




Baseline Study of the Flora in Offaka Sub County, Arua District

Abridged (Shortened) version

Prepared by:
Andama Edward
Lead Consultant

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Adraa Agriculture College

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List of Acronyms

AAC:	Adraa Agriculture College
CFM:	Collaborative Forest Management
FGD:	Focus Group Discussion
FMNR:	Farmer Managed Natural Regeneration
IUCN:	International Union for Conservation of Nature
NAADS:	National Agricultural Advisory Services
NFA:	National Forest Authority
OSLG:	Offaka Sub County Local Government
UBOS:	Uganda Bureau of Statistics
ZARDI:	Abii Zonal Agricultural Research Development Institute

Author

Dr. Andama Edward works as Senior Lecturer at Busitema University, Faculty of Science and Education. He is also the initiator and coordinator of Greater Eastern Uganda Regional Center of Expertise. His study interests have for long focused on indigenous plants knowledge utilization and management for sustainable development of the local community.

Disclaimer

This research, commissioned by Trócaire Uganda and Adraa Agriculture College, was undertaken and written by Dr. Andama Edward, Mr. Robert Ocatre and Constance Alezuyo.

The opinions expressed in this document are the sole responsibility of the author (s) and do not necessarily represent the official position of Trócaire Uganda and Adraa Agriculture College unless otherwise stated.

All photographs in this report are courtesy of Andama Edward and the research team unless otherwise stated.

Foreword

Trócaire is very pleased to have been associated with this study, done with ADRAA and Dr. Andama and his team, given its global interest in environmental justice and climate change.
As far as we are aware this is the first comprehensive botanical study of a Sub County carried out in Uganda. Given that the Sub County is the lowest autonomous geographical unit of action in the Government system – which functions socially, economically and politically as independent unit - it is the crucial level at which planning, implementation and management must and does take place.
Genetically modified food is one route to trying to meet the ever growing food needs of the world but it hardly looks a sustainable one. There seem to be significant dangers of focusing on a narrow range of crops – maize, banana, cassava, potatoes or rice. A couple of bad seasons or a resistant disease can have devastating effects as we in Ireland know all too well from the Great Potato Famine of the 1840s.

This study shows that there is still great diversity of flora in Offaka and that we neglect this rich biodiversity at our peril.

However, there have been dramatic, not to say drastic, changes in land use patterns in Offaka Sub County in the last 14 years. An 87% reduction in closed woodland, a 77% increase in use of land for agriculture, communal lands that are not being actively managed, a doubling of the human population in the Sub County every 23 years, a doubling of the livestock population in the eight years to 2008, massive exports of charcoal (made from communal precious trees) from the Sub County, growing tobacco which demands large amounts of fuel wood for curing leaves, bush burning and practically no replacement by tree planting – it all looks like a "perfect storm" for biodiversity destruction in Offaka in the next 10 years. Don't say you weren't warned. One wonders to what extent Offaka is replicated in other Sub Counties in Uganda. From anecdotal evidence many other Sub Counties are already further down the route of environmental destruction. From my rough conservative calculations, Offaka Sub County is exporting 300 bags of charcoal a day which is equivalent to about 75 trees every day!

It seems like there is a very short window to try and turn this juggernaut around and get back to sustainable management. This report gives recommendations that can help get us back on track and reverse this biodiversity destruction before it is too late. Even in economic terms the study shows the potential of a number of plants identified.

This report highlights the great need for sustainable land use planning as well as environmental management. I hope that planners, agriculturalists, educationalists, medical people, administrators, and researchers in every Sub County and district in Uganda will study this report and relate the outcome of the study to their own ethno-botanical ecosystems.

I hope that this reflection will lead our administrators, planners and leaders at all levels of Government system to debate and come up with development approaches, processes and strategies that will ensure we manage our biodiversity holistically and that the multifunctional role of ethnobotanical plants be highlighted in government development policies, development and action plans.

Ian Dolan,
Trócaire Uganda Country Director

Acknowledgements

On the behalf of the research team I want to thank the community of Offaka Sub County termed "Madi Okollo" with whom and for whom this project was carried out. Their hospitality and keen interest in the proceedings was an inspiration during field work and training sessions. This report owes much to the dedicated work of the Offaka Botanic Study committee, clan leaders, traditional herbalists, bee keeping associations, Shea nut oil processors, and others far too many to name individually here. The documentation of biological knowledge of Offaka Sub County and its presentation in accessible form has been one of the objectives formulated by the Offaka Botanic Study Team. Adraa Agriculture College supported the project by providing logistic support and availing its staff for training to support the research activity. In this regard we are indebted to the College Principal Bro. Tony Dolan, the Ag. Deputy Principal Ms. Sarah Oates and the field team from Adraa Agriculture College particularly Mr. Dan Dunia and Mr. Bayua Richard.

The project was funded by Trócaire Uganda country office and we are grateful to the Country Director Mr. Ian Dolan, Rose Hogan Trócaire technical advisor and Programme Officer Ms. Mary Baganzi for entrusting my team with the opportunity to do the work. Our thanks also go to vehicle driver Mr. Geoffrey Naluwayiro who ensured safe travelling to various parts of the study area for data collection. The volunteer team at Adraa Agriculture College worked with dedication, particularly Mr. Adaku Kennedy, Ms. Oturu Peace, Ms. Driciru Hellen, Mr. Asiku Robert, Mr. Aliama Godwin, Mr. Olea Primus, Mr. Acidri Gilbert, Mr. Oyella Adamic, and Mr. Atabua Geoffrey. We thank the Offaka Sub County administration, clan elders in Offaka and many other stakeholders for their vigilance and cooperation.

