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Harvesting of wild climbers, food security and ecological implications in Bwindi Impenetrable National Park, S.W uganda

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List of Acronyms

BINP	Bwindi Impenetrable National Park
BMCA	BwindiMgahinga Conservation Area
BMCT	BwindiMgahinga Conservation Trust
DRC	Democratic Republic of Congo
FAO	Food and Agriculture Organization
HUGO	Human-Gorilla Conflict Resolution Program
HWC	Human Wildlife Conflict
IGCP	International Gorilla Conservation Program
ITFC	Institute of Tropical Forest Conservation
IUCN	World Conservation Union
MGNP	Mgahinga Gorilla National Park
MUST	Mbarara University of Science and Technology
PAs	Protected Areas
PAC	Problem Animal Control
PAM	Problem Animal Management
UWA	Uganda Wildlife Authority
WCS	Wildlife Conservation Society
WWF	World Wide Fund for Nature

Executive Summary

Humans have harvested wild climbers from forests for subsistence and commercial use for thousands of years. In the early four decades, wild climbers were considered a "nuisance" by foresters claiming they suppressed timber tree production and therefore cleared expanses of forests free of the wild climbers. This trend was nevertheless discarded later on, after the realizations that the wild climbers played crucial roles in the rural economies of most tropical countries. Wild climbers (lianas and vines) have played important roles in the livelihoods of people locally and internationally. The use of wild forest climbers is more evident in the tropics, where they are used by rural farmers in food and cash crop production processes. The importance of wild climbers in rural economies for sustenance of food security in homesteads cannot, therefore, be overemphasized.

In Bwindi Impenetrable National Park (BINP), the exploitation and use of wild climbers by local communities has been ongoing long before BINP was designated a national park. Currently local communities harvest wild climbers within a framework of Uganda Wildlife Authority's (UWA) Multiple Use Program (MUP). It is against this background that this study was designed, to assess the ecological and food security implications of the exploitation of the wild climbers in BINP.

The study was carried out in parishes surrounding the park (Bushura, Rutungunda, Eastern Ward and Southern Ward) where climber harvesting by the local people was legalized in 1994 by UWA. Fifty-six resource users were interviewed of which 67% were males and 33% were females. Household surveys involving 120 respondents (58% were males and 42% were females) were conducted. Forest surveys and inventories were carried out to assess the abundance and distribution of the harvested wild climbers in the BINP forest. The forest survey method used followed an adaptive management approach that focused on the category of the wild climbers plants being harvested. The wild climbers sustainable harvest levels were based on size, class, distribution and regeneration characteristics. This data was then compared with the household survey data on food security and use of alternatives in the study parishes.

Eight different types of wild climber products were made by resources users around BINP and these were; fishing baskets, beehives, granaries, ordinary baskets, mats, small baskets (*ebibo*), tea baskets and winnowing trays. The most common types of food security related products found in homesteads were; small baskets (*ebibo*), followed by mats, then ordinary baskets, winnowing trays and tea baskets. Each household had an average of 2.3 small baskets, 2 mats, 1.6 ordinary baskets and 1.5 winnowing trays all made from wild climbers. The least common type of household wild climber products were the granaries and others like grinding trays.

The most commonly used wild climbers in the study area for making food security products were; *Smilax anceps* (18%) followed by *Monathotaxis littoralis* (15%), *Dracaena laxissima* (8%) and *Marantochloa manni* (6%). The most used alternative products in the households were synthetic nylon bags (18%) and synthetic nylon mats (18%). The most used alternatives to make products were plastics/nylon (26%), followed by eucalyptus trees (18%), metals & steel (13%) and banana fibres (5%). Granaries made from *Pristimera gracilifolia,* small baskets made from *Marantochloa mannii* and tea baskets made from *Loeseneriella apocynoides* were the most expensive wild climber products that were each sold at UGX 33,000, 25,000 and 20,000 respectively. The cheapest products were the winnowing trays and mats made from *Triumfetta brachyceras* sold at UGX 3,000 and 2,500 respectively. According to the respondents, the high pricing of the wild climber products such as winnowing trays and baskets was their biggest limitation to using wild climbers. This was attributed to the increasing difficulty in obtaining the wild climbers used in making those products within the area.

The size, class and distributions of most of the useful wild climbers harvested showed a healthy regenerating plant

population that is expected of populations that recruit successfully and continuously over time. This is an indicator of a stable size structure of a self-replacing plant population and therefore indicates a sustainably harvested plant population in BINP. However, a few other plants such as *Loeseneriella apocynoides, Toddalia assiatica* and *Monanthotaxis littoralis* showed a size, class and distribution that has been heavily harvested by the local people. These three plants are widely used in making of winnowing trays, baskets and granaries that are important for food security in households.

In conclusion, wild climbers provide important raw materials used in the making of products for handling, processing and storage of food crops and therefore important in safeguarding food security in rural poor households around BINP. Despite this, the wild climbers are continually being replaced by alternatives such as synthetic nylon sacks and plastic basins, among others, because of the unavailability, none free access and expensiveness of the wild climbers. Thus, more and more people are continually and gradually shifting to use of alternative synthetics for food storage purposes. It goes without saying; that the use of synthetics such as nylon sacks and plastic basins is detrimental to the environment and the soils around BINP.

The study recommends increased access to the wild climbers (that are not heavily harvested) by the local people through increased and allowable off-take quotas by park officials. Furthermore, more efforts needs to be put towards planting of these widely used wild climbers in local community lands for future use and conservation of genetic materials. More efforts should be put in on-farm cultivation of the important wild climbers that are sufficiently valuable to local communities. The Institute of Tropical Forest Conservation (ITFC) has an ethnobotanical garden at Ruhija that breeds indigenous tree seedlings and can be facilitated to enhance the production of the wild climbers useful to the local communities. Although the use of synthetic materials such as plastics and nylons is slowly but gradually replacing the wild climbers, we discourage their use since the plastics and other synthetics materials have been proven to be detrimental to the environment and soils alike.

1. INTRODUCTION

Millions of people world-wide, many of them poor, derive their livelihoods from wild tropical plants and animals (Ticktin, 2004; Bitariho, 2013). Non-timber forest products (NTFPs) have been harvested by humans from forests for subsistence use and trade over thousands of years (Ticktin, 2004). Until the past three decades, sustainable use and conservation of NTFPs were not considered important by conservationists (Scott, 1998; Ticktin, 2004; Bitariho, 2013). NTFPs such as wild climbers were considered a "nuisance" by foresters as they suppressed timber tree production (Scott, 1998). Foresters then were interested in systematically removing the lianas and vines to help the growth of trees for timber (Scott, 1998; Cunningham, 2001; Ticktin, 2004; Bitariho, 2013). The need for utilization of NTFPs and contribution to forest ecology was seldom considered important.

Three decades later, NTFPs such as wild climbers have gained increased attention to tropical forest conservation (Cunningham, 2001;Ticktin, 2004; Bitariho, 2013). This paradigm shift was caused by the increased roles wild climbers (Lianas and vines) 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 over-exploitation (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 (Ticktin, 2004; Ghazoul & Sheil, 2010).

In most tropical African countries, wild climbers play a significant role in the livelihoods of rural farmers during food and cash crop production processes such as harvesting, drying, winnowing, grinding and storage of agricultural produce (Muhwezi et al 2009). The wild climbers are used in diverse range for making products such as granaries and baskets used in the food processing value chains. Granaries made from wild climbers (lianas) are the major means of storing crops while baskets made from vines are the major means of crop processing, harvesting and temporarily storing of produce. Therefore, the importance of wild climbers in proving food security for local people around Bwindi cannot be over emphasized.

Pre and post-harvest crop loss is not only of worldwide concern but also of local concern too especially around Bwindi. This can be exacerbated by the current high costs of food. For small–scale farmers such as those around Bwindi, even small losses of crops from processing up to storage can cause serious famine (Itto & Wong 2002; Muwhezi et al 2013). Several factors and agents such as insects, fungi, rats and crop raiding animals cause food crop losses and this is as a result of poor storage of the food crops.

Controlled exploitation of non-timber forest products holds great potential as a method for integrating the use and conservation of tropical forests (Peters, 1994). Presently, managers of protected areas are seeking ways of accommodating the needs of traditional forest users while maintaining the biodiversity and ecosystem functions of the protected areas. Almost any type of resource exploitation conducted in tropical forests will have an impact on the ecological functions of the forests (Peters, 1994). The exact magnitude of this impact depends on the nature and intensity of harvesting and the particular species or type of resource under exploitation (Peters, 1994).

In reality, there are few, if any examples, of the demonstrably sustainable extraction of non-timber forest products due to lack of sufficient knowledge base to design a sustainable extraction system (Boot and Gullison, 1995). Information on how a plant population is regenerating can provide valuable data for resource management. Regeneration status of resource plants can be observed from population structure data that can be visualized in form of survivorship curves (Cunningham, 1999). Both static and dynamic population characteristics vary naturally over time. A direct comparison between natural and harvested populations yields sufficient information to assess sustainability of the resource plants (Hall and Bawa, 1993).

There is little or no biological information known on most of the plants being harvested in BINP. Some work on the density, size, class and distribution of *Loeseneriella apocynoides* (Muhwezi, 1997), *Smilax anceps* (Ogwal, 1998) and *Arundinaria alpina* (Bitariho, 1999) was done in BINP. However, these data may not reflect the general condition of the resource plants in the whole forest. For this study, we will assess and monitor important and selected priority plant species used in the making of granaries and baskets important for food security for local communities around Bwindi.

2. WHY IS THIS STUDY IMPORTANT?

Over two-thirds of the one billion people in Africa rely on NTFPs for their livelihoods, welfare or both (Timko et al. 2010). While this dependence is clear, the opportunities to improve welfare through use and improvement on food security remain uncertain. Presently in Uganda, most government programs are geared towards 'prosperity for all' and poverty alleviation particularly among the rural poor (Uganda Poverty Status Report 2014). These programs aim at tapping the opportunities and resources available to improve livelihoods and incomes including food security.

