AVAILABILITY AND UTILIZATION OF AGROFORESTRY TREES: SOCIO-ECONOMIC PERSPECTIVES IN KESSES AND KAPSERET SUB COUNTIES, UASIN-GISHU COUNTY, KENYA

BY

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DECLARATION

Declaration by Candidate

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DEDICATION

This thesis is dedicated to: The Lord Jesus Christ, My wife Grace, children Derrick and Natasha, parents John and Nelly and innumerable relatives and friends.

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ABSTRACT

Majority of rural area communities worldwide highly depend on natural resources for their livelihood. Despite the enormous benefits of trees on farms, little is known about the social and economic perspectives that influence their preference, utilization and availability. Therefore, this study focused on the factors influencing the availability and utilization of agroforestry trees in Kesses and Kapseret Sub Counties, Uasin Gishu Kenya. The study utilized the survey design and targeted 233,112 residents of the two two sub counties. A sample of 120 farmers were interviewed using a pre-tested questionnaire to generate information on demographic trends, tree cover on farms, capacity of local institutions on utilization of trees and socio-economic perspectives on a scale of 1 (strongly disagree) to 5 (strongly agree). Data was analysed descriptive statistics and Pearson Coefficient of Correlation. 71 respondents (62.3%) were female while 43 respondents (37.7%) were male. 10.5% of the respondents had no formal education, while 89.5% had various level of education ranging from adult education to post-secondary education. Only 14.9% had post-secondary education. 27.2% of respondents agreed that the tree cover on farms has been increasing over the years with *Eucalyptus grandis* being the dominant species at 84.2% present in 96 households, 35.1% agreed that the tree cover had decreased and 37.7% agreed that the tree cover on farms had remained the same. 82.6% of respondents strongly agreed that agroforestry trees generates substitute income for purchased products, 77.5% agreed that agroforestry trees are used for timber and fuel wood while 47.5%, 27.7% and 10% of respondents agreed that agroforestry trees improves soil fertility, increase food security and use agroforestry trees as livestock fodder respectively. Land and tree tenure has a high influence on availability and utilization of agroforestry trees as strongly supported by 100% of respondents followed by farm size at 96.5%, availability of information and training at 80.7%, gender at 79.8%, household security at 74.6%, access to market at 62.3% and lastly level of education and availability of labour supported by 57.9% of respondents. The study also found out that an average land holding in Kesses and Kapseret Sub Counties is 1.5 acres. Availability and utilization showed a positive relationship; ($r= .786$, $n=114$, $p<0.0001$) while availability and socio-economic factors also showed a ($r= .877$, $n=114$, $p<0.0001$). Utilization and socio-economic factors also had a positive relationship ($r= .854$, $n=114$, $p<0.0001$). Put together these results suggests a positive correlation between socio-economic factors influencing agroforestry, availability and utilization of trees on farms. There is a need to promote agroforestry technologies, practices and capacity building in Kesses and Kapseret Sub Counties.

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LIST OF ACRONYMS

AEZ	Agro Ecological Zones
CFA's	Community Forest Associations
CIDP	County Integrated Development Plan
CSC's	Certificate of Stewardship Contracts
DFID	Department for International Development
FAO	Food and Agriculture Organization of the United Nations.
FFS	Farmer Field Schools
Ha	Hectare.
IAEA	International Atomic Energy Agency
ICRAF	International Centre for Research in Agroforestry. (Also called World Agroforestry Centre)
IEBC	Independent Electoral and Boundaries Commission
ISFP	Integrated Social Forestry Program
KEFRI	Kenya Forestry Research Institute
KFS	Kenya Forest Service.
KWS	Kenya Wildlife Service
MDGs	Millennium Development Goals
MoA	Ministry of Agriculture.
N	Target Population.
NGO	Non-Government Organisation.
NRI	Natural Resource Institute
NRM	Natural Resource Management
UGC	Uasin Gishu County
UN	United Nations
UNDP	United Nations Development Program.
UoE	University of Eldoret.

OPERATIONAL DEFINITION OF TERMS

Agroforestry - The integration of agriculture and/or farming with forestry so the land can simultaneously be used for more than one purpose. This practice is meant to have both environmental and financial benefits. The presence of trees can provide benefits such as sheltering livestock from the elements and improving the soil so that crops will be more productive. The agroforestry system can also provide a more even income for landowners since all of their income is not tied to a few crops or a single season. Agroforestry can also make it easier for farmers to transition from one type of crop to another as market demand for their products changes.

Agroforestry practices - denotes a distinctive arrangement of components in space and time.

Agroforestry systems - are specific local agroforestry practices characterized by environment, plant species and their arrangement, management, and socioeconomic functioning. They include both traditional and modern land-use systems where trees are managed together with crops and/or animal production systems in agricultural settings on Structural basis, Functional basis, socioeconomic basis or on ecological basis.

Agroforestry technologies - refers to innovations or improvements, usually through scientific intervention, to either modify an existing agroforestry system or agroforestry practice, or develop a new one. Such technologies are often distinctly different from the existing systems/practices; so, they can easily be distinguished and characterized.

Agroforestry Trees – These are trees that are grown and managed for more than one output. When an agroforestry tree is planted, several needs and functions can be fulfilled at once. They may be used as a windbreak, while also supplying a staple food for the owner. They may be used as fencepost in a living fence, while also being the main source of firewood for the owner. They may be intercropped into existing fields, to supply nitrogen to the soil, and at the same time serve as a source of both food and firewood.

Availability - Availability in this context mean the physical availability of the agroforestry trees on farms and also the level at which trees can be accessed for use. The trees can exist in the farm but may not be available for use by the farmer due to existing government policies, cultural restrictions or other reasons.

Socio-economic perspectives - is the social science that studies how economic activity affects and is shaped by social processes. In general, it analyzes how societies progress, stagnate, or regress because of their local or regional economy, or the global economy.

Tree cover - The proportion per unit area of the ground covered by the vertical projection on to it of the overall tree crowns' (Spurr and Barnes, 1980).

Utilization - "Utilization" in its broadest sense means "*using in any form*." Forestry definition of utilization is "converting trees and other forest products into forms and commodities usable by mankind." This would include methods of logging, milling, and marketing.

CHAPTER ONE
INTRODUCTION

1.0. Introduction

This chapter focus on the background of the study, problem statement, purpose of the study, research objectives and questions, justification, significance, limitations and scope of the study.

1.1. Background to the Study

Agroforestry is a collective name for land-use systems and practices where woody perennials such as trees, shrubs, bamboos and vines among others are deliberately integrated to create an agro-ecosystem with crops and/or animals on the same land management unit (Nair, 1993). The integration can either be in spatial mixture or in time sequence. There must be both ecological and economic interactions between the woody and non-woody components to qualify the system as agroforestry (Tewari, 2008).

One of the eight millennium development goals (MDGs), to which world leaders committed themselves in 2000, was to half extreme hunger and poverty by 2015 (UN Millennium Project, 2003). Since the mid-1990s, donor agencies have recognized the potential of trees for both poverty alleviation and provision of environmental services. These benefits change as household situations change and are influenced by a number of factors such as availability of land and labour, types of trees available, techniques, and risks involved in growing them, guaranteed benefits as well as markets for tree products. Thus, incorporation of appropriate trees in agroforestry land use systems provides an opportunity for subsistence farmers to reduce poverty, enhance food and nutritional security, human health and environmental sustainability. In this way, agroforestry tree domestication is seen as an important component of strategies to achieve the Millennium Development Goals (Garrity, 2004). In agroforestry systems, household characteristics, exogenous economic forces and biophysical factors interact in a complex way resulting in highly diverse, mixed smallholder agriculture systems (Shepherd and Soule, 1998).

Trees in rural landscapes provide a number of important socio-economic benefits among them fuelwood, fodder, timber, poles and mulch as well as services such as

soil conservation, land demarcation, cultural rights and mitigation of climate change effects.

Past studies have shown that the management and utilization of resources by individuals, households and communities are characterized by their socioeconomic, cultural, political and Institutional characteristics and constraints, which ultimately control their access to and rights over these resources (Masozera and Alavalapati 2004). Despite these enormous benefits, little is known about social and economic factors that influence utilization of these trees. More investigations are needed to better understand how social networks can shape farmers' ecological knowledge of agrobiodiversity management, the adoption of more environmental-friendly farming systems and how their knowledge is transmitted through generations. (Segnon *et al*, 2015).

1.2. Statement of the Problem

In Kesses and Kapseret Sub Counties of Uasin Gishu County in Kenya, many smallholder farmers own a diversity of tree species on their farms. Despite the tremendous importance of tree products and environmental services that underpin livelihoods for the rural poor, these products and services remain little understood and are thus poorly managed, barely recognized, inadequately appreciated and underinvested in. No studies have been done to asses whether these trees are available, how they benefit the communities nor whether they are efficiently and sustainably utilized. This study therefore focused on understanding the issue of tree availability and utilization at the level of households, and on understanding the broader context from which trees help farmers earn their living.

