MAKERERE UNIVERSITY

ON-FARM APPROACHES FOR CONSERVATION OF INDIGENOUS TREE SPECIES AMONG HOUSEHOLDS IN ABOKO PARISH KWANIA DISTRICT

BY

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DECLARATION

For its first time this work has been now presented by me not anywhere else for a Bachelor degree in Social and Entrepreneurial Forestry.

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APPROVAL

This research report has been submitted with my approval as the supervisor

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Associate Professor John Bosco Lamoris Okullo

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DEDICATION

I dedicate this study report to my father Mr. OKWIR TOM, all our family members, Mujibhai Madhvani Group of Company and friends who have been too supportive towards accomplishment of the study. I also dedicate this work to my Lecturers and Instructors at the School of Forestry, Environmental and Geographical Sciences for their support and continued guidance.

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LISTS OF ACRONYMS AND ABBREVIATIONS

APA	Apac Statistical Abstract
ALG	Apac Local Government
CBOs	Community Based Organizations
COA	Commonwealth of Australia
FGD	Focus Group Discussion
GOU	Government of Uganda
ICRAF	International Centre for Research in Agro-Forestry
ITs	Indigenous Trees
KII	Key Informant Interview
m	Meter
Mr.	Mister
MWE	Uganda Ministry of Water and Environment
NAADS	National Agricultural Advisory Services
NFA	National Forestry Authority
NGOs	None Governmental Organizations
SPSS	Statistical Package for Social Scientists
UBOS	Uganda Bureau Of Statistics
%	Percentage

ABSTRACT

A study to elicit the knowledge on approaches for the conservation of Indigenous Trees (Its) on-farms was carried out in Aboko Parish, Aduku Sub County, Kwania District between June to December 2018. The specific objectives were to: assess the availability of ITs on-farms, document the different approaches for conserving ITs on-farm, assess the benefits of conserving ITs on-farm, assess the challenges related to conservation of ITs on-farms and examine the socio-economic and demographic factors influencing conservation of ITs on-farms. Cross sectional socio-economic surveys were used to collect the data. Questionnaires (Interviews), key informant interviews and Focus Group Discussions were conducted. Data in the questionnaires were coded, entered into SPSS program and analyzed for the availability of ITs on-farm, on-farm conservation approaches for ITs, preferred benefits, challenges and socioeconomic factors that influence households to conserve ITs on-farms. Logistic regression was used to show how the socio-economic and demographic factors influenced peoples' willingness to conserve ITs. Indigenous trees were reported in all the villages to be available and the common ones were *Makhamia lutea, Senna siamea, Albizia coriaria, Borassus aethiopum, Pilostigma thonningii* and *Albizia grandibracteata.* On-farm conservation approaches being used in the area by households included tree spot weeding (63.3%), sparing sprouts (44.9%), pruning trees (40%), controlling fire burning (38%), local beliefs attached to trees and retaining ITs on-farm boundaries with 28.6% each, protecting the younger ones from the destruction of livestock (24.4%) and protecting ITs from pests (22.7%). Benefits got from consumptive goods included firewood, fruits, stakes, medicines and poles. Ecological benefits included wind breaks, soil fertility enhanced, soil erosion control, provision of shades and provision of ecological (environmental) beauty. Easy management, resistance to pests/disease and fast growth were some of the management benefits recorded in the area. Reported challenges related to conservation of ITs on-farms were over utilization of firewood, over collection of poles, conversion of land for settlement and crop growing, poor soils, animal damage, slow growth of these indigenous trees, pests and diseases and ignorance about conservation of ITs. Solutions suggested by households to overcome challenges included community sensitization (48%), provision of fast growing species (46%), planting more trees (44%), fire control (38%), land tenure modification, law enforcement (34%) and early pruning (26%). Sex and marital status had a significant impact on peoples willingness to conserve ITs on-farms ($p=0.027$ and $p=0.032$) respectively. There is need to improve on the level of effectiveness of participation by households in on-farm conservation of ITs. To improve on the level of benefits that households get from conserving ITs, a proper nutritional analysis on food and medicinal potential of ITS should be properly done. There is also need to sensitize households (men and women) to enable them engage in more planting of indigenous trees and promoting conservation of Its. This can be done through provision of both financial and technical support by institutions like NAADS, NFA and CBOs operating in the area.

Key words: Agroforestry, Conservation Strategies, Indigenous knowledge, On-farms, Trees

CHAPTER ONE
INTRODUCTION

1.1 Background

Today the world is concerned with the conservation of indigenous trees on-farm because of several uses they have towards the livelihood of the community around them. Due to over use of these indigenous trees, the latter is disappearing globally and locally and threatened now than before affected biological diversity (Buyinza *et al.,* 2015).These trees used to occur naturally by wildling or at times planting on farm and in the world's indigenous forests which are now cleared. Indigenous trees are gone with only a small percent (1%) of world's indigenous forest being managed and sustainably utilized (Asselin, 2018). The underlying cause is the increasing population that contribute to the clearance of indigenous forests for plantation, ranching, fuel logging, road construction and spontaneous settlement (Parrotta *et al.,* 2016).

Indigenous trees are also decreasing throughout the world especially in the developing countries where forest reserves remain the major source of wood. This situation is not in exception to Uganda where between 1967 and 1990, for example, about 3.2% of forest was lost from a previous 5.2% of its national average (Katende *et al.,* 1995). Indeed the rising loss of indigenous trees species on farm could have some far reaching effects such as threatened sources of medicines, food, fuel wood and building materials. Some of the effects could have negative environmental implications such as water catchment deterioration, soil impoverishment and general loss of biological diversity (Getahun *et al.,* 2017).

Other factors influencing conservation of indigenous trees include tree population decline and structural changes due to forest removal and conversion of forest land to other uses, forest fragmentation, climate variability, diseases, introduced pests and settlement (Charnley *et al.,* 2008). The above situation thus calls for alternative management strategies that promote conservation of indigenous tree resources on-farm. These strategies may be appropriate because most smallholding farming areas have high population and private land tenure system (Hamilton *et al., 2016)*. Such approaches for the conservation of indigenous trees are vital and need to be documented among households in rural areas.

There exist few studies that focus on on-farm approach in conservation of indigenous trees with a particular emphasis on social and economic aspects of households. This is in spite of the social, cultural, ecological and economic values households attach to these trees. There is also need to focus on on-farm approaches to conserve indigenous trees among households (Samaila *et al*., 2013; Getahun *et al.*, 2017).

1.2 Problem statement

Much as the different approaches and conservation strategies of indigenous trees on-farm have been reported by rural people in some places (Buyinza *et al.*, 2015), this has not been documented in many places in Uganda including Aboko Parish. In fact, there is little information available on indigenous trees availability on farms, specific communities' on-farm approaches for conservation, benefits, challenges and socioeconomic and demographic factors influencing conservation of indigenous trees on-farm in Aboko Parish.

Since information about the conservation of indigenous trees on-farm is very scanty, documenting the local approaches, benefits, challenges and socioeconomic factors influencing conservation of indigenous trees on-farm would be a necessary step towards addressing this gap.

1.3 Objectives

1.3.1 General objective

The general objective of the study was to elicit local approaches/knowledge on on-farm approaches for the conservation of indigenous trees on-farm among households in Aboko parish.

1.3.2 Specific objectives

The specific objectives of the study were to:

1) Assess the availability of indigenous trees on farmers' farmlands in the study area
2) Document the different approaches for conserving indigenous trees on-farm in the area.
3) Assess the benefits of conserving indigenous trees on-farm.
4) Assess the challenges in conservation of indigenous trees on-farms.
5) Examine the socio-economic factors influencing on-farm conservation of indigenous trees on the households' farmlands.

1.4 Research questions

The following research questions were paused;

a) What types of indigenous trees is available within the farmlands in the study area?

b) What different on-farm approaches are employed by households to conserve indigenous trees?

c) What are the benefits of conserving indigenous trees on-farm?

d) What are the challenges in conserving indigenous trees on-farms?

e) What are the influence of socio-*economic* factors on the conservation of indigenous trees on-farm in the study area?

1.5 Significance of the study

Eliciting local knowledge on on-farm approaches for conserving indigenous trees would be a starting point for awareness creation on the need best way to promote conservation of indigenous trees by households (Hens, 2017).

This study was also to provide a better understanding of the benefits, values, priorities of households and best ways of how to implement on-farm conservation of indigenous trees for enhanced biological diversity. The findings of the study can also be used to promote sustainable indigenous trees resources conservation activities (Sobrevila, 2008).

