Factors Affecting Adoption of Agroforestry Technologies by Women and Young Farmers in the Mt. Elgon Region, Eastern Uganda

RESEARCH REPORT

BY

Aggrey Ntakimanye, Charles Galabuzi, Phiona Kwaga, Geoffrey Werikhe Immaculate Sekitto, Ivan Wanambwa, Geofrey Kimenya, Hillary Agaba , Catherine Muthuri

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ACRONYMNS AND ABBREVIATIONS

ACIAR	Australian Centre for International Agricultural Research
ANAFE	African Network for Agriculture, Agroforestry & Natural Resources Education
CABI	Centre for Agricultural Bioscience International
CBOs	Community Based Organizations
CSIRO	Commonwealth Scientific and Industrial Research Organization
DAO	District Agricultural Officers
DFO	District Forestry Officer
DFS	District Forestry Services
DPO	District Production Officer
FAO	Food and Agricultural Organization
FAO	Food and Agriculture Organization
FBOs	Faith Based Organizations
FGDs	Focus Group Discussions
GDP	Gross Domestic Product
GP	Government Parastatals
ICRAF	International Centre for Research in Agroforestry
IUCN	International Union for Conservation of Nature
KII	Key Informant Interviews
LG	Local Government
MAAIF	Ministry of Agriculture Animal Industry and Fisheries
MAK	Makerere University
Mbale-CAP	Mbale Coalition Against Poverty
MENP	Mountain Elgon National Park
METGE	Mountain Elgon Tree Growers Enterprise Ltd.
METGE	Mountain Elgon Tree Growers Enterprise
MFPED	Ministry of Finance Planning and Economic Development
MFPED	Ministry of Finance Planing and Economic Development
MRRC	Mbale Rural Resource Centre
MWE	Ministry of Water and Environment
NaFORRI	National Forestry Resources Research Institute
NARO	National Agricultural Research Organization
NEMA	National Environment Management Authority
NFA	National Forestry Authority
NGOs	Non-Governmental Organizations
NRO	District Natural Resource Officer
NUSAF	Northern Uganda Social Action Fund
PNOs	Private Nursey Operators
RCD	Root Collar Diameter
SDGs	Sustainable Development Goals
SPGS	Saw log Production Grant Scheme
T4FS-2	Trees for Food Security Project Phase two
UBOS	Uganda Bureau of Statistics
UTGA	Uganda Timber Growers Association
UWA	Uganda Wildlife Authority
WVU	World Vision Uganda
WWF	Worldwide Fund for Nature

EXECUTIVE SUMMARY

The global climate is changing due to increases in amounts of carbon dioxide in the atmosphere. Although the carbon market nearly doubled from US$11 billion in 2005 to US$21.5 billion in 2006, global greenhouse gas emissions have continued to rise, a plain indication that a more practical and direct solution to cutting emissions is urgently needed. One of these practical solutions is to plant trees. In the Mt. Elgon region agroforestry has been a key strategy being used by the ACIAR projects to reduce greenhouse gas emissions, restore land productivity and increase food security. The projects foster the importance of trees in fields and farming landscapes for enhancing and sustaining crop yield and food security. Specifically, the second phase of the T4FS project focuses on identifying innovative approaches to address natural resource management issues; improving access to quality germplasm and tree management options; identifying market opportunities; capacity building and working within the science policy interface on agroforestry.

During implementation, the farmers' level of involvement, benefits, incentives, strategies and challenges facing adoption of agroforestry technologies by women and young farmer were investigated in the region. The purpose was to assess factors hindering or facilitating promotion of agroforestry technologies amongst women and young farmers. The specific objectives were to; i) determine the socio-economic qualities of women and young farmers, ii) assess the applicability and suitability of agroforestry technologies used under the various farming contexts and iii) Identify challenges, incentives and strategies for effective adoption of agroforestry among women and young farmers in the Eastern Highlands of Uganda. Farming systems in areas with unstable economies depend on a complex array of socio-economic attributes and there are important differences between men women young farmers' perceptions on and approaches to using and managing forest and allied tree system resources.

The study was conducted in three districts including Mbale (01°00′36″N 34°19′54″E), Manafwa (01°01′N 34°21′E), Bududa (01°00′36″N 34°19′54″E) in Eastern Uganda. Data were collected through literature review, Participatory Rural Appraisal (PRA), Key Informant Interviews (KIIs), Focus Group Discussions (FGDs) and semi-structured household interviews. A total of 250 farmers were engaged during the study including 170 participants in farming household interviews, 10 KIIs and 70 during FGDS.

Up to 64% of the respondents were female and 36% male. Most (60%) were engaged in agroforestry as casual laborers while other served as spouses (36%) and children (4%) of landlords. The respondent farmers were generally young and vibrant with an average age class of (25 – 34) years old. They were commonly (82%) illiterate (including 47% and 35% with primary and secondary education respectively) and used primitive methods and tools to farm. The average household size (average number of people living in one household) was 5 persons (Std. Error = 0.169; Std. Deviation = 2.193 years) and had lived in the study area for an average of 21.05 years (Std. Error = 0.916; Std. Deviation = 11.948 years). Up to 70% of the farmers were engaged in farm business as the most important source of household income, earning an average of UGX 896,411.76 equivalent to USD$250 (Std. Error = UGX98, 122.14 (USD$ 27); Std. Deviation =UGX 1,279,356.14 (USD$ 352) per. As much as most the land was owned, 64.7% of the farmers had no land tittles, 30% held tittle deeds suggesting high levels of land tenure insecurities.

Agroforestry practices known to women and young farmers involved 28% in tree planting (including woodlots, trees scattered on farm and along boundaries) establishment of bush bands (26%) along the slope using *Calliandra caloythrsus*, construction of soil erosion trap trenches (15%) and 9% were breeding selected tree and shrub species (involving *Neolamarkia cadamba*, *Maesopsis eminii*, *Eucalyptus grandis*, *Cordia africana* and *Grevillea robusta*). Various technologies and practices were observed on farms in the Mt. Elgon region. Out of the 170 farming households visited, up to 65% practiced boundary planting, 49% scattered trees on farm, and

38% owned home gardens. Other technologies included 18% strip cropping/hedgerows, 13% with terraces while 12.9%% established fruit orchards and 5.8% tree planting along river banks.

Generally, land scarcity (65.9%), inadequate tree seedlings (45.9%), lack of market information (27.1%) and limited technical knowledge (22.9%) were among the major challenges highlighted by women farmers. The young farmers on the other hand reported land scarcity (52%) lack of capital (28%), pest and disease outbreak (11.8%), market price fluctuations (5%), and trees competition for water (3.2%). The major incentives for practicing or adopting agroforestry technologies included farmer trainings and sensitization (32.4%), increasing demand for tree products (18.8%) and access to free seedlings (18.8%). The other motivations included availability of fertile soils (12%), favorable weather conditions (9%), farmer group cooperations (6%) and government policy on tree planting (3%). The major strategies included farmer training (71.2%), community sensitization (48%), proper timing of seedling distribution (48%), establishment of community satellite nurseries (30%), promoting fast growing tree species (28%) and improving access to market information (25%).

In conclusion the farmers were generally young and vibrant but illiterate and mostly engaged in agroforestry as casual laborers. They used primitive tools and methods to farm, engaged in farm business as the most important source of household income and earned an average of UGX 896,411.76 equivalent to USD$250 per annum through selling various agricultural and tree products including stakes, fruits (mangoes, avocado, and jackfruits), poles, timber and firewood. They also engaged in other income generating activities including brick laying, charcoal burning, brewing, beekeeping, art and craft, fish farming, *Boda-Boda* transport, retail shops to earn side income.

The known agroforestry technologies and practices included tree planting along the slope, establishment of bush bands using *C. calorythrsus* and elephant grass (*P. purpureum*), construction of soil erosion trap trenches and breeding selected tree and shrub species. Most of these technologies and practices were suitable and well applied under various the farming contexts encountered. The choice of species planted or retained was dictated by anticipated needs of a farming household including trapping the soil and water loss, supply of fodder to boost milk yields for animals among others. Land scarcity, inadequate supply of germplasm, lack of market information, limited technical knowledge, pest and disease outbreak and lack of capital were among the major challenges highlighted by the young farmers.

The major incentives for practicing agroforestry included availability of farmer trainings opportunities by the various organizations, increasing demand for tree products especially firewood, bean/tomato/banana stakes and timber in the region. We recommend strengthening farmer capacity building activities, community sensitization, ensuring proper timing of seedling distribution with rains, establishment of community satellite nurseries, promoting fast growing tree species and improving access to market information for agroforestry products. Small-scale farmers have high discount rates, reflecting their strong preference for present income as compared to future returns. These will arouse more interest for women and young farmers to adopt agroforestry technologies and practices in the Mt. Elgon region.

1. INTRODUCTION

1.1 Background to the study

Agriculture is key to the physical and economic survival of every human being (World Bank, 2012). With the majority of the world's poor living and working in rural areas, investment in agriculture and rural development only makes sense if it leads to achieving the Sustainable Development Goals (SDGs) on poverty reduction and food security (FAO, 2011). The United Nations forecasts that the global population will reach more than 9 billion by 2050 (World Bank, 2012). To feed everyone, food production will have to increase by 70 percent. Unfortunately, primitive farming practices, farmers' attitude, poverty and cultural systems have affected productivity of agricultural landscapes in the Sub-Saharan Africa.

Moreover, over 80% of rural households in this region are resource-poor, food-insecure and vulnerable to climate change. The global climate is changing due to increases in amounts of carbon dioxide in the atmosphere. Although the carbon market nearly doubled from US$11 billion in 2005 to US$21.5 billion in 2006, global greenhouse gas emissions have continued to rise, a stark indication that a more pragmatic and direct approach to cutting emissions is urgently needed (Lang & Byakola 2006). These pressures are a manifestation of increased demand for food, water and energy and yet declining farm productivity, over-exploitation of trees in agricultural landscapes and deforestation have escalated the consequences including land degradation due to soil erosion.

Soil erosion in Uganda, is more reported in the densely populated highlands (MFPED, 2000; NEMA, 2008). For example, the clearing of forest vegetation cover on the steep slopes covering the Mt. Elgon range has increased soil erosion episodes including sedimentation of river systems and landslides (NEMA, 2008 NEMA, 2004; Barungi *et al*. 2013). The farmers in this region, therefore, live to deal with a double tragedy of costly and inefficient land management strategies. Consequently, agricultural production has dwindled and food insecurity has escalated. It is regrettable that current national interventions to address the challenges of soil erosion in this region are insufficient or expensive. Strategies were required to increase food security and mitigate climate change.

One of the key strategies is to plant trees. In the Mt. Elgon region agroforestry has been a key strategy used by the ACIAR T4FS-2 project to reduce greenhouse gas emissions, restore land productivity and increase food security. The project fosters the importance of trees in fields and farming landscapes for enhancing and sustaining crop yield and food security. The second phase of the project focuses on identifying innovative approaches to address natural resource management issues; improving access to quality germplasm and tree management options (Figure 1); identifying market opportunities; capacity building and working within the science policy interface on agroforestry. During the project implementation, over 1,000,000 seedlings of assorted agroforestry tree technologies were distributed to over 500 farmers within the Mt. Elgon range. During the process, we observed that approval of the tree technologies especially by women and young farmers was still low, just like Franzel and Scherr (2002) reported inadequate rates of adoption and abandonment soon after uptake by 1989 of agroforestry projects in Africa (Patanayak et al. 2003). No matter how elegant, efficient, productive, and/or ecologically sustainable, agroforestry systems can contribute to sustainable land use only if they are adopted and maintained over long time periods (Sanchez 1995; Mercer 2004).