We are very grateful for very useful comments from key institutional stakeholders which shaped the report. These include Trócaire Uganda, Adraa Agriculture College, Uganda Wildlife Authority, National Forest Authority, Abii ZARDI, Arua District Local Government Departments of Environment and Forestry among others. At individual level Trócaire Uganda country Director Mr. Ian Dolan, Principal Adraa Agriculture College Bro. Tony Dolan, and Programme Officer Ms. Mary Baganzi are among many persons who contributed many valuable suggestions which shaped the presentation of the content and design of the report. To you all I say awadifo!

The research team was led by Dr. Andama Edward, and supported by Mr. Ocatre Robert, Ms. Constance Alezuyo, Mr. Rwaburindore Protase, and Mr. Amandu Benard as technical/expert persons in their various fields of expertise.

1.0 Introduction

A baseline study of plants was undertaken in Offaka Sub County in Arua District. The study focused on the terrestrial plants, community knowledge, attitudes and practices in relation to the use of the plant resources and looked at the threats to biodiversity. The survey was conducted from June to August 2014. The study established a body of knowledge to provide the basis for designing interventions to promote sustainable utilisation of the plant resources.

1.1 Problem statement

The FAO (2000) vegetation cover map for Offaka Sub County had high (68.8%) vegetation cover, consisting mainly of indigenous plant species. Over 14 year period the vegetation was degraded due to uncontrolled extraction of the plant resources by the population. These changes have negative consequences for conservation of biodiversity, agricultural productivity, regulation of the water cycle, retention of soil fertility and for the general well being of the human societies. According to the Offaka Sub County five year development plan (2010/2011- 2014/2015), about 95% of the community depend on natural resources for their livelihood and 99% are employed in agriculture and 100% depend on wood fuel for their domestic needs. Tree cutting for charcoal, timber and firewood for tobacco curing without replacement and agricultural land expansion were identified as key challenges to sustainable natural resource use. The consequences of the loss of biodiversity are already being felt by the local community. For example within West Nile region Offaka Sub County is listed among those with high levels of poverty which according to the Sub County strategic plan (2010-2015) is a result of the low crop production because of the degraded soils, unreliable rainfall patterns arising from climate change impacts in the region.

1.2 Rationale of the study

Effective planning for sustainable utilisation of plant resources requires knowledge of the availability, quantity and distribution of the resources, the threats to the resources and the knowledge of the level of dependence of the local communities on goods and services provided by plant resources. This ethno-botanical study was deemed vital to identify strategies for managing plant resources for promoting their sustainable utilization. The study was also to provide information on local environmental management practices that could be used to design culturally appropriate conservation strategies (Casas et al., 2007). This is the first study of its kind in Arua District, West Nile region and perhaps in the country which focuses on the biological resource base at Sub County level. The information gained is intended to be used to develop sustainable modules of natural resource use that link conservation goals with the economic well-being of the community who depend upon wildlife for their livelihoods.

1.3 Aim and objectives

Aim

The general objective of the study was to identify and draw up an inventory of the flora of Offaka Sub County, focusing on the economic, medicinal and environmental importance of the plants to the community and to make recommendations on how stakeholders working in the Sub County can rehabilitate, conserve, propagate and promote such flora for sustaining livelihoods and the environment.

Specific Objectives were to:

(i) Identify and document vegetation types, mosaics and plant species which make up the flora of the Sub County.

(ii) Document flora which have economic, nutritional, medicinal and social potential to make a contribution to the achievement of sustainable livelihoods of the community.

(iii) Identify medium sized to large mammal species occurring in the area.

(iv) Describe current female and male dominated human practices that are affecting either positively or negatively the maintenance of a rich bio-diverse flora.

(v) Identify key challenges facing conservation and sustainable use of the plant resources.

(vi) Determine vegetation cover change over the past ten year period in the Sub County.

(vii) Describe the responsibilities of all levels of governance and of households and individuals in relation to indigenous plant and habitat protection outside of the officially protected areas in Uganda.

(viii) Make recommendations on the management, rehabilitation and propagation of economically, nutritionally, medicinally and socially important flora.

(ix) Recommend approaches, processes and strategies for promoting identified flora to support sustainable livelihoods while maintaining ecosystem services.

2.0 Study Area Characteristics

2.1 Cultural identity and traditional livelihood strategies

The indigenous communities who live in Offaka Sub County are generally referred to as "Madi". The "Madi" and the Lugbara communities in West Nile region had a common ancestor who is said to have migrated from Sudan southwards and as a result the "Madi" are referred to as Sudanic people (Katende et. al., 1999). Based on language differences, there are many ethnic groups of "Madi" who settled within West Nile Region. To distinguish the Madi community who settled in Offaka Sub County and for the purpose of this report we adopted the term "Madi Okollo" which refers to the larger area (County) occupied by this ethnic community in the West Nile region. The "Madi Okollo" coexist with other tribal communities such as Lugbara, Kebu, Alur, Rigbo and Jonam in the West Nile region. The Madi community are organised on patrilineal basis, headed by the male clan leaders termed "elders", usually elected from the community (ADLG 2011). These elders play an important role in land resource allocation, management and in resolving inter-clan conflicts.

