slope distributions ($z = 1.98$, $p = 0.05$ Wilcoxon's test). Percent tree canopy cover was higher in the non-harvest zones than in the harvest zones (figure 6.2). Tree canopy cover in the harvest zones ranged from 21%

to 1.4% while that in the non-harvest zones ranged from 30% to 10%. This implies that harvest zones had more open areas and therefore were more disturbed than the non-harvest zones. Furthermore, most non-harvest zones were located at higher elevations (altitudes) than the harvest zones. Altitude range in the harvest zones was 1170 m to 2100 m a.s.l while that in the non-harvest zones was 1600 m to 2580 m a.s.l. There were little variations in % slopes between harvest and non-harvest zones with % slopes ranging between 3% to 45% and 0% to 45% respectively (Figure 6.2).

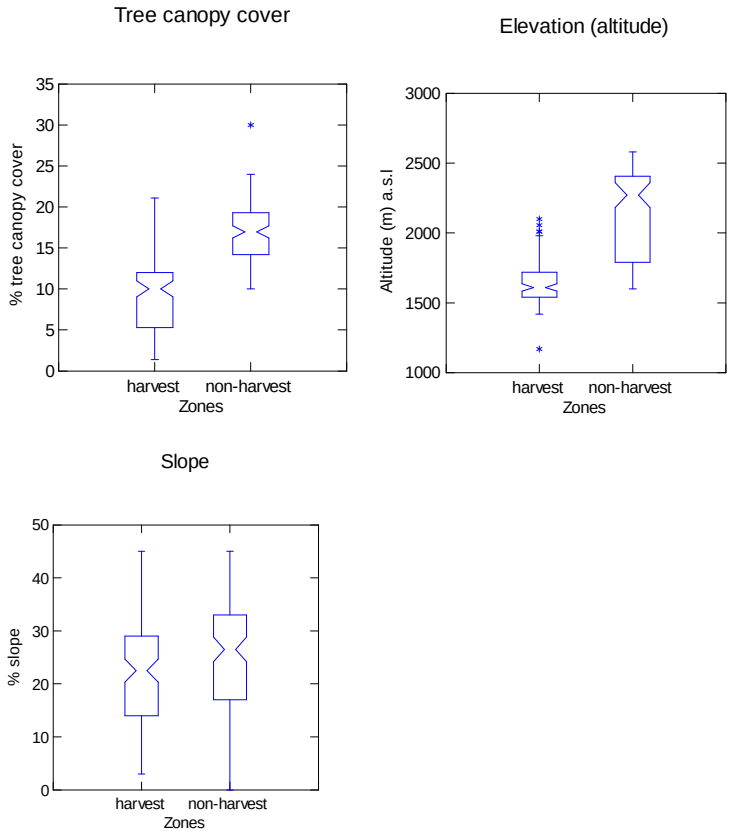


Figure 6.2: Environmental variations between harvest and non-harvest zones.

6.8.2 Stem density and abundance of important plants

Stem density of the eleven important forest plants was significantly different between harvest and non-harvest zones (χ^2 = 1188, df 10, p value< 0.05, chi-square goodness of fit). Stem density of most plants (8 out of 11) was highest in the harvest zones than in the non-harvest zones; only a few plants (3 out 11), *Salacia elegans,* Welw. ex Oliv., *Rytigynia kigeziensis* Verdc. and *Loeseneriella apocynoides* (Welw. ex Oliv.) N.Hallé ex J.Raynal had high stem densities in the non-harvest zones than in the harvest zones (table 6.1). The highest stem density was that of *Dracaena laxissima* Engl. (633±57 stems/ha) followed by those of *P. guineense* (453±65 stems/ha) and *Smilax anceps* Willd.(310±28 stems/ha*)* in the harvest zones. The least stem density was that of *Dioscorea praehensilis* Benth. (3±1 stems/ha) and *O. usambarensis* (5±1 stems/ha) in the non-harvest zones (table 1). *D. praehensilis* and *L. apocynoides* in the harvest zones also had the least stem densities (5±1 stems/ha and 6±0.4 stems/ha respectively).

Table 6.1 Stem density of important forest plants in harvest and non-harvest zones.

Plant species	Stem densities per hectare at 95% CI			
	Harvest zones		Non-harvest zones	
	Stem density/ha	SD	Stem density/ha	SD
Smilax anceps	310	28	37	3
Ocotea usambarensis	41	2	5	1
Dioscorea praehensilis	5	1	3	1
Dracaena laxissima	633	57	290	54
Monanthotaxis littoralis	62	7	23	2
Piper guineense	453	65	140	14
Marantochloa manii	120	21	27	1
Milletia dura	67	3	17	1
Salacia elegans	38	4	49	6
Loeseneriella apocynoides	6	0.4	13	3
Rytigynia kigeziensis	12	2	25	3

6.8.3 Size class distribution of important plants

With the exception of *D. praehensilis* and *L. apocynoides, s*ize class distribution of most important plants (9 out of 11) was significantly different between harvest and non-harvest zones (P values were < 0.05, Wilcoxon's test). Wilcoxon's tests for *D. praehensilis* and *L. apocynoides* in non-harvest zones were z = 1.10, p = 0.29 and z = 0.52, p = 0.60 respectively. Large sized individuals of all plants (mature) were more abundant in the non-harvest zones than in the harvest zones and vice versa for small sized individuals (Table 6.2).

Seven out of the eleven important forest plants had a typical "inverted" J type of diameter size class distribution in both zones (Figures 6.3, 6.4 & 6.5). These were *O. usambarensis, M. dura, D. praehensilis, D. laxissima, Monanthotaxis littoralis,* (Bagsh. & Baker f.) Verdc.

P. guineense and *S. elegans*). *L. apocynoides* had a population with very many seedlings and juveniles but no harvestable mature or adult individuals (those >18mm) and showed an "L" type of size class distribution as shown in figure 6.4. *R. kigeziensis* had a unimodal type of population distribution and is represented equally in both seedling and adult individuals. *Marantochloa manii* (Benth.) Milne-Redh. on the other hand, had a "J" type of size class distribution in both zones, this is a population with few seedlings but many mature individuals (Figure 6.5).

Table 6.2: Mean size class distribution of important plants in harvest and non-harvest zones.

Import forest plant species	Mean dbh/basal diameter (mean±SD) at 95% CI	
	Harvest zones	Non-harvest zones)
Smilax anceps	7.7±2.0	10.5±11.0
Ocotea usambarensis	87.1±116.6	117±125
Dioscorea praehensilis	9.1±5.3	9.2±8.8
Dracaena laxissima	9.2±4.4	9.3±2.6
Monanthotaxis littoralis	16.2±13.3	24.2±10.3
Piper guineense	5.1±2.1	8.3±6.9
Marantochloa manii	6.6±1.9	10.5±6.1
Milletia dura	61.4±55.1	105±109
Salacia elegans	13.1±5.1	13.2±9.4
Loeseneriella apocynoides	3.6±2.1	4.3±1.5
Rytigynia kigeziensis	23.8±17.5	35.5±31.3

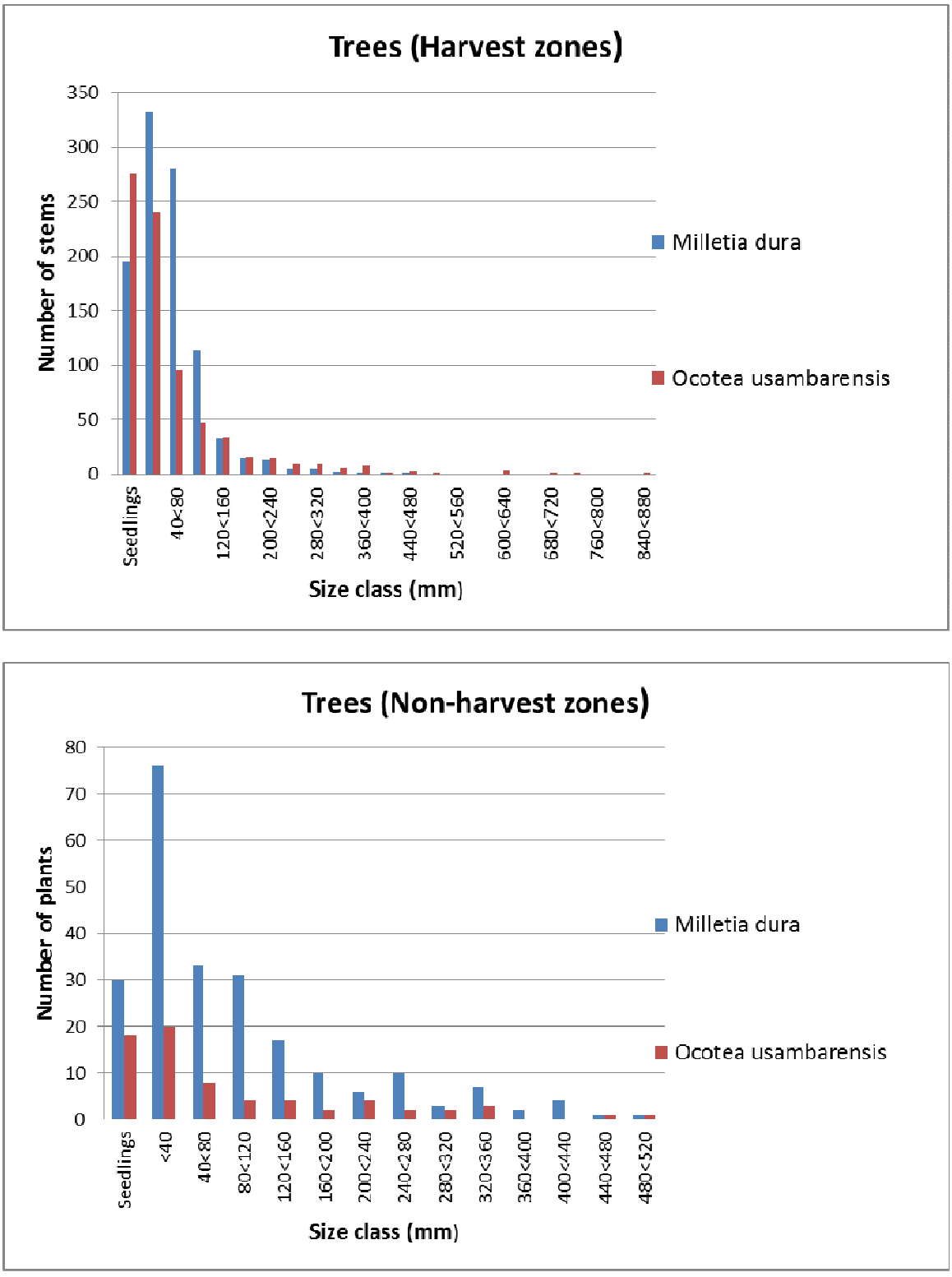


Figure 6.3: Size class distributions of important trees in harvest and non-harvest zones.

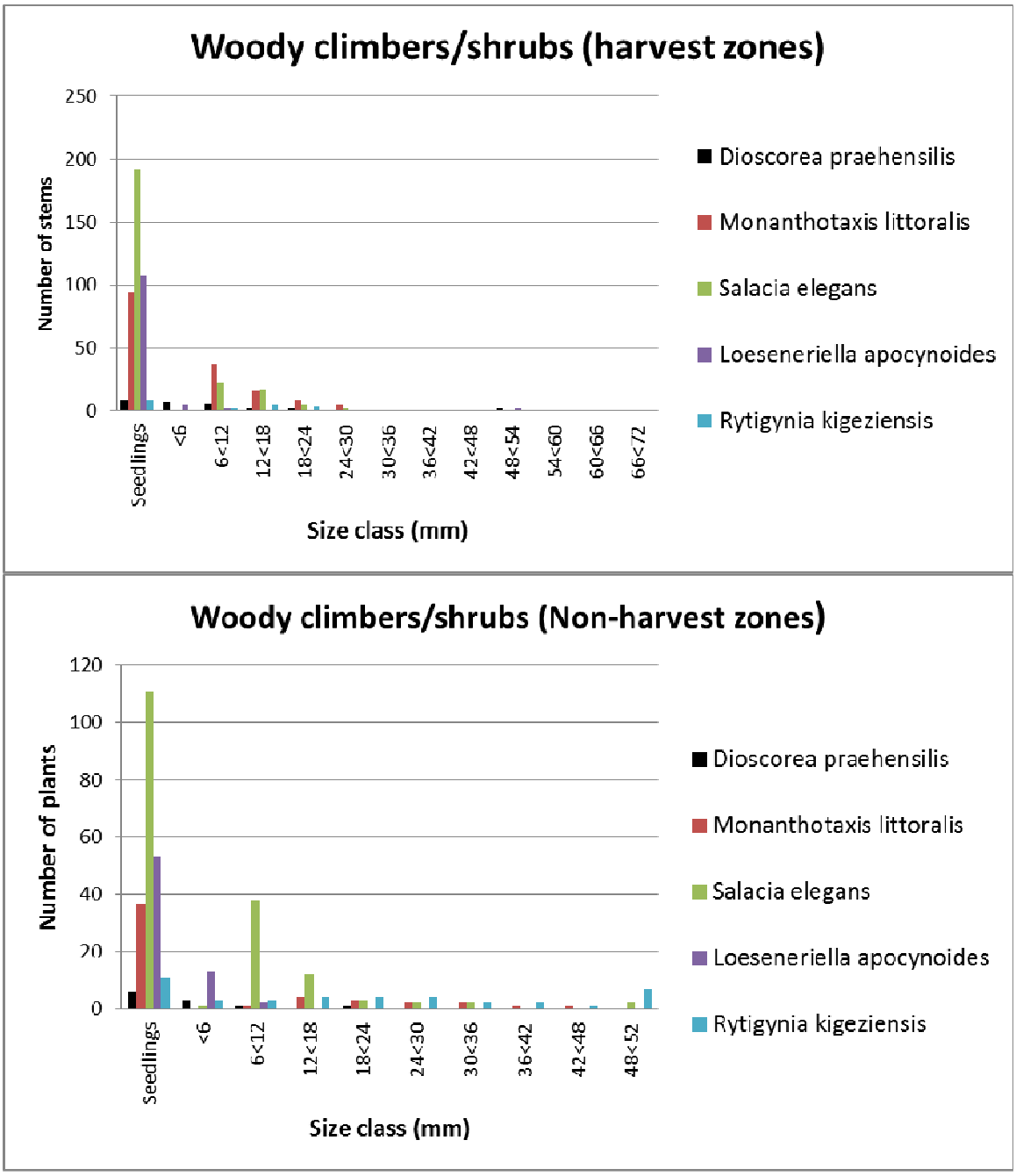


Figure 6.4: Size class distributions of woody climbers/shrubs in harvest and non-harvest zones.