Adoption occurs when one decides to make full use of the new intervention as a best course of action for addressing a need (Rogers, 2003). 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 and Alavalapati, 2003). In fact researchers have lamented about how adoption and diffusion have lagged behind scientific and technological advances in agroforestry research, reducing the potential impacts (Adesina et al. 2000, Mercer 2004). As argued by Patanayak et al. (2003), this situation explains the concern of researchers and policy-makers to put more emphasis on socio-economic attributes, agroforestry technology dissemination and development. A study on adoption of agroforestry technologies by farmers in the Mt. Elgon region was commissioned. Adoption of agroforestry is considerably more complex than traditional agriculture because it usually requires establishing a new input-output mix of annuals, perennials, green manure, fodder and other components, combined with new conservation techniques (Rafiq et al. 2000).

Although a substantial amount of literature on agroforestry adoption has been published over the past 20 years (Franzel 1999; Mercer 2004; Nkamleu and Manyong 2005; Buyinza et al. 2008; Mwase et al. 2015), many of the studies concern specific geographical areas making it difficult to draw general conclusions. Different incentives, institutional mechanisms, and policies could be implemented to facilitate agroforestry adoption, depending to the specificities of an area (Nkamleu and Manyong 2005). Unfortunately, in rural highly populated places of developing countries, including the Mt. Elgon region of Uganda, data on factors driving adoption and performance of agroforestry technologies is scarce making it difficult for development partners to implement proper interventions. Achieving the full promise of agroforestry requires a fundamental understanding of how and why farmers make long-term land-use decisions and applying this knowledge to the design, development, and 'marketing' of agroforestry innovations (Mercer 2004).

By agroforestry we mean the practice of growing trees with other crops either simultaneously or in rotations with the purposes of diversifying products and increasing yield as well as conserving the environment. In this study we focused on trees growing independently or integrated on farms or landscape including the agro-forests, and contribute in various ways to the general ecosystem functions and livelihoods. The purpose was to assess factors hindering or facilitating promotion of agroforestry technologies amongst women and young farmers. In developing countries, there are important differences between men's and women's perceptions as well as young people's approaches to utilization and management of forest and allied tree resources (Maginnis et al. 2011; Mulugo et al. 2019). The specific objectives were to; i) determine the socio-economic traits of women and young farmers, assess the applicability and suitability of agroforestry technologies used under the various farming contexts, iii) Identify challenges, incentives and strategies for promoting agroforestry among women and young farmers in the Eastern Highlands of Uganda.

Figure 1: **Managing *Neolamarckia cadamba (Roxb.)* trial for timber production at Mbale Rural Resource Center (MRRC). Photo: Gerald Ongodia, 2019.**

1. STUDY AREA AND METHODS

2.1 Study Area

The study was conducted in three districts including Mbale (01°00′36″N 34°19′54″E), Manafwa (01°01′N 34°21′E), Bududa (01°00′36″N 34°19′54″E) in Eastern Uganda. The districts are situated within the Mt. Elgon range bordering Kenya in the East (Figure 2) Sironko District to the north, Bukedea, Palisa and Busembatia Districts in West and Tororo Districts in the Southwest.

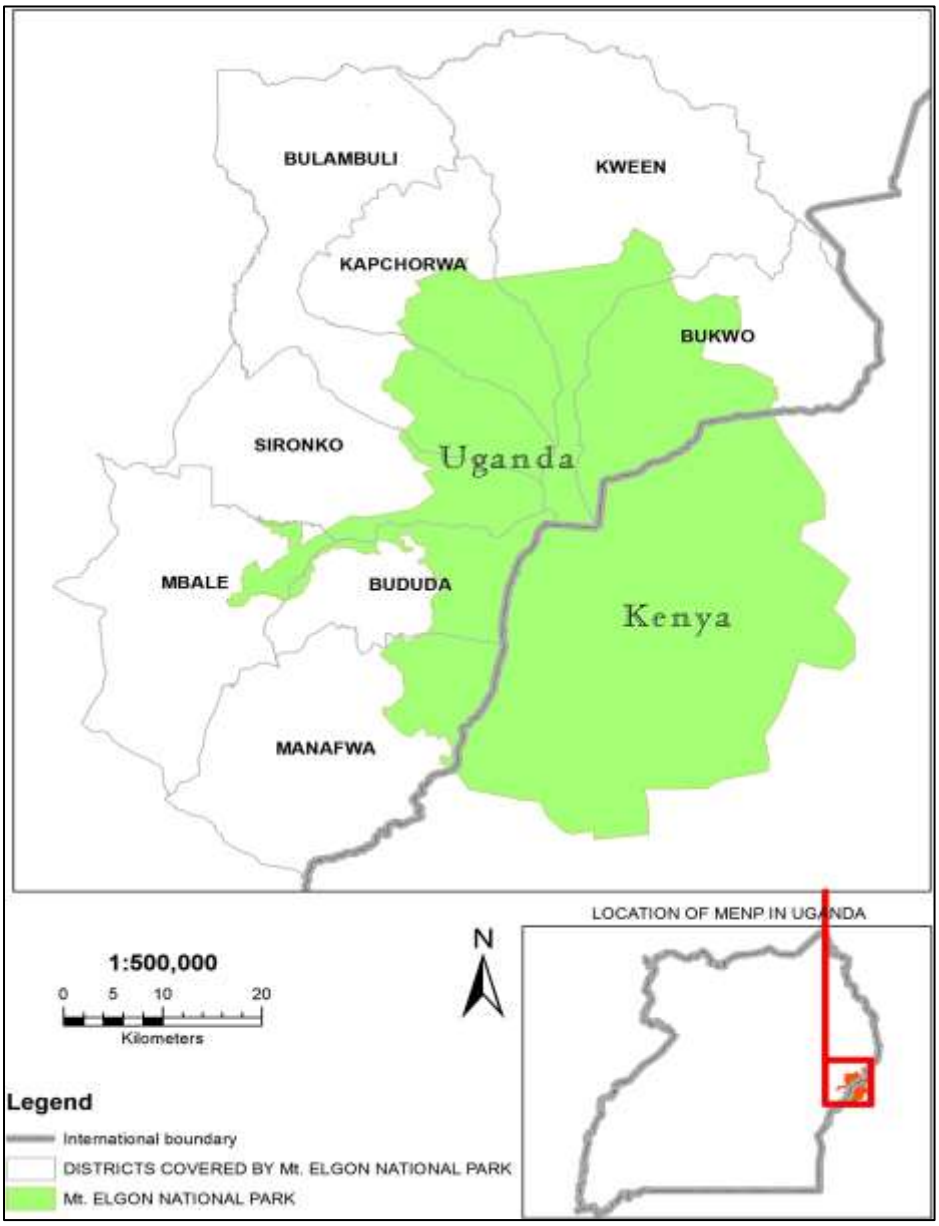

Figure 2: Location of the study districts in Eastern Uganda. Adopted from Nakakaawa et al. 2015.

Mt. Elgon (4322m), an extinct Pliocene shield volcano on the border of Uganda and Kenya, is one of the East African volcanic rings partly associated with the Great Rift System (Knapen et al. 2005). According to World Reference Base (WRB) classifications, the dominating soils in the Mt.

Elgon range include Acrisols, Ferralsols, Nitisols and Luvisols (Deckers et al. 1999). However, Malesu and Nyolei (2018) generally classified the soils of Mbale, Manafwa and Bududa as sandy, clay-loam, sandy-loam, sandy and clay (Figure 3). Most lands on the lower and outer slopes of the mountain and surrounding landscapes have rich soils, conducive for agriculture due to their volcanic origin and plentiful rainfall (Scott 1998).

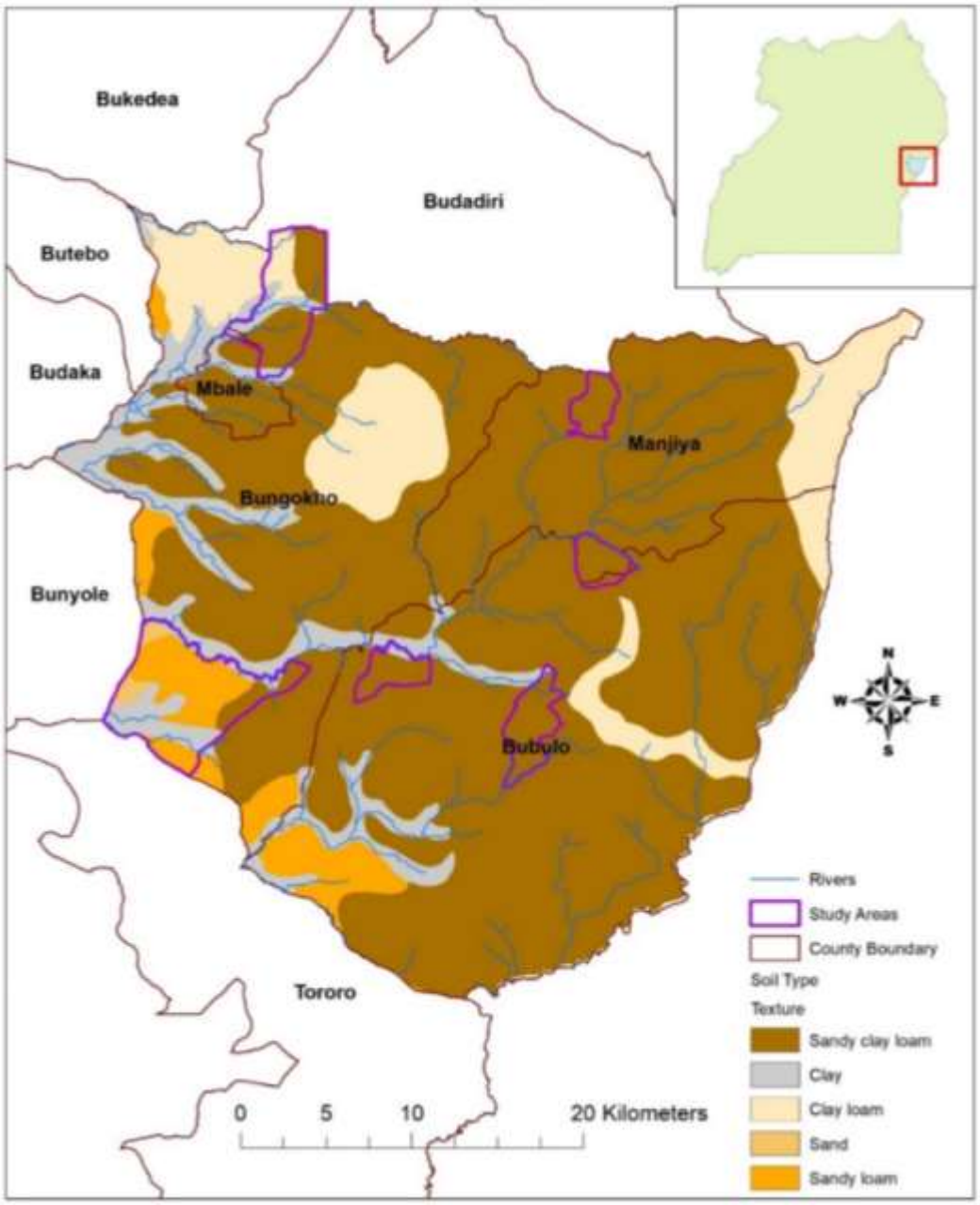

Figure *3*: Soil types in study area. Adopted from Malesu & Nyolei, 2018.

