

**THE POTENTIAL SUPPLY OF PLANT RESOURCES FOR
LOCAL COMMUNITY USE IN QUEEN ELIZABETH
PROTECTED AREA, WESTERN UGANDA**

Robert Bitariho¹

Alastair McNeilage¹

Robert Barigyira¹

Crispine Safari¹

Robert Neema²

Institute of Tropical Forest Conservation¹

Uganda Wildlife Authority²

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I Executive summary

Plant resources for local community use in Queen Elizabeth Protected Area (QEPA) have been designated in areas called integrated resource use zones. The integrated resource use zones of QEPA are the four islands on Lake George (Akiika, Butonga, Rwebitokye and Kankuranga) and Kigezi wildlife reserve (South Maramagambo forest). The four islands on Lake George were designated to an area of 23.2km² for the extraction of papyrus, ambatch and phragmites while the integrated conservation area of Kigezi Wildlife reserve was designated to an area of 147km² for the extraction of medicinal and weaving plants.

We carried out a study to assess the availability of plant resources in the designated integrated resource use zones of QEPA in order to determine the plant stock and prevent the over-exploitation of the plant resources when harvesting begins. We used participatory rural appraisal (PRA) methods to interview the local fishermen, basket weavers and traditional herbalists that live adjacent the designated integrated resource use zones of QEPA. We also used subjective focused searches in the zones to scientifically identify the plant resources used by the local people and to assess whether the plant resources are available or absent in the zones. Forest surveys using transects and plots were also used in the zones to determine the abundance and distribution of plant resources used by the local people.

From the interviews, 103 medicinal and 21 basket weaving plants were requested for harvest by the local people living adjacent Kigezi Wildlife Reserve. The fishermen requested for three plants of ambatch, papyrus and phragmites from Lake George islands. A comparison of the requested plant abundance using the subjective focused searches and the transect/plot methods revealed little difference between the two methods. Only 18% and 33% of the requested medicinal and basket weaving plants respectively were common, while all the three requested plants from Lake George islands were common. From the list of resource plants considered common, we further used a cut-off stem density of ≥ 0.1 stems/ha, ≥ 10 stems/ha and 40 stems/ha for trees, lianas/shrubs and vines respectively at the lower limit of 95% confidence interval as

the recommended plants sufficiently abundant for harvest. We also recommend an annual harvest quota of the requested plants based on 1% of available plant stock in the integrated resource use zone. As such from a list of 21 weaving plants, only 8 plants were recommended for harvest. Also from a list of 103 medicinal plants, only 18 were recommended for harvest. Ambatch has not been recommended for harvest from Lake George Islands because the demand for it greatly outstrips the potential supply and it is an important food for elephants, which feed frequently in areas where ambatch grows on these islands. Papyrus and phragmites can be harvested by the fishermen of Kashaka and Kasenyi. We further recommend more studies on the harvested plants annual biomass production in order to determine their sustainable harvest quotas effectively.

II) Acknowledgements

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III) Table of contents

<i>I Executive summary</i>	2
<i>II) Acknowledgements</i>	4
<i>III) Table of contents</i>	5
<i>1.0 Introduction</i>	6
<i>2.0 Study objectives</i>	8
<i>3.0 Methods</i>	9
3.1 Participatory Rural Appraisal (PRA)	9
3.2 Focused Searches and Herbarium Specimen Collection	9
3.3 Mapping of resource plants	10
3.4 Resource Plant Sampling	10
<i>4.0 Results</i>	13
4.1 Participatory Rural Appraisal	13
4.2 Focused searches and transect/plot methods	13
4.3 Abundance of the most common occurring plant species	16
<i>5.0 Discussions and harvest quota recommendations</i>	27
5.1 Lake George Island plants	27
5.2 Plants from Kigezi wildlife reserve	29
<i>6.0 References</i>	38
<i>7.0 Appendix</i>	40
7. 1 List of plant resource requested from Kigezi Wildlife Reserve	40

1.0 Introduction

Queen Elizabeth Protected Area (QEPA) covers an area of 2465Km² and comprises of Queen Elizabeth National Park (1978Km²), Kyambura Wildlife Reserve (157Km²) and Kigezi Wildlife reserve (330Km²). The QEPA is located on the equator in the Albertine Rift Valley and falls in the four districts of Kabarole, Kasese, Bushenyi and Rukungiri (UWA 2000). The Kigezi Wildlife Reserve of QEPA covers also the South Maramagambo forest that is jointly managed by Uganda Wildlife Authority (UWA) and the National Forest Authority while the Kyambura Wildlife Reserve includes islands located on Lakes George and Edward (UWA 2000).

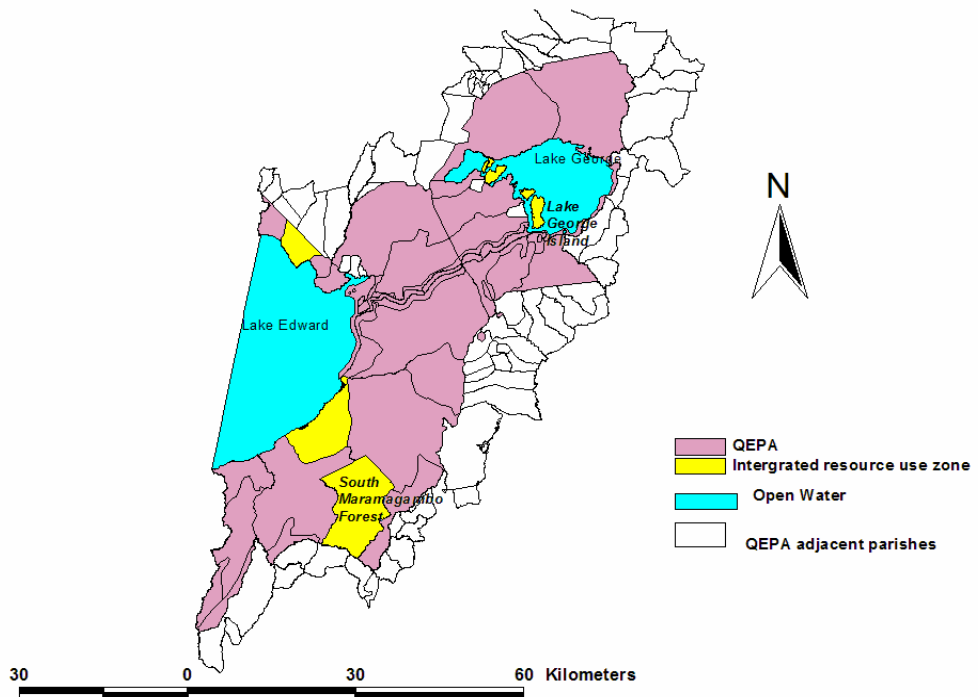
QEPA lies on the convergence of two distinct vegetation types of the Central African rainforest and East African grassland biomes. As such the QEPA has a range of diverse habitats, including open grasslands, grassland with thickets, thick bush forests wetlands and lakes (UWA 2000). Such a range of habitats is the reason that QEPA has uniquely high species richness of avian species (556 recorded bird species), large carnivores such as lions, leopards and spotted hyena, primates such as chimpanzees and red-tailed colobus monkeys, and other large mammals such as elephants, buffaloes, hippopotamus, topi and kobs.

Queen Elizabeth National Park was designated a Biosphere Reserve in 1979 with the implicit goal of integrating sustainable use of park resources by local people while at the same time helping in the protection of the environment (UWA 2000). The QEPA management plan of 2000 has designated the park into zones called integrated resource use zones where plant resource for medicines, basketry and others can be extracted by the adjacent local communities. Such zones include four islands on Lake George and Kigezi wildlife reserve (South Maramagambo forest). The four islands on Lake George (Akiika, Butonga, Rwebitokye and Kankuranga) were designated to an area of 23.2km² for the extraction of papyrus, ambatch and phragmites by the fishing villages of Kashaka (Bushenyi district) and Kasenyi parishes (Kasese district). The integrated conservation area of Kigezi Wildlife reserve was designated to an area of 147km² of

the forest in which access for the regulated extraction of medicinal and weaving plants, regulated beekeeping and regulated firewood collection by the local people from three parishes of Kiyaga, Rwoburunga and Iramira was allowed (UWA 2000).

Before any kind of plant exploitation begins, it is imperative to carry out a plant resource inventory in order to determine the plant stock and prevent the over-exploitation of the plant resources (Peters, 1994, Cunningham 2001, Bitariho *et al* 2005). Almost any type of plant resource harvesting conducted in a tropical forest has an impact on the ecological functions of the forest. Controlled harvesting of plant resources holds a great potential as a method for integrating the use of natural resources in a sustainable manner (Peters, 1994, Bitariho *et al* 2005). With the realization that harvesting of the requested plant resources in QEPA needs to be done sustainably, the Institute of Tropical Forest Conservation (ITFC) was tasked by UWA with funding from PRIME/WEST to undertake a plant resource inventory that will act as a first step towards the realization of sustainable harvest of the plants from QEPA. This study is an initial step towards the determination of a sustainable plant harvest quota. In order to be ensure maximum sustainable yields, subsequent studies of biomass production for plants vulnerable to overexploitation will be needed.

Figure 1: The Integrated resource use zones of QEPA



2.0 Study objectives

The major goal of the study was to assess whether the proposed integrated resource use zones were able to supply the requested plant resources that the local communities were requesting. The other specific objectives will be to:-

- (i) Determine the presence or absence of the requested plants;
- (ii) Assess the abundance, distribution and patterns of habitat preference of the requested plants;
- (iii) Determine together with key resource users sustainable harvest methods of the requested plants
- (iv) Recommend to QEPA management the plants that can be harvested and initial allowable annual offtakes

3.0 Methods

3.1 Participatory Rural Appraisal (PRA)

A team comprising of the Community Conservation section of QEPA's, PRIME/WEST and ITFC carried out a rapid appraisal of fishermen in the fishing villages of the parishes of Kashaka and Kasenyi near the Lake George Island of Kyambura Wildlife Reserve to assess the use of the three requested plants. Information sought included the amount of resource plants needed, number of plant pieces (or pieces of stem) needed for a fishing net float, how long the plant pieces last and the total number of fishermen and fishing nets per parish.