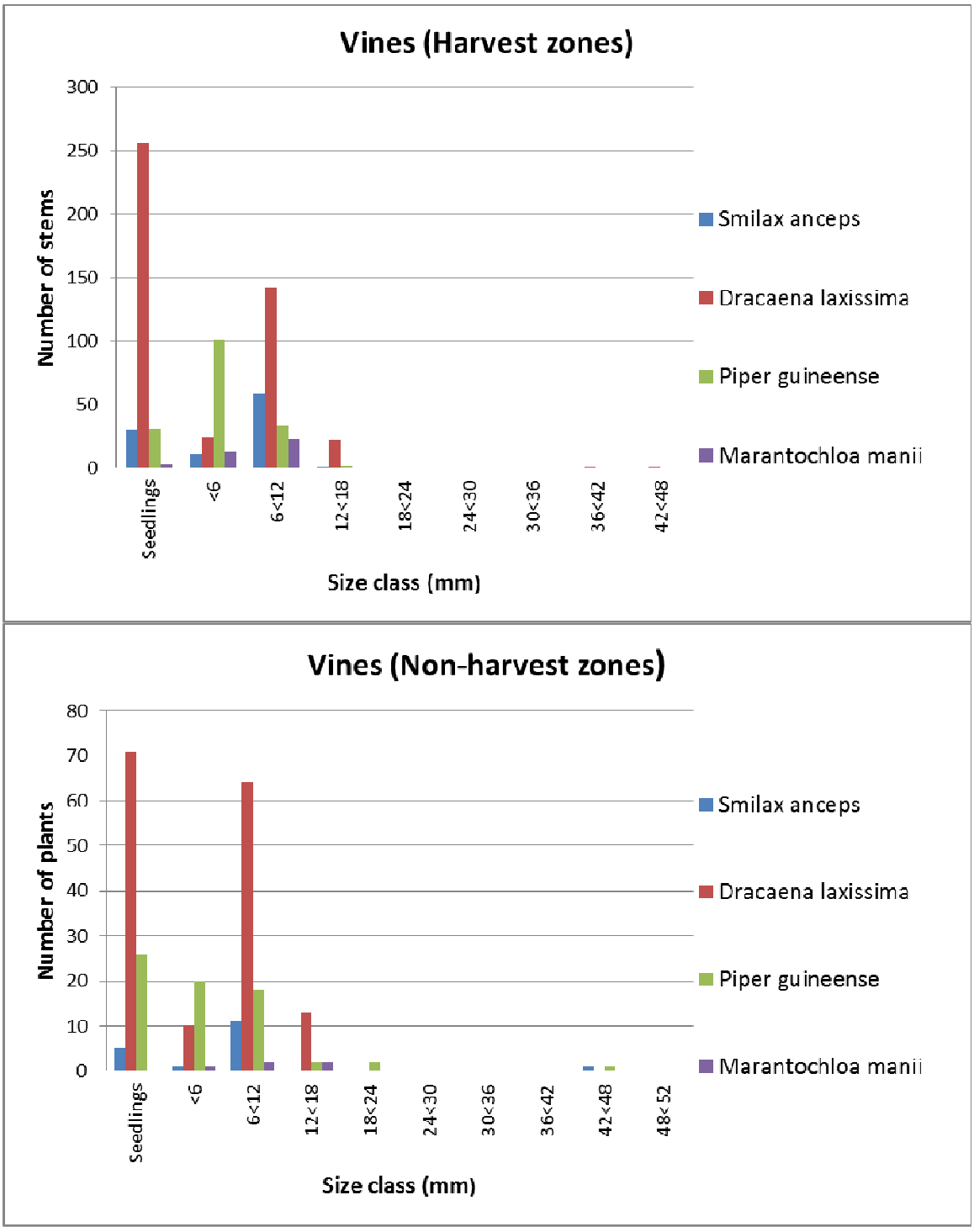


Figure 6.5: Size class distributions of important vines in harvest and non-harvest zones.

6.8.4 Annual biomass production (yields) of important plants

Mean annual bark production of *O. usambarensis* tree in the harvest zones was 0.052±0.082 kg (mean±SD) while that from non-harvest zones was 0.034±0.040 kg. Furthermore, mean annual stem growth rate of *P. guineense* was 0.97±1.00 mm and 0.56±0.38 mm in harvest and non-harvest zones respectively. And for *M. dura* the mean annual stem growth rate was 1.48±0.89 mm and 2.03±1.16 mm in harvest and non-harvest zones respectively. Indicating that bark yields of *O. usambarensis* and stem growth rates of *P. guineense* was higher in harvest than non-harvest and vice versa for *M. dura*. However, annual bark production (bark yield) and stem growth rates (yield) of the three plants were not significantly different between harvest and non-harvest zones ($z = 0.51$, p value >0.05, $z = 0.87$, p value>0.05 and $z = 0.83$, p value >0.05, Wilcoxon's test for *O. usambarensis, P. guineense* and *M. dura* respectively).

Yield curves of *O. usambarensis* and *M. dura* resemble in both harvest and non-harvest zones (Figure 6.6). For *O. usambarensis* tree, bark yields increased exponentially with DBH up to tree diameter of 400 mm in both zones. Further increases in tree diameter had little effect on bark production up to 600 mm DBH; beyond this size, bark production began to decrease notably. This was also true for *M. dura* where its stem growth rates increased exponentially with dbh up to 200 mm. Further increases in tree diameter had little effect on stem growth rates up to 250 mm dbh; beyond this size, stem growth rates began to decrease. For *P. guineense* stem growth rates increased exponentially with basal diameters from 10 mm up to 40 mm in the non-harvest zones but increased linearly with basal diameters in the harvest zones as shown in figure 6.6.

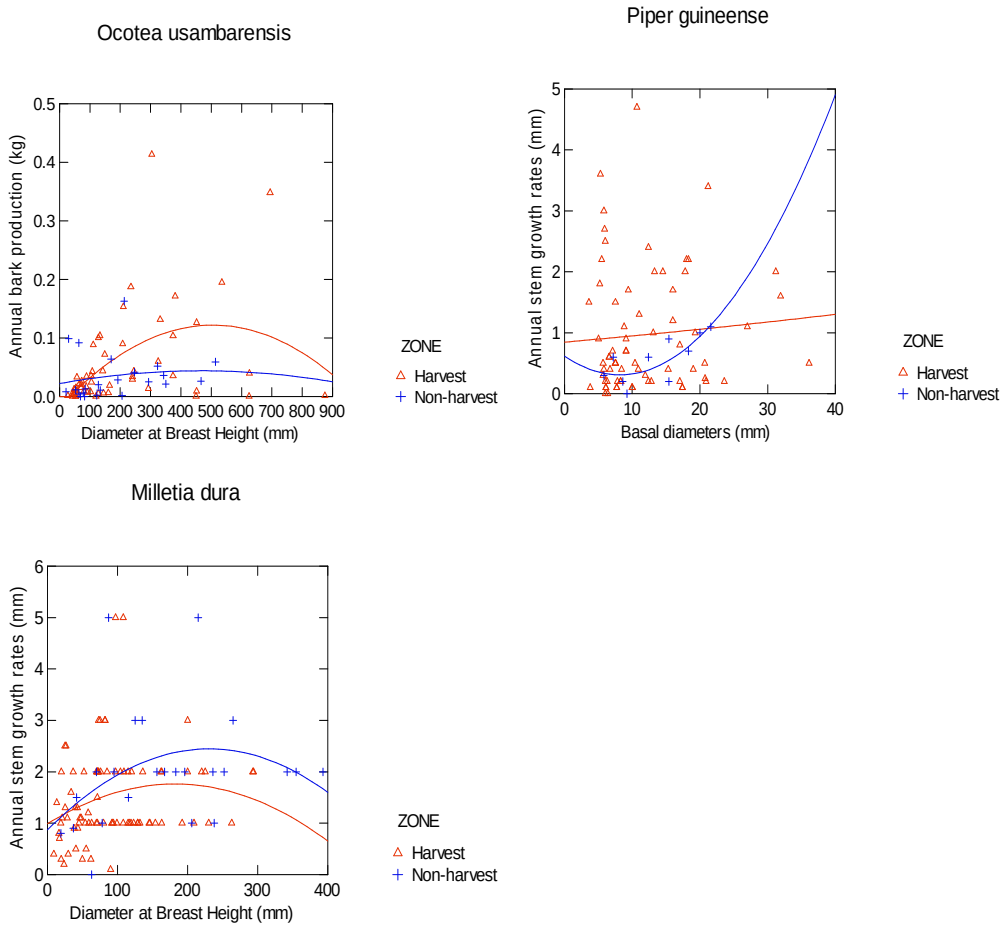


Figure 6.6: Yield curves of some important plants in harvest and non-harvest zones.

6.8.5 Influences of environmental variables on plant stem densities

There was a significant relationship between tree canopy cover and stem densities of most important plants (8 out of 11) in the harvest zones (Anova, P values <0.05- see table 6.3) except for stem densities of *M. dura*, *Marantochloa manii* and *L. apocynoides* (Table 6.3). In the non-harvest zones there was no significant relationship between % tree canopy cover and stem densities of most important plants (9 out of 11) (Anova, P values >0.05) except for stem densities of *M. dura* and *O. usambarensis*. Stem densities of most plants such as *S. anceps* and

D. laxissima in the harvest zones decreased with increasing tree canopy cover as shown in Appendix 12.1a & 12.1b.

There was a significant relationship between elevation (altitude) and stem densities of most plants (8 out of 11) in the non-harvest zones (Anova, P value <0.05 see table 6.4) except for those of *O. usambarensis, S. elegans* and *L. apocynoides* (Table 6.4). In the harvest zones, there was no significant relationship between altitude and stem densities of most plants (8 out 11) (Anova, P value >0.05) except those of *S. anceps, D. praehensilis* and *R. kigeziensis*. In the non-harvest zones, stem densities of most plants decreased with increasing altitude as shown in appendix 12.2a & 12.2b. In the harvest zones, most of the plants were located between altitudes 1500 to 2000 m a.s.l while for non-harvest zones, most of the plants were located between altitudes 1700 to 2500 m a.s.l (Appendix 12.2a & 12.2b).

There was no significant relationship between slope and stem densities of most plants in both zones (Anova, P value >0.05) except those of *D. laxissima, M. manii, O. usambarensis* and *L. apocynoides* in harvest zones (table 6.5). For the four plants, stem density decreased with increasing slope percentage as shown in Appendix12.3a and 12.3b. Furthermore, the plant distributions among the different slope percentages varied and ranged from 0 to 43% slope (Appendix 12.3a & 12.3b).

Table 6.3: Relationship between plants' stem densities and tree canopy cover.

Plant species	Plant harvest zones		Non-plant harvest zones	
	F-ratio (F)	Probability (P)	F-ratio (F)	Probability (P)
Smilax anceps	**5.67**	**0.0001**	0.31	1.000
Dracaena laxissima	**2.81**	**0.0006**	0.57	0.98
Piper guineense	**2.89**	**0.0001**	0.41	1.000
Monanthotaxis littoralis	**2.89**	**0.0001**	0.39	1.000
Milletia dura	0.87	0.66	**2.95**	**0.0003**
Ocotea usambarensis	**1.90**	**0.008**	**1.54**	**0.051**
Marantochloa manii	0.35	1.00	0.44	0.97
Dioscorea praehensilis	**1.65**	**0.028**	0.85	0.74
Salacia elegans	**2.98**	**0.0001**	0.71	0.91
Loeseneriella apocynoides	0.93	0.61	0.86	0.72
Rytigynia kigeziensis	**1.75**	**0.02**	0.55	0.99

Note: **bold** is to emphasise significant relationship between tree canopy cover and stem densities

Table 6.4: Relationship between plants' stem densities and elevation

Plant species	Plant harvest zones		Non-plant harvest zones	
	F-ratio (F)	Probability (P)	F-ratio (F)	Probability (P)
Smilax anceps	**5.64**	**0.02**	**4.26**	**0.05**
Dracaena laxissima	1.25	0.27	**4.13**	**0.044**
Piper guineense	0.88	0.35	**6.14**	**0.02**
Monanthotaxis littoralis	0.83	0.37	**3.83**	**0.05**
Milletia dura	1.29	0.26	**28.26**	**0.0001**
Ocotea usambarensis	0.44	0.51	1.59	0.21
Marantochloa manii	1.16	0.28	**7.18**	**0.008**
Dioscorea praehensilis	**4.38**	**0.04**	**5.64**	**0.02**
Salacia elegans	3.05	0.084	0.83	0.36
Loeseneriella apocynoides	0.54	0.47	2.44	0.12
Rytigynia kigeziensis	**10.37**	**0.002**	**4.33**	**0.05**

Note: **bold** is to emphasise significant relationship between elevation and stem densities

Table 6.5: Relationship between plants' stems densities and slope

Plant species	Plant harvest zones		Non-plant harvest zones	
	F-ratio (F)	Probability (P)	F-ratio (F)	Probability (P)
Smilax anceps	1.13	0.32	1.49	0.07
Dracaena laxissima	**1.74**	**0.02**	1.39	0.11
Piper guineense	1.26	0.19	0.60	0.96
Monanthotaxis littoralis	0.99	0.51	0.50	0.99
Milletia dura	**2.30**	**0.001**	0.61	0.96
Ocotea usambarensis	**5.82**	**0.0001**	0.64	0.94
Marantochloa manii	1.25	0.20	1.18	0.07
Dioscorea praehensilis	0.81	0.78	0.85	0.71
Salacia elegans	1.11	0.34	0.93	0.60
Loeseneriella apocynoides	**1.85**	**0.010**	0.21	0.98
Rytigynia kigeziensis	0.98	0.52	1.00	0.48

Note: **bold** is to emphasise significant relationship between % slope and stem densities

6.9 Discussion

6.9.1 Environmental differences between harvest and non-harvest zones

Altitudinal differences between harvest and non-harvest zones are a result of the differences in elevations between the southern and northern sectors of Bwindi. Of the two sectors, the northern sector contributes more than two thirds of the plant harvest zones while the southern sector contributes also more than two thirds of the non-harvest zones. The northern sector of Bwindi Park has an altitudinal range of between 1200 m to1800 m a.s.l while the southern sector is between 1600 to 2607 m a.s.l and has got the highest point in Bwindi (Butynski, 1984; Howard, 1991; Olupot, 2008; Olupot *et al.,* 2009a). This inevitably has contributed to the elevation differences between the two zones, with the non-harvest zones being at the highest elevation. Because of this altitudinal difference, the northern sector of Bwindi is dominated by medium altitude moist evergreen forest trees while the southern sector is dominated with high altitude moist evergreen forest trees (Butynski, 1984, Howard, 1991, Stas, 2011).

Forest disturbance in Bwindi is a result of past exploitation of the forest for timber before 1991. Over 60% of Bwindi was heavily disturbed by timber logging during the 1900s to 1980s period (Howard, 1991; Scott, 1992; Babaasa *et al*., 2004; chapter 2). Plant harvest zones in Bwindi were established at the park periphery in 1994 (Bitariho *et al.,* 2006). These park periphery areas were intensively pitsawn by timber loggers up to 1991 (Howard, 1991; Babaasa *et al*., 2004). Compounded with this, Bwindi Park's northern sector (which contributes over two thirds of the harvest zones) has suffered repeated burnings from fires and this has led to forest cover loss there than in the southern sector (Butynski, 1984; Scott, 1992; Babaasa *et al.,* 1999). The above factors have contributed to more forest disturbances in harvest zones than in the non-harvest

zones. The harvesting of non-timber forest products such as lianas and vines do not contribute significantly to forest tree canopy cover openings much as the timber logging and fires of the past. Therefore past and present anthropogenic forest disturbances and altitudinal differences between the two zones have likely influenced the population dynamics of important plants harvested in Bwindi as explained below.

6.**9.2 Stem density and abundance of the plants**

The abundance of the most important forest plants (8 out of 11) is highest in harvest zones when compared to the non-harvest zones probably because of the differences in elevations and forest disturbances. Indeed, according to several studies, elevation has a negative effect on plant stem densities (Hegarty & Caballe, 1991; Obua *et al.*, 2000; Eilu *et al.*, 2004; Bruun *et al.*, 2006; Ghazoul & Sheil, 2010); and since harvest zones were located at lower elevations than the non-harvest zones, abundance of the plants was highest in the harvest zones. It is also true that harvest zones are more disturbed than non-harvest zones resulting in plants' abundance being highest in the harvest zones. These results are consistent with those of Hegarty & Caballe, (1991); Peters (1994); Shackleton *et al.* (1994); Chazdon, (2003); McGeoch *et al.*, (2008); Olupot (2008) and Ghazoul & Sheil (2010). They reported that plant stem densities are often high in forest regenerating areas such as forest edges that have previously experienced disturbances. High tree canopy cover in the non-harvest zones suppresses plants' seedling establishment and hence abundance of the important plants as observed by Chazdon, (2003); Oyugi *et al* (2008) and McGeoch *et al.* (2008).

