ASSESSING THE OPPORTUNITIES AND CONSTRAINTS OF ADOPTING AGRO-FORESTRY PRACTICES BY SMALLHOLDER FARMERS IN LUWERO DISTRICT, CENTRAL UGANDA

BY

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2021-08-05500

A RESEARCH DISSERTATION SUBMITTED TO THE SCHOOL OF NATURAL AND APPLIED SCIENCES (SONAS)IN PARTIAL FULFILMENT OF THE REQUIREMENTS FORTHEAWARD OF MASTER'S DEGREE OF ENVIRONMENTAL MANAGEMENT OF KAMPALA INTERNATIONAL UNIVERSITY

AUGUST, 2023

DECLARATION

I Ali Hashi Ahmed, declare that the research entitled "Assessing the opportunities and constraints of adopting agro-forestry practices by smallholder farmers in Luwero district, central Uganda" is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

Signature: ..... **Date:** 7/8/2023

APPROVAL

I confirm that the study research on the topic "Assessing the opportunities and constraints of adopting agro-forestry practices by smallholder farmers in Luwero district, central Uganda" has been done under my supervision and was submitted to KIU with the approval of the university Supervisor/s

Signature: ..... **Date:** 7/8/2023

DR. BARASA BERNARD

Supervisor

DEDICATION

This research is dedicated to my beloved parents my sistersand my brotherswho have contributed immeasurably to my studies.

ACKNOWLEDGEMENTS

The success in producing this work is attributed to such a number of people, to whom I wish to acknowledge my thanks. The completion of this piece of work has been such a task that would not have been a success when handled solely.

I first of all thank the Almighty Allah, who gave me abundant health, strength, and courage to be able to complete this work. My sincere gratitude goes to my supervisorsDr Barasa Bernard (PhD)and Mr Oluwole Akiyode whose commitment, patience and guidance, gave form to this piece of work. By the same token, I wish to thank the lecturers and all staff in the Departments of my study.

Finally, special thanks go to my family and relatives for their tolerance, patience and sacrifice throughout my struggle for this academic achievement. They have never lost hope in me.

I further take recognition of my friends, for their encouragement and support in my academic endeavours.

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ABSTRACT

The study assessed the opportunities and constraints of adopting agro-forestry practices by smallholder farmers in Luwero district, central Uganda. It characterizes the agro-forestry practices undertaken by smallholder farmers in Luwero. It examines the determinants for the adoption of agro-forestry by smallholder farmers. It also ascertains the opportunities for adopting agro-forestry practices by smallholder farmers and establishes the constraints to adopting agro-forestry practices. Data was collected from 304 respondents providing information from administered questionnaires and interviews with 10 respondents. The study discovered that agro-forestry in Luwerois characterized by the presence of home-based agriculture schemes and field agricultural programsthat are expected to enable food security. It found that agro-forestry is determined naturally by the presence of good rainfall and climatic conditions, education of the community and family size, government policy supporting adoption of agro-forestry and presence of institutions such as NEMA in the regulations.The study found that agro-forestry provides economic opportunities through employment and income, rainfall, provide a sense of environmental sustainability, supporting environmental security, provision of food and animals as food for the people in the small holder farms.The study also identifiesthat agro-forestry is constrained bythe ineffective implementation of policy, poor policy management, lack of effective control for agriculture, drought constraint the agro-forestry, presence of disastrous winds, lack of water for irrigation and high costs of the agro-forestry schemes.Hence, it concludes that agro-forestry practices are common amongst the small holder farmers in the Luwero district, though the farmers are not conversant with the programme (crops and trees are cultivated on the same piece of land). Secondly, it affirms that agro-forestry by small holder farmers in the Luwero district is supported by the presence of rainfall and good climatic conditions, supportive government policy and institutions which agitate for theschemes in the district. Thirdly, it surmises that agro-forestry in the Luwero district provides positive economic, environmental and food security mechanisms for the people. It also concludes that agro-forestry is constrained bythe lack of adequate policy essential to significantlysupports the schemes, low access to irrigation.The study recommends theadoption of agro-forestry-based climate change adaptation technologies among smallholder farmers in the Luwero district. There is a need for improvement and increasing governmental and institutional support systems that will enable farmers in the watershed to have equitable assess to interventions that promote the practising of agro-forestry. Also, farmers' access to markets needs to be improved with the creation of value chains for agro-forestry products.There is a need for developing strategies, frameworks and indicators at alllevels to continuously measure progress in agro-forestry systems and their climate benefits.

CHAPTER ONE

INTRODUCTION

1.0 Introduction

This chapter presents and describes the background of the study, the problem to be addressed in the research, the purpose and objectives of this study, the research questions, the scope and significance of the study.

1.1 Background of the study

The background of the study is presented from four perspectives namely historical, theoretical, conceptual and contextual perspectives.

1.1.1 Historical Perspective

The association of trees, crops and animals in a farming system is an ancient practice throughout the world, probably dating back to 7000 B.C., in the form of shifting cultivation (World Agro-forestry Centre,2006). Agro-forestry has been defined as a dynamic, ecologically based, natural resource management system that, through the integration\ of trees on farms and in the agricultural landscape, diversifies and sustains production for increased social, economic and environmental benefits for land users at all levels (World Agro-forestry Centre, 2006)

Agro-forestry and conservation agriculture have emerged as sustainable land management practices addressing land degradation and loss of soil fertility (FAO/REOSA, 2010). It is regarded as an effective, low-cost means of minimizing the degradation of cultivated land and of maintaining or even increasing the productive capacity of agricultural ecosystems. By World Bank estimates, over 1.2 billion people derive their livelihoods from agro-forestry systems. Owing to its capacity to enhance multiple functions in agriculture, agro-forestry will become increasingly important in land-use practices around the world (World Agro-forestry Centre, 2008). If properly conceived and practised, agro-forestry can contribute to the sustained productivity of the natural resource base by enhancing soil fertility, controlling erosion, enhancing the microclimate of cropping and grazing lands and general improvement of the environment (Dulay, 2015). The importance of agro-forestry in Africa can, therefore, not be under-stated. As one kind of land use practice, traditional agro-forestry systems already have a

long history of hundreds of years in practice and still play a significant role in the world today, especially in tropical and subtropical areas.

In this era of globalization andfood insecurity, more and more governments andnon-governmental organizations are payingattention to traditional agro-forestry systemsbecause of their economic, ecological and socio-culturebenefits. These benefits are also inaccord with the characteristics of GloballyImportant Agricultural Heritage Systems (GIAHS) (Weiwei, Wenhua, Moucheng and Fuller, 2014).

Since 1988, Agro-forestry research in Ugandahas focused on identifying tree species that couldbe incorporated on agricultural land withoutsignificantly interfering with food crops. SeveralAgro-forestry practices were been introduced andpromoted in the country, mainly by theInternational Center for Research in Agro-forestry(ICRAF) and the Uganda Forestry ResourcesResearch Institute (FORRI) in collaboration witha number of non-governmental Organizations(NGOs). Practices for soil fertility improvementand production of fuel wood, timber, fodder, fruits andother products were being tested on bothresearch stations and farmers' fields in severaldistricts in the country. Many of the Agro-forestryactivities were been targeted in areas with verysevere land degradation, including the southernand eastern highlands, the Lake VictoriaCrescent, Southwestern rangelands and theeastern lowlands (Kakuru, Okia and Okorio, 2005).

1.12 Theoretical Perspective

The study adopted a diffusion of innovation theory by Rogers (1995). There are different types of models that have been used to explain adoption decisions of new technologies. However, no single model can embrace and explain all aspects of adoption and the traditional attitude of smallholder farmers towards technologies. According to Rogers (2003), adoption occurs when one has decided to make full use of the new technology as the best course of action for addressing a need. Adoption is determined by several factors including socioeconomic, environmental, and mental processes that are governed by a set of intervening variables such as individual needs, knowledge about the technology and individual perceptions about methods used to achieve those needs (Thangata & Alavalapati, 2003).This model assumes that the heart of the diffusion process lies in the modelling and imitation by potential adopters of their neighbours

with the new practice (Rogers, 2003), and that the tendency to adopt new practices relies on the relative innovativeness and; the personal attributes of farmers, with some farmers adopting innovations more quickly than others. There is an assumption in this model that research generates information that is inherently valuable, desirable and suitable for increasing farm production and productivity (Jangu, 1997). In this study, it is also assumed that agro-forestry technologies are feasible, efficient and suitable for increasing productivity in Eastern Zambia and that it is the best option for use by resource-poor smallholder farmers. Therefore this study adapts Rogers' model but also looks at other studies conducted on agro-forestry in the Luwero district and elsewhere to gain insights on levels of adoption and influencing factors.

1.1.3 Conceptual Perspective

Agro-forestry is a long-established farming practice in many parts of the world. Broadly defined, agro-forestry refers to a land-use system in which trees are grown simultaneously, sequentially, or in conjunction with annual crops or livestock. The trees are cultivated primarily for agricultural uses, for example, to protect or enrich top soils for the benefit of crops or to provide browse and fodder for livestock (Otsuki, 2010).

Although the term "agro-forestry" has been in use since the late l970s, experts still debate over a concise definition of the concept. For example, at least 11 definitions were discussed at the l979 International Cooperation in Agro-forestry Conference sponsored by the International Council for Research in Agro-forestry (ICRAF). The most cited definition of agro-forestry is by ICRAF, which refers to agro-forestry as a collective name for land use systems and technologies where woody perennials such as trees, shrubs, palms, and bamboos are deliberately used on the same land management unit as agricultural crops or animals either in some form of spatial arrangement or temporal sequence (ICRAF,1997).

However, one of the most comprehensive definitions of agro-forestry refers to it as a dynamic, ecologically based, natural resource management system, which involves the integration of trees on farms and in the agricultural landscape that seeks to diversify and sustain production for increased social, economic and environmental benefits for land users at all levels (Nair, 1993). This is a definition that considers agro-forestry as justified for being beneficial to the environment, household income, productivity, and sustained development of the community.

The common element in the various definitions that have been used is that in each type of land use, naturally occurring or cultivated tree species constitute part of a mixed farming system. For the purpose of this study, agro-forestry practices refer to activities intended primarily to encourage farmers to grow trees using species and techniques that can sustain or contribute to their crop or livestock production, and, in most cases, can also provide additional subsistence or cash crop. This is a practice that would be much beneficial in the African context where we have harsh environmental conditions, low technologies of agricultural production, a fragmented land tenure system, and chronic food and nutrition insecurity.

1.1.4 Contextual Perspective

Tumwebaze and Byakagaba also argue that agro-forestry is able to enhance food security and augment household income (Tumwebaze and Byakagaba, 2015). This is mostly because agro-forestry provides diversification of income. Trees are an important source of food and can play a critical role in communities that suffer from food insecurity and malnutrition. They provide nutrition directly through the supply of nuts and fruits, but they can also assist in putting food on the table in several different ways. Indirect support comes in various forms including; fuel wood, timber, pesticides, and fodder (FAO, 2016). The bark and leaves of some trees can be used for medicinal purposes, e.g., in laboratory tests need extracts have shown potential both as a treatment for malaria and can also be used to kill mosquito larvae. Trees also provide timber that can be used as building material or for crafts. Indeed, agro-forestry trees can produce a wide range of other products that include oils, resins, tannins, pigments, latex, mushrooms, fibres, wax, and honey, and for this reason, they have the capacity to diversify income at different times of the year and in the long term (UNHCR; IUCN, 2016). Income generated from these activities can make a significant contribution for households that are food insecure because of low employment opportunities.

The agro-forestry project has been operating in Uganda since 1992 with the initial aim of halting desertification and soil erosion through tree planting. The Lake Victoria watershed region and the southwestern districts of Uganda were its first target areas. These areas were prone to erosion and occasional flooding and were also poor after the HIV/AIDS disease outbreak which left most households vulnerable to different shocks. By 2015, VI Agro-forestry was working with over 18000 households who were involved in one or more of the project activities. Project activities

included training on the effects of climate change, efficient use of energy, diversification of income, and erosion control among other things (VI Agro-forestry 2013-2015). These activities were expected to increase farmers' knowledge, diversify their income and reduce their vulnerability. Despite these interventions, there has been no evaluation of the extent to which these activities have achieved their intended objective.

Despite the large number of households involved in the project activities, little documentation is available on the impact of agro-forestry activities on the target communities. Most of the available documentation is annual publications from the organization featuring a few individual household case studies of agro-forestry impacts. However, with a large household involvement such as this, more studies are required to assess the contribution of agro-forestry to reducing the vulnerability of these farmers based on larger sample size. Using a large sample size for evaluating impacts captures more details than when based on a small sample size. Moreover, comparing results with a control group gives a better picture of the impacts of the agro-forestry implementation on farmer households. Often, internal evaluations tend to be biased and are usually deemed successful because negative results can cause projects to lose funding.

1.2 Statement of the Problem

Uganda is committed to implementing the Rio Declaration, Agenda 21 and its outcomes, including the Rio-environmental conventions which intend to ensure environment protection and management. Several schemes are in place to ensure the effective implementation of the Rio declaration agro forestry inclusive. Agro-forestry is both a scheme for environment preservation and a provision of food to the people which the current environmentalists and food agitators have employed in the bid to increase both the environment and providing mechanisms for food security (Kakuru, Turyahabwe and Mugisha, 2017).Despite the fact that agro forestry is capable of providing substantial net economic and ecological benefits to households and communities in Ugandan,there seems to be a low rate of adoption of agro-forestry. Despite the relevance and value of agro-forestry, its inculcation and implementation remain generally lowin Uganda and Luwero in particular (Nabunya, 2017). The policies and mechanisms towards agro-forestry remain low in Uganda with districts such as Luwero only attempting to implement the same but in struggles.This notwithstanding, agro-forestry, if integrated well at the household level, has the potential to provide economic, social and environmental benefits that are capable of addressing

household income, fuel, food supply and environment related challenges. Its incumbent to this that a study on assessing the opportunities and constraints of adopting agro-forestry practices by smallholder farmers in Luwero district, central Uganda.

1.3 Purpose of the study

To assess the opportunities and constraints of adopting agro-forestry practices by smallholder farmers in Luwero district, central Uganda.

1.4 Specific Objectives

1) To characterize the agro-forestry practices undertaken by smallholder farmers in Luwero.
2) To document the determining factors for the adoption of agro-forestry by smallholder farmers in Luwero district.
3) To ascertain the opportunities of adopting agro-forestry practices by smallholder farmers in Luwero district, central Uganda.
4) To establish the limitations to adopting agro-forestry practices by smallholder farmers in Luwero district, central Uganda.

1.5 Research Questions

1) What are the characteristics of agro-forestry practices undertaken by smallholder farmers in Luwero
2) What are the drivers for the adoption of agro forestry by smallholder farmers in Luwero district, central Uganda?
3) What are the opportunities foradopting agro-forestry practices by smallholder farmers in Luwero district, central Uganda?
4) What are the limitations to adopting agro-forestry practices by smallholder farmers in Luwero district, central Uganda?

1.6 Scope of Study

1.6.1 Scope of the study

The study was conducted in Luwero District, a district in the Central Region of Uganda. Luweero District is bordered by Nakasongola District to the north, Kayunga District to the east, Mukono District to the southeast, Wakiso District to the south, and Nakaseke District to the west.

The district headquarters at Luweero is approximately 75 kilometres (47 mi), by road, north of Kampala, Uganda's capital and largest city.

1.6.2 Subject Scope

The study was on characteristics of agro-forestry practices undertaken by smallholder farmers. Determining factors for the adoption of agro forestry, and the opportunities and constraints of adopting agro-forestry practices by smallholder farmers in Luwero district, central Uganda.

1.6.3 Time Scope

Data collection in this study was takenover a period of 5 months from February to August 2022

1.7 Significance of the study

This study had double-edged dimensions namely intellectual and applied for research work. In the intellectual sense, the outcome of the study is significant in the ongoing debate on the determinants of food shortage (Wang, 2017). and poverty in rural households as well as environmental degradation in developing countries.