Rapid appraisals of local communities living in three parishes of Kiyaga, Rwoburunga and Iramira adjacent Kigezi Wildlife Reserve were also carried out to assess the requested plant resources used by local communities. A list of the plants requested by the local communities of the three parishes of Kigezi Wildlife Reserve was compiled. We also carried out interviews of the specialist's resource users (traditional herbalists and basket weavers) to assess the plant resources needed. Interviews were in the form of discussions and open-ended questions.

3.2 Focused Searches and Herbarium Specimen Collection

In order to identify scientifically all the requested plants, the ITFC herbarium technician, together with key selected plant resource users from each parish, carried out focused searches for these plants in Kigezi Wildlife reserve and Lake George Islands while collecting samples and identifying them. As requested plants that were encountered, fertile specimens were collected for herbarium identification.

For the plant resources requested by the local communities adjacent Kigezi Wildlife Reserve, a subjective assessment of abundance based on the number of encounters was done for each of the resource plants found. The categories were "common" if more than 10 stems of an individual species were encountered; "rare" if the plant species stems ranged from 1 to 10 stems; and "not found" if only none of the plants were encountered (ITFC 1999).

3.3 Mapping of resource plants

Together with key resources users, we mapped out areas of the two integrated zones where the requested plants occur using a global positioning system (GPS). The GPS readings were then incorporated in the QEPA Geographical Information System (GIS) database to produce maps where the plants were common.

3.4 Resource Plant Sampling

3.4.1 Sampling Design

For the requested plants found on Lake George Islands, we used a boat and protective waterproof waders to assess the abundance and distribution of the requested plant Ambatch. We did not assess the abundance of Papyrus and Phragmites since they occurred at extremely high stem densities. Estimations of abundance would therefore have been extremely labour intensive and expensive, while at the same time not being a particular high priority. Rather the two plants were recorded for presence and absence.

Random plots of 10 x 10m were established along Butonga Island and into the estuary. The first plot was subjectively established in areas where Ambatch occurred and thereafter the other plots were located at random distances of 10m, 20m, 30m and 40m. Using waterproof waders and a boat, individual stems of Ambatch located within the plots were recorded for dbh and height.

For the requested plants found in Kigezi Wildlife Reserve, we carried out a forest survey to assess the abundance and distribution of the requested plants. Three randomly placed belt transects running from the forest edge into the resource use zone were established in each adjacent parish. Belt transects of 10m width and 1km lengths were used to assess the requested plant species of tree life-form. Belt transects were chosen because for a survey over long distances, they account better for heterogeneity of the forest than a quadrat of the same area (Hladik and Dounias 1993, Tuxill and Nabhan, 1998, Bitariho *et al* 2005).

On each transect nested square quadrats (See Figure 1 and Table 1) were placed regularly at 10m intervals alternating from right to left sides of the transect to assess requested plants of other life forms (shrubs, lianas, vines and herbs) (ITFC 1999). Systematic sampling plots have the advantage of estimating population abundance and density well and can be done without prior knowledge of the total area (Tuxill and Nabhan, 1998, Bitariho *et al* 2005).

3.4.2 Data collection

3.4.2.1 Transect

The belt transects were used to enumerate the requested resource trees whose diameters are $\geq 10\text{cm dbh}$. Diameters were measured at 1.3m height. Inclusion of large stems in the plots was based on a perceived central line within the stem lying within the plot boundary at the point where the diameter was to be measured.

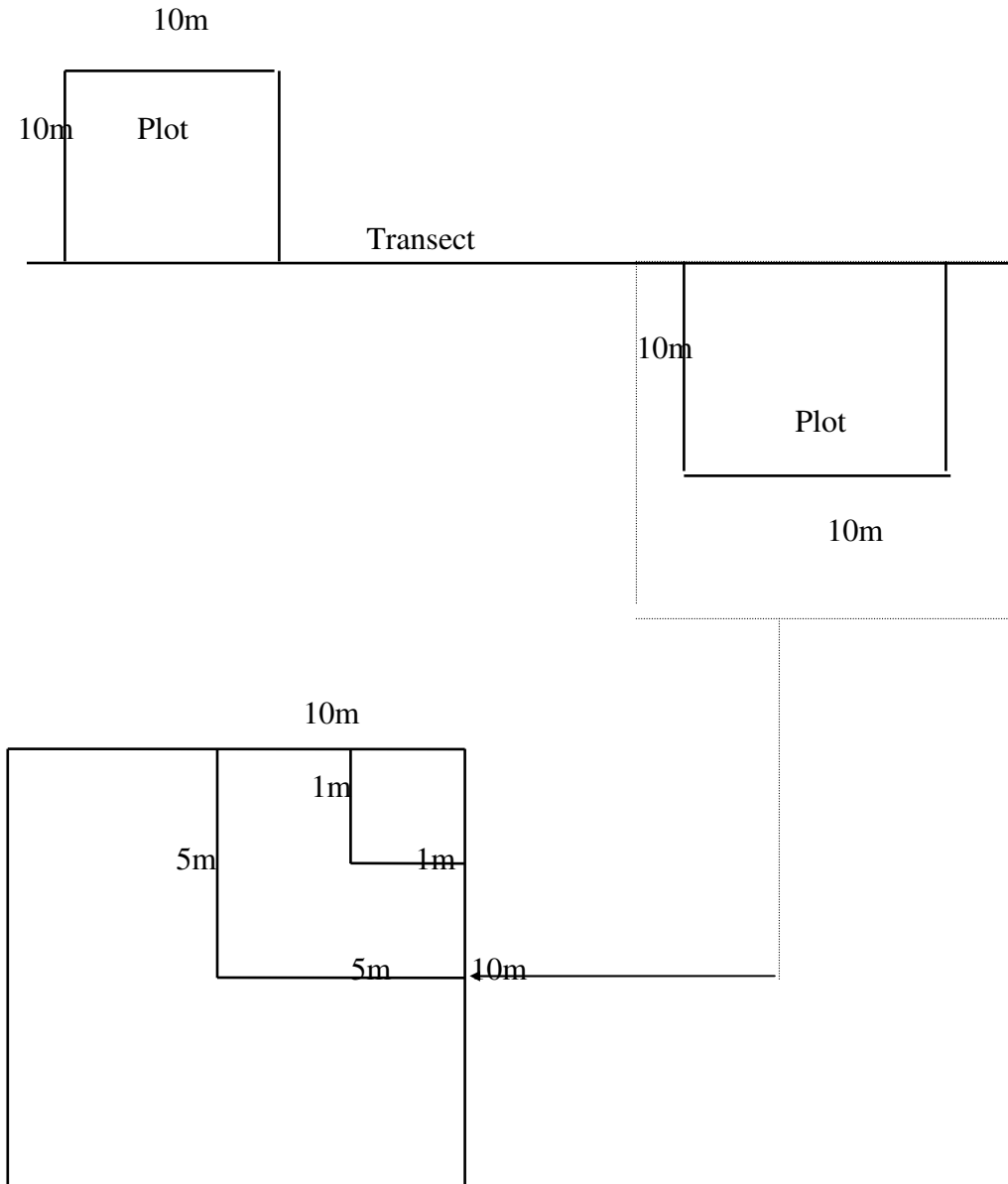
3.4.2.2 Nested Quadrat

For the other requested plants from Kigezi Wildlife Reserve of growth forms other than trees and poles, enumeration was done in the nested quadrats. Nesting involved smaller plots contained within larger plots (Figure 1). Size of the sub-plots varied with the adult life-form of the target plant species as shown in Table 1. Lianas were considered as large, woody bare-stemmed climbers while vines were predominantly herbaceous, leafy smaller climbers. The stems enumerated were only those rooted within the plots. In cases where climbers and shrubs stems were found formed by clonal extension of larger individuals, these were treated as separate plant individuals (ITFC 1999). Quantification of the encountered plant species was done by tallying their abundance based on stem numbers.

Table 1 Quadrat sizes for the various plant life-forms (ITFC 1999)

Quadrat Size (m)	Plant Life-form
1 x 1	Herbs
5 x 5	Vines and small shrubs
10 x 10	Lianas and large shrubs

Figure 2 Nested plot layout on transect



3.4.2.3 Selective Resource User Assessment

We also assessed the quality of the plants from the resource users' point of view by using specialist plant resource users (fishermen, herbalists and basket weavers) who accompanied us during the plant resource sampling described above. The resource users

provided information on the quality of the resource plants (ITFC 1999). The quality of an individual plant to provide a resource was categorized into use-classes such as "too-young", "useable but not great", "just right", "crooked", "too old and brittle" and so on, from the resource users point of view (ITFC 1999).

4.0 Results

4.1 Participatory Rural Appraisal

The resource plants requested by the fishing communities of Kashaka and Kasenyi parishes from Lake George Islands were Ambatch (*Aeschynomene elephroxylon*), Phragmites (*Shoenoplectus corymbossus*) and Papyrus (*Cyperus papyrus*). Papyrus and Ambatch are needed as fishnet floats while Phragmites is needed for making mats to line the floor of boats. From the interviews we established that Kashaka and Kasenyi parishes have 71 and 59 licensed fishing boats respectively.

The requested plant resources from Kigezi wildlife reserve were forest plants of diverse life-forms (trees, lianas, vines and herbs) that are found mainly in South Maramagambo forest and are needed for medicinal and basketry purposes. Twenty one plants were requested for basketry while 103 plants were requested for medicinal purposes by the local communities from the adjacent parishes of Kiyanga, Iraramira and Rwoburunga (see appendix for list of all requested plants).

4.2 Focused searches and transect/plot methods

A comparison of the requested plant abundance found by the subjective focused searches and the transect/plot methods revealed little difference in the species that were classified as "common", "rare" or not found in South Maramagambo forest by the two methods (Figure 3). This was also noted by ITFC (1999) for requested plant species in Bwindi. Thirty nine percent of the requested medicinal plants were not encountered at all using subjective focused searches whereas 62% of the requested medicinal plants were also not encountered using transect/plot methods. Forty three percent of the requested weaving plants were not encountered at all using subjective focused searches compared to 52% when transect/plot method was used (Figure 3). Figure 3 also shows

that when focused search and transect/plot methods were used, only 26% and 18% respectively of the requested medicinal plants were classified as common and for the weaving plants only 43% and 33% respectively of the plants were classified as common.