The United Nations Sustainable Development goal 2 is explicit at ending hunger and increasing food security and malnutrition for all and more particularly in the rural Africa and Asia by 2030. Majority of the rural people in Africa are subsistent farmers who depend on NTFPs for food harvesting, processing and storage (Muhwezi et al., 2009; Cunningham 2001). The human population densities in the Bwindi eco-region are extremely high and sometime reaching 700 people/km2 (Muhwezi et al., 2009). This increased high human population inevitably has led to more agricultural practises that will require increased food crop planting, harvesting, processing and storage. Hence leading to an increased need for wild climbers used in the making of granaries and baskets. Without the supply and sustainable use of these wild climbers, this will lead to a potential impact on food security in the region.

Therefore an assessment of the role wild climbers play in food security around Bwindi is needed in order to help park managers and development organisation such as BMCT plan better for the park adjacent local communities. Probably the most difficult question asked by many conservationists is whether harvesting of particular plant species is sustainable or not. There is little or no information available on the biomass production of most tropical plant species or about the ways in which plant species interact (Cunningham, 2000). Information on the response of these vulnerable resource plants to exploitation is an important requirement before resource management recommendations can be made on sustainable harvest levels.

In BINP, resource plant exploitation is already on-going and there is need to determine whether this exploitation is sustainable or not. Over-exploitation of plant resources will not only affect the forest ecosystem but also the livelihood of the people concerned by loss of the resource plant being harvested. The continued harvesting of the plant resources in Bwindi without the harvest impact monitoring is detrimental to Bwindi forest conservation as this is likely to cause over-exploitation of the forest. In such a scenario Bwindi forest conservation objectives will likely be compromised. The BMCT vision as pointed out in its strategic plan (2013) is to make sure Bwindi Mgahinga Conservation Area's ecological integrity are in harmony with the development needs of the local communities (BMCT Strategic Plan, 2013). Therefore for BMCT to support the continued maintenance of the Permanent Sample Plots (PSPs) and the collection of data for the harvested plants, it will have contributed to achieving BMCT's vision and helping with the conservation of Bwindi forest.

3. OBJECTIVES AND GOALS

The major goal of the study was to determine the implications of harvesting forest climbers (lianas and vines) on the local people's food security, use of alternatives and the harvested plants' population dynamics in Bwindi's multiple use zones. The study was designed to achieve the following objectives:

A. Assess the implications of wild climbers (lianas and vines) harvests on local people's food security and this was achieved by;

I. Assessing the type and amount of wild climbers used in the making of granaries and baskets for food crop harvesting, drying, winnowing, storage etc.

II. Determining through inventories, the number of granaries/baskets made of wild climbers in a household

III. Determining the number of households that use granaries/baskets (useful in food security) made from forest wild climbers

IV. Assessing the type of crops/foods stored in granaries, types of food/crops harvested in baskets

V. Estimating the quantity of food/crops stored in granary made from wild climbers

VI. Estimating the longevity of the products (granaries and baskets) made from wild climbers

B. Assess the implications of wild climbers (lianas and vines) harvests on the use of alternatives; this was achieved by;

VII. Assessing the type of alternative products and their source of materials used by households for granaries/baskets

VIII. Determining through inventories, the number of granaries/baskets made from alternatives in a household

IX. Determining the number of household that use granaries/baskets made from alternatives

X. Estimating the quantity of food/crops stored in a granary made from alternatives

XI. Estimating the longevity of products (granaries and baksets) made from alternatives

C. Establish Permanent Sample Plots (PSPs) in Bwindi to assess and monitor harvest impacts of wild climbers on their population ecology (3 year plan with an annual assessment); this is being achieved by;

XII. Determining the size-class structure of harvested plant populations in the MUZ

XIII. Determining the yield and regeneration potentials of harvested plants in the MUZs

XIV. Determining whether wild climbers harvest in Bwindi is sustainable or not (to be completed after a 3 year plan of data collection).

4.0 METHODS

Study Area

The study was carried out in Bwindi Impenetrable National Park in the parishes of Bushura, Rutungunda, Eastern Ward and Southern Ward, where forest wild climbers harvesting by the local people was legalized since 1994. These parishes have two gazetted Multiple Use Zones (MUZs) as shown in figure 1. These parishes are all located in Kanungu district just adjacent Bwindi Impenetrable National Park. An adaptive management approach that is focused on the category of the wild climbers plant species being harvested was employed. The wild climbers sustainable harvest levels were based on monitoring plant stem density, plant distribution; plant yield potentials and regeneration characteristics of the plants being harvested. This data was then compared with the household surveys data on food security and use of alternatives in the study parishes.

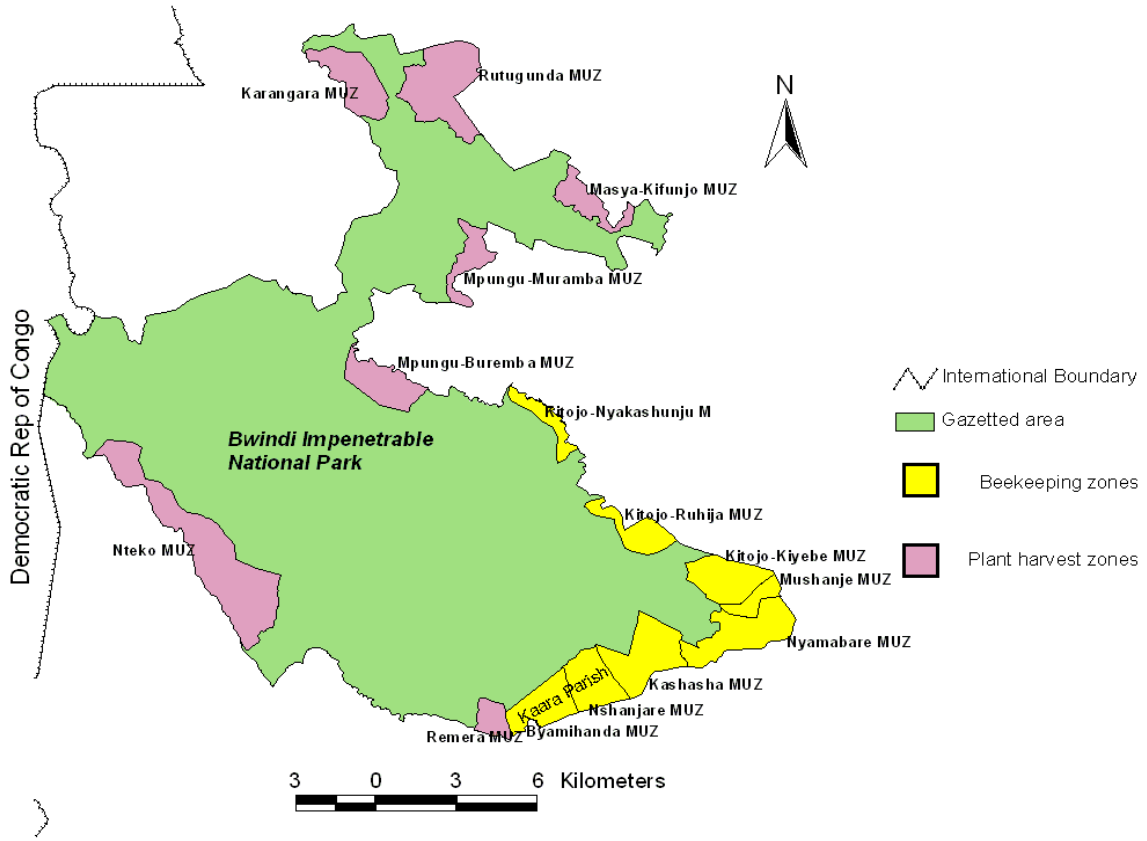

Figure 1 Map of BINP's Multiple use Zones showing the study Areas

Implications of wild climbers harvests on food security

Household interviews

The interviews in homesteads were carried out in the villages of the 4 study parishes to investigate plant resource use for granary, winnowing trays and basket making. The village interviews also assessed the use and livelihood dependency on forest plant resources by the local people (Martin, 1995; Cunningham, 2001; Ndangalasi, 2004). The village interviews were in form of a semi-structured questionnaire with open- ended questions and free ranging questions on plant resource use (Martin, 1995; Tuxill and Nabhan 1998). Semi–structure questionnaires are less rigid than surveys and rather than have a formal list of pre-written questions.

The Uganda national population census household lists kept by local council officials were used to select respondents for interviews (Eilu et al, 2004; Bitariho 2013). Questionnaires were randomly administered to households from villages in the 4 study parishes. The randomization procedure was done by assigning numbers of households per household on pieces of papers and placing the paper notes in a hat. These were then shuffled before picking out the households for interviewing. Information sought from respondents included; type and number of baskets/granaries per households, materials used to make products (either wild climbers or alternatives), type of crops/foods stored in granaries, types of food/crops harvested in baskets, estimated longevity of products (either wild climbers or alternatives), estimated quantity of food stored in granary, use of food items (sell and home use), longevity of food stored in granary, amount of food/crop stored or harvested per product and number of materials used to make product (specific to resource users).

Resource user interviews

Households with specialist granary and basket makers were identified and interviewed separately from the village interviews above (Ndangalasi, 2004; Eilu et al, 2007). Information sought from the specialists' granary, winnowing trays and basket makers included; forest resources used in making the product, 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 (whether scarce or abundant in the forest).

Implications of wild climbers' harvest plant-population dynamics

Sampling design and plot sizes

The study identified a Multiple Use Zone (MUZ) where harvesting of plant resources is on-going in the study parishes of Bushura, Rutugunda, Eastern Ward and Southern Ward where wild climbers are harvested for basketry and granaries. Plot size depended on type of plant in question. For example, Peters (1996) recommends plot sizes of 16 to 100 m^2 for shrubs and understory vegetation such as *Rytigynia spp* and *Loeseneriella apocynoides*. Smaller plots are easier to lay out and count but they frequently produce density estimate with a large error term (Peters, 1996). Each plot was permanently marked with small concrete blocks (with metal spikes) placed on only one side of the plots for easy location and future monitoring. Location of each plot was recorded using a Global Positioning System (GPS).