The general assumption by rural development proponents has been that once a project or new idea has been communicated and implemented to a potential beneficiary group, it will be adopted, internalized and implemented by another group. However, the study sought to provide an opposing view from empirical evidence to show that this may not necessarily be the case.

This is an important policy-related question because the reasons underlying the introduction of agro-forestry practices and any future interventions may not be successful without such information. In its applied dimension, the study contributes towards enhancing the rate of adoption of new agro-forestry ideas in the study area. The researcher will specifically delve into explaining what farmers want and what will lead them to adopt new technologies.Similarly, from local people's point of view, the people venture to devote their land to agro forestry and have a chance to rip the benefits accruing from the project.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

In this chapter, the researcher critically analyzes the works of other people related to the variables under study. The theoretical review constitutes the theory underlying the relationship between the two variables, conceptual framework, related literature and related studies.

2.1 Theoretical Review

The study adopted a diffusion of innovation theory by Rogers (1995). There are different types of models that have been used to explain adoption decisions of new technologies. However, no single model can embrace and explain all aspects of adoption and the traditional attitude of smallholder farmers towards technologies (Thangata & Alavalapati, 2003). Rogers (1995) developed the adoption and diffusion of innovations theory, which has been widely used to identify factors that influence decisions to adopt or reject an innovation. He defines an innovation as a "new idea, practice or object that is perceived as new by an individual or other unit of adoption" and said that the perceived newness of the idea for the individual is what determines their reaction to it (Rogers, 1995).

According to Rogers (2003), adoption occurs when one has decided to make full use of the new technology as the best course of action for addressing a need. Adoption is determined by several factors including socioeconomic, environmental, and mental processes that are governed by a set of intervening variables such as individual needs, knowledge about the technology and individual perceptions about methods used to achieve those needs (Thangata & Alavalapati, 2003).The adoption and diffusion model identifies five aspects that influence adoption: perceived attributes of the innovation; type of innovation decision; communication channel; nature of the social system; and the extent of change agent promotion efforts (Rogers, 2003). Some of Rogers' generalizations as significant variables that affect adoption, which has also been used in other adoption studies, include educational level, farm size and income.

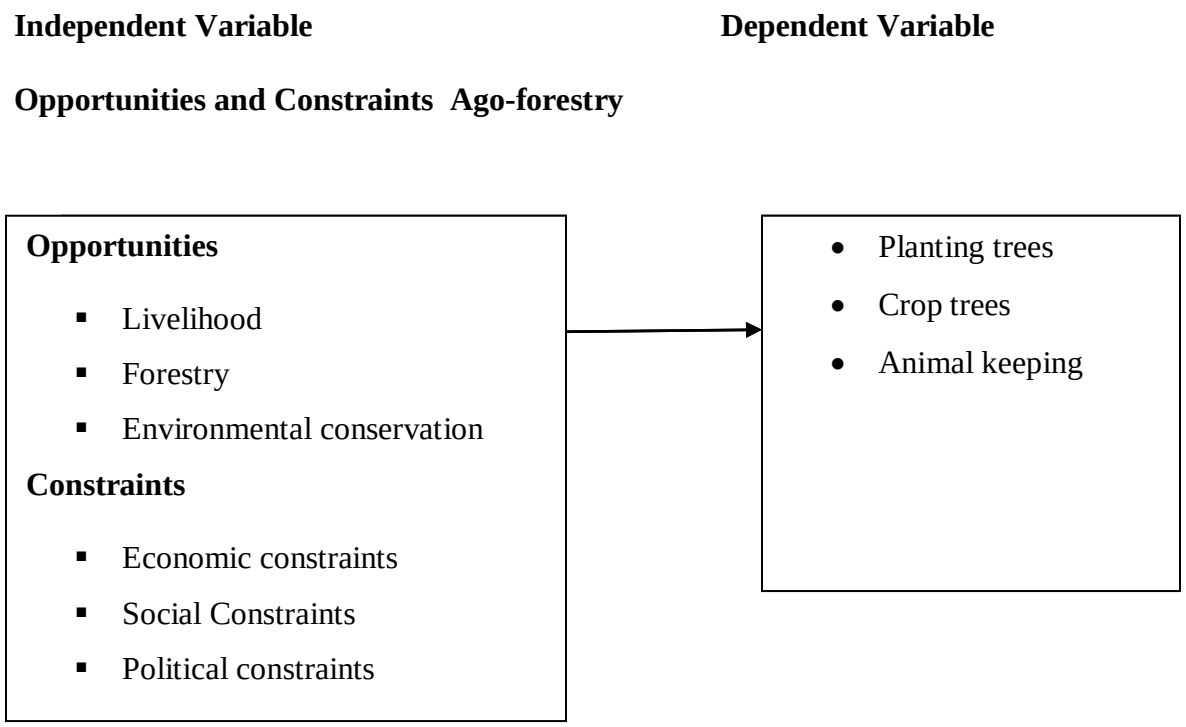
The adoption-diffusion of innovations model is a useful model for understanding farmers' decision-making processes when they consider taking up and eventually adopting new

technologies. Adoption is reached after an innovation-decision process that occurs in a five-step time-ordered sequence namely: knowledge; persuasion; decision; implementation; and confirmation (Rogers, 2003). This model assumes that the heart of the diffusion process lies in the modelling and imitation by potential adopters of their neighbours with the new practice (Rogers, 2003), and that the tendency to adopt new practices relies on the relative innovativeness and; the personal attributes of farmers, with some farmers adopting innovations more quickly than others. There is an assumption in this model that research generates information that is inherently valuable, desirable and suitable for increasing farm production and productivity (Jangu, 1997). In this study, it is also assumed that agro-forestry technologies are feasible, efficient and suitable for increasing productivity in Eastern Zambia and that it is the best option for use by resource-poor smallholder farmers.

Rogers (2003) has categorized adopters into five including innovators, early adopters, early majority, late majority and laggards. This kind of classification is a problem to use in a situation where adoption has not reached 100 percent use (Rogers, 2003) as it does not include those that cannot be grouped within the five groups, the discontinuance and non-adopters. Therefore this study adapts Rogers' model but also looks at other studies conducted on agro-forestry in the Luwero district and elsewhere to gain insights into levels of adoption and influencing factors.

2.2 Conceptual Framework

Figure 2.1: Showing Conceptual Framework



The framework shows the connection between the opportunities and constraints of adopting agro-forestry practices by smallholder farmers in the Luwero district, central Uganda. The variable measures are opportunities and constraints against agro-forestry. The aspect of opportunities is measured through livelihoods, forestry and environmental conservation. Constraints are economic constraints, Social Constraints and political constraints. The agro-forestry was measured as planting trees, Crop trees and animal conservation.

2.3 Characteristics of agro-forestry practices undertaken by smallholder farmers

Agro-forestry is a long-established farming practice in many parts of the world. Broadly defined, agro-forestry refers to a land-use system in which trees are grown simultaneously, sequentially, or in conjunction with annual crops or livestock. The trees are cultivated primarily for agricultural uses, for example, to protect or enrich top soils for the benefit of crops or to provide browse and fodder for livestock (Otsuki, 2010).

Although the term agro-forestry has been in use since the late l970s, experts still debate over a concise definition of the concept. For example, at least 11 definitions were discussed at the l979 International Cooperation in Agro-forestry Conference sponsored by the International Council for Research in Agro-forestry (ICRAF). The most cited definition of agro-forestry is by ICRAF, which refers to agro-forestry as a collective name for land use systems and technologies where woody perennials such as trees, shrubs, palms, and bamboos are deliberately used on the same land management unit as agricultural crops or animals either in some form of spatial arrangement or temporal sequence (ICRAF,1997).

The common element in the various definitions that have been used is that in each type of land use, naturally occurring or cultivated tree species constitute part of a mixed farming system. For the purpose of this study, agro-forestry practices refer to activities intended primarily to encourage farmers to grow trees using species and techniques that can sustain or contribute to their crop or livestock production, and, in most cases, can also provide additional subsistence or cash crop. This is a practice that would be much beneficial in the African context where we have harsh environmental conditions, low technologies of agricultural production, a fragmented land tenure system, and chronic food and nutrition insecurity.

Agrisilvicultural Systems, In this system, agricultural crops are intercropped with tree crops in the interspace between the trees. Under this system agricultural crops can be grown for upto two years under protective irrigated conditions and under rainfed farming for upto four years. The crops can be grown profitably upto the above said period beyond which it is uneconomical to grow grain crops. However fodder crops, shade loving crops and shallow rooted crops can be grown economically. Wider spacing is adopted without sacrificing tree population for easy cultural operation and to get more sunlight to the intercrop. The performance of the tree crops is better in this system when compared to monoculture.

Silvopastoral Systems: The production of woody plants combined with pasture is referred to Silvipasture system. The trees and shrubs may be used primarily to produce fodder for livestock or they may be grown for timber, fuelwood, fruit or to improve the soil. The occurrence is provided as a protein bank, Livefence of fooder trees and hedges and trees and shrubs on pastures.

Home gardens**:** This system is found extensively in high-rainfall areas in tropical South and South east Asia. This practice finds expression in the states of Kerala and Tamil Nadu with humid tropical climates where coconut is the main crop. Many species of trees, bushes, vegetables and other herbaceous plants are grown in dense and random or spatial and temporal arrangements. Most home gardens also support a variety of animals. Fodder grass and legumes are also grown to meet the fodder requirement of cattle. In India, every homestead has around 0.2 to 0.5 ha of land for personal production. Home gardens represent land use systems involving deliberate management of multipurpose trees and shrubs in intimate association with annual and perennial agricultural crops and livestock within the compounds of individual houses. The whole tree- crop- animal units are being intensively managed by family labour. Home gardens can also be called as Multitier system or Multitier cropping**.**Home gardens are highly productive, sustainable and very practicable. Food production is a primary function of most home gardens.

Structure of Home Gardens:Home gardens are characterized by high species diversity and usually 3-4 vertical canopy strata. The layered configuration and compatible species admixture are the most conspicuous characteristics of all home gardens. Generally, all home gardens consist of a herbaceous layer near the ground, a tree layer at the upper levels and an intermediate layer. The lower layer can be partitioned into two, the lowermost being at less than 1.0m in height, dominated by different vegetables and the second layer of 1.0 -3.0/m height comprising food crops such as banana, papaya and so on. The upper tree layer can also be divided into two, consisting of emergent, full-grown timber and fruit trees occupying the upper most layer of 25m height and medium size trees of 10-20m occupying the next lower layer. The intermediate layer of 5-10m in height is dominated by various fruit trees.

Choice of species this is characteristics, Woody species: Anacardium occidentale,Artocarpus heterophyllus, Citrus spp, Psidium guajava, Mangifera indica, Azadirachta indica, Cocus Nucifera,Herbaceous species: Bhendi, Onion, cabbage, Pumpkin, Sweet potato, Banana, Beans, etc. Woody Hedgerows: In this system, various woody hedges, especially fast-growing and coppicing fodder shrubs and trees are planted for the purpose of browse, mulch, green manure, soil conservation etc. The following species viz., Erythrina sp, Leucaena luecocephala, Sesbania grandiflora are generally used.

2.4 Determinants for the adoption of agro forestry by smallholder farmers

According to Rogers (2003), adoption occurs when there is a need to address a problem. When there is a problem, one decides to make full use of the new technology as the best course of action for addressing the problem. There is anarray of factors that influence the adoption of agricultural innovations such as agro-forestry by smallholder farmers who are at the mercy of climate change impact. The factors take the form of bio-physical, socio-cultural, government and institutional and economic in nature. These factors are governed by a set of intervening variables such as individual needs, knowledge about the technology and individual perceptions about methods used to achieve those needs (ThangataandAlavalapati, 2013).

Biophysical Factors: The major biophysical factors influencing the adoption of agro-forestry technologies include the nature of the soil, the source of farming water and topography (Bannister and Nair, 2003). In most watersheds, soil degradation is influenced by topography coupled with anthropogenic activities. Agro-forestry is a possible option to sustainably redress the degrading socio-environmental situation. This influences people's decisions in adopting agro-forestry technologies. In another vein, the availability of water resources for farming influences farmers‟ decisionstothe adoption of agro-forestry technologies. A study in Machakos county of Kenya found that farmers do not adopt agro-forestry technologies due to the high water demand in production, especially at the nursery (Bannister and Nair, 2013).

Socio-cultural factors: Results from empirical studies on agricultural technology adoption suggest that socio-cultural factors such as gender, farmers‟ age, level of education, and family size influence the adoption rate of new agricultural technologies among farmers (Ayinde*et al*., 2010;Idrisa*et al*., 2012). For example, Ayinde*et al*. (2010) in their study found that gender, education level of a farmer, farming experience, access to extension agents and access to credit have a significant and positive influence on adoption.

Government and Institutional Factors: The success of agro-forestry development for the past three decades can be attributed to support from various governments and non-governmental institutions. Chitakira andTorquebiau (2010) identified research, extension and, technical and material support as major benefits farmers receive from external organisations. Also, extension interventions play a significant role in the adoption of agro-forestry technologies. Through

extension, farmers are trained and provided information including climate change adaptation strategies. Farmers who benefited from various extension interventions in form of on-farm experimentation of agro-forestry technologies were more likely to adopt than those who did not benefit. Adoption of agricultural technologies by farmers is largely influenced by sensitisation, mentoring and demonstration by extension agents (Lawal andOluloye, 2018).

Economic Factors: Off-farm income and the value of household assets are some of the major economic factors that influence the adoption of agricultural technologies. The ability or inability to afford pesticides, fencing material, seeds and other inputs required for implementing new agro-forestry technologies is dependent on household income. With low incomes, many households would not be able to acquire the inputs required for substantial crop production, let alone for managing agro-forestry projects (Chitakiraand Torquebiau, 2010).

Education, age, income, social status, land ownership, caste, etc., represent thesocio-economic factors. It is expected that younger farmers are more likely to adoptnew technologies and/or are more likely to be early adopters (Bannister & Nair, 2013).Therefore, age is expected to be negatively associated with technology adoption.Furthermore, the farmers with higher income and social status are more likely to adoptagro-forestry than those with low income and social status. It is also expected that thefarmers with sources of off-farm income in addition to their farm income are less riskaverse and the farmers without sources of off-farm income tended to be more riskaverse. Molin, Chazdon, Frosini and Brancalion, 2018 contend that risk aversion is expected to be associated positively with an increase in age andnegatively with higher levels of education. It is recognized that change agents work withhigher-status households who tend to be opinion leaders, therefore, socio-economicstatus is expected to be positively associated with adoption. The socio-economic status index for farmers was constructed on thebasis of their educational level, caste, occupation, asset position, type of house owned,material possession and social participation.

The communication factors are represented by the farmer's awareness ofagro-forestry practices and are therefore expected to be positively associated with the adoption of agro forestry. An awareness index developed by Anon (2012). with slight modifications was constructed to

determine the extent of knowledge aboutagro-forestry practices.Psychological factors include farmers' attitudes towards agro-forestry. Attitudehas been defined as the degree of a farmer's positive or negative feelings towards aninnovation. It is assumed that the attitude largely depends on the household's values,beliefs and situations. The attitude towards agro-forestry was measured by developinga scale for each household. A higher positive attitude towards tree planting isexpected to have a positive relationship with the adoption of farm forestry. An indexdeveloped by Lawal & Oluyole (2018) with small modifications was used to measure the attitudeof farmers towards agro-forestry systems.

The adoption of agro-forestry systems by farmers will depend on a variety of socioeconomicfactors. Agro-forestry systems are labour-intensive and require careful management.They will be more attractive to farmers as a soil fertility management tool wheremanufactured fertilizers are unavailable or too costly, or where the soils have becomedegraded through continuous monocropping. However, for optimum production inagro-forestry systems, it will be necessary to provide small amounts of fertilizer to overcomesevere nutrient deficiencies, such as phosphorus deficiency (Hsieh, Jan and Zhang, 2016).