All the three requested plants from Lake George Islands (*Ambatch-Aeschynomene elephroxylon*, *Phragmites-Shoenoplectus corymbossus* and *Papyrus-Cyperus papyrus*) were encountered frequently using both subjective focused searches and transect/plot methods and were all classified as common. These were found on Butonga and Akika Islands of Lake George (Figure 4).

Figure 3 A Comparison of focused search and transect/plot methods

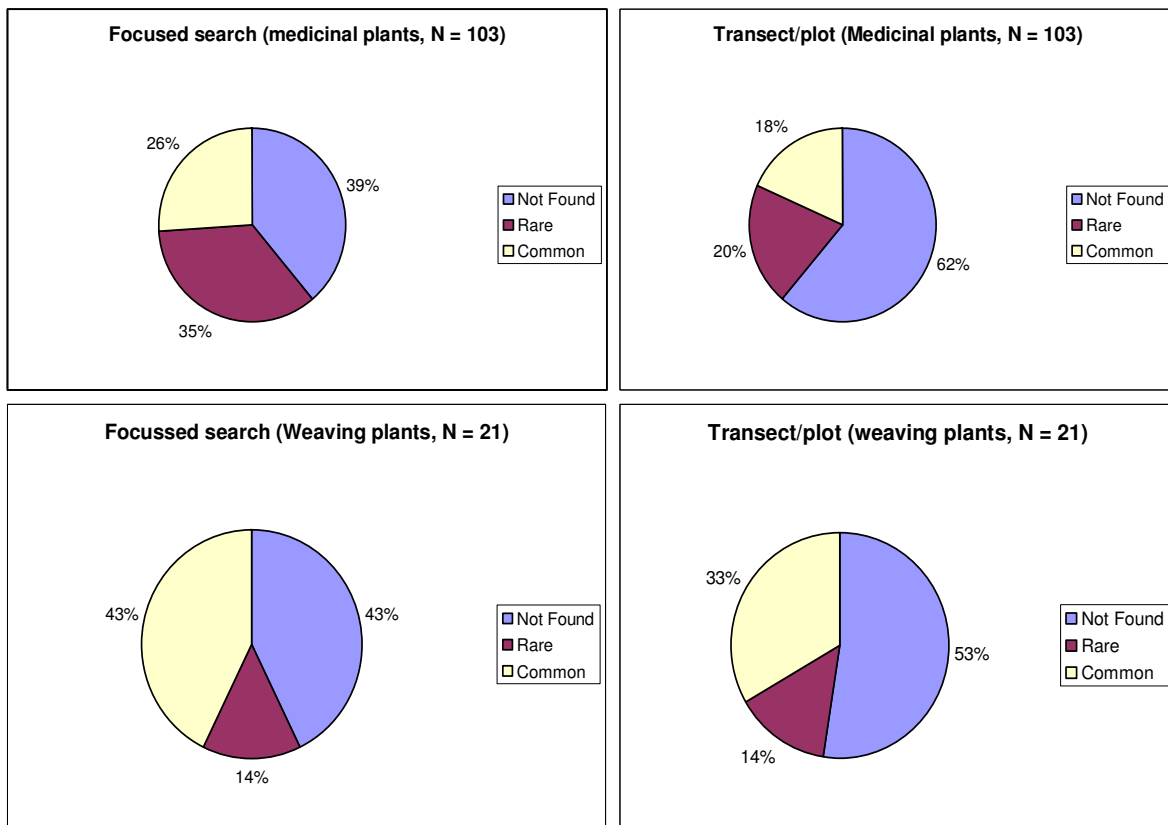
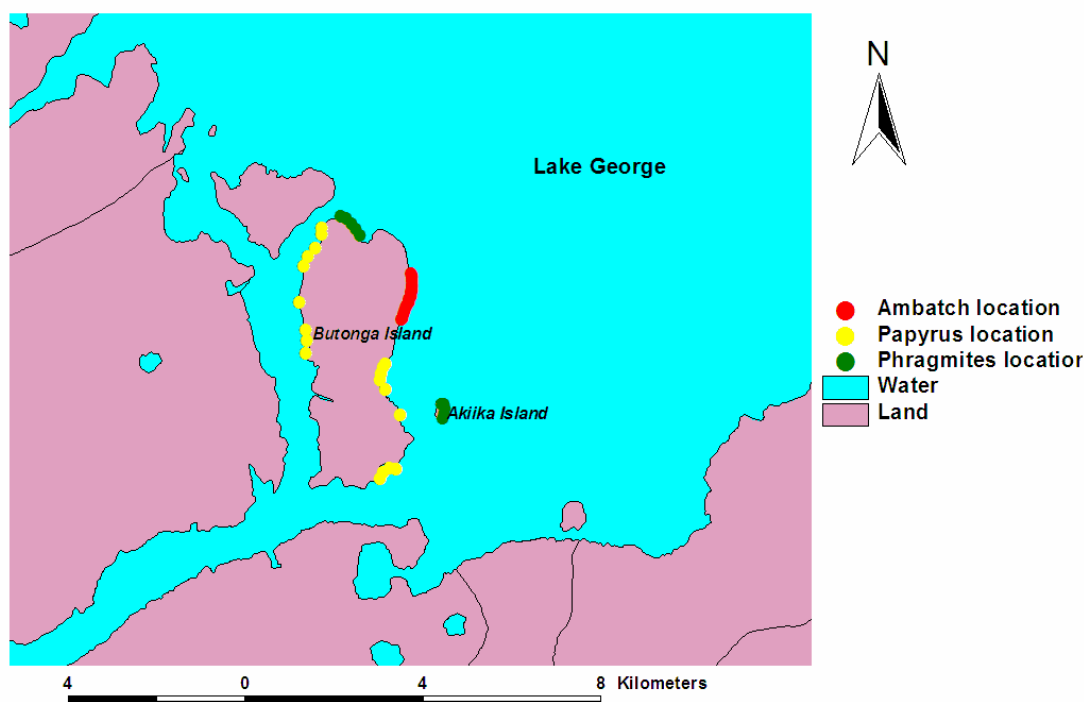


Figure 4 Areas of Lake George Islands that had the most common occurrence of the requested plants



4.3 Abundance of the most common occurring plant species

4.3.1 Lake George Island plants

The calculated stem density of *Aeschynomene elephroxylon* (ambatch) was 85 stems/ha while those of *Shoenoplectus corymbossus* (phragmites) and *Cyperus papyrus* (papyrus) were too high to be sampled and calculated. The minimum harvestable stem density for Lake George Island plants was considered to be ≥ 10 stems/ha at the lower limit of 95% confidence interval, as for that used for lianas and shrubs in this study (ITFC 1999) and thus this study found that the three Lake George Island plant species *Aeschynomene elephroxylon* (ambatch), *Shoenoplectus corymbossus* (phragmites) and *Cyperus papyrus* (papyrus) have in principle a high enough stem density enough to be harvested.

The diameter class distribution of ambatch is a typical inverted 'J' type of distribution that is commonly observed in natural populations that are stable and self replacing

(Figure 5) (Hall and Bawa, 1993; Bitariho *et al* 2006). Most of the Ambatch was found in the upper class limit of diameter 40mm and 120mm dbh. The thinnest Ambatch stem was 0.82mm while the thickest was 365mm of dbh. Average diameter of Ambatch was 83.9mm dbh. Ambatch is a vigorous sprouting plant that is resilient to cutting (see Figure 6). This is also true for the other requested plants of phragmites and papyrus.

Figure 5 Diameter class distributions (upper limit) of Ambatch on Lake George Islands

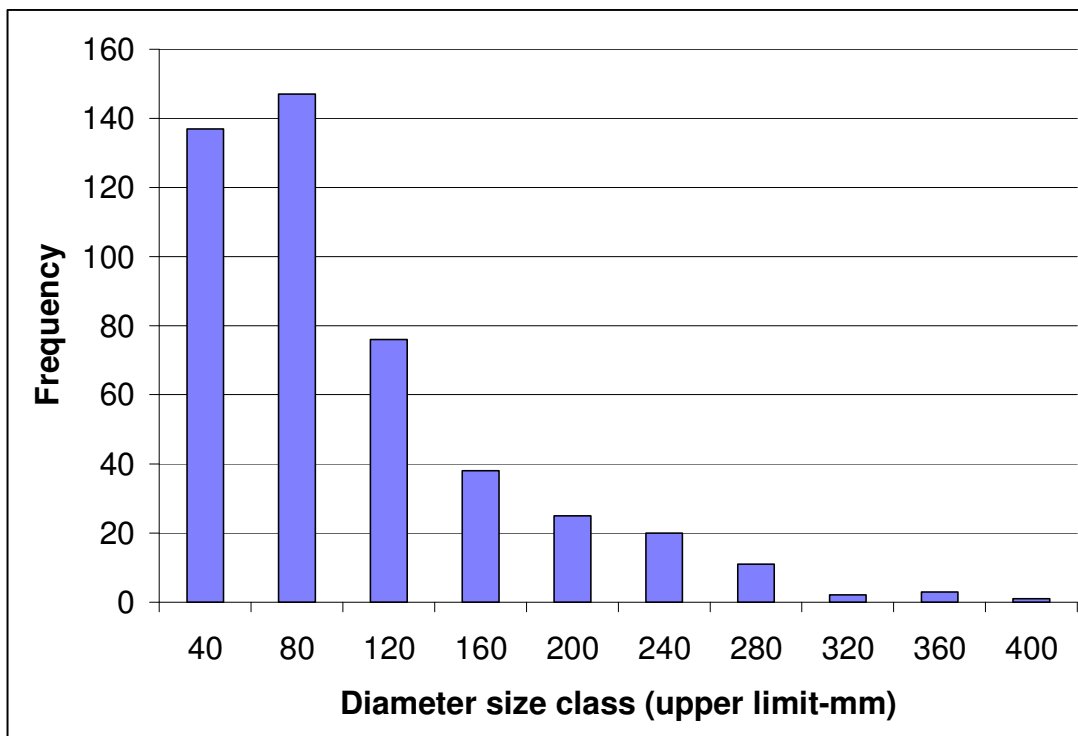


Figure 6 Photograph showing the many sprouting stems of Ambatch after cutting



4.3.2 Kiyanga Parish

Plants with sufficiently high stem density for harvesting were considered to be those with stem density of ≥ 0.1 stems/ha, ≥ 10 stems/ha and ≥ 40 stems/ha for trees, woody climbers and vines respectively at the lower limit of 95% confidence interval. These limits were adapted from those previously used in Bwindi Impenetrable National Park ITFC (1999). Figure 8 and 9 show the abundance of the requested weaving and medicinal plants from the forest adjacent Kiyanga parish. From the two figures, only 6 weaving and 11 medicinal plants were found to have a sufficiently high stem density to be harvested. The six weaving plants are *Triumfetta macrophylla* (Eminaaba), *Smilax anceps* (Enshuri), *Loeseneriella africana* (Embugu), *Vernonia cistifolia* (Enkureju), *Flueggea virosa* (Emikarara) and *Cyphostemma adenocaula* (Orubogore/Bikaku). Figure 7, shows areas of Kiyanga parish that had the highest abundance of weaving and medicinal plants. These areas were mapped during focused searches and transect/plot methods plant sampling.