1.6 Scope of the study

The study was to elicit the knowledge on conservation of indigenous trees on-farm and ascertained peoples' information on availability, on-farm approaches for conservation, preferred benefits, challenges, and socioeconomic and demographic factors influencing households towards conservation of indigenous trees on-farms in Aboko Parish, Aduku Sub County, Kwania District

CHAPTER TWO
LITERATURE REVIEW

2.1 General Issues on Indigenous Trees

Indigenous trees (ITs) are naturally growing trees which exist in most parts of the world both naturally and planted/retained (Agyarko *et al.*, 2014). Indigenous trees are socio-culturally, economically and ecologically important trees in many parts of Uganda. In those areas where they are found, ITs provide multifunctional uses in the form of shelter, food supply, livelihood improvement and protection of the environment from degradation and biodiversity depletion (Agyarko *et al.*, 2014). Indeed millions of people throughout the world make extensive use of these biological products from the wild for both subsistence and commercial use, either regularly or as a fallback during times of need.

Indigenous trees are available in many areas of world (International, 2010). These indigenous trees species also exist in most parts of Uganda and are equally distributed on farms (MWE, 2016). Consumption and conservation of these indigenous on farm in Uganda has been noted in the semi-arid areas mainly in the Northern and Eastern parts of the country (Oryema & Roos, 2015). Example of indigenous trees in Uganda include *Makhamia lutea, Senna siamea , Albizia coriaria, Anona chrysophyla, Vitex doniana, Tamarindus indica, Carissa edulis, Borassus aethiopum, Sclerocarya birrea* and *Strychnos spinosa* (Fandohan & Assogbadjo, 2015).

Indigenous trees are ranked among the priority species and there is strong evidence across on farms lands of Uganda that local communities have utilized them for generations. They have been used to meet varied household needs for food, nutrition, medicines and general livelihood balancing (Obua *et al.*, 2008). Therefore there are on-farm conservation strategies adopted in most parts of the world towards proper management and conservation of indigenous trees (Fandohan *et al.* 2015).

Indigenous trees however have challenges related to their on-farm conservation accompanied with socioeconomic and demographic factors that influence their conservation by households (Oryema *et al.* 2015). Thus, this review has focused on the availability of indigenous trees on-farm, benefits, challenges related to conservation on-farm and socioeconomic and demographic factors influencing conservation of indigenous trees on-farms.

2.2 Availability of Indigenous Trees

Indigenous trees are commonly found especially on-farms where minimum cultivation operations are usually carried out (Abdullahi *et al.,* 2013). They do exist on-farm as wildling, retained by farmers and planted/sown seedlings (Agea *et al.,* 2007).

In most developing countries, indigenous trees are sparsely distributed on-farm where people are doing other activities like livestock farming and crop growing (Parrotta *et al.,* 2016). Due to this, the remaining indigenous forests are diminishing and cannot therefore rely upon only their gazettement. This implies that developing on-farm conservation strategies for indigenous trees would be the right palliative measure to this shortfall (Okia, 2013).

Indigenous trees on-farm are shrinking, with most being greatly threatened (Fandohan *et al.* 2015). Impacting on the livelihood of the affected household and ecological system differently, approaches for conservation of indigenous trees on-farm is paramount.

It should be noted that, availability of indigenous trees on-farm are based on farmers' efforts especially focusing on priority species that have been determined by farmers because of their values. Conservation strategies used in conservation of ITs on-farms are many (Agea, 2004; Gumbo *et al.,* 2009).

2.3 Different Approaches for Conserving Indigenous Trees On-farms

Local people for long have developed many strategies to conserve indigenous trees on farm and maintain their number in the different parts of the farms (GOU, 1998). protecting sprouts, controlling fires and valuing local beliefs attached to indigenous trees on-farm are the common practices at hand (Fandohan *et al.,* 2015). According to Kakudidi (2004), fire control is one of the most common and effective approach used by the local community in the conservation of

indigenous trees on-farm. These are mainly done in dry seasons when the trees have dry fibers that easily catch fire if exposed to fires.

Weeding of indigenous trees by local people help to improve the growth rate and health of indigenous trees on-farm. Apart from helping to conserve indigenous trees on-farm, it should, however, be noted that weeding also increase the population of ITs in weeded areas (Mulugo *et al.*, 2019). In order to conserve IT, farmers mainly focus on the commonly used indigenous trees like *Makhamia lutea, Senna siamea , Albizia coriaria,* and *Albizia grandibracteata* (Fandohan *et al.*, 2015).

Domestication (the accelerated and human induced evolution to bring wild or semi-wild indigenous trees into wider cultivation) is also an approach for promoting on-farm conservation of indigenous trees. It is usually done through adapting indigenous trees to farmers' needs and environmental conditions. It usually commences from exploitation of the tree products from the wild followed by deliberate selection and retention (Abdullahi *et al.*, 2013). This reduces the pressure on the threatened indigenous species on-farm and in turn promotes their conservation (Awodoyin *et al.*, 2015).

Cultural and traditional beliefs in an area are the practices in most rural areas in Uganda that most farmers use as an on-farm approach for conserving indigenous trees for the benefit of the community where these trees exist (Rankoana, 2016). According to Miranto & Schulman (2012), local people can use their experience in innovation and evaluation to identify and develop useful on-farm conservation approaches and their full involvement can inspire wide adoption of new practices.

Consequently, active local participation is important for importing and adopting traditional tree management approaches and for fitting trees into new situations such as settlements, cropping systems or rangelands (Idowu *et al.*, 2014).

Unlocking the storehouse of rural household approaches and finding ways of integrating it with modem scientific ideas is the key to tackling on-farm conservation of indigenous trees needs and

problems. This is so because these approaches of the environment are unsurpassed and any outside plan or modem or scientific techniques introduced is to inevitably have to face the rigors and idiosyncrasies of a given environment (Abdullahi *et al*., 2013).

2.4 Benefits of Conserving Indigenous Trees

Factors that motivate farmers to conserve trees on their land come from the cultural, ecological and economic benefits people get from the trees on-farm in form of goods or services (Okia *et al.,* 2013). Indeed, the widespread occurrence of trees in traditional agricultural systems throughout the tropics provides evidence of the benefits that farmers obtain from their presence. These benefits can be divided into a number of broad categories: consumptive benefits, ecological benefits and management benefits (Guevara *et al.,* 2012).

The most widespread benefit from on-farm trees conservation systems is their function of maintaining or restoring the productivity of the land. This underlies all systems of noncontiguous cultivation that incorporate a period of tree fallow in the farming system (Guevara *et al.,* 2012).

Indigenous trees are good to use for soil conservation as they have micro-site effects. Those with nutritious biomass help in formation of top soil much faster. Such trees enrich the soil by adding manure when the leaves fall and decompose (ECOTRUST, 2016). According to Buyinza *et al.* (2015), indigenous legume trees have been recommended for their capacity to add nitrogen to the soil, hence increasing soil fertility. They are also best for soil erosion control as they hold together soil particles more effectively than exotic trees. Soil enriching impact of trees is also one of the principal economic incentives to participation in tree growing as they add fertility to the land through leaves fall (Buyinza *et al.,* 2015).

Trees also perform this soil-enriching function in certain permanent cultivation systems. For example, trees can be intercropped with alley crops to raise nutrients to the surface layers of the soil through litter or green mulch, a function often combined with addition of nitrogen through use of leguminous tree species (Kakudidi, 2004). According to Armesto & Rozzi (2010), indigenous trees provide a low-cost alternative to fertilizers and soil conditioners. Because of these, indigenous trees are also employed to protect the soil (by providing shade), shelter from

wind, protection from destructive rain impact on the soil and reduction in soil loss through row plantings to check runoff (Abdullahi *et al*., 2013; Backes, 2009).

A wide spread beneficial impact of trees is also seen in increasing the total output of the land by adding a tree crop to one or more lower layers of crops. The selected intercropped species have root and above ground structures that make complementary use both of different layers of the soil and of the space exposed to sunlight above the soil surface. Indeed, a wide variety of such vertically structured multiple crop combinations are found in the tropics (Buyinza *et al.*, 2015).

Other categories of benefit from indigenous trees include raising household incomes by exploiting tree crops that provide higher returns from the land than alternative crops. According to Kalaba & Prozesky (2009), indigenous trees can produce poles and firewood for sale or production of other products that can provide resources inform of goods like sap, medicine and fruits used by the households. Thus, by better use of available resources, trees can also be an additional source of income (ICRAF, 2014).