Most of the important forest plants in Bwindi are secondary forest species that are colonizing the forest after past human disturbance (Cunningham, 1992; Wild & Mutebi, 1996). Fischer &

Killmann (2008) described most of these harvested plants in Bwindi as understory montane forest species that are often found in secondary forest clearings. The highest stem densities shown by some plants such as *D. laxissima, P. guineense* and *S. anceps* in the harvest zones is an indication that some of the plants respond positively to harvest by vigorously sprouting and therefore increasing in numbers after harvest (Hegarty & Caballe, 1991; Peters, 1994; Shackleton *et al.,* 1994; Cunningham, 2001; Chazdon, 2003; McGeoch *et al.,* 2008).

6.9.3 Size class distributions of the plants

One first signal indicating that a plant population is being subjected to an overly intensive level of harvest is usually the manifestations of size-class distribution of that population (Peters, 1994; Hall & Bawa, 1993; Peters, 1996; Sampaio *et al.,* 2008). The differences in plant size distributions between harvest and non-harvest zones observed in this study could be from the differences in levels of past forest disturbance than differences in elevations. Forest disturbance is highest in the harvest zones than in the non-harvest zones and elevation gradients are highest in the non-harvest zones than harvest zones as noted above. As such, if altitude influenced plant size distributions, we would expect non-harvest zones to have more smaller sized plants than the harvest zones as reported by Hegarty & Caballe, (1991); Denslow, 1995; Gilliam *et al.* (1995); Obua *et al.* (2000); Eilu *et al.* (2004) and Bruun *et al.* (2006). These authors reported that altitude is negatively correlated with plant sizes. However, this is not the case; large sized individuals were more abundant in the non-harvest zones than in harvest zones and small sized individuals were most abundant in harvest zones. Hegarty & Caballe, (1991); Botha *et al.* (2004); McGeoch *et al.* (2008) and Ghazoul & Sheil (2010) reported that forest disturbance has a negative impact on plant sizes but a positive impact on seedling regeneration. Therefore, past forest disturbances may have influenced the plant size distribution than altitude with more large sized individuals

abundant in non-harvest zones than harvest zones. This study therefore has not been able to determine the fact that the differences in plant sizes between harvest and non-harvest zones is a result of impacts from the present plant harvests.

That most plants (9 out of 11) had an "inverted" J type of size class distribution in both harvest and non-harvest zones, shows that most of the harvested plants in Bwindi have a typical natural population with self-replacing individuals as stated by Hall & Bawa (1993); Peters (1994); Peters (1996); Tuxill & Nabhan (1998); Cunningham (2001), Bitariho *et al.* (2006) and Sampaio *et al.* (2008). It is a kind of distribution that shows strong recent reproductions and establishments of individuals that are evenly distributed throughout all the size classes but the largest individuals-adults (Peters, 1996; Tuxill & Nabhan, 1998). The size class distribution is of plants that have experienced less harvest impacts (Hall & Bawa, 1993; Peters, 1994; Sampaio *et al.,* 2008). The fact that the plants had this type of distribution in both zones, suggests that the current harvest levels of the plants may be sustainable as defined by Peters (1994); Peters, (1996); Struhsaker, (1998); Pfab & Scholes (2003), and Sampaio *et al.,* (2008).

The size class distribution of *L. apocynoides* ("L" type) is typical of heavily harvested mature and juvenile individuals with very many sprouts and therefore need urgent monitoring (Tuxill & Nabhan, 1998). In agreement with this study, previous work carried out in Bwindi have revealed that *L. apocynoides* has experienced serious negative harvest impacts from tea harvesters that use the plant stems for making tea harvest baskets (Ndangalasi *et al.,* 2007;Muhwezi *et al.,* 2009; Kasangaki *et al., in press,* see also chapter 4 of this thesis). As such Bwindi park management

and researchers alike have identified the plant as important for harvest impact monitoring to forestall its overexploitation in the forest.

The "J" type of size class distribution shown by *M. manii* sometimes reflects light demanding and early pioneer plant species whose regeneration may be limited by tree canopy size (Hall & Bawa, 1993; Peters, 1994; Peters, 1996; Tuxill & Nabhan, 1998). Such plants may be producing flowers but their establishment as seedlings is limited by the plant harvesters (Peters, 1994). This may also be true for the *M. manii* plant. The species of *M. manii* is harvested for seasonal flower stalks by women to make weave material of small baskets sold to tourists. Overharvesting the flower stalks for the baskets may have resulted in the loss of seeds for seedlings establishment and therefore negative harvest impacts. If this trend continues, the plant may permanently disappear from the forest as observed by Peters (1994) and Peters (1996). Indeed, women basket makers from Rutugunda parish in Bwindi have reported that it is now difficult to get harvestable flower stalks of *M. manii* plants for basketry than in the past (see also chapter 4 of this thesis).

6.9.4 Annual biomass productions (yield) of the plants

Differences in biomass production of harvested and un-harvested plant populations is one way in which harvest impacts of plants can manifest themselves (Godoy & Bawa, 1993; Peters, 1994; Peters, 1996; Boot & Gullison, 1995; Haig & Westoby, 1988; Cunningham, 2001; Bitariho *et al.,* 2006; Guedje *et al.,* 2008). This study has shown that annual bark production of *O. usambarensis*, and annual stem growth rates of *P. guineense* and *M. dura* were not significantly different between harvest and non-harvest zones despite the differences in environmental variables and plant harvest levels. This therefore suggests that the plants were neither growing nor decreasing in size as a result of bark and stem harvests as reported by Guedje *et al.* (2007).

According to the definitions of sustainable plant harvests by Struhsaker, (1998) and Pfab & Scholes (2003), the present harvest levels of *O. usambarensis* bark, *P. guineense*, and *M. dura* stems may therefore be sustainable. Indeed, Stas (2011) and Bitariho *et al.* (2006) agree that the present bark harvests from *O. usambarensis* trees in Bwindi are sustainable. Furthermore, Olupot *et al.* (2009b) reported that most plants used for nontimber purposes in Bwindi are currently being harvested sustainably

6.9.5 Influence of environmental variables on plant stem densities

All species occur in a characteristic, limited range of habitats and within their range, they tend to be most abundant around their particular environmental optimum (terBraak, 1987; Bruun *et al*.,2006). Indeed, Hegarty & Caballe, (1991); Denslow (1995); Gilliam *et al.* (1995); Obua *et al.* (2000); Eilu *et al.* (2004); Ndagalasi (2004) and Bruun *et al.* (2006) have noted that abundance of plant species increases with decreasing tree canopy cover and altitude. This is in agreement with this study as results show that tree canopy cover and altitude affected the abundance and distribution of most plants.

However for some plants in the harvest zones, altitude did not significantly influence stem density distribution as shown by the results. This disparity could be because of the greater impact of past anthropogenic forest disturbances than altitude in harvest zones. Indeed as discussed above, Howard, (1991); Scott, (1992) and Babaasa *et al*, (2004) have noted that past logging in Bwindi during the 1900s to 1980's have heavily disturbed Bwindi forest especially more so in the harvest zones. In agreement with this study, Peters (1994); Oyugi *et al.* (2008); Olupot *et al.* (2009a) and Ghazoul & Sheil (2010) have reported that tropical forest plants' abundance and distribution is a function of forest disturbance and that where there is disturbance, stem densities

of secondary forest species are likely to be higher than in undisturbed sites. Olupot *et al* (2009a) further noted that compared to other forests, in Bwindi, edge-related plant species patterns are probably a result of anthropogenic disturbances. It therefore appears that in Bwindi, although environmental variables play a role in plant stem densities distribution; past anthropogenic disturbances are largely the most important factors influencing the distribution of harvested plant stems.

6.10 Conclusions

Differences in levels of forest disturbance between harvest and non-harvest zones are a result of past historic forest disturbance from pitsawyers who selectively cut timber trees in Bwindi majorly at the park periphery. These disturbances were more in the harvest zones than in the non-harvest zones. The recent non-timber forest products (plants) harvests introduced under the multiple use programme in 1994 may not have influenced forest disturbance greatly like the past tree timber logging and forest fires. Past anthropogenic perturbations and altitude in Bwindi have largely played a role in the distributions of important plants' stem densities. Altitude however did not influence the plants' size class distributions and annual yields although forest disturbance was important for all the key plant parameter distributions.

This study has not detected any negative harvest impacts on most of the plants being harvested in Bwindi except for two, i.e. *L. apocynoides* and *M. manii* that are harvested for stems and flower stalks respectively. Plant harvesting in Bwindi may have caused increased regeneration of most harvested plants since harvest zones had the highest stem densities of the plants. This study further concludes that the present Bwindi plant harvest may be sustainable but the study was not able to determine impacts of plant harvesting on size class distribution. The useful and important

plants in Bwindi are majorly secondary forest types that prefer disturbance and more light conditions since they responded by increased regeneration in highly disturbed areas such as the harvest zones.

6.11 Study limitations

This study was not able to conclusively determine plant harvest impacts in Bwindi as it was limited by the failure/inability to establish control plots that were free from local people use (where plant harvestings was completely restricted). It was also not possible to establish the non-harvest control plots in forest adjacent areas of harvested zones which had similar environmental variables and therefore be able to have sufficient replicates for comparisons. The whole of Bwindi park periphery (where most useful plants occur) has been heavily disturbed by past and present anthropogenic disturbances. Furthermore, towards the interior of Bwindi forest, useful plant resources start diminishing as pointed by Olupot *et al* (2009b) and locating un-harvested important plant populations is practically impossible. The establishment of control plots for comparisons with treatments of harvest plots in Bwindi is difficult if not impossible. Therefore, comparisons made by this study may also have been influenced by environmental variables such as altitude, wind and soils apart from the plant harvests; factors that were beyond the scope of this study.

This study therefore risks criticisms of pseudoreplication as pointed out by Hurlbert, (1984). However, the author also recognizes valid scientific contributions where replication is impossible as in this study and particularly in impact assessment studies. Hurlbert, (1984) states that in such cases, ecological but not statistical conclusions should be drawn even though treatments are not adequately replicated. However, Hargrove & Pickering (1992) criticizes Hurlbert (1984) and

notes the difficulties in trying to make replications at landscape or ecosystem levels as encountered by this study. Hargrove & Pickering (1992) note that experiments done at scales larger than lab benches cannot be replicated exactly, only repeated approximately. Difficulties in replicating large-scale manipulations make quantifying cause-effect relationships difficult. Plot replications as recommended by Hurlbert (1984) are ideally possible in small scale environments such as lab bench experiments; in large landscapes such as natural tropical forests such as Bwindi plot replications as recommended by Hurbert (1984) are very difficult to be achieved (Hargrove & Pickering, 1992). Rather, Hargrove & Pickering (1992) recommend use of quasi-experiments as a compromise between classical experimentation proposed by Hurlbert (1984) and descriptive techniques as necessary for such studies. Quasi- experiments assume that there would have been no changes in a region, landscape or ecosystem if no treatment (plant harvest in this case) had been applied or if the treatment had no effect. Examples of where Quasi-experiments may be applicable include the harvest impact studies such are those applied to this study (Hargrove & Pickering (1992). A recommendation for this study is to initiate and establish experimental harvest trial plots of different harvest intensities through active harvesting of the plants and comparing the different harvest levels using transition matrix models; this requires long term studies and adequate funding and time.

6.12 Further recommendations

Bwindi park management should strengthen strategies of ex-situ cultivation of some important plant species for the local people. Whereas this study encourages the strategy of in-situ conservation of the plants, more efforts should be put in the ex-situ cultivation of some of these important plants as a strategy of decoupling local people from forest dependence. Development organizations such as CARE and Bwindi Mgahinga Conservation Trust (BMCT) should focus on

agroforestry strategies using indigenous tree species that are also useful for medicinal and other non-timber forest products. Such trees include *O. usambarensis, P. africana, F. saligna, M. dura* and *R. kigeziensis.* The ex-situ cultivation of these plants should be seen as a long term strategy for Bwindi's multiple use programme.

There is need to enforce the ban on the harvest *of L. apocynoides* from Bwindi as this plant has been and continues to be heavily exploited. It is still highly demanded for tea baskets and is sometimes illegally harvested from the forest. It seems merely banning the harvest of this plant from the forest has not stopped local people from illegally harvesting it. There is therefore a need to enforce this ban though regular patrols in the affected forest areas and through confiscation of tea harvest baskets made from the plant in the local markets. During this study I encountered a trader in Butogota market near Bwindi selling these baskets. Another plant to be considered for the harvest ban is *M. manii* that is harvested for flower stalks by women for making small baskets. Alternatives for *L. apocynoides* and *M. manii* such as *S. anceps* and *Raphia farinifera* (Gaertn.) Hyl. respectively should be encouraged to replace the functions of the two plants.

The present Bwindi plant harvest annual offtakes of 1% of available plant stock recommended for Bwindi should be increased upwards without affecting the plant populations' dynamics but increasing on more local people participation and appreciation of Bwindi's MUP. The annual harvest offtakes could be increased for some of the bark harvested plant species such as *O.usambarensis, P. africana* and *R.kigeziensis* but after more studies have established the sustainable harvestable offtakes. Other plants to be considered for increased annual harvest offtakes include; *D. laxissima, M. littoralis* and *S. anceps.* Specific long term studies of transition

matrix models on these plants should be carried out before increase on the annual harvest offtakes.

A proposal by the local people to harvest *M. dura* tree stems for tool handles (hoes, axes and walking sticks) should be shunned as this is likely to increase on the negative harvest impacts already shown by the plant. Harvest of stems of this plant is likely unsustainable in the long run as it has also been shown to have decreased stem growth rates in the harvest zones.

Monitoring of the multiple use programme should be strengthened by establishing more permanent sample plots (PSPs) to monitor more plant species (presently on three are monitored) like those highlighted above. Plant species such as *M. manii*, *P. africana* (a CITES listed plant) and others that are harvested and have been shown by this study to be affected by the harvesters should be included in the PSPs for harvest monitoring. The monitoring of plant harvest impacts in the PSPs should incorporate parameters useful for transition matrix modeling; these include tagging of all individuals plants, studying mortality and regeneration potentials of the plants and others.

There is also a need for an increased role by the local people in monitoring plant harvests offtakes through establishing a local community monitoring tool by Bwindi park management. This local community monitoring tool should be simple and easy to use by the local people involved in plant harvests (see also chapter 7).

References

Adams, W.M & Hutton, J., 2007. People, Parks and Poverty: Political Ecology and Biodiversity Conservation. *Conservation Society* 5:147-183.

Agrawal, A & Gibson, C.C., 1999. Enchantment and disenchantment: The role of community in natural resource conservation. *World Development* 27:629-649.

Agrawal, A & Redford, K., 2009. Conservation and Displacement: An Overview, *Conservation Society* 7 (1):1-10

Alder, D., & Synnott, T.J., 1992. Permanent Sample Plot Techniques for Mixed Tropical Forest. Tropical Forestry Papers, Oxford Forestry Institute Department of Plant Sciences University of Oxford, Oxford.

Arnold, J.E.M, & Perez, R.M., 2001. Can non-timber forest products match tropical forest conservation and development objectives (analysis), *Ecological economics* 39: 437- 447.