Figure 7 Areas of South Maramagambo that had high plant abundance of the requested weaving and medicinal plants

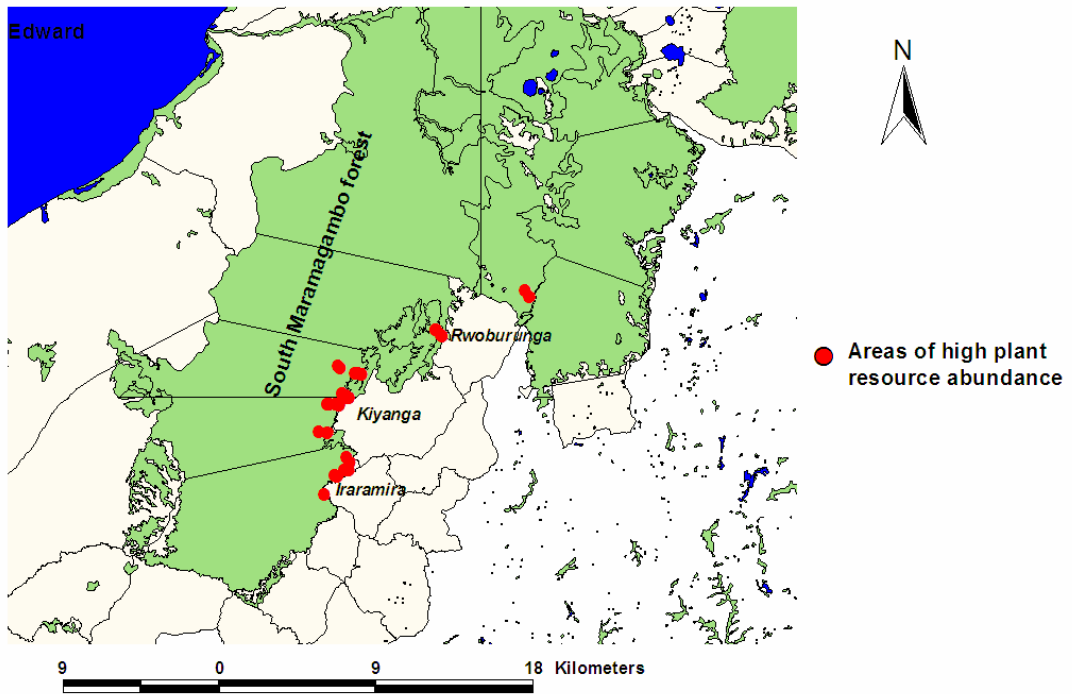
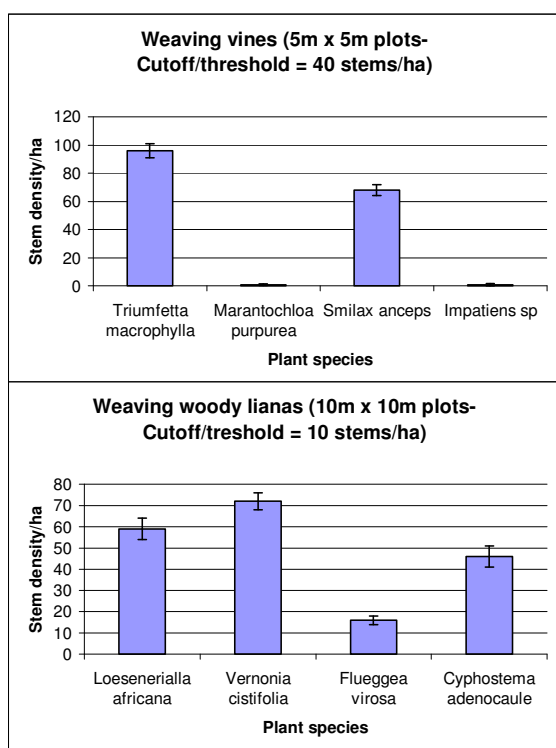


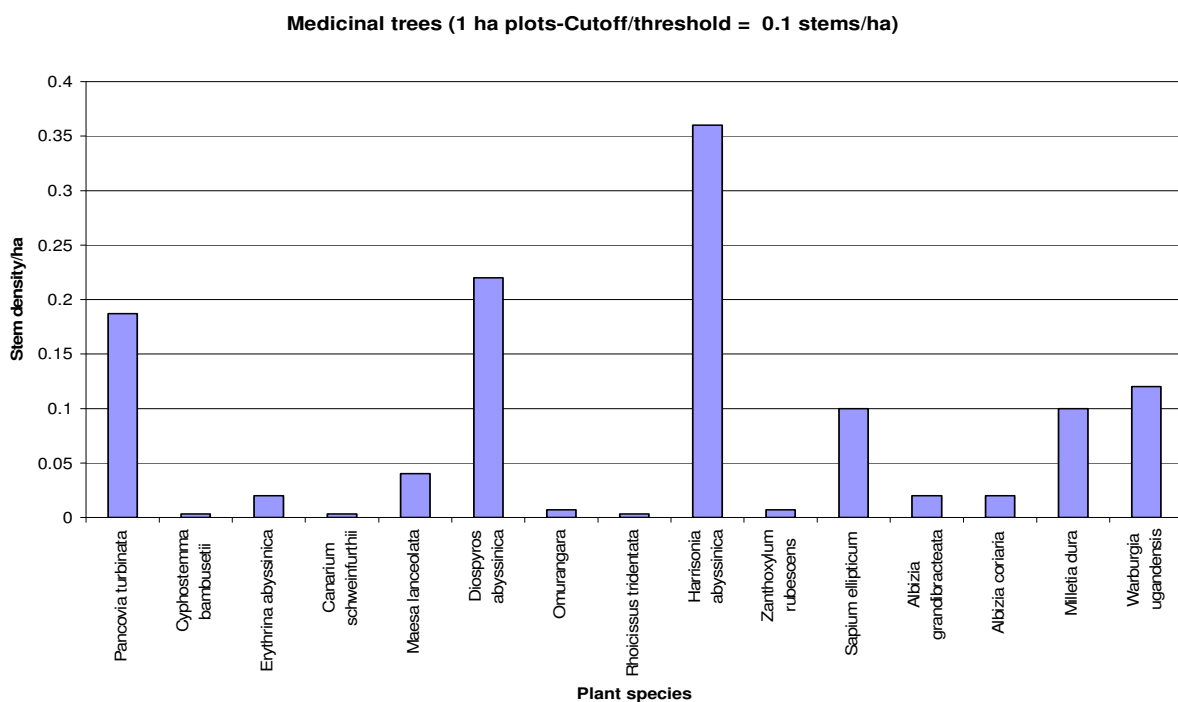
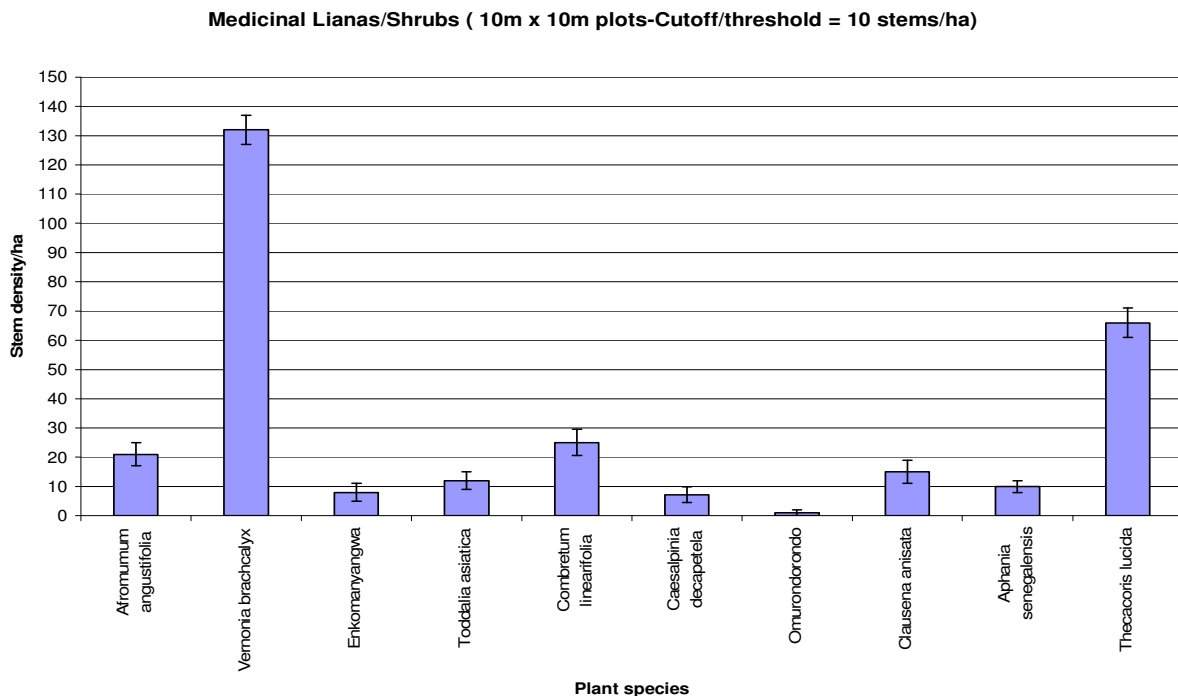
Figure 8 Abundance of requested weaving plants from Kiyanga parish