Less labor-intensive systems of tree growing can be used to allow farm families to utilize more of the available land hence indigenous trees can equally contribute to reduction in costs. The saved money/resources can be used to meet essential local needs, such as fuel, forage and building materials. Other products may also be provided in kind at lower cost by growing trees rather than using alternative sources of supply (Abdullahi *et al*., 2013).

Trees can also provide a capital reserve for use in emergency, or to meet exceptional cash outlays. This is because trees are widely grown as reserves by farmers and do not have to be harvested at a particular time. These trees thus accrue in value over time (Miranto *et al.*, 2012). According to Okia (2013), indigenous Trees have cultural, aesthetic and scientific values that provide basic survival items which are still vital today and will remain so in future. As part of communal heritage, such indigenous trees do provide food, shelter, fuel wood and medicine.

In addition to the above, different communities naturally rely on indigenous trees to supplement cultivated produce for their basic nutritional requirements (Rankoana *et al.*, 2016). During

drought when food reserves run out, wild foods are often the main source of calories and nutrients. This is so because indigenous trees have some fruits and seeds with high nutritional value. The evergreen indigenous trees also provide fodder for goats, cattle, camel among others during long dry periods (Neudeck *et al.*, 2012).

Naturally growing trees are also used as building materials such as timber, poles, ration and roofing materials that enable community to helps them to maintain acceptable standards of living. Timber from indigenous trees such as *Markhamia lutea* is durable, termite resistant and thus can be put into various uses (Agúndez *et al*., 2016; Tchoundjeu *et al*., 2010).

According to Kalaba *et al*. (2009), indigenous trees also form the basis of traditional systems of both human and animal medicines all over the world. In developing countries, 80% of local people continue to rely chiefly on herbal/traditional medicines for primary health care. The demand for herbal medicines which developed over a long period of time through close interaction between local people and the natural world keeps rising because modem medicines are too expensive for many people in developing countries to afford. More so, traditional medicine is often trusted at least for certain ailments and its promotion affirms the value of local cultures (Guevara *et al.*, 2012).

2.5 Challenges Related to Conservation of Indigenous Trees On-farms

Challenges related to conservation of forest genetic resources include indigenous tree decline and detoriation in their structure, changes due to tree removal and conversion of forest land to other uses, crop growing, forestry practices, climate change, disease conditions, introduced pests, atmospheric pollution, and settlement (Backes, 2001; Hamilton *et al*., 2016).

As has been reported by Mulugo *et al.* (2019), limited land by most of the households in Uganda has hindered the conservation of indigenous trees on-farm. The sharing of inherited lands from the parents through generations leads to land fragmentation and insecure tree ownership. This has got a negative impact on promotion of indigenous tree on-farm conservation. Despite having limited land sizes, farmers have to also convert some land areas for settlement and crop growing to sustain their living in the area (GOU, 2003).

According to Camacho *et al.* (2012), many farmers also lack access to improved sources of planting materials for indigenous trees. For instance, over 90% of the communities in Uganda lack access to improved seeds of most indigenous tree species such as *Makhamia lutea*, *Senna siamea* , *Albizia coriaria* and *Anona chrysophyla*. There is also lack of enough knowledge of how to raise seedlings of indigenous trees for planting by most farmers. This has greatly affected the conservation of indigenous trees on farms (Guevara *et al.*, 2012).

Man-made hazards such as careless grazing of cattle are one of the factors limiting on-farm conservation of indigenous trees in most parts of Uganda. In such areas, grazing is done on-farm where young indigenous trees are damaged by the animals in the process of moving around the farmlands. Where such practices exist, it is very difficult for farmers to establish new indigenous trees on-farms (Obua *et al.* 2003).

The economic pressures on conservation of indigenous trees on-farm is also a challenge. The destruction and removal of the indigenous trees is happening and the pressures that discourage the introduction of indigenous trees in situations where there are no trees in the agricultural system at present (Chenyambuga *et al.*, 2010; Patil & Depommier, 2008).

While indigenous trees constitute a productive element in so many traditional agricultural systems in the tropics and are essential for sustained production from the land, production of agricultural crops for food and income in the short term naturally takes precedence over these longer-term values (Masiga *et al.* 2012). Thus a central challenge in introducing on-farm trees conservation is in the inability of trees to meet these immediate needs as opposed to longer-term aims of stability and sustained productivity of ITs (Newton, 2008).

Population growth also endangers conservation of indigenous trees on-farm because of the need for more land to settle the growing population. Such rapid population increase usually puts pressure on the indigenous tree resources thereby raising the value of the latter to the point at which economic pressures to cut and use it exceed its move towards conservation and sustainability (Guevara *et al.*, 2012).

The longer juvenile phase before production period also imposes another economic constraint to on-farm conservation of ITs. As this can increase the level of risk for those conserving indigenous trees on their farms, few households invest in a long-term conservation of indigenous trees because many fear that they will not be present to harvest the returns in the future (Getahun *et al.,* 2017).

2.6 Socio-economic and Demographic Factors Influencing Conservation of Indigenous Trees on-farms

Generally, there are positive feelings towards on-farm conservation of IT by the households in Uganda. According to Obua *et al.* (2003), many farmers are willing to conserve indigenous trees on their farmlands because most of them value IT for food, cash, building materials, local medicine and firewood.

Gender, education, farm size and occupation are other factors that can influence farmers' attitudes towards conservation of indigenous trees on-farms (Masiga *et al.,* 2012). According to Kaboggoza, (2011), gender significantly influences local willingness to conserve ITs as there is a higher probability to conserve ITs by females. This should be taken to as an incentive to encourage women to invest their labour conservation.

In most studies, it has been shown that education level can have positive influence on farmers' perception to conserve ITs (Kaboggoza, 2011). According to Agea *et al* (2009), there is a higher chance of conserving indigenous trees if a farmer has formal education. This is also so because education can increase people's environmental awareness and appreciation of the value of indigenous trees on farm. In general, there is always a marginal change on the willingness of people to conserve indigenous trees as a result of education.

In a study conducted by ECOTRUST (2018), farmers' willingness to conserve ITs is also influenced by farm sizes where the larger the farms, the more willing people are to conserve ITs. Apart from this, occupational status also has high probability for one to conserve ITs on-farm. This is so because farmers usually attach values to trees and withstand high risks associated with conserving and managing indigenous trees on their farms (Obua & Aluma, 2003).

The number and efficiency of labor by households also influence conservation of indigenous trees on-farm indeed where families with enough labor force are motivated to conserve more of the available ITs on their farms than where labor are few in the households (Stangeland *et al.*, 2011).

According to Rabevohitra, & Fernandes (2009), indigenous trees form the basis of traditional systems of both human and animal medicines all over the world. In developing countries, 80% of local people continue to rely chiefly on herbal/traditional medicines for primary health care and hence those households that have more demand for herbal medicines are highly motivated to conserve indigenous trees than others. Since traditional medicine is often trusted at least for certain ailments, its promotion affirms the value of local cultures in influencing conservation of indigenous trees on-farm (Guevara *et al.*, 2012).

CHAPTER THREE

STUDY AREA AND METHODS

3.1 Study Area

3.1.1 Location and Size

The study was carried out in Aboko parish located in Aduku Sub County Kwania district (Figure 1).