1.3. Objectives

1.3.1. Main Objective

The main objective of this research was to asses the availability and utilization of agroforestry trees from a Socio-economic perspective in Kesses and Kapseret Sub Counties in Uasin - Gishu County, Kenya.

1.3.2. Specific objectives

1. To determine the availability of agroforestry trees in Kesses and Kapseret Sub Counties.

2. To assess the utilization of agroforestry trees in Kesses and Kapseret Sub Counties.
3. To determine the socio-economic factors that influence the availability and utilization of agroforestry trees in Kesses and Kapseret Sub Counties.
4. To establish how socio-economic factors influence the availability and utilization of agroforestry trees in Kesses and Kapseret Sub Counties.

1.4. Research Questions

1. Are agroforestry trees available to farmers in Kesses and Kapseret Sub Counties?
2. How do farmers in Kesses and Kapseret Sub Counties utilize trees in their farms?
3. What are the Social and economic factors that influence the availability and use of agroforestry trees in Kesses and Kapseret Sub Counties?
4. How do Social and economic factors influence the availability and use of agroforestry trees in Kesses and Kapseret Sub Counties?

1.5. Justification and Significance of the study

Very few studies focusing on availability and utilization of agroforestry tree species in Kesses and Kapseret Sub Counties have been done. This has led to poor understanding of the benefits and profitable investment of the trees on farms. Results of this study will help in making appropriate recommendations for local and national policy formulation that would enhance availability and efficient use of on-farm tree species for domestic and industrial purposes. A broader understanding of the socio-economic factors affecting tree growing and management among smallholder farmers would enhance tree domestication, sustainable utilization and environmental conservation from a multi-disciplinary perspective.

1.6. Scope of the study

The study covered two Sub Counties; Kesses and Kapseret of Uasin Gishu County. The target populations constituted farmers at different farming scales with similar climatic conditions and altitude range. Data collected included social, cultural and economic aspects of tree growing, management and utilization on farms.

CHAPTER TWO
LITERATURE REVIEW

2.0. Introduction

This Chapter sheds light on what the study is all about by highlighting what other researchers have done over the years in Kenya, Africa and around the world. The study is conducted in context of availability and utilization of agroforestry trees.

2.1. Agroforestry Situation

Cultivating trees in combination with crops and livestock is an ancient practice. Trees are harvested and processed into products for the intended consumers. They play a pivotal role in how rural households earn their living. Trees - Whether protected, cultivated or managed, have taken an important place as one of many smallholder land use options (FAO, 2014). For a farmer to consider tree cultivation, he or she looks at the possible benefits in terms of increasing income and his / her food and nutritional security.

Agroforestry production systems have been found to provide a multitude of goods and services and hence the capacity to address different constraints for different consumers over different time periods. They can contribute to household income or consumption directly through the production of goods such as fruits, poles, fuelwood and indirectly through goods and services such as fodder for livestock, reduction of land degradation, and improved soil and water conservation. In addition, other benefits can be realized downstream through reduction of soil erosion and/or increased water flow control. These systems at a more aggregate level can also provide services for international consumers, through benefits for example of carbon sequestration and protection of international waters (NRI, 2002).

There is, however, very little information available quantifying the contribution of agroforestry trees to household income, food security and welfare. This gap is especially of concern given the widespread use of agroforestry in development projects and extension programmes (Scherr and Müller, 1991).

Blaikie (1989) in his four premises reports that environment and access to resources is interpreted as: a dynamic relationship between patterns of access to resources and the ‘environmental data’ on which the outcomes of patterns of access are played out. So

why are many issues of access to resources clouded with uncertainty? Is it because of unreliable data particularly on environmental change or the inability to identify reliably human agency in environmental change, or is it due to contradictory interpretations of the impact of land degradation? Despite all the questions and issues surrounding resource use and land degradation, formidable factors remain. Blaikie (1989) further argues that several factors will influence resource access and utilization trends. These factors are interlinked and include: environmental, social, political, economic and cultural aspects within and sometimes beyond the resident community.

2.2. Agroforestry promotion

Agroforestry promotion efforts by the government, aid agencies and local organizations have seldom taken into account the extent of existing tree growing on farms. Even when they have, project design and implementation have been hampered by a lack of information about why farmers have undertaken these types of activities on their own. In particular, the relationships between land use, capital, labour, and land ownership with respect to tree growing are not well-understood.

Arnold and Dewees (1998) argued that strategies to encourage tree planting on farms need to be based on an understanding of farmers' tree management in the context of household livelihood strategies, pointing out that little is known about "farmers' perceptions of the value of trees and about the constraints they face in developing tree resources. The concept of on-farm tree growing has been refined and expanded with emphasis on it being a farmer-driven and market-led process (Simons, 1996; Simons and Leakey, 2004) that takes a participatory approach to involve local communities (Leakey *et al*, 2003; Tchoundjeu *et al*, 1998). According to Simons and Leakey (2004), majority of species on most farms may be indigenous taxa but at the same time, introduced exotic taxa account for many of the trees on a farm. In Kenya, most farmlands contain tree species that are predominantly introduced varieties, such as *Grevillea robusta*, *Eucalyptus spp., Acacia mearnsii*, *Cupressus lusitanica*. A number of indigenous species such as *Markhamia sp*., *Croton sp* and *Sesbania sesban* also feature in farmlands (Bradley and Kuyper, 1985).

2.3. Availability of agroforestry trees

Availability in the context of this study means the extent to which the tree is available for use. According to Meurant (1991), trees can exist in the farm but may not be

available for use by the farmer due to existing government policies or cultural restrictions, among others. Even though there may be well known regulations on the utilization of various tree species, local institutions may lack the capacity to implement the same due to a number of reasons like insecurity or general laxity by the government of the day. Logging of trees like *Juniperus procera, Santalum spicatum* and other endangered tree species have been banned. There are other tree species like *Ficus thonningii* which have cultural restrictions; harvesting of such trees is prohibited by most African Cultures because they are used to perform cultural rituals (Beech and Mervyn, 1913).

These factors may also contribute to overexploitation or underutilization of the agroforestry trees. There is, therefore, a need to build capacity on these regulations and consequently popularize them at various levels. There is also need to always have information regarding the policies and restrictions in place in order to monitor the extent of utilization of agroforestry trees.

2.4. Utilization of agroforestry trees

Utilization of agroforestry trees is the extent to which the farmers are using agroforestry trees (Simons, 1996; Simons and Leakey, 2004). The concept of on-farm tree growing has been refined and expanded with emphasis on it being a farmer-driven and market-led process. It has also been expanded in scope to accommodate methods and techniques involved in their management for multiple uses rather than for timber alone in order to improve their economic, social and ecological role. Trees contribute significantly to the total social and environmental benefits across a range of landscapes and economies. Some of the main benefits of agroforestry trees are discussed in subsequent sections.

2.4.1. Fodder production

Integrating trees into agroforestry systems where they can be planted close to each other and pruned or browsed intensively can help increase economic benefits. Trees and shrubs have long been used by farmers to feed their livestock as fodder. In this regard, it is Common practice for the farmers to prune branches or allow their animals to browse. In the highlands of central Kenya, farmers plant *Calliandra calothyrsus* and *Leucaena leucocephala* to use as feed for their zero grazed dairy cows (Franzel e*t al,* 2003). This increases milk production and reduces production costs.

2.4.2. Soil improvement and Maintenance

Decline in soil fertility is a key problem in many farming systems throughout the tropics due to intensified agriculture and reduced fallow periods. Improved tree fallows is one of the means developed by researchers to improve crop production. Place *et al,* (2004) argue that both poor and non-poor households in western Kenya were equally likely to use improved fallows and biomass transfer to increase soil fertility. Nuga and Iheanacho (2011) state that agroforestry practice through the incorporation of woody perennials has the potential of mitigating the impact of soil erosion, through the incorporation of both the above and below-ground tree biomass.

Biomass transfer (the manual transfer of green manure to crop plots) is another agroforestry practice that has been adopted by many farmers. This practice increases vegetable yields, extends the harvesting season and improves the quality of produce. Farmers in western Kenya who treated their farms with leaves from *Tithonia diversifolia* hedges grown along field boundaries, together with small amounts of phosphorus fertilizer, doubled their returns to labour (Place *et al*, 2002). In Malawi and Zambia, Franzel *et al,* (2002) found out that planting of either *Cajanus cajan, Tephrosia vogelii, Sesbania sesban* or *Gliricidia sepium* in fallows for two years, cutting them back, then following them with two to three years of maize cultivation increased maize yields compared with planting continuous unfertilized maize.

2.4.3. Food Security

As population estimates for 2050 reach over 9 billion, issues of food security and nutrition have been dominating academic and policy debates, especially in relation to the global development agenda beyond 2015 (Agarwal *et al*, 2015).

In parallel, there is considerable evidence that suggests that forests and tree-based systems can play an important role in complementing agricultural production in providing better and more nutritionally-balanced diets (Vinceti *et al,* 2013). A study conducted in Europe showed that growing trees and crops in agroforestry systems generated a higher value of ecosystem services than growing them separately (Graves *et al,* 2007) as shown in Figure 2.1 below.