The vegetation of Mt. Elgon reflects an attitudinally controlled zonal belts commonly associated with large mountain massifs (Mugagga et al. 2012). Four broad vegetation communities are recognized including a mixed montane forest up to 2500m, bamboo forest and low canopy

montane forests existing from 2000-3000m and moorland above 3500m asl (Scott 1994). Vegetation types on Mt. Elgon include closed forests, closed bushes, open forests and wetlands (Table 1). The density and extent have reduced since 1973 due to clearing of land for agricultural production (Mugagga et al. 2012; IUCN, 2015).

Table 1: Type and extent of vegetation/ land cover of study area, Eastern Uganda. Adapted from Malesu and Nyolei, 2018.

Type	Slope (%)					Extent (Km^2)	%
	0 - 5%	*5 - 16%*	*16 - 30%*	*30 - 60%*	*>60%*		
Closed Forest	0.595	3.531	7.298	31.518	169.202	212.144	15.5
Grassland	0.094	0.507	1.641	6.833	10.179	19.255	1.4
Rain fed Agriculture	78.499	164.245	133.138	129.691	187.054	692.628	50.7
Urban/Settlements	6.721	6.583	2.996	1.426	0.604	18.330	1.3
Open Forests	2.978	8.558	10.207	22.991	58.950	103.685	7.6
Wetlands	2.714	2.266	0.579	0.253	0.124	5.936	0.4
Irrigated Agriculture	51.123	20.207	6.586	2.486	1.486	81.890	6.0
Bush/Shrub-land	17.708	45.623	48.469	53.254	59.322	224.376	16.4
Rock Outcrop	0.065	0.344	0.811	2.803	4.584	8.607	0.6

Agriculture is the main economic activity mostly practiced on extensively fragmented landholdings. The average size of farmland land ranges from 0.25-2 acres. The crops grown mostly include (*Zea mays* L.), beans (*Phaseolus vulgaris* L.), groundnuts (*Arachis hypogaea* L.), sweet potatoes (*Ipomea batatus* L.), cassava (*Manihot esculenta* Grantz), tomatoes (*Solanum lycopersicum* L.), Irish potatoes (*Solanum tuberosum* L.) and plantain (*Musa* L. spp.) (Knapen et al. 2006; Nakakaawa et al. 2015).

The Mt. Elgon range supports a high (average 5.6% per year) and rapidly growing population (Knapen et al. 2006), that is highly dependent on agriculture and natural resources for economic growth and livelihoods. About 1.5 million people live in in the study area (Petursson and Vedeld 2017) with high population densities (400–800 people/sq.km) (Soini 2007; UBOS 2014). Over 80% of the population is predominantly rural and their livelihoods depend largely on access to land and natural resources including forests and allied tree systems.

The average annual rainfall is 1500 mm, with two distinct wet seasons (occurring in the months of April–June and August–November) separated by a pronounced dry period from December to February (Knapen et al. 2005).The mean annual maximum and minimum temperature range between 32°C and 15°C (Buyinza et al. 2019).

The Elgon range provides a wide array of resources (including firewood, medicine, construction materials, pastures and forest foods such as bamboo mushrooms for both the *Bamasaba* and the *Sebei* communities (Scott, 1998; Gosalamang et al. 2008; Katto 2004; Namugwanya 2004; Norgrove 2002). The livelihoods of *Bamasaba* and *Sebei* are heavily dependent on agriculture and access to forest resources for subsistence and commercial purposes (Nakakaawa et al. 2015). The forests and trees in the region are regarded as important sources of fuel, timber, fiber, medicine as well as handicraft and building materials. Forests and trees are also very useful in the cultural functions of *Bamasaba* and *Sebei*, the native people living on the slopes of Mt. Elgon. Various trees and shrubs have been promoted and integrated into the landscape as intervention to flooding and soil erosion and degradation in the region.

2.2 Data collection methods

2.2.1 Literature review

A review of literature was conducted to inform the sampling design during data collection. The key documents reviewed included case studies and research reports from Mt. Elgon region on tree planting projects, collaborative resource management and rural livelihoods, Landslides characteristics and causal factors, Conservation resource use agreements and management plans, by Uganda Wildlife Authority (UWA), resource use policy and Strategy and related documents by the International Union for Conservation of Nature (IUCN), International Center for Research in Agroforestry (ICRAF) in Uganda. The documents included research reports such as the Mapping Land & Water Management Options for Uganda, Wildlife Policy 2014; Mt. Elgon National Parks General Management Plan, District Environment Plans and MENP's Multiple Use MoUs. Also the General Management Plan for MENP and associated ecosystems and reports on their implementation were reviewed

2.2.2 Preliminary field visits

As part of the data collection process, preliminary visits to the project implementation sites were carried out for purposes of getting firsthand information on general farming practices, tree planting trends, challenges and motivations from stakeholders. During this process, the farmers participating in the project were identified and engaged using a semi-structured questionnaire. The farmer engagements were useful in generating new ideas on tree planting activities, benefits, challenges and opportunities. The new ideas were used to revise the data collection tools and field work plans and sampling strategies during the main survey.

2.2.3 Participatory Rural Appraisal (PRA)

A total of 70 local farmers were engaged in discussions on agroforest resource use trends, management problems, and priority list of tree species. Data were collected on agroforest resource uses such as the multi-purpose trees priorities, approaches to planting or retaining trees on farm under different contexts, frequency of resource extraction, quantity extracted, willingness to manage agroforests and benefits expected. These data were collected through 10 Focus Group Discussion (FGD) FGDs covering at least one farmers group per sub-county (Figure 4). Using a focus group discussion guide, the participants were facilitated in *Lumasaba* the main local language. Experience was a very important aspect of a participants and was based on number of years involved in agroforestry practices/technologies (including farmer trainings, community sensitization activities and farm demonstrations) of the farmer in the study (Figure 5). Men, women, youths, community leaders, special interest groups and other community members knowledgeable in the socio-economic dynamics of the communities were included. Separate FGDs were carried out for youths and women.

Figure 4: Facilitating a Focus Group Discussion during the main data collection process in Busiu Sub-county, Mbale District. Photo John Wakhooli, 2019.

Figure 5: Richard Namunyu explaining the benefits of using Cordia africana in a coffee and bananas agroforestry system to farmer in Butta sub-county during a training of trainers workshop in Manafwa District. Photo: Charles Galabuzi 2018.

2.2.4 Key informant interviews

A total of 10 Key Informant Interviews (KIIs) targeting local leaders, development partners including officers at ICRAF, Uganda Wildlife Authority (UWA), National Forestry Authority (NFA), National Forestry Resources Research Institute (NaFORRI), Mountain Elgon Tree Growers Enterprise (METGE), World Vision Uganda, Mbale-Coalition Against Poverty (Mbale-CAP) IUCN, Eco-TRUST were conducted. The organizations have played a major role in promoting tree planting and livelihood improvement in the Mt. Elgon region. Respondents were engaged on incentives, challenges and strategies for promoting adoption of agroforestry tree technologies, progresses and challenges by women and young farmers.

2.2.5 Individual semi-structured interviews

A random sampling strategy was employed to identify farming households to participate in the individual semi-structured interviews. A random sample has the advantage of reducing costs of data collection from larger groups and allows researchers to employ probability tests on a population. A list of farmers per sub-county was obtained from the project staff and random numbers were assigned to each farmer. The sampling unit was a farming household and selection of respondents per household did exclude men. The main respondents were women and youth however in households where men as heads expressed interest to participate were also interviewed as well. Issues of development activities that require contribution of land were very sensitive in the Mt. Elgon region because land is very scarce. Moreover, the women and children did not have sufficient rights over its use while the male youths would have a right after inheriting from their fathers. If one group was excluded from such a study, conflicts would escalate.

A total of 170 farming households were selected. Among these, 65 farmers including 30 and 35 were from Namanyonyi and Busiu sub-counties in Mbale District. Another 70 farmers were identified from Manafwa District including 40 in Buta and 30 Nalwanza sub-counties. In Bududa District only 35 farmers in Namabya sub-county were involved. The interviews were guided using semi-structured questionnaires. Questionnaires were prepared and administered on a house-to-house basis. The interviews were conducted in *Lumasaba* and *Luganda* and later translated into English. *Lumasaba* is the main local language, however a reasonable number of participants especially in Namanyonyi and Busiu sub-county communicated in Luganda. Permission to use either language was requested before engaging the respondents. Data were collected on socio-economic characteristics of farmers, agroforestry tree technologies, benefits, challenges, incentive and strategies for promoting adoption of agroforestry by women and youths.

2.2.6 Data analysis

Data from focus group discussions, key informant interviews and farm visits were analyzed qualitatively while data from individual semi-structured interviews were analyzed quantitatively using SPSS 20.0. The qualitative data were simultaneously analyzed together with the respondents. Analyzing data alongside field work, allows for better thinking about its existence and generates new strategies for subsequent gatherings (Miles and Michael 1999). Quantitative data summaries were transferred to Microsoft Excel for graphical presentation. Descriptive statistics including means, standard error and standard deviations were computed to determine the average household size, average period of farming and household income earnings per annum. Approaches to analyzing agroforestry adoption have relied on logit models to analyze adoption decisions in which a dependent variable is binary (Mercer 2004). In particular, they permit for interpretation of the dependent dichotomous variable as a probability. In these models, farmers are assumed to make adoption decisions basing on objectivity of utility maximization (Nkamleu 2005). Under most conditions, the two models yield similar results. The further

statistical analysis technique of logit regression employed in this study is also well documented in literature (e.g. Cramer 1991; Nkamleu and Adesina 2000; Nkamleu and Coulibaly 2000; Nakamleu 2005).

2. RESULTS AND DISCUSSION

3.1Socio-economic traits of youth and women farmers in Mt Elgon region

Out of 170 farming households involved in semi-structured interviews, almost 86% were male headed with a wife or wives. The result is consistent with UBOS, reports of 2017 were more male headed households (89%) and less female headed households (10%) were recorded with the Elgon range. Up to 64% of the respondents were female and 36% male. Most (60%) were engaged in agroforestry as casual laborers while other served as spouses (36%) and children (4%) of landlords. The respondent farmers were generally young and vibrant with an average age class of (25 – 34) years old. They were commonly (82%) illiterate (including 47% and 35% with primary and secondary education respectively) and used primitive methods and tools to farm. According to Amaza and Tashikalma (2003), the literacy level of farmers is important as it determines the rate of adoption of improved technology for increased productivity. For example, slash and burning was encountered or reported on almost 89.6% of the participating household while soil ploughing was by use of a hoe was reported by almost 96% of the respondents. Pruning tree branches was by use of a pang or a knife enhance with a long pole to reach higher branches, especially in banana-coffee agroforestry systems.