2.3 Opportunities of adopting agro-forestry practices by smallholder farmers

With the majorityof the world’s poor living and working in developing countries, investment in agro-forestry will only make sense if it addresses the challenges of specific farming contexts. Even though agro-forestry is beneficialto stakeholdersins ever always, it has received mixed reactions from farming communities in developing countries. Accordingly,the adoption of new technologies has not been as fast as desired (Mwase, 2015). In Ugandaagro forestry is spear headed by the women and youth because they comprise a critical labour force on the farm. In the Mt. Elgon region, interesting agro forestry technologies is low and yet prevailing soil and water management challenges require a robust mechanism to address them

The importance of agro forestry cannot be over-emphasised, as it has several advantages in the provision of food and other basic needs (i.e. fuel wood, staking materials, fibres, timber, medicinal concentrates, oils, fruits, and fodder for animals) for a large proportion of the rural population as well as its role in soil fertility restoration and the control of weeds in addition to amelioration of environmental degradation. Agro-forestry practices are being increasingly

advocated as possible remedies and had been claimed, to have the potential of improving agricultural land use systems, providing lasting benefits and alleviating adverse environmental effects at the local and global level. Amadi, 1Idiege and Sobola (2013) agreed that agro-forestry can provide new and useful solutions to many of the adverse consequences of human land use, including increased diversification of agricultural production system, increased yield of crops and livestock, reduction of non-point source pollution and increased rural development by contributing to an ecosystem-based management system that guarantees sustainability and environmental quality. Agro-forestry should therefore be seen as a system that addresses the declining quality of the environment, including the soil, while also increasing the variety of produce by the farmer. This will not only increase the farmers' income but also help ensure food security and balance. The retention of trees in farming systems has been recognized to increase crop output in the semi-arid region of Adamawa state. Ajake (2012) also recognized the function of forest trees in terms of income generation, good medicare, employment generation, raw materials, and provision of food among others. Agro forestry is increasingly promoted for restoring forests, and degraded environment, reducing greenhouse gases, and gaining other co-benefits.

Biodiversity conservation, environmental (watershed) Protection, and Climate change mitigation and adaptation. It was therefore viewed as being useful in promoting afforestation /reforestation and in the unfurling mechanism for forestry development: “Reduction of Emissions from Deforestation and forest Degradation (REDD)” has also been recognized, as well as, meeting (inter)national climate change objectives. Agro-forestry is also known for, its role in traditional employment generation, thus it has the capability to deliver several benefits (e.g. income generation for poor farmers, environmental and ecosystem stabilization including control of desertification and deforestation (Jacob, Ufot and Sotande, 2013).

The contribution of agro-forestry to environmental sustainability is very significant through its environmental, economic and social functions. Not creating a negative impact on the environment, while improving the production capacity of the soil. It is known for its ability to conserve natural resources at the same time as maintaining human activities. The ever-increasing world population has made the traditional system of African farming unsustainable. There is an

upsurge in demand for food, leading to more pressure on forestlands and forest products have contributed greatly to the unsustainable use of the nation's natural resources. In view of these, agro-forestry as a technique is considered one of the sustainable management systems for land that increases production, ecological stability and supports sustainable environmental development (Owolabi, 2017). Apart from providing wood, food and/or animal products, the integration of trees in the farming system could go a long way to help ameliorate environmental problems: specifically by creating microclimates favourable for crop growth, and enhancing the recycling of minerals to provide a more complete ground cover which could help to protect the soil from erosion and moderate extreme temperatures (Adedire, 2004). Evans (1992) also stated that the contribution of agro-forestry to sustainable development is very significant through its economical, environmental, and social functions. They further maintained that agro-forestry has been proved to meet the criteria of sustainable development that has no negative impact on the environment.

Climate change is a global phenomenon that imposes economic, social, and ecological challenges on the global community. Research has shown that climate change is attributed to human activities, which bring about CO2 emissions, through the removal of forest cover (Owolabi, 2010). Deforestation, human-induced conversion of forests to non-forestland uses, is typically associated with large immediate reductions in forest carbon stock through land clearance. Poor forest management policies and illegal encroachment into forest reserves, urban development, road construction, fossil fuel combustion and excessive harvesting of fuel wood, contribute to the depletion of the ozone layer. The food and Agricultural Organisation of the United Nation FAO (2010), observed that deforestation account for approximately 18% of global carbon emissions. It was further reported by FAO (2001) that reduced deforestation, forest regeneration, increased plantations development and agro-forestry account for 12 to 15% of global sequestration of carbon emission from fossil fuels. Agro-forestry has a high potential to reduce the atmospheric concentration of carbon dioxide (CO2) and mitigate climate change. It is an established fact that planting more trees, increasing the amount of forested land or increasing the density of the existing forest in Nigeria would help mitigate climate change impacts in the country and at a global level. Franzluebbers, Paustian, and Schoeneberger (2018) also supported the fact that rising levels of atmospheric carbon dioxide and associated global warming can only

be addressed by adopting CO2 reduction strategies. Agro-forestry, as a system that combines trees and/or shrubs (perennial) with agronomic crops (annual or perennial), offers great promise to sequester Carbon, both above and below-ground. Agro-forestry systems even though not primarily designed for carbon sequestration have been reported to present a unique opportunity to increase carbon stock in terrestrial biosphere.

Nuga and Iheanacho (2017) recognized soil erosion as another long-time serious environmental problem that has adverse effect on the economy of Nigeria. This has several environmental and economic impacts, especially in West Africa where the resilience ability of soil is limited. Hence an agro-forestry practice through the incorporation of woody perennial has the potentials of mitigating the impact of soil erosion, through the incorporation of both the above and below tree biomass. The system of agro-forestry is properly enhanced and place in the right perspectives by all environmental stakeholders, this will help in addressing some issues of economic instability in the country. Trees in agro-forestry system are known to provide fuel wood, food, shelter, drugs, income, raw materials and improvement of soil fertility for crop growth. As well as wide range o f environmental protection, the products and services forest product provides are essential to every aspect of life. Basu (2014)conducted a survey on the economics of some forest fruit trees and found out that harvesting, processing and marketing of products from economic forest trees plays an important role in food security, employment and income generation

The ultimate aim of agro-forestry is to improve and sustain the livelihood of poor marginal and small farmers in era of climate change. Integration of trees with agricultural crops has the potential to improve local economy through stable income, diversification of land use and rural skills, improved food, fuel and fodder security besides improving the environment (Smith 2016). Agro-forestry has the high biomass production potential with diverse products resulting in higher financial benefits compared to monoculture of crops. Product diversification reduces the risk associated with farming of single crop and gives the year round income (Singh, Singh, Gulati, and Kujur, 2016). There are different uses of tree products (timber, fuel, fodder and bioenergy) which can reduce the inputs and enhance the eco-efficiency of agro-forestry systems (AFS). Furthermore, agro-forestry land use is more labour intensive as compared to monoculture of

crops; hence different component of AFS diversifies the skills base of the labour force (Basu, 2014).

Agro-forestry systems have been in use for at least 1300 years according to pollen records although tree domestication probably started earlier (Torralba, Fagerholm, Burgess, Moreno and Plieninger, 2016). In recent decades, traditional agro-forestry systems and traditional forest-related knowledge all over the world have received increasing attention by decision makers, conservation and development organizations, and scientific communities. Forest-related knowledge is "a cumulative body of knowledge, practice and belief, handed down through generations by cultural transmission and evolving by adaptive processes, about the relationship between living beings (including humans) with one another and with their forest environment.

Traditional agro-forestry systems and forest-related traditional knowledge have received increasing attention, both at scientific and political levels, in relation to their multifunctionalrole and as sustainability-enhancing practices that combine the best attributes of forestry andagriculture. Today, their importance is mainly based on the fact that they can represent examplesof adaptation and resilience to the changes occurring in rural areas and to climate change (UNFF, 2014). In fact, despite the fact that agro-forestry systems can have some minor negative effects (labor-intensive,competition between different species for natural resources, amount of biomass production), they couldbe a strategically beneficial in rural planning and sustainable rural development in terms of landuse

Forests and agro-forestry systems have always played a fundamental role for rural communities'economy, contributing multiple benefits according to different agro-ecosystem features. Therefore,even among the sites in the GIAHS program, forests and agro-forestry systems are characterized bydifferent degrees of importance: in some cases, the landscape is the result of a close interaction of forestedand cultivated patches, while some other forests play only a minor part inside their agro-ecosystem (Agnoletti, Emanueli, Corrieri, Venturi, Santoro, 2019)

Gonçalves et al. (2019) revealedthat healthy trees and forests provide communitieswith a host of climate-related benefits. Active planning,management and care of the urban forest can improve itsresilience to Climate change and help cities and communitiesbetter adapt. In the same vein,

IntergovernmentalPanel on Climate Change (IPCC) (2014) revealed that themaintenance of urban green spaces is also one of the approachessuggested for the management of Climate changerisk through adaptation, in particular through the reductionof vulnerability and exposure through development, planningand practices that include "low-regret" measures, i.e.those that produce benefits even in the absence of Climatechange and with which the adaptation costs are relativelylow compared to the benefits of the action

Frigeri, Krefta, Paula, Germano and Krefta (2017) listed ecological advantages derived from urban forests including absorption of gaseous pollutants (e.g. ozone, nitrogen, oxides, sulfur chlorides) through leave surfaces, interception of particulate matter (e.g. dust, ash, pollen, smoke), capturing of CO2 and the release of oxygen through photosynthesis and lastly, transpiration of water and shade surfaces, which lowers air temperatures, thereby reducing ozone levels. Furthermore, urban tree are also valued for their roles in carbon sequestration and storage, which is, however, salient to the process of Climate change mitigation.

Donovan (2017) noted the followingbenefits: that roots create air spaces in soil and therebyincreasing the rate at which soil absorbs rainfall and thecapacity of soil to store water which reduces runoff; treecanopies reduce soil erosion by diminishing the impacts ofraindrops on bare soil; transpiration through tree leaves reducesoil moisture, increasing the soil's capacity to store rainfall. When runoff is reduced, the number of pollutantsentering groundwater, rivers and lakes decreases. Culture of planting the right tree in the right place recognizesthe importance of context and is clearly embeddedin the psyche of many arbor culturists and foresters (Hale et al. (2015) resolvedthat the potential benefits of urban street trees plantingare often dependent on the presence of system conditionsrelated to the level of tree maintenance, public values,local government policies and the density and configurationof the surrounding built form

Agro-forestation improves environmental sustainability. Areas devoid of plants and trees become highly susceptible to soil erosion as there is no interconnecting network of roots to hold the topsoil layer of the land which is highly fertile. This leads to topsoil runoff, leading to soil erosion which is no less than land pollution. The land becomes infertile as it loses the topsoil layer, eventually becomes barren and unable to support any plantation in the future.

Afforestation helps to tackle this issue (Wan, 2018). Planting trees to prevent soil erosion allows for the soil to be protected by the plants and trees as they form deep roots which hold the soil in place, preventing runoff and ultimately reducing soil erosion.

Agro-forestry helps to stabilize the climate of the region and helps in the transformation of arid and semi-arid regions into productive areas. The trees planted in afforestation help in reducing the greenhouse gas effect which helps prevent global warming. Trees help in the reversal of the greenhouse effect by storing carbon dioxide and converting carbon into oxygen through the process of photosynthesis. This helps in creating a carbon sink in the form of forests which helps reduce global warming by eliminating carbon from the atmosphere leading to an overall reduction in climate change.

Reforestation through trees helps to produce oxygen through the process of photosynthesis. This leads to the production of better, oxygenated fresh air which is easy to breathe in. A breath of fresh, unpolluted air is very important in today's time especially for people at risk of respiratory diseases like the Coronavirus. The oxygen production by trees planted thorough afforestation is absolutely necessary to tackle more and more carbon dioxide being produced from various processes like the burning of fossil fuels (Wang, 2017).

2.4 Constraints to adopting agro-forestry practices by smallholder farmers

Poor planning, weak regulation and inappropriate processing technology have resulted in the unsustainable harvesting of forest products, and the degradation of the resource base (Kayanja & Byarugaba, 2017). The problem of overharvesting manifests itself when the annual harvesting rate exceeds the carrying capacity. These problems are attributed to limited institutional capacity and limited resource in both central and local government to improve planning and regulation, and little incentive for the private sector to improve its performance in the absence of firm regulation and the enforcement of professional standards.

Urbanization and industrial growth are putting pressure on the forest estate. Many urban and peri-urban reserves are under threat of being degazetted. The increasing demand for industrial land has led to the degazetting of nearly 10,000 ha, which will result in a permanent net reduction of the forest estate unless alternative non-forested areas are identified and developed.

The most affected forest reserves are those close to the urban and industrial centers, for example Mpigiforest near the capital, Kampala (Kyambadde, 2017). Underlying factors; a number of factors that underlies the decline in the forest resource base and these includes; Policy deficiencies relating to the private sector and local communities over land tenure, access rights and responsibilities for resource management For instance, much of the deforestation occurring in the districts of Buganda is on mailo land. There are no clear mechanisms which allow the Uganda Forest Department to regulate the private forests on these lands.

There is poor regulation by weakened institutions, which lack funding, and capacity the institutions mandated to manage forest reserves are inadequately funded and they lack enough human resources to implement the government policies of protecting forests however even these institution are being affected by corruption which takes several form that relates to granting concessions, embezzlement of institution funds among others. Population growth and migration has increased demand for agricultural land and firewood (Malaba, 2016) energy, and rural poverty restricts the ability to invest in sustainable land use practices. The population growth rate of 3.4% per anum leads to exerted high pressure on the forest resources in order to derive people's livelihoods, higher population makes land for settlement and agriculture inadequate and consequently resort to the forest land. Therefore, Deforestation has been reported to be more intense in areas with high population densities. In districts such as Mpigi, Mpigi and Luwero, major tracts of land have been cleared in the last decade. Much of this vegetation has secondary woody biomass. Higher poverty levels over 46% of the people in Uganda live below the poverty line poor people are driven by the higher demand to sustain their livelihoods from the forest resources because they lack alternative sources of income (Obua, Agea & Ogwal, 2018) as a consequence depletion of the forests become inevitable. Shifting agriculture also called slash and burn agriculture is the clearing of forested land for raising or growing the crops until the soil is exhausted of nutrients and/or the site is overtaken by weeds and then moving on to clear more forest. It is been often reported as the main agent of deforestation. Smallholder production in deforestation and the growing number of such producers notably shifting cultivators were the main cause of deforestation mostly all reports indicate shifting agriculture as responsible for about one half of tropical deforestation and some put it up to two-thirds. Shifting agriculture was greatest in Asia (about 30 per cent) but only about 15 per cent over the whole tropical world. It

appears that the proportion of direct conversion of forest to agriculture is increasing and the proportion of shifting agriculture is decreasing with time.

Fires destroy reforestation schemes in communities completely eliminating the state of forest provision to the communities. Fire is a good servant but has a poor master. Fire used responsibly can be a valuable tool in agricultural and forest management but if abused it can be a significant cause of deforestation. Based on the data available from 118 countries representing 65 per cent of the global forest area, an average of 19.8 million hectares or one per cent of all forests were reported to be significantly affected each year by forest fires (Okinda, 2015). Deforestation due to road pavements in Brazil had also lead to higher incidences of forest fires.