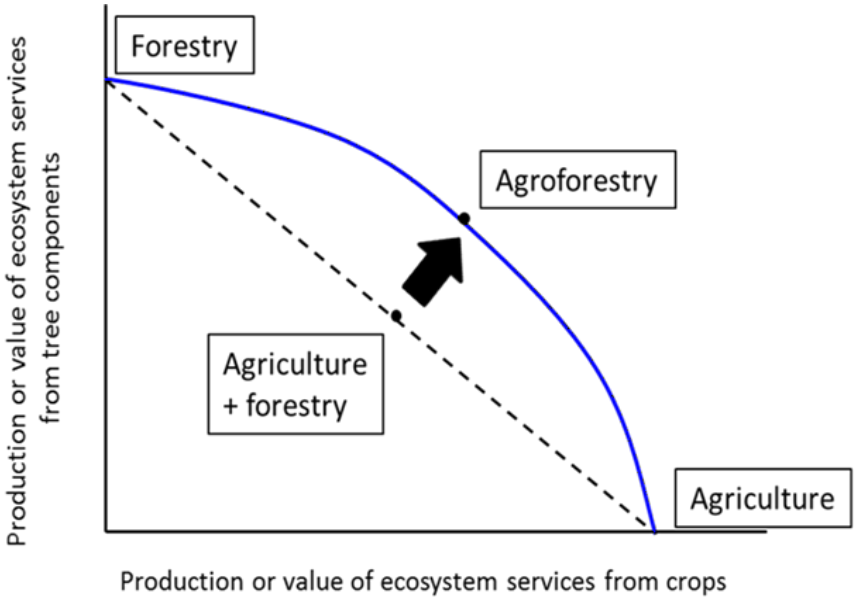

Figure 2.1. Relationship between Agroforestry trees and Food Production

(Source: Graves *et al*, 2007)

2.4.4. Timber and fuelwood production

Agroforestry trees throughout the world are known to produce timber and fuelwood. In so doing, agroforestry practices provide alternative sources of tree products and services, hence reduce pressure on natural forests. They also prevent the felling of trees from the forests, reducing forest degradation and saving costs of transporting fuelwood. A case study in Tabora District, Tanzania showed that about 1,000 tobacco farmers started *Acacia crassicarpa* woodlots on farms to produce fuelwood for tobacco curing, intercropping the trees with maize during the first two years (Ramadhani *et al*, 2002). This tremendously reduced the cost of curing tobacco and improved food production.

2.4.5. Substitute income for purchased products

Agroforestry generates cash income through the sale of tree products. It also provides products that the farmer would otherwise have to purchase, this is important given the lack of available cash in many farming households. For example, farmers substitute fodder shrubs for expensive dairy meal, nitrogen-fixing plants for mineral fertilizers and home-grown timber and fuelwood for wood bought off the farm (FAO, 2005).

Other benefits include production of medicinal herbs, Reduction of surface run-off and carbon sequestration.

2.5. Factors influencing availability and utilization of agroforestry trees

Many factors among them socio-cultural and environmental affect the management and utilization of agroforestry trees. These factors determine the domestication of agroforestry trees. It is worth noting that these factors naturally do not act in isolation. They are interrelated with each other as well as with other factors like social and economic factors. Socio-economic factors which greatly influence on farm tree domestication and these include: household security, access to capital and incentives, access to markets, labour, gender, land tenure, farm size and knowledge on tree management. Socio-economic factors are aspects that relate to social and economic conditions of communities and less to the cultural and biophysical environment (Wafuke, 2012).

2.5.1. Gender

Agroforestry systems are not gender-neutral. Compared with men, women are frequently disadvantaged, for a range of interrelated cultural, socio-economic and institutional reasons, in their access to and control over agroforestry resources and in the availability of economic opportunities. They play different roles in a community and this can in different ways influence the management, availability and utilization of agroforestry trees. They often have different objectives for planting trees. Men are usually interested in trees for commercial purposes such as timber for production of poles, while women are more inclined to tree products for subsistence use such as firewood, soil fertility improvement, fodder and fruits. This is reflected in the tree attributes that men and women prefer. In some cultures, women may not be allowed to plant trees, (FAO 2013). In Uganda, the proportion of households where women managed fodder shrubs was over 80%. In Kenya, male-headed households had somewhat higher survival rates for fodder shrubs (45%) than women as compared to 31% but the differences were highly variable and not significant. In Zambia, 47% of women and only 29% of men had survival rates for *Sesbania sesban* of over 75%, six months after planting. For *Tephrosia vogelii* men had somewhat higher survival rates than women (Kiptot and Franzel 2011). All these studies have shown the difference between men and women in the management and utilization of agroforestry trees. Hence the current study set out if the same is the practice in Kesses and Kapseret Sub Counties.

2.5.2. Level of Education

Agroforestry systems continually change in design and management, thus calling for changes in knowledge, management skills and extension strategies. For farmers, introduction of a new species and/or system means that they will have to learn how to take care of it. The level of formal education is an important variable in any given population. Generally, education and awareness, whether formal or informal, shape perceptions, resource utilization, conservation, management and mindfulness of one's environment. Not only does education influence the demographic, but also the socio-economic characteristics of the population. In areas where there has been a tradition of agroforestry or use of forest products, promoters may be able to gain useful knowledge from the people practicing those techniques.

According to a study conducted in Yemen that involved Highland and Lowland farmers, and in which lowland farmer groups had higher average education levels than highlanders (Safa, 2005), schooling was positively related to income. This may be due to the presence of educational infrastructure and the level of farm income which affected the interest in acquiring education for the poorer lowland farmers. The significant coefficients for the highland farms were similar to those of the regression of farmer income generally. This may suggest that either lowland farmers required a higher education level to complement their farm income or that education was more accessible for the lowland farmers. This generally suggests that level of education was a significant explanatory variable. Muhammad (2011) notes that education level of the head of the family is an important factor that determines on-farm growing of trees. The influence of education (literacy) on agroforestry systems is highly correlated. The educated farmers allocate more land to trees as compared to illiterate farmers (Jamilu *et al*, 2014). This may be associated with the higher incomes of the educated class due to more off-farm employment opportunities and the higher level of awareness/understanding on the importance of tree cultivation. Farmer's knowledge of agrobiodiversity management is correlated with involvement in crop-tree-livestock systems and agroforestry systems (Segnon *et al*, 2015)

2.5.3. Labour

Most agroforestry systems are not mechanized. This is illustrated in a study conducted on integrated crop management and organic systems in Europe which

involved pest management, weed control, defoliation and thinning in apples (Tresnik and Parente, 2007). Apple production in an agroforestry setup requires more labour since it involves manual operations. In another study on socio-economic factors affecting apple production in Southwestern Uganda, labour costs were the highest, accounting for 41.8% of the total annual production costs (Ntakyo *et al*, 2013*)*. These findings show that labour is a major factor in agroforestry systems involving apple production.

2.5.4. Household and Food Security

Household security, as a factor in the domestication of agroforestry trees relates to the need that any introduced agroforestry system must at least not detract from farmer/household security, and at best increase it (IAEA, 2008; Glover, 2011), whereas food insecurity is described as a condition in which people lack basic food intake to provide them with the energy and nutrients for fully productive lives. This implies that food security exists when all people, at all times, have access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life. Food security has four major aspects; food availability, food access, food stability and food utilization (Cromwell and Slater, 2004).

The reliance of people on trees and forests is limitless. Nearly 1.6 billion people in the World rely on forest resources for their livelihood and 1.2 billion people in developing countries use trees on farms to generate food and cash (FAO, 2011). Farmers will always be reluctant to plant trees unless the security of their household is not put at risk and preferably enhanced such as through meeting basic needs such as food or poles or through production of goods which can be sold. Security can be enhanced by an agroforestry system through provision of basic needs such as food, construction wood, and fuelwood, through cash income or through decreasing labour or input costs (Current and Scherr, 1995)

2.5.5. Land and Tree Tenure

In agroforestry, tenure concerns both land tenure and tree tenure. Although tree and land tenure are distinct, each affects the other (Wessel, 1996). Because of the long-term nature of agroforestry systems, security of land tenure is an important factor in planting, managing and utilizing tree species in agroforestry systems. The household rights over trees must be sufficient to justify the effort of planting them, and the right

to harvest and utilize trees must be exclusive enough to give a return on investment. Generally, in most areas of Kenya, property rights are traditionally passed from father to son. If a man has more than one wife, each wife with sons may be allotted an equal share of the father's land to be distributed among the sons, although the wife may continue to work on the lands she worked even after her husband has passed on. If a man dies without male heirs, his eldest brother will usually get control over the land (Kameri-Mbote, 2005). It is critical to realise that women are rarely land owners in Kenya. The Right of women to use land generally comes through men, either from a husband as part of his holdings or from other male family members.