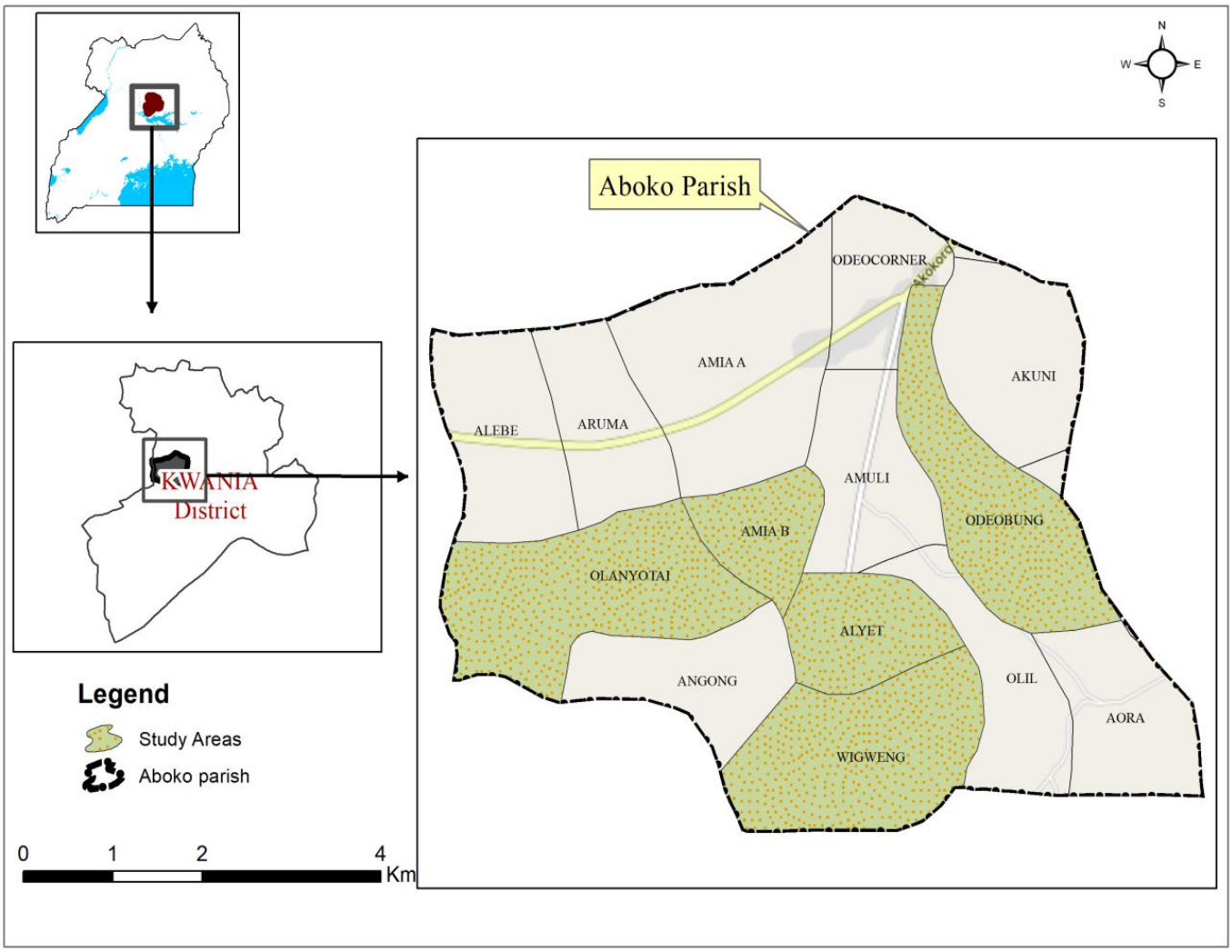

Figure 1: Map of the Study Area in Kwania District

Aboko parish has total area of 28.6 square kilometers of land with approximately 1614 households(GOU, 2018). The parish consists of Odeo corner, Odeo bung, Amuli, Aora, AmiaA, Amia B, Olanyotai, Alebe, Angong, Acandek, Alyet, Aruma, wigweng and olil villages (APA,2012).

3.1.2 Climate and Vegetation

Rainfall in the area is reliable, well distributed throughout the year and is adequate for cultivation. The high potential areas in region receive average annual rainfall between 1,400 mm and 1,600 mm. The average annual rainfall in medium potential areas ranges between 900 mm and 1,400 mm and the average annual rainfall in low potential areas is between 500mm and 900mm(UBOS, 2002).

The temperature in the parish varies with altitude. In most of the areas, the maximum annual temperature ranges between 23°C and 28°C, while the minimum annual temperature ranges between 14 and 18°C (MWE, 2017).

The vegetation of the area is predominantly dry savannah indigenous tree types and are sparsely distributed in the region (APA, 2012). The area also has both permanent and seasonal wetlands. These are mainly papyrus swamps which have been found to have high biological diversity. At present, over 1.2% of the total seasonal wetlands have been reclaimed and converted to various forms of land use ranging from farm land, residential to business areas (APA, 2012).

3.1.3 Topography, Geology and Soils

According to MWE (2017), the district's topography is characterized by low plains and rolling hills along the river, at 900m above sea level, rising to a series of hills and peaks in the eastern and, north eastern parts of the district. The district lies at an average altitude of 1150mm above sea level. The soils in the district are reddish brown layer of clay loam. This covers over 90% of the cultivable land. This soil is very suitable for rain fed-agriculture.

The rocky soils account for 3% and black clay soils accounts for 97% of the total soil mass in the region (Stangeland *et al.*, 2011). This coupled with high rainfall regime in the most parts of the area can make cotton, sunflower and food crops such as maize, beans and potatoes do well. The parish rises gradually from altitude of 900m in low lands to 1150m along the higher topography. The area is drained by several wetlands. All the wetlands flow have temporary water which dries off in dry seasons (UBOS, 2017).

3.1.4 People and Economic Activities

Kwania District is a predominantly rural district which is occupied by the Lango tribe as the main ethnic group (Nunoa *et al.*, 2010). According to UBOS (2018), the population of kwania District is about 183,304 of which 49.2% are males and 50.8% are females. The economic activity of the district is agriculture with a bias towards food crops like maize, finger millet, cassava, beans, simsim, pigeon peas, sun flower, cow peas, and bananas in addition to a few cash crops like cotton, cabbage, sunflower and onions (Rwabwogo, 2005). The main livestock that are kept by the people of Kwania District are cattle, goats, sheep, pigs and chicken (MWE, 2017)

3.1.5 Communication

Kwania District has a well distributed feeder-road network that links most of the parts of the District (Rwabwogo, 2005). The district is linked by a weather road to districts of Lira, Apac, kole and Oyam. Kwania District has Lango as the common language spoken by most of the people in the area (ALG, 2017).

3.2 Methods

3.2.1 Research Design

The study was a cross sectional socio-economic survey designed to collect both quantitative and categorical/qualitative data from households (Mulugo *et al.*, 2019; Nimachow 2011). Data were collected using questionnaires, focus group discussions, key informant interviews and direct observation about issues of conservation of indigenous trees on-farm by households in Aboko Parish (Nations & Peoples,2005).

3.2.2 Sampling Procedure and Size

The study was carried out in Aboko Parish. The parish was clustered into several zones consisting of Odeo corner, Odeo bung, Amuli, Aora, AmiaA, Amia B, Olanyotai, Alebe, Angong, Acandek,Alyet, Aruma, Wigweng and olil villages. A total of five villages consisting of Odeo bung, Amia A, Olanyotai, Wigweng and Alyet were then purposively selected because of the presence and adequate distribution of indigenous trees in them.

Ten households were randomly sampled in each of the selected villages. The 10% sampling intensity was used since it gave an effective representation of the population (Okia *et al.*, 2013). Since each village in Aboko Parish had fairly equal number of households (GOU, 2018),10 households were randomly sampled per village thus a total of 50 questionnaires were administered during the study.

3.2.3 Instrumentation

Pre-tested semi-structured questionnaires were used to collect information about the local uses, benefits, challenges and socio economic factors influencing the conservation of Indigenous Trees on-farm (Agea, 2007). Both Focus Group Discussions (FGDs) and Key Informant Interviews were also carried out using interview guides (Kakudidi, 2004).

3.2.4 Data Collection

Several methods were used in collecting data from both primary and secondary sources. The process entailed administration of questionnaires, recording of observations, conducting interview schedules, on-farm visits, listening to oral traditions, community timeline, photographs, and review of recorded literature.

a) Key Informant Interviews (KII)

Key informant interview was used to collect general information on indigenous trees usually retained on-farms and the area where the study was carried out. It also involved discussions with local leaders, for example, local council three of Aduku sub county and the local council one of the sampled villages (Symposium & Lanka, 2013).

b) On farm Visits

On farm visits was carried out to examine the availability of indigenous trees within the farmlands and approaches used by households in conservation of indigenous tree species within the farmlands (Abdullahi *et al*., 2013).

c) Self-Administered Questionnaires

Self-administered questionnaires were used to extract the respondents' experience to which they are exposed (Hens, 2017). Questionnaires were used to examine the availability of indigenous trees within the farmlands and factors influencing conservation of indigenous trees in the study area in addition to challenges faced in conserving indigenous trees (Asselin, 2018).

d) Focus Group Discussion (FGD)

Focus Group Discussion was also employed during the data collection process majorly to validate the information on the socio economic and demographic factors influencing conservation of indigenous trees (Santos *et al.,* 2004). For instance, a group of eight persons (women) from the area was interviewed on the challenges and socio economic factors influencing conservation of indigenous tree on-farm (Obua, 2007).

e) Review of Literatures

Secondary data sources that were reviewed included information from books, journals, documents from the forestry bodies and web references. The reviewed literature was used to assess the general issue on indigenous trees in the area and conservation approaches used by the local community (Symposium & Lanka, 2013).