The recommended 11 medicinal plants for harvest from Kiyanga parish are;

Afromumum angustifolia (Amatunguru), *Vernonia brachycalyx* (Emihe), *Combretum linearifolia* (Omuhankuruba), *Clausena anisata* (Omutana), *Thecacoris lucida* (Omuzirakarenga), *Pancovia turbinata* (Akarema), *Diospyros abyssinica* (Omuhoko/Omwirote), *Harrisonia abyssinica* (Omurarikye), *Sapium ellipticum* (Omushasha), *Milletia dura* (Omutaate) and *Warburgia ugandensis* (Omwiha) (Figure 9)

Figure 9 Abundance of requested medicinal plants from Kiyanga parish

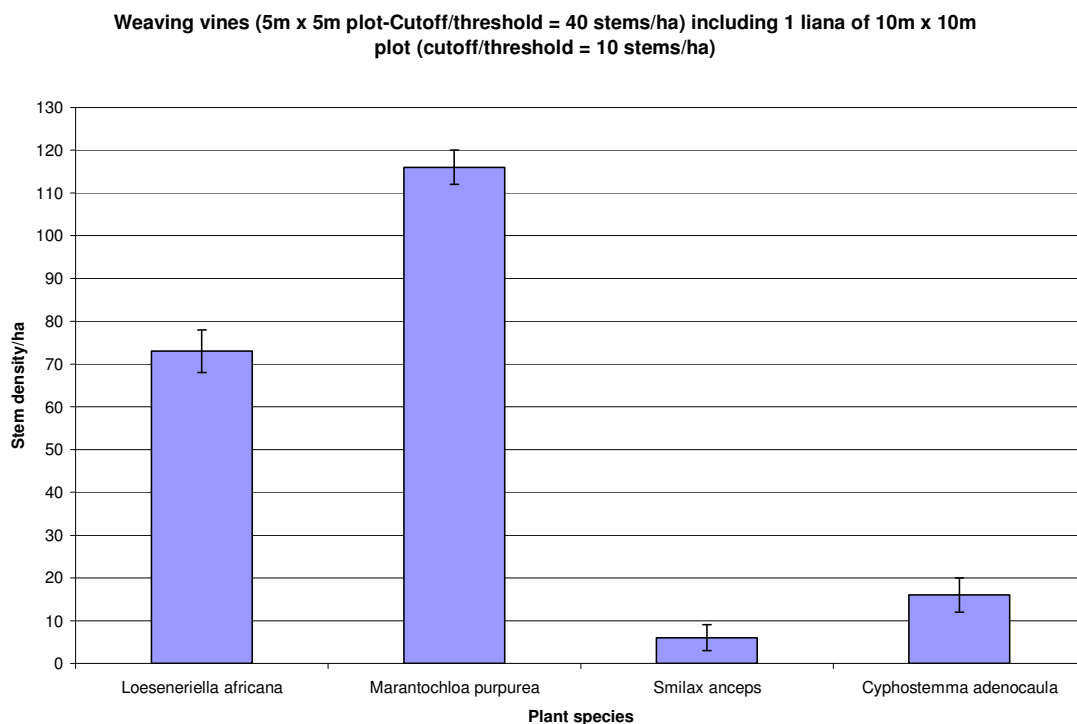


4.3.3 Iraramira parish

As for Kiyanga parish, plants with sufficiently high stem density for harvesting were considered to be those with stem density of ≥ 0.1 stems/ha, ≥ 10 stems/ha and ≥ 40

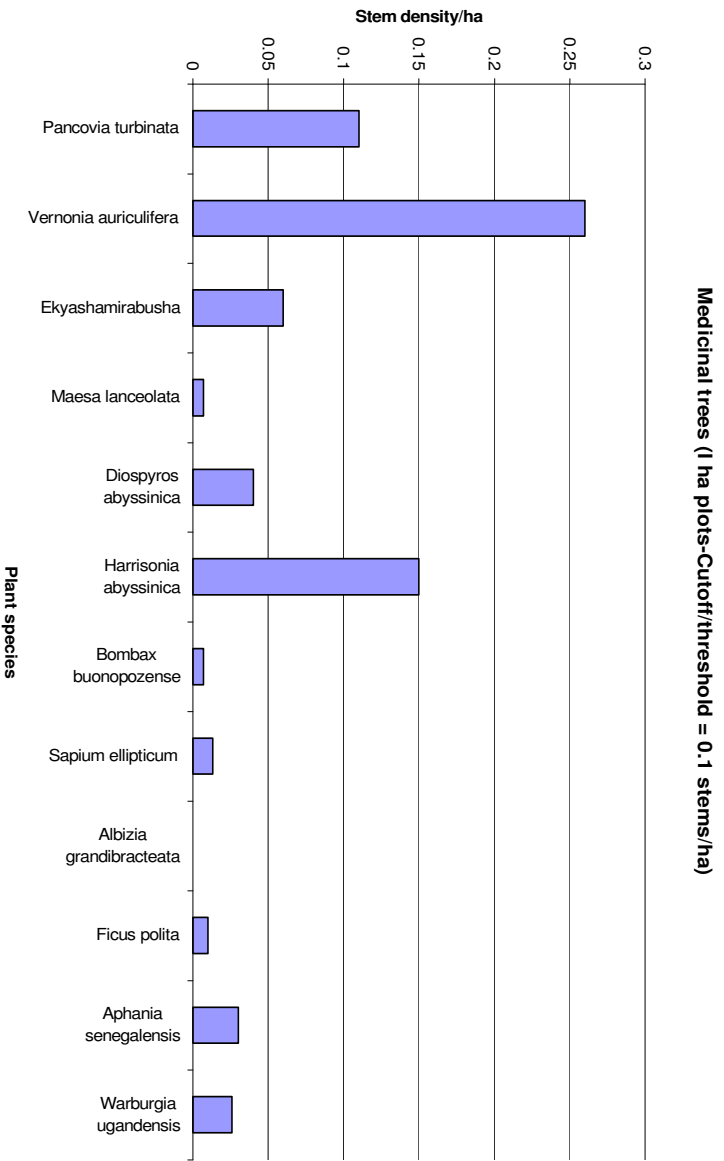
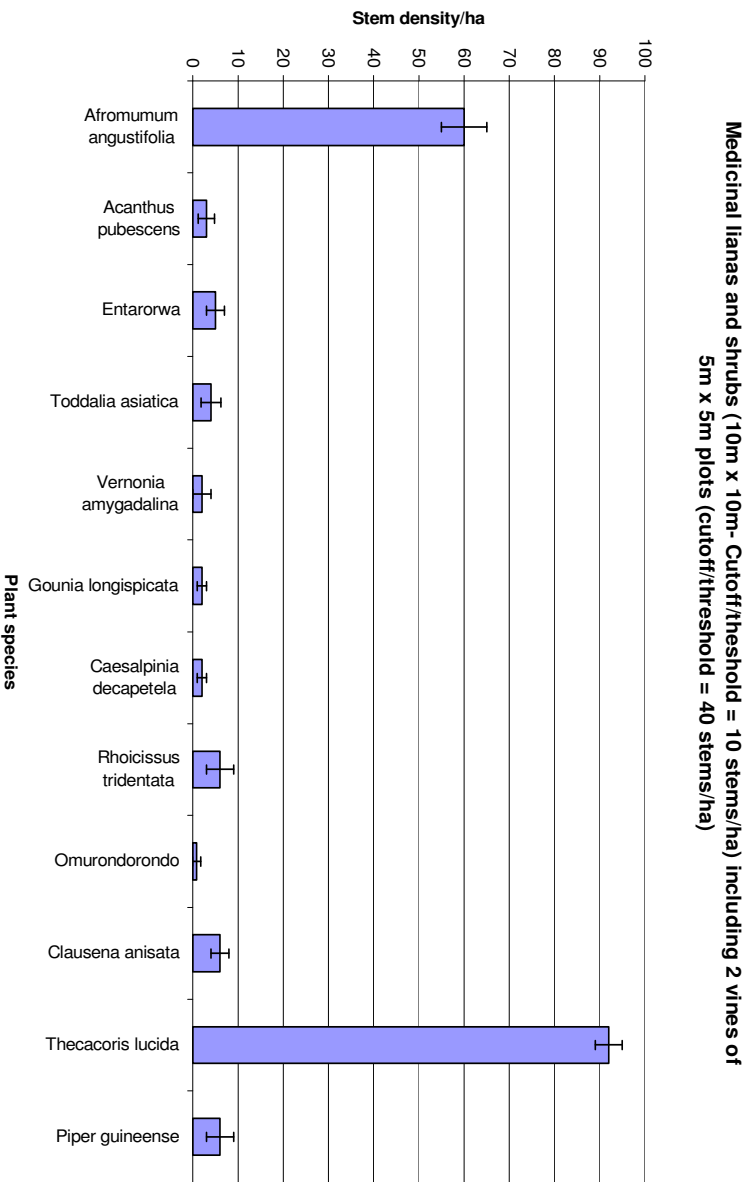
stems/ha for trees, woody climbers and vines respectively at the lower limit of 95% confidence interval (ITFC 1999) and were therefore recommended for harvest. Figure 10 and 11 show the abundance of the requested weaving and medicinal plants from the forest adjacent Iraramira parish. From the two figures, only 2 weaving and 5 medicinal plants had a high stem density enough to be harvested from the forest adjacent Iraramira parish. The 2 weaving plants are *Loeseneriella africana* (Embugu) and *Marantochloa purpurea* (Emyorwa). Figure 7, shows areas of Iraramira parish that had the highest abundance of weaving and medicinal plants.

Figure 10 Abundance of requested weaving plants from Iraramira parish



The five medicinal plants recommended for harvest from Iraramira parish are; *Afromumum angustifolia* (Amatunguru), *Thecacoris lucida* (Omuzirakarenga), *Pancovia turbinata* (Akarema), *Vernonia auriculifera* (Ekinyaminyami) and *Harrisonia abyssinica* (Omurarikye) (Figure 11).