1. Lianas (e.g. Loeseneriella apocynoides)

Plot size of 10 x 10 m plots separated from each other by 15 m were used to assess Lianas such as *Loeseneriella apocynoides* stem densities and size, class and distribution. Muhwezi (1997) used similar plot size. These plots were laid along line transects running from the forest edge into the forest and permanently marked using concrete blocks for future re-location. Each transect was separated from each other by 100 m. All individuals of lianas in the plots (including sprouts greater than 1.3 m long) were counted and their basal diameters recorded using a vernier calliper. Representative samples of lianas (at least 3 for each size class) were then selected to assess stem growth rates. The selected plants were measured and recorded for basal diameters. The plants were permanently marked with plastic tags at the base of the stem for future relocation and measurements. After every interval of six months, similar measurements were made on the same plants.

The study also assessed the regeneration potential of the lianas in the plots of 10 x 10 m. Seedlings and juveniles (less than 1.3 m long) were recorded within the plots. Careful digging around the stem was done to determine whether the stem was from vegetative shoots or was a seedling (Putz, 1984).

2, Vines (e.g. Smilax anceps)

Vines such as *Smilax anceps* were assessed in plots of 5 m x 5 m sizes separated from each other by 15 m following Clarke (1986); Hall & Bawa, (1993) and Ndangalasi et al (2007) methods. These plots were laid along line transects running from the forest edge into the forest and permanently marked using concrete blocks for future re-location. Each transect was separated from each other by 100 m. All individuals of vines in the plots (including sprouts greater than 1.3 m long) were counted and their basal diameters recorded using a vernier calliper.

Representative samples of vines (atleast 3 for each size class) were selected to assess stem growth rates. The selected plants were measured and recorded for basal diameters. The plants were then permanently marked with plastic or metal tags at the base of the stem for future relocation and measurements. After every interval of six months similar measurements were made on the same plants.

The study also assessed the regeneration potential of the vines in the plots of 5 m x 5 m. Seedlings and juveniles (less than 1.3 m long) were recorded within the plots. Careful digging around the stem was done to determine whether the stem was from vegetative shoots or from seedlings. Basic information on the density, size, class, distribution, productivity (yield) and the ecological impacts of differing harvest levels is essential in determining sustainable level of resource use (Peters, 1994). The study also collected baseline data on the plant resource characteristics and habitat descriptive characteristics, which is described below.

Density and Size class distribution

Density or the number of individuals per unit area is probably the ecological parameter of greatest interest to ethnobotanists (Peters, 1996). The first signal that a plant population is being subjected to an overly intensive level of harvest is usually manifested in the size, class, distribution of that population (Peters, 1994; Hall and Bawa, 1993). Individual plants were counted in sample plots and the basal diameters recorded using a vernier calliper. These recordings were done every interval of six months for three years.

Regeneration characteristic

Regeneration assessments are used for quantifying the initial density of seedlings in plant populations being exploited, and monitoring the way in which these densities fluctuate in response to different harvest levels (Peters, 1994). All seedlings in plots were counted. These are individuals less than 10 cm *dbh* or <1.3 m in height (Peter, 1994). Young sprouts for the Lianas and Vines were also recorded. The plots were continuously assessed every six months for a period of three years to monitor fluctuations in numbers of seedlings and saplings.

Data analysis

Social demographic data of respondents

The social demographic data of the respondents was mainly analysed using thematic analysis. The study used gender and age to establish demographic characteristics of the resource users interviewed in the parishes of Bushura, Eastern Ward, Southern Ward and Rutungunda. Descriptive statistics were applied to generate tables, charts and graphs. Thematic analysis or sometimes referred to as content analysis was used to make references by systematically and objectively identifying special characteristics of the messages (Holsti, 1968: 608). The analysis focused on identifying and describing both implicit and explicit ideas within the data. The socioeconomic variables were dis-aggregated according to the parishes in order to create an in-depth analysis of the differences that exist between and among parishes and protected areas.

Density and Size Class distribution

Data for the plant density and size, class, distribution was compiled into size,-class, histograms showing the number of individuals in different diameter size, classes and grouped into 5 cm diameter class interval as recommended by Peters (1994). The size class distribution histograms provided an immediate identification of the poorly represented stages of the life history, therefore suggesting the heavily harvested individuals that require immediate attention (Hall and Bawa, 1993).

5.0 RESULTS

Gender distribution of respondents

The distribution of gender among the respondents is shown in Figure 2. From the figure, majority of respondents interviewed during household surveys were males although females were equally represented. A typical household in a study area constitutes of a husband (male and usually household head), a wife (female), children (child) and a household helper. The interviewed women were either representing their husbands while away or were household heads themselves and/or were either widows or were not living with their husbands. Bushura parish had the highest number of respondents contributing to about 33% while the least was in the Eastern Ward. Gender composition of a population can have significant implications on the kind of wild climber resources a population uses. For example women usually harvest wild climbers used for making mats and small baskets (*ebibo*) while men harvest wild climbers used for making granaries and winnowing trays.

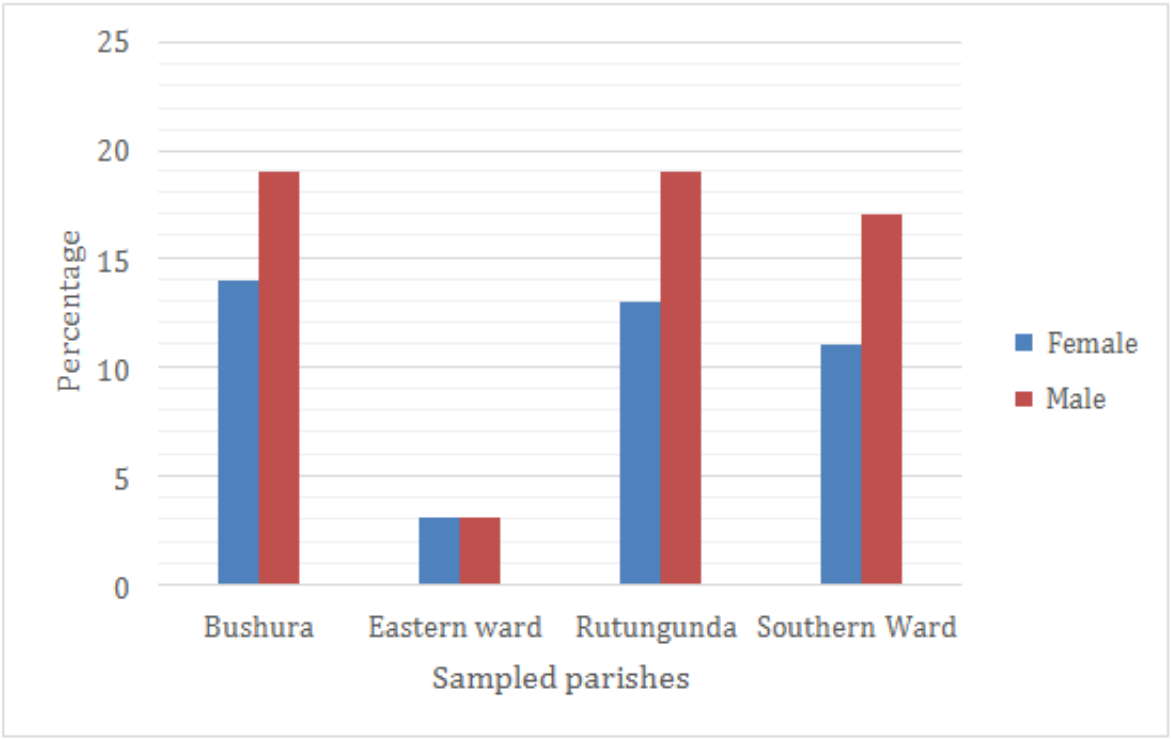

Figure 2: Gender categorizations of respondents per parish (N= 120 respondents)

Age distribution of respondents

Overall, the age category of 41-60 years had the highest percentage of interviewed respondents (51%) while that of 21-40 age category was the least (Figure 3). Furthermore, for all the respondents, there was no age category below 20 years of the interviewed respondents since the interviews targeted household heads only. Age and Age distribution among respondents is an important component in socioeconomic assessments since it informs the kind of responses that can be generated from the respondents (Kumar, 1989).

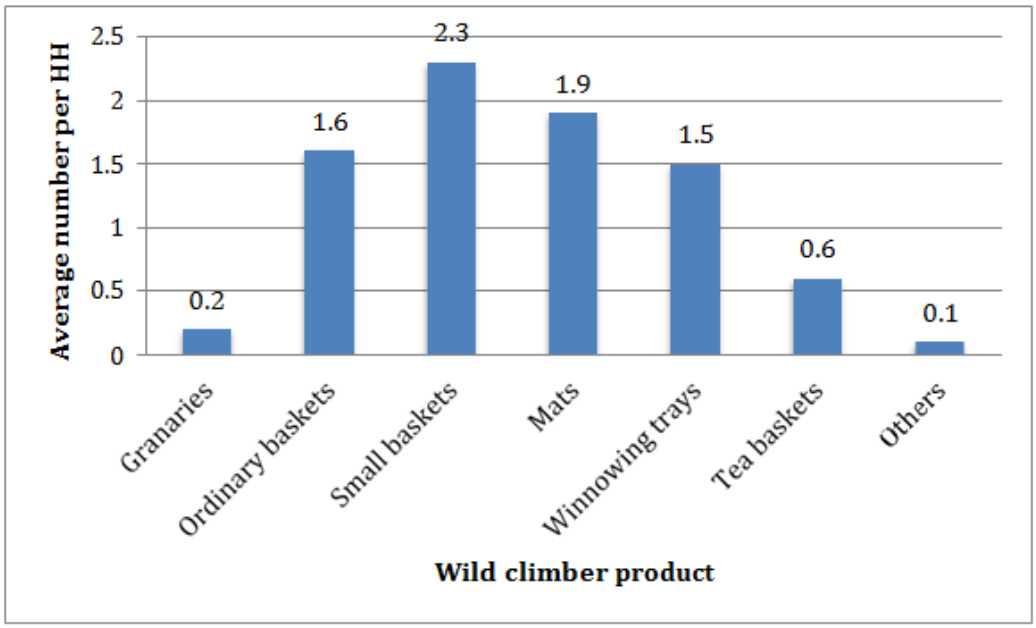

Figure 3: Age category of respondents (N = 120 respondents)

Wild climber products used by households

The most wild climber products used by households in the study area were; granaries, mats ordinary baskets, small baskets, tea baskets, winnowing trays and others (grinding trays, table mats *etc*) as Figure 4 shows. Figure 4 further shows the average number of wild climber products per household. The most used wild climber products in the study area were the small baskets (*ebibo*), followed by mats, then ordinary baskets, winnowing trays, and tea baskets. The least used products were the granaries and others such as grinding trays and table mats. On average, a household in the study area uses about 2.3 small baskets, 2 mats, 1.6 ordinary baskets and 1.5 winnowing tray made from wild climbers. The small baskets (*ebibo*) are mostly used for serving food, cereals and millet bread; the mats are used in the drying of food crops that left out in the sun to dry. Majority of the ordinary baskets are used in harvesting crops like beans, maize, sorghum and millet but they are also used to store and transport these crops to markets and home visits. The tea baskets are used to harvest, transport and store tea leaves by households. The winnowing trays are used for drying, winnowing and sorting out cereals and grains while granaries are mainly used for storage of the food crops but mainly millet, sorghum and even maize. From the interviews, it was estimated that ordinary baskets we able to carry maximum an average of 13 kgs of food crops, granaries were estimated to store and carry about 300 kgs food grains (millet and maize) while tea baskets were estimated to carry and store of about 13 kgs of tea leaves.