Urbanization hinders and limits the schemes of reforestation due to lack of sufficient land for the execution of agriculture. Expanding cities and towns require land to establish the infrastructures necessary to support growing population which is done by clearing the forests (Sands, 2015). Tropical forests are a major target of infra-structure developments for oil exploitation, logging concessions or hydropower dam construction which inevitably conveys the expansion of the road network and the construction of roads in pristine areas. The construction of roads, railways, bridges, and airports opens up the land to development and brings increasing numbers of people to the forest frontier. Whether supported or not by the governmental program, these settlers have usually colonized the forest by using logging trails or new roads to access the forest for subsistence land

Overpopulation and poverty hinders forests planting activities.The role of population in deforestation is a contentious issue (Sands, 2015). The impact of population density on deforestation has been a subject of controversy. Poverty and overpopulation are believed to be the main causes of forest loss according to the international agencies such as FAO and intergovernmental bodies. It is generally believed by these organizations that they can solve the problem by encouraging development and trying to reduce population growth. Conversely, the World Rainforest Movement and many other NGOs hold unrestrained development and the excessive consumption habits of rich industrialized countries directly responsible for most forest loss. However there is good evidence that rapid population growth is a major indirect and over-

arching cause of deforestation. More people require more food and space which requires more land for agriculture and habitation. This in turn results in more clearing of forests. Arguably increasing population is the biggest challenge of all to achieve sustainable management of human life support systems and controlling population growth is perhaps the best single thing that can be done to promote sustainability. Overpopulation is not a problem exclusive to Third World countries. An individual in an industrialized country is likely to consume in the order of sixty times as much of the world's resources as a person in a poor country. The growing populations in rich industrialized nations are therefore responsible for much of the exploitation of the earth and there is a clear link between the overconsumption in rich countries and deforestation in the tropics.

Corruption and political cause leads to Illegal forest practicesmay include the approval of illegal contracts with private enterprises by forestry officers,illegal sale of harvesting permits, under-declaring volumes cut in public forest, under pricingof wood in concessions, harvesting of protected trees by commercial corporations,smuggling of forest products across borders and allowing illegal logging, processing forestraw materials without a license (Turyahabwe, Tumusiime, Byakagaba and Tumwebaze, 2018).

2.5 Research Gap

The study assesses the opportunities and constraints of adopting agro-forestry practices by smallholder farmers. The study reviews literature based on the previous author works based on the views presented by the different authors on the opportunities and constraints in adopting the agro-forestry practices. The study review literature drawn across countries based on majorly single research instruments, the current study addressed the contextual and methodological gaps (study based on two instruments) which the current study addressed by conducting a study on adopting the smallholder farmers in Luwero district, central Uganda.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

The chapter discusses how the respondents were selected, how data was collected and analyzed. The chapter also presents research design, population of study sample size, sampling technique, research instruments, data sources, reliability and validity, data gathering procedures, data analysis and limitations of the study.

3.1 Study Area

3.1.1 Location

The study was conducted from Luwero District. Luweero District (also spelled as Luwero) is a district in the Central Region of Uganda. Luweero is the site of the district headquarters. Luweero District is bordered by Nakasongola District to the north, Kayunga District to the east, Mukono District to the southeast, Wakiso District to the south, and Nakaseke District to the west. The district headquarters at Luweero are approximately 75 kilometers (47 mi), by road, north of Kampala, Uganda's capital and largest city". The coordinates of the district are 00 50N, 32 30E (Latitude: 0.8333; Longitude:32.500)

3.1.2 Map of Study

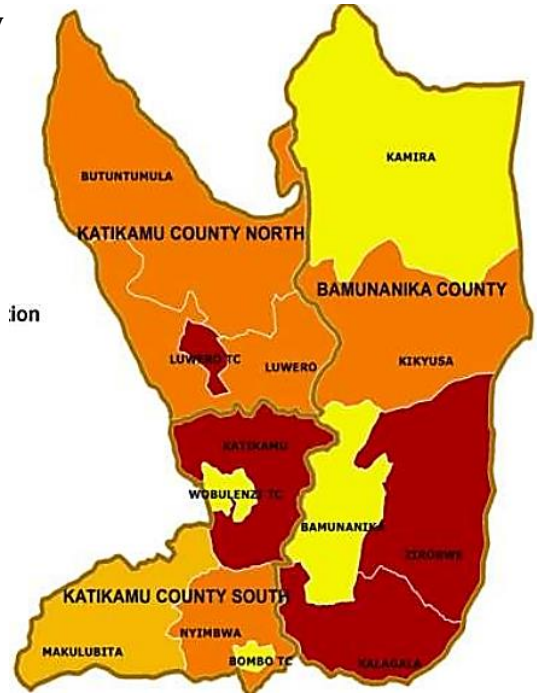


Figure 3.1: Map showing location of Luwero district

The research was conductedfrom Luweero District due to continued decline in the livelihood of local communities mainly because of farmers perception of drought and its implications.

3.1.3 Climate

The “climate in Luwero is warm, muggy, and overcast. Over the course of the year, the temperature typically varies from 59°F to 88°F and is rarely below 57°F or above 95°F. The temperature in Luwero varies so little throughout the year that it is not entirely meaningful to discuss hot and cold seasons.

In Luwero the average percentage of the sky covered by clouds experiences significant seasonal variation over the course of the year. The clearer part of the year in Luwero begins around June 13 and lasts for 3.5 months, ending around September 30. On August 30, the clearest day of the year, the sky is clear, mostly clear, or partly cloudy 50% of the time, and overcast or mostly cloudy 50% of the time. The cloudier part of the year begins around September 30 and lasts for 8.5 months, ending around June 13. On April 16, the cloudiest day of the year, the sky is overcast or mostly cloudy 84% of the time, and clear, mostly clear, or partly cloudy 16% of the time.

To show variation within the months and not just the monthly totals, we show the rainfall accumulated over a sliding 31-day period centered around each day of the year. Luwero experiences extreme seasonal variation in monthly rainfall. Rain falls throughout the year in Luwero. The most rain falls during the 31 days centered around April 18, with an average total accumulation of 7.1 inches. The least rain falls around January 21, with an average total accumulation of 1.6 inches.

3.1.4 Topography

The topography within 2 miles of Luwero contains only modest variations in elevation, with a maximum elevation change of 180 feet and an average elevation above sea level of 3,613 feet. Within 10 miles contains only modest variations in elevation (719 feet). Within 50 miles contains significant variations in elevation (1,913 feet). The area within 2 miles of Luwero is covered by cropland (61%) and trees (26%), within 10 miles by cropland (54%) and trees (34%), and within 50 miles by cropland (34%) and trees (27%).

3.1.5 Soils

The soils of Luweero are generally of high productivity and are mainly sandy clay soils. The dominant soils types are red gravely loams with occasional murram, reddish brown sandy loam on red clay loam and yellowish sands with quartz grave. The soils in the wetlands include grey sands whose parent material is alluvium and hill wash, grey coarse sand from lake deposits, black and grey clays from river alluvium and peat sands and clay formed from papyrus residue and river alluvium. Luweero district soils are generally of high farming productivity although most of it has been turned into the built up environment compromising on the role the national food basket Luweero has been playing over years.

3.1.6 Water Resources

The access rates in Luwero vary from 44 % in Kamira Sub-County to 95 % in Katikamu Sub-County. Luwero has 1,284 domestic water points which serve a total of 360,513 people – 290,068 in rural areas. 164 water points have been non-functional for over 5 years and are considered abandoned. Generally, the district safe water Coverage is (43%-rural and 44%-Urban) as compared to 68% national coverage.

3.1.7 Socio-Economic Activities

It is estimated that 85 percent of the district population are engaged in agriculture (farming and livestock rearing). In the Northern part of the district, they mainly grow cassava, sweet potatoes, maize and bananas. Agriculture is the mainstay of the district economy. It has been estimated that 85 percent of the district population are engaged in agriculture.

3.2 Research Design

This study adopted a descriptive research design based on both qualitative and quantitative research design. The design is chosen in order to provide an elaborate report on the state of opportunities and constraints to agro-forestry practices in Luwero district. It employed the quantitative approach in that it was partly based on variables with numbers and analyzed with statistical procedures. It employed a qualitative approach because it was aimed at obtaining data expressed in non-numerical terms. In particular, it was descriptive design because it was seeking to gather data from a sample of a population at a particular time and in so doing, pertinent data was collected from all respondents once and for all to reduce on time and costs involved.

3.3 Study Population

The study was conducted on the locality of Luwero district focusing on the local population and different categories of personalities found in the district. According to the Demographia 2020, Luwero district has a population of 85,000 adults. The study target the local population, district staff, environment staff and NGOs located in Luwero district. Therefore, the study targeted the population in the area of the study.

3.4 Sample Size

The sample in this study was restricted to the information required and for the purpose of this study; a sample size was determined using Slovene's Formula to come up with appropriate sample size to be used in the study. Slovene's Formula states that, given a population, the minimum Sample size is given by:

$$n = \frac{N}{1 + N\alpha^2}$$

Where; n = the sample size

N = total population of respondents, that is 85,000.

α = the level of significance, that is 0.05

$$n = \frac{N}{1 + N\alpha^2}$$

$$n = \frac{85{,}000}{1 + 85{,}000(0.05)}$$

$$n = \frac{85{,}000}{1 + 85{,}000 * 0.0025}$$

$$n = 398$$

A sample size of 398 respondents selected to participate in the study.

3.4.2 Sampling Technique

Sampling is the process of selecting elements from a population in such a way that the sample elements selected represents the population. Because of resource constraints, a small sample was

selected and handled using a simple random sampling procedure, purposive sampling and convenience sampling. Purposive sampling was used in the selection of the civil servants ofLuwero district, environment staff and NGO staff this is because these are perceived to have more suitable information so purposive sampling enabled the attaining those officials with key knowledge on the study. The convenience sampling was used in selection of local population sampling was used because it enabled the selection of respondents.

Table 3.1: Population and Sample Size of the study

Categories of respondents	**Sample size**	**Returned**	**Methods Used**
Environmentalists	5	3	Purposive Sampling
District staff (agricultural staff)	3	3	Purposive Sampling
NGOs	7	5	Purposive Sampling
Local population (Agro-farmers)	383	304	Convenience sampling
Total	**398**	**315**	

Source: Researcher, devised.

3.5 Data Collection Instruments

This study comprised of two research techniques to collect data i.e. data collection was done using two methods, in-depth interviews and questionnaires was administered to some respondents who can read and interpret the question.

3.5.1 Questionnaire

This is a technique in which the researcher listed of short questions to the respondents requesting them to fill and collect data later. Open and closed ended questions were designed to suit the objectives used to effectively attain data for the study. The questionnaires were used to collect data from all respondents concerning opportunities and constraints of agro-forestry practices adoption. The questionnaires were made to elicit for data from local population, district staff who was answer the questionnaires and return them to the researcher.

3.5.2 Key Informant Guide

In this technique, the researcher personally goes to the respondents and asks them questions directly related to the topic of study. It involved individual interviews. The interviews was conducted with the NGOs and environmentalists.This enabled the researcher to triangulate the data collected. These are intended to attain more detailed information from the respondents and their views concerning the study areas. This sought information detailed to supplement the questionnaire and field data for the respondents.

3.6 Validity and Reliability

3.6.1 Validity of the study

The validity was measured by using content validity where all questions answered by the respondents were made sure that they truly measured the variables being researched upon (Amin, 2005). To ensure the validity of the questionnaires two experts in research will be involved in instrumentation of the research instruments. In this regard, after formulating the questionnaires were submitted to the two experts to ensure their validity through their duties' basis. This was based on the estimated alpha coefficient value of 0.7 and more. Thus, after the experts' judgment, the compilation of the resonances from raters will be computed to determine the content validity index.

3.6.2 Reliability of the study

To ensure that the data is reliable and valid, standard tests were done. The reliability test involved a '' test and retest'' exercise. This means the instrument will be subjected to the representative sample. Whether each time the question asked and the respondent answered a question similar or consistent, then the instrument was considered reliable. Reliability refers to the degree to which the instrument is consistent with whatever it is measuring Amin, (2005). A research instrument is said to be valid if it actually measures what is supposed to be measured Amin, (2005). Since validity is a measure of how the question asked makes sense to the respondent. A few selected respondents advised whether the question makes sense by ranking it on a scale of very clear, not clear, and very unclear.. Alpha was used to measure instrument reliability and the minimum reliability of 0.7.

3.7 Data Analysis

3.7.1 Quantitative Analysis

The quantitative data involved information from the questionnaires only. Data from the field raw for proper interpretation. The coded data was entered into the computer, checked and statistically analyzed using the Statistical Package for Social Scientists (SPSS) software package to generate descriptive and inferential statistics descriptive analysis that was applied to the primary variable and associated indicator items related to the study objectives. The coded data was entered into the Computer, checked and statistically analyzed using the Statistical Package for Social Scientists (SPSS) software package to generate descriptive statistics. Descriptive analysis were applied to describe the primary variable and associated indicator items related to the study objectives. The results for the study presented inform of tables then discussed in relation to existing literature. The presentations were done using frequency and percentages and then personal analysis according to the questionnaire presentations. For objective two, to document the determining factors for the adoption of agro-forestry by smallholder farmers in Luwero district the researcher used chisquare to test the relationship between the variables of the study.

3.7.2 Qualitative analysis

The researcher used manual coding on the transcripts to identify the significant statements across individual interviews. Subsequent readings of the significant statements helped in identifying sub-themes emerging within the patterns. For presentation of thematic findings, both textural and structural descriptions were used in the results section. Textural descriptions are significant statements used to write what the participants experience. Structural descriptions are the interpretation of the context or setting that influenced participants' experiences. For textural descriptions, the quotes of participants will be given in italics with the respondent to whom that quote belongs marked with type. The structural descriptions as interpreted by the researcher were provided in plain text.

3.8 Ethical Considerations

It is important during the process of research for the researcher to make respondents to understand that participation is voluntary and that participants are free to refuse to answer any question and to withdraw from participation any time they are chosen.

Another important consideration involved getting the informed consent of those going to be met during the research process, which involved interviews and observations on issues that may be delicate to some respondents. The researcher undertook to bear this seriously in mind.

Accuracy and honesty during the research process is very important for academic research to proceed. A researcher treated a research project with utmost care, in that there had no temptation to cheat and generate research results, since it jeopardizes the conception of the research.

3.9 Limitations and Solutions

Lack of co-operation by some respondents was possible constraint to this study. In Uganda it is common that researchers are viewed in a negative way, usually staff thinks that it is a problem of finding exercise that rendered most of the jobless at the end of the exercise. This study assured the respondents that the study is purely for academic purposes.

Time, the researcher anticipate that there was a problem of insufficient time. However, this was solved by making sure that the researcher is given enough/ sufficient time and maximum concentration.

The cost of the research was high in regard to the already incurred cost of accessing relevant stationary, printing and the yet to be incurred cost of photocopying, binding, transport, and telephone charges. The financial constraints were solved by asking my friends and family to raise some money for my research work.

CHAPTER FOUR

DATA PRESENTATION, INTERPRETATION, AND DISCUSSION

4.0 Introduction

The study was done to assess the opportunities and constraints of adopting agro-forestry practices by smallholder farmers in Luwero district, central Uganda.The data was quantitatively collected from 315 respondents through questionnaires and qualitatively from the environmentalists of the district who answered the interview questions. The objectives were to characterize the agro forestry practices undertaken by smallholder farmers in Luwero, secondly to examine the determinants for the adoption of agro forestry by smallholder farmers, thirdly to ascertain the opportunities of adopting agro-forestry practices by smallholder farmers in Luwero district, central Uganda and finally to establish the constraints to adopting agro-forestry practices by smallholder farmers in Luwero district, central Uganda.Therefore the results attained reflect what it takes to answer the research questions and the characteristics of the respondents to whom the research questions were administered. The first part presents the respondents demographic information and followed by the results for the four research objectives of the study.

4.1 Response Rate

The research achieved a response rate of 80.4 percent out of the quantitative sample of 378 respondents of questionnaires that were administered and distributed. The data was attained from 11 Interviews. Therefore with this response rate, there is high confidence that the responses received on the study are reliable. Mugenda (1999) as well as Saunders (2007) suggest that a response rate of 50% is adequate when quantitative data is manually collected. Table 4.1 below presents a breakdown of the response rate of the respondents by their categorization.