Security of tenure over the land cultivated stimulates the farmers' commitment to protect and develop the area owned. Being able to harvest, utilize and market the products derived from the development of their tenured land are incentives for them to continue doing so not only for their individual benefit in the long term but also for the community and nation in general (Bugayong, 2003). In Philippines, the expansion of cultivated uplands were observed in sites due to parcellation of forestlands through the Certificate of Stewardship Contracts (CSCs) awarded to Integrated Social Forestry Program (ISFP) participants (Tadeo, 1994).

According to Place (1995), farmers with insecure land rights are unable or unwilling to maintain trees on their farms. In many countries, bans on cutting down trees are a disincentive for farmers to plant them. Therefore, mechanisms are needed to exempt trees on farms from such ordinances (Current and Scherr, 1995).

In Ghana, tenants were required to maintain economic tree growing on the land but they were prohibited from planting any themselves (Fortmann, 1985). Hence the landowners had the right to the fruits; while the tenants could harvest for personal use, but never for sale. Without the landlord's permission they could not fell certain trees. Therefore, in such a system, sustainable management of agroforestry trees may be difficult.

2.5.6. Farm Size

When household farm sizes are large, farmers may be more willing to plant agroforestry trees (Glover *et al*, 2013). On the other hand, when farm sizes are small, they may become more interested in higher yielding crop systems or highly

productive home gardens. Substantial efforts are required to domesticate tree species and to increase their cultivation on smallholder farms. Under these conditions, integrated land use practices such as agroforestry are a convenient approach to improved livelihoods (Glover *et al*, 2013).

2.5.7. Access to Markets

Agroforestry systems can produce cash income through marketing of tree products. If an agroforestry unit's objective is a marketable product, then it is critical that there is an accessible and stable market. The market prices have to be favourable and attractive to the farmer. This means that prices have to be stable and high enough to secure a profit margin.

According to Roshetko *et al*, (2002), commercial opportunities exist for farm communities to transform their traditional agroforestry systems towards market orientation. Traditional management approaches produce small quantities of many products primarily for household consumption with limited market sales. In Indonesia replicable and efficient extension approaches are designed to reach motivated and innovative farmers who are committed to improving their incomes by increasing the production and market access for their agroforestry products (Roshetko *et al*, 2002).

Ideally, demand assessment before planting trees is a critical first step in agroforestry, as looking for a market only in times of surplus is problematic. Predo (2002) found that tree farming was more profitable than annual crop production, although uncertain marketing conditions deterred tree planting. Further, smallholders generally have weak market linkages and poor access to market information (Hammett, 1994; Arocena-Fransico and Raintree, 1993). It is advantageous to assist farmers to sell their produce locally before they attempt to enter a more competitive export market, and to help them strengthen their links with the private sector as part of market development.

Scherr (1999) and Landell-Mills (2002) allude that the existence of accessible markets for tree products is a vital criterion for any agroforestry system. Otherwise, the development of economically viable systems might not be achieved. Disregarding few exceptions, the marketing system for agroforestry produce in India is unorganised (National Agroforestry Policy, 2014).

2.5.8. Availability of information and training

Farmers need more information and training for agroforestry relative to other agricultural activities, the absence of which limits the spread of some agroforestry practices. When starting operations, farmers often lack skills to establish tree and shrub nurseries, pre-treat the seeds, and carry out tree pruning activities. However, extension strategies that include farmer field schools (FFS), exchange visits and farmer training, are effective ways of disseminating needed information (FAO, 2005).

2.6. Knowledge gap

Although agroforestry trees are widely known to diversify and sustain on-farm production for increased social, economic and environmental benefits to households, these benefits could not be ascertained for land users in Kesses and Kapseret Sub Counties of Uasin Gishu County, Kenya where trees are a common feature in the majority of farm holdings unless this study was conducted. This research was guided by a Sustainable livelihoods framework (Carney, 1998; DFID, 1999) The study aimed at addressing the foregoing observations by identifying and examining the social and economic factors influencing the availability and efficient utilization of agroforestry trees in the two Sub Counties with a view of proposing policy and management recommendations to improve this.

2.7. Conceptual Framework

The conceptual framework below shows the relationship between socio-economic factors, benefits of agroforestry trees; availability and utilization of agroforestry trees and their possible effects on livelihoods of smallholder farmers.

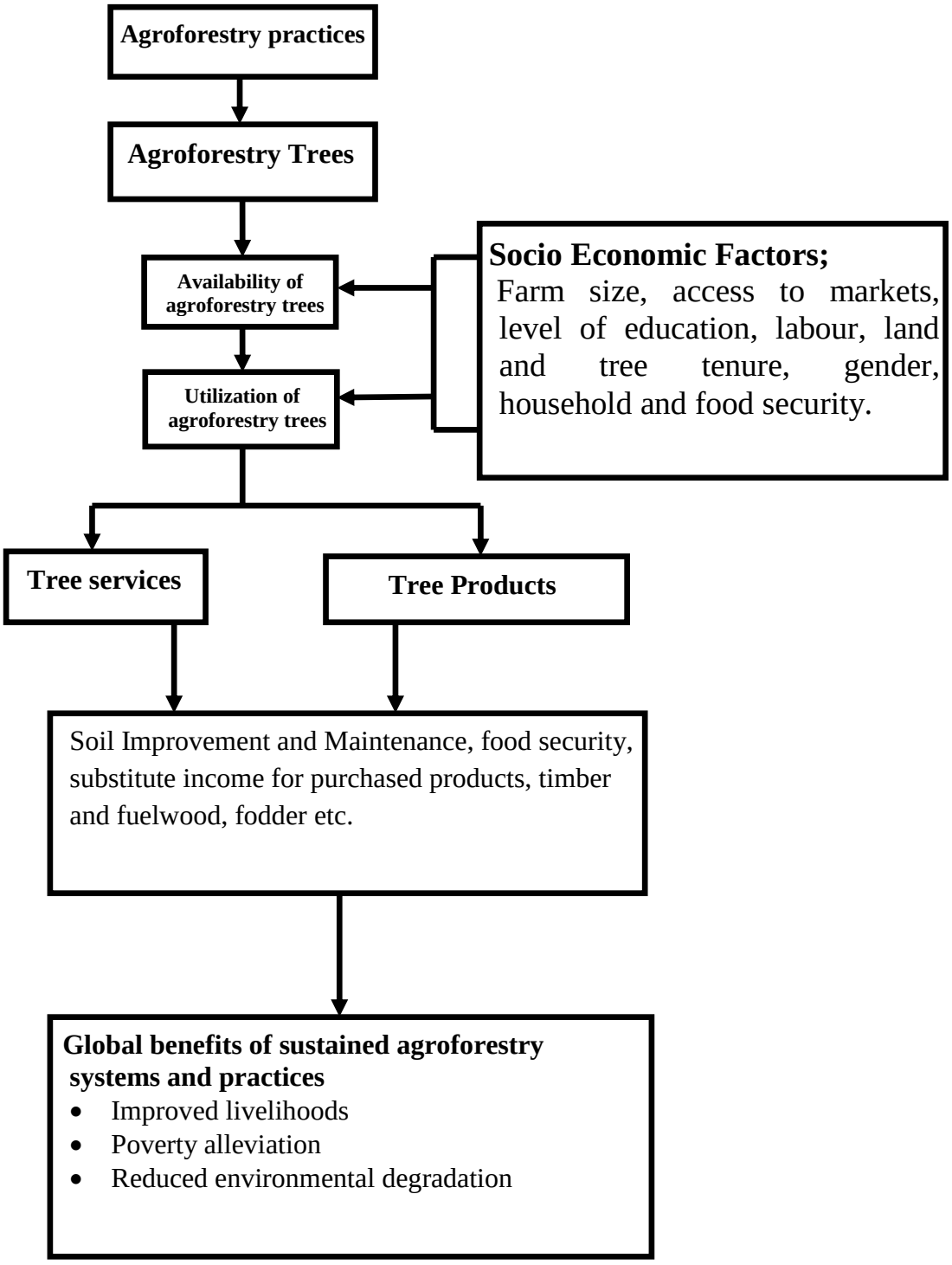

Figure 2.2. Conceptual Framework for the sudy

CHAPTER THREE

MATERIALS AND METHODS

3.0. Introduction

This chapter discusses the study area and methods that were used to achieve the objectives of the study. The chapter begins with a description of the study area, research design adopted for the study, sampling design, data collection, methods, instruments and procedures, description of the target population and the sample, validity of the research instruments used, data collection procedures and data analysis; procedures and presentation techniques.

3.1. Study Area

The study was conducted in Kesses and Kapseret Sub Counties, two of the six Sub Counties of Uasin Gishu County, Kenya (Figure 3.1). Uasin Gishu County lies on a 1680m to 2980m plateau in Kenya's former Rift Valley Province. The County, which is situated in the mid-west of the Rift Valley and 330km North West of Nairobi, is a cosmopolitan region, covering an area of 3345.2 square kilometres. It borders Kericho County to the south, Nandi to the south west, Kakamega to the west, Trans Nzoia to the north, Elgeyo Marakwet to the east and Baringo to the South East. The county is named after the *Ilwuasinkishu* Maasai clan who initially used the area for grazing. Uasin Gishu is a major Wheat, maize and livestock-producing region. Most agricultural production comes from smallholders with wheat and maize produced under plantation systems. Vegetables, Millet and sorghum are produced for both domestic and commercial purposes. The other Sub Counties that make up Uasin Gishu are Ainabkoi, Moiben, Soy and Turbo. The County has 51 locations and 100 sub-locations (Figure 3.1). Uasin Gishu County has a total population of 894,179 with 345,559 residing in urban areas with 202,000 households (NPC 2009). The County has an average land holding of 5 hectares in rural areas and a quarter of a hectare in Eldoret municipality.