3.2.5 Data Analysis

Data were first checked for consistency, coded and entered into Statistical Package for Social Scientists version 6.1 (SPSS 16) computer program for analysis (Okia *et al.,* 2010). Coding was done after data collection so as to transform data into computer readable format (Adhikari & Rawat, 2010). Open ended questions that resulted into non numerical responses were first coded before analysis.

The purpose of the coding was to ensure that all the variables were to be considered during analysis (Getahun *et al.,* 2017). The numeric codes of the data were then entered into the SPSS Version 6.1 for analysis and the unit of analysis was both the individuals and households (Cernansky *et al.,* 2015).

Data on benefits of indigenous trees, challenges to conservation, and on-farm approaches for conservation, community characteristics was summarized into frequencies where descriptive statistics like frequencies, means and percentages were generated to indicate the responses of the respondents (Vinogradov, 2015). The results were then presented in tabular form consisting of frequency and percentages (Momin & Singh, 2016).

Logistic regression was also used to determine whether socio-economic and demographic characteristics such as gender, education, occupation, could have influenced people's attitude towards conservation of indigenous trees on-farms (Cavaleri & Sack, 2014).

CHAPTER FOUR

RESULTS

4.1 Socio-Economic and Demographic Characteristics of the Households

Majority of the respondents were females (60%). While 60% of the respondents attained primary level of education, 18%, 08% and 16% had attained secondary, tertiary and never any level of education respectively (Table 1).

Table 1: Demographic Characteristics of the Households (N=50)

Factor		Frequency	Percentage (%)
Sex	Female	30	60
	Male	20	40
Marital status	Married	34	68
	Single	16	32
Education	Primary	30	60
	Secondary	09	18
	Never	07	14
	Tertiary	04	08
Acres of land	2 below	19	38
	2.1 to 3	15	30
	3.1 to 4	08	16
	4.1 above	08	16
Land acquisition	Inherited	34	68
	Inherited and bought	11	22
	Bought	05	10
Activity on land	Cultivation	50	100
	Livestock	32	64
	Bee keeping	05	10
Common crops	Maize	39	78
	Cassava	32	64
	Beans	19	38
	Sorghum	13	26
	Sweet potatoes	12	24
	Millet	10	20
	Soya bean	10	20
	Sunflower	09	18
	Groundnuts	09	18
	Banana	08	16
	Peas	07	14
	Simsim	06	12
	Cotton	05	10
	Rice	05	10

Major crops grown in the area included maize, cassava and beans reported by 78%, 64% and 38% of the respondents respectively

4.2 Availability of Indigenous Trees On-farms

Indigenous trees available on-farms included *Makhamia lutea*, *Senna siamea*, *Albizia coriaria*, *Borassus aethiopum*, *Pilostigma thonningii*, *Albizia grandibracteata* and *Ficus natalensis* reported by 31.9%, 25.5%, 17%, 17%, 17%, 14% and 12% of the respondents respectively (Table 2).

Table 2: Common Indigenous Trees available on-farms (N=50)

Scientific name	Family name	Local name	N	Percentage (%)
Makhamia lutea (benth).	Bignonaceae	Acambya	15	31.9
Senna siamea (Fresen).	Fabaceae	Agacia	12	25.5
Albizia coriaria (Taub).	Fabaceae	Itek	08	17.0
Borassus aethiopum (Mart).	Arecaceae	Tugo	08	17.0
Pilostigma thonningii (schumach)	Fabaceae	Ogali	08	17.0
Albizia grandibracteata (Taub).	Fabaceae	Abata atar	07	14.9
Ficus natalensis (Prota).	Moraceae	Ananga	06	12.8
Ficus sycomorus (Del).	Moraceae	Olam	05	10.6
Grewia mollis (Juss)	Malvaceae	Opobo	05	10.6
Croton macrostacchyus (Del).	Euphorbiaceae	Okango	05	10.6
Melicia excels (Lam).	Moraceae	Ilwa	05	10.6
Terminalia macroptera (Prota).	Combretaceae	Opok	05	10.6
Erythrina abyssinica (D.C)	Fabaceae.	Awilakot	05	10.6
Combretum molle (Prota).	Combretaceae	Odugo	04	08.5
Acacia senegal (Itis)	Fabaceae	Okutokech	04	08.5
Stereospermum kunthianum (Lam).	Bignoniaceae	Olutokwon	04	08.5
Ziziphus abyssinica (Hochst).	Rhamnaceae	Okuto langо	03	06.4
Kigelia africana (Del).	Bignoniaceae	Yago	03	06.4
Dichrostachys cinerea (Sickle bush).	mimosaceae	Okutu ipet	03	06.4
Annona senegalensis (Anuse).	Annonaceae	Obwolo	03	06.4
Tamarindus indica (Norad).	Fabaceae	Cwao	03	06.4
Bridelia micrantha (Hochst).	Phyllanthaceae	Orweco	03	06.4
Ficus ovatta (Decne).	Moraceae	Ebule	02	04.3
Ficus glumosa (Miq).	Moraceae	Kworo	02	04.3
Vitex doniana (Sweet)	Lamiaceae	Owelo	01	02.1
Acacia sieberiana (D.C).	Fabaceae	Okuto itir	01	02.1
Croton sylvaticus (Del).	Euphorbiaceae	Cetwingo	01	02.1

4.3 Conservation Approaches for Indigenous Trees On-farms

The main conservation approaches of indigenous trees on-farms included tree spot weeding, leaving sprouts, pruning, controlling fires, local belief attached to indigenous trees, retaining ITs on-farm boundaries, protecting the younger ones from the destruction of livestock and protecting ITs against pests and diseases reported by 63.3%, 44.9%, 40.8%, 38.8%, 28.6%, 28.6%, 24.4% and 22.7% of the respondents respectively (Table 3).

Table 3: Conservation Approaches for conserving Indigenous Trees on-farms (N=50)

Approaches	N	Percentage (%)
Tree spot weeding	31	63.3
Sparing sprouts	22	44.9
Pruning trees	20	40.8
Controlling fire burning	19	38.8
Local beliefs attached to trees	14	28.6
Retaining its on farm boundaries	14	28.6
Protecting the younger ones against livestock	12	24.4
Protecting ITs from pests and diseases	10	22.7

4.4 Benefits of Conserving Indigenous Trees on-farms

4.4.1 Benefits of Conserving Indigenous Trees on-farms

Respondents reported several benefits associated with conserving IT on-farms. Consumptive benefits like firewood, timber, poles, stakes, fruits and medicine were reported by 71%, 57%, 51%, 48%, 35% and 24% of the respondents respectively (Table 4).

Table 4: Benefits from Conserved Indigenous Trees on-farms (N=50)

Factor	Benefits	N	Percentage (%)
Consumptive Benefits	Firewood	32	71.1
	Timber	26	57.8
	Poles	23	51.1
	Stakes	22	48.9
	Fruits	16	35.6
	Medicine	11	24.4
Ecological benefits	Wind breaks	41	80.2
	Enhancing soil fertility	38	79.8
	Soil erosion control	35	75.7
	Provision of shades	30	68.9
	Ecological (environmental) beauty	30	68.9
Management benefits	Easy management in terms of costs	23	46.0
	High disease resistant	17	34.0
	Fast growing	10	20.0

Ecological benefits included trees acting as wind breaks, enhancement of soil fertility, soil erosion control, provision of shades and ecological (environmental) beauty recorded by 80.2%, 79.85, 75.75%, 68.9% and 68.9% of respondents respectively (Table 4).

There were some management benefits of indigenous trees which were recorded in the study area. These included easy management in terms of costs, its high level of disease resistance and faster growth of indigenous trees reported by 46%, 34% and 20% of the respondents respectively (Table 4).

4.4.2 Benefits of Conserving Different Indigenous Trees on-farms (N=50)

Most indigenous trees conserved on-farms provide various benefits ranging from consumptive, ecological and management benefits respectively (Table 5).

4.5 Challenges Related to Conservation of Indigenous Trees on-Farms and Measures taken to overcome these Challenges

4.5.1 Challenges Related to Conservation of Indigenous Trees on-Farms

Challenges related to conservation of indigenous trees on-farms included excess firewood collection, conversion of cropland for settlement, opening land for crop growing, poor soils, unreliable rainfall, fires, collection of poles, animal damage and torrential rainfall reported by 52%, 44%, 38%, 34%, 32%, 26%, 24% and 24% of respondents respectively (Table 6).