Babaasa D., Bitariho, R & Kasangaki, A., 1999. Fire incidences in Bwindi Impenetrable National Park, SW Uganda. Unpublished Report, Institute of Tropical Forest Conservation, Ruhija, Kabale

Babaasa, D, Eilu, G, Kasangaki, A & Bitariho, R (2004). Gap characteristics and regeneration in Bwindi Impenetrable National Park, Uganda, *African Journal of Ecology,* 422: 217-224.

Bewick, V, Cheek, L & Ball, J., 2003. Statistics review 7: Correlation and regression, *Critical Care* **7**:451-459.

Binh, M.B., 2009. Rattans of Vietnam: Ecology, Demography and Harvesting, Phd thesis Utrecht University, Utrecht.

Bitariho, R., Babaasa, D., Kasangaki, A., 2000. Weather patterns at Ruhija, Bwindi Impenetrable National Park, S. W Uganda. Unpublished report Institute of Tropical Forest Conservation, Ruhija, Kabale.

Bitariho, R., McNeilage, A., Babaasa, D., Barigyira, R. 2006. Plant harvest impact and sustainability in Bwindi Impenetrable National Park, S.W. Uganda. *African Journal of Ecology* 44, 14-21.

Blomley, T., Namara, A., McNeilage, A., Franks, P., Rainer, H., Donaldson, A., Malpas, R., Olupot, W., Baker, J., Sandbrook, C., Bitariho, R. and Infield, M., 2010. Development and gorillas? Assessing fifteen years of integrated conservation and development in south-western Uganda, Natural Resource Issues No. 23. IIED, London.

Botha, J, Witkowski, E.T.F & Shackleton,C.M, 2004. The Impact of Commercial Harvesting on *Warbugia salutaris* (‘pepper-bark tree”) in Mpumalanga, South Africa. *Biodiversity and Conservation* 13:1675-1698.

Boot R.G and Gullison., 1995. Approaches to Developing Sustainable Extraction Systems for Tropical Forest Products. *Ecological applications*. 5(4):896-903.

Bruun, H.H., Moen, J.,Virtanen, R., Grytnes, J, A., Oksanen, L., Angerbjörn, A., 2006. Effects of altitude and topography on species richness of vascular plants, bryophytes and lichens in alpine communities, *Journal of Vegetation Science* 17(1):37-46.

Butynski, T.M. 1984. Ecological survey of the Impenetrable (Bwindi) Forest, Uganda and recommendations for its conservation and management. *New York Zoological Society*, Bronx, New York.

Byarugaba, D., Ndemere, P., & Midgley, J. 2007. The vulnerability and resilience of Dioscorea species in utilized and nonutilized zones of Bwindi Impenetrable National Park. *African Journal of Ecology* 45, 258-264.

Caswell, H. 2001. Matrix Population Models: Construction, Analysis, and interpretation. Second edition. Sinauer Associates, Sunderland, Massachusetts.

Chazdon, R.L., 2003. Tropical Forest Recovery: Legacies of human impact and natural disturbances, *Perspectives in Plant Ecology, Evolution and Systematics* 6(1-2):51-71.

Clarke, R., 1986. The Handbook of Ecological Monitoring. A GEMS/UNEP publication. Clarendon Press. Oxford.

Cunningham, A.B., 1992. People, park and plant use: Research and recommendations for multiple-use zones and development alternatives around Bwindi-impenetrable National Park, Uganda. Report to CARE-International, Kampala.

Cunningham A. B., 2001. Applied ethnobotany, people, wild plant use and conservation, WWF, Earthscan Publications Ltd, London.

Davey, C., Peters, C.M, and Byarugaba, D., 2001. Participatory review of the Multiple Use Programme, Bwindi Impenetrable National Park and Mgahinga Gorilla National Park. CARE- Uganda and Uganda Wildlife Authority, Kampala.

Denslow, J.S., 1995. Disturbance and diversity in Tropical Rainforests: The Density Effect. *Ecological Applications* 5(4): 962-968.

Eilu, G, Hafashimana, D.L.N & Kasenene, J.M., 2004. Density and Species Diversity of Trees in four Tropical Forests of the Albertine Rift, Western Uganda. *Diversity and Distributions* 10:303-312.

Feinsinger, P. 1997. Utilised species monitoring, a DTC consultancy report and Provisional plan for the multiple-use programme of Bwindi Impenetrable National Park, Kabale.

Fischer, E & Killmann, D., 2008. Illustrated Field Guide to the Plants of Nyungwe National Park, Rwanda, Koblenz Geographical Colloquia, Series Biogeographical Monographs, Koblenz.

Freckleton, R.P, Silva Matos, D.M, Bovi, M. L. A,Watkinson, A. R.2003. Predicting the impacts of harvesting using structured population models: the importance of density-dependence and timing of harvest for a tropical palm tree, *Journal of Applied Ecology*, 40(5): 846–858.

Freese, C.H., 1997. Harvesting Wild Species, Implications for Biodiversity Conservation. The Johns Hopkins University Press, 2715 North Charles street, Baltimore, Maryland.

Ghazoul, J & Sheil, D., 2010. Tropical rain forest ecology, diversity, and conservation. Oxford University Press, Great Clarendon Street, Oxford.

Ghimire, S.K, Gimenez, O,Pradel, R, McKey, D, Aumeeruddy-Thomas, Y, 2008. Demographic variation and population viability in a threatened Himalayan medicinal and aromatic herb *Nardostachys grandiflora*: matrix modelling of harvesting effects in two contrasting habitats. *Journal of Applied Ecology* 45(1): 41-51

Gilliam, F.S., Turill, N. and Adams, M.B., 1995. Herbaceous layer and overstorey Species in clear cut and mature Central Appalachian Hardwood forests. *Ecological Applications* 5(4): 947-955.

Godoy, R. A and Bawa, K.S., 1993. The Economic Value and Sustainable Harvest of Plant and Animals from the Tropical Forest: Assumptions, Hypotheses, and Methods. *Economic Botany*, 47(3):215-219.

Guedje, N.M, Zuidema, P.A, During, H, Foahom, B, Lejoly, J., 2007. Tree bark as a non- timber forest product: The effect of bark collection on population structure and dynamics of *Garcinia lucida* Vesque. *Forest Ecology and Management*, 240 (1-3):1-12.

Hall, P., Bawa K., 1993. Methods to Assess the Impact of Extraction of Non-Timber Tropical Forest Products on Plant Populations, *Economic Botany* 47:234-245.

Haig, D., Westoby, M., 1988. On limits to seed production. *The American Scientist* 131, 757–759.

Hargrove, W.W & Pickering, J.,1992. Pseudoreplication: a *sine qua non* for regional ecology, *Landscape Ecology* 6(4): 251-258.

Hegarty, E.E, & Caballe, G., 1991. Distribution and abundance of vines in forest Communities. In *The biology of vines*. Putz F.E and Mooney H.A. (eds). Cambridge University Press, Cambridge.

Hladik, A. and Dounias, E. 1993. Wild yams of the African forest as potential food resources. In Hladik, C.M., Linares, O.F., Pagezy, H., Semple, A. and Hadley, M. (eds). *Tropical forests, people and food: biocultural interactions and applications to development.* 13:163-176.

Howard, P.C., 1991. Nature Conservation in Uganda's Tropical Forest Reserves. IUCN, Gland.

Hurlbert, S.H., 1984. Pseudoreplication and Design of Ecological Field Experiements. *Ecological Monographs* 54(2):187-211.

Hutton, J., Adams, W.M & Murombedzi, J.C., 2005. Back to the Barriers? Changing Narratives in Biodiversity Conservation. *Forum for Development Studies* 32 (2): 341-370.

ITFC, 1999. The potential supply of weaving and medicinal plant resources in the proposed Kifunjo-Masya Multiple - Use Zone of Bwindi Impenetrable National Park, South-Western Uganda. Unpublished Report, Ruhija, Kabale.

Iqbal, M., 1993. International Trade in non-wood forest products. An overview. Food and Agriculture Organization (FAO), Rome.

Jongman, R.H.G, Ter Braak, C.J.F & Van Tongeren, O.F.R., 1995. Data Analysis in Community and Landscape Ecology, Cambridge University Press, Cambridge.

Kamatenesi, M. 1997. The Conservation and Utilisation Status of Nyakibazi (Rytigynia spp.) in the Multiple - Use Areas of Bwindi Impenetrable National Park, Uganda. MSc. Thesis, Makerere University, Kampala.

Kasangaki, A, Bitariho, R, Shaw, P, Robbins, M & McNeilage, A, *in press.* Long-term Ecological and Socio-economic changes in and around Bwindi Impenetrable National Park, south-western Uganda.

Marchant, R, Taylor, D and Hamilton A., 1997. Late Pleistocene and Holocene history at Mubwindi swamp, southwest Uganda. *Quaternary research* 47:316-328.

Marchant, R, Taylor, D & Hamilton A., 2000. Late Holocene fluctuations in the composition of montane forest in the Rukiga highland, Central Africa: a regional reconstruction. In human ecodynamics, Bailey, G, Charles, R, Winder, N (Eds) Oxbow Books, Cambridge.

McGeoch, L, Gordon, I & Schmitt, J., 2008). Impacts of land use, anthropogenic disturbance, and harvesting on an African medicinal liana. *Biological Conservation* 141: 2218-2229.

Muhwezi, O, Cunningham, A.B & Ziraba-Bukenya, R.., 2009. Lianas and Livelihoods: The Role of Fibrous Forest Plants in Food Security and Society around Bwindi Impenetrable National Park, Uganda, *Economic Botany* 20 (10):1-13

Musimami, P.M and Mcneilage, A., 2003. Natural regeneration and ecological recovery in Bwindi Impenetrable National Park, *African Journal of Ecology* 41, 93-98

Ndangalasi, H.J., 2004. Implications of utilization of non-timber forest products in mountain ecosystems a case study of Uzungwa scarp and Njerera forest reserves, Tanzania. Unpublished Phd thesis University of Dar es salaam, Dar es salaam.

Ndangalasi, H, Bitariho, R, Dovie, D., 2007. Harvesting of non-timber forest products and implications for conservation in two montane forests of East Africa, *Biological Conservation* 134 (2):242-250.

Newton, A.C., 2007.Conservation of Tree Species through Sustainable Use: How Can it be Achieved in Practice? *Oryx* 42 (2):195-205.

Obua, J., Ogwal, S.M.,Mosango,D., 2000. Ecology, utilization and conservation of *Smilax kraussiana* in Bwindi Impenetrable Forest National Park, Uganda, *Journal of Tropical Forest Science* 12 (3): 542-551.

Olupot W., 2008. A variable edge effect on trees of Bwindi Impenetrable National Park, Uganda, and its bearing on measurement parameters. *Biological Conservation* 142: 789-797.

Olupot, W, Barigyira, R, & Chapman, C., 2009a**.** The status of anthropogenic threat at the people-park interface of Bwindi Impenetrable National Park, Uganda. *Environmental Conservation* 36 (1): 41–50.

Olupot, W, Barigyira, R &Mcneilage, A., 2009b. Edge-Related Variation in Medicinal and Other "Useful" Wild Plants of Bwindi Impenetrable National Park, Uganda, Conservation Biology *23(5):1138-1145*

Oyugi O.J, Brown, J.S., & Whelan, C.J., 2008. Effects of human disturbance on composition and structure of Brachystegia woodland in Arabuko-Sokoke Forest, Kenya, *African Journal of Ecology* 46 (3):374–383.

Peters, C.M, 1994. Sustainable Harvest of Non - Timber Plant Resources in Tropical Moist Forest: An Ecological Primer. USAID Biodiversity Support Programme, Washington D.C.

Peters, C.M., 1996. The Ecology and Management of Non-Timber Forest Resources. World Bank Technical Paper 322, Washington DC.

Pfab, M.F & Witkowski, E.T.F., 2000. A simple Population Viability Analysis of the Critically Endangered *Euphorbia clivicola* R.A.Dyer under four management scenarios. *Biological Conservation* 96:263-270

Pfab, M.F & Scholes, M.A., 2003. Is the collection of *Aloe peglerae* from the wild sustainable? An evaluation using Stochaic population models, *Biological Conservation*, 118(2004):695-701

Riviera, A & Mayer, C., 2008. BioTrade in the Amazon: In Financing Sustainable Forest Management by Holopainen, Jani and Marieke Wit (eds), *Tropenbos International*, Wageningen, xvi + 176pp.

Sampaio, M.B, Schmidt, I.B & Figueiredo, I.B., 2008. Harvesting Effects and population Ecology of the Buriti Palm (*Mauritia Flexuosa* L.F., Arecaceae) in the Jalapao Region, Central Brazil. *Economic Botany*, 62(2): 171-181.

Scott, P., 1992. Fringe benefits: National Park boundaries as areas for local community utilisation: the case of the Impenetrable (Bwindi) forest. MSc. Thesis, Agricultural University of Norway, A˚s, Akershus-Oslo.

Scott, J.C., 1998. Seeing like a State. How certain Schemes to improve the human condition have failed. Yale University Press, New Haven and London.

Struhsaker, T.T., 1998. A biologist's Perspective on the Role of Sustainable Harvest in Conservation. *Conservation Biology* 12 (4): 930-932.

Stas, S.M., 2011. Analyzing the impacts of bark harvest on *Ocotea usambarensis* in Bwindi Impenetrable National Park, Uganda, Unpublished MSc thesis Utrecht University, Department of Natural resource management, Utrecht.

Shackleton, C.M, Griffin, N.J, Banks, D.J, Mavrandonis, J.M & Shackleton, S.E, 1994. Community structure and species composition along a disturbance gradient in a communally managed South African savannah. *Vegetation* 115:157-167.

Siegel, S & Castellan, J.N., 1988. Nonparametric Statistics for Behavioral Sceinces (2^{nd} edn). McGraw-Hill Book Company, Newyork.

terBraak, C.J.F., 1987. Unimodal models to relate species to Environment: Agricultural Mathematics group, Pudoc, AC Wageningen.

Ticktin, T., 2004. The ecological implications of harvesting non-timber forest products. *Journal of Applied Ecology* 41, 11-21.

Tuxill,J and Nabhan, G.P. 1998. Plants and protected areas. A guide to In Situ management. WWF, Stanley Thornes publications, Ellenborough house, Wellington street Cheltenham.

Wild, R, & Mutebi, J., 1996. Conservation Through Community Use of Plant Resources: Establishing Collaborative Management at Bwindi Impenetrable and Mgahinga Gorilla National Parks. People and Plants Working Paper 5. UNESCO, Paris.

Wisdom, M. J., Mills, L. S & Doak, D.F., 2000. Life Stage Simulation Analysis: Estimating Vital-rate Effects on Population Growth for conservation. *Ecology* 81:628–641.

Wong, J. 2003. Recommendations for resource assessment for collaborative Forest management in Uganda. SC/08/2002. Report to the EDF/Uganda Forest Department: Forest resources management and conservationprogramme, Kampala.

Woodroffe, R., Thirgood, S., & Rabinowitz (eds)., 2005. People and Wildlife: Conflict or Coexistence? Cambridge University Press, Cambridge.