Table 4.1: Response Rate

Respondents Category	**Sample Size**	**Actual returned**	**Percentage**
Questionnaire	378	304	80.4%
Interview	15	11	73.3%
Total			

Source: Primary Data, 2022

Table 4.1 above presents the response rate of the responses to which the research instruments were administered. The results attained a high response rate from both the questionnaire and interview responses for the study.

4.2 Demographic Characteristics of Respondents

This chapter presents the characteristics of the sample population selected. The findings in table 4.2 to 4.7 below are for demographic characteristics of respondents who participated in the study.

4.2.1 Gender of respondents

Here the researcher was interested in attaining the information about gender of the respondents. The information from the respondents is provided in the table 4.2 below.

Table 4.2: Gender of respondents

Responses	Frequency	Percent
Male	178	58.6
Female	126	41.4
Total	**304**	**100.0**

Source: Field Data, 2022

The study results show that majority of the respondents of the study were male with 178 representing 58.6% of the respondents, female were 126 representing 41.4% of the respondents. The study results indicate that the majority respondents were males although females also contributed to the study , the findings can be relied upon for decision making. The study results indicate that agro forestry practice is done by both male and females in Luwero district.

4.2.3 Age of respondents

Here the researcher was interested in attaining the information about the age of the respondents. The information attained from the respondents is provided in the table 4.3 below.

Table 4.3: Age of respondents

Responses	Frequency	Percent
20-29	43	14.1
30-39	85	28.0
40-49	95	31.3
50 years above	81	26.6
Total	**304**	**100.0**

Source: Field Data, 2022

Results in table 4.3 show that majority respondents were in the age of 40-49 years represented by 31.3% of the respondents, those of 30-39 years were 28%, those in the age of 50 years above were 26.6 % of the study and finally those of 20-29 years were 14.1% of the study. The findings implied that majority respondents were youth, the researcher carried out his research form both the youthful and adult population. The respondents employed were preferably because they are more productive and more accessible to provide data for the study. The study findings show that agro forestry is conducted by people of different age groups including males and females for the study.

4.2.4 Education of respondents

Here the researcher was interested in attaining the information about the education of the respondents. The information attained from the respondents is provided in the table 4.4 below.

Table 4.4: Education of respondents

Responses	Frequency	Percent
Primary	47	15.5
Secondary	91	29.9
Post secondary	100	32.9
Technical education	66	21.7
Total	**304**	**100.0**

Source: Field Data, 2022

Results in table 4.4 shows that the majority of the respondents were holding post secondary education who were 32.9% % of the study, secondary educated respodents were 29.9%, technical education had 21.7% respondents and finally primary education were 15.5% of the study. The findings show that the though many respondents were not highly educated, they have an adequate understanding of the study and hence have been able to answer the questions for the respondents.

4.2.5 Occupation of respodents

Here the researcher was interested in attaining the information about the occupation of the respondents. The information attained from the respondents is provided in the table 4.5 below.

Table 4.5: Occupation of respodents

Responses	Frequency	Percent
Only Agriculture	106	34.9
Agriculture + Business	95	31.3
Agriculture+ Civil Service	62	20.4
Other Occupation(s)	41	13.5
Total	**304**	**100.0**

Source: Field Data, 2022

Results in Table 4.5 indicate that majority respodents were practicing only agriculture who was 34.9% of the respodents, this was followed by those in agriculture and business who were 31.3% of the respodents, those of agriculture and civil service were 20.4% and finally other different occupations were represented by 13.5% of the respodents. The study findings show that the respodents who provided information were agriculturalists, information attained indicate that the agriculture practice was done by the respodents in the study though the data was attained from different occupations in the study.

4.2.6 Religion of respodents

Here the researcher was interested in attaining the information about the religion of the respondents. The information attained from the respondents is provided in the table 4.6 below.

Table 4.6: Religion of respodents

Responses	Frequency	Percent
catholic	82	27.0
Protestant	53	17.4
Muslim	34	11.2
Pentecostal	45	14.8
African Traditional	9	3.0
Adventist	44	14.5
Others	37	12.2
Total	**304**	**100.0**

Source: Field Data, 2022

Findings in Table 4.6 on the religion of the respodents, its indicated that the majority respodents were Catholics who were 27% of the study, the protestant were 17.4% of the study, Adventists were 14.5% of the respodents, Pentecostal were 14.8%, Muslim respodents were 11.2% of the study, other religions were 12.2% and African traditional were 3% of the respodents. The study shows that the information on agro-forestry was collected for the purpose of the study, information show that the majority respodents were from the different religions.

4.2.7 Marital Status of respodents

Here the researcher was interested in attaining the information about the marital status of the respondents. The information attained from the respondents is provided in the table 4.7 below.

Table 4.7: Marital status of respodents

Marital Status	Frequency	Percent
Married	206	67.8
Single	77	25.3
Divorced	12	3.9
Widowed	9	3.0
Total	**304**	**100.0**

Source: Field Data, 2022

Marital status of the respodents indicate that majority respodents were married who were 67.8% of the study, 25.3% respodents were single, those who divorced were 3.9% of the respodents and widowed were 3% of the respodents. The results show that overall study indicates that information was attained from generally married respondents a sign of responsibility hence information was attained from generally married respodents for the study.

4.2.8 Frequency in Agriculture

Here the researcher was interested in attaining the information about the frequency of the respodents in agriculture. The information attained from the respondents is provided in the table 4.8 provided here under.

Table 4.8: Frequency in Agriculture

Responses	Frequency	Percent
1-5 Years	26	8.6
6-10 Years	88	28.9
10 Years above	190	62.5
Total	**304**	**100.0**

Source: Field Data, 2022

Results in Table 4.8 on Frequency in Agriculture indicate that the majority respodents have been in agro forestry for the period of 10 years and above who were 62.5%, those of 6-10 years were 28.9% and finally those of 1-5 years were 8.6% of the respodents. The study findings show that the majority respodents had been in the agricultural sector for more than 10 years of the study, the respodents provided adequate information for the study.

4.2 Characterize the agro forestry practices undertaken by smallholder farmers in Luwero district

The study first objective was to characterize the agro forestry practices undertaken by smallholder farmers in Luwero. The results attained from the field concerning the study are both qualitative and quantitatively provided in the responses provided from the field provided here under.

4.2.1 Presence of Agro-forestry in Luwero district

Table 4.9: Presence of Agro-forestry in Luwero district

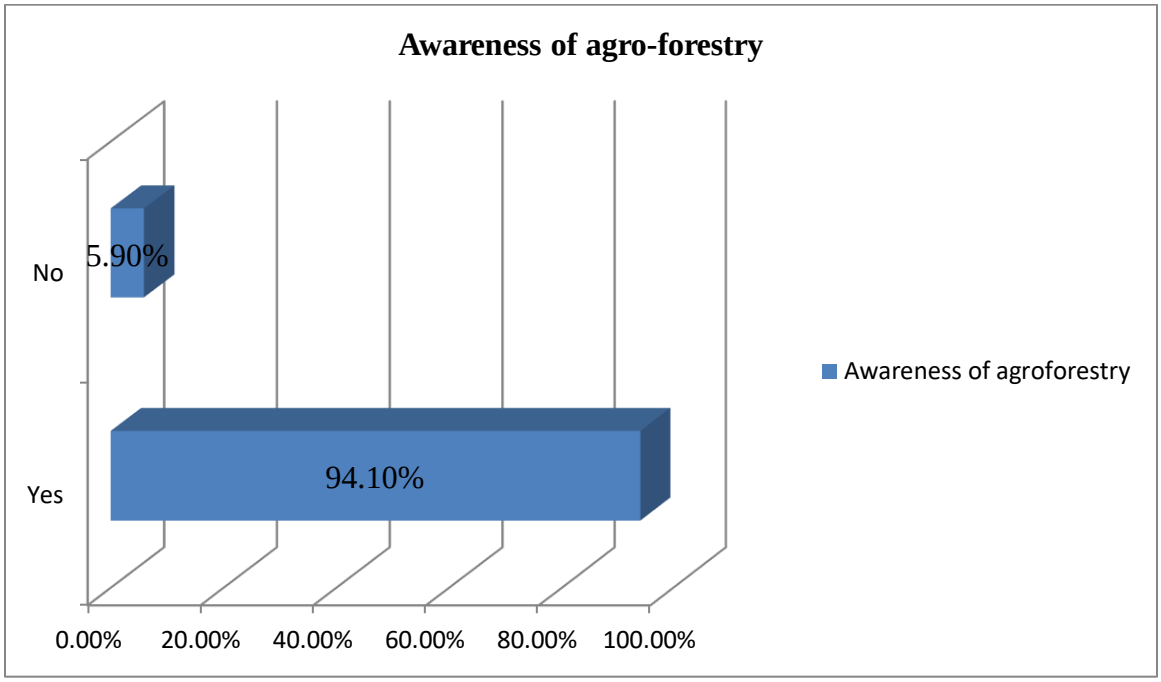
Responses	Frequency	Percent
Yes	293	96.4
No	11	3.6
Total	**304**	**100.0**

Source: Field Data, 2022

Results in Table 4.9 provide findings on the presence of Agro-forestry in Luwero district practice in Luwero district, the study results indicate that Agro-forestry practice is prevailing according to 96.4% of the respodents while just only 3.6% respodents disagree. The study results indicate that there is agro-forestry practices prevailing in Luwero district, the study indicate that the state of the agro forestry practiced is occurring in Luwero district.

4.2.2 Awareness on the agro-forestry Practice in Luwero district

Figure 4.1: Awareness on the agro-forestry Practice in Luwero district



Source: Field Data, 2022

Results in Figure 4.1 on the awareness on the agro-forestry Practice in Luwero, reveal that 94.1% respodents agree that there is awareness of agro forestry with 5.9% of the respodents disagree. The study findings indicate that the respodents are aware about agro-forestry practices in Luwero district. The study findings show that the majority respondents agree that they are aware about the agro-forestry practiced in their district.

4.2.3 Agro-forestry Practices undertaken by farmers in Luwero district community.

Table 4.10: Agro-forestry Practices undertaken by farmers in Luwero district community

Improved fallow practice

Responses	Frequency	Percent
Yes	195	64.1
No	109	35.9
Total	304	100.0

Alley Cropping

	Frequency	Percent
Yes	204	67.1
No	100	32.9
Total	304	100.0

Home Garden

	Frequency	Percent
Yes	197	64.8
No	107	35.2
Total	304	100.0

Shelter belts and wind break line hedges

	Frequency	Percent
Yes	121	39.8
No	183	60.2
Total	304	100.0

Fuel wood production

	Frequency	Percent
Yes	175	57.6
No	129	42.4
Total	304	100.0

Tree on range land or pasture

	Frequency	Percent
Yes	167	54.9
No	137	45.1
Total	304	100.0

Home garden involving animals

	Frequency	Percent
Yes	176	57.9
No	128	42.1
Total	304	100.0

Multipurpose woody hedge rows

	Frequency	Percent
Yes	174	57.2
No	130	42.8
Total	304	100.0

Apiculture with trees

	Frequency	Percent
Yes	181	59.5
No	123	40.5
Total	304	100.0

Aqua forestry

	Frequency	Percent
Yes	182	59.9
No	122	40.1
Total	304	100.0

Multipurpose wood lot

	Frequency	Percent
Yes	193	63.5
No	111	36.5
Total	304	100.0

Source: Field Data, 2022

The study in Table 4.10 identifies 11 agro-forestry activities in the district.

Results in Table 4.10 show responses on the different Agro-forestry Practices undertaken by farmers in Luwero district community. , the study findings indicate that, there is a practice ofimproved fallow practice which had 64.1% respodents who agreed while only 35.9% respodents disagreed with the occurrence of improved fallow practice.

Alley cropping had 67.1% respodents who contend to its prevalence while just 32.9% respodents. It's prudent to assess that alley cropping generally exists among the farmers in Luwero district.

On the agro-practice of Home Garden, it was found that 64.8% respodents agree while 35.2% respodents disagree. The study findings show that the home garden exist as an agro forestry practice among farmers in Luwero district.

The practice of agro-forestry exists with Shelter belts and wind break line hedges according to 39.8% respodents and 60.2% respodents disagree. The study results show that there exists an agro-forestry practice in Luwero farms.

On the practice of Fuel wood production, 57.6% respodents agreed while 42.4% respodents disagree, the study results based on the findings indicate that fuel wood production practice is existing in Luwero district.

Tree on range land or pasture had the 54.9% respodents who agree, then 45.1% respodents disagree, on overall, it was found that there exist tree on range land or pasture as an agroforesty practice in Luwero district.

Furthermore, it was found that there exist home gardens for animals according to 57.9% respodents who contend in agreement while 42.1% respodents disagree. The study findings show that there exist home garden for animals. The practice of Multipurpose woody hedge rows had it that 57.2% respodents agree with the presence of a multipurpose wood hedge rows with 42.8% respodents who disagreed in the regard to the agro-forestry practice in the study.

There exists a practice of Apiculture with trees according to 59.5% respodents who agreed, 40.5% respodents disagree. The results show that never the less there exist apiculture trees in Luwero district. It was found that aqua forestry exist according to 59.9% respodents while 40.1% respodents disagree. Concerning the study on the presence of a practice of multipurpose wood lot had 63.5% respodents who agree and 36.5% respodents who disagree. The study contend that there exist practices of agro-forestry.

4.2.4 Characteristics of agro forestry practices undertaken by smallholder farmers in Luwero

Table 4.11:Characteristics of agro forestry practices undertaken by smallholder farmers in Luwero

There are home based agricultural schemes

Responses	Frequency	Percent
Yes	272	89.5
No	32	10.5
Total	304	100.0

There are field agricultural programs

	Frequency	Percent
Yes	264	86.8
No	40	13.2
Total	304	100.0

There are agricultural schemes for food security

	Frequency	Percent
Yes	249	81.9
No	55	18.1
Total	304	100.0

There is a policy on agro forestry practices

	Frequency	Percent
Yes	146	48.0
No	158	52.0
Total	304	100.0

The government supports the agricultural sector growth

	Frequency	Percent
Yes	147	48.4
No	157	51.6
Total	304	100.0

The agro-forestry scheme is supported with irrigation schemes

	Frequency	Percent
Yes	138	45.4
No	166	54.6
Total	304	100.0

Source: Field Data, 2022

Results in Table 4.11 on the characteristics of agro forestry practices undertaken by smallholder farmers in Luwero reveal that 89.5% respodents agree to the presence of home based agriculture schemes, there are home based agricultural schemes with 10.5% respodents in disagreement.

On the agro-forestry characteristics of there are field agricultural programs, the 86.8% respodents agreed while 13.2% respodents disagree. In this findings its provided that agro-forestry in Luwero is characterized with the field agricultural schemes and programs

It was found that agro-forestry is characterized with the presence of agricultural schemes for food security according to 81.9% respodents while 18.1% respodents disagree, the study results indicate that the agro forestry is highly characterized with agricultural scheme for food security.

The characteristics of there are a policy on agro forestry practices had 48% respodents who agreed, while 52% respodents disagree. The study results show that agro forestry is not eminently determined by the agro forestry policy.