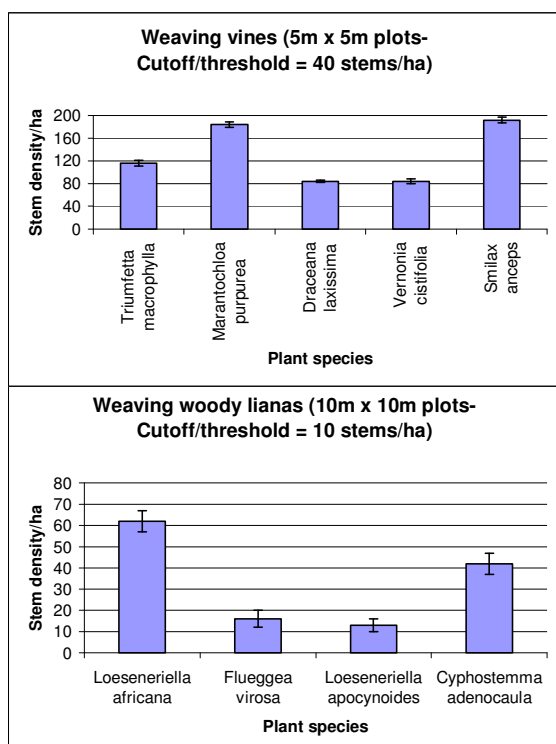
Figure 11 Abundance of requested medicinal plants from Iramira parish



4.3.4 Rwoburunga parish

As with the other two parishes above, plants with sufficiently high stem density to be recommended for harvest were considered to be those with stem density of ≥ 0.1 stems/ha, ≥ 10 stems/ha and ≥ 40 stems/ha for trees, woody climbers and vines respectively at the lower limit of 95% confidence interval (ITFC 1999). Figure 12 and 13 show the abundance of the requested weaving and medicinal plants from the forest adjacent Rwoburunga parish. From the two figures, only 8 weaving and 13 medicinal plants had a high stem density enough to be harvested from the forest adjacent Rwoburunga parish. The 8 weaving plants are; *Triumfetta macrophylla* (Eminaaba), *Marantochloa purpurea* (Emyorwa), *Draceana laxissima* (Enchenche), *Vernonia cistifolia* (Enkureju), *Smilax anceps* (Enshuri), *Loeseneriella africana* (Embugu), *Flueggea virosa* (Emikarara) and *Cyphostemma adenocaula* (Orubogore/Bikaku). Figure 7, shows areas of Kiyanga parish that had the highest abundance of weaving and medicinal plants.

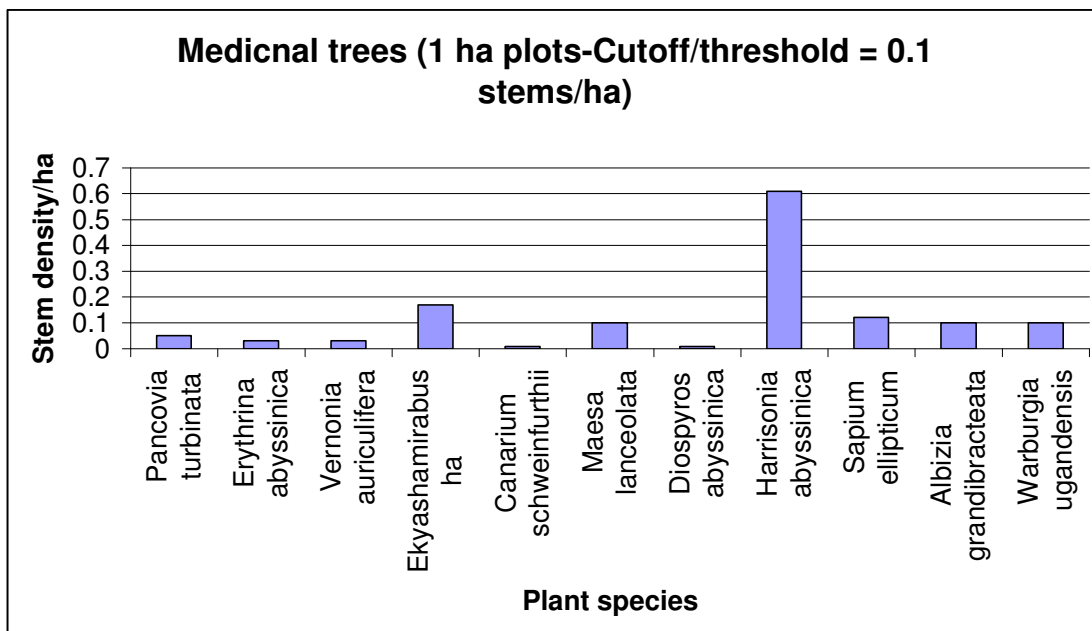
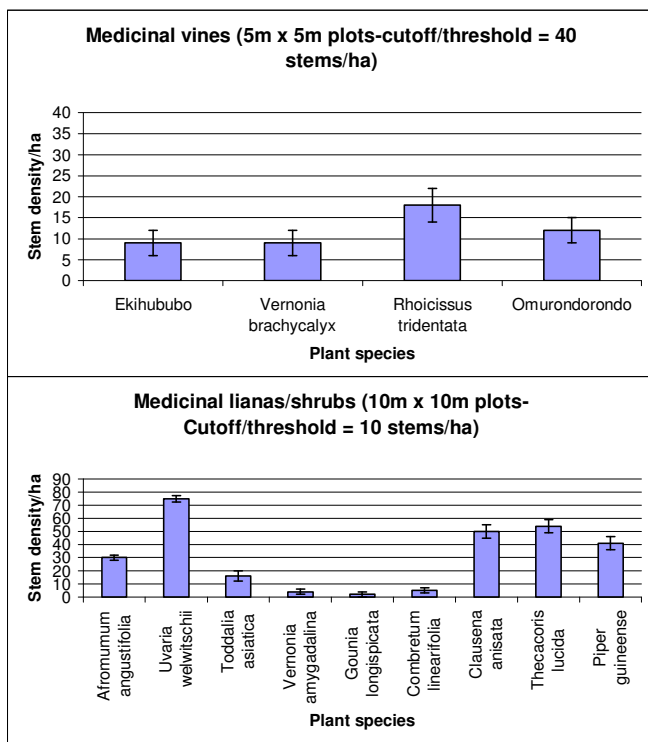
Figure 12 Abundance of requested weaving plants from Rwoburunga parish



The 12 medicinal plants recommended for harvest from Rwoburunga parish are;

Afromumum angustifolia (Amatunguru), *Uvaria welwitschii* (Entazigurukwa),
Toddalia asiatica (Kabakura), *Thecacoris lucida* (Omuzirakarenga), *Piper guineense*
(Rukokota), *Clausena anisata* (Omutana), Ekyashamirabusha, *Maesa lanceolata*
(Omuhanga), *Harrisonia abyssinica* (Omurarikye), *Sapium ellipticum* (Omushasha),
Albizia grandibracteata (Omushebeya) and *Warburgia ugandensis* (Omwiha) (Figure
13).

Figure 13 Abundance of requested medicinal plants from Rwoburunga parish



We used a conservative figure of plant stem density per hectare of ≥ 0.1 , ≥ 10 and ≥ 40 stems for trees, lianas/shrubs and vines respectively as the minimum stem density of the plants abundant enough to be harvested (ITFC 1999).

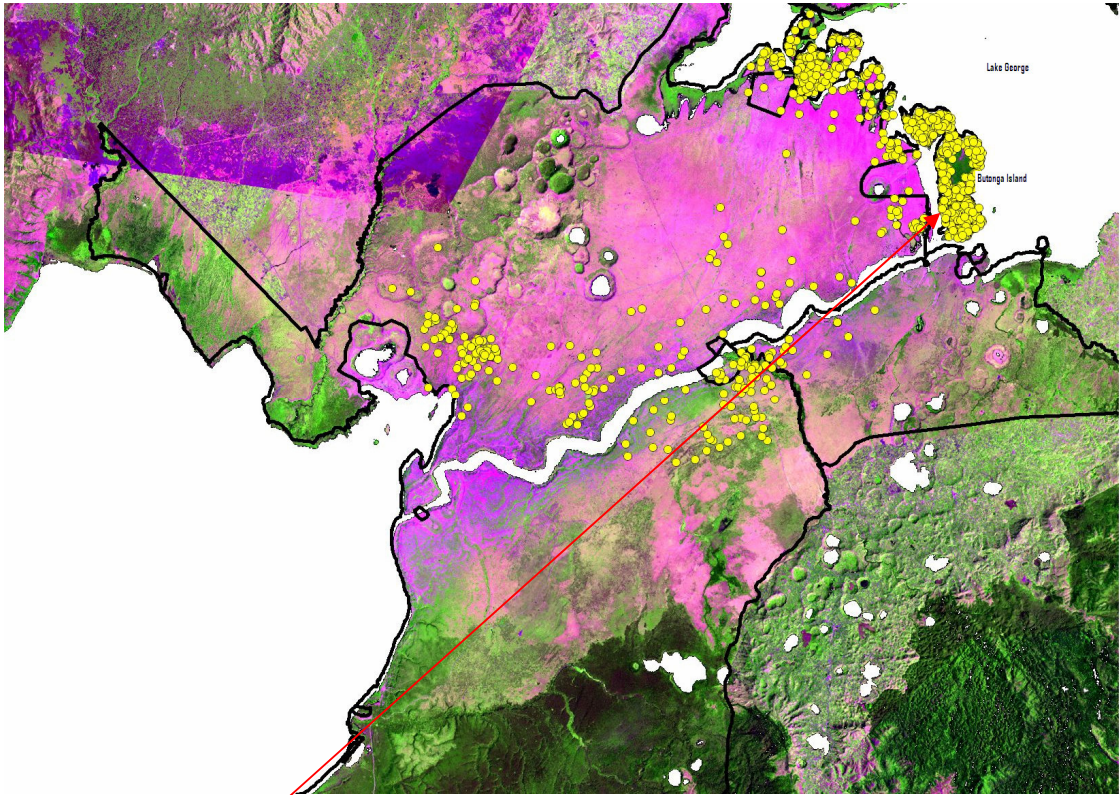
5.0 Discussions and harvest quota recommendations

5.1 Lake George Island plants

Ambatch is used for fishnet floats when the moon is out and the fish are near the water surface (UWA 2000). We used an annual harvest quota of 1% of available plant resource stock on the Lake George Islands (ITFC 1999). Each mature stem of ambatch can produce about 100 pieces of fishnet floats (Fishermen interviews). Using the 1% harvest quota of available stock of ambatch, 120 stems of ambatch would be available for harvest annually (Table 2). These stems of ambatch would produce 12,000 fishnet floats for use in a year. However this is not enough to meet the demand of ambatch (see table 3). There are 71 and 59 licensed fishermen (total 130) in Kashaka and Kasenyi respectively who require about 5,865 stems of ambatch annually for their fishnets. The total annual demand for ambatch is actually equal to half the total resource base of ambatch on Lake George islands (Table 3). This demand is so high that it would outstrip the supply of ambatch and therefore lead to its over-exploitation. Elephants were also observed feeding quite extensively on ambatch. The Wildlife Conservation Society (WCS) is studying elephant movement in QEPA and has shown that the four Islands (Akiika, Butonga, Rwebitokye and Kankuranga) are frequently used by elephants and are located in areas where the ambatch grows (Figure 14). Legalizing the harvest of ambatch is therefore likely to cause a negative impact on the food availability for the elephants. There is a need to find other alternatives for

ambatch floats such as plastic floats and avail them to the fishermen to avoid a scenario of ambatch over-exploitation.