The most used wild climbers by households for products

Different wild climbers were used in weaving and making of the food security home products. Some products are made using only one species of wild climber while others were made with a mixture two or more species of different wild climbers. The small baskets are made mainly from *Maranthochoa manii,* mats are made mainly from *Triumfetta brachyceras* and *Cyperus renschii*, ordinary baskets are made mainly from *Smilax anceps* and *Dracaena laxissima*, granaries are made mainly from *Monathotaxis littoralis* and *Toddalia asiatica*, tea baskets are mainly made from *Loeseneriella apocynoides* and *Smilax anceps*. The winnowing trays are mainly made from *Smilax anceps* and *Dracaena laxissima*.

Figure 5 shows the major types of wild climber species used in the making of household products used in food security. It is evident that the most used wild climbers in the study area were the *Smilax anceps* (used for ordinary baskets, trays- see photo 1) (28%), followed by *Monathotaxis littoralis* (used for granaries, trays and baskets) and *Maranthochoa manii* (used for small baskets). *Phoenix reclinata* (used for tea baskets) was the least used wild climber for products.

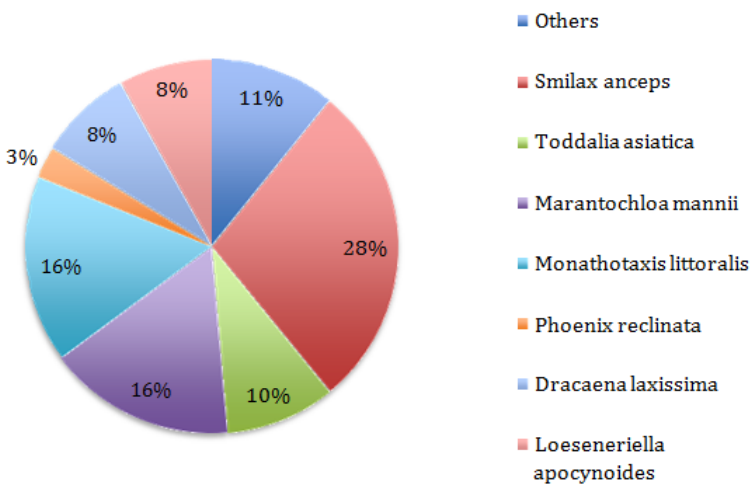

Figure 5 The most used wild climbers species for household products's food security (N = 120 respondents)

Photo 1. A resource user carrying a bundle of Smilax anceps (enshuri) from BINP

Costs and life span of commonly use wild climber products in study area

The most costly wild climber products are the granaries made from *Pristimera gracilifolia* at UGX 33,000 followed by small baskets made from *Marantochloa leucantha* at UGX 25,000 and tea baskets made from *Loesenerialla apocynoides* at UGX 20,000. The cheapest products were the mats and winnowing trays all made from *Triumfetta brachyceras* and sold at UGX 2,500 and UGX 3,000 (see Table 1). Products made from the wild climber *Pristimera gracilifolia* and *Loesenerialla apocynoides* (granaries and baskets) lasted a long time than the others. The two wild climbers are highly demanded and used because of their longevity. Tea baskets made from *Loesenerialla apocynoides* have been estimated to last up to a maximum of 15 years.

Table 1 Costs and life span of commonly used wild climber products

Product	Wild climber	Average Cost (Ugx)	Average Life span of product (months)
Basket	*Smilax anceps*	6,000	28
Granary	*Alchornea hirtella*	9,000	83
Granary	*Pristimera gracilifolia*	33,000	123
Mats	*Triumfetta brachyceras*	2,500	12
Mats	*Cyperus renschii*	5,000	24
Small basket	*Marantochloa manii*	25,000	36
Tea-picking basket	*Phoenix reclinata*	9,000	12
Tea-picking basket	*Loesenerialla apocynoides*	20,000	96
Winnowing tray	*Triumfetta brachyceras*	3,000	12
Winnowing Tray	*Smilax anceps*	6,000	36

Sources of wild climber products for households

Figure 6 shows how households in the different study parishes obtained the wild climber products for household use. Most households relied on buying finished products from resources/markets and or both making products themselves. Very few households used products solely made by themselves (Figure 6). The results indicate that households have diversified all possible sources of acquiring wild climber products for household use. The reasons of diversification being due to the limitations of accessing wild climbers from the BINP.

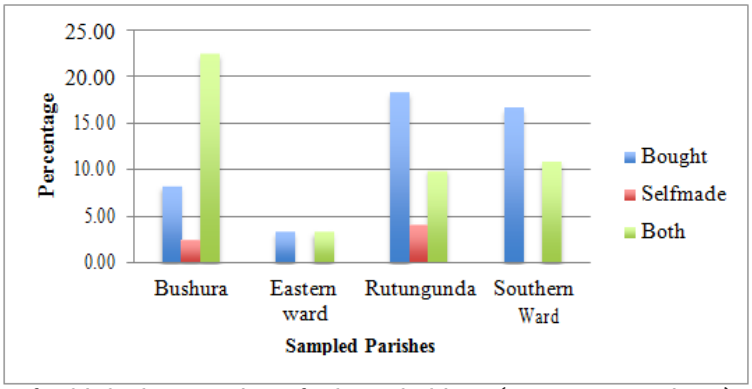

Figure 6: Sources of wild climbers products for household use (N = 120 respondents)

Factors influencing use of alternatives in the Study Area

Majority of respondents (76 %) suggested the most important reason as to why they use alternatives as being due to the ease of availability and accessibility of the alternatives than the wild climbers (Figure 7). Only 20% and 10% of respondents attributed the reasons for the use of alternatives to their capacity to store more products and the fact that they are affordable. Scarcity of forest resources was the least reason 6% respondents attributed to use alternatives.

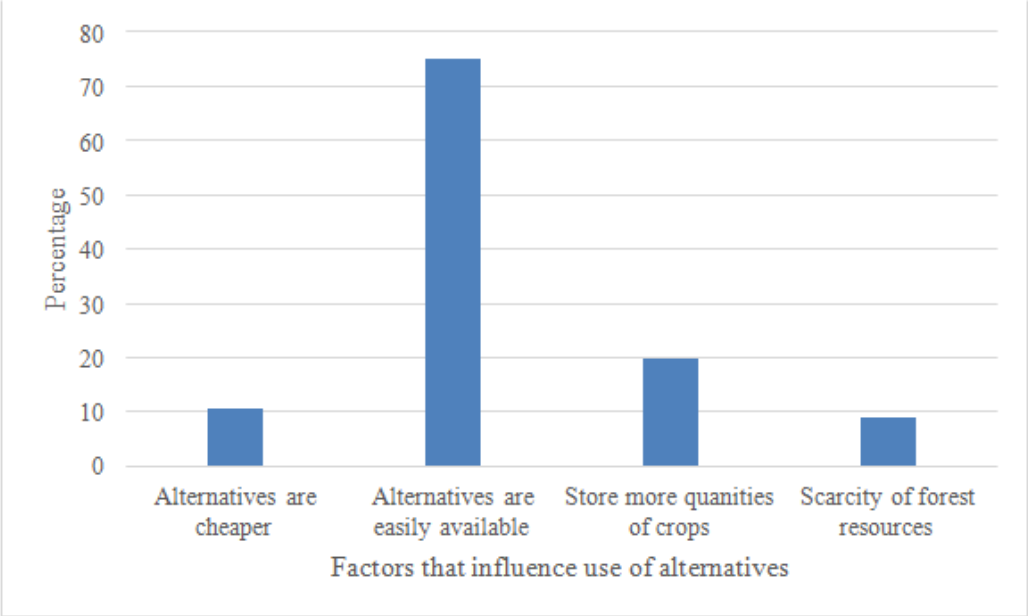

Figure 7: Factors influencing use of alternatives to wild climber products (N = 12-0 respondents)

Types of alternative products and their uses

The types of wild climber alternatives mentioned by respondents were; those made from natural sources such as eucalyptus, bamboo and banana fibres and those made from synthetics such as nylon sacks, metals and plastic basins. We recorded 11 different types of alternative products in the 4 parishes as Table 2 shows. These included plastic basins, plastic and metallic buckets, metallic drums, synthetic bags and tarpaulins etc. (Table 2).

Most of the alternative products found in households were used for food crop harvesting and storage. The most commonly used products in households were mats made from *Cyperus spp* and *Triumfetta spp* and synthetic bags made from nylons. The synthetic bags are used to harvest, dry and store various kinds of food crops such as beans, maize, tea and potatoes (Table 2). The second most common alternative product found in households were tea baskets (made from bamboo) and small baskets (made from *Cyperus papyrus*, *Leusene indica etc*) each accounting for an average of 3 per household. The tea baskets are used in the harvesting and storage of tea leaves and can also be used for other crops too. Products that accounted for an average of 2 in most households were the plastic basins and buckets and are used in the harvesting and storage of a variety of crops as Table 2 shows. The least number of alternative products per households were the granaries (made from mud and wattle *etc*), tarpaulins, metallic drums, plastic containers and saucepans. The tarpaulins are made from synthetic materials and are used to dry crops and grains in the sun. On average the alternative granaries (mud and wattle) were estimated to last for 75 months. Plastic containers and saucepans are used in the storage and harvesting of millet grains and other cereals. According to the respondents we interacted with metal drums are alternatives used to store maize grains and cobs. The durability of plastic containers and saucepans were estimated to be about 48 months respectively (Table 2).