Table 2: Socio-economic traits of women and youth farmers in Mt. Elgon region, Uganda

Socio-economic traits	Frequency	%
Gender		
Female	109	64.1
Male	61	35.9
Position in Household		
Child	6	3.5
Spouse	62	36.5
Other (domestic worker, casual laborer)	102	60.0
Age class of respondents		
15y but less than 25y	20	11.8
25y but less than 35y	84	49.4
35y but less than 45y	27	15.9
45y but less than 55y	22	12.9
55y but less than 65y	11	6.5
65+y	4	2.4
Education level		
No formal education	7	4.1
Primary education	80	47.1
Ordinary level	60	35.3
A level	6	3.5
Tertiary (University/Vocational training)	17	10.0
Household type		
Male headed, with wife/wives	146	85.9
Male headed: single, divorced or widowed	6	3.5
Female headed: single, divorced or widowed	15	8.8
Female headed, husband away	2	1.2
Household income levels		
Less than 500,000	68	40.0
500,001-1,000,000	37	21.8
1,000,000-2,500,000	22	12.9

2,500,001-5,000,000	25	14.7
5,000,001-10,000,000	16	9.4
10,000,000+	2	1.2

The average household size (average number of people living in one household) was about 5 persons (Std. Error = 0.169; Std. Deviation = 2.193 years) and had lived in the area for an average of 21.05 years (Std. Error = 0.916; Std. Deviation = 11.948 years). Up to 70% of the farmers were engaged in farm business as the most important source of household income, earning an average of UGX 896,411.76 equivalent to USD$250 (Std. Error = UGX98, 122.14 (USD$ 27); Std. Deviation =UGX 1,279,356.14 (USD$ 352) per annum (Table 3).

The farmers earned income by selling products such as maize (*Zea mays* L.), beans (*Phaseolus vulgaris* L.), groundnuts (*Arachis hypogaea* L.), sweet potatoes (*Ipomea batatus* L.), cassava (*Manihot esculenta* Grantz), tomatoes (*Solanum lycopersicum* L.), Irish potatoes (*Solanum tuberosum* L.) and plantain (*Musa* L. spp.) fruits (including passion, mangoes, avocado, and jackfruits), milk, eggs, poles, timber and vegetables.

Almost 36% of the farmers were engaged in other income generating activities including brick laying, charcoal burning, brewing, selling firewood, beekeeping, art and craft, fish farming, *Boda-Boda* transport, retail shops, and earned less than UGX 500,000 (USD$ 140) per annum. Up to 50% of these farmers also hired labor to engage in labor intensive activities (including trenching, bush clearing, ploughing, watering, mulching, and staking) on farms (Figure 6).

Up to 98% owned land, cultivated food crops and either owned scattered trees on farm or a woodlot. Almost 76% of the land including 38.2% was donated and 34.3% inherited from their past relatives, 23.8% cultivated on purchased land and only 3.6% rented to grow crops. As much as most of the land was reported to be owned, 64.7% of the farmers did not have land tittles, 30% held tittle deeds suggesting a high level of land tenure insecurities.

Table 3: Statistic mean of income earned per activity in Mt. Elgon area

Statistic	Valid	Mean (Ugx)	Std. Error of Mean (Ugx)	Std. Deviation (Ugx)
Farm business	170	896,411.76	98,122.14	1,279,356.14
Brewing	170	8,117.65	2,809.65	36,633.29
Casual labour	170	187,882.35	62,205.89	811,065.62
Retail shop	170	271,764.71	62,971.02	821,041.59
Charcoal burning	170	37,588.24	15,898.99	207,297.50
Firewood selling	170	35,411.76	10,737.22	139,996.22
Construction	170	64,411.76	21,489.27	280,185.81
Brick making	170	84,411.76	34,188.51	445,763.70
Boda-Boda transport	170	57,941.18	25,094.17	327,187.94
Beekeeping	170	3,529.41	3,529.41	46,017.90
Tree nursery	170	26,470.59	11,272.78	146,979.09
Public service	170	31,764.71	17,209.09	224,379.10
Local artisan	170	41,176.47	20,818.41	271,438.91
Others	52	86,539.81	59,410.64	428,416.25

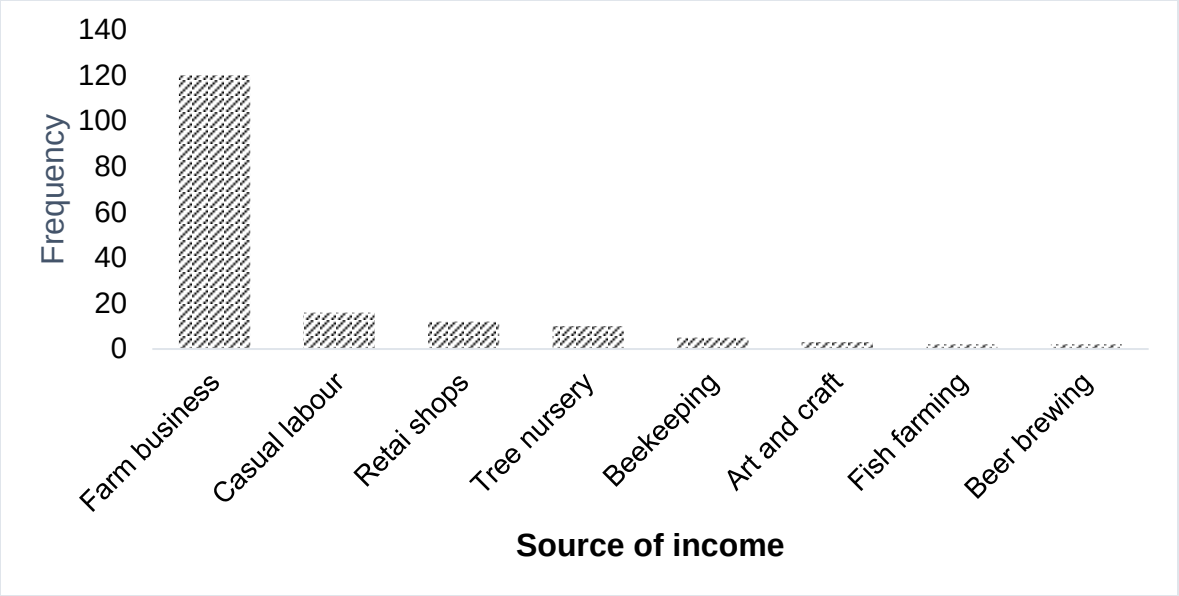

Figure 6: Income generating activities of farming households in Mt. Elgon range

Socio-economic factors have been widely studied and found to influence farmers approach to farming activities in agroforestry systems. For example, Buyinza et al. (2007), reported that age structure, education status and gender constituent of a farming household influenced on-farm tree planting while Mulugo et al. (2019) observed that gender was rendered extraneous on cultural ways of knowing the forest and allied tree system management but the farmer's age substantially affected the timber harvesting propensities in central Uganda. In the current study gender and age were not considered important because sample sampling was biased toward women and young farmers. The average age class suggests the age at which most farmers become active in farming or agroforestry enterprises. While some women indicated that they got engaged in tree planting only after they got married, the men reported that by 20 years of age they were already involved agroforestry following their father's footsteps suggesting that more men in this region are involved in agroforestry by default.

Just as observed in other studies (Nabanoga 2005; Buyinza and Nabalegwa 2007; Buyinza et al. 2008; Galabuzi et al. 2015; Galabuzi et al. 2016; Mulugo et al. 2019) in Uganda, women not inherit land and probably have limited interest in farm components including trees because they are not financially motivated to participate. Studies in Ghana (e.g. Jamala et al. (2013; Obeng and Weber 2014) reported household labor, willingness to plant trees on farms to be the predicting factors affecting decision to adopt agroforestry practices as inheritance of land negatively affected the decision to adopt trees on farm. In the case of Mt. Elgon region, the young men had interest in agroforestry system components possibly because they expected to take over responsibility from their fathers to support their widowed mothers and orphaned siblings as well as help them to start or sustain a new family. In this region however, it should be observed that some intermarriages have contributed some contamination in ways of doing things on farm. For example some women had acquired land, planted trees and were involved in several tree based enterprises including apiculture, fish farming and tree breeding in nurseries.

For farming to dominate other income generating activities, is consistent with the findings of the National Planning Authority (NPA). According to NPA (2015) farming employed 72% (including 77% women, 63% youths living mainly in rural areas) of the population in Uganda. This result further suggests that productivity of a farm business can potentially be increased through adopting better technologies including agroforestry in Mt. Elgon region. Moreover, agroforestry

has been reported to increase annual returns in an acre 10 - 12 times with a wide range of social and ecological benefits (Gangadharappa, et al. 2003).

2.2 Application and suitability of agroforestry technologies under farming contexts

3.2.1 Farming activities, technologies and practices on-farm in Mt. Elgon region

The women and young farmers reported to be involved in various activities including tree planting, land clearing, harvesting, weeding, pruning, transportation, mulching, pesticide and herbicide application, tree nursery management, seed collection, fruit processing, brickmaking and domestic work (including collecting firewood, cooking and fetching water. The farmers in the Mt. Elgon region were knowledgeable about various technologies and practices including 28% reported tree planting along the slope (including woodlots, trees scattered on farm and along boundaries), 26% establishment of bush bands (e.g. along the slope using *Calliandra calorythrsus* and elephant grass (*Pennisetum purpureum*), 15%construction of soil erosion trap trenches and 9% indicated breeding selected tree and shrub species such as *N. cadamba*, *Maesopsis eminii*, *Eucalyptus grandis*, *Cordia Africana, Grevillea robusta* and *Leucaena leucocephala* (Figures 7&8). Various agroforestry practices and technologies were observed on farms in the study area. Out of the 170 farming households visited, up to 65% practiced boundary planting, 49% scattered trees on farm, and 38% owned home gardens. Other technologies included 18% practiced strip cropping/hedgerows, 13% with terraces while 12.9%% established fruit orchards and 5.8% planted trees along river banks (Figure 9).

Myrtaceae, Proteaceae Anacardiaceae, Rutaceae and Fabaceae families comprised the most species planted while Moraceae and Boraginaceae consisted species deliberately retained on-farm (Table 5). During FGDs the farmers elucidated that the choice of species planted or retained was based on anticipated needs of a farming household and the local farming context. For example *Calliandra calorythysus* was planted in strips and crops between along the slop to help trap the soil during heavy rains. The hedge eventually served as a source of fodder for animals and the flowers provided bee foliage in a few household as well. Moreover, tree species such as *Cordia africana, Albizia coriaria, A. gumifera, Maesopsis eminii, Khaya anthotheca*, *Spathodea campanulata*, *Milicia excelsa, Antialis toxicalia* were generally scattered on-farm to provide shade to crops and animals and complimented very well on the appearance on the landscape.. The crops commonly grown by farmers in agroforestry systems were maize (69.4%), beans (58.2%), bananas (29.4%) and coffee (25.3%) (Figure 10).