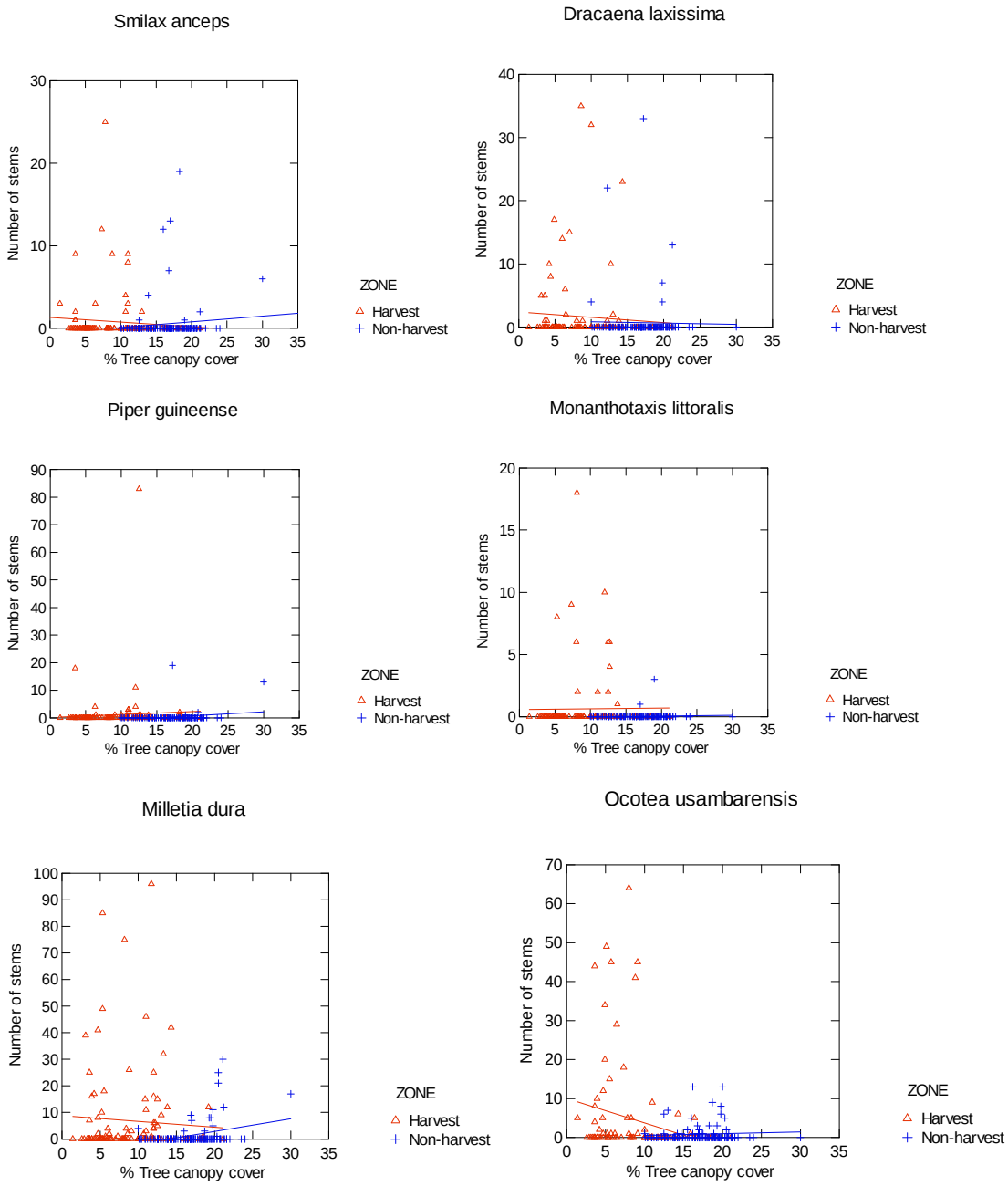
Zar, J. H., 1996. Biostatistical analysis. 3rd. ed. Prentice Hall, New Jersey

Zuidema, P. A., & Franco, M., 2001. Integrating Vital rate Variability into Perturbation Analysis: An Evaluation for Matrix Population Models of six plant species. *Journal of Ecology* 89:995–1005.

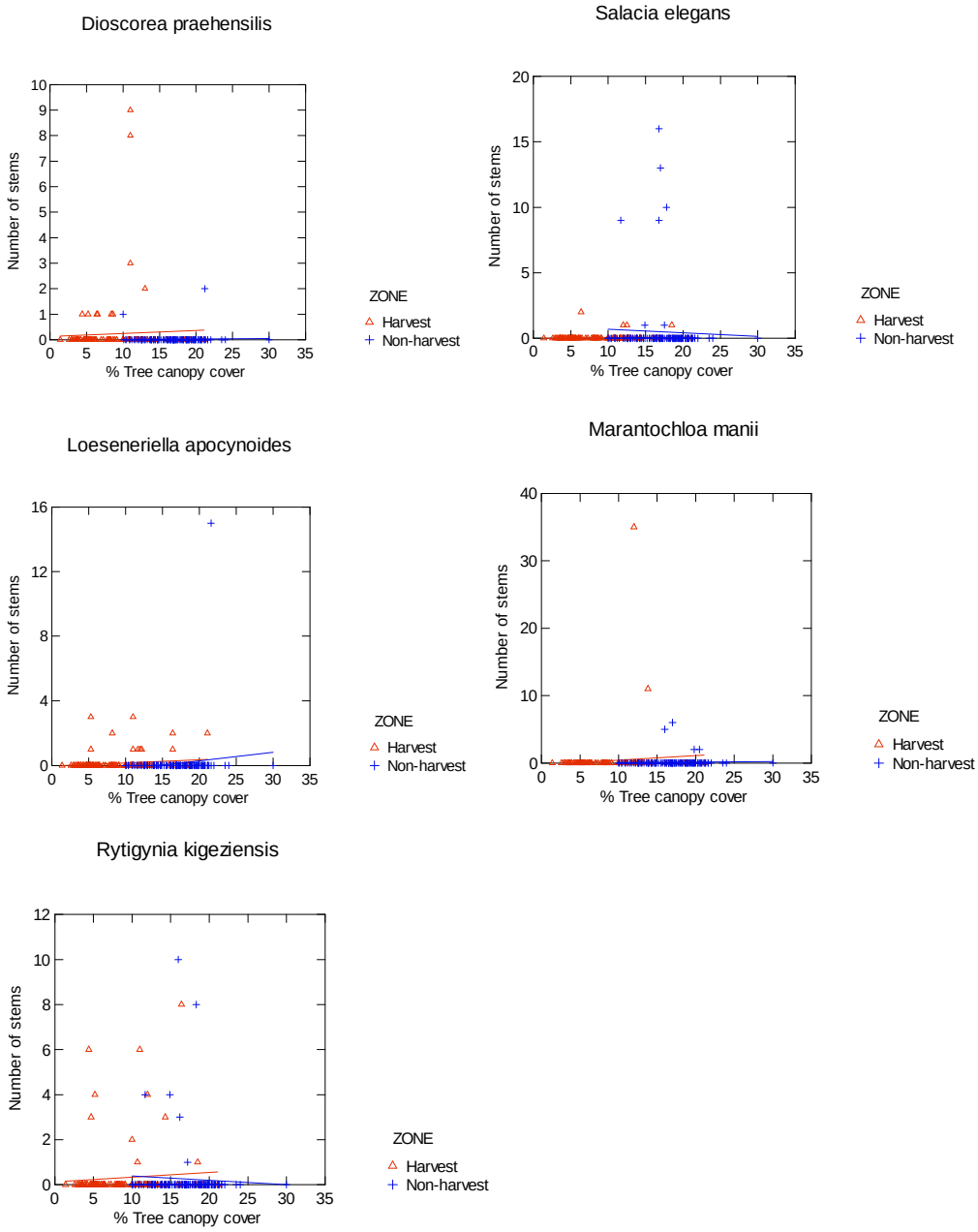
Zuidema, P.A, Kroon, H.D & Werger, M.J.A., 2007. Testing Sustainability by Prospective and Retrospective Demographic Analyses: Evaluation for Palm Leaf harvest. *Ecological applications*, 17(1) 118-128.

Appendix

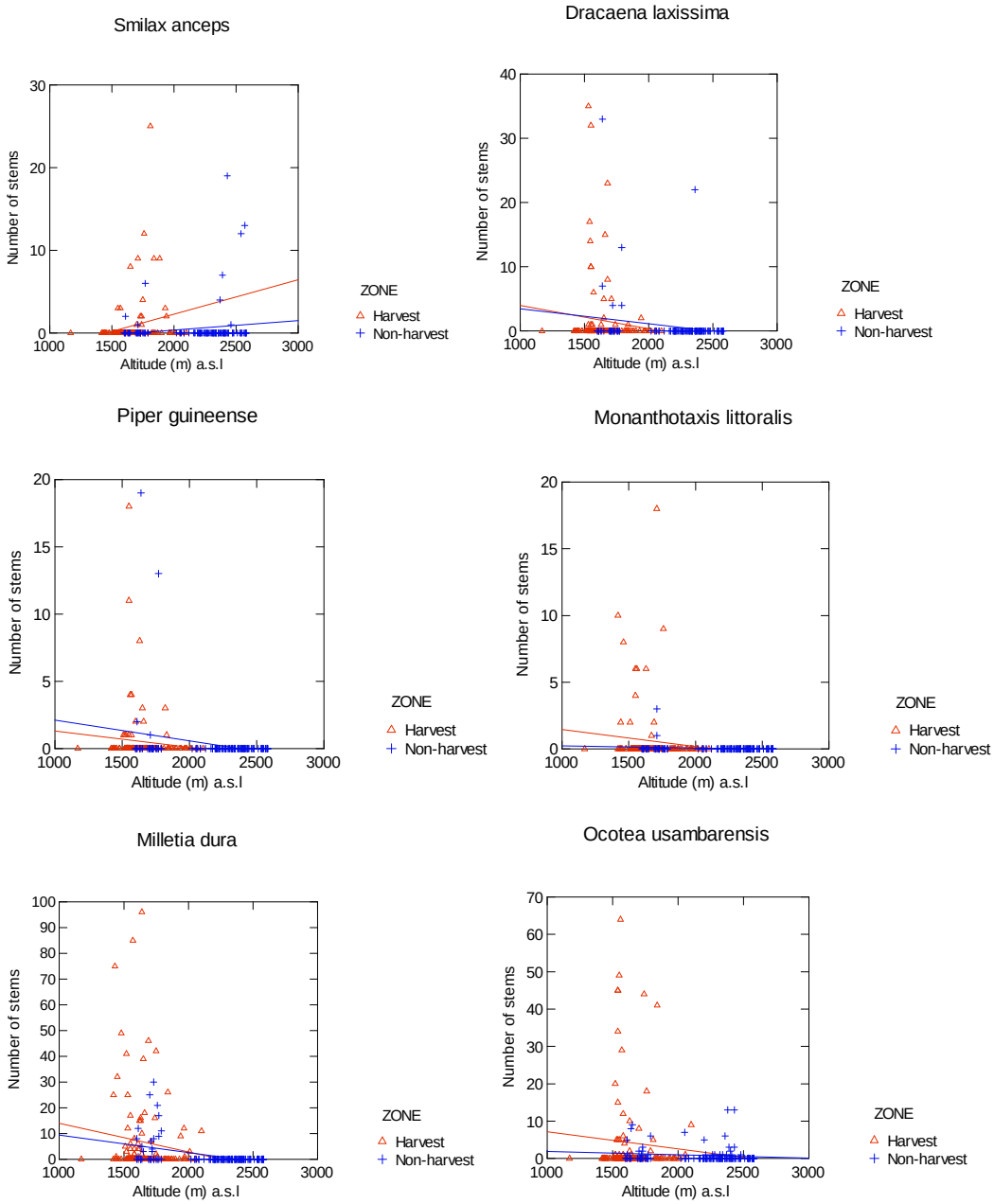
12.1a Scatterplot of stem density and % tree canopy in harvest and non-harvest zones



12.1b Scatterplot of stem density and % tree canopy in harvest and non-harvest zones

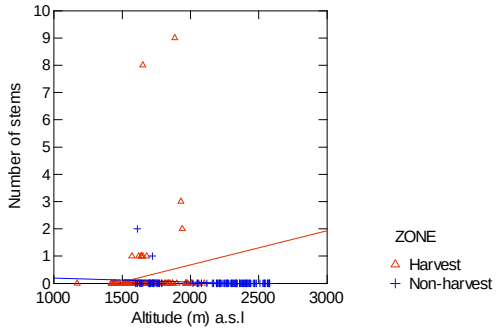


12.2a Scatterplot of stem density and altitude (m) a.s.l in harvest and non-harvest zones

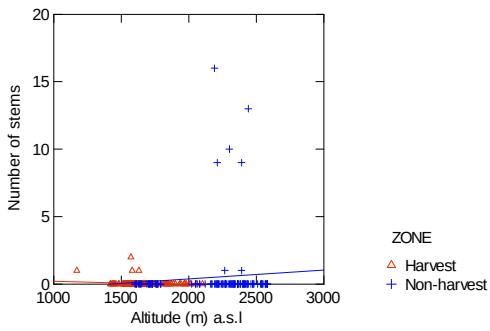


12.2b Scatterplot of stem density and altitude (m) a.s.l in harvest and non-harvest zones