4.5.2 Measures Taken to Overcome Challenges related to Conservation of Indigenous Trees on-farms

Measures to solve the challenges related to conservation of ITs on-farm included community sensitization, provision of fast growing species, planting more trees, fire control, land tenure modification to enhance effective conservation of indigenous trees, law enforcement and early pruning reported by 48%, 46%,44%, 38%, 34%, 34% and 26% of the respondents respectively (Table 7).

Table 5: Benefits of Conserving Different Indigenous Trees on-farm (N=50)

Tree species	Local name	Consumptive benefits	Ecological benefits	Management benefits
Makhamia lutea	Acambya	Fw,Ti,Po & St,	Wn, Sf, Ec, Sh & Eb	Em, & Fg
Senna siamea	Agacia	Fw, Po & Ti	Wn, Sf, Ec, Sh & Eb	Em, & Fg
Albizia coriaria	Itek	Fw, Ti, Po & St	Wn, Sf, Ec, Sh & Eb	Em & Dr
Borassus aethiopum	Tugo	Fr & Ti	Wn, Sf, Ec, Sh & Eb	Em & Dr
Pilostigma thonningii	Ogali	Fw,Me & Po	Wn, Sf, Ec & Sh	Dr
Albizia grandibracteata	Abata atar	Fw, Ti & Po	Wn, Sf, Ec, Sh & Eb	Em, Dr & Fg
Ficus natalensis	Ananga	Fw & St	Wn, Sf, Ec & Sh	Em, Dr & Fg
Ficus sycomorus	Olam	Fw, Ti & Po	Wn, Sf, Ec & Sh	Em & Dr
Grewia mollis	Opobo	Po & St	Sf, Ec & Eb	Em, Dr & Fg
Croton macrostacchyus	Okango	Fw, St & Me	Sf & Ec	Em, Dr & Fg
Melicia excelsa	Ilwa	Fw, Ti & Me,	Wn, Sf, Ec, Sh & Eb	Em & Dr
Terminalia macroptera	Opok	Fw & po	Wn, Sf, Ec & Sh	Em, Dr & Fg
Erythrina abyssinica	Awilakot	Fw,St , & Me	Wn, Sf, Ec & Sh	Em, Dr & Fg
Combretum molle	Odugo	Fw & Po	Wn, Sf, Ec, Sh & Eb	Em & Dr
Acacia senegal	Okutokech	Fw & Po	Sf, Ec & Sh	Em, Dr & Fg
Stereospermum kunthianum	Olutokwon	Fw, Me & St	Wn, Sf, Ec, Sh & Eb	Dr & Fg
Ziziphus abyssinica	Okuto lango	Po & St	Sf, Ec, Sh & Eb	Em, Dr & Fg
Kigelia africana	Yago	Me & St	Sf, Ec & Eb	Em, Dr & Fg
Dichrostachys cinerea	Okutu ipet	Fw, Po & Me	Wn, Sf, Ec & Sh	Em & Fg
Annona senegalensis	Obwolo	Fw, Fr & St,	Wn, Sf, Ec, Sh & Eb	Em
Tamarindus indica	Cwao	Fr & Me	Wn, Sf, Ec & Sh	Dr
Bridelia micrantha	Orweco	Fw, Ti, Po & St,	Wn, Sf, Ec & Sh	Em & Dr
Ficus ovatta	Ebule	Fw & Ti	Wn, Sf, Ec, Sh & Eb	Em & Fg
Ficus glumosa	Kworo	Fw & Po	Sf, Ec & Eb	Em, Dr & Fg
Vitex doniana	Owelo	Fr, St &Po	Sf, Ec, Sh & Eb	Dr
Acacia sieberiana	Okuto itir	Fw, Ti & Po	Wn, Sf, Ec & Sh	Em, Dr & Fg
Croton sylvaticus	Cetwingo	Po & St	Sf, Ec & Eb	Dr & Fg

Fw=Firewood, Ti=Timber, Po=Pole, St=Stake, Fr=Fruits Me=Medicine, Wn=Wind break, Sf=Soil fertility, Ec=Erosion control, Sh=Shade provision, Eb=Ecological beauty, Em=Easy management, Dr=Disease resistant, Fg=Fast growing.

Table 6: Challenges related to Conservation of Indigenous Trees on farms (N=50)

Challenges	N	Percent (%)
Firewood collection	26	52
Conversion of cropland for settlement	22	44
Opening land for crop growing	19	38
Poor soils	17	34
Unreliable rainfall	16	32
Fires	13	26
Pole collection	13	26
Animal damage	12	24
Slow growth of the indigenous trees	12	24
Pests and diseases	09	18
Ignorance about its conservation	08	16
Stealing of trees	07	14
Infrastructural development	05	10

Table 7: Measures to solve the Challenges related to Conservation of Indigenous Trees on-Farms (N=50)

Measures	N	Percentage (%)
Community sensitization	24	48
Provision of fast growing species	23	46
Planting more trees	22	44
Fire control	19	38
Land tenure modification	17	34
Law enforcement	17	34
Early pruning	13	26

4.6 Socio-Economic and Demographic Factors Influencing Conservation of Indigenous Trees on-farms

Logistic regression analysis indicated that the respondents' willingness to conserve indigenous trees on farm was influenced by the sex (P=0.027). Marital status (P=0.032), education background, acres of land owned and land acquisition had no significant influence on the willingness to conserve indigenous trees on-farm (Table 8).

Table 8: Logistic regression of Socio-Economic Characteristics and Demographic factors that influences Conservation of Indigenous Trees on-farms

Significant at $p \leq 0.05$

Variables	B	S.E.	Wald	df	Sig.	Exp(B)
Sex	2.230	1.518	.023	1	***.027***	2.259
Marital status	1.069	1.713	.390	1	***.032***	1.343
Education background	-.107	.753	.020	1	.887	.898
Acres of land owned	-.626	1.022	.375	1	.540	.535
Land acquisition	-17.034	6.254	.000	1	.998	.000
Constant	21.138	8.254	.000	1	.998	10.537

CHAPTER FIVE
DISCUSSION

5.1 Availability of Indigenous Trees On-farms

In the study area, more than a half of farmers incorporate indigenous trees in their farms especially, where there is a minimum cultivation operation. In such areas, trees do exist on-farm as wildlings, or those retained by farmers and planted/sown seedling (Abdullahi *et al.*, 2013). According to Agea *et al.,* (2007), farmers usually plant and retain indigenous tree species that are compatible with agricultural crops and those suitable species depending on their uses. Even then, most indigenous trees are sparsely distributed on-farm where people are doing other activities like livestock farming and crop growing (Parrotta *et al.,* 2016).

Indigenous trees with highest level of availability such as *Markhamia lutea, Erythrina abyssinica* and *Senna siamea* are common where subsistence farming is largely practiced (Figure 2).

Figure 2: *Markhamia lutea* and *Senna siamea* trees on-farm

Promotion of such species is attributed to farmer's knowledge of their propagation and traditional value among the community (Table 2). According to Okia (2013), indigenous trees are also distributed on-farm boundaries separating people's farms. This implies that developing on-farm conservation strategies for indigenous trees would be the right palliative measure to improve conservation of indigenous trees and reduce boarder conflicts among land owners.

5.2 Approaches used by Households to Conserve Indigenous Trees on-farms

The most common strategies for conserving indigenous trees on-farms are spot weeding, leaving sprouts, control of fires and local beliefs attached to indigenous trees (Table 3). Other approaches for indigenous tree conservation in the study area was manifested in the area of minimizing negative tree-crops interactions, retaining ITs on-farm boundaries, protecting the younger ones from the destruction of livestock pest control and performing field operations such as weeding and sparing sprouts (Table 3).

According to Obua (2004), indigenous trees are conserved and protected on-farm through sparing during cultivation and weeding around the seedlings/saplings/trees to prevent fire from burning them. These tending operations that includes thinning and pruning of heavily branched trees to reduce the effect of shading on agricultural crops are very common in northern Uganda.

Traditionally, farmers do not cut all trees at the time of land clearing for agricultural production. In most cases, usually conserve and nurture valuable species such as *Makhamia lutea* and *Senna siamea* on-farms. Indeed, indigenous tree species which easily regenerate naturally are not traditionally planted but are spared during clearing of land for agricultural production (Boffa, 2009).

a) Pruning of Indigenous Trees

According to Camacho *et al.,* (2012), indigenous trees are frequently pruned because of their importance in providing commodities and services to local people. Such benefits must be reconciled with their function as reservoirs of biodiversity and major regulators of hydrologic and economic cycles on both regional and global scales.