2.2 Location, Climate and Vegetation

Offaka Sub County is located in southern part of Arua District (figure 1.), approximately 56 kms from Arua district headquarters along Arua to Packwach road (Offaka Sub County Development Plan 2010-2015). The Sub County covers a total land area of approximately 204.5km^2 and is bordered by Logiri Sub County to the north-west, Ullepi and Arivu sub counties to the north, Okollo Sub County to the east, Anyiribu Sub County to the south and Zombo district to the south west. The area experiences bi-modal rainfall pattern, with the first season

in March-April, ending in May. The second rainy season starts in July up to November, with the wettest months being August and September which receive 120mm/month. In the dry season (December-March) temperatures are usually high, ranging between 28 to 30 degrees Centigrade.

The dominant vegetation in the Sub County consists of savannah woodland. The important common tree species include Shea nut butter tree (*Vitellaria paradoxa* -formerly *Butyrospermum paradoxum*) locally called "Awa" (in Madi Language), Oli (*Acacia* species), Adu / emeku (*Combretum* species), Zabibu (*Ficus* species) among others. The common grass species include spear grass (*Imperata cylindrica)* and elephant grass (Napier grass, Uganda grass) (*Pannisetum purpureum*).

Figure 1 Location and rivers of Offaka Sub County in Arua District

2.3 Soils and river system

The soils are sandy with loose structure, which are easily eroded and leached. Most of soils in the Sub County are acidic and the texture varies from place to place. The Sub County is endowed with several rivers and streams which pass through or originate from the area, some of which include Nyagak, Nyara, Aji and Ajugi rivers.

2.4 The population and economy

The 2014 provisional national population census result (UBOS 2014) indicate that Offaka Sub County population was 18,934 within 3,991 households, with the average of 4.7 persons per household distributed as 9,041 males and 9,893 females. The Sub County population density increased from 95 persons /km^2 in 1980 to 179.60 persons /km^2 in 2002.

Madi Okollo people live in rural peasant communities with the main source of income being crop agriculture and livestock rearing which employs over 98% of the population. The common food crops grown include: cassava, simsim, ground nuts, sweet potatoes, finger millet, sorghum, maize, beans, and pigeon pea. Before 1980s cotton was the main cash crop of the Sub County but has been replaced by tobacco. The community members keep livestock such as goats, pigs, sheep, poultry and cattle. Charcoal production has recently become an important source of income to many families from the year 2008 when northern Uganda became peaceful. Bee keeping is being promoted within communities as additional source of income for families by various stakeholders such as NAADs, AAC and the Sub County (AAC, 2013).

3.0 Materials and Methods

The study focused on wildlife and in particular terrestrial plants consisting of trees, shrubs and herbs. It targeted composition, conservation status and vegetation cover. Information on mammal species was collected from hunters in the area. Information was collected on human impacts on vegetation use which have potential to influence vegetation cover. Household questionnaire was used to collect socio-economic and cultural information in relation to livelihood practices. Focus Group Discussion (FGD) method targeted traditional herbalists, hunters, charcoal sellers, Shea nut oil sellers and clan leaders. Targeted informant interviews were undertaken for officers from National Forestry Authority (NFA), District Forest Department, NARO staff at Abii ZARDI, Sub County health unit and parish chief to collect specific information in relation to their specialized areas of work. Vegetation ground truthing was done using Village transect walks. The vegetation survey was conducted using the standard nested quadrants laid alternately along 9 transects with lengths ranging from 800 to 1,200 meters to record tree species. Landsat and Google Spot images were used to undertake vegetation change analysis between the 2000 FAO land cover map and the 2014 land cover map.

4.0 Results

4.1 Socio economic background of the respondents

The respondents consisted of 154 persons distributed as 51.3% males and 48.7% females. The findings indicated that the majority (74%) dropped out before completing primary school education. The average household family size was 6.7 persons per home, ranging from 1 to 17 persons. The occupation of the majority (80%) of the respondents was farming. As a proxy to household wealth status 37.6 % of the respondents owned key household items such as bicycle, radio and phone. The majority of the respondents owned livestock especially goats (91.6%), and chickens (77.3%). The majority (74%) had an annual income of below 500,000 UGX. Only a small percentage (19%) earned more than one million UGX per year.The average land size owned by respondents was 3.5 acres, with the majority (87%) owning ranging from 0.5 to 10 acres. The small land size ownership depicts increased land shortage and fragmentation in the area as the limited land resource continues to be sub divided along the traditional patrilineal land inheritance system due to population increase. Some of the land was owned communally as common property resource by the clans. The household (self declared) food security status indicate that about 50% of the families had insufficient food supply during the months of the year when crops are not yet mature.

4.2 Plant uses and ethno-botanical knowledge

4.2.1 Plants use for wood fuel

The tree species favoured for domestic wood fuel were *Combretum, Grewia, Acacia* and *Lannea* which were mainly collected from the nearby bushes but not from woodlots. During FGD female respondents noted that tree species for wood fuel had become scarce and as a result they travelled over one kilometer or more on average to collect wood fuel. During the FDG with the women groups the most important plant species to them in the order of importance were; Shea butter tree (*Vitellaria paradoxa* (Awa), Mangoes (*Mangifera indica*), Oranges (Citrus lemoni), *Eucalyptus, Cassia,* Lira (*Melia Azadirachta)*, Cassia (*Senna spectabilis*), *Acacia* species, Tamarind *(Tamarindus indica*) and Brother heart (*Annona maricata*).