Climate

Being in a highland area, Uasin Gishu experiences high rainfall that is evenly distributed throughout the year. The average rainfall ranges between 624.9mm-1560.4mm occurring between the months of March and September with two distinct

peaks in May and August. The areas with relatively higher rainfall are Ainabkoi, Kapseret and Kesses Sub counties. Turbo, Moiben and Soy sub-counties receive relatively lower amounts of rainfall. The dry spells begin in the month of November and end in February. Temperatures range between 7^{o}C and 29^{o}C (a mean of 18^{o}C). The rainfall and temperatures in the County are ideal for both livestock and crop farming. (Figure 3.1)

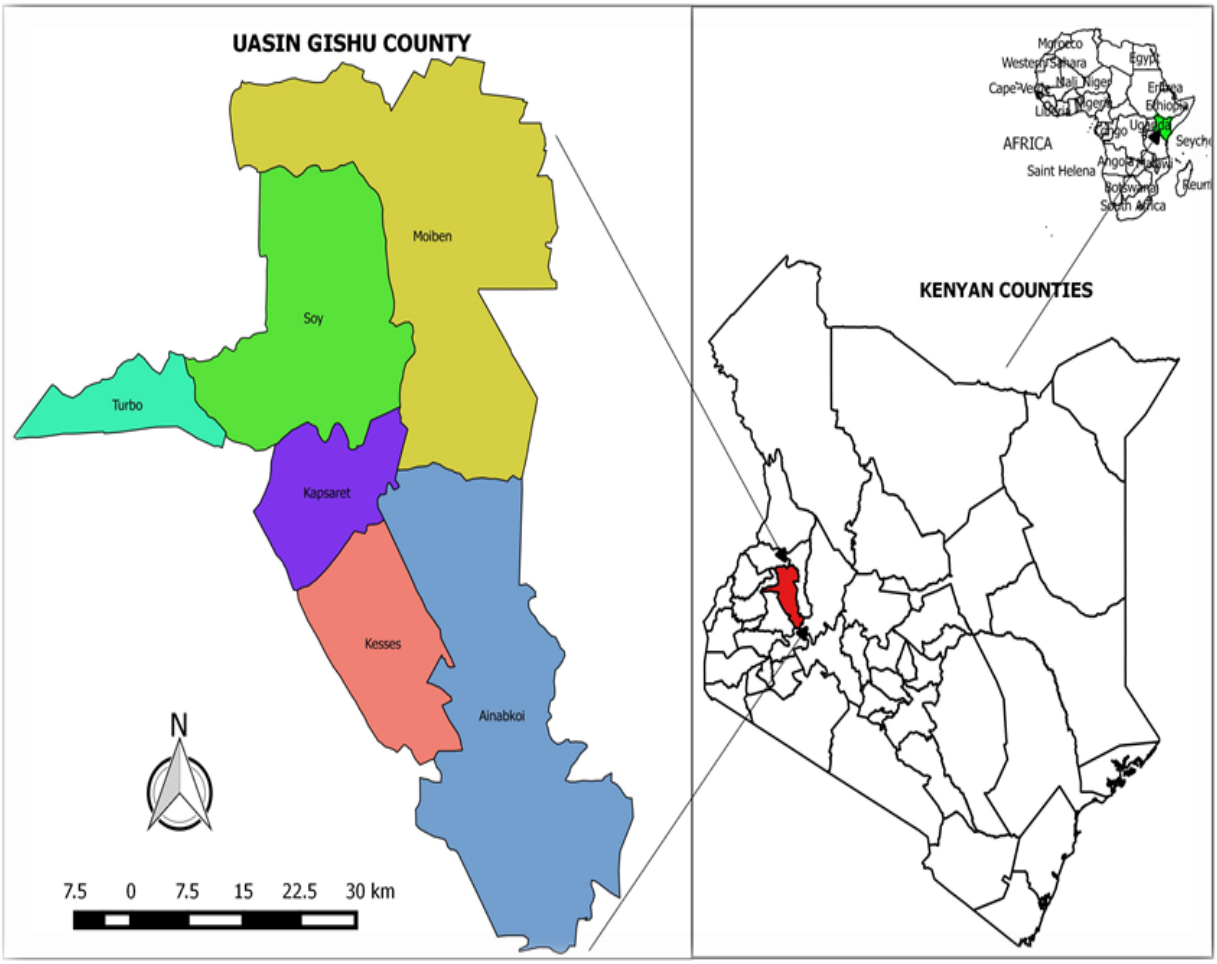

Figure 3.1. Map of Uasin Gishu County showing the Study area
(Source: IEBC 2012)

Soils

There are four main soil types in the County;

Red loam soils: occur mainly in the northern part of the County in Turbo, Moi's Bridge and Lower Moiben. The soils are derived from the basement complex rocks e.g. granites and laterites, and support maize and sunflower farming and cattle rearing. Vegetation is comprised of trees and grassland.

Brown loam soils occur in high altitude areas of the County around Ainabkoi, Kesses and Kaptagat. They derive from both volcanic and basement complex rocks. Vegetation is natural highland forest, thick grassland (mainly Kikuyu grass), and bush land. These are deep soils good for forestry, and farming of dairy, wheat, pyrethrum, potato, oat and barley.

Red clay soils are found around Soy, Upper Moiben, and Nandi border areas. In some areas, there is murram close to the surface. The soils support wheat and maize growing.

Brown clay soils characterize the plateau and cover most of the Upper Lessos plateau areas. They are mostly shallow with murram close to the surface and are poorly drained. The soils are excellent for livestock rearing.

Agricultural Activities

Uasin Gishu County has 2,995 sq. km arable land, 332.78 sq. km non arable (hilly and rocky), 23.4 sq. km water mass and 196 sq. km urban area). Vegetation range from open grassland with scattered acacia trees, to natural highland forests and bush land. It has 3 agro ecological zones (AEZ) (lower highland, upper highland and upper midland). The crop enterprises include food crops, cash/industrial crops and horticultural crops whereas the livestock enterprises include dairy, poultry, sheep, goats, pigs, bee keeping and fish farming.

Forestry

The County has a total of 29,802 hectares of gazetted forests out of which 13,184 hectares (or 44%) is under plantation while 16,618 (or 56%) are under indigenous forest cover. The gazetted forests are in Nabkoi, Timboroa, Kipkurere, Lorenge, Cengalo and Kapseret. There exist Community Forest Associations (CFAs) involved in forestry as an income generating activity. The growing of woodlots is scattered across the County and is emerging as a significant carbon sink and income generating activity. There exists a big market both in the County and outside for forest products such as poles, timber and wood fuel.

Study Sites

The study was conducted in two of the Sub-Counties of Uasin Gishu County; Kesses and Kapseret. Kesses has an area of approximately 299 square kilometres with a total population of 135,979 and a Population Density of 454.8 per square Kilometre

whereas Kapseret has an area of approximately 451 square kilometres with a total population of 121,178 (Republic of Kenya, 2009) and a Population Density of 268.7 per square Kilometre.

3.2. Research Design

The study employed a survey design: A survey is an investigation about the characteristics of a given population by means of collecting data from a sample of that population and estimating their characteristics through the systematic use of statistical methodology.

3.3. Target Population

The research targeted 60 farmers, one agricultural extension officer and one forest extension officer per Sub County giving a total of 120 farmers and two extension officers in total.

3.4. Sampling procedures, sample selection and size.

The farmers were purposively selected at both Sub County and locational levels with assistance from the extension officers. Purposive Sampling was used to select a total of 120 farmers who had practiced agroforestry for at least two years. 60 farmers were selected from Kesses sub county and 60 farmers from Kapseret Sub County. They were purposively selected using lists of agroforestry farmers obtained from Agricultural and forestry extension offices at the Sub County headquarters. Heads of selected households were interviewed from July 2013 to September 2013 using a pre-tested questionnaire. During the same period, 1 Forestry and 1 agricultural extension officer from each Sub County were interviewed. In situations where farmers were not able to understand English, the interviews were conducted in the farmers' local language. Key local informants and extension staff from the Ministry of Agriculture provided logistic support to selected farms. Appointments and consent for interviews were sought from prospective interviewees with the purpose and benefits of the study explained prior to the actual interview

3.5. Data collection

A Pilot survey was carried out in both Kesses and Kapseret Sub Counties but on a separate population with similar characteristics to the target population to test the research instruments. The farmers were interviewed using a pretested questionnaire

and extension officers were interviewed qualitatively to extract supplementary information.