In this area, pruning is normally done during the dry seasons by households to allow the cut parts of the trees to dry well and avoid rotting. The pruning processes in the area involves the use of tools like pangas, axes and knives which are affordable to the preferred by the communities in the area (Camacho *et al.,* 2012).

There have been a few efforts that have attempted to assess the impact of tree pruning on indigenous trees by households. Why pruning have assumed to be such an important approach for conservation of indigenous trees on-farm (Chavangi, 2007), a number of these attempts have focused on good growth of trees on-farm and their health.

b) Spot Weeding

Weeds are removed by hand around the indigenous trees within the farms. Hand-weeding is reportedly used to minimize interference with root system of the target tree crop (Kakudidi, 2004). It should, however, be noted that weeding requires a lot of labor especially during onset of rains (Armesto *et al.,* 2001).

Since farmers have exhibited vast knowledge approach of indigenous tree conservation through spot weeding (Parrotta *et al.,* 2016). Knowledge in conservation of indigenous trees in the study area is needed to minimize negative tree-crops interactions, pest control and performing field operations.

c) Valuing Local Beliefs

According to Gombya *et al.,* (2000), conservation of indigenous trees on-farm or allied tree system knowledge in the area is reported to be through valuing of local beliefs by communities. Cultural beliefs and knowledge on natural resource use and conservation has been reported to have gained recognition in the study (GOU, 2003 & Mulugo *et al.*, 2019).

As also been reported by Agea *et al.,* (2007) and Korach (2016), Information on cultural significance of indigenous trees can contribute to the conservation of indigenous tree species. For example *Ficus natalensis* commonly used as a medicinal plant in the study area is reported by over 12.8% of the respondents to be found on their gardens.

Local cultures use indigenous trees for many purposes often unknown elsewhere (Gombya *et al.,* 2000). This is so because trees often possess spiritual or cultural significance for the members of the community. Being an integral part of the natural and cultural environment, such trees are

used during rituals and ceremonies. Against the stated values of indigenous trees, it is crucial that their conservation becomes a priority.

d) Sparing Sprouts

According to MWE (2016), indigenous tree species are an integral part of land resources that need careful management for sustainable utilization. In this study, most of the respondents acknowledged that indigenous tree species existing on their farms had been retained by sparing sprouts to continue growing after the trees had been cut (Figure 3).

Figure 3: Spared sprout of *Senna siamea* tree on-farm

Spared sprouts of indigenous trees have high level of adaptability since they are used in the particular point on-farm. Faster growth and good health of indigenous trees growing on-farm, this can enhance conservation of indigenous trees on-farms (Momin & Singh, 2016).

e) Controlling bush fire

Among the approaches for indigenous tree conservation on-farm is control of fire burning (Parrotta *et al.*, 2016). Controlling fire burning as a method of conserving indigenous trees on-farm are reported by 38.8% of the respondents (Table 3).

Since controlling fires is normally done in the dry seasons when the fuels can easily catch fire, it usually leads to great destruction. Despite this, the approach usually plays a significant role in the conservation of indigenous trees on-farm (GOU, 2003 & Parrotta *et al.*, 2016).

5.3 Benefits of Conserving Indigenous Trees on-farms

According to ICRAF (2005), ITs such as *Ficus natalensis* and *Makhamia lutea* are socio-culturally, economically and ecologically important trees which are usually prepared for both consumptive and non-consumptive uses. In addition, indigenous trees provide firewood to the households depend on these indigenous trees for their livelihood.

Indigenous trees are also valued as food/food supplements inform of fruits because it is an as excellent source of vitamin C among other food values like carbohydrates (Parrotta *et al.*, 2016). Vitamins and carbohydrates are food substances that can reduce malnutrition; a commonly widespread problem in many Sub Saharan African countries (Akinnifesi *et al.*, 2007).

Indigenous trees also provide valuable timber and have strong wood/ timber that are very durable and resistant to sea water, termite and fungal attack (Ayarkwa, 2007). Indigenous trees also have excellent working-properties (Sambou *et al.*, 2012). Furthermore, wood from indigenous trees are also used for fuel (Parrotta *et al.*, 2016).

Ecologically, if conserved on farms and agricultural fields ITs can also provide shade/shelter for both human beings and livestock, in addition to improving soil fertility and controlling soil erosion (Zubair *et al.*, 2006). A report by Sambou (2012) indicates that several aspects of the ecology of indigenous trees make it an interesting plant from an agricultural point of view as its fibrous root system can forms a dense mat in the surface layers of the soil which helps to prevent soil erosion.

According to Parrotta *et al.*, (2016), the indigenous trees are highly preferred by farmers because they are cheap to manage on-farm compared to other trees. Such management requires less capital and labor for effective conservation and proper management. Indigenous trees are also in

most cases fast growing and resistant to pests and diseases hence favoring conservation by the local communities (Table 4).

5.4 Challenges in the Conservation of Indigenous Trees on-farms

On-farm conservation of indigenous trees is faced with many challenges such as firewood collection, conversion of land for settlement, conversion of land for crop growing, high demand of timber for construction of houses, over exploitation, pests and diseases, fires, and animal damage (Ahmed *et al.,* 2010).

According to Zira (2013), over collection of firewood from indigenous tree is the biggest challenge facing conservation of indigenous trees on-farms. Other perceived reasons for over exploitation of indigenous trees include increased demand of poles, firewood and fruits, lack of substitutes for goods and services from indigenous trees, cultural preference, population growth, poverty and increased market value of firewood from indigenous trees (Table 6).

Repeated cutting for timber, beehive making, fuelwood, craft materials among others severely limits the conservation of indigenous trees on-farm (Sambou *et al.,* 2012). Indeed, over exploitation of ITs can alter the distribution and structure of the species, resulting into a decline in the numbers of such species (Kalaba *et al,* (2009).

Agricultural expansion is also one of the major challenges influencing conservation of ITs (Table 6). In the study area, local people usually cut down indigenous trees to give agricultural crops a better chance to grow healthy. This is further exacerbated by the fact that most respondents that harvest tangible from those ITs limit conservation of indigenous trees on-farm (Okia *et al.,* 2010).

Another challenge is the high rate of animal damage of young and mature indigenous trees on-farm especially in the dry seasons. This is also due to the absence of functioning bye-laws governing animal movement. According to Awodoyin *et al.,* (2014), the absences of functional laws/bye-laws regarding controlling animal movement and protection of ITs usually discourage people from conserving ITs. This in turn leads to over exploitation as each user aims to

maximize individual benefits. It is therefore wise to come up with appropriate bye-laws that can empower community groups to manage ITs on-farms.

5.5 The Socio-Economic Factors Influencing Conservation of Indigenous Trees On-farms

While Agea *et al*, (2010) reports that farmers' willingness to conserve indigenous tree species (ITs) can be influenced by their gender, education level, utilization patterns, land size and occupation, only sex and marital status had a significant relationship with the respondents' willingness to conserve indigenous trees on-farms in the study (Table 8).

The positive significant influence of sex on respondents' attitude towards conservation of indigenous trees on-farms could be attributed to the fact that women are more active in conservation of indigenous tree resources on-farms (Table 8). Indeed, women's roles are often invisible to project designers and to policy makers.

Women are involved in all aspects of fuel wood use, and they are primary collectors of fuel wood (Momin & Singh, 2016). Since the women's use of indigenous tree resources extends beyond consumption of fuel wood, they should involve in many activities for conservation of indigenous trees on-farms such as pruning, spot weeding and sparing young indigenous trees.

According to Rankoana *et al.,* (2016), being married, single, divorced, and widowed has a very big impact on the respondent's willingness to conserve such ITs on-farm. This could be linked to cultural values and regulation of tree ownership in Lango culture (Obua *et al.* 2003).

In the area it is clear that, marital status usually play a significant role in the conservation of indigenous trees on-farm. On the other hand, being married had a highly positive attitude towards conservation of indigenous trees on-farms more than being single, divorced and widowed people (Table 1).

Accordingly, there is always a high level of awareness and willingness of the married to conserve indigenous trees on-farms as compared to the unmarried (Obua *et al.* 2003). This

implies that extension workers should involve married persons when promoting conservation of ITs on-farm (Sambou *et al.*, 2012).