Results in Table further show that the government supports the agricultural sector growth with only 48.4% respodents agreeing while 51.6% respodents disagree. The study findings show that the government's support for agriculture sector growth and development is still low in Luwero district.The agro-forestry scheme is supported with irrigation schemes with 45.4% respodents who agree and 54.6% respodents disagree. The study responses indicate that the majority

respodents disagree with the support high support presence for the agro forestry through irrigation,

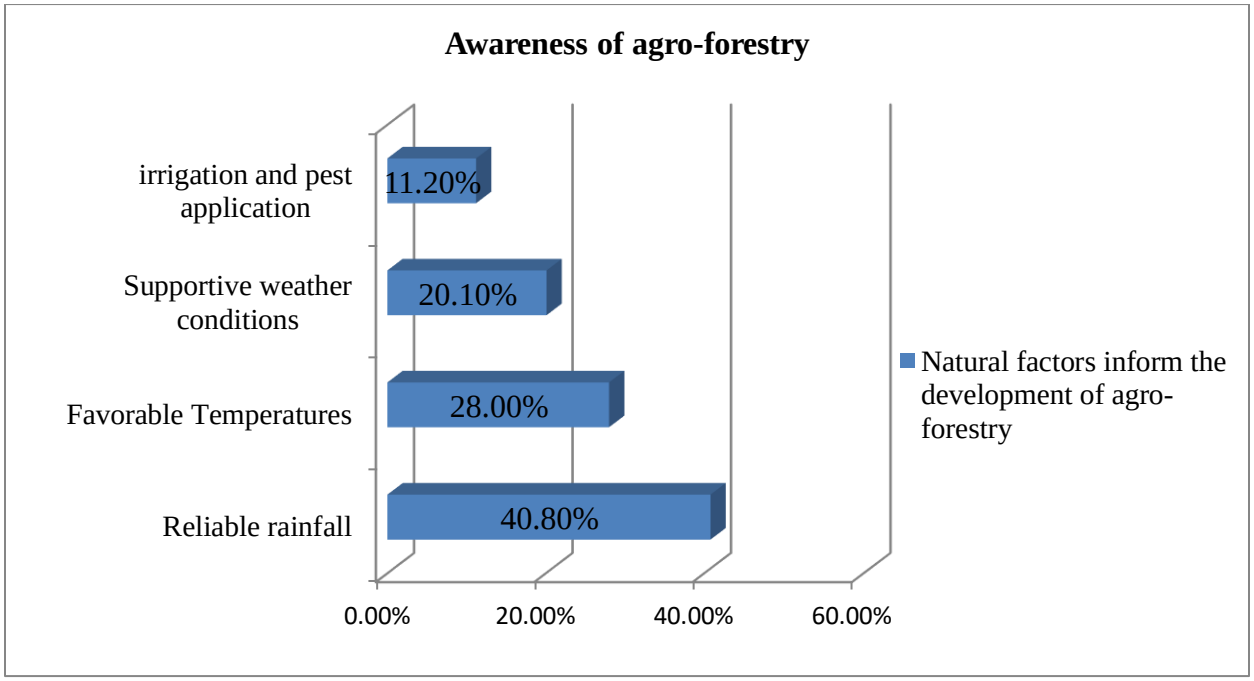
Asked about what characterizes the agro-forestry schemes in Luwero district, the interviewee responses revealed that

> *Agro forestry practice is generally available, practiced amongst the people in Luwero district, there is government support on agro forestry but the schemes and support continue to generally be low amongst the people in the communities of Luwero district.*

KII with district agricultural officer, 01.08.2022

4.2.4 Natural factors inform the development of agro-forestry schemes in Luwero district

Figure 4.2: Natural factors inform the development of agro-forestry schemes in Luwero district



Source: Field Data, 2022

Figure 4.2 show results on whether natural factors inform the development of agro-forestry schemes in Luwero district, it was found that reliable rainfall had 40.8% respodents, favorable temperatures had 28% respodents, supportive weather conditions had 20.10% and finally

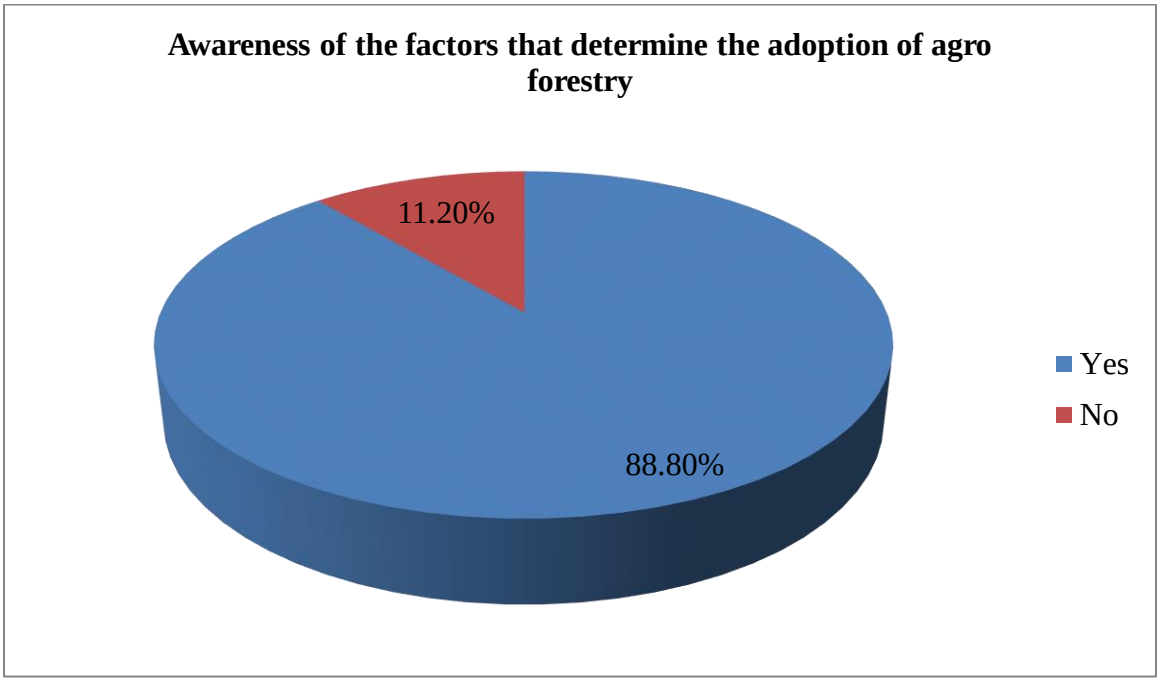
irrigation and pest application had 11.2% respodents. The study results shows that generally the natural factors slightly inform the development of agro forestry schemes in Luwero district.

4.3 Drivers for the adoption of agro forestry by smallholder farmers in Luwero district

The second objective of the study was to examine the determinants for the adoption of agro forestry by smallholder farmers in Luwero district. The results concerning this study findings are collected as presented in Tabulations provided here under in assessing the factors which determine the adoption of agro forestry by small holder farmers in the district of Luwero.

4.3.1 Awareness of the factors that determine the adoption of agro forestry by smallholder farmers in Luwero district

Figure 4.3: Awareness of the factors that determine the adoption of agro forestry by smallholder farmers



Source: Field Data, 2022

Figure 4.3 show responses on awareness of the factors that determine the adoption of agro forestry by smallholder farmers, the study reveal that 88.8% of the respodents agreed while 11.2% respodents disagreed, the study results on overall indicate that the respodents/ people are aware about the adoption of agro-forestry in Luwero district. The findings show that the state of the adoption is provided in the small holder farmers.

4.3.2 Natural factors determining the adoption of agro forestry practice in Luwero district community.

Table 4.12: Natural factors determining the adoption of agro forestry practice in Luwero district community

Responses	Frequency	Percent
Good rainfall	77	25.3
Fertile Land	61	20.1
Good Temperatures	97	31.9
Presence of natural forests	69	22.7
Total	**304**	**100.0**

Source: Field Data, 2022

Responses in Table 4.12 on the natural factors determining the adoption of agro forestry practice in Luwero district community, it was found that good temperatures account for 31.9% in contributing to agro forestry, fertile land accounted for 20.1%, while good rainfall had 25.3% of the respondents and finally 22.7% respodents argued that presence of close proximity to the natural forests. The study findings show that the natural factors are significant in determining the agro forestry adoption. The study indicates that agro-forestry is determined by the natural factors to some extent.

4.3.3 Human factors determining the adoption of agro forestry practice in Luwero district

Table 4.13: Human factors determining the adoption of agro forestry practice in Luwero district

Responses	Frequency	Percent
Education of community	70	23.0
Communication	85	28.0
Food Availability	67	22.0
Family Size	82	27.0
Total	**304**	**100.0**

Source: Field Data, 2022

Results in Table 4.13 show responses on the human factors determining the adoption of agro forestry practice in Luwero district, it was found that family size was the greatest factor in determining agro-forestry with 27%, communication especially usage of ICT had 28% respodents while education of the community had 70(23%) and finally food availability had 67(22%) of the respodents. The study findings show that human factors play a fundamental role in determining the occurrence or implementation of agro forestry practice in Luwero district, especially tailored to attainment of sustainability.

4.3.4 Governments factors determining the adoption of agro forestry practice in Luwero district.

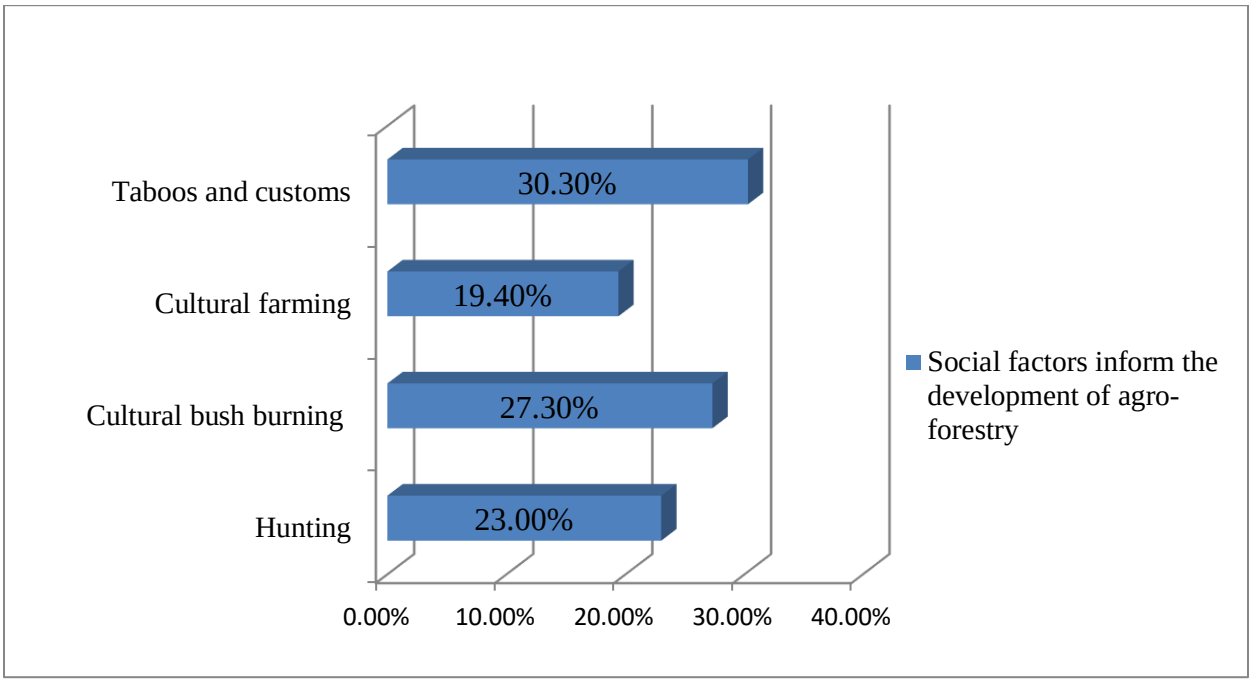
Table 4.14: Governments factors determining the adoption of agro forestry practice in Luwero district.

Responses	Frequency	Percent
Government policy for agro forestry	138	45.4
Government support for agro forestry	71	23.4
Government regulations on environment	31	10.2
Facilitation in monitoring	64	21.1
Total	**304**	**100.0**

Source: Field Data, 2022

Results in Table 4.14 on whether there are governments factors determining the adoption of agro forestry practice in Luwero district, it was found that government has developed a policy for agro-forestry according to 45.4% respodents, Government support for agro forestry had 23.4% respodents, Government regulations on environment had 10.2% respodents and finally Facilitation in monitoring had 21.1% of the respodents. The study findings show that there are government factors which determine the adoption of agro-forestry practice in Luwero district. Its significant to argue that government has had a low issue in the government for the determination of the agro forestry schemes.

4.3.5 Social factors determining the adoption of agro forestry practice in Luwero district



Source: Field Data, 2022

Figure 4.4: Social factors determining the adoption of agro forestry practice in Luwero district

Figure 4.4 show results on the social factors determining the adoption of agro forestry practice in Luwero district, it was found that several factors which determine the adoption of agro-forestry socially with Cultural Bush burning having 83(27.3%) of the respodents, hunting had 70(23%) respodents, taboos and customs had 92(30.3%) respodents and finally 59(19.4%) respodents. It was found that socially, there are several factors which determine the adoption of agro-forestry. The study indicating that the social factors are significant in assessing the agro-forestry practice in Luwero district.

> *The responses attained from the field also indicate the same; it was found that, there are social environments which support the agro-forestry practice. The state of the agro forestry is supported by the socially compliant society which has been in need of growing culturally and socially compliant foods systems hence the adoption of agro forestry.*

KII with environmental staff, 01.08.2022

4.3.6 Institutional factors determining the adoption of agro forestry practice in Luwero district.

Table 4.15: Institutional factors determining the adoption of agro forestry practice in Luwero district.

Responses	Frequency	Percent
Low effectiveness in monitoring by NEMA	118	38.8
Limited institutional capacity to plant vegetation	93	30.6
Limited institutional development for vegetation	19	6.3
Poor Institutional Monitoring schemes	74	24.3
Total	**304**	**100.0**

Source: Field Data, 2022

Results in Table 4.15 show responses on the Institutional factors determining the adoption of agro forestry practice in Luwero district, the findings show that Low effectiveness in monitoring by NEMA had 118(38.8%) respodents agree, 93(30.6%) respodents agree with limited institutional capacity to plant vegetation with 30.6% respodents, Poor Institutional Monitoring schemes had 74(24.3%) respodents and finally Limited institutional development for vegetation had 19(6.3%) respodents for the study. The study results indicate that there are institutional factors which significantly affect the adoption of agro forestry practices in Luwero district. The study show that institutionally there is agro forestry.

> *The response with the interview provide the responses in the same line as above, Institutionally there are institutions which are mandated to manage the environment and agricultural development, these are have been significant in providing the need for agro forestry.*

KII with agricultural staff, 01.08.2022

> *The results also indicate that there is an institutional framework developed and designed to provide an avenue for the management of agro forestry practices in*

the communities here, the agricultural department is well oriented in their work to provide guidance for agro forestry.

KII with NGO staff, 01.08.2022

Table 4.16: Bivariate analysis of drivers for the adoption of agro forestry by smallholder farmers in Luwero district

Variable		Presence of agroforestry			
	Responses	Yes	No	X^2	P-value
Awareness of determinants of Agro forestry	Yes	119	87	7.891	0.005
	No	60	38		
Natural factors determining the adoption of agro forestry	Good Rainfall	39	27	8.056	0.001
	Fertile land	70	48		
	Good temperatures	55	42		
	Presence of natural forests	39	35		
Human factors determining the adoption of agro forestry	Education of community	50	40	5.034	.010
	Communication	28	30		
	Food Availability	40	28		
	Family Size	34	54		
Governments factors determining the adoption of agro forestry	Government policy	70	34	4.13	.045*
	Government support	66	58		
	Regulations on environment	57	30		
Social Factors determining the adoption of agro forestry	Cultural Bush burning	36	68	0.816	.656*
	Hunting	40	40		
	Cultural farming	72	58		
Institutional factors determining the adoption of agro forestry	Low monitoring by NEMA	82	40	4.989	0.031
	Low institutional capacity	42	47		
	Limited institutional development	50	43		

Source: Primary Data, 2022 ** Statistically significant at P< 0.05

Table 4.16: Bivariate analysis of drivers for the adoption of agro forestry by smallholder farmers in Luwero district, from the analysis of the variables of the study, the study found that the major significant factors determining the adoption of agro forestry by smallholder farmers in Luwero district are natural factors determining the adoption of agro forestry with (X^2 = 8.056, P= 0.005) and human factors determining the adoption of agro forestry had (X^2 = 5.034, P= 0.010). The driver of governments factors determining the adoption of agro forestry had (X^2 =4.13, P= .045)

and finally institutional factors determining the adoption of agro forestry had (X^2 = 4.989, P= 0.031. Based on the findings it indicates that natural factors are the main drivers of agro forestry by smallholder farmers in Luwero district, followed by human factors, institutional factors and finally governments factors.