4.2.2 Charcoal production and business

Charcoal was produced and sold for gaining cash by most families. The charcoal collected from production site was either sold along the road side by the middle business persons organised into associations or large quantities were sold directly to the transporters who reach up to the production site. Charcoal was sold using standard bags for packaging 50 kg of sugar. The Sub County government was said to receive 2,000 UGX fee for every bag of charcoal sold. The trees targeted for charcoal production were those with 10 cm diameter at breast height and above. Under this scenario about 0.5 hectare of intact woodland is cleared to produce 22 bags of charcoal.

4.2.3 Tobacco production and associated environmental costs

The common variety of tobacco crop introduced in Offaka Sub County was the Flue Cured Tobacco (FCT) which is dried using heat produced from burning

firewood. Three tobacco leaf buying companies operate in the Sub County viz; British American Tobacco (BAT), Leaf Tobacco Company (LTC) and Continental Tobacco Company. Each tobacco farmer had at least one tobacco burn (a house for drying or curing tobacco) which used at least 20 cubic meters of wood every year. This results in total of 2,000 cubic meters of wood fuel used by the 100 BAT farmers alone every year, an equivalent of 40 hectares of forest cut per year in the Sub County (UCCEE, www, 1999 in Nor consult Tanzania Limited 2002). One acre of tobacco farm yields about 600 kilograms of dry tobacco leaf (which is sold at various grade prices) and from which a famer may get about 3 million Uganda shillings in one year.

Tobacco cultivation contributes negatively to the environment because it uses large quantities of chemical fertilizers, pesticides and most importantly, tobacco requires large quantities of wood for curing the leaves which is obtained from the wild trees in the communal woodlands. Additionally, growing tobacco contributes to food insecurity because family labour is mainly used for tobacco production at the expense of food crops for most of the year due to the labour intensive nature of the crop.

4.2.4 Medicinal plant use by the community

88% percent of the respondents reported that they used herbal medicine in their family. Commonly cited plants for medicinal purposes included; *Tabernaemontana ventricosa* (Kanza), *Solanum* sp. (Elianga), *Ricinnus cummunis* (Olu), *Aloe lateritia, Kigelia africana, Tamarindus indica (Iti), Mangifera indica (Mango), Melia Azadirachta* (Lira), *Euphobia hirta. Vernonia amygadalia* (Eciro), *Eucalyptus globulus* (Kalatusi), *Capsicum fruitescens* (Pilpili), *Moringa oliefera, Datura stramonium* (Ulu), *Azadirachta indica* (Neem), *Citrus lemoni* (Ndima), *Cassia alata* (Cassia) (figure 2). The herbalists interviewed mostly collected medicinal plants from the wild or communal areas. Most of the respondents (65%) (including herbalists) reported that the medicinal plants had become rare, while 24% reported that they were still common and 11% reported that some of the useful plants had disappeared in the area. Only 19% propagated some of the medicinal plants at their home gardens. Generally, there was no deliberate cultural effort to propagate the medicinal plants within the community.

Tabernaemontana ventricosa (Kanza)

Solanum sp. (Elianga)

Ricinnus cummunis (Olu)

Aloe lateritia

Kigelia africana

Aloe sp.

Tamarindus indica (Iti)

Mangifera indica (Mango)


Melia Azadirachta (Lira)


Datura stramonium (Ulu)


Euphobia hirta


Vernonia amygadalia (Eciro)


Moringa oliefera


Kalanchoe pinnata


Capsicum fruitescens (Pilpili)


Eucalyptus globulus (Kalatusi)


Alum species (Ojoo)


Azadirachta indica (Neem)


Citrus lemoni (Ndima)


Cassia alata (Cassia)

Figure 2. Some of the Medicinal plants recorded in the study area.

4.2.5 Plant species used for food.

The common plant species harvested for food either from the wild or planted (figure 3) included *Saba comorensis (Ogo), Carisa edulis* (Esisi), *Ximenia caffra* (Ecifi), *Vitex doniana* (Awa), *Balanities aegyptiaca* (Eto), *Psidium guava, Annona maricata,* Jack fruit (*Artocarpus heterophyllus*), *Aframomum angustifolium, Annona senegalensis* (Lipa), *Persea americana, Carica papaya* (pepei), African ebony tree, *Vitex doniana* (Odo), *Sclerocarya birrea* (Nungu/Amarula), *Syzygium gueneese, Strychnos spinosa* (Ndri-lomgboro), *S. innucua* (Ti lomgboro), *Ziziphus abyssinica* (Liria) and *Borussus aethipium* (Itu) among others. The parts of the plants consumed varied from fruits to seeds or both, depending on the species. Most adults regarded wild fruits as "children's food", undermining their use as source of nutrients for the whole family.