In the Mt. Elgon region, farmers experience inadequate supply of firewood and landslides owing to the heavy deforestation (NEMA, 2016). *Grevillea robusta* and *Eucalyptus grandis* were consequently,commonly established as woodlots and along farm boundaries while *Mangifera indica*, *Artocarpus heterophyllus*, *Persea americana* and *Citrus* spp. were encountered as fruit orchards, trees on farm or along the boundary. While *E. grandis* and *G. robusta* are commonly appreciated for firewood, charcoal, timber, poles, fodder, bee forage, shade, ornamental, soil conservation and windbreak (Bekele-Tesemma, 2007; Katende et al., 1995) the low quality of tree germplasm is always recognized as a limiting factor for adoption (Nabanyumya, 2016). This observation is consisten with the farmers in the Elgon region. A more robust community-based germplasm strategy that ensures quality and accreditation source of tree planting materials would be an incentive for adoption of agroforestry among farmers (Nyoka et al., 2011).

Figure 7: Maize farming within Calliandra calorythrsus hedge bunds across the slope in Busiu sub-County, Eastern Uganda. Photo: Charles Galabuzi 2019.

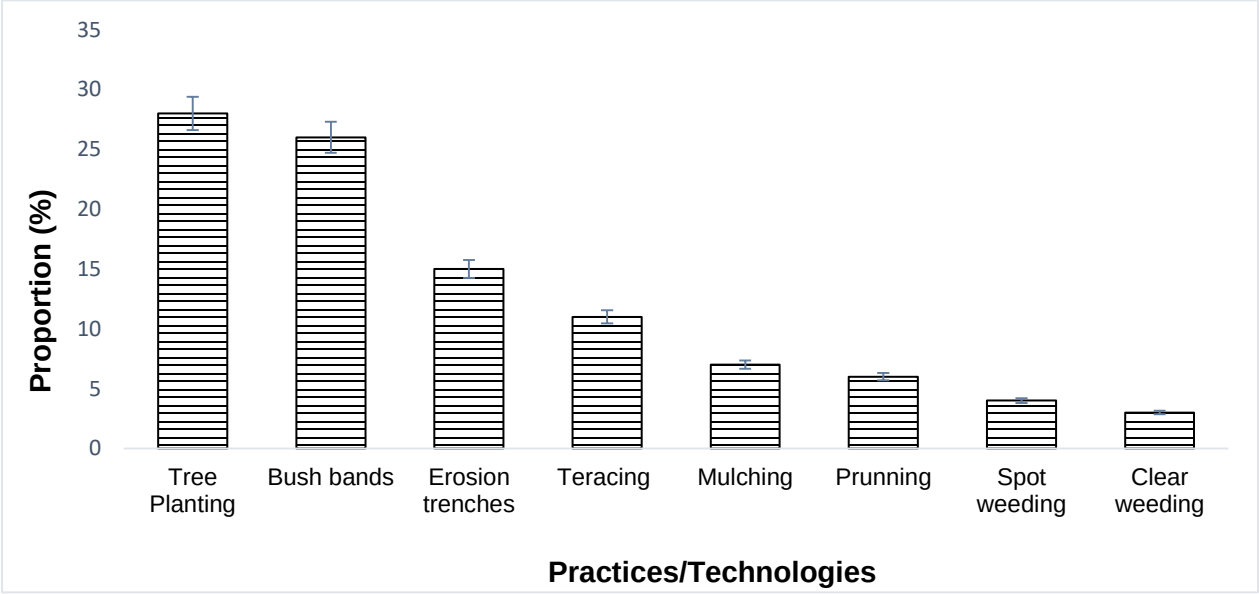

Figure 8: Agroforestry practices/technologies known by women and youth farmers in Mt. Elgon region

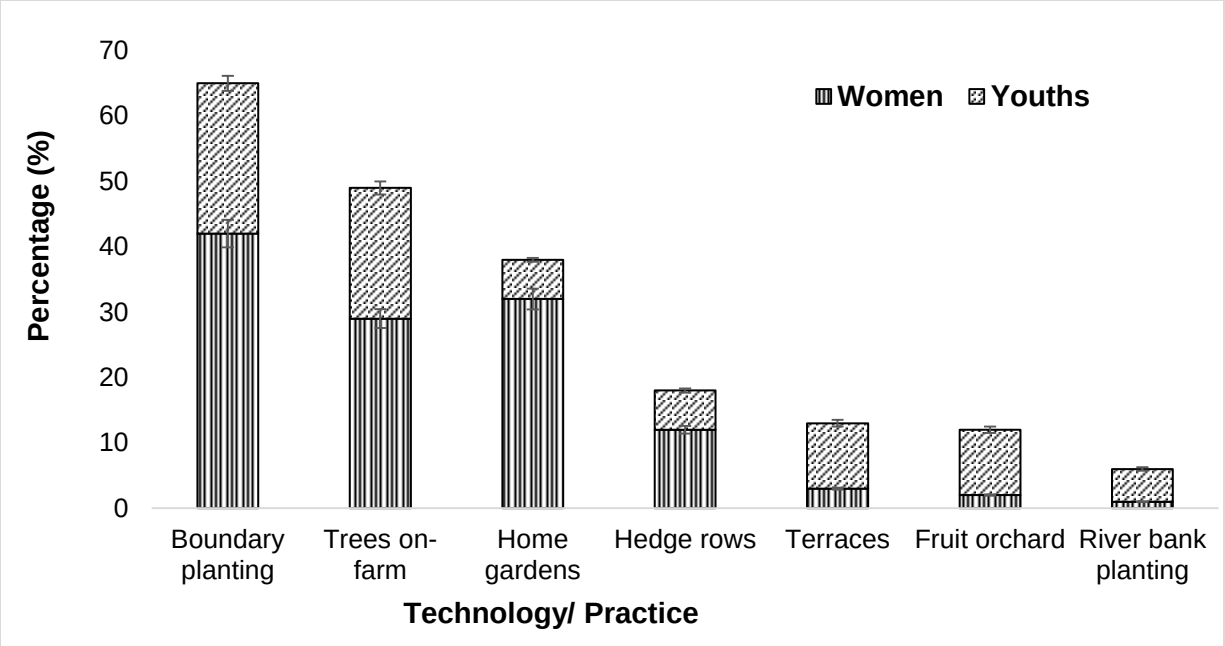

Figure *9*: Agroforestry technologies/practices observed on farms in the Elgon region

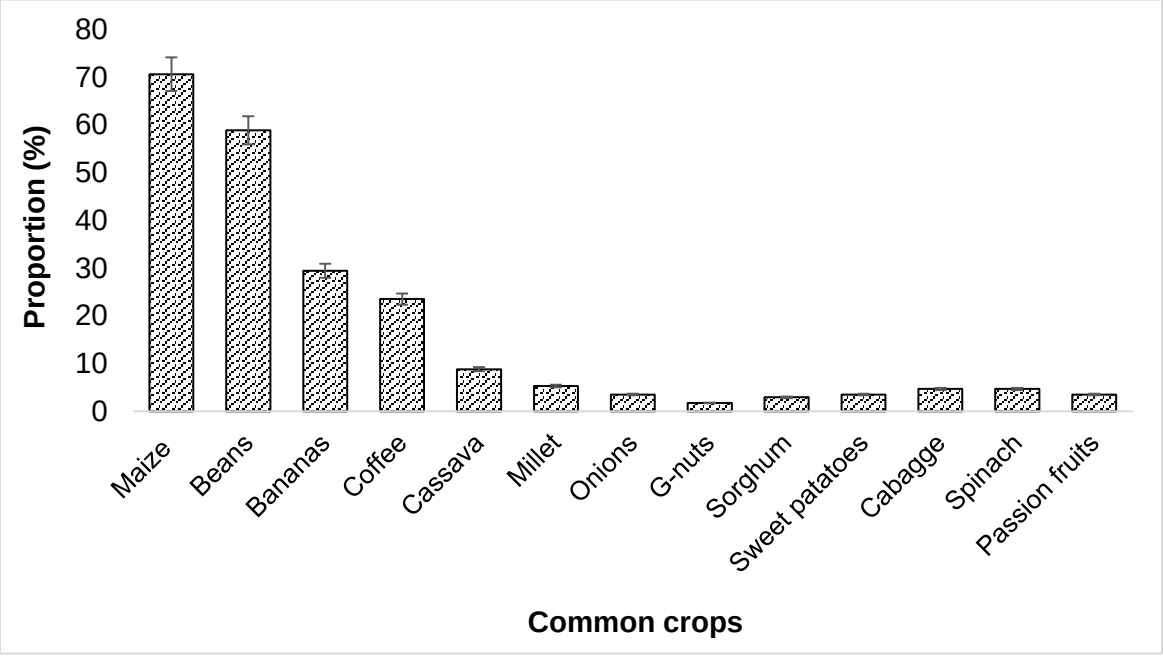

Figure 10: Common crops in agroforestry systems within the Mt. Elgon range, Uganda

Table 4: Common agroforestry species under faming contexts and local uses in Mt. Elgon region.

Botanic name	Family	Context	Local Uses	Freq.
Albizia glabberima (Schumach. & Thonn) Benth	Fabaceae	Trees on farm	Timber, charcoal, firewood, medicine, shade	5
Albizia zygia (DC.) Macbr	Fabaceae	Trees on farm	Timber, charcoal, firewood, medicine, shade	10
Albizia coriaria	Fabaceae	Trees on farm	Timber, charcoal, shade, firewood, medicine	28
Antiaris toxicaria (Rumph.ex Pers.) Lesch	Moraceae	Trees on farm	Medicine, timber, bark cloth	1
Artocarpus heterophyllus Lam	Moraceae	Trees on-farm, fruit orchard	Food, firewood, shade	9
Calliandra calothyrsus (Meisn.)	Leguminosae	Hedgerows	Fodder, bee foliage,	23
Carica papaya L.	Caricaceae	Fruit orchard, trees on farm	Food, medicine	5
Citrus sinensis (L.) Osbeck.	Rutaceae	Fruit orchard and trees on- farm	Food, medicine, firewood	10
Coffea arabia L.	Rubiaceae	Trees on-farm	Food, firewood, charcoal	20
Cordia africana Lam	Boraginaceae	Trees on farm	Shade, timber, firewood	05
Dracaena fragrans	Ruscaceae	Boundary planting	Land demarcation, medicine	
Erythrina abyssinica Lam. Ex DC.[1]*	Fabaceae	Trees on farm	Medicine & firewood	01
Eucalyptus grandis Hill ex Maid.	Myrtaceae	Woodlots, riverbank planting	Timber, poles, stakes firewood	91
Ficus exasperata Vahl	Moraceae	Trees on farm	Firewood, shade & medicine Craft	03
Ficus mucuso Welw. Ex Warb	Moraceae	Trees on farm	Timber, Firewood, shade & medicine	05
Ficus natalensis Hochst.	Moraceae	Trees on farm	Shade, firewood, medicine, soil conservation	15
Ficus sur	Moraceae	Trees on farm	Firewood, shade & medicine	01
Grevillea robusta A.Cunn. ex R.Br.	Proteaceae	Boundary planting, woodlot	Firewood, timber, shade	75
Khaya anthotheca (Welw.) C. DC	Meliaceae	Trees on-farm		01
Maesopsis eminii Engl.	Rhamnaceae	Trees on farm	Timber, firewood & medicine	15
Mangifera indica	Anacardiaceae	Fruit orchard	Food, medicine, firewood	42
Markhamia lutea K. Schum.	Bignonaceae	Boudary planting, trees on farm	Timber, poles & medicine	02
Mellia volkensii Guerke	Meliacea	Trees on-farm, woodlots	Timber, firewood	26
Milicia excelsa (Welw.) C. Berg.	Moraceae	Trees on-farm	Timber, firewood	01
Moringa oleifera Lam.	Moringaceae	Trees on farm	Medicine and soil conservation	01
Neolamarckia cadamba (Roxb.) Bosser. Bosser, J.	Rubiaceae	Trees on-farm	Shade, firewood, timber	15
Persea americana Mill.	Lauraceae	Fruit orchard and trees on-farm	Food, firewood, shade	12
Pinus spp.		Woodlots	Timber, firewood, boundary	11
Polycias fulva (Hiern) Harms	Araliaceae	Trees on farm	Timber, shade &firewood	01
Psidium guajava L. (guava)	Myrtaceae	Fruit orchard, trees on farm	Food, medicine, firewood	01