Table 2 Household products made from alternatives and the longevity of the alternative products

Products used in household for food/crop	Number of products in the household	Longevity of product (in months)	Ingredients used to make them	Use of the product	Type of food crop used for product
Basin	2	22	Plastic	Crop harvest	Beans, millet,
Tea baskets	3	12	Bamboo	Harvesting	Tea
Bucket	2	33	Plastic	Storage	Millet and
Drum	1	36	Metal	Storage	Maize
Granary	1	75	Eucalyptus poles, *Pennisetum purpurem*, *Trimuffeta spp* , Mud &	Crop storage	Millet and beans
Mats	4	12	*Cyperus latifoliu* and *Triumfetta*	Crop drying	G-nuts,
Small baskets	3	30	*Cyperus papyrus*, *Leusene indica, Setaria, Eragrostis sp* and nylons	Serving food	Millet bread
Plastic container	1	48	Plastic	Storage	Millet
Saucepan	1	12	Metal	Harvesting	Millet
Synthetic bag	4	14	Synthetic Nylon	Harvesting, drying and	Millet, maize,
Tarpaulin	1	28	Synthetic Nylon	Drying , harvesting	Millet, beans,

Stem density and abundance of the wild climbers in BINP

The stem density and abundance of most utilized wild climbers is shown in Table 3. The most abundant wild climbers with highest stem densities were; *Dracaena laxissima Engl.* (23.8±3.5 stems/ha), followed *Smilax anceps Willd.* (12.9±2.3 stems/ha) and *Salacia elegans* (11.20±2.1 stems/ha). The least abundant wild climber and with the lowest stem densities were *Toddalia assiatica* (0.2±0 stems/ha), *Embelia liberiana* and *Loeseneriella apocynoides* with stem densities of 0.7±0.2 stems/ha and 0.5±0 stems/ha respectively. Six years ago, Bitariho (2013) observed similar results for the same wild climbers in BINP.

Table 3: Stem densities of important wild climbers in BINP

Plant Species	Stem densities per hectare at 95% CI	
	Stem density/hectare	±SD
Smilax anceps	12.9	2.3
Salacia elegans	11.2	2.1
Monanthotaxis littoralis	0.72	0.1
Toddalia assiatica	0.2	0
Loeseneriella apocynoides	0.5	0
Dracaena laxissima	23.8	3.5
Pristimera gracilifolia	1.2	0.5
Embelia liberiana	0.7	0.2
Enfulensia Montana	0.4	0
Rytigynia rwenzoriensis	1.8	0.6

Size class distribution of the most used wild climbers in BINP

Four types of diameter class distributions were exhibited by the wild climbers in BINP, these were; inverted "J" type, bell shaped, "L" shaped and "J" shaped. The four types of diameter class distributions depict impacts from harvesting intensities (Hall and Bawa, 1993; Mwavua and Witkowski, 2009). Most of the wild climber plants depicted the diameter size class distributions characteristic of the inverted 'J' type of distribution as Figures 8 to 12 show. These were; *Dracaena laxissima, Rytigynia rwenzoriensis, Salacia elegans, Smilax anceps* and *Pristimera gracilifolia*. Two wild climbers, i.e. *Embelia liberiana* and *Enfulensia montana* showed a "bell" shaped type of population distribution (Figures 13 &14).

The inverted "J" type of population distributions exhibited by the five plants above, are a type of population distributions that has many seedlings than adults while the bell shaped type depicts a population with many mature harvestable individuals with a sizeable number of seedlings. The two types of population distribution (inverted "J" and bell shaped) are a self-replacing population that is usually found in normal populations (Hall and Bawa, 1993; Mwavua and Witkowski, 2009).

On the other hand, the population distribution of wild climbers *Monanthotaxis littoralis* and *Loesenerialla apocynoides* is "L" shaped and that of (Figure 16 & 17). This is a type of population distribution that depicts the wild climbers that have been heavily harvested by the local people. In that type of wild climber population, there are almost no mature harvestable (>16mm) stems for use by the local people (Hall and Bawa, 1993; Mwavua and Witkowski, 2009). The *Loesenerialla apocynoides* and *Monanthotaxis littoralis* has been heavily harvested in BINP as noted by various authors (Bitariho et al. 2006; Bitariho, 2013).

The population distribution of *Toddalia assiatica* is of a "J" shaped type that depicts a population with many mature stems but very few or no seedlings (Figure 15). This is an "unhealthy" population that is susceptible to being wiped out from the population (Hall and Bawa, 1993; Mwavua and Witkowski, 2009). The *Toddalia assiatica* climber therefore exhibited a type of population with poor regeneration potentials. Perhaps also caused by the impact of overharvesting of the mature stems (poor or no seedling reproduction) for granary making like the case of *Monanthotaxis littoralis* and *Loeseneriella apocynoides*. These results therefore indicate that with exception of three wild climbers; *Loesenerilla apocynoides, Monanthotaxis littoralis* and *Toddalia assiatica* most of the wild climbers in BINP are sustainably being harvested.

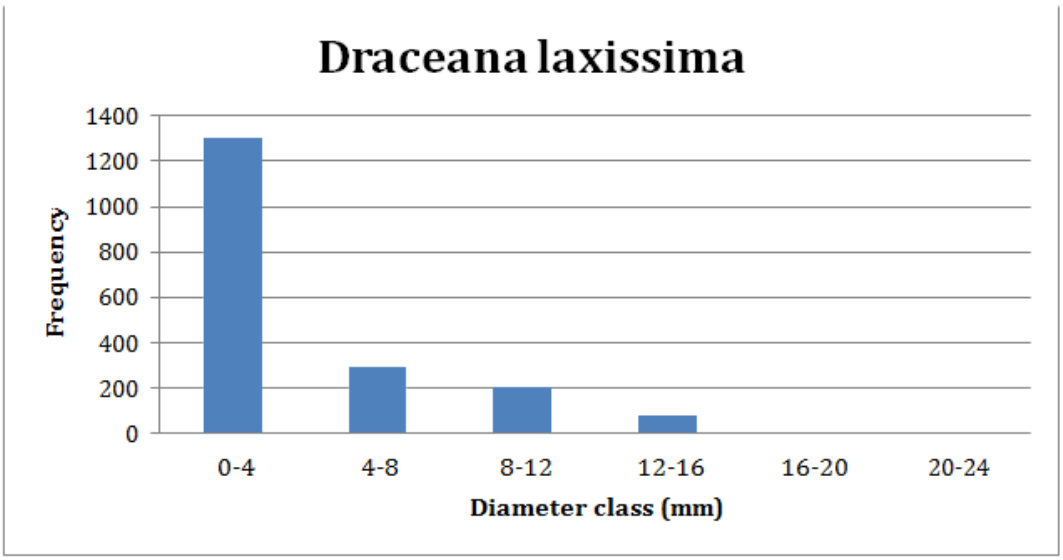

Figure 8 Size class (diameter) distribution of Dracaena laxissima (inverted "J")

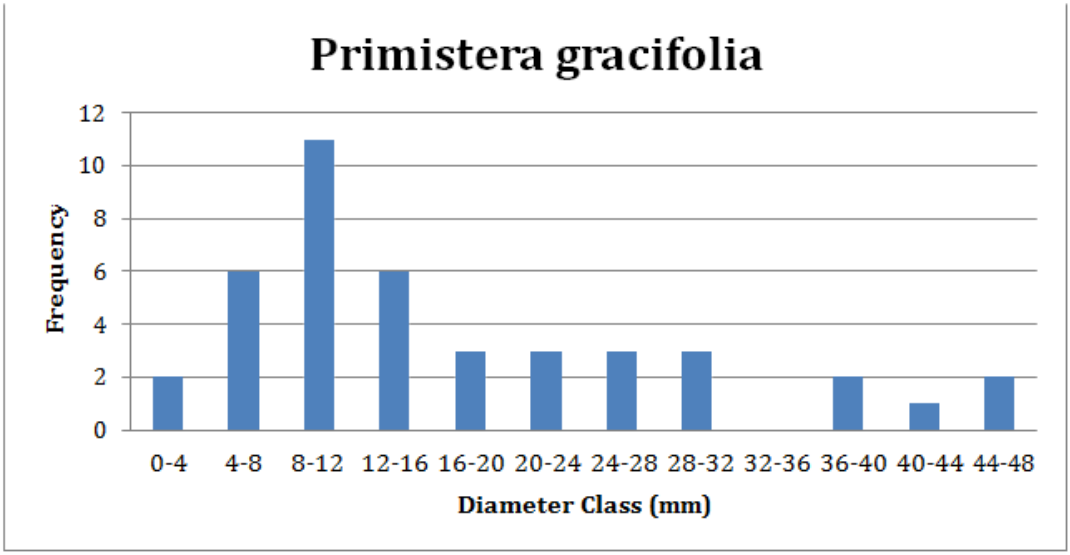

Figure 9 Size class (diameter) distribution of Pristimera gracifolia (inverted "J")