Saba comorense (Ogo)


Carisa edulis (Esisi)


Ximenia caffra (Ecifi)


Vitex doniana (Awa)


Balanities aegyptiaca (Eto)


Jack fruit
(*Artocarpus heterophyllus*)


Psidium guava (Guava)


Annona maricata
(Brother heart)


Aframomum angustifolium


Persea americana (Avocado)


Carica papaya (pepei)


Annona senegalensis (Lipa)


Dispyros mesipiliformis (African ebony tree) Dulumu


Vitex doniana (Odo)


Sclerocarya birrea Sclerocarya birrea (Nungu/Amarula)


Syzygium gueneese


Strychnos spinosa (Ndri-lomgboro)


S. innucua (Iti) lomgboro)


Ziziphus abyssinica (Liria)


Borassus aethipium (Itu)

Figure 3. Some of the common fruit plants recorded in the Sub County with potential for value addition

4.2.6 The plants commonly used for constructing houses and crafts

The plants commonly used for construction work included both indigenous and exotic species such as Lira (*Melia Azadirachta*), *Eucalyptus, Combretum* species, *Grewia* species, Bamboo (*Arundinaria alpina*), *Acacia*, species, *Linnea* species, *Vernonia* species among others. For craft construction the favored tree species were *Grewia moli* (Onzu), *Acacia* species (Oli), *Phileneptera laxiflora* (Wawa), *Piliostigma thonnongi* (Aza), *and Stereospermum kunthianum* (Lepe) among others. The crafts commonly produced and sold locally in the area included beds, benches, chairs, stool, hoe handles, chicken houses, mingling sticks among others.

4.2.7 Wild animal hunting

The traditional annual wild mammal hunting expeditions organized communally by the clan leaders locally termed "Dori" still persists up to the present day in Madi Okollo community. The hunting was exclusively undertaken by adult males, accompanied by talented teenagers to the traditional hunting grounds during the dry season. The hunters used traditional weapons, consisting of bows, arrows, spears, accompanied by dogs. Most respondents (66%) reported that at least one of their family members go to hunt every year. The common wild animals hunted included wild pigs (Ngiri), warthogs (Ezo), bush duiker (Ova), Oribi (Oce), Bush back (Eba),Waterbuck (Yere), Uganda Kob (Tili), Aardvark (Apino), African hare (Eto) and cane rat (Alu), guinea fowl (Ope), Francolins (Alibo) and doves (Alua). The persistence of hunting expeditions is an indication of the existence of reasonable wildlife populations in the area which could be used to promote sustainable use of these resources.

4.3 Nature Based Enterprises

4.3.1 Bee keeping and bee forage

Bee products were one of the key resources from the wild. The majority (77%) of respondents reported that they harvest honey from the wild while 60.8 % of the respondents had bee hives near their homes. The community also formed

associations for group bee keeping and by the time of this study the harvested honey was sold to Adraa Agriculture College honey processing unit. The respondents demonstrated good knowledge of beekeeping and identified the following plants as favourable bee forage; flowers of Awa (Shea nut tree), Mango, Oli (Acacia sp.), Iti (*Tamarindus*), Chawo, Oliro, Sweet potatoes, Simsim, Pumpkin, Ijiribi (*Amaranthus*), Osunyiriki (beans), Maize, Cassava among others.

4.3.2 Shea nut oil processing

The Shea nut tree produces fruits with the soft fleshy sweet outer part consumed while fresh. The seeds are enclosed in a hard shell and are used for extracting the famous and valued Shea nut oil. Culturally no one owns Shea nut tree in Offaka area and as such it is regarded as a public good. Every family collects the seeds and processes the oil for home consumption and excess is sold in the local markets. A few groups of women undertake commercial Shea nut oil production for sale at Ullepi Trading center along the main Arua to Packwach tarmac high way.

4.3.3 Gender and participation in household decision

Rural women and men usually perform different tasks and responsibilities in food production and natural resource extraction which results in different needs, priorities, and concerns. Women in particular were more concerned with wood fuel collection for domestic use and processing of Shea nut oil among others. At household level women dominated weeding, processing of farm products and transportation of farm produce to the market. Women were said to have equal (50.7%) control of household cash, which confirms their equal involvement in decision making in regard to the use of the cash from sale of agricultural produce.

4.4 Key human threats to natural resource

The human impacts recorded in the study area included degradation of vegetation due to grazing by large herds of livestock, fire deliberately lighted to burn dry vegetation to facilitate wildlife hunting and also to initiate regeneration of fresh grass for livestock, cutting trees for fire wood and charcoal production and clearing vegetation for farming.

4.5 Human wildlife conflicts

The communities similarly experienced crop raiding by the wild animal species that came from the nearby bushes such as bush pigs, duikers, baboons, vervet monkeys and patas monkey. Due to the above challenge many of them invest in guarding their crops to reduce crop loss to the crop raiders.

4.6 Environmental degradation concerns

The majority (71.7 %) of the respondents confirmed that rampant cutting of trees for charcoal production, overgrazing by the livestock, tree cutting for curing tobacco and bush burning among others had degraded the land, leading to soil erosion and reduced crop yield. Uncontrolled cutting of trees was especially rampant in land under communal ownership and management. Culturally the tree resources are still regarded as communally owned and therefore no one takes responsibility to promote sustainable utilisation. As demonstrated in this study, the communal land and resource ownership impacts negatively on sustainable resource utilization. The respondents proposed various remedies to address the degradation which included; tree planting, controlled grazing and good farming practices among others.

4.7 Institutional structures for management of biodiversity

There exist both traditional and local government institutional structures for regulating the use of natural resources in the Sub County. Clan leaders regulate cutting of important tree species and could only permit cutting of such trees for house construction and craft production but not for commercial gain. The Sub County local government also enacted bye-laws to prevent rampant cutting of the Shea nut trees. Despite the social, economic and cultural attachments to the trees and the existence of the elaborate cultural and government institutional structures, cutting of the traditionally important tree species continues unabated as the existing measures are ignored and law enforcement fails.