Sesbania sesban (L.) Merr**.**	Fabaceae	Fodder bank	Soil manure, animal feeds, firewood	01
Spathodea campanulata P. Beauv.	Bignoniaceae	Trees on farm	Timber, medicine, firewood, shade	04
Syzigium cumini (L.) Skeels	Myrtaceae	Trees or farm	*Food medicine, firewood and shade*	04

3.2.2 Family level of involvement, and benefits from applying agroforestry technologies by women and youth in Mt. Elgon region

On-farm tree management practices were carried out by different family members including up to 45% adult male farmers, 22% women, 20% youths (Figure 10). Among the benefits, the women mentioned economic benefits including self-employment opportunities (40.2%), increased crop yields (34.8%), supply of animal feeds (14.3%) and soil and water conservation (10.7%). The youths on the other hand reported 39% income, food (23.1%), and shelter (18.9%), firewood (10%), and bean / tomato stakes (9%) as the main benefits (Figure 11). Other benefits mentioned included improved land management, reduced incidences of pest and diseases, recharge of underground water, windbreaks, reduced conflicts related to natural forests and trees, and improving the general appearance of the Elgon landscape.

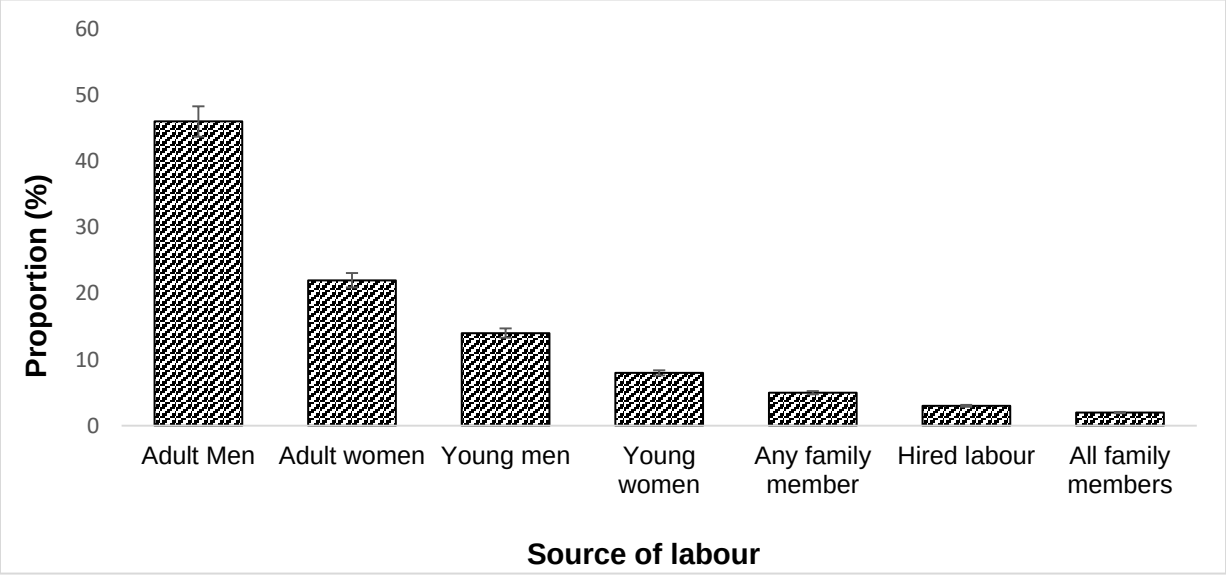

Figure 10: Level of family involvement in management of agroforests in Mt. Elgon region, Uganda

This trend suggests variation of land rights among family members. Studies (e.g. Okullo et al. 2003; MAFAP 2013; Obeng and Weber 2014) onsereved that generally insecure land tenure has a negative impact on adoption of agroforestry and that women disengage from agroforestry investments where only men are responsible for land ownership, management, resource allocation and major income generating activities. In this study the famers revealed that some family members may become hesitant to work on farm or make investment due to lack of titular rights. In the Mt. Elgon region, more adult male farmers were involved in agroforestry activities than adult women farmers. A similar trend followed down to young male farmers compared with young female farmers. This result suggest that adult men and or their sons were preferred to inherit land from their parents.

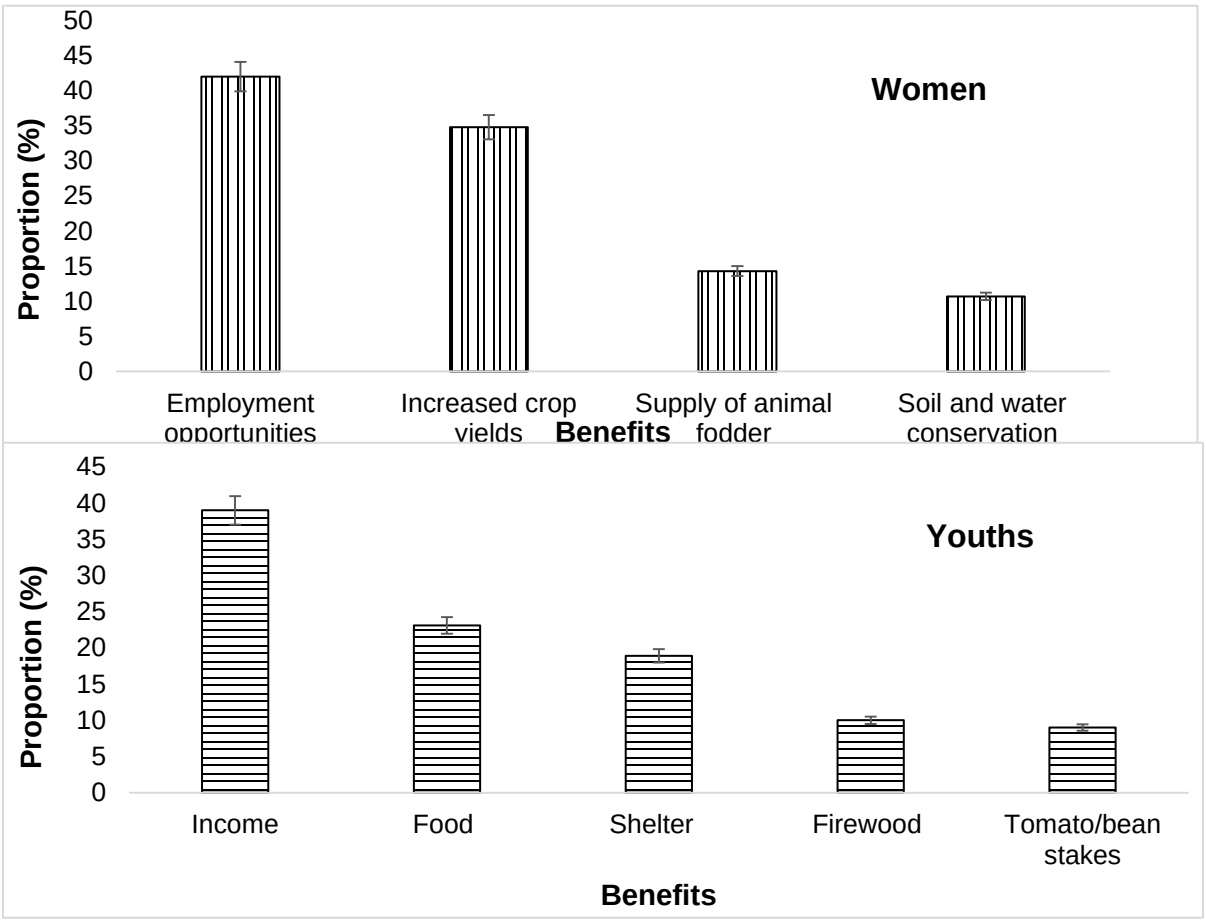

Figure 11: Benefits from various agroforestry technologies by women and youth in Mt. Elgon region.

3.3 Challenges, incentives and strategies for effective adoption of agroforestry among women and young farmers in Mt. Elgon region

On one hand, land scarcity (65.9%), inadequate supply of germplasm (45.9%), lack of market information (27.1%) and limited technical knowledge (22.9%) were among the major challenges highlighted by women farmers (Figure 12a). The young farmers on the other hand reported land scarcity (52%) lack of capital (28%), pest and disease outbreak (11.8%), market price fluctuations (5%), trees competition for water (3.2%) among the major challenges (Figure 12b). The other challenges included lack of market for agroforestry products, long rotation period for trees, conflicts with neighbors (e.g. when tree roots and crown cross to other plots, compete with the neighbors crops for water, nutrients and shade), climate change and perceived low benefits from tree-crop interactions on farm.

Furthermore, different agroforestry activities were faced with various challenges. For example up to 62% tree planting households were was obstructed by land scarcity while 57% were affected by uncertainty over weather conditions. Tree planting in other households was hindered by water scarcity (45%), low quality of tree germplasm (33.5%), pest and disease infestation (22.4%), landslides (13.8%), limited forestry advisory services, 8% low tree survival and 5% limited market information (Figure 13). The other activities specifically affected including harvesting, land preparation, transportation and seed collection are detailed in table 5.

On the other hand, the motivations for practicing or adopting agroforestry technologies included farmer training and sensitization (32.4%), increasing demand for tree products (18.8%) including (firewood, bean/tomato/banana stakes, timber, shade and protection against wind and landslides) and access to free seedlings (18.8%) were among the main incentives for adopting agroforestry tree technologies. The other incentives included fertile soils (12%), favorable weather conditions (9%), farmer group cooperation (6%) and government policy on tree planting (3%) (Figure 14).

The challenge of insecure land tenure is envisaged in literature by many authors as a limiting factor for adoption of agroforestry (FAO, 2005). FAO (2005) however lists other challenges to include adaptation to local conditions, availability of information and training, government and project support, linking farmers to markets, insecure land tenure and exemptions from government ordinances and decentralized, community-based germplasm strategies.