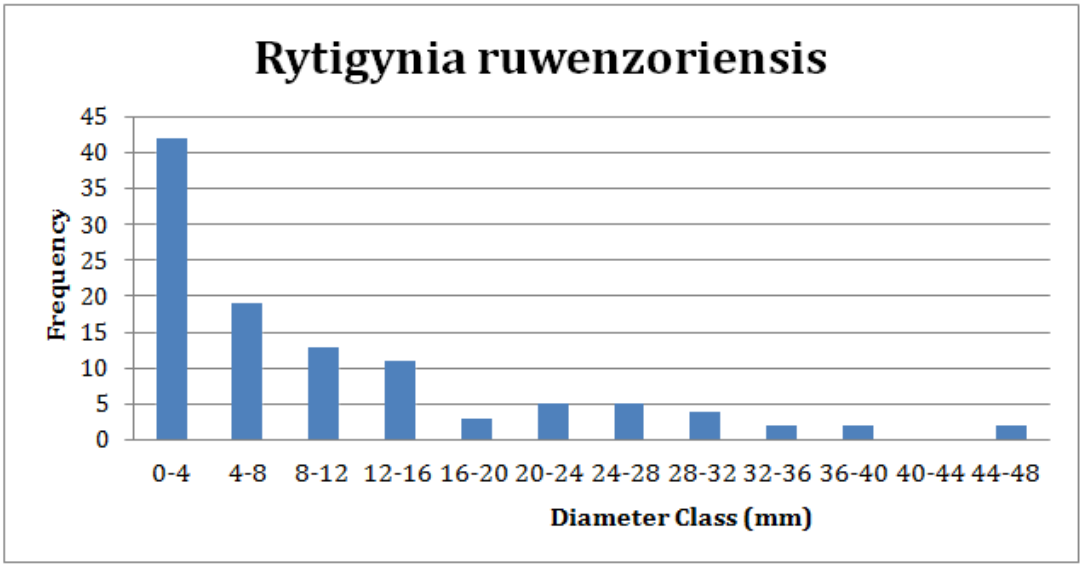

Figure 10 Size class (diameter) distribution of Rytigynia ruwenzorinsis (inverted "J"

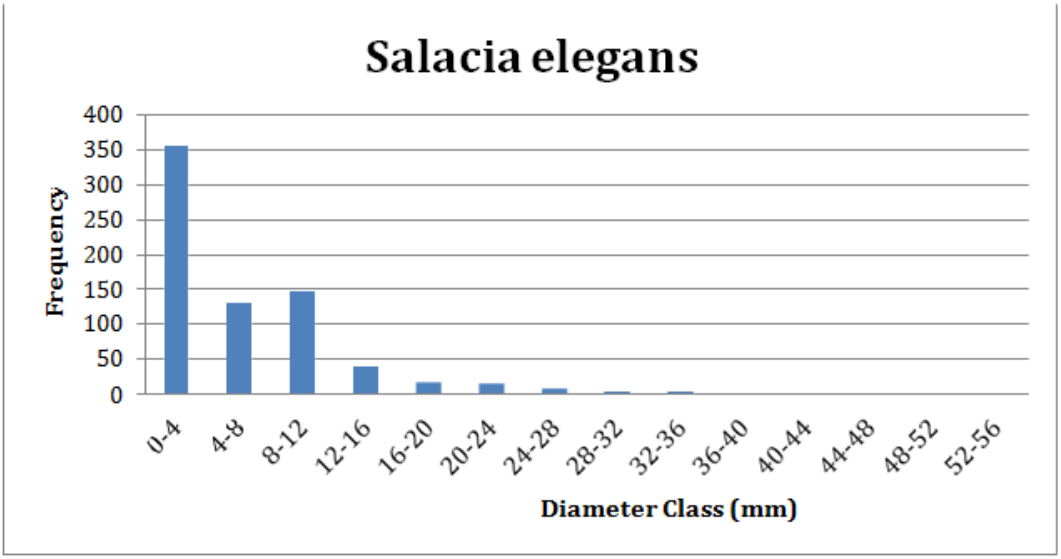

Figure 11 Size class (diameter) distribution of Salacia elegans (inverted "J")

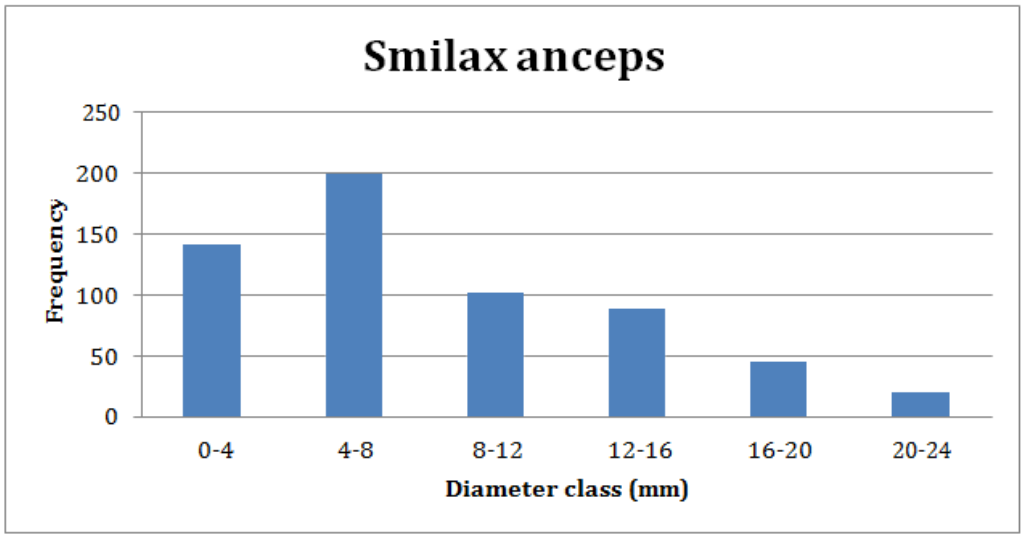

Figure 12 Size class (diameter) distribution of Smilax anceps (inverted "J")

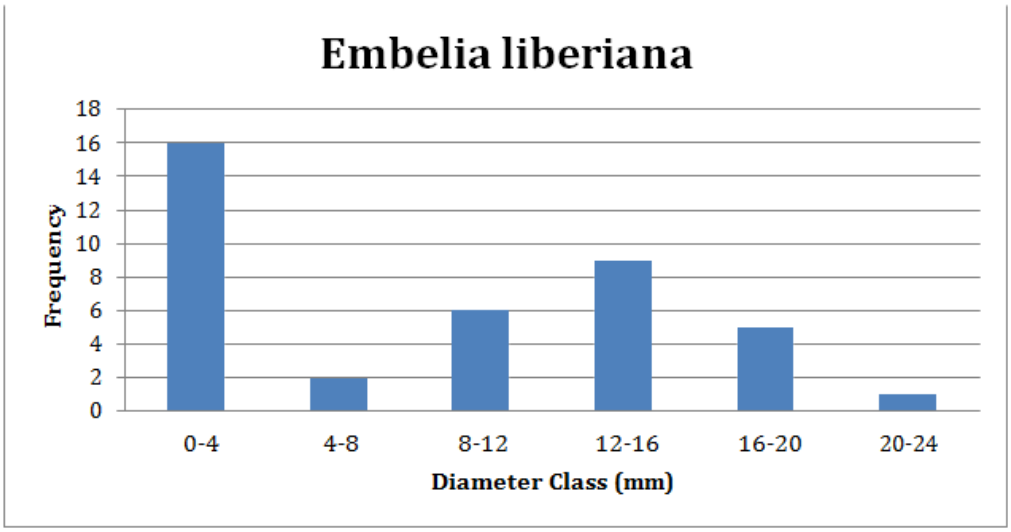

Figure 13 Size class (diameter) distribution of Embelia liberiana ("Bell shape)

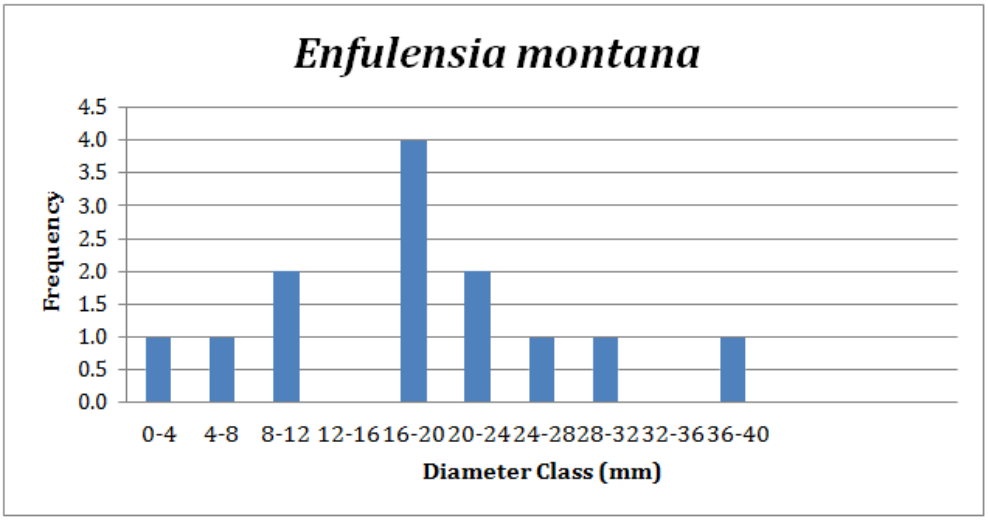

Figure 14 Size class (diameter) distribution of Enfulensia montana ("Bell" shaped)

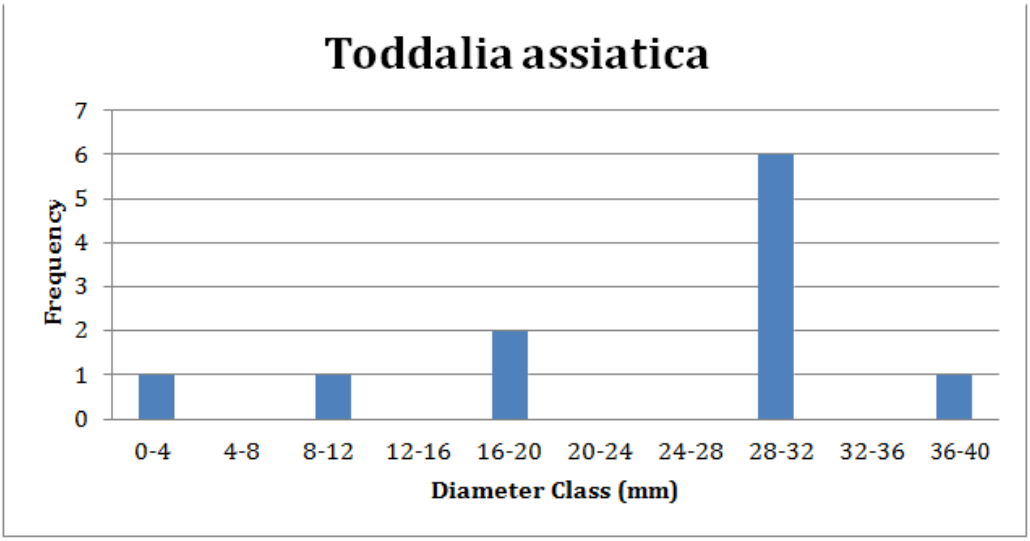

Figure 15 Size class (diameter) distribution of Toddalia assiatica ("J" shape)