4.4 Opportunities of adopting agro-forestry practices by smallholder farmers in Luwero district, central Uganda

The third objective of the study to ascertain the opportunities of adopting agro-forestry practices by smallholder farmers in Luwero district, central Uganda. The results attained from the field concerning the study are provided in assessing the degree of responses and agreement in regard to the study.

4.4.1 Whether people are aware of opportunities in adopting the agro-forestry practices

Table 4.17: Have you had the opportunities in adopting the agro-forestry practices

Responses	Frequency	Percent
Yes	225	74.0
No	79	26.0
Total	**304**	**100.0**

Source: Field Data, 2022

Results in Table 4.17 on whether there have been the opportunities in adopting the adopting agro-forestry practices, it was found that 74% respodents were in agreement with the presence of opportunities in adoption of agro-forestry practice. Its was found in contra with 26% respodents who provided otherwise, the study results show that there has been issues connected to the opportunities in agro forestry.

4.4.2 Economic opportunities of adopting the adopting agro-forestry in Luwero district

Table 4.18: Economic opportunities of adopting the agro-forestry in Luwero district

Responses	Frequency	Percent
Source of income	97	31.9
Source of employment	71	23.4
It provides food	73	24.0
Source of medicine	63	20.7
Total	**304**	**100.0**

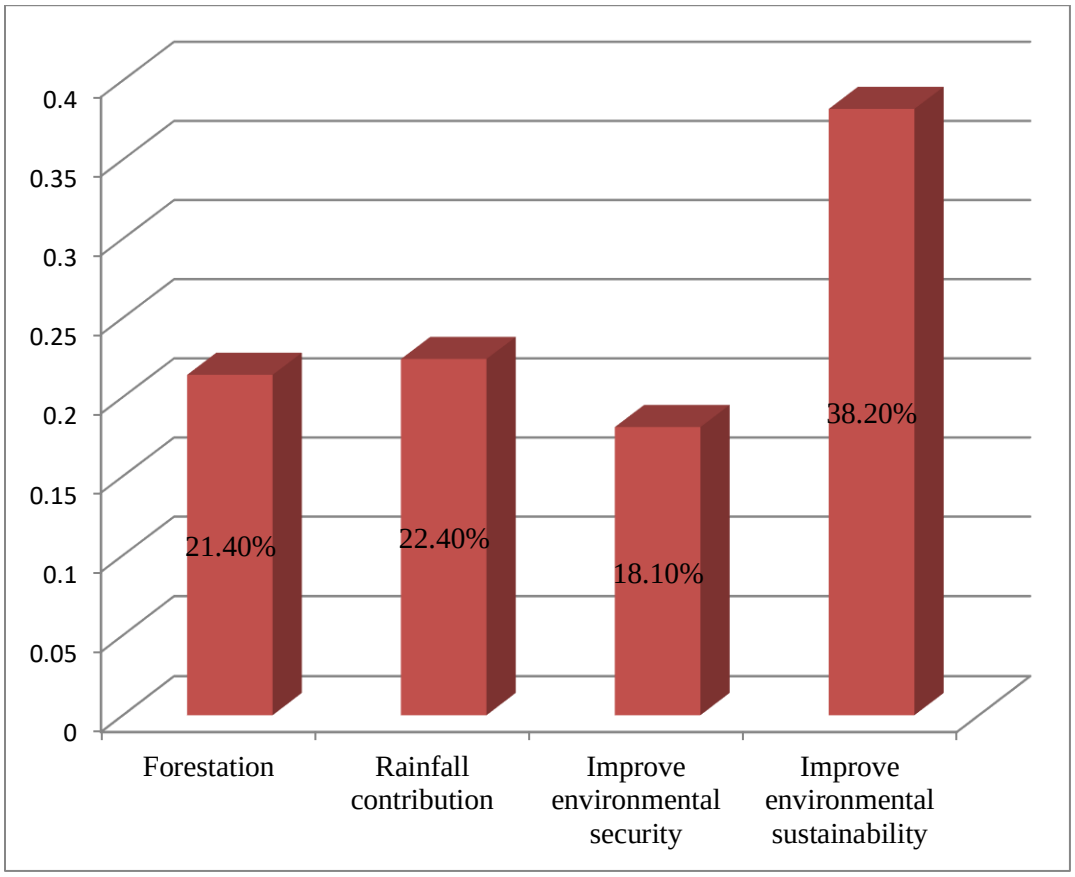
Source: Field Data, 2022

The results in table 4.18 show responses on the economic opportunities of adopting the adopting agro-forestry in Luwero district which indicate that it's a source of income with 97(31.9%) respodents who agree, it's a source of income according to 71(23.4%) respodents, it provides food with 73(24%) respodents and finally source of medicine with 63(20.7%) respodents. The study findings show that economically agro forestry provide income, employment, food, medicine for the people in Luwero district hence the state of economic opportunities occurring in the district of Luwero.

> *In addition, agro-forestry indeed provide an economic benefit to the people of Luwero district with the people getting both food and medicine including natural protection of their environment, its provided that the status of the agro systems is beneficial to the communities in Luwero district.*

KII with NGO officer, 04.08.2022

4.4.3 Environmental opportunities of adopting the agro-forestry in Luwero district



Source: Field Data, 2022

Figure 4.5: Environmental opportunities of adopting agro-forestry in Luwero district

Environmentally, Figure 4.5 show that environmental opportunities of adopting the adopting agro-forestry in Luwero district are eminent in Luwero district, with improving environmental sustainability having 38.2% respodents, improving environmental security with 18.1% respodents, rainfall contribution had 22.4% respodents and finally 21.4% respodents agued in line with the forestation. The study findings show that environmentally, there are opportunities for the adoption of agro-forestry systems in Luwero district, its eminent that there is improvement in the environment systems.

4.4.4 Social opportunities of adopting the adopting agro-forestry practices by smallholder farmers in Luwero district

Table 4.19: Social opportunities of adopting the agro-forestry practices by smallholder farmers in Luwero district

Responses	Frequency	Percent
Establishment of social food protection systems	96	31.6
Support for social living	78	25.7
Provision of social animal husbandry	90	29.6
Provision of social food systems	40	13.2
Total	**304**	**100.0**

Source: Field Data, 2022

Results in Table 4.19 show Reponses to the social opportunities of adopting the adopting agro-forestry practices by smallholder farmers in Luwero district, it was found that agro forestry lead to establishment of social food protection systems with 31.6% respodents, provision of social animal husbandry with 90(29.6%) respodents, then support for social living had 25.7% respodents had 78(25.7%) respodents and finally provision of social food system had 13.2% respodents. The study show that there are social opportunities provided to the people in the practice of agro-forestry in Luwero district through the prevalence of the occasional systems of agriculture coupled with the agriculture systems.

Table 4.20: Technological opportunities of adopting the agro-forestry practices by smallholder farmers in Luwero district

Technological opportunities	Frequency	Percent
Attainment of agricultural technology	77	25.3
Introduction of new crop varieties	81	26.6
Provision of drought resistant crop varieties	80	26.3
New forms of environmental conservation	66	21.7
Total	**304**	**100.0**

Source: Field Data, 2022

Results in Table 4.20 show responses on the technological opportunities of adopting the adopting agro-forestry practices by smallholder farmers in Luwero district, it was found that there was Introduction of new crop varieties with 26.6% respodents, Provision of drought resistant crop varieties with 80(26.3%) respodents, Attainment of agricultural technology had 77(25.3%) respodents and New forms of environmental conservation had 66(21.7%) respodents who provided in the same notion. It was found generally that there are technological opportunities provided through agro-forestry schemes among the people practicing it in Luwero district.

The results in addition are supplemented with the same, as it was found that agro-forestry has provided social and technological benefits to the communities were the people are in Luwero district.

> *Agriculture provide avenues for the establishment of social values and traditional systems of animal keeping, there has also been encouragement to the introduction of drought resistant crops by the government in the area.*

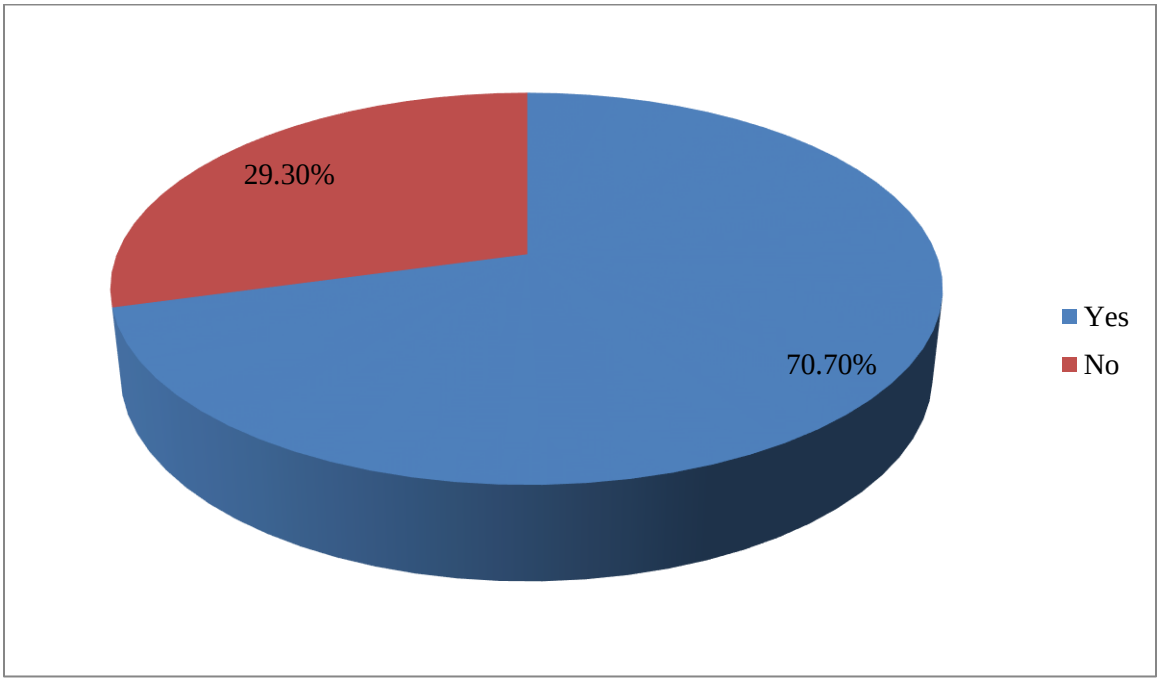
KII with NGO officer, 04.08.2022

4.5 Constraints to adopting agro-forestry practices by smallholder farmers in Luwero district, central Uganda

The fourth objective of the study was to establish the constraints to adopting agro-forestry practices by smallholder farmers in Luwero district, central Uganda. The study results based on the information from the field is provided in the results provided as tabulated in the presentations underlined.

4.5.1 Are there constraints to adopting agro-forestry practices by smallholder farmers in Luwero district?

Figure 4.6: Are there constraints to adopting agro-forestry practices by smallholder farmers in Luwero district



Source: Field Data, 2022

Results in figure 4.6 on whether there are there constraints to adopting agro-forestry practices by smallholder farmers in Luwero district, it was found that there are constraints to adopting agro-forestry practices by smallholder farmers in Luwero district according to 70.7% respodents and 29.3% respodents disagreed. The study findings indicate that majority respodents agree that there are constraints to adopting agro-forestry in the district, indeed there are serious hindrances to the implementation of the agricultural scheme in the district.

4.5.2 Institutional constraints to adopting agro-forestry practices by smallholder farmers in Luwero district

Table 4.21: Institutional constraints to adopting agro-forestry practices by smallholder farmers in Luwero district

Responses	Frequency	Percent
Ineffective implementation of policy	104	34.2
Poor policy management	73	24.0
Ineffective leadership on vegetation	60	19.7
Lack effective control for agriculture	67	22.0
Total	**304**	**100.0**

Source: Field Data, 2022

Table 4.21 provide results on institutional constraints to adopting agro-forestry practices by smallholder farmers in Luwero district, it was found that institutionally there is an ineffective implementation of policy according to 102(34.2%) respodents, Poor policy management had 73(24%) respodents, Ineffective leadership on vegetation had 60(19.7%) respodents and finally Lack effective control for agriculture had 67(22%) respodents. The study results show that there exist institutional hindrances to agro forestry systems among smallholder farmers in Luwero district. The study show institutional setup for agriculture is not well provided to enhance the agriculture systems among farmers in Luwero district.

> *Agro forestry is constrained by the presence of no proper local government or central government institution in the management of the agricultural systems in Luwero district. It is hence arguing that there are no well designed local governance or central governance institutions hence the un wellness of the agro forestry system in the district.*

KII with Environmentalists, 03.08. 2022

4.5.3Environmental constraints to adopting agro-forestry practices by smallholder farmers in Luwero district, central Uganda

Table 4.22: Environmental constraints to adopting agro-forestry practices by smallholder farmers in Luwero district, central Uganda

Responses	Frequency	Percent
Prevalence of drought	67	22.0
High degree of rains	53	17.4
Presence of disastrous winds	91	29.9
Lack of water for irrigation	93	30.6
Total	304	100.0

Source: Field Data, 2022

Results in Table 4.22 show information on environmental constraints to adopting agro-forestry practices by smallholder farmers in Luwero district, central Uganda; it was found that presence of drought constraint the agro-forestry scheme according to 22%, Lack of water for irrigation with 30.6% respodents, Presence of disastrous winds had 29.9% respodents and finally 53(17.4%) respodents who agreed. It was found that accordingly that environmental constraints exist which hinder the schemes of agro forestry in the area. The study notes that there have been instances of existence of the environment which hinder the presence of the agro-forestry systems in the area.

4.5.4 Perception Challenges to agro-forestry practices by smallholder farmers in Luwero district, central Uganda

Table 4.23: PerceptionChallenges to agro-forestry practices by smallholder farmers in Luwero district, central Uganda

Responses	Frequency	Percent
Agro forestry practice is very complex to understand	42	13.8
Practice is costly to adopt	43	14.1
It takes lot of time to practice	48	15.8
It has increased my land area for cultivation	59	19.4
It affects the crop yield	34	11.2
Land ownership pattern affects pattern of adoption	18	5.9
It is not socially feasible	20	6.6
Practice has high labour requirement	40	13.2
Total	**304**	**100.0**

Source: Field Data, 2022

Results in Table 4.23 on the perception Challenges to agro-forestry practices by smallholder farmers in Luwero district, central Uganda, it was found that Agro forestry practice is very viewed as complex to understand with 13.8% respodents, Practice is costly to adopt with 14.1% respodents, It takes lot of time to practice had 15.8% respodents, It takes lot of time to practice had 15.8%, It has increased my land area for cultivation had 19.4% respodents, It affects the crop yield had 11.2% respodents, Land ownership pattern affects pattern of adoption had 5.9% respodents, It is not socially feasible with 6.6% respodents and finally the practice has high labour requirement with 13.2% respodents who agreed. The study results indicate that agro-forestry is generally viewed by the people as being faced with the general constraints being consuming of time to cost of managing both the agricultural and forest management in the same area.

> *In addition to this, the interview responses provided in agreement, It's true that there is an agricultural of agro-forestry with the people complaining of lack of land to accommodate both schemes, others don't see the value of both agriculture and forest in the same environment. Its provided that that the status of the agricultural system need to be ventured and developed well in the manner of*

enhancing the systems of the growth and development for agriculture in the country.