4.8 Plant biodiversity

4.8.1 Tree species diversity

A total of 193 different plant species were recorded during the study, belonging to 57 families. This indicates richer plant biodiversity compared to other savannah woodlands such as in Masindi district (Acworth 2005.). In the natural habitat the dominant tree species were *Combretum* (Adu), *Acacia* (Oli). The shrub layer was dominated by *Grewia* (Inzu) and *Annona senegalense* (Lipa) species. While tree species on the farm land were dominated by *Vitellaria, Vitex, Tamarindus* and *Ficus* tree species. Whereas the grass cover was dominated by *Hyperthermia dissolute* (embetia), *Branchiaria* (Licoo) and *Enteropogan (Tangu)* species. In this study four plant species *Afzelia Africana (Lokoko), Dalbergia melanoxylon (Poyi), Vitellaria paradoxa (Awa)* and *Khaya anthotheca* are categorized in the IUCN category as endangered plant species. These findings indicate that Offaka Sub County contains nationally and internationally important plant species which need to be conserved for the benefit of humanity.

4.8.2 Vegetaion and agro-ecology and vegetation cover changes

The natural Offaka Subcounty vegetation was dominated by woodland-savanna mosaic. Closed woodland and closed to open woodland were dominated by *Combretum* and *Acacia* species, while wooded grassland were dominated by *Combretum* sp., *Pseudocedrella kotschyi, Gardenia ternifolia* and *Acacia species.* It was noted that the local community purposely preserved certain plant species in their gardens which they considered important. Some of these included fruit plants such as *Vitellaria paradoxa, Vitex doniana, Balanities eagyptiaca, Carssa edulis, Tamarindus indica, Cordia sinensi,* and *Zizyphus mauritiana* among others. Abandoned agricultural land was dominated by grass species such as *Panicum maximum, Setaria kagerensis* and *Sporobolus pyramidalis.*

The land cover change analysis between 2000 and 2014 (figure 4) shows that land converted to agriculture use increased to 11,249.51 ha in 2014 from 6,374.68 ha in 2000. Closed woodland vegetation area reduced from 11,912.88 ha to 1,582.78 ha. These changes were mainly due to the clearing of the natural vegetation to open up land for agriculture and through use of communal lands for charcoal production. In general 86.71% of the closed woodland was transformed to other uses and 23.8% of the natural vegetation was cleared for charcoal production during the last 14 year period. These results indicate that agricultural land use is expanding very rapidly coupled with charcoal production

and extraction of wood fuel for tobacco production and that these practices are threatening the biodiversity based ecosystem services to sustain the community.

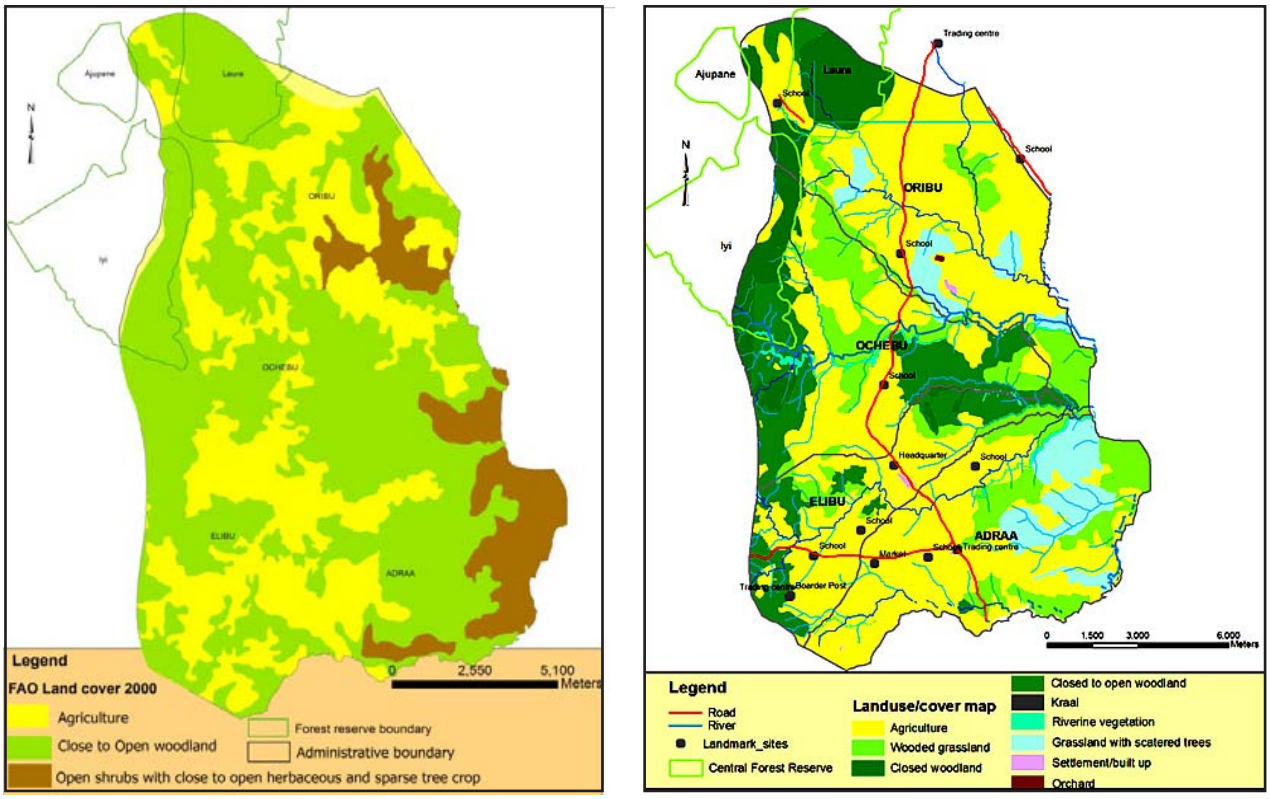

Figure 4. Land cover in the year 2000 (left) and the year 2014 (right) for Offaka Sub County