Tree Species and their availability for use

A total enumeration of all the existing trees within the selected farms was done using a structured questionnaire with specific questions to determine their growing niches, ascertain availability of the said tree species for use by the farmers, and record the specific uses of the trees. All trees were inventoried according to Beentje (1994) for each tree species encountered, its abundance (the total number of trees on the farm) and on-farm functions (defined in this survey as all products and services provided by the species to the farming household).

Socio-economic factors

Structured questionnaires were used to get information from the respondents on the various social and economic factors affecting availability and use of the various agroforestry tree species in the households, and how these factors influenced the target parameters. The questionnaires contained both open and closed – ended questions.

3.6. Data Analysis and Presentation.

Data was entered and analysed using the Statistical Package for Social Sciences (SPSS Version 18). Statistical analyses were done using descriptive statistics to determine means, frequency counts and percentages. A 5 point scale was also used to categorize qualitative data using a scale ranging from (1-Strongly Disagree to 5-Strongly agree). Pearson's Coefficient of Correlation was used to show how the socio-economic factors influence availability and utilization of agroforestry trees. The results were presented in tables and plates.

CHAPTER FOUR

RESULTS

4.0. Introduction

This chapter presents the results of the study. The results are presented in form of tables and descriptive summaries.

4.1. Questionnaire Response Rate

From the study, 114 respondents out of the target 120 respondents sampled from Kesses and Kapseret Sub Counties returned the questionnaires duly completed. This gave a response rate of 95% (Table 4.1). The reason why some of the questionnaires were not returned include; respondents misplaced the questionnaires and were not willing to refill them, while others were unreachable even after home visits.

Table 4.1. Questionnaire Response rate

Category	Kesses		Kapseret		TOTAL	
	Frequency (F)	Percentage (%)	Frequency (F)	Percentage (%)	Frequency (F)	Percentage (%)
Returned	56	47	58	48	**114**	**95**
Not returned	4	3	2	2	**6**	**5**
Total	**60**	**50**	**60**	**50**	**120**	**100**

4.2. Socio-Demographic Characteristics of respondents.

Demographic information encompasses the size, structure, and distribution of a population, and associated spatial and/or temporal changes in response to time, birth, migration, ageing and death.

4.2.1. Gender of Respondents

From Table 4.2, 49% of the respondents comprising 14% male and 35% female were from Kesses Sub County, while 51% comprising 25% male and 26% female were from Kapseret. Overall, majority of the respondents (71 out of 114, 61%) were females while (43 out of 114, 39%) were male.

Table 4. 2. Gender of respondents

		Gender		Total
		Male	Female	
Kesses	No.	16	40	56
	% of Total	14	35	49
Kapseret	No.	28	30	58
	% of Total	25	26	51
Total	No.	43	71	114
	% of Total	39	61	100

4.2.2. Age of respondents

Table 4.3 shows that 56 respondents (49%) were from Kesses Sub-county, whereas 59 respondents (52%) were from Kapseret. Overall, of the 56 respondents in Kesses, (9%) were youthful at the age of 21 -30 years, while (5%) were above 51 years. Of the 58 respondents in Kapseret, (15%) were above 51 years while the minority (4%) were 21 – 30 years of age. Overall, twenty two (22) respondents (20%) were above 51 years, 13% were between 21-30 years while 30% were between 31-40 years. The highest percentage of respondents (38%) was recorded for the age group between 41-50 years.

Table 4. 3. Age of respondents

		Age (years)				**Total**
		21-30	**31-40**	**41-50**	**Above 51**	
Kesses	No.	10	19	21	6	**56**
	% of Total	9	17	18	5	**49**
Kapseret	No.	5	15	22	16	**58**
	% of Total	4	13	19	15	**52**
Total	No.	15	34	43	22	**114**
	% of Total	13	30	38	20	**101**

4.2.3. Level of Education

Table 4.4 indicates that 10% of the respondents had no formal education, while 90% had various levels ranging from adult education (9%), primary education (22%), secondary education (43%) to post-secondary education (16%).

Table 4.4. Level of education

Level of Education		LEVEL OF EDUCATION					Total
		No Formal Education	Adult Education	Primary Education	Secondary Education	Post-Secondary Education	
Kesses	No.	8	4	14	23	7	56
	% of Total	7	4	12	20	6	49
Kapseret	No.	4	6	11	26	11	58
	% of Total	3	5	10	23	10	51
Total	**No.**	12	10	25	49	18	114
	% of Total	10	9	22	43	16	100

4.3. Availability of Agroforestry trees on farms

4.3.1. Agroforestry Tree Cover

Tree cover on farms

From the results in Table 4.5 below, 31 respondents (27.2%) indicated that the tree cover on farms in Kesses and Kapseret sub counties had increased, 40 respondents (35.1%) agreed that the tree cover had decreased, while 43 of the respondents (37.7%) agreed that the tree cover on farms had remained the same. This shows that more respondents (37%) reported that tree cover on farms has remained the same.

Table 4. 5. Tree Cover on Farms

Tree Cover on Farms	**Frequency**		**Percentage (%)**		**Percentage (%) Total**
	Kesses	Kapseret	Kesses	Kapseret	
Increased	19	12	17	11	27
Decreased	17	24	15	21	36
Remained Same	20	22	18	19	37
Total	**56**	**58**	**49**	**51**	**100**

Plate 4.1. A Plantation of *Eucalyptus grandis* trees in Kapseret
(Source : Author, 2015)

General tree cover

The Study also sought to understand the general tree cover in the study area. Results in Table 4.6 below, indicated that 23 respondents (19% of the total) stated that the general tree cover had increased, 52 respondents (47%) reported that the tree cover had reduced, while 39 respondents (34%) alluded that the general tree cover has remained the same. This shows that more respondents (47%) indicated that the tree cover in Kesses and Kapseret Sub Counties has generally reduced.

Table 4.6. General Tree Cover

General Tree Cover	Frequency		Percentage (%)		Percentage (%)
	Kesses	Kapseret	Kesses	Kapseret	Total
Increased	14	9	12	8	**19**
Decreased	23	29	20	25	**47**
Remained Same	19	20	17	18	**34**
Total	**56**	**58**	**49**	**51**	**100**

Tree species diversity

An inventory of tree species among the sampled households and their uses was taken and a list of species of trees that existed on their land and their uses documented. A total of 31 tree species was observed in the study area, most of which had multiple uses (Appendix I). According to the results, an average of 96 (84.2%) respondents

grew *Eucalyptus grandis*, while 92 (80.7%) respondents grew Cypress on their farms. (Plate 4.1 and 4.2) 71 (62.3%) respondents cultivated Grevillea 45 (39.5%) grew Wattle trees. The least cultivated agroforestry trees are *Cordia abyssinica* and *Spathodea campanulata at* 4 (3.5%) and 3 (2.6%) of the respondents respectively. This showed that Blue gum was the most preferred and widely grown tree species followed by cypress, Grevillea and Wattle trees. Some respondents however, grew fruit trees (Plate 4.2).

Plate 4.2. A fruit garden with variety of fruit trees in Kesses
(Source : Author, 2015)

4.3.2. Tree Accessibility for Use

Although trees can exist in the farm, they are not available for use by the farmer due to existing government policies or cultural restrictions a fact that was supported by 81.6% of the respondents who responded in the affirmative. On a 5-point scale, the mean score of the responses was supported by a mean of 4.2807, indicating that there was a higher level of agreement on the questionnaire statements by respondents, (Table 4.7).

Table 4. 7. Availability of Agroforestry trees for use in Kesses and Kapseret

Availability of Agroforestry Trees for use (N = 114)	Strongly Agree		Agree		Undecided		Disagree		Strongly Disagree		Mean
	F	%	F	%	F	%	F	%	F	%	
Trees are available for use	53	46.5	54	47.4	7	6.1	0	0.0	0	0.0	4.41
Trees exist in the farm but not available for use by farmers	53	46.5	40	35.1	21	18.4	0	0.0	0	0.0	4.28
Lack of capacity to implement regulations on utilization	46	40.4	54	47.3	14	12.3	0	0.0	0	0.0	4.16
A need to build capacity to implement tree regulations and popularize them at various levels	30	26.3	33	28.9	6	5.3	22	19.3	23	20.2	3.22

According to the results, 93.9% of the respondents agreed that the trees were available for use. The responses were spread around the mean at 4.41. From these results, it may be concluded that trees were available for use in Kesses and Kapseret sub counties.

Further, the issue that local institutions such as KFS and KWS lack the capacity to implement regulation on utilization of trees due to insecurity or the general laxity by the government was supported by 87.8% of respondents who strongly agreed. On a 5-point scale the mean score of the responses was 4.16 which indicate that there was a higher level of agreement on the questionnaire statements by respondents. 55.2% of the respondents agreed that there was need to build capacities of Institutions such as KFS and KWS so that they can have the ability to implement regulations and popularise agroforestry trees at various levels of society. This was supported by a mean of 3.22.