Figure 14 Map showing areas frequented by elephants in QEPA



The yellow dots are locations of a radio-tracked elephant in QEPA (Source: Wildlife Conservation Society-WCS in conjunction with PRIME/West)

Papyrus fishnet floats are used when the fish are deep in the lake and phragmites are used to line boats of the fishermen. From the interviews, we found out that only 2 stems of papyrus are used for making 10 pieces of floats needed for a fishnet. Papyrus and phragmites are a fast growing swamp plants that respond with vigorous growth of young ones after being disturbed through cutting. And although we did not determine stem density of papyrus and phragmites, we found that where the two plants grow, they had high stems densities and grow vigorously even after being cut. We recommend the harvest of the papyrus and phragmites by the fishermen. However this harvest should

be restricted to accessories to help the fishermen only and care should be taken to avoid the commercial exploitation of the two plants. Fishermen that use the papyrus and phragmites should be registered by UWA and records of their annual harvests made.

5.2 Plants from Kigezi wildlife reserve

According to Peters (1994) and Bitariho *et al* (2006), most tropical forest plant species are distributed at very low densities and are susceptible to over-harvesting. This is in agreement with this study where only few requested medicinal and weaving plants are recommended for harvest. There is a positive relationship that exists between plant species stem density and the quantity of plant material available for harvest (Cunningham 2001; Peters 1994; Godoy and Bawa 1993; Bitariho *et al* 2006). This relationship is modified by species ecology, life history, and the parts of the plants that are harvested (ITFC 1999; Peters 1994; Cunningham 1996). Sustainable harvest of plants resources can best be determined through calculating annual biomass production of harvested plant parts and comparing it with annual plant parts harvested (Godoy and Bawa 1993; Bitariho *et al* 2006). This study was limited by time, labor and funds, and could not determine the annual biomass production (yield) of the requested plants (about 127 plant species). Yield studies can take up to three years (Peters 1994; Bitariho *et al* 2006). We used annual plant harvest offtake quotas basing on 1% of available plant resource stock in the plant harvest zones of QEPA (ITFC 1999). (See table 4 to 9). For all the medicinal trees and shrubs that are harvested for bark, we assumed the average bark mass to be 0.45 kg per tree after Bitariho *et al* (2006). Also plant species that were to be harvested for leaves, we did not limit their harvest at all since leaf harvest from plants causes very minimal harvest impacts (Cunningham 2001; Peters 1994; Bitariho *et al* 2006). We also recommend the

limit of harvest of papyrus and phragmites to be based on the number of licensed fishermen/boats on Lake George Island parishes. For plants that were requested for harvest for roots such as *Piper guineense* (Rukokota) and *Toddalia asiatica* (Kabakura) we do not recommend their harvest until further studies to determine annual roots production (yields) and their harvest impacts are carried out. This is in order to avoid any negative impacts that may be associated with root harvests, which can be particularly destructive of plants (Cunningham 2001; Peters 1994). Other recommendations are:

- I) Before any harvest begins, plant harvest societies (e.g. forest societies) should be formed with the help of UWA, ITFC and possibly other NGOs such as PRIME/West and CARE working in QEPA. The aim of formation of these societies would be to help in recording annual harvest offtakes of the plants, to manage the plant harvest, register plant users and help in the reporting any illegal activities within the wildlife reserves
- II) There is need for more studies to determine harvested plants annual biomass production (yield) to allow more conclusive determination of sustainable harvest quotas
- III) There is need to set up a plant harvest monitoring system to help detect and mitigate any negative impacts that may occur as a result of plant harvest in QEPA.
- IV) Conservation and developmental organizations working in QEPA could help the local communities e.g fishermen of Kashaka and Kasenyi landing sites to obtain alternatives to the plants used that are highly demanded (like ambatch) and yet have not been recommended for harvest.

Table 2 Recommended annual harvest quotas of requested plants from Lake George

Plants Species	Part Used	Plot area used (m ²)	Average stems/ha	Estimated stems in whole zone (1.4km ² of estuary)-available stock	Recommended annual harvest quotas
<i>Aeschynomene elephroxylon</i> (Ambatch)	Stem	100	86	12,040	????
<i>Cyperus papyrus</i> (Papyrus)	Stem	-	-	-	No limit (for fishnets floats only)
<i>Shoenoplectus corymbossus</i> (Phragmites)	Stem	-	-	-	No limit (for fishing boat mats only)

Table 3 Demand and supply of *Aeschynomene elephroxylon* (Ambatch)

Parish	No. of licensed fishermen	Total fishnets in use (94 per fisherman)	No. ambatch/fishnet/month	No. plants needed to meet demand	Ambatch resource base	% demand for ambatch
Kashaka	71	6,674	4	3,203		
Kasenyei	59	5,546	4	2,662		
Total	130	12,220	4	5,865	12,040	49%

Table 4 Recommended annual harvest quotas of weaving plants from Kiyanga

Plants Species	Part Used	Stem density/ ha	Estimated stems in whole zone (58.4km ²)- available stock	Recommended maximum annual harvest stems (1% of available plant stock)
<i>Loeseneriella africana</i> (Embugu)	Stem	59	344,560	3,446 stems
<i>Triumfetta macrophylla</i> (Eminaaba)	Stem	96	560,640	5,606 stems
<i>Vernonia cistifolia</i> (Enkureju)	Stem	72	420,480	4,205 stems
<i>Smilax anceps</i> (Enshuri)	Stem	68	397,120	3,971 stems
<i>Flueggea virosa</i> (Emikarara)	Stem	16	93,440	934 stems
<i>Cyphostemma adenocaula</i> (Orubogore/Bikaku)	Stem	46	268,640	2,686 stems

Table 5 Recommended annual harvest quotas of weaving plants from Iraramira

Plants Species	Part Used	Stem density/ ha	Estimated stems in whole zone (56.6km ²)- available stock	Recommended maximum annual harvest stems (1% of available stock)
<i>Loeseneriella africana</i> (Embugu)	Stem	73	413,180	4,132 stems
<i>Marantochloa purpurea</i> (Emyorwa)	Stem	116	656,560	6,566 stems

Table 6 Recommended annual harvest quotas of weaving plants from Rwoburunga

Plants Species	Part Used	Stem density/ ha	Estimated stems in whole zone (37.9km ²)- available stock	Recommended maximum annual harvest stems (1 % of available plant stock)
<i>Loeseneriella africana</i> (Embugu)	Stem	62	234,980	2,349 stems
<i>Triumfetta macrophylla</i> (Eminaaba)	Stem	116	439,640	4,396 stems
<i>Vernonia cistifolia</i> (Enkureju)	Stem	84	318,360	3,184 stems
<i>Smilax anceps</i> (Enshuri)	Stem	192	727,680	7,277 stems
<i>Flueggea virosa</i> (Emikarara)	Stem	16	60,640	606 stems
<i>Marantochloa purpurea</i> (Emyorwa)	Stem	184	697,360	6,974 stems
<i>Cyphostemma adenocaula</i> (Orubogore/Bikaku)	Stem	42	159,180	1,592 stems
<i>Draceana laxissima</i>	Stem	84	318,360	3,184 stems

Table 7 Recommended annual harvest quotas of medicinal plants from Kiyanga

Plant Species	Part Used	Stem density/ ha	Estimated stems in whole zone (58.4km ²)	Average bark masst/plant (Kg)	Estimated bark mass in whole zone (Kg)	Recommended maximum annual harvest (1% of available stock)
<i>Afromumum angustifolia</i> (Amatunguru)	Stem	21	122,640	-	-	1,226 stems
<i>Vernonia brachycalyx</i> (Emihe)	Stem	132	770,880	-	-	7,709 stems
<i>Combretum linearifolia</i> (Omuhanurankuba)	Leaf	25	146,000	-	-	No limit
<i>Clausena anisata</i> (Omutana)	Leaf	15	876,000	-	-	No limit
<i>Thecacoris lucida</i> (Omuzirakarenga)	Leaf	66	358,440	-	-	No limit
<i>Pancovia turbinate</i> (Akarema)	Bark	0.19	11,010	0.45	4,906	49.1kg
<i>Diospyros abyssinica</i> (Omuhoko/Omwirote)	Bark	0.22	12,848	0.45	5,782	57.8kg
<i>Harrisonia abyssinica</i> (Omurarikye)e	Bark	0.36	21,024	0.45	9,461	94.6kg
<i>Sapium ellipticum</i> (Omushasha)	Bark	0.1	5,840	0.45	2,628	26.3kg
<i>Milletia dura</i> (Omutaate)	Bark	0.12	6,833	0.45	3,075	31kg
<i>Warburgia ugandensis</i> (Omwiha)	Bark	0.12	7,008	0.45	3,154	31.5kg