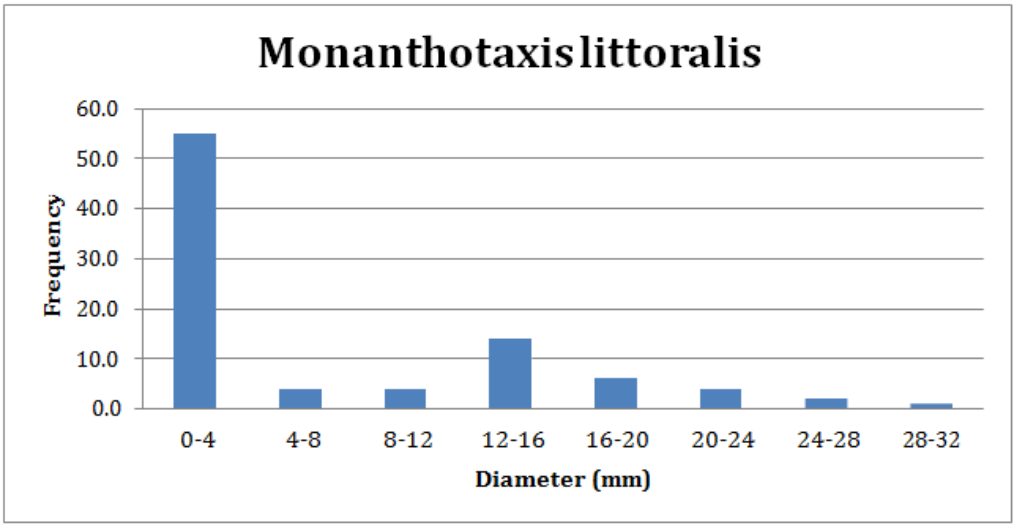

Figure 16 Size class (diameter) distribution of Monanthotaxis littoralis ("L" shape)

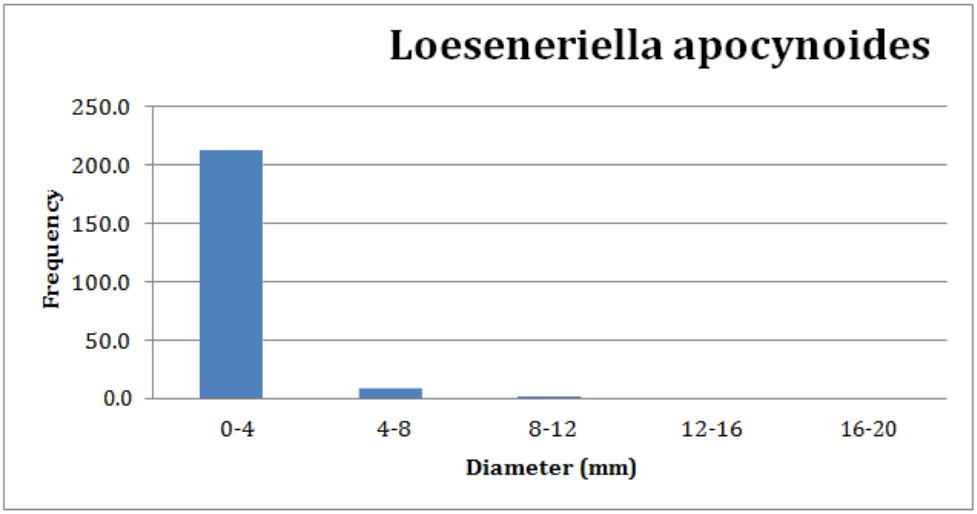

Figure 17 Size class (diameter) distribution of Loeseneriella apocynoides ("L" shape)

6. DISCUSSION

Demography of resource users and implications on wild climber use

Age and gender composition of resource users can have implications on the number and types of wild climbers harvested from the forest. For example women maybe more interested in wild climbers that are used for making mats and baskets, while the men would be more interested in the wild climbers used for granaries and winnowing trays. In his study (Muhwezi et al. 2009) observed that men were responsible for making products such as granaries and winnowing trays while women predominantly made mats (*omucheche*) for sitting or sleeping on, as well as making the small baskets (*ebibo*). Among the age categories the largest percentage of resource users were over 41 years for both sexes. The result shows that perhaps the younger generation are less interested in forest resource extraction and use. We also observed that younger people (below 41 years) were more interested in the wild climbers that are used to make crafts sold on the tourism market where they can make more money. Most of the respondents talked to said they were no longer using granaries to store their food and relied on synthetic sacks that were easier and cheaper to obtain. Muhwezi et al. (2009) in his study around Bwindi unlike in this study attributed the low use of granaries in Nteko parish as a consequence of less food production compared to other parishes.

Most commonly used wild climber products in households

The use of wild climber products in the households ranged from harvesting of food crops to drying of food crops then to winnowing of cereals and grains, food crop storage and serving of a meal. Some wild climber products served more than one function while others were used only for one function. For example ordinary baskets could be used when harvesting and also in storage of food especially cereals and grains. Ordinary baskets also perform many functions such as; harvesting of food crops mostly cereal, storage of food crops and transportation of food crops to markets. It is therefore common that most people have these baskets in their households. Winnowing trays are basically used for sorting and winnowing cereals and grains such as sorghum, millet and sometimes beans. Tea baskets are used while picking tea leaves and can also be used to store the tea. Furthermore, millet baskets are used for a variety of functions; crop harvest, storage, serving food and measuring of food. While products like granaries were only used to store food.

Most wild climber products carried more food product as compared to their alternative products. For example it was estimated that granaries made from wild climbers could carry anywhere between 250-350kg of millet while a synthetic suck though much cheaper could only carry about 100kg of millet. Also granaries compared to synthetic sucks had much more longevity/life span. For example, a granary made from Pristimera garcilifolia could last up to 15 years while a granary made from eucalyptus poles, mud and iron sheets could last up to 6 years and synthetic sucks could last just for a few months. This result cuts across for many of the wild climber products when compared to their alternatives.

Use of alternatives to wild climber products

This study revealed a diverse number of alternatives used by households to fill the gap created by the shortfalls and unavailability of wild climber products. These ranged from synthetic nylons and plastic products to metallic and natural products such as nylon sacks/bags, plastic basins, metallic buckets etc. The synthetic/nylon bags are commonly used products because of their low price and are used in processing many different items. These include from harvesting food crops to storage and transport of the food crops. The nylon sacks are the most single important product used in households not only in our study area but also all over the country. Apart from processing food crop synthetic bags are also used to carry charcoal an important source of livelihoods for local people.

The easy of availability of alternatives was a major reason given by over 75% of respondent as to why they use the alternatives. The availability and low prices of alternatives compounded with the scarcity of wild climbers were

identified by Muhwezi et al. (2009) and Dash and Behera (2016). In respect to food security, especially preventing post-harvest loss it is important that the available alternatives are as good as the wild climbers to prevent food loss to already impoverished communities that suffer with other loses due to crop raiding, soil erosion and long dry seasons. Minimising post-harvest loss is of critical importance to the local communities. It therefore seems the use of alternative products has exacerbated the food crop loss of the local people than if they used the wild climbers products. Such loss is experienced in pre and post harvest periods while harvesting and storing the food crops. Furthermore, the use of alternative products such as the synthetic fabrics and materials are detrimental to the soils around BINP. The synthetic nylons and plastics are not biodegradable and are therefore in the long run dangerous to the soils for agriculture. The alternatives were also said to have short long spans than the wild climber products

Stem Density and abundance of wild climbers in BINP

These results are consistent with those of Hegarty & Caballe, (1991); Peters (1994); Shackleton et al (1994); McGeoch et al., (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. This is the situation in most of the BINP's multiple use zones and in particular this study area. High tree canopy cover 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 wild climbers plants such as Dracaena laxissima and Smilax anceps that were observed to have high stem densities in Bwindi are secondary forest species that are colonizing the forest after past human disturbance (Cunningham, 1992; Wild & Mutebi, 1996). Fischer & Killmann (2008) described such plants as understory montane forest species that are often found in secondary forest clearings. The highest stem densities shown by such as D. laxissima, S. anceps and Salacia elegans 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).

Size distribution of wild climbers in BINP

One of the first signals 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). 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. That most plants had an "inverted" J type of size class distribution is an indication 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 most plants had this type of distribution may be an indication of sustainable plant harvests as defined by Peters (1994); Peters, (1996); Struhsaker, (1998); Pfab & Scholes (2003), and Sampaio et al., (2008).

The size class distribution of Loeseneriella apocynoides and Monanthotaxis littoralis ("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 and Monanthotaxis littoralis and have experienced serious negative harvest impacts from tea harvesters that use the plant stems for making tea harvest baskets and granaries (Ndangalasi et al., 2007;Muhwezi et al., 2009; Bitariho, 2013). As such Bwindi park management should restrict the harvests of these two plants and need harvest impact monitoring to forestall its overexploitation from the forest.

The "J" type of size class distribution shown by Toddalia assiatica is a kind that 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 could be limited by the plant harvesters (Peters, 1994). Overharvesting mature Toddalia assiatica stems for the granaries 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).

7. CONCLUSION

This study has shown that wild climbers are of great importance to the local people around BINP. Not only are wild climbers a source for income for resource users but are also very important in the sustenance of food security among households. The most important wild climber products used in households were: small baskets (*ebibo*), mats, ordinary baskets (*ebiteebo*), winnowing trays (*entaara*) and tea baskets. The unavailability and expensiveness of these wild climber products for households has led to the local people to use the alternatives such as the synthetic nylons and plastics that are detrimental to the environment and soils. Furthermore, majority of households around BINP are experiencing pre and post harvest crop losses due to the use of alternative products that are not good for food crop storage and harvesting.