KII with NGOs leader, 04.08.2022

It was further found that the lack of knowledge and education for supporting the agro-forestry systems in Luwero district indicate that there exist a limited scheme of agriculture due to absence of knowledge and education on the value of the agro forestry system,

KII with Environmental officer 03.08.2022

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.0 Introduction

This chapter presents the results obtained from the study relating it to previous studies in literature to discuss and conclude the research. The summary of the findings are discussed below:

5.1 Discussion of the findings

5.1.1 Characteristics of the agro-forestry practices undertaken by smallholder farmers in the Luwero district

The agro-forestry is characterized by the presence of home-based agriculture schemes, field agricultural programsfor food security and a policy-based agro-forestry practices. The findingis in agreement with previous authors such as Otsuki, (2010) who claims that agro-forestry is characterized bythe presence of home gardenswith the system found extensively in high rainfall areas in tropical South and Southeast Asia. ICRAF (1997) also contend that agro-forestry is informed with the collective name for land use systems and technologies where woody perennials such as trees, shrubs, palms, and bamboo are deliberately used on the same land management unit as agricultural crops or animals either in some form of spatial arrangement or temporal sequence.

5.1.2 Determinants for the adoption of agro-forestry by smallholder farmers in Luwero district

The determinants for the adoption of agro-forestry by smallholder farmers is the presence of good rainfall and climatic conditions, education of the community and family size, government policy supporting adoption of agro-forestry and the presence of institutions such as NEMA in the regulations of the environment. The results are in agreement with those of Bannister and Nair (2013) who emphsise the importance of biophysical factors in the determining the adoption of agro-forestry.The major biophysical factors influencing the adoption of agro-forestry technologies include the nature of soil, source of farming water and topography. Also, Chitakira andTorquebiau (2010) identified research, extension and, technical and material support as major

benefits farmers receive from external organizations. Also, extension interventions play a significant role in the adoption of agro-forestry technologies.

5.1.3 Opportunities of adopting agro-forestry practices by smallholder farmers in Luwero district, central Uganda

It was found that agro-forestry provides economic opportunities to the people through employment and income. Also rainfall provided a sense of environmental sustainability, that supported environmental security, provision of food and animals as food for the people especially the smallholder farmers. The findings are in line withAmadi et. al.,(2013), who agreed that agro-forestry can provide new and useful solutions to many of the adverse consequences of human land use. These include increased diversification of agricultural production system, increased yield of crops and livestock, reduction of non-point source pollution and increased rural development. Through contributing to an ecosystem-based management system that guarantees sustainability and environmental quality.Results also agree with Ajake (2012) who recognized the function of forest trees in terms of income generation, good medicare, employment generation, raw materials, and provision of food among others. Therefore, agro-forestry is increasingly promoting restoration of forests, degraded environment, reducing greenhouse gases, and gaining other co-benefits. The findings also agree with Owolabi (2017) who proved that agro-forestry to environmental sustainability is very significant through its environmental, economic and social functions. Not creating a negative impact on the environment, while improving the production capacity of the soil. It is known for its ability to conserve natural resources at the same time as maintaining human activities. The study is also in agreement with Gonçalves et al. (2019) revealedthat healthy trees and forests provide communitieswith a host of climate-related benefits. Active planning,management and care of the urban forest can improve itsresilience to Climate change and help cities and communitiesbetter adapt

5.1.4 Constraints to adopting agro-forestry practices by smallholder farmers in Luwero district, central Uganda.

The study found that agro-forestry is constrained institutionally with the ineffective implementation of policy, poor policy management, ineffective leadership on vegetation and lack

of effective control for agriculture, the presence of drought, presence of disastrous winds,lack of water for irrigation and high costs of the agro-forestry schemes. The results agree with Kayanja and Byarugaba (2017) who contend that poor planning, weak regulation and inappropriate processing technology have resulted in the unsustainable harvesting of forest products, and the degradation of the resource base. The findings are in agreement with Okinda (2015) who contend that fires destroy reforestation schemes in communities completely eliminating the state of forest provision to the communities. The results agree with Sands (2015) that urbanization hinders and limits the schemes of reforestation due to the lack of sufficient land for the execution of agriculture. Expanding cities and towns require land to establish the infrastructures necessary to support the growing population which is done by clearing the forests.

5.2 Conclusion

The study set to assess the opportunities and constraints of adopting agro-forestry practices by smallholder farmers in Luwero district, central Uganda. The objectives of the study was to characterize the agroforestry practices undertaken by smallholder farmers in Luwero, secondly to examine the determinants for the adoption of agro forestry by smallholder farmers, thirdly to ascertain the opportunities of adopting agro-forestry practices by smallholder farmers in Luwero district, central Uganda and finally to establish the constraints to adopting agro-forestry practices by smallholder farmers in Luwero district, central Uganda.

5.2.1Characteristics of the agroforestry practices undertaken by smallholder farmers in Luwero district

The agro-forestry is characterized with the presence of home based agriculture schemes, then the there are field agricultural programs for food security and it’s also characterized with a policy on agro forestry practices

The study conclude that agroforestry practices are common amongst the small holder farmers in Luwero district, these are however not known among the farmers as most of them have crops grown with trees to have both crops and trees little knowing that the practice is actually agroforestry practice conducted among the small holder farmers in Luwero district.

5.2.2 Determinants for the adoption of agro forestry by smallholder farmers in Luwero district

Agroforestry is determined naturally by the presence of good rainfall and climatic conditions, education of the community and family size, government policy supporting adoption of agroforestry and presence of institutions such as NEMA in the regulations.

The study conclude that agro forestry by small holder farmers in Luwero district is supported by the presence of rainfall and good climatic conditions, supportive government policy and institutions which agitate for the agro-forestry schemes in the district. These presences of supportive determinants induce the prevalence of agro-forestry in Luwero district.

5.2.3 Opportunities of adopting agro-forestry practices by smallholder farmers in Luwero district, central Uganda

The study found that agro-forestry provide economic opportunities through employment and incomes, rainfall, provide a sense of environmental sustainability, supporting environmental security, provision of food and animals as food for the people in the small holder farms. The study concludes that agro-forestry practice is significant for providing opportunities of incomes, environmental sustainability and provision of food to the people. The study conclude that agro-forestry in Luwero district provides positive economic, environmental and food security mechanisms for the people in Luwero district.

5.2.4 Constraints to adopting agro-forestry practices by smallholder farmers in Luwero district, central Uganda.

The study found that agroforestry is constrained with ineffective implementation of policy, poor policy management, lack effective control for agriculture, drought constraint the agro-forestry, presence of disastrous winds, lack of water for irrigation and high costs of the agroforestry schemes. The study conclude that agroforestry is constrained through lack of policy significant to induce the presence of agroforestry, lack policy implementation, low access to irrigation, high costs of agroforestry which hinder effective agroforestry schemes in the district. Its also concluded that high costs which require irrigation, cost of implementing the agroforestry serious hinder the agro-forestry schemes.

5.3 Recommendations

Agro-forestry is characterized by the presence of home-based agriculture schemes, and field agricultural programsfor food security and it's also characterized by a policy on agro-forestry practices. The study recommends the following:

- To increase the level of adoption of agro-forestry-based climate change adaptation technologies among smallholder farmers in the Luwero district,there is the need for improvement in government and institutional support systems that will enable farmers in the watershed toto have equitable assess to interventions.
- Ministry of Agriculture through their mandates should enhance their support to farmers by providing inputs such as seedlings. They also should continue to building the capacity of farmers on a regular basis
- There is the need forimproving access to credit and monetary resources,e.g. by supporting scalable financial models addressinglong-term returns on investment in agro-forestry practices.
- Improving farmers' access to markets and creatingvalue chains for agro-forestry products.Improving farmers' access to high-quality plantingmaterial and extension services.
- Improving demand-driven, participatory and inclusiveagro-forestry-related research needs to be developed to generate schemes of best agro-forestry
- To enhance the opportunities, there is the need for developing strategies, frameworks and indicators at alllevels to continuously measure progress in agro-forestry systems and their climate benefits.
- There is the need for creating effective, cost-efficient and equitable policies by using agro-forestry to combine climate change adaptation and mitigation, as well as their cross-cutting synergies, with economic development.
- Land tenure rights should be secured and create incentives to encourage farmers to invest time and money in land use practices with a longer return on investment, such as agro-forestry

- The governments should make agro-forestry visible, by exploring policy changes to include agro-forestry, for instance in development cooperation strategies, technical assistance and budgets.
- There is a need to introduce farmers to other agro-forestry based climate change adaptation technologies in order to effectively build resilience. This can be done through the extension programs.

5.4 Areas for further research

The study suggest the following areas for future research on the scope.

- Policy mechanism for managingagro-forestry schemes.
- Community in management of agro-forestry schemes
- Policy and institutional framework for the management of agro-fore

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APPENDICES

APPENDIX 1: RESEARCH TOOLS

Questionnaire for Local population (Agro-farmers)

Questionnaire on assessing the opportunities and constraints of adopting agro-forestry practices by smallholder farmers in Luwero district, central Uganda

Dear Respondent,

I am,Reg. number 2021-08-0500, a student of the Kampala International University. I am currently carrying out a study for the purpose of writing a dissertation as a requirement for the award of Masters of master'sdegree of environmental at Kampala International University. My topic of the study is Opportunities and constraints of adopting agro-forestry practices by smallholder farmers in Luwero district, central Uganda. You have been selected to participate in the study due the importance of your information in the study. The information you provide will only be used for the purpose of this study and will be treated with utmost confidentiality. I kindly request you to answer the questions fully and honestly.

Thank you!

Section A:Demographic characteristics of respondents

For the questions in this section, please answer by ticking the box representing the most appropriate response for you.

NO.	QUESTION	RESPONSE
A1	Sex : Male Female	Male Female
A2	How old are you? (years)	20-29 Years 30-39 years 40-49 Years 50Years above
A3	What is your highest level of education attained?	(1) Never attended (2) Primary (3) Secondary (4) Post-secondary

A4	What is your main occupation?	(1) No Business (2) Business person (3) Civil servants (4) Others(please specify)
A5	What is your religion affiliation?	(1) Catholic (2) Muslim (3) Protestant (4) Pentecostal (5) African Tradition (6) Jehovah's Witness (7) Others(specify)
A6	What is your marital status?	(1) Cohabiting (2) Married (3) Divorced (4) Separated (5) Widowed (6) Widower
A8	Frequency in Agriculture	(1) 1-5 Years (2) 5-10 years (3) Above 10 Years

Section B: Characterize the agro forestry practices undertaken by smallholder farmers in Luwero

1. Is there agro forestry practice undertaken by smallholder farmers in Luwero district?

a) Yes

b) No

c) Not Sure

2. If yes, are you aware of the agro-forestry practices undertaken by smallholder farmers in Luwero district?

a) Yes

b) No

c) Not Sure

3. The following are the agro-forestry Practices undertaken by farmers in your community?

Agro-forestry Practices	**Yes**	**No**
Improved fallow practice		
Alley Cropping		

Multipurpose tree on cropland

Home Garden

Shelter belts and wind break line hedges

Fuel wood production

Tree on range land or pasture

Home garden involving animals

Multipurpose woody hedge rows

Apiculture with trees

Aqua forestry

Multipurpose wood lot

4. What are the characteristics of agro forestry practices undertaken by smallholder farmers in Luwero?

Responses	**Yes**	**No**
There are home based agricultural schemes		
There are field agricultural programs		
There are agricultural schemes for food security		
There is a policy on agro forestry practices		
The government supports the agricultural sector growth		
The agro-forestry scheme is supported with irrigation schemes		

6. What natural factors inform the development of agro-forestry schemes in Luwero district?

a) Reliable rainfall
b) Favorable Temperatures
c) Supportive weather conditions
d) Any other, Specify

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Section C: Determinants for the adoption of agro forestry by smallholder farmers

8. Are you aware of the factors that determine the adoption of agro forestry by smallholder farmers?

a) Yes
b) No
c) Not sure

9. What are the natural factors determining the adoption of agro forestry practice in your community?

a) Good rainfall
b) Fertile land
c) Good temperatures
d) Presence of natural forests

Any other. …….
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10. What are the human factors determining the adoption of agro forestry practice in your community?

a) Education of community
b) Communication
c) Food availability

d) Family size

e) Any other.

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11. What are the governments factors determining the adoption of agro forestry practice in your community?

a) Government policy for agro-forestry

b) Government support for agro-forestry

c) Government regulations on environment

d) Any other.

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12. What are the factors determining the adoption of agro forestry practice in your community?

a) Hunting

b) Cultural bush burning

c) Cultural farming

d) Any other.

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13. What are the institutional factors determining the adoption of agro forestry practice in your community?

a) Low effectiveness in monitoring by NEMA

b) Limited institutional capacity to plant vegetation

c) Limited institutional development for vegetation

d) Any Other mention …….

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14. Comment on the factors responsible for the adoption of agro forestry practice in your community?

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Section D: Opportunities of adopting agro-forestry practices by smallholder farmers in Luwero district, central Uganda.

15. Have you had the opportunities in adopting the adopting agro-forestry practices by smallholder farmers?

a) Yes
b) No
c) Not sure

16. What are the economic opportunities ofadopting the adopting agro-forestry practices by smallholder farmers?

a) Source of incomes
b) Source of employment
c) It provides food
d) Any Other mention …….

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17. What are the environmentalopportunities ofadopting the adopting agro-forestry practices by smallholder farmers?

a) Forestation
b) Contribute to rainfall
c) Improves environment security

d) Improves environmental sustainability

e) Any Other mention …….

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18. What are the socialopportunities ofadopting the adopting agro-forestry practices by smallholder farmers?

a) Establishment of social food protection systems

b) Support for social living

c) Provision of social animal husbandry

d) Any Other mention …….

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19. What are the technological opportunities ofadopting the adopting agro-forestry practices by smallholder farmers?

a) Attainment of agricultural technology

b) Introduction of new crop varieties

c) Provision of drought resistant crop varieties

d) Any Other mention …….

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Section E: Constraints to adopting agro-forestry practices by smallholder farmers in Luwero district, central Uganda.

20. Are there constraints to adopting agro-forestry practices by smallholder farmers in Luwero district, central Uganda?

a) Yes

b) No

c) Not sure

21. What are the institutional constraints to adopting agro-forestry practices by smallholder farmers in Luwero district, central Uganda?

a) Ineffective implementation of policy

b) Poor policy management

c) Ineffective leadership on vegetation

d) Any Other mention …….

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22. What are the environmental constraints to adopting agro-forestry practices by smallholder farmers in Luwero district, central Uganda?

a) Prevalence of drought

b) High degree of rains

c) Presence of disastrous winds

d) Lack of water for irrigation

e) Any Other mention …….

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23. What are the challenges to agro-forestry practices by smallholder farmers in Luwero district, central Uganda?

a) Agro-forestry practice is veryComplex to understand

b) Practice not costly to adopt

c) Inputs required are easily available

d) It takes lot of time to practice

e) It has increased my land area for cultivation

f) It affects the crop yield

g) Land ownership pattern affects pattern of adoption

h) It is not socially feasible

i) Practice has high labour requirement

24. What more are the challenges to agro-forestry practices by smallholder farmers in Luwero district, central Uganda?

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End of Questionnaire, Thanks

Appendix II: Interview Guide

5) What are the characteristics of agro-forestry practices undertaken by smallholder farmers in Luwero
6) What are the determinants for the adoption of agro forestry by smallholder farmers in Luwero district, central Uganda?
7) What are the opportunities of adopting agro-forestry practices by smallholder farmers in Luwero district, central Uganda?
8) What are the constraints to adopting agro-forestry practices by smallholder farmers in Luwero district, central Uganda?
9) What are the environmental factors constraining the adopting of agro-forestry practices by smallholder farmers in Luwero district, central Uganda?
10) What mechanisms are designed in ensuring agro-forestry practices by smallholder farmers in Luwero district, central Uganda?
11) What government efforts have been provided in improving the agro-forestry practices by smallholder farmers in Luwero district, central Uganda?