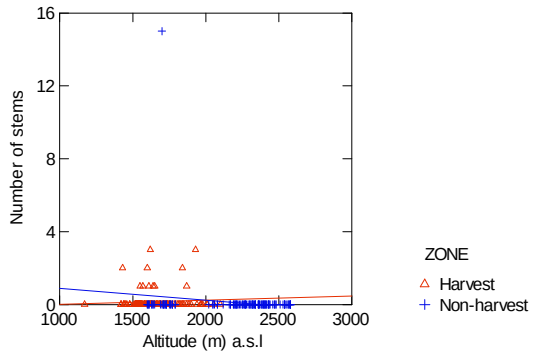
Dioscorea praehensilis



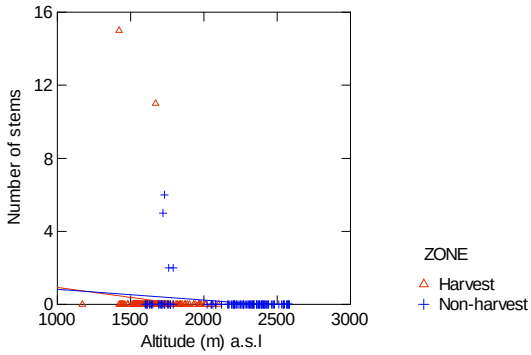
Salacia elegans



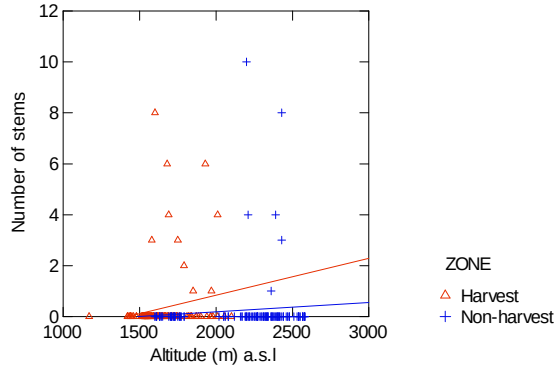
Loeseneriella apocynoides



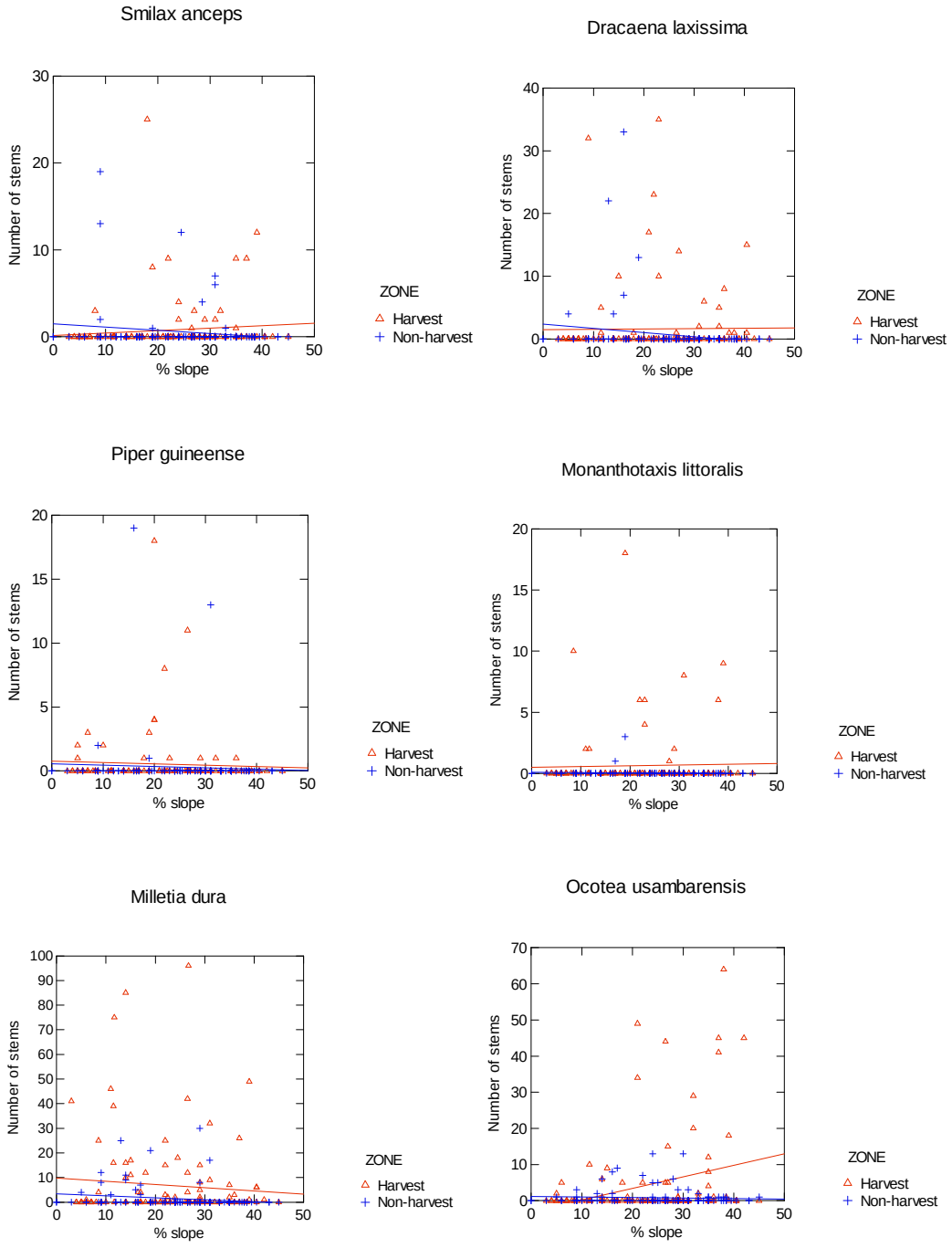
Marantochloa manii



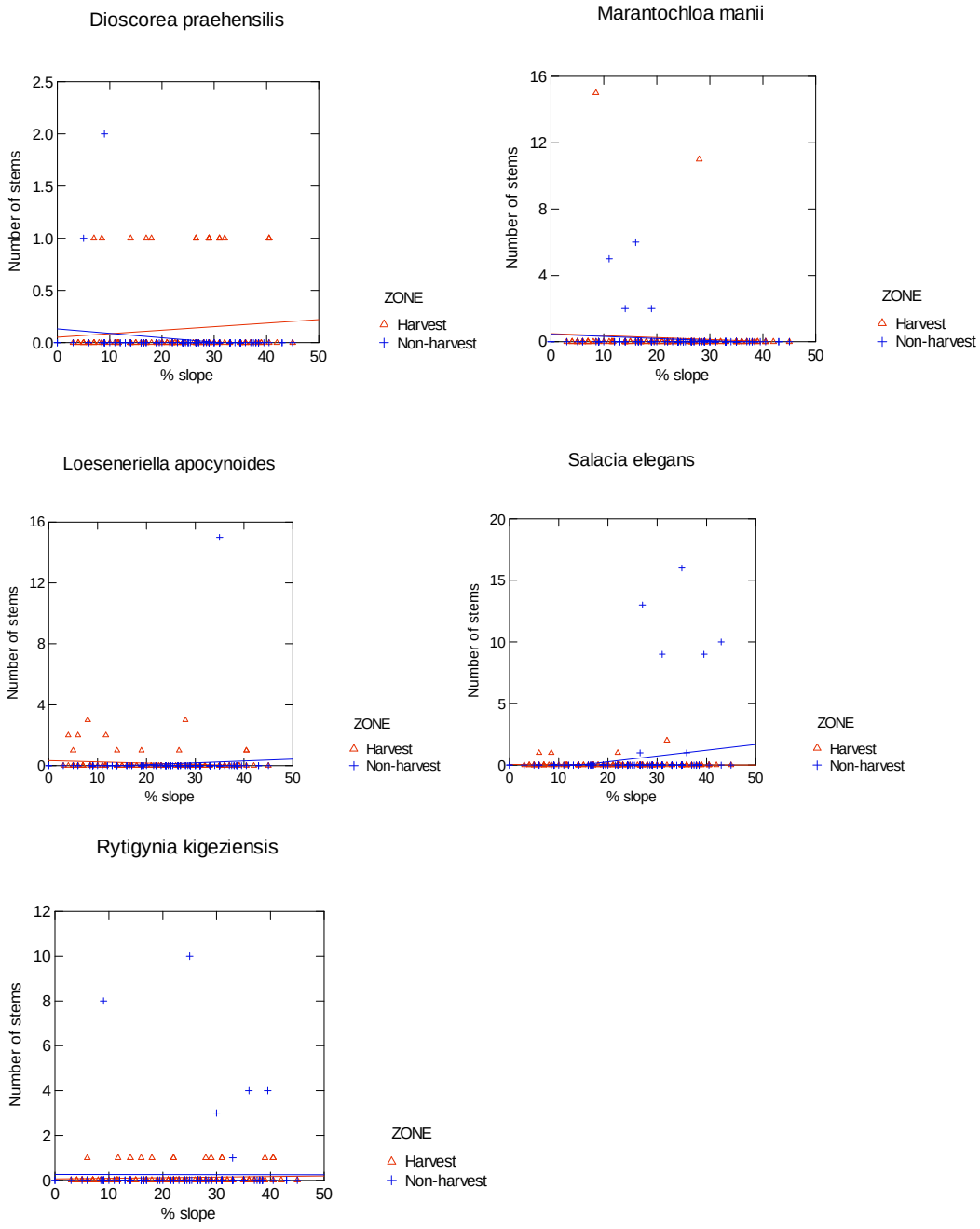
Rytigynia kigeziensis



12.3a Scatterplot of stem density and % slope in harvest and non-harvest zones



12.3b Scatterplot of stem density and % slope in harvest and non-harvest zones



Chapter 7

7. How can Bwindi's Multiple Use Programme be improved?

Recommendations for Park Managers and other Stakeholders

7.1 Introduction

The last six chapters have described Bwindi's multiple use programme (MUP) and issues to do with local people benefits from the programme and the conservation impacts of plant resource harvests. Successes, failures and inefficiencies of the MUP have also been pointed out. Three key issues need to be addressed to improve the MUP to benefit all stakeholders. These are:

1) Developing guidelines and steps describing the implementation of resource use programs in protected areas in general and Bwindi's in particular
2) Using a rapid vulnerability assessment method (RVA) for plant resource assessment rather than using the expensive and labor intensive random plots/transects methods in the PAs and particularly Bwindi.
3) Developing a simple local community monitoring tool for plant harvest impacts to be used by resource user groups or forest societies in the PAs in general and Bwindi in particular. The monitoring tool should work alongside existing monitoring protocols such as permanent sample plots in Bwindi. Rather than measure biodiversity parameters, the tool should focus on resource extraction and disturbance. High levels of commitment by the resource user groups to using the tool are needed. The tool should be simple, cost effective and cheap, transparent, requiring minimum training and education, and with the ability to stimulate discussions on plant resource harvest trends and threats at a village level (Danielsen *et al.*, 2000; Topp-Jørgensen *et al.*, 2005).

7.2 Guidelines for implementing Bwindi's Multiple Use Programme

7.2.1 Background

These guidelines are designed for park management and stakeholders who wish to understand the steps needed to implement resource use programmes in PAs in general and Bwindi's Multiple Use Programme (MUP) in particular. The steps herein may also guide protected area managers who wish to initiate resource use programs elsewhere or revise already existing ones. The guidelines are meant for park managers, local people (especially resource users) and other partners to have a quick reference on specific steps needed to implement resource use programmes. These guidelines were adapted from those recommended for use in Rwenzori Mountains National Park to suit Bwindi and Mgahinga Conservation Area (BMCA), (UGANEB, 2011). Information is provided on the importance of conducting resource use inventories while highlighting the relevant methods and techniques at each stage of resource use inventory exercise.

7.2.2 Working definition of the Multiple Use Programme

"Multiple use" in Bwindi initially referred to a combination of activities, i.e., biodiversity conservation, tourism development, bee keeping and forest resource collection. This later evolved to only resource collection and bee keeping (Wild, 2001). Under the MUP, specific local people gain permission to access and collect specified plant resources from the park. Presently these activities are limited to the collection of some plants for medicinal use and others for basketry. In some locations there are agreements allowing specific people to place beehives inside the park (Wild & Mutebi, 1996; ITFC, 1999; Wild, 200). The collection of firewood, wild honey, yams, fruits, vegetables, mushrooms and bushmeat are not included in the current agreements despite their importance to local people (see also chapter 4 of this thesis).

The Bwindi's MUP in its present working definition does not confirm to a true Collaborative Forest Management as shown in chapter 3 of this thesis. Consideration for the use of forest resources such as wild honey, wild yams, fruits, vegetables and mushrooms should be made for Bwindi's MUP to confirm to a true Collaborative Forest Management. Other MUP restrictions such as use of only 20% of the park's total area should also be revised upwards to cater for other parishes not involved in the MUP.

7.2.3 Policy and legal framework

An act of parliament mandates Bwindi to be managed by the Uganda Wildlife Authority (UWA). UWA is guided by the Uganda Wildlife Act 2000 CAP which empowers its Executive Director to enter into any commercial or collaborative arrangement with any person/s for management of the PA. The act thus states; "***the Executive Director shall be responsible for regulating and controlling harvesting in the wildlife protected areas and, in exercising his or her responsibility shall ensure that annual harvest does not exceed the sustainable yield level"***. UWA involves local people through Community Protected Area Institutions (CPIs) that constitute local government representatives at the parish level (Namara, 2006). The CPIs were formed to address interests of local people at the park management level. To strengthen the MUP, Resource Use Committees (RUCs) should constitute the CPIs i.e. RUC chairpersons should be members of the CPIs. The CPIs should also act as arbitrators in cases where UWA and local people need to appeal or update the resource use agreements. The CPIs are legally supported by the Community Protected Area Institutions Policy (2000). Bwindi's RUCs need to be legally registered by for example as community based organizations (CBOs). Legally registered RUCs are empowered and can sue or are sued; they have stronger negotiating power when initiating CFMs (Sumar Singh *et al.,* 1997; Worah, 2008).

7.2.4 Aims and objectives

Aims and objectives of the resource use programme set up by two parties are required for agreements between the two parties to function adequately and efficiently. This should be a prerequisite of the multiple use programme agreements in Bwindi. The objectives of the multiple use programme agreements should include but not limited to the following:

1) To protect and conserve biodiversity within the park including guarding against illegal activities within the park through shared responsibilities between park management and the local people or any other interested partners.
2) To allow regulated access of some park resources needed by the local people as long as sustainability can be guaranteed
3) To help improve relationship between park managers and the local people neighboring Bwindi.
4) To help the local people improve their livelihoods through collection of park resources that may contribute to their household incomes.
5) To induce the appreciation of the PA by the local people neighboring the park since they also suffer costs from animals that raid their crops or that may harm them.

7.2.5 Roles and responsibilities of key stakeholders

The key stakeholders involved in Bwindi's MUP include; Uganda Government represented by the Uganda Wildlife Authority (UWA), local community members (at village and parish level) represented by the RUCs, local councils and stretcher groups, Non-Governmental Organizations represented by development organizations such as CARE, Bwindi Mgahinga Conservation Trust (BMCT), International Gorilla Conservation Programme (IGCP) and Conservation Through Public Health (CTPH), Civil Society Organizations (CSOs) such as African International

Christian Ministries (AICM) and Rukungiri Functional Literacy Resource Center (RFLRC) (these two CSOs have already been involved in advocating for involvement of local people in the MUP), and research institutions represented by the Institute of Tropical Forest Conservation. Each of the stakeholders has specific roles and responsibilities to play.

7.2.5.1 Roles and responsibilities of Uganda Wildlife Authority (UWA)

The roles and responsibilities of UWA who are the custodians of the park include the following;

a To initiate the MUP process where opportunities exist for PA resource use.

b To allow regulated resource harvest within the park and issue licenses/permits for resource use to Resource Use Committees (RUCs).

c To be responsible for monitoring harvest impacts within the harvest zones together with local people and research institutions.

d To be responsible for the protection and conservation of natural resources within the national park

e To be responsible for sensitization of the local people on conservation issues

f To analyze local community resource harvest data (from RUCs) and take back results to the local people (feedback mechanisms).

g To monitor the implementation of the MUP together with partners and the local people

h To take appropriate legal actions on illegal activities reported by the local people

7.2.5.2 Roles and responsibilities of local community members

The local community members include Resource use committee (RUC) members, local council members, stretcher groups' members and other local administrative units. Their roles and responsibilities include to:

a Initiate the resource harvest in the MUP through community protected Area Institutions (CPIs) by expressing interest to use the national park for resource access.

b Assist UWA by participating in the monitoring and reporting illegal activities within the areas designated for resource access through their respective RUCs

c Monitor harvest impacts of the resources within the zones designated for use using a simple monitoring tool developed by ITFC

d Record resource harvest offtake data (through the chairman) of the resources harvested from the park all the time for harvest impact monitoring by the park management

e Help resolve conflicts arising out of illegal harvesters etc. through RUCs and stretcher groups meetings

f Hold regular meetings to discuss issues concerning resource use and monitoring in the MUP and local people livelihoods

g Ensure that no rubbish or any other litter or "foreign" objects are brought into the park.

7.2.5.3 Roles and responsibilities of non-governmental organizations

The Non-governmental and development organization involved in Bwindi include CARE, BMCT, CTPH, IGCP and CSOs. Their roles and responsibilities include to:

a) Help in supporting the local people in ex-situ planting of the forest resources outside the national parks through providing funds and technical assistance.

b) Help UWA facilitate the negotiation of the MUP process by acting as arbitrators (when both parties i.e. local people and UWA agree to them).

c) Help fund other activities that will help the local people generate income for their livelihoods and other alternatives that reduce pressure on Bwindi forest

d) Act as arbitrators when conflicts arise between UWA and the local people

7.2.5.4 Roles and responsibilities of research organizations

The major research organization working in Bwindi is the Institute of Tropical forest Conservation (ITFC) whose roles and responsibilities include to;

a Help UWA facilitate the process of participatory rural appraisal and the assessment of forest resource for local people in Bwindi.

b Help UWA and the RUCs design a simple monitoring tool for the local people to use in the monitoring of harvest impacts of resources from the park.

c Help UWA analyze local community resource harvest data (from RUCs) and take back results as feedback to the local people

d Help UWA in designing and implementing a more complex monitoring tool for resource harvest impact monitoring in the park (e.g. plant population matrix models in the permanent sample plots)

e Give guidance to UWA during the initiation process of the MUP

7.2.6 Geographical extent of the resource use zones

The MUP agreements must state the area coverage of the zones in which the resource users will be involved when harvesting forest resources from the park. Usually a map detailing the extent of the resource use zones is availed to the RUCs showing the physical boundaries such as hills, trails and rivers that define the extent of the zones. The resource harvest zones should be at the park periphery in areas extending into the interior up to a maximum distance of 2 km.