Table 8 Recommended annual harvest quotas of medicinal plants from Iraramira

Plant Species	Part Used	Stem density/ ha	Estimate d stems in whole zone (56.6km ²)	Average bark weight/plant (Kg)	Estimated bark mass available in whole zone (Kg)	Recommended maximum annual harvest (1% of available plant stock)
<i>Afromumum angustifolia</i> (Amatunguru)	Stem	59	333,940	-	-	3,339 stems
<i>Thecacoris lucida</i> (Omuzirakarenga)	Leaf	91	515,060	-	-	No limit
<i>Pancovia turbinate</i> (Akarema)	Bark	0.11	6,226	0.45	2,802	28kg
<i>Vernonia auriculifera</i> (Ekinyaminyami)	Bark	0.1	5,660	0.45	2,547	25.5kg
<i>Harrisonia abyssinica</i> (Omurarikye)	Bark	0.26	14,716	0.45	6,622	66.2kg

Table 9 Recommended annual harvest quotas of medicinal plants from Rwoburunga

Plant Species	Part Used	Stem density/ha	Estimated stems in whole zone (37.9km ²)	Average bark weight/plant (Kg)	Estimated bark mass available in whole zone (Kg)	Recommended maximum annual harvest (1% of available plant stock)
<i>Afromumum angustifolia</i> (Amatunguru)	Stem	30	113,700	-	-	1,137 stems
<i>Clausena anisata</i> (Omutana)	Stem	50	189,500	-	-	1,895 stems
<i>Thecacoris lucida</i> (Omuzirakarenga)	Leaf	54	204,660	-	-	No Limit
<i>Uvaria welwitschii</i> (Entazigurukwa)	Leaf	27	102,330	-	-	No Limit
<i>Toddalia asiatica</i> (Kabakura)	Root	15	56,850	-	-	Need further study
<i>Piper guineense</i> (Rukokota)	Root	41	53,060	-	-	Need further study
Ekyashamirabusha	Bark	0.17	6,443	0.45	2,899	29kg
<i>Albizia grandibracteata</i> (Omushhebeya)	Bark	0.1	3,790	0.45	1,706	17.1kg
<i>Harrisonia abyssinica</i> (Omurarikye)	Bark	0.61	22,936	0.45	10,321	103kg
<i>Sapium ellipticum</i> (Omushasha)	Bark	0.12	4,548	0.45	2,047	20.5kg
<i>Maesa lanceolata</i> (Omuhanga)	Bark	0.10	3,790	0.45	1,706	17.1kg
<i>Warburgia ugandensis</i> (Omwiha)	Bark	0.1	3,790	0.45	1,706	17.1kg

6.0 References

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7.0 Appendix

7.1 List of plant resource requested from Kigezi Wildlife Reserve

Medicinal Plants

ID	Local name	Scientific name	Life form	Part harvested	Harvest form
1	Akarema		Tree	Leaf/Bark	Handful
2	Amatunguru		Liana	Leaf	Handful
3	Eigangura			Leaf	Palmful
4	Eihoza			Leaf	Handful
5	Eikizamyamuriro				
6	Ekaranzya			Leaf	Palmful
7	Ekibombo		Shrub/liana	Leaf/Bark	Handful
8	Ekihimbo			Leaf	Palmful
9	Ekihububo		Small vine		
10	Ekijumbura			Root	Palmfull
11	Ekiko		Tree	Leaf/Bark	Handful
12	Ekinyaminyami		Tree	Leaf/Bark	Handful
13	Ekitojo		Shrub	Leaf/Bark	handful
14	Emihe		Small vine	Leaf/stem	Handful
15	Endungu			Bark	handful
16	Engomera			Leaf	Handful
17	Enkaka			root	Handful
18	Enkomanyangwa		Shrub	Root	Handfull
19	Enshozi			Bark	palmful
20	Entafumbuuza			Bark	Handful
21	Entareyeirungu			Leaf	Handful
22	Entarogwa		Liana	Root	Palmful
23	Entazigurukwa		Shrub	Leaf	Palmful
24	Kabakura		Shrub/liana	Root	Palmfull
25	Kaboha			Fruit	Handfull
26	Kamarabyoona			Fruit	Handfull
27	Kamarampaka			Root	palmful
28	Kamarirane				
29	Kanisyampato			Bark	palmful
30	Katunguikumi			Root	handful
31	Kibuguta			Root	palmful
32	Kimanzi			Leaf	Handful
33	Mukurutitabye			root	Handful
34	Murisanyo			Leaves	handful
35	Nyakibazi		Shrub/liana	Bark	palmful
36	Nyakiko			Leaf	Palmful
37	Obubani			Root	palmful
38	Obufumbwa			Bark	Palmfull
39	Obuhandanyonjo			Bark	Palmful
40	Obukindiine				
41	Obututu			Leaf	Handful
42	Obuyuzya				

43	Omubirizi	Shrub	Stem	handful
44	Omuboro	Tree	Leaf/Bark	Handful
45	Omubuza		Leaf	Handful
46	Omufurura	Liana	Leaf	Handful
47	Omugiti		Bark	Palmful
48	Omugoonampiri		Leaf	Handful
49	Omugoshooru		Bark	Handful
50	Omugyegye	Tree		
51	Omuhanga	Tree	Leaf/Bark	Palmfull
52	Omuhankuruba	Shrub/liana	Leaf/Bark	Handful
53	Omuharakuku		Root	Palmfull
54	Omuhigura		Leaf	Handfull
55	Omuhoko	Tree	Leaf/Bark	palmful
56	Omujuma		Root	Handfull
57	Omukarara	Shrub	Leaf/Bark	Handful
58	Omukazanyama		Root	palmful
59	Omukwatangwe	Liana	Leaf/stem	Handfull
60	Omumara	Shrub	Leaf	Palmful
61	Omunura		Leaf	Handfull
62	Omunyakashorora		root	Handful
63	Omunyeganyeye		Root	handful
64	Omurarike	Tree	Leaves/bark	handful
65	Omureema		Leaf	Handful
66	Omureembe		Leaves/stem	handful
67	Omuremankobe	Tree	Bark	Handful
68	Omurinzi		Leaf	Handful
69	Omurokora		Bark	handful
70	Omuryanyonyi		Leaf	Handful
71	Omusavu		Bark	Handfull
72	Omushasha	Tree	Leaf/Bark	Handfull
73	Omushebeya	Tree	Leaves	palmful
74	Omushuura		Leaf	Palmful
75	Omusikikiza		Bark	handful
76	Omusinga		Leaf	Handful
77	Omusisa	Tree	Root	palmful
78	Omusoroza		Leaf	Palmful
79	Omutaanga		Leaves	handful
80	Omutaate	Tree	Leaf/root	Handfull
81	Omutana	Shrub/liana	Leaves	handful
82	Omutatembwa	Tree	Bark	Palmful
83	Omutooma	Tree	Leaf/Bark	Palmful
84	Omuturaibare	Tree	Fruit	Handful
85	Omyonza		Bark	Handfull
86	Omuziko		Bark	Handfull
87	Omuzirakarenga	Shrub	Bark	Palmful
88	Omuziranfu		Root	handful
89	Omwamira		Leaves	handful
90	Omwatibaire	Tree	Leaf/bark	Palmful
91	Omwefuzo		Bark	Palmfull
92	Omwetaango		Leaf	Handful

93	Omwiha	Tree	Bark	Handful
94	Omwiwura		Bark	Handfull
95	Omwiwa		root	Handful
96	Oruhigura		Leaf	Handful
97	Orushabebe		Bark	handful
98	Rubinga	Liana	Leaf	Handful
99	Rukaka		Root	Handfull
100	Rukoota		Root	
101	Rwakashaho		Root	palmful
102	Rwezirringa			
103	Ekyashamirabusha	Tree	Leave/Bark	Handful

Basket weaving plants

ID	Local name	Scientific name	Life form	Part used	Harvest form
1	Ebikamba		Liana	Stem	Handfull
2	Emitembe		small vine	Stem	Headload
3	Emyorwa		small vine	Stem	Handfull
4	Enga		Liana	Stem	Handfull
5	Enkyindo		Shrub	Stem	Handfull
6	Enshuri		small vine	Stem	Headload
7	Embugu		Liana	Stem	headload
8	Emiganda			Stem	headload
9	Emikarara		Shrub	Stem	headload
10	Eminaaba		small vine	Stem	headload
11	Emishinya			Stem	headload
12	Emisinga			Stem	headload
13	Enchenche		small vine	Stem	headload
14	Endengamatare		Shrub/liana	Stem	headload
15	Enkurenju		Liana	Stem	headload
16	Entaro		Liana	Stem	headload
17	Obugyesa			Stem	headload
18	Obuhungye		Shrub	Stem	headload
19	Emishambya			Stem	Headload
20	Oburima			Stem	Headload
21	Orubogore/Bikaku		Shrub/liana	Stem	Handful

7.2 Data sheets used

Village interviews

Weaving plants

Date: -----Parish/Village:-----

[illegible]

Medicinal plants

Date:-----Parish/village:-----

Resource user name	Plants used	Part used (bark, root, leaf)	Harvest form (palm-full, handfuls etc)	Form used. (Fresh or dry?)	No of people treated per handfuls/palm-full etc

Ambatch and Papyrus

Fisherman's name	Plant used	No. of fishnets used	No. of plant stem pieces used/fishnet	Estimated No. of plant stem pieces from each mature plant		Longevity of each plant stem piece when used for fishnets	
				Ambatch	Papyrus	Ambatch	Papyrus

Forest surveys

Focused Searches

Date_____

Parish/Village/location_____

Plant species	Common/Rare	Quality	GPS	
			Easting	Northing

Quality=Good, Fair, Poor (According to resource user's point of view)

Requested plant abundance and distribution

Wildlife Reserve: _____ Date: _____

Transect No: _____ Plot No: _____ Altitude: _____ Slope Aspect: _____

Slope Position _____ Canopy cover: _____

Easting _____ Northing _____

Plant species	Diameter (mm) (dbh/basal diameter)	Length/height of stem (where applicable)	Quality	Why

Quality= **Poor, Young, Fair, Good** (according to specialists resource users)

Canopy cover= **0** = no cover (0-20%); **1** = adjacent crowns meet (20-40%); **2** = crowns overlap (40- 80%); **3** = sky not visible (80-100%)