CHAPTER SIX
CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The following conclusions are drawn from the study:

i. The most available and popular on-farm indigenous trees were the farms *Makhamia lutea*, *Senna siamea*, *Albizia coriaria* and *Borassus aethiopum* reported by 31.9%, 25.5%, 17% and 17% of the respondents respectively.

ii. Indigenous trees that were sparsely distributed and incorporated on-farms had either been planted and / or retained and were also reported to be to be compatible with agricultural crops.

iii. The major on-farm conservation approaches for indigenous trees were spot weeding, sparing sprouts, pruning, controlling fires, promoting local belief attached to indigenous trees, retaining ITs on farm boundaries, protecting the younger ones from the destruction of livestock and protecting ITs against pests and diseases reported by 63.3%, 44.9%, 40.8%, 38.8%, 28.6%, 28.6%, 24.4% and 22.7% of the respondents respectively.

iv. Indigenous trees retained on-farm were multi-purpose providing a wide range of local benefits ranging from the provision of timber, firewood, poles, building materials, fruits, and stake which can also be sold to generate cash income in addition to non-consumptive uses like boundary marking, wind breaks, shade and control of soil erosion.

v. Challenges related to on-farm conservation of indigenous trees included excess firewood collection, conversion of cropland for settlement, opening land for crop growing, poor soils, unreliable rainfall, fires, collection of poles, animal damage and torrential rainfall reported by 52%, 44%, 38%, 34%, 32%, 26%, 24% and 24% of the respondents respectively.

vi. Measures suggested to solve challenges related to conservation of ITs on-farm included community sensitization, provision of fast growing species, planting more trees, fire control, land

tenure modification to enhance effective conservation of indigenous trees, law enforcement and early pruning reported by 48%, 46%,44%, 38%, 34%, 34% and 26% of the respondents respectively.

vii. Sex and marital status were found to have significant (P=0.027 and P=0.032) influence on the households willingness to conserve indigenous trees on-farm.

6.2 Recommendations

The following recommendations have been made from the study:

i. People should be engaged in planting of indigenous trees instead of depending on nature and this can be spearheaded by institutions like NAADS, NFA and CBOs through provision of both financial and technical support that can encourage households to participate in planting of indigenous trees on-farms.

ii. There is need to improve on the level of effectiveness and in the participation of households in on-farm conservation of ITs and other management approaches like increasing weeding and pruning frequencies, increasing planting of indigenous trees on-farm, increasing the numbers of spared ITs on-farm and proper fire control. In addition, there should be sensitization on better approaches of conservation of indigenous tree on-farms.

iii. To improve on the level of benefits and livelihoods of people utilizing ITs, there is need to carryout proper nutritional analysis on food and medicinal potential of indigenous trees and value addition for ITs. This is anticipated to increase the market value and facilitate extension programs geared towards promoting the growing and conservation of indigenous trees on-farms.

iv. There is need for reduction in the rate of cutting trees for fuel wood by increased participation in on-farm planting of other faster growing tree species for fuel wood, through woodlot establishment and boundary plantings.

v. Appropriate sensitization of households by local governments and NGOs can increase households' participation in conserving ITs on-farms, encourage both men and women to increase their levels of participation in conservation of ITs on-farms.

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APPENDICES

Appendix 1: ON-FARM APPROACHES FOR CONSERVATION OF INDIGENOUS TREE SPECIES AMONG HOUSEHOLDS IN ABOKO PARISH KWANIA DISTRICT

HOUSEHOLDS' INTERVIEW SCHEDULE

The information that this questionnaire seeks to collect will be used for academic purposes. The responses will be treated with utmost confidentiality.

SECTION A: Background Information and Demography of household

Date…… Village…….

1. Household serial No…… 2. Sex of respondent (a) Male …….. (b) Female……..…

3. Age of the respondent ……....years.

4. Marital status of the respondent (a) Single…… (b) Married…..… (c) Separated……

(d) Widowed ……

5. Number of children (if any)…….

6. Highest education standard attained

(a) Primary……. (b) Secondary…… (c)Tertiary ……. (d) Never……..

7. (i) Do you own any land? (a) Yes……. (b)No……..

(ii) If yes how many acres? .....acres

(iii) How is land acquired? (a) Inherited……... (b) Bought…… Both……..

(iv) How is the land owned? (a) Rented……. (b) Lease……

9. What farming activity do you carry out on the land?

(a) Cultivation..... (b) Livestock rearing…….. (c) Bee keeping…… (d)Others…….

10. How many acres of your land are under cultivation? ……..acres (ha)

11 (a) If (all of it) is under cultivation, are there periods when you leave some parts of land uncultivated? (a) Yes……. (b) No…….

(b) If your answer is yes, why do you leave this land uncultivated?

……

12. Which crops do you grow on your land?

…….....

SECTION B: Availability of indigenous Trees On-Farm

1. Are there any trees growing on your land? (a) Yes…… (b) No……..

2. If yes, are they; (a) Retained on land…….. (b) Grown on land……. (c) Both……...

(b) If no, do you intend to plant any? (1) Yes…… (2) No……..

(c) If yes, list the reasons

……

3 If yes, what species are growing on your land? For each species, indicate the purpose for which it is intended and the site where it is growing.

Species retained	**Purpose/ value for retaining**	**Site on farm**
Species planted	**Purpose/value for planting**	**Site on farm**

4. If there is indigenous tree on-farm, how many are they?

Species planted per year	**No. Planted**	**No. Surviving**
Species retained per year	**No. retained**	**No. survived**

Section C: Approaches for conserving indigenous trees on-farm

1. Are there approaches used in conservation of indigenous trees on your farm?

2. If yes, list them

Indigenous tree	Site	Conservation approach

3 .How often do you get technical advice on tree planting on your farm?

(a) Fair …….. (b) High……. (c) Very high…… (d) Not at all…….

4. In which aspects do you require the technical advice on trees growing?

(a) Planting…… (b) Seed collection……..…(c) Tending……..… (d) Harvesting ……

(e) Others……

5. Where on your land do you think indigenous trees can perform best?

(a) Among crops……. (b) Compound……. (c) Terraces…… (d) Others……..

Section D: Benefits of conserving indigenous trees on-farm

1. Are there some consumptive benefits got from conservation of indigenous trees on-farms?

(a)Yes …….. (b) No ……

2. If yes, which products do you expect to get from your trees on-farms?

(a)Firewood……..(c) Stakes…….. (e)Poles……. (g) Others…….

(b) Timber…… (d) Fruits……. (f) Medicine…….

3. What consumptive benefit(s) have you got from on-farm indigenous trees so far?

Species	Consumptive benefit

4. Are there some ecological benefits got from conservation of indigenous trees on-farms?

(1) Yes …….. (2) No ……

5. If yes, what are the ecological benefits from your indigenous trees on-farms?

(a)Wind break…… (b)Ecological beauty……..(c) Enhancing soil fertility…….

(d) Provision of shades …… (e) Soil erosion control …….

6. What ecological benefit(s) have you got from on-farm indigenous trees so far?

Species	**Ecological benefit**

7. Are there some management benefits got from conservation of indigenous trees on-farm?

(a)Yes …….. (b) No ……

8. If yes, which benefits do you expect to get from your trees on-farm?

(a) Easy management costs…….. (b) High disease resistance ….. (c) Fast growing …….

9. What management benefit(s) have you got from on-farm indigenous trees so far?

Species	**management benefit**

SECTION E: Challenges related to conservation of indigenous trees on-farm and measures

1. Are there challenge(s) related to conservation of indigenous trees on-farms?

(a) Yes …… (b) No ……

2. Indicate the affected indigenous species and the challenge(s) related to conserving it on-farms

Indigenous tree	**Challenges related to conservation**

3. Are there measure(s) you employ to reduce the challenges related to conservation of indigenous trees on-farms? (a) Yes …… (b) No ……

4. If Yes, list them

Challenges related to conservation	**Measures used**

7. In your opinion what do you think can be done to enhance conservation of indigenous trees within your farms?

……

……

Thank you so much for your time

Appendix 2: AN OBSERVATION RECORD SHEET

The checklist given below guided the process of observation to provide evidence for on-farm conservation of indigenous trees.

Date……...…village……

1. Indigenous trees available on-farms

Indigenous tree species	Site where trees are planted/retained

2. Approaches used in conservation of indigenous trees on-farms

Approach	Indigenous trees

3. Benefits of conserving indigenous trees on-farms

Indigenous trees	Consumptive benefit	Ecological benefit	Management benefit

4. Challenges related to and measures in conservation of indigenous trees on-farms

Challenges related	Measures