7.2.7 Dispute resolution

The resource use agreements must state how disputes between the local people and UWA and within the RUCs should be settled. The MUP agreements could point out for example how

disputes between the two parties (park management and local people) are settled amicably within 15 days as noted in the Budongo forest resource use MoUs. Procedures for terminating the resource use agreements by either party should be clearly spelled out when a need arises. The time frame (notice) of informing either party should be clearly spelled out. Dispute resolution should also point out penalties/ sanctions for breach of terms between the two parties. Also what might be important in the MUP are rewards clearly spelled out for illegal activity reporting by a member of the RUC.

7.2.8 Duration of the resource use agreements

The resource use agreements should be time bound showing how long the agreement between the two parties (park management and the local people) will last. This is normally 10 years with a review period of five years in between to coincide with the making of the park general management plans. Between the 10 years will be periods of revision or revoking the agreements if there is a need. This might be from the failure of one of the parties to comply with their responsibilities and roles.

7.3 The Multiple Use Programme Process

The initiation and implementation of the MUP is described under nine major steps below:

Step 1: Documenting park resources needed by the local people

The initial request for forest resources by local people should be expressed through the local Community Protected Area Institutions (CPIs). The CPI is a key local community institution that was formed to address local people interests at the park management level (Namara, 2006). The Chairpersons of the forest resource user committees should be members of CPIs. The CPIs have representatives of local people and park management who meet regularly to address

interests of the local people and park management concerns over the conservation of park resources.

The local people should therefore request for forest resources from the PAs through the CPIs who should in turn inform other key stakeholders (top park management, research institutions, development partner e.g. CARE, IGCP and BMCT). The partners will be consulted to help in carrying out the process to the next level of participatory rural appraisals (PRAs). During the PRAs, a wish list of park resources desired by the local people is compiled by the PRA team together with the local people (Bitariho *et al.,* 2006). The PRA is usually carried out in local community villages/parishes to assess local people's desire for forest resources (Plate 7.1).

Plate 7.1 Compiling a park resource use wish list by the local people using PRAs.

Step 2: Mapping PA resource by the local people

During the PRA exercise, local people are involved in the making of resource use maps using available local materials such as “dry sticks”, stones, seeds and leaves. This exercise is called participatory forest resource mapping. The local people will indicate (on the maps) resource use boundaries, major and minor physical boundaries such as rivers and hills as well as areas with high stem densities of the plants (Plate 7.2). The stick maps are then transcribed on paper maps for field use. The paper maps are the ones used as guides for forest walks while using a Global Positioning System (GPS) to geo-reference plant resource densities, distributions and physical boundaries such as rivers and hills.

All GPS points are then plotted in a computer map making software such as ArcView 3.3 and ArcGIS or any other GIS software with a digitized map of the park. The polygons of the plant use zones are then overlayed on the polygon maps of the parks to produce resource use management zones or multiple use zones (MUZs). Furthermore, boundaries of MUZs are walked using the GPS to record co-ordinates of the boundaries. Physical features such as major and minor rivers and hills are noted and their GPS coordinates also recorded. The walking of the boundaries of the forest should be carried out together with key resource users that were identified during the PRA exercise above.

Plate 7.2 an example of a sticks and stones map made by local people during PRA.

Step 3: Focused searches and herbarium specimen collections

Subjective focused searches for forest resources are carried out to locate and identify plants for herbarium identification (Bitariho *et al.,* 2006). The aim of the subjective focused searches is to identify the requested plant species together with plant resource user specialists. Forest walks are made together with a herbarium technician and the specialist forest resource users. During the forest walks, the requested plants are subjectively sought and at the same time, plant specimens collected for herbarium identification. The herbarium specimens are pressed, and taken to the herbarium (e.g. ITFC herbarium) for identification. The value of the herbarium specimen collection is to help in correctly identifying the requested plants since local people sometimes describe the plants with more than one vernacular name during the PRAs.

Step 4: Rapid vulnerability assessment of the PA resources

This involves assessment of abundance and distribution of resources within the park. This should be done using a Rapid Vulnerability Assessment (RVA) method. The method was assesses subjectively the abundance and distribution of resources through knowledge of specialist resource users and a few subjective forest visits (Wild & Mutebi, 1996; Wong, 2003; Cunningham, 2001). The method involves park managers and local people working together rapidly to assess the vulnerability of PA resources to utilization (Wild, 2001; Wong, 2003). The method is designed to collect ecological and social data on resources desired by the local people from the PAs. It integrates indigenous knowledge with scientific knowledge. The PA resource vulnerability parameters such as life form (for plants), habitat specificity, abundance and distribution, growth rates, response to harvesting, parts used, pattern of selection and use and demand for each desired resource from the PA are used. After subjecting each of the desired resources to the RVA method, the resources permitted for extraction are listed down together with the local people. This method has the advantage of involving local people in resource assessment

Step 5: Feedback to stakeholders and local people

A meeting is then called to review and discuss findings from earlier steps (1 to 4) with key stakeholders and a large local people membership (usually all members of the village community). The meeting is aimed at reaching consensus on the results of the forest resources to be harvested. Village and Batwa based resource use committees (RUCs) are then formed from the large village community members. These committees are elected from the large village local people membership. The amounts (annual offtakes) of the resources to be harvested as recommended from the RVA are then spelled out to the local people with clear roles, rights,

responsibilities and returns (4Rs) of key stakeholders. The local people should clearly understand the 4Rs in resource use before commencing the harvest.

Step 6: Resource use agreements

Memoranda of Understanding (MOU) between the different resource user groups and park management are then prepared jointly. The MoUs should state the roles, rights, responsibilities and returns (4Rs) of both UWA and local resource users. They also should clarify the resources to be harvested, where, when and by whom. Penalties in cases of non-compliance to the MoUs should be clearly stated. The MoUs as discussed previously should be village/Batwa based as a sub-committee of the RUCs. The parish RUCs should serve as an umbrella for all the village and Batwa RUCs. Parish RUCs will be formed from each Chairperson of the village and Batwa RUCs. The draft MOUs are then given to the RUCs and park management for comments, additions and subtractions. Changes are then made to the draft MoUs whenever applicable and the final MoUs presented to all the stakeholders. Where possible the drafting and finalization of making of the MoUs should be managed by an independent third party (e.g. CARE development organization or a hired consultant).

The village and Batwa based RUCs will constitute of the chairman, secretary, treasurer and committee members. These are usually members who are versed with forest resource use e.g. specialist basket makers, herbalists and beekeepers. A day for signing the MoU is then set where the resource use committees, stretcher group chairpersons, local government, parish chief and staff of UWA especially the Conservation Area Manager (CAM) are present. The signatories should be the CAM, chairpersons' resource use committee, chairperson stretcher group, parish

chief and other key witnesses. The MoUs are then signed for implementation a copy of which is given to each signatory (Plate 7.3).

Plate 7.3: Exchange of signed MoUs between a park manager and a RUC chairman.

Step 7: Start of the forest resource harvesting

Park resource harvests can begin when the MoUs have been signed by all parties concerned (Plate 7.4). There is a need to ensure strict adherence to the set conditions of the MoUs. The frequency of forest resource harvest should be spelled out in the MoUs. It is desirable for UWA not to restrict the forest resource harvest frequency to twice in a year as practiced in Bwindi. This should be raised to at least six times in a year. Other National Parks located in the Albertine Rift such as Rwenzori Mountains, Kibale and Semuliki National Parks allow harvest of some plant resources from the park to twelve times a year.

Plate 7.4: Women harvesting plant resources after signing resource use MoUs.

Step 8: Monitoring impacts of resource harvesting

Monitoring impacts of resource use should be done by the using two methods: one by the use of transects and plots set up permanently in the forest (Bitariho *et al* (2006), and the other by using a local community monitoring tool. The local community monitoring should be by the village RUCs supervised by the parish RUCs and park management.

Evaluation and monitoring of the progress and implementation of resource use agreements should also be carried out. The evaluation should be done by a hired consultant or arbitrator that is not part of the resource use MoUs. From the monitoring and evaluation results adjustments may be made to the implementation of the resource use programme.

Step 9: Review of the resource use programme

The following decisions may be made after reviewing the resource use programme:

- Increasing the plant harvest off takes (if no impact on resources and demand is high)
- Decreasing the plant harvest off takes (if negative impacts on resources and demand is high)
- Stopping the harvest of some plants (if high harvest impacts on resources has been experienced)
- Re-drafting and signing of new MoUs

These steps are cyclic or reiterative and can be taken up from any stage depending on the progress of the resource use programme.

7.4 Rapid Vulnerability Assessment Method

The Rapid Vulnerability Assessment (RVA) method was developed by Tony Cunningham (1992). It is a rapid method used for determining the plant resources that are threatened by exploitation (Wong, 2003). The RVA method assesses subjectively the abundance and distribution of forest resources using local forest resource users' knowledge of the forest resource (Wild & Mutebi, 1996; Wong, 2003; Cunningham, 2001). This method has the advantage of involving local people in resource assessment and is not restrictive like the random transect/plot method used earlier on in Bwindi.

The RVA method was developed as a protocol for collecting available knowledge, indigenous as well as scientific, about forest resources needed by the local people (Wong, 2003). The method

requires the integration of local knowledge (gathered through Participatory Rural Appraisals-PRAs) and scientific information (from literature and Herbaria) and depends on being able to match local and scientific names (Wong, 2003). The collated information is used to identify species, resources or sites that may be exploited or those that may not be exploited due to their vulnerability (Wong, 2003).

This method has been adapted to suit the prevailing conditions in the Bwindi Mgahinga Conservation Area (BMCA). It has been used in Mgahinga Gorilla National Park and Queen Elizabeth National Park by the Institute of Tropical Forest Conservation (ITFC). First the resource plants are assessed based on three ecological criterions; life-form and part harvested (Table 7.1). The plants are subjectively assessed based on the number of encounters of the resource plants found. Three categories of resource plants are used to categorize the plants; common, rare and not found plants. The categories of "common plants" are those with more than 10 stems of an individual species encountered; "rare" if the plant species encountered are less than 10 and not found plants if none of the plants are encountered (ITFC, 1999).

Table 7.1 Criteria used for Rapid Vulnerability Assessment (RVA)

Criteria	Potential for sustainable use	
	Low	High
Ecology	Low abundance	High abundance
	Slow growth	Fast growth
	Slow reproduction	Fast reproduction
	Sexual reproduction	Vegetative reproduction
	Habitat specific	Habitat non-specific
Life form	Use of grasses, vines, herbs are more sustainable than use of whole tree stem	
Part to be harvested	Use of leaves are likely to be more sustainable than use of whole stems of a plant	

Adapted from Watts *et al.*, (1996) and Wong, (2003)

Appendix

7.5 RVA Data sheets for Resource Assessment

Field data sheet 1

Date:_____
Location (Village/Parish)_____
Time taken for forest walk (hours)_____

Local name	**Botanical name**	**Tally**	**Total number**

7.6 Field data sheet 2

Date_____
Parish/location_____

Plant Species	Life form	Part harvested	Common/rare/not found

Plant species- use both local name and botanical name where possible- otherwise use either
Life form—Herb, Vines, Lianas, Shrubs and Trees
Part harvested- Leaves, Bark, Root, Whole stem, Fruits, Flowers and Stalks
Common = > 10 stems, Rare = <10 stems, Not found = none encountered

References

Bitariho, R., Kagoda, E., Barigyira R.,Amanya, S., Safari., C., 2006. The potential supply of forest resources demanded by Batwa from Bwindi Impenetrable National Park, S.W Uganda, Unpublished report, Institute of Tropical Forest Conservation, Kabale.

Cunningham, A.B., 1992. People, park and plant use: Research and recommendations for multiple-use zones and development alternatives around Bwindi-impenetrable National Park, Uganda. Report to CARE-International, Kampala.

Cunningham A B., 2001. Applied Ethnobotany, People, Wild Plant Use and Conservation, WWF, Earthscan Publications Ltd, London.

Danielsen, F.,Balete, D.S.,Poulsen, M.K, Enghoff, M.,Nozawa, C.M & Jensen, A.E, 2000. A simple system for monitoring biodiversity in protected areas of a developing country. *Biodiversity Conservation* 9:1671-1705.

ITFC., 1999. The potential supply of weaving and medicinal plant resources in the Proposed Kifunjo/Masya multiple-use zone of Bwindi Impenetrable National Park, Ruhija, Kabale.

Namara, A., 2006. From Paternalism to real partnership with local communities? Experiences from Bwindi Impenetrable National Park (Uganda). *Africa Development* 31 (2):39-68.

Samar Singh, Avenash Datta, Anil Bakshi, Arvind Khare, Sushil Saigal, & Navin Kapoor, 1997. Participatory Forest Management in West Bengal, India. In Harvesting Wild Species, Implications for biodiversity conservation by Freese CH. The John Hopkins UniversityPress, Baltimore, Maryland, London.

Topp-Jørgensen, E., Poulsen, M.K., Lund, F.J & Massao, J.F, 2005. Community-based monitoring of natural resource use and forest quality in montane forests and miombo woodlands of Tanzania, *Biodiversity and Conservation* 14:2653-2677.

UGANEB, 2011. Ten steps for forest resource use inventories, a field guide. Unpublished report for WWF-Norway & WWF-Eastern Africa Regional Programme Office (EARPO), Kampala.

Watts, J., Scott, P & Mutebi, J., 1996. Forest assessment and monitoring for conservation and local use: Experiences in three Ugandan National Parks. Pp. 212-243. In Carter J. (ed) Recent approaches to participatory forest resource assessment. Rural development forestry study guide 2. ODI, London.

Wild, R.G., 2001. Plants from the Park: Establishing Community Harvesting of Plants as a Conservation Tool at Bwindi Impenetrable and Mgahinga National Parks, Uganda. Unpublished Master of philosophy thesis Department of Botany, University of Capetown, Capetown.

Wild R & Mutebi, J.,1996. Conservation Through Community Use of Plant Resources: Establishing Collaborative Management at Bwindi Impenetrable and Mgahinga Gorilla National Parks. People and Plants Working Paper 5. UNESCO, Paris.

Wong, J.,2003. Recommendations for resource assessment for collaborative forest management in Uganda. SC/08/2002. Report to the EDF/Uganda Forest Department: Forest resources management and conservation programme, Kampala.

Worah S., 2008. Participatory management of forests and protected areas, a trainer's manual. Regional community forestry Center (RECOFTC), Bangkok.

Chapter 8:

8. General discussion, conclusion and recommendations

8.1 Discussion

Understanding historical trends in tropical forest use by local people adjacent a protected area is an important component for park management. The present challenges to most protected areas (PAs) such as Bwindi Impenetrable National Park are partly a result of the history of forest use by local people, as a source of livelihood. It is important to understand the historical trends and views in forest use by the local people. This is a prerequisites for incorporating their views into new development initiatives and future reviews of resource use programs and documenting them in a format that is readily accessible to planners and developers for PAs (Cunliffe *et al* 2007). It is understood that the reasons why different management regimes of Bwindi Impenetrable forest have altered the way local people relate to are results of past anthropogenic use of the forest.