Plate 4.3. A farmer harvesting *Cupressus lusitanica* for timber in Kesses
(Source : Author, 2015)

4.5. Utilization of agroforestry trees

According to the results, 82.6% of the respondents agreed that agroforestry generates substitute income for purchased products (Table 4.8). This was supported by a mean of 3.82. Agroforestry trees also produce timber and fuel wood as supported by 77.5% of the respondents, and was supported by a mean of 3.48. That agroforestry trees improves soil fertility was supported by of 47.5% of the respondents and a mean of 3.76.

Table 4.8. Utilization of Agroforestry trees by respondents

Utilization of agroforestry trees	Strongly Agree		Agree		Undecided		Disagree		Strongly Disagree		Mean
	F	%	F	%	F	%	F	%	F	%	
Fodder for livestock	6	5	6	5	24	22	32	28.3	45	39.7	4.20
Fuel wood and timber	52	46	36	31.5	23	20	3	2.5	0	0	3.48
Increased Income	57	50	37	32.6	11	9.5	9	7.9	0	0	3.82
Food Security	12	10.6	19	17.1	31	27	30	26	22	19.3	4.15
Soil Improvement	38	33	17	14.5	23	20	26	23	11	9.5	3.76

The issue that trees increase food security was supported by 27.7% of the respondents and supported by a mean of 4.15, while 10% of the respondents used trees for livestock fodder. The results were supported by a mean of 4.20 on a 5-point scale, which indicates a higher level of agreement on the questionnaire statement.

Plate 4.4. A farmer uses agroforestry trees in multiple ways in Kesses
(Source : Author, 2015)

4.6. Socio-economic factors that influence availability and utilization of agroforestry trees

According to the results, 79.8% of the respondents agreed that gender influences the management and utilization of agroforestry trees, 57.9 % supported the issue that the level of education influences the availability and utilization of agroforestry trees, and 57.9% agreed that availability of labour influences the management and utilization of agroforestry trees. Further, 74.6% of the respondents agreed that household security influenced the domestication of agroforestry trees, all respondents agreed that land and tree tenure influences the availability and utilization of agroforestry trees, and 96.5% agreed that farm size influences the availability and utilization of agroforestry trees. The study also found out that an average land holding in Kesses and Kapseret is 1.5 acres. In addition, 62.3% agreed that access to market influences the availability and utilization of agroforestry trees, and lastly, 80.7% of the respondents agreed that availability of information and training influences the availability and utilization of agroforestry trees.

Results also show that the overall mean score of the above responses was 4.17 which indicates that there was a higher level of agreement on the questionnaire statements by respondents. From these results, it can be concluded that gender, level of education, availability of labour, household security, land and tree tenure, farm size, access to market and availability of information and training are socio-economic factors that influence the availability and utilization of agroforestry trees in Kesses and Kapseret sub counties (Table 4.9) and Plate 4.5.

Table 4.9. Socio-economic factors influencing availability and utilization

Factors Influencing Utilization	Strongly Agree		Agree		Undecided		Disagree		Strongly Disagree		Mean
	F	%	F	%	F	%	F	%	F	%	
Gender	56	49.1	35	30.7	23	20.2	0	0.0	0	0.0	4.29
Level of Education	26	22.8	40	35.1	35	30.7	9	7.9	4	3.5	3.66
labour	27	23.7	39	34.2	37	32.5	9	7.8	2	1.8	3.70
Household security	38	33.3	47	41.2	29	25.4	0	0	0	0	4.29
Land and Tree Tenure	66	57.9	48	42.1	0	0.0	0	0.0	0	0.0	4.58
Farm Size	47	41.2	63	55.3	4	3.5	0	0.0	0	0.0	4.38
Access to market	19	16.7	52	45.6	43	37.7	0	0.0	0	0.0	3.79
Information and training	53	46.5	39	34.2	10	8.8	12	10.5	0	0.0	4.17

Plate 4.5. *Grevillea robusta* windbreaks on the edge of a garden in Kapseret
(Source : Author, 2015)

4.7. Effects of Socio-economic factors on Agroforestry Trees

Correlations between availability, utilization and socio-economic factors using Pearson's coefficient of correlation showed significant positive relationships. Availability of agroforestry trees showed a positive relationship with utilization (r= .786, n=114, p<0.0001) while availability of agroforestry trees also showed a positive relationship with socio-economic factors (r= .877, n=114, p<0.0001). Utilization also had a positive relationship with the socio-economic factors (r= .854, n=114, p<0.0001) as shown in Table 4.10

Table 4.10. Relations between availability and utilization of agroforestry trees and socio-economic factors

		Availability of Agroforestry Trees	**Utilization of Agroforestry Trees**	**Socio-economic Factors**
Availability	Pearson Correlation	1	.786**	.877**
	Sig. (2-tailed)		.000	.000
Utilization	Pearson Correlation	.786**	1	.854**
	Sig. (2-tailed)	.000		.000
Socio-economic Factors	Pearson Correlation	.877**	.854**	1
	Sig. (2-tailed)	.000	.000	
**. Correlation is significant at the 0.01 level (2-tailed).				

CHAPTER FIVE
DISCUSSION

5.0. Introduction

This chapter discusses the results of the study. Discussion of the findings is guided by the study objectives. The discussion is supported with findings from existing literature and other research works.

5.1. Socio – demographic factors and their implications on availability and utilization of agroforestry trees.

The questionnaire return rate of 95% is viewed as being very good and gives an adequate representation of the characteristics of the entire targeted population according to Mugenda and Mugenda (2003). More support is received from Creswell (2003) who provides guidance that a 40% response rate is adequate.

5.1.1. Gender of Respondents and its implications

From the results, 60.5% of the respondents were females. This indicates that women have started taking management roles of the households which may imply that men are more involved in off-farm activities more than the women, although these could not explain whether women have control over agroforestry trees existing on farms. This gender difference between male and female respondents was significant and therefore indicates the importance of women in agroforestry. These may be linked to the lower priority given by both men and women to agroforestry as an economic venture, although the percentage of women prioritizing agroforestry is slightly higher than that of men (Catacutan and Naz, 2015). However, this is not in agreement with the study by Catacutan and Naz (2015) who found out that decisions regarding agroforestry and crop production are generally held by men. Women participate less in deciding what trees or crops to plant, harvest and / or how much of the produce should be sold to the market due to socio-cultural reasoning others.

A research by Meijer, Sileshi, Kundhlande, Catacutan & Nieuwenhuis, (2015) suggested that male and female farmers play different roles when it comes to decision-making and implementation of activities related to tree planting and tree management. Tree planting and tree management were found to be mainly the domain of men; although decision-making on tree planting by the wife and joint decision-

making on tree management resulted in higher densities of trees planted on farms compared to situations where decisions were made by the husband alone. These findings do not concur with results of the current study where there are more women involved in agroforestry activities yet there is a decline in the general tree cover.

5.1.2. Age of Respondents and its implications

From the results, it emerged that 57% percent of respondents were above the age of 41 years and according to Olujide and Oladele (2011), age is significantly related to the knowledge of agroforestry and therefore in this case it means that there is a good source of labour. An explanation to this is that more adult members in a household means that more quality labour would be available for planting and domestication of agroforestry trees. This agreed with the findings of Villano and Fleming (2004).

5.1.3. Level of Education and its implications

From the results it emerged that 10.5% of the respondents had no formal education, while 89.5% are of various levels of education. According to Amaza and Tashikalma (2003) and Hawkins *et al*, 2009), the literacy level of farmers is important as it determines the rate of adoption and practice of agroforestry technologies and their ability to adapt to change in agroforestry technologies. This means that farmers who acquire some level of education are more likely to practice and benefit from agroforestry trees than the ones who don't have any form of education. At the same time it implies that the respondents could practice most agroforestry technologies due to their enhanced ability to acquire technical knowledge like application of fertilizers, use of pesticides and improved planting materials (Jamala *et al,* 2013). This is also the case in Kesses and Kapseret Sub Counties.

5.2. Availability of agroforestry trees

5.2.1. Agroforestry tree cover and its impact on food security

Majority of the respondents agreed that tree cover on farms in the two study areas has remained the same over the years. According to Sanchez & Swaminathan (2005), rapid population growth is increasing pressure on land, and as a result, smallholder farmers are forced to undertake more intensive agriculture with continuous cropping, which in turn results in declining levels of soil fertility and crop yield, thus compromising food security. Colfer *et al*, 2008; Vinceti *et al*, 2008; Arnold *et al*,

2011) found results that are supportive of the fact that agroforestry is likely to play a positive role in food security. Zubair and Garforth (2006) studied the perceptions and attitudes of farmers in Pakistan and found that their willingness to grow trees on their farms was a function of their attitudes towards the benefits and challenges of growing trees. Findings of the current study agree with these reasons since 72.7% of respondents reported that tree cover on farms had either reduced or remained the same.

General tree cover and its implications on respondents on-farm decision making.