Adaptation to local conditions as a factor influencing adoption of agroforestry can be explained by the competing household schedules, natural calamities, hostility of neighbors and inadequate labor among factors envisaged in the present study. Among the households, 23.5% realized there was limited skills and knowledge about agroforestry. Linking farmers to markets can be explained by absence of ready market and high transport costs. The community-based germplasm strategies are envisaged by identified challenges as poor quality seedlings, inadequate seedlings and delayed supply of seedlings. An agroforestry system is likely to take three to six years before benefits begin to be fully realized compared to the few months needed to harvest and evaluate a new annual crop or method (Franzel and Scherr 2002). These characteristics can enhance opportunities for adoption by allowing more farmer experimentation and adaptation but can also complicate analysis of who adopts, what they adopt, and how they modify the system adopted (Vosti et al. 1998).

3.3.1 Strategies for effective adoption and implementation of agroforestry

Various strategies were highlighted by stakeholders. Farmer training (71.2%), community sensitization (48%), proper timing of seedling distribution (48%), establishment of community satellite nurseries (30%), promoting fast growing tree species (28%) and improving access to market information (25%) were among the major strategies identified by farmers. The other strategies included improving community farm access roads (25%), establishment of tree planting byelaws (15%) and provision of tree planting credit facilities (19%) Figure 15).

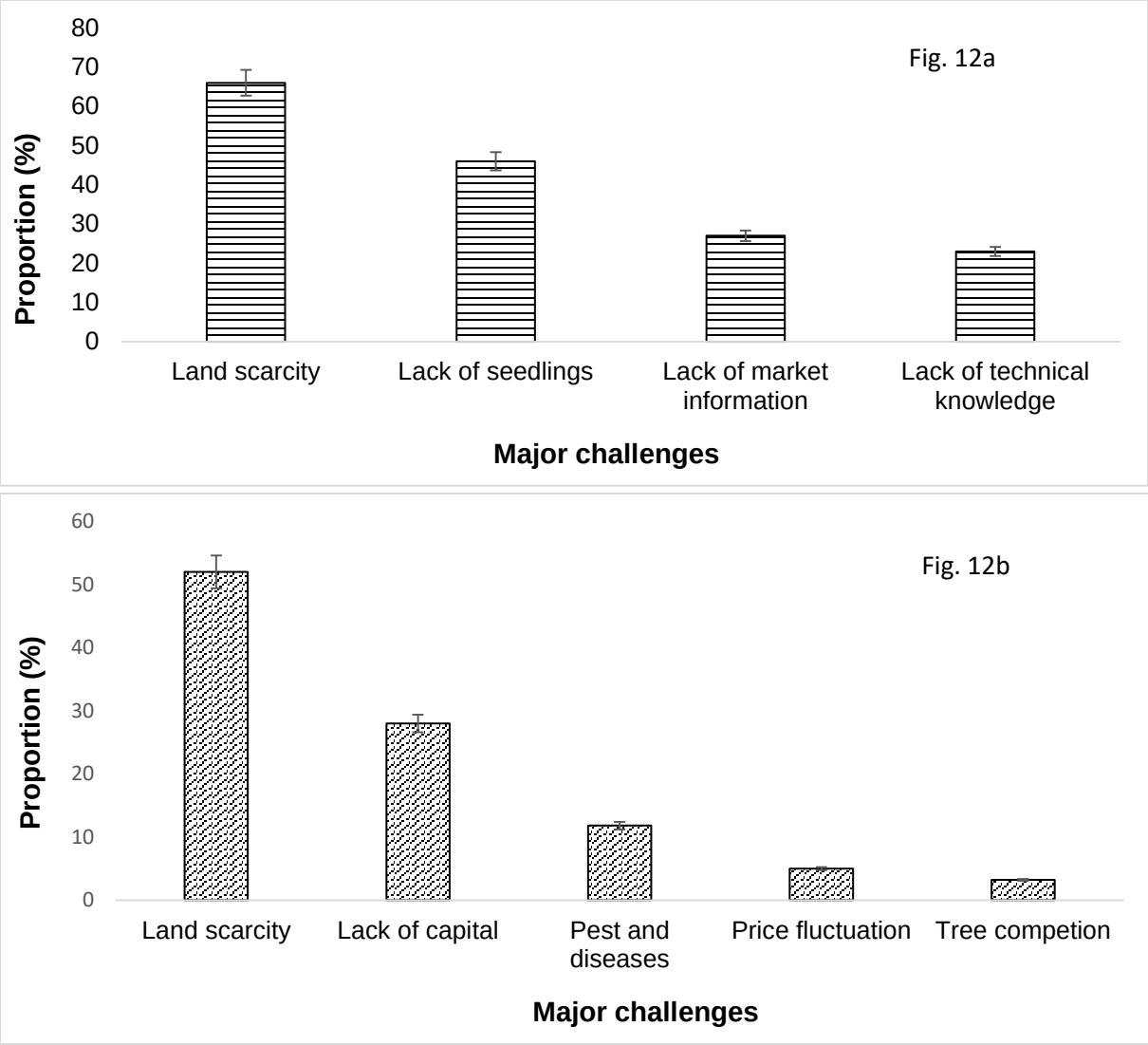

Figure 11a&b: Challenges faced by women and young farmers within the Mt. Elgon range, Eastern Uganda

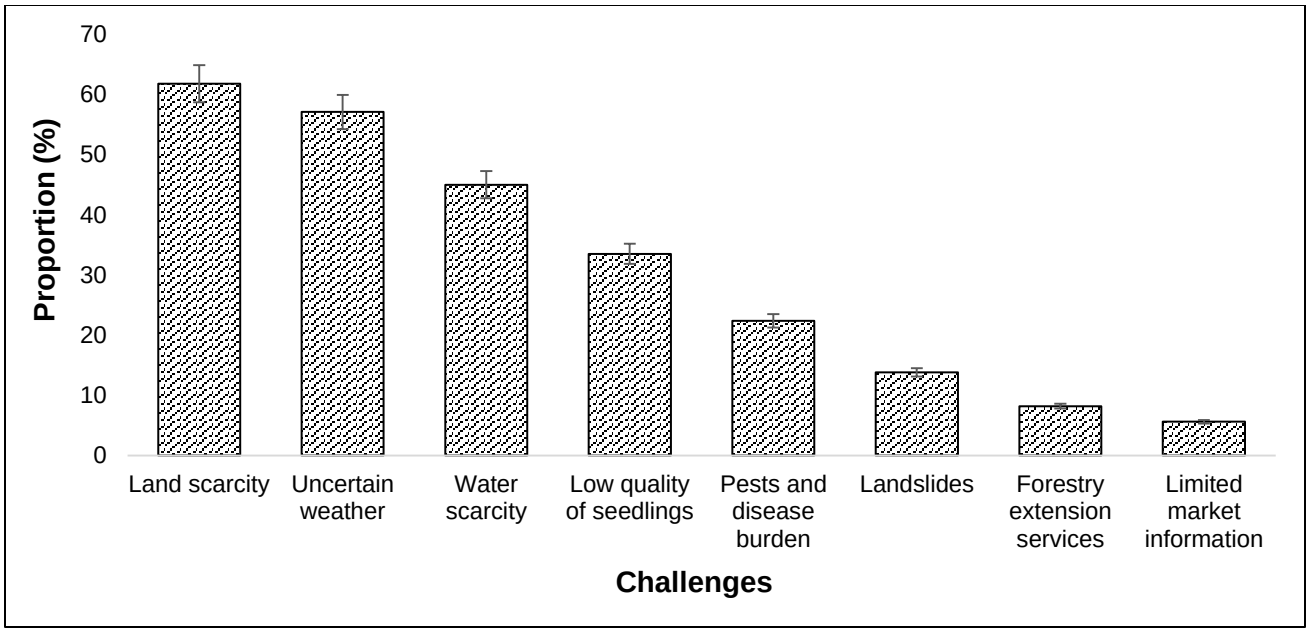

Figure 12: Challenges affecting tree planting in agroforestry systems with Mt. Elgon range

Table 5: Challenges affecting specific agroforestry activities on farms in Mt. Elgon region

Agroforestry activity	Challenges[1]					%
	a	B	C	d	d	
Planting	✓	✓	✓	✓	✓	74.1
Tree management		✓		✓	✓	60.0
Crop management	✓	✓	✓	✓	✓	17.1
Harvesting	✓	✓		✓	✓	16.5
Land preparation	✓	✓	✓	✓	✓	15.9
Nursery raising of seedlings	✓	✓	✓	✓	✓	12.9
Transporting inputs & produce	✓	✓	✓	✓	✓	9.4
Marketing	✓	✓		✓	✓	7.6
Processing	✓	✓		✓	✓	7.6
Collecting seed	✓	✓	✓	✓		5.3

Challenges[1] (a=Inadequate labour, b=Insufficient tools and equipment, c=Inadequate tree/shrub seed/seedlings, d=Limited technical knowledge, skills, e=other (drought, inadequate capital and land)

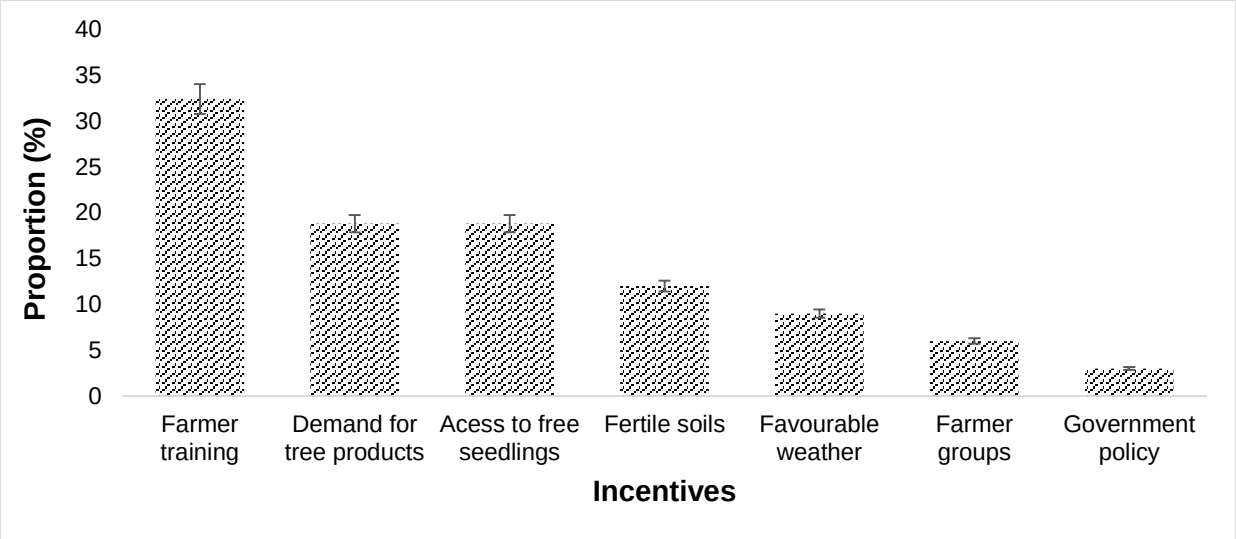

Figure 13: Incentives for adopting agroforestry technologies in Mt. Elgon region, Uganda