With the exception of three plants i.e. *Loeseneriella apocynoides, Monanthotaxis littoralis* and T*oddalia assiaitica*, this study has not detected any negative harvest impacts for most of the harvested wild climber plants in BINP. Plant harvesting in BINP may have caused increased regeneration of most harvested wild climbers since some of the plants such as *Draceana laxissima, Smilax anceps* and *Salacia elegans* had high stem densities. This study further concludes that the present BINP plant harvests may be sustainable. The useful and important wild climbers in BINP are majorly secondary forest types that prefer disturbance and more light conditions since they responded by increased regeneration when harvested.

8. RECOMMENDATIONS

• This study is the beginning of several others that will be carried out by ITFC in establishing the wild climber sustainable harvest levels in BINP. Permanent Sample Plots (PSP) were established in the MUZs of the study parishes that will be used to assess the yield levels (biomass production), regeneration potentials and further population dynamics of the harvested wild climbers to conclusively ascertain the plant harvest sustainable levels. It is hoped that BMCT will continue to fund these future studies.

• Efforts such as planting of the most utilised wild climbers within community farmland should be initiated and promoted by BMCT. Concentrating on wild climbers that are sufficiently valuable to local communities would likely enhance such practices. The Institute of Tropical Forest Conservation (ITFC) has an ethnobotanical garden at Ruhija that breeds indigenous tree seedlings. This creates an opportunity for NGOs like Bwindi Mgahinga Conservation Trust (BMCT) to encourage and help the local communities they work with to acquire some of the wild climber seedlings and plant them on their land.

• Monitoring in the multiple use programme should be strengthened by establishing more permanent sample plots (PSPs). This is in order to monitor more plant species (as the study shows here three more) that have been shown to being overharvested currently. The PSPs should consider carrying out long-term monitoring activities for the three plants; *Loeseneriella apocynoides, Monanthotaxis littoralis* and *Toddalia assiatica*. The monitoring of plant harvest impacts in the PSPs should incorporate parameters useful for transition matrix modelling; these include tagging of all individuals plants, studying mortality and regeneration potentials of the plants and others.

• It is important to note that some alternatives are fairly good and offer cheap options to poor households. We therefore recommend that a study on which alternatives are best suited to work in households are studied. For example those that are comparable to products made from wild climbers and are resistant to insects, rot, humidity (food crop loss).

• The present BINP plant harvest annual off-takes of 1% of available plant stock recommended for BINP should be increased upwards to probably 3% without affecting the plant populations' dynamics but increasing on more local people participation and appreciation of BINP's MUP. This should be done to those wild climbers that are highly demanded yet have high stem densities as this study has shown. Such plants include; *Smilax anceps, Draceana laxissima* and *Rytigynia ruwenzorinsis*.

• There is also a need for an increased role by the local people in monitoring plant harvests off-takes through establishing a local community monitoring systems for BINP by park management. This local community monitoring tool should be simple and easy to use by the local people involved in plant harvests

9.0 REFERENCES

Abdulla, Ahmed Mohammed. 2013. "Non-Timber Forest Products and Food Security: The Case of Yabelo Woreda, Borana Zone, Ethiopia." Food Science and Quality Management 22:9-22.

Bitariho R (1999). The Abundance, Distribution and Use of Montane Bamboo in Bwindi Impenetrable and Mgahinga Gorilla National Parks, S.W Uganda, MSc thesis Makerere University Institute of Environment and Natural Resources, Kampala Uganda.

Bitariho, Robert, Alastair McNeilage, Dennis Babaasa and Robert Barigyira. 2006. "Plant harvest impacts and sustainability in Bwindi Impenetrable National Park, SW Uganda." African Journal of Ecology 44(1):14-21.

Bitariho, R (2013). Socio-economic and Conservation Implications of local people's use of Bwindi forest in South West Uganda. Unpublished PhD thesis, Mbarara University of Science and Technology, Mbarara

Boot R.G and Gullison (1995). Approaches to Developing Sustainable Extraction Systems for Tropical Forest Products. Ecological applications. 5(4). pp 896-903. The ecological Society of America.

Clarke, R., 1986. The Handbook of Ecological Monitoring. A GEMS/UNEP publicationClarendon Press. Oxford.
Cunningham A B,. (2001) Applied Ethnobotany, People, Wild Plant Use and Conservation, WWF, Earthscan Publications Ltd, London, N1 9JN, UK.

Davenport TRB and Howard PC (1996). Bwindi Impenetrable National Park – A Biodiversity Report. No. 19. The Forest Department, Kampala, Uganda.

Dash, Madhusmita and Bhagirath Behera. 2016. "Determinants of household collection of non-timber forest products (NTFPs) and alternative livelihood activities in Similipal Tiger Reserve, India." Forest Policy and Economics 73:215-228.

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.

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) pp 215-219. The New York Botanical Garden. Bronx, NY 10458 U.S.A

Hall P and Bawa K (1993). Methods to Assess the Impact of Extraction of Non-Timber Tropical Forest Products on Plant Populations, Economic Botany 47 (3) pp. 234-245. The New York Botanical Garden. Bronx, NY 10458 U.S.A

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.

Itto, A and Wongo, L. (2002). Post-Harvest Grain Losses in On-farm and Cooperative Stores: A case Study of Maridi and Yambio Countries, Western Equatoria, Southern Sudan. Contract Number AOT-R-00-95.USAID/Office of Foreign Disaster Assistance, Washington, D.C

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

Muhwezi, O, AB Cunningham and R Bukenya-Ziraba. 2009. "Lianas and livelihoods: the role of fibrous forest plants in food security and society around Bwindi Impenetrable National Park, Uganda." Economic botany 63(4):340.

Mwavu, Edward N and Ed TF Witkowski. 2009. "Population structure and regeneration of multiple-use tree species in a semi-deciduous African tropical rainforest: implications for primate conservation." Forest Ecology and Management 258(5):840-849.

Ndangalasi, Henry J, Robert Bitariho and Delali BK Dovie. 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 SF (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, Uganda.

Olupot, William, Robert Barigyira and Alastair J McNeilage. 2009. "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 CM (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 & Scholes, M.A., 2003. Is the collection of Aloe peglerae from the wild sustainable? An evaluation using Stochaic population models, Biological
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, J.C., 1998. Seeing like a State. How certain Schemes to improve the human condition have failed. Yale University Press, New Haven and London.

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.

Sunderland, Terry, Ramadhani Achdiawan, Arild Angelsen, Ronnie Babigumira, Amy Ickowitz, Fiona Paumgarten, Victoria Reyes-García and Gerald Shively. 2014. "Challenging perceptions about men, women, and forest product use: a global comparative study." World Development 64:S56-S66.

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

Timko JA, Waeber, PO, Kozak RA. 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.

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

10. APPENDICES

10.1 HOUSEHOLD INTERVIEWS (Food security assessment)

Date of interview…… Parish……..

Village…… Household number……..

Product in household (granary/basket)	Ingredients (*Plant species e.g. enshuri, emijega*)	Use of Product (*food harvest, winnowing, storage etc.*)	Type of food crop used for product (*maize, sorgum, millet,*	Quantity of food crop used per product	Longevity of product (*estimate-months*)	Length (time) of storage of food product (granaries only (months)

10.2 HOUSEHOLD INTERVIEWS (Use of alternatives)

Date of interview…… Parish……..

Village…… Household name……..

Product in household (granary/basket)	Alternative Ingredients	Use of Product (*food harvest, winnowing, storage etc.*)	Type of food crop used for product (*maize, sorghum, millet, etc.*)	Quantity of food crop used per product	Longevity of product (*estimate-months*)	Length (time) of storage of food product (granaries only (months)

STEM DENSITY, SIZE CLASS DISTRIBUTION AND VISUAL HARVEST IMPACT ASSESSMENT

Date:_____Location_____

____

Transect No._ _____Plot No. _____Altitude _____

% Slope.
g _____GPS _____Easting _____Northin

Tree cover _____
cover _____ Shrub cover _____Herb

Dominant tree _____
Dominant shrub _____
Dominant herb_____

Climber Species name	Basal Diametr (mm)	No. Sprouts	Notes

8.5 YIELD POTENTIAL ASSESSMENT

Stem growth rate

Date _____ Location _____
Transect _____ Plot _____

Sample No.	Basal Diameter (mm)	Increase	Notes

10.4 REGENERATION POTENTIAL ASSESSMENT

Date_____Location_____
____

Transect No_ _____Plot No. _____.

Species	Seedling/ Sapling height (cm)	Notes

10.5 RESOURCE USE DATA SHEET (DEVELOPED BY UGANDA WILDLIFE AUTHORITY)

Name of Recorder:_____Parish:_____Zone:_____

Date	Name of resource user	Resource harvested	Plant Name	Amount harvested	Time taken (hours)	Remarks (e.g illegal activities)

25 YEARS

BMCT
1994 - 2019

CONSERVING FOR DEVELOPMENT

They year 2019 will be the year when we commemorate the Twenty-fifth Anniversary of BMCT. It gives us great pleasure to make this announcement now and to extend our advance gratitude to our friends and to those that have supported us through the times. We still have the goals of the Organization at heart and will continue to take pride in their achievement. We will be informing you of the date and venue for the commemorative event.

About Bwindi Mgahinga Conservation Trust

Bwindi Mgahinga Conservation Trust (BMCT) was established in 1994 under the Uganda Trustees Laws. Its mission is to foster conservation of biodiversity of Mgahinga Gorilla National Park (MGNP) and Bwindi Impenetrable National Park (BINP) through investments in community development projects, grants for research and ecological monitoring, funding park management and protection and programmes that create greater conservation awareness. It is mandated to work with communities surrounding Mgahinga Gorilla National Park (MGNP) and Bwindi Impenetrable National Park (BINP). This area is also known as Bwindi Mgahinga Conservation Area (BMCA). The area of operation is located in South Western Uganda, bordering DRC and Rwanda with operational headquarters in Kabale at Bwindi Trust House and a sub office in Kampala.

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