4.8.3 Herbage plant species

Of the plant species enumerated a total of 24 were suitable for herbage (feeding livestock). Herbage plant species recorded were dominated by the Poaceae family which formed the largest number of species followed by Asteraceae and Euphorbiaceae. The most common species found in the study areas was *Hyperthelia dissolute*. Other common species were; *Brachiaria brizantha, Enteropogon macrostachyus, Hyperhenia filipendula, Phyllanthus amarus*, and *Digitaria diagonalis*. These plant species have been reported to be important fodder plants elsewhere (Kabirizi, 2014). Among others they include grasses such as Elephant (Napier) grass (*Panisetum purpureum, P. clandestunum*), *Cailver leaf desmodium), Clitori ternatea, Chloris gayana* (Rhodes grass), Panicum maximum (Guinea grass), *Setaria sphacelata, Brachiara species* (signal grass) *Panisetum clandestunum* (kikuyu grass), *Hyperhenia rufa* (thatching grass). Fodder trees promoted in the area included; *Calliandra, calathysus (Calliandra), Leucaena leucocephala and Gliricidia sepium (Glicidia)* species. *Macroptilium atropurpureum* (Sirato), *Desmodium intortum, Desmodium ancinatum*. Usually in wet season herbage availability exceeds the quantity required by livestock. The excess could therefore be harvested to make hay and silage within the community as a strategy for feeding livestock during dry season when herbage is scarce.

4.9 Mammal Diversity

During this study a total of 24 mammal species (table 1) were reported to occur

in the area. These included, Uganda Kob, Waterbuck, Bushbuck, Bushpig, Bush duiker, Wild rabbit, Warthog, Aardvark, Serval cat, Genet cat, Civet cat, banded mongoose, Baboon, Black and White Colobus Monkey, Vervet monkey, Patas monkey and Tree Squirrel. Some of the species such as Sitatunga, Side stripped Jackal; Hyrax among others were not be confirmed due to their secretive and nocturnal foraging behaviour.

4.10 Complimentary stakeholder activities in the Sub County

The key stakeholders of Offaka Sub County that were already actively involved in supporting communities in sustainable management of natural resource included; World Vision Uganda-Offaka Programme which recently implemented the Farmer Managed Natural Regeneration (FMNR) project aimed at restoring and improving agricultural productivity in degraded areas. Abii Zonal Agricultural Research Development Institute (ZARDI) is testing the possibility of domesticating indigenous fruit plants such as Dulu (*Saba comorensis*), Iti (*Tamarindus indica*), Awa (*Vitellaria paradoxa*), Eto (*Balanities aegytiaca*). They also promote exotic fruit plants such as Apples, Mangoes, Avocadoes, Oranges, and Avocados. Abii ZARD can be targeted for provision of technical support for introducing indigenous fruit plants in the Sub County.

5.0 Discussion

5.1. Biodiversity use and indigenous knowledge

Compared to other similar habitats studied elsewhere, Offaka Sub County recorded higher (over 193 species) plant species compared to 191 (Ripples Consult Ltd, 2012) recorded in Queen Elizabeth National Park Dura area which is natural with similar land area. The study also indicated that the local communities have valuable knowledge on the plant resource management where they sometimes deliberately maintained important tree species such as *Vitellaria paradoxa* (Awa), *Annona senegalensis, Vitex* species and *Tamarindus indica* in the gardens. This practice has also been recorded elsewhere in the world, and is normally termed as "Agroforestry parkland" system (Raison, 1988). The consumption and marketing of these useful fruit plants can contribute substantially to household livelihoods not only during critical famine periods but as future investment in natural plant products.

5.2. Unsustainable floral resource utilisation

The widespread vegetation loss was a result of expansion of agricultural land, the rampant felling of the trees for wood-fuel production (mainly charcoal) and tobacco curing. Charcoal burning was recorded to be rampant in the area to fulfill the nationally high demand for charcoal in the country. These are currently the main driving forces resulting in unsustainable utilisation of plant resources. The challenge currently faced in Offaka Sub County is how to reverse the high rate of degradation of plant resources while meeting increasing demands for them. Considering that efforts by the tobacco companies and other stakeholders to promote tree planting is not yielding success, this trend is likely to pose constraints on the resource availability for the future generations. Unfortunately, the traditional taboos and the bye-laws that are expected to govern the collection of wild plants are not an effective safeguard against over-harvesting in the Sub County as is also noted across East Africa (Dharani and Yenese, 2010, and Kalema and Beentje, 2012). This presents a big challenge to sustainable utilisation of plant species in the area and thus requires urgent attention by all stakeholders including cultural and the local government leaders. There is a need to take urgent action to combat the situation through restricting charcoal production from indigenous trees, the promotion of increased tree planting efforts – including their protection, as well as a holistic adoption of fuel wood saving stoves. All these have to go along with adequate efforts and resources devoted to law enforcement.