This study examined the following aspects: 1) historic trends in use of forests by local people, 2) A review of whether Bwindi's MUP initiates local people' participation in park management, 3) Forest resources important to local people adjacent PAs, 4) The contributions of Bwindi's MUP to local people livelihood and income and 5) ecological implications of harvesting forest resources from Bwindi forest. The main findings show that: past local people use of Bwindi forest relate to the present challenges and issues affecting park management such as illegal resource extractions presently observed in Bwindi. The study further notes that important forest resources for local people from Bwindi forest were those prohibited by Park management under the MUP. This is the reason why the MUP contributes less to local people livelihoods. The study

also found out that there were no negative ecological implications caused by the Bwindi's MUP from plant harvests by the local people and that fears for resource overexploitation in Bwindi are unfounded except for two species of *Loeseneriella apocynoides* and *Marantochloa manii*.

Despite recent technological advancements, more than 25% of the world's population still relies on forest resources for their livelihoods and local people around Bwindi are no exceptions. They live in extreme poverty and lack the basic necessities for a decent life and cannot be divorced from the forest (Freese, 1997; Arnold & Perez, 2001; World Bank, 2001; Ticktin, 2004; Vedeld*et al.* 2004; FAO, 2006; Kaimowitz & Sheil, 2007; Babulo *et al*., 2008; Ghazoul& Sheil, 2010). However, most resource use programmes in tropical PAs such as Bwindi have tended to divorce local people from them through limited access to PA resources and through decoupling strategies such as substitution/on-farm cultivation and agriculture development progammes (Blomley, *et al.,* 2010; Namara, 2006).As such these resource use programs have rarely been successful and Bwindi's MUP is one such example as shown by this study.

Like most collaborative forest management programs elsewhere, the MUP in Bwindi was a result of conflicts between natural resource managers and adjacent local people (Wild, 2001; Borrini-Feyerabend *et al.,* 2007; Worah, 2008); The programme was set up on the premise that the relationship between park management and local people would be enhanced through access to minor forest products for livelihoods, and that illegal activities within the park would stop or reduce (Cunningham, 1996; Multiple use MoUs, 1994; Wild, 2001). This study has shown that the programme has failed to achieve these goals despite the several reviews carried out to improve the programme (Bensted-Smith *et al.* 1995; Davey *et al.*2001; Bitariho *et al.*2004 and Tushabomwe-

Kazooba & Mbamanya, 2005). Local people access to the forest resources has been limited to only those PA managers think are not ecologically destructive and as such, the local people continue to access the resources "illegally" to maintain their livelihoods. Some of the illegal activities observed in Bwindi are manifestations by the local people to access the forest resources like was in the past despite risking arrests and fines by PA managers (Namara, 2006).

A similar scenario was observed in Bardia National Park in Nepal by Shova & Hubacek (2010) where more than 50% of households extracted resources from the park illegally. Even with the introduction of other park management programmes such as revenue sharing, resource use programmes and tourism, the illegal activities in PAs still remain a problem to most PA managers (Shova & Hubacek, 2010). What is needed therefore is for PA managers to undertand historical trends in forest use and put into considerations the views of the local people adjacent the PAs to involve them actively in PA management (Cunliffe *et al* 2007).

Destruction or degradation of forest resources is most likely to occur in open-access forests where those involved, or external authorities, have not established effective governance of resource use committees (Ostrom, 1999). Despite efforts by PA managers and partners in Bwindi to form Resource use committees (RUC) to enhance self-governance in forest resource collection and management, the RUCs are poorly governed and lack cohesion as shown by this study. Furthermore, self-governance, cooperation and cohesion of the RUCs cannot be attained without provision of motivations and adequate incentives in form of access to livelihood requirements from the PAs (Ostrom, 2000; Barrow &Murphree, 2001Beck, 2000; Castro & Nielsen, 2001; Borrini-Feyerabend*et al.,* 2007). This therefore implies that the Bwindi forest resources are likely to be

degraded in future from illegal resource collections if the RUCs are not reviewed to improve their governance and organization capabilities.

The past two decades have witnessed efforts to promote extraction of non-timber forest products from protected areas (PAs). These efforts are based on the assumption that the PAs must offer incentives to local people and as such help to reduce on threats to the PAs (Ticktin, 2004; Newton, 2007; Agrawal & Redford, 2009; Blomley *et al.*, 2010). Local people around the PAs suffer costs of being PA neighbors such as through displacement, crop damage and harm from animals (Woodroffe *et al.*, 2005, Adams & Hutton, 2007). Therefore, achieving conservation in the PAs is difficult if the local people resent the PAs due to the costs they incur. This study has shown that the most important forest resources to the local people around Bwindi were those prohibited by park authorities.With the limited access to forest resources as practiced in Bwindi, the MUP offers little socioeconomic incentives the local people involved. This is the reason the Bwindi's MUP alone cannot alleviate poverty among the local people nor compensate for costs incurred from the crop raiding animals.

This study has further shown that most rural local people around Bwindi tend to diversify their source of income as a strategy of alleviating themselves out of poverty and to maintain a sustainable livelihood. This is a strategy employed by most rural poor households that have limited access to resources (Illukptiya&Yanagida, 2008; Debela *et al*, 2012). When local people's livelihoods are threatened and limited by PA managers, there is bound to arise conflicts over the forest resources (Borrini-Feyerabend *et al.*, 2007; Worah 2008). Although the multiple use programme was initiated to help mitigate such conflicts, limited access to the forest resources by

the Bwindi's MUP could initiate new conflicts between park managers and the local people for the resources. Indeed experience elsewhere has shown that co-management regimes can set into motion new conflicts or cause old ones to escalate if not well managed (Castro & Nielsen, 2001). What is required for PA resource use programs such as the Bwindi's MUP is to find a balance in a sustainable manner between natural resource conservation and the needs for local people livelihoods.

This study also assessed the ecological implications of harvesting plant resources from Bwindi forest. The study did not detect any negative harvest impacts on most of the plants being harvested by the local people from Bwindi forest. Most of the forest plants harvested by local people in Bwindi are secondary forest species that are colonizing the forest after past human disturbance from timber logging (Cunningham, 1992; Wild &Mutebi, 1996).This study noted that the observed forest disturbances in Bwindi are a result of past anthropogenic perturbations caused by past tree timber logging and forest fires and not non-timber forest products extractions. Indeed, plant harvesting in Bwindi forest may have caused increased regeneration of most harvested plants since harvest zones had the highest stem densities of the harvested plants. It therefore would seem a good option not to limit plant resource harvests to low levels and forest resource access frequency when no negative harvests have been detected. This should be the case in Bwindi as this study shows. What is needed is to determine sustainable harvest levels of the most threatened plants such as those highly used and commercialized e.g. *Loeseneriella apocynoides* in Bwindi through yield studies while allowing unlimited and self-governed access to other forest resources not considered threatened such as the *Smilax anceps* used by local people in Bwindi.

8.2 Conclusions

The main conclusions from the present study are: Resource use programmes that are restrictive and that tend to limit local people participation in park management such as the MUP in Bwindi are a source of future conflicts between PA managers and the local people. Instead of helping abate the conflicts, the MUP programme might exacerbate the conflicts if local people participation and desires are not considered by park management. Extraction and conservation of forest resources from the PAs should be done with the active participation of adjacent local people. Some of the illegal activities experienced in Bwindi are a manifestation of such conflicts that need to be addressed by park managers. Moreover as this study shows, despite the illegal activities and the limited resource access, plant resource harvest in Bwindi is sustainable. What is required in the Bwindi's MUP is to find a balance between meeting the local people's aspirations and conserving the forest resources for future generations.

8.3 Recommendations

Resource use programs in PAs need to be frequently monitored and reviewed for successes and failures in order for them to be relevant. As such, there is a dire need by Bwindi park managers to review the MUP to incorporate some of the local people aspirations while at the same time not compromising the conservation goals of Uganda Wildlife Authority. Local people should be involved right from the first stage of negotiating, implementing and monitoring the MUP. This will empower them and make them more accountable to PA managers and therefore be directly involved in park management and forest resource conservation.

Perhaps to achieve this, park management needs to reconsider some of the restrictions imposed on the MUP and also synergize the MUP with other park management programs such as tourism development and revenue sharing.

A review of the forest resource user committees (RUCs) is needed. The review should point out how the RUCs should be made well governed, accountable to the large community members and cohesive. For example, such RUCs should be made smaller such as those based on villages or stretcher groups.

Local community members should be empowered to assess and monitor harvested forest resources by training the RUCs in ways that are simple to undertake such as use of a simple local community plant harvest monitoring tool. Such tool should be simple and easy for the local people to understand and be able to mitigate plant resource over-harvesting.

References

Adams, W.M & Hutton, J., 2007. People, Parks and Poverty: Political Ecology and Biodiversity Conservation. *Conservation Society* 5:147-183.

Agrawal, A & Redford, K., 2009. Conservation and Displacement: An Overview, *Conservation Society* 7 (1): 1-10.

Arnold, J.E.M, & Perez, R.M., 2001. Can non-timber forest products match tropical forest conservation and development objectives (analysis), *Ecological economics* 39; 437- 447.

Babulo, B, Muys, B, Nega, F, Tollens, E, Nyssen, J, Deckers, J, Mathijs, E, 2008. Household Livelihood strategies and forest dependence in the highlands of Tigray, Northern Ethiopia, *Agricultural Systems* 98: 147-155Ghazoul, J & Sheil, D., 2010. Tropical rain forest ecology, diversity, and conservation. Oxford University Press, Great Clarendon Street, Oxford.

Barrow, E & Murphree, M., 2001.'Community conservation. From concept to practice' In D.Hulme and M. Murphree, eds., *African Wildlife and Livelihoods. The promise and Performance of community conservation*, James Currey, Oxford

Beck, P., 2000. Collaboration and Credible Commitments: Experiments with Collaborative Resource Management in Uganda. Unpublished report prepared for delivery at the 2000 meeting of the international association for the society of common property. School of public and environmental affairs, Indiana University, Bloomington.

Bensted-Smith, R., Infield, M., Otekat, J. and Thompson-Handler, N., 1995. Review of the multiple-use (resource sharing) programme in Bwindi Impenetrable National Park. A report to CARE-Development Through Conservation Project, Kabale.

Blomley, T., Namara, A., McNeilage, A., Franks, P., Rainer, H., Donaldson, A.,

Malpas, R., Olupot, W., Baker, J., Sandbrook, C., Bitariho, R. and Infield, M., 2010 Development and gorillas? Assessing fifteen years of integrated conservation and development in south-western Uganda, Natural Resource Issues No. 23. IIED, London

Bitariho R, Mugyerwa B, Barigyira R and Kagoda E., 2004. Local people's attitudes and new demands since inception of multiple use programme in Bwindi Impenetrable National Park, S. W Uganda, Unpublished report, Institute of Tropical Forest Conservation, Kabale.

Borrini-Feyerabend, G., Pimbert, M., Farvar, M.T., Kothari, A & Renard, Y., 2007. Sharing Power: A global guide to collaborative management of natural resources. Earthscan Publications limited, London.

Castro, A.P & Nielsen, E., 2001. Indigenous people and co-management: Implications for conflict management, *Environmental Science and Policy* 4:229-239.

Cunliffe, R.N, Timothy J. P. Lynam,T. J.P,Sheil, D, Wan, M, Salim, A, Basuki, I, and Priya, H., 2007. Developing a Predictive Understanding of Landscape Importance to the Punan-Pelancau of East Kalimantan, Borneo, *Ambio* 36,(7): 593:599

Cunningham, A.B., 1992. People, park and plant use: Research and recommendations for multiple-use zones and development alternatives around Bwindi-impenetrable National Park, Uganda. Report to CARE-International, Kampala.

Cunningham, A.B., 1996. People, Park and Plant Use, Recommendations for multiple use zones and development alternatives around Bwindi Impenetrable National Park, Uganda. A report for people and plants initiative, division of ecological sciences, UNESCO, 7 place de fontenoy, Paris.

Davey, C., Peters, C.M, & Byarugaba, D., 2001. Participatory review of the Multiple Use Programme, Bwindi Impenetrable National Park and Mgahinga Gorilla National Park. CARE-Uganda and Uganda Wildlife Authority, Kampala.

Debela, B, Shively, G, Angelsen, A & Wik, M., 2012. Economic Shocks, Diversification, and Forest Use in Uganda, *Land Economics* 88 (1): 139–154.

FAO., 2006. Better forestry, less poverty, a practitioner's guide. Food and Agriculture Organization of the United Nations, FAO forestry paper 149, Rome.

Freese, C.H., 1997. Harvesting Wild Species, Implications for Biodiversity Conservation. The Johns Hopkins University Press, 2715 North Charles street, Baltimore, Maryland.

Illukptiya, P., & Yanagida, J.F., 2008. Role of income diversification in protecting natural forests: Evidence from rural households in forest margins of Sri Lanka. *Agroforestry Systems* (74):51-62.

Kaimowitz, D & Sheil, D., 2007. Conserving What and for Whom? Why Conservation Should Help Meet Basic Human Needs in the Tropics, *Biotropica* 39(5): 567–574.

Multiple use MoU, 1994. Memorundum of Understanding Between Uganda National Park- Bwindi Impenetrable National Park and the People of Rutugunda Parish, Kanungu District. An agreement concerning collaborative forest use and management at Bwindi Impenetrable National Park, Kanungu.

Namara, A., 2006. From Paternalism to real partnership with local communities? Experiences from Bwindi Impenetrable National Park (Uganda). *Africa Development* 31 (2):39-68.

Ostrom E., 1999. Self-Governance and Forest Resources. Occasional paper no.20

CIFOR, Indonesia. http://www.cgiar.org/cifor

Ostrom, E., 2000. Collective Action and Evolution of Social Norms, *Journal of Economic Perspectives* 14 (3):137-158.

Shova, T & Hubacek, K., 2011. Drivers of illegal resource extraction: An analysis of Bardia National Park, Nepal, *Journal of Environmental Management* 92:156-164

Ticktin, T., 2004. The ecological implications of harvesting non-timber forest products. *Journal of Applied Ecology* 41, 11-21.

Tushabomwe-Kazooba, C, & Mbamanya, H., 2005. Multiple use program in Bwindi Mgahinga Conservation Area (BMCA) – South western Uganda. Unpublished report of a stakeholders' workshop held in White Horse Inn Kabale, A consultancy report for CARE-REPA, Kampala.

Vedeld, P., .Angelsen, A., Sjaastad, E., & Kobugabe, G. B., G., 2004. Counting on The Environment, Forest Incomes and the Rural Poor. Environment Economics Series paper

Wild, R., 2001. Plants from the Park: Establishing Community Harvesting of Plants as a Conservation Tool at Bwindi Impenetrable and Mgahinga National Parks, Uganda. Unpublished Master of philosophy thesis Department of Botany, University of Capetown, Capetown.

Wild, R., & Mutebi, J.,1996. Conservation Through Community Use of Plant Resources: Establishing Collaborative Management at Bwindi Impenetrable And Mgahinga Gorilla National Parks. People and Plants Working Paper 5. UNESCO, Paris.

Worah S., 2008. Participatory management of forests and protected areas, a trainer's manual. Regional community forestry center (RECOFTC), Bangkok.

World Bank**.,** 2001. A revised forest strategy for the World Bank Group. Draft. Washington, DC.

Woodroffe, R., Thirgood, S., & Rabinowitz (eds)., 2005. People and Wildlife: Conflict or Coexistence? Cambridge University Press, Cambridge.,