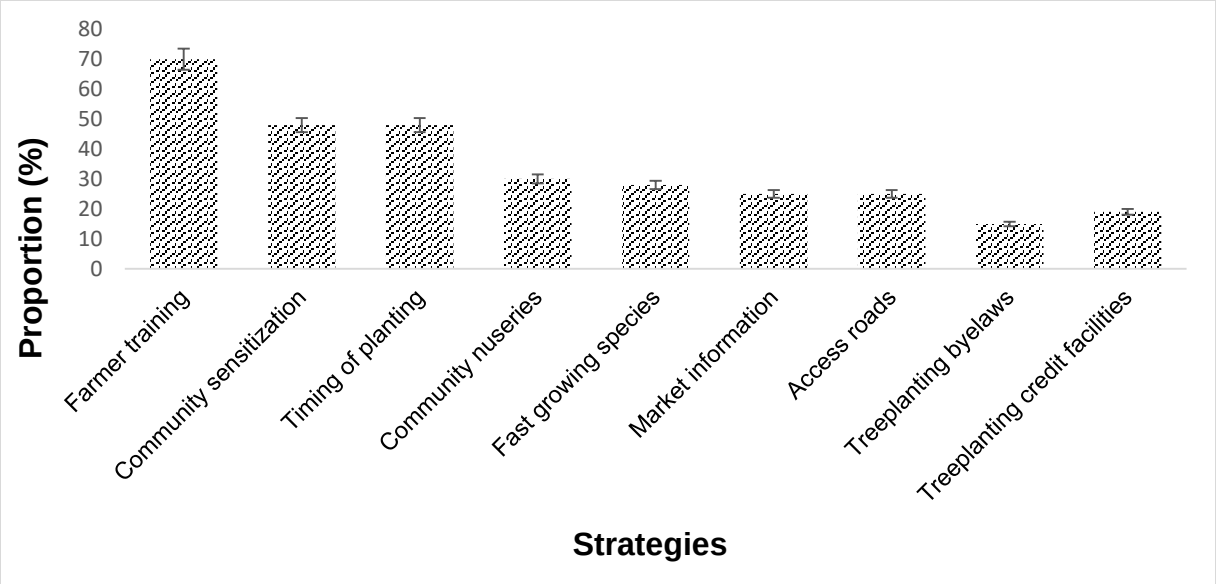

Figure 14: Strategies for effective adoption and implementation of agroforestry in Mt. Elgon region

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

4.1.1 Socio-economic traits of youth and women farmers

Generally the farmers were young, vibrant but illiterate and mostly engaged in agroforestry as casual laborers. They used primitive tools and methods to farm, engaged in farm business as the most important source of household income and earned an average of UGX 896,411.76 equivalent to USD$250 per annum through selling various agricultural (including maize beans groundnuts sweet potatoes, cassava, tomatoes, Irish potatoes and plantain) and tree products such as stake, fruits (mangoes, avocado, and jackfruits), poles, timber and firewood. The women and young farmers also engaged in other income generating activities including brick laying, charcoal burning, brewing, selling firewood, beekeeping, art and craft, fish farming, *Boda-Boda* transport, retail shops to earn some side income.

4.1.2 Application and suitability of agroforestry technologies under farming contexts

The women and farmers in the Mt. Elgon region were knowledgeable about various technologies and practices including tree planting along the slope establishment of bush bands using *C. caloythrsus* and elephant grass (*P. purpureum*), construction of soil erosion trap trenches and breeding selected tree and shrub species. Most of these technologies and practices were suitable and well applied under various farming contexts on their farm. The choice of species planted or retained was dictated by anticipated needs of a farming household including trapping the soil and water loss, supply of fodder to boost milk yields for animals, increasing crop yields and nutritional supplement as well supply of firewood, stakes and timber.

4.1.3 Challenges, incentives and strategies for effective adoption of agroforestry

Land scarcity, inadequate supply of germplasm, lack of market information, limited technical knowledge, pest and disease outbreak and lack of capital were among the major challenges highlighted. The other challenges included long rotation period for trees, conflicts with neighbors, climate change and perceived low benefits from tree-crop interactions on farm.

The major incentives for practicing agroforestry technologies included farmer trainings and sensitization provided by various organizations, increasing demand for tree products especially firewood, bean/tomato/banana stakes and timber in the region The other incentives included favoring soils, favorable weather conditions, farmer group cooperation (and government policy on tree planting.

The strategies involved strengthening farmer capacity building activities, community sensitization, ensuring proper timing of seedling distribution with rains, establishment of community satellite nurseries, promoting fast growing tree species and improving access to market information for agroforestry products.

4.2 Recommendations

4.2.1 Strengthening women and youth farmer capacity building

The stakeholders including the Ministry of Water and Environment (MWE) in Collaboration with the Ministry of Agriculture Animal Industry and Fisheries (MAAIF) should engage in or promote more farmer capacity building and community sensitization programs in the Elgon region. Farmer education, experimentation, and modification are important for agroforestry and Natural Resource Management development (Barrett et al.2002).The trainings and community awareness should

target more women and young farmers and should focus on areas of modern farming practices and technologies, environmental conservation and restoration using tree technologies, tree pest and disease management, soil and water conservation and food security. The women and young people are more affected by these broad areas and should be trained to improve their efficiency and effectiveness during execution of the various interventions on their farms.

4.2.2 Promote development of community tree planting byelaws

The Ministry of Water and Environment in Collaboration with the Ministry of Agriculture Animal Industry and Fisheries should engage stakeholders in the tree germplasm sector to develop policy guidelines for streamlining tree seed and seedling production in Uganda. The purpose is to establish a high quality, well-coordinated and harmonized tree germplasm production and distribution system. The policy should spell out the minimum standards (including e.g. technical personnel, size of land, pest and disease management strategy, business plan) for establishment and management of a tree nursery and minimum qualities (involving e.g. the root to shoot ratio, height, pest and disease load) of a seedlings for planting out.

4.2.3 Developing structures and mechanisms for quality checks

The Local governments from district to village level in consultation with stakeholders should establish and empower farmer committees/platforms to monitor e.g. seed collection and management, pest and disease management, seedling size, pricing and movement of germplasm within the region. The farmers need to have a basket of options to choose from, as different farmers in the same area may adopt different practices, depending on their preferences and circumstances

4.2.4 Strengthening research and extension outreach

Government should prioritize research on tree pest and disease in order to identify practical solutions to new tree pest and disease burden in the region and country in general. Identification and adequate facilitation of forestry extension service at districts and respective sub-counties will help to expedite learning and development. This requires enhancing the partnership between research and farmers. Researchers and farmers together need to understand the circumstances, problems, and preferences of rural households and how these vary among different types of farmers and agroforest component system

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6. APPENDICES

6.1 Appendix 1: List of Farmer Groups

1. Busiu Organic Ecological Forum
2. Busiu Youth Forum
3. Buwalasi Women Group
4. Buwalasi Yetana Group
5. Buwalasi Youth Farmers' Forum
6. Buyaka Youth Farmers' Group
7. Dembe Women Farmers' Group
8. Fuluma Coffee Farmers' Group
9. Fuluma Society for Farmers
10. Nabweya Women Farmers' Group
11. Namabya Dairy Farmers' Group
12. Namabya Dairy Farmers' Liberation Platform
13. Namabya Farmers' Group
14. Namabya Intergrated Farmers' Group
15. Namabya Women Dairy Farmers' Group
16. Namabya Youth Farmers' Forum
17. Namabya Youth Farmers' Initiative
18. Namatala Farmers' Group
19. Namawondo United Farmers' Group
20. Namengo Farmers' Group
21. Namwondo United Farmers' Group
22. Nansu Farmers' Group
23. Nubmey Women Farmers' Group
24. Tubana Group
25. Wanyanya Farmers' Group

6.2 Appendix 2: Species grown

Spp	Freq	Percent
Eucalyptus	133	78.2
Grevillea	73	42.9
Mangoes	63	37.1
Mvule	38	22.4
Musizi	37	21.8
Coffee	28	16.5
Grevelia	27	15.9
Avocado	21	12.4
Calliandra	17	10.0
Pine	12	7.1
Cordia	9	5.3
Apples	8	4.7
Albizia	6	3.5
Bisola	6	3.5
Jackfruit	5	2.9
Melia	5	2.9
Oranges	5	2.9
Bilisi	4	2.4
Bilukhu	4	2.4
Bisolo	4	2.4
Muvule	4	2.4
Pawpaws	4	2.4
Buthelium	3	1.8
Cordia Africana	3	1.8
Improved mvule	3	1.8
Lira	3	1.8
Oranges	3	1.8
Avocados	2	1.2
Bihukhu	2	1.2
Cordkia	2	1.2
Elephant grass	2	1.2
Ffene	2	1.2
Jackfruit	2	1.2
Mahogan	2	1.2
Mutuva	2	1.2
Zisola	2	1.2
Alibizia	1	0.6
Avocado	1	0.6
Barthadavia	1	0.6

Spp	Freq	Percent
Bathedium	1	0.6
Bikhuwa	1	0.6
Bikhuyu	1	0.6
Bisoyo	1	0.6
Bitoto	1	0.6
Burhedan	1	0.6
Cyprus	1	0.6
Evergreen	1	0.6
False Muvule	1	0.6
Kimiruba	1	0.6
Kimitoto	1	0.6
Kimutoto	1	0.6
Kyigikili	1	0.6
Lemons	1	0.6
Mahogany	1	0.6
Mondole	1	0.6
Mondoli	1	0.6
Moringa	1	0.6
Mutivu	1	0.6
Muvule	1	0.6
Pine	1	0.6
Pines	1	0.6
Sena	1	0.6
Umbrella	1	0.6

6.3 Appendix 3: Ranked priority of species (% households)

Species	Rank 1	Rank 2	Rank 3	Rank 4
Eucalyptus	54.1	15.9	5.9	2.4
Coffee	11.2	4.1	0.6	0.6
Grevillea	7.6	23.5	18.2	9.4
Mangoes	4.1	12.9	14.1	5.9
Avocado	3.5	1.8	5.9	2.9
Mvule	2.9	11.8	9.4	1.8
Musizi	2.4	7.1	8.8	3.5
Albizia	1.8	1.8	0.6	
Calliandra	1.8	2.9	4.1	1.2
Cordia	1.8	1.2	3.5	1.8
Buthelium	1.2		0.6	
Pine	1.2	4.1	2.4	0.6
Barthadavia	0.6			
Bisola	0.6		1.8	1.2
Cyprus	0.6			
Mahogany	0.6		0.6	0.6
Mondole	0.6			0.6
Mutuva	0.6			1.2
Oranges	0.6			1.2
Pawpaws	0.6			1.8
Zisola	0.6		0.6	
Apples		1.2	1.2	2.4
Bathedium		0.6		
Bihukhu				1.2
Bikhuwa				0.6
Bikhuyu				0.6
Bilisi			1.2	1.2
Bilukhu		0.6		1.8
Bisolo		2.4		
Bisoyo		0.6		
Bitoto		0.6		
Burhedan		0.6		
Elephant grass				1.2
Evergreen			0.6	
Improved mvule			1.2	0.6
Jackfruit		1.2	1.8	2.4
Kimiruba				0.6
Kimitoto			0.6	0.6
Lemons			0.6	
Lira				1.8
Melia		1.8	1.2	
Moringa			0.6	
Oranges		1.2	1.8	
Sena			0.6	
Umbrella				0.6