The use of plants and plant based derivatives for preventing and treating human diseases and afflictions is as old as civilization itself (Dharani and Yenesew 2010). Indeed plants are backbone of modern medical and health care systems in all places around the world including Offaka Sub County as was recorded in this study. By far the most pressing conservation concern to medicinal plants in the Sub County is the alarming rate at which the natural habitats of the plants are being degraded to make way for agricultural cultivation, charcoal production and wood logs as was noted in the area despite the traditional taboos and bye-laws. Therefore the need to develop new and adaptable strategies to save not only medicinal plants but also other natural vegetations has become very urgent for all stakeholders

at different levels to consider. Initiatives to promote use of herbal medication are already underway at Kuluva Hospital and promotion of growing of these plants by the Traditional Medicinal Practitioners and households is vital.

5.3 Potential for value addition to biodiversity

This study demonstrated that the local community possessed diverse knowledge on uses of plant resources. The key uses included building, craft, food, medicines and fuel. While fruit collection by the families was only limited to few plants such as *Vitellaria paradoxa* (Awa) and *Tamarindus indica* (Iti), and exotic or introduced species, the rest of the indigenous plant fruit were generally neglected by the general community as "*children's food*". Currently there was no deliberate effort to promote indigenous fruit trees as source of income. Instead a narrow range of exotic plant species such as Neem tree (*Azadirachta indica*) and Moringa (*Moringa oliefera* Lam.) have been promoted by the government and development agencies resulting in further neglect of indigenous fruit plants. Elsewhere many high value products have been developed from Shea nut oil e.g. in Ghana and recently Uganda. In Southern Africa *Sclerocarya birrea* is used to produce the famous Amarula wine (and liquor) and fruit drink, such opportunities can be tried in Offaka Sub County to promote sustainable us of the plant resources.

6.0 Conclusions And Recommendations

6.1. Conclusions

This study showed that Offaka Sub County still has reasonably high plant biodiversity which is being used for food, biomass energy, and as a source of medicine among other uses. The wide portfolio of plant biodiversity resources provides a crucial opportunity to adapt and develop sustainable mechanisms to support community needs, production systems and for regulating local ecosystems to meet the needs of the current and future generations. The study indicates that in Offaka Sub County women are key players in natural resource management through collection of wild foods that provide important micronutrients in diets that are vital for households during food shortages, and processed for income. It is important to note that there is a promising potential to improve crop yields through maintenance of the plant biodiversity, while providing food, fuel wood, medicinal and promoting commercialization of these useful products from the plants.

6.2. Recommendations

The following are recommended for sustainable use and management of the floral and faunal resource of Offaka Sub County.

(a) Promote value addition to plant products which offer financial incentive to the community through initiating enterprises for processing, value addition and provide financial incentives to the community. For example processing of fruits and seeds of Shea nut tree (*Vitellaria paradoxa*), Amarula tree (*Sclerocarya birrea*), *Annona senegalensis, Saba comorensis, Carisa edulis* among others.

(b) Promote home herbal gardens to help revive local knowledge on medicinal plants and conserve the plants of medicinal value within the community.

(c) Promote Farmer Managed Natural Regeneration (FMNR) as a strategy for promoting rapid, low cost and easily replicated approach to restoring and improving agricultural, forested and pasture lands. FMNR facilitates environmental sustainability due to the fact that it promotes regeneration of the indigenous plant species.

(d) Substitute tobacco growing with economically attractive crops which will provide an alternative source of income to them.

(e) Promote sustainable management and production of biomass fuel through promoting improved technologies for charcoal production such as Casamance kiln, half orange kiln and drum kiln among others.

(f) Promote habit of producing charcoal from established tree plantations. Deliberately promote household woodlots. These measures will lead to more sustainable charcoal production and biomass energy business.

(g) Promote energy saving stoves, the improved version of the traditional charcoal “jikos” that use little wood fuel thereby saving forest from being destroyed.

(h) Initiate community ownership and management of the communal forest resources in less utilized communal lands.

(i) Promote additional research on other

biodiversity of the Sub County that remains largely uninvestigated. Key taxa recommended for study include the bird species and insects.

(j) Develop nature based tourism in the Sub County. Identify areas of cultural, botanic and scenic importance that could be developed into tourism attractions. This coupled with the biodiversity especially birds, butterflies and other biodiversity, could be linked to the traditional clan based hunting ceremonies, dancing as a source of tourism attraction.

(k) Education is key to building a better and stronger future for the community. Promote community education on the floral and other resources of the area within the youth and adults at primary, secondary and schools, vocational training institutions and community based associations.

(l) Establishing a botanical garden and herbarium as a tool for educating the stakeholders targeting medicinal, fruit and indigenous fodder plants.

(m) Initiate Collaborative Forest Management, targeting communities living adjacent to the Central Forest Reserves at Ajupane, Laura and Iyi.

(n) Develop and enact bye-laws to regulate activities that are detrimental to the flora/vegetation e.g. charcoal burning from the wild tree sources, bushfires, and compulsory tree planting.

(o) Develop Sub County environmental action plan to for promoting sustainable management of the biological resources.

(p) Undertake land evaluation and land use planning to develop appropriate land use systems for communities to adopt so as to promote most profitable land use practices on the available land and to realize maximum output.

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Plot 1812 Mitala Road
Kasanga, Kampala
P.O.Box 72721 Clock Tower
Kampala, Uganda
Tel/Fax +256 414 347260
www.trocaire.org