The study also sought to understand the general tree cover in Kesses and Kapseret Sub counties and results showed that most of the respondents (46%) believe that the general tree cover had reduced. This could be supported by a number of reasons among them population pressure which is a major hindrance to agroforestry tree planting (Mauambeta *et al,* 2010; NSO, 2008). However, smaller farm sizes were found to be a factor which contributes to higher density of trees in Chiradzulu compared to Mzimba in Malawi (Meijer *et al*, 2015). Factors like farmers' perceptions of the cultural and policy restrictions on tree felling on their own land were found to be the most important socio-psychological factors influencing the decision to grow trees (Sood and Mitchell, 2004). Gender is also another factor that determines agroforestry tree planting.

Poverty could also be another reason that encourages reduced tree cover in Kesses and Kapseret. A research conducted in Malawi suggested that poverty is an important limiting factor when it comes to agroforestry tree planting (Walker, 2004). These findings are also supported by other studies for example, Jerneck and Olsson (2014) who found out that agroforestry fails to be taken up by the ‘poorest of the poor’, whose main priority is to get food on the table, and who cannot afford too much risk-taking by investing time and labour in new technologies which have uncertain benefits in the long term. In contrast, farmers who enjoy higher levels of food security are more likely to be ‘opportunity seekers’ and might be more inclined to venture into agroforestry (Jerneck & Olsson, 2014).

Tree species diversity and its influenced on availability and utilization of agroforestry trees

Out of the total of 31 tree species identified, *Eucalyptus grandis*, is the most preferred tree species followed by *Cupressus lusitanica.* These two trees were mostly grown on the borders of farms may be because of their low canopy structure. This is supported by a study carried out by Ibrahim *et al*, (2011) in Mymensingh, Bangladesh where people in the study area did not want to plant trees in their crop fields due to its wide spread canopy, but planted Eucalyptus trees for its minimum canopy structure on the border of their land. A similar research was done by Belali (2011) in the Narayangonj district where he observed a total of 78 plant species of which the dominant species was Eucalyptus, while Shabuj *et al*, (2010) whose study was done in the Natore district reported that Eucalyptus was dominant. This shows that Eucalyptus is one of the most preferred agroforestry tree species maybe because of its multiple uses including timber, fuelwood, mint, charcoal, shade, and also because of its fast growth. Eucalyptus tree species have a high water and nutrients consumption rates. Planting of Eucalyptus however, alters the hydrological cycles and depletes nutrients in the soil (Munslow *et al*, 1988). The presence of *Grevillea robusta* was also significant with 62.3% of the households having grown the tree. This could be attributed to its first growth and its ability to improve degraded soils.

5.2.2. Tree Accessibility for Use

Availability of agroforestry trees was supported by the 93.9% of the respondents at Availability may not necessarily mean that the tree can be harvested for use. There may be reasons that may not allow the utilization of the agroforestry tree. These findings were in line with the assertions of Simons and Leakey (2004) who stated that trees can exist in the farm but are not available for use by the farmer due to existing government policies or cultural restrictions, and probably other reasons. The results also in line with those of Arnold and Dewees, (1998) who stated that even though there may be well known regulations on the utilization of various tree species, local institutions may lack the capacity to implement regulations on utilization of trees due to insecurity or the general laxity by government, and there is a need to build capacity to implement tree regulations and popularize them at various levels. Findings further indicated that tree species available for use included *Eucalyptus grandis, Cupressus lusitanica, Acacia meansii, Pinus patula, Grevillea robusta and Juniperus procera*

among others. Results also showed that Blue gum was the most preferred tree species. This study therefore looked at availability from two perspectives namely, if not well regulated, availability may also lead to over-exploitation or underutilization of the agroforestry trees.

5.3. Utilization of agroforestry trees

Findings on utilization of agroforestry trees in Kesses and Kapseret sub counties show that trees are used by farmers for various reasons among them as a source of income for purchased products followed by trees as a source of fuel wood and timber. Least of all is the provision of fodder for livestock. These findings are also supported by Leakey (2004) who states that utilization of agroforestry trees is the extent to which the farmers are using the agroforestry tree resource. Simons (1996) also states that the concept of utilization of agroforestry trees has been broadened to emphasize on it being a farmer-driven and market-led process that takes a participatory approach to involve local communities.

As soil improving agents, agroforestry trees have been shown to positively alter the soil-crop environment by improving soil aggregation, enhancing water infiltration and water holding capacity which reduces water runoff and soil erosion and thus contribute to reduction of the effects of droughts in soils under trees (Phiri *et al*, 2003). The contribution of trees to soil improvement is one of the major assets of agroforestry. Some evidence on the effects of trees on soils comes from comparing soil properties under canopy of individual trees with those in the surroundings without tree cover (Young 1997). This argument is also supported by a study conducted in Europe which showed that growing trees and crops in agroforestry systems generated a higher value of ecosystem services than growing them separately (Graves *et al*, 2007).

While the actual and potential benefits of agroforestry have been well documented in several parts of the world, it is important to note that agroforestry is not a total panacea against food insecurity and environmental degradation (FAO 2013). Utilization of agroforestry trees in Kesses and Kapseret was found to be hampered by a number of things which includes Government bans on species like *Juniperus procera*, this reduced the rate at which farmers plant this particular species because they can't utilize it. They would rather plant species like *Eucalyptus grandis*,

Cupressus lusitanica or *Grevillea robusta* which they can harvest and utilize. In most cases land use rights affected utilization of various agroforestry trees in the study area.

Gender played a significant role where culturally trees belonged to the husbands and women do not own trees and thus cannot use them as was the case according to Rocheleau and Edmunds (1997). Sorghum (*Sorghum bicolor*) production in 15 transect blocks, each with a Sheanut (*Vitellaria paradoxa*) tree at each end, was evaluated on-farm in a village of southern Burkina Faso in a season of below-average rainfall. Most farmers were very protective of the shea trees on their farmlands, indicating the strength of the incentives these trees provided. In contrast, the income from locust bean was almost non-existent, which is not surprising as most households had restricted rights to access and use of these trees even on their own farmlands (Kater *et al*, 1992; Kessler 1992; Boffa *et al*, 2000).

Agroforestry is often subject to policy conflicts and omissions, creating gaps or adverse incentives that work against its development. In addition, when policies are restricted to exclusively sectoral bureaucratic regulations, mistrust between farmers and decision-makers is the result (FAO 2013). This usually creates confusion among the law enforcement agencies and Extension officers. In Kesses and Kapseret, corruption was a major element that prevented the officer's from performing their duties. Kenya Forest Service Rangers would focus much in gazetted forest lands while taking bribes from farmers to let them misuse agroforestry trees that are regulated whereas the Kenya Police officers would focus on traffic and other crimes and take bribes from the farmers and let them scot free regarding tree regulations as a preserve of KFS rangers. In many countries, in principle, agroforestry is regarded as belonging to "all sectors", but in practice, it belongs to none and rarely occupies a special line in a government body nor has its own policy space. It falls between the agriculture, forestry and environment departments, with no institution taking a lead role in the advancement of agroforestry or its integration (FAO 2013).

There is therefore need to build capacity for institutions handling agroforestry tree regulations and agroforestry matters in general. Policies as drivers are mainly to create a favourable economic and institutional environment, in which private local actions can be carried out without significant restrictions. In all places where the legal

framework is weak or poorly implemented, it is more attractive to continue illegal practices on trees.

5.4. Socio-economic factors that influence the availability and utilization of agroforestry trees

According to study results, socio-economic factors that influence the availability and utilization of agroforestry trees in Kesses and Kapseret Sub-counties include level of education, availability of labour, household security, land and tree tenure, farm size, access to market and availability of information and training. Ideally, agroforestry trees serve to improve the resilience of farmers and increase their household income through the harvesting of diverse products at different times of the year. It also brings job opportunities from the processing of tree products, expanding the economic benefits to rural communities and national economies (FAO 2013).

5.4.1. Land Tenure

Household security, affects domestication of agroforestry trees, land tenure is an important factor in planting, managing and utilization of agroforestry tree species, Security of tenure over the land cultivated stimulates the farmers' commitment to protect and develop the area owned, land area influences farm income and agroforestry systems can produce cash income through marketing of tree products (Speranza *et al*, 2008). Pattanayak *et al*, (2003) identified tenure security and extension support as two of the most important determinates of increased agroforestry practice. In this study, land and tree tenure were found to have direct influence on availability and use of agroforestry tree species within the study area. All the respondents (100%) believe that land tenure has direct effect on agroforestry tree utilization. Land tenure insecurity has long been hypothesized as a barrier to wider agroforestry uptake, though there are few studies that have been able to demonstrate a definitive link between improved tenure security and changing agroforestry practices (Arnot *et al,* 2011). To date, no clear consensus has emerged from empirical studies across sub-Saharan Africa on whether and how stronger land tenure security may, in general, incentivize farmer decision-making and pursuit of different land investment strategies on their farms (Place 2009).

A study carried out in Maragoli, Western Kenya observed that traditional land tenure and ownership rights were based on male patrilineage. Land ownership and transfer

through inheritance are customarily almost exclusively on an individual male tenure, which hardly gave provision to women's access and permanent ownership rights. In this respect, men influenced decisions relating to land allocation for tree planting and utilization (Ekisa 2010). Fortmann (1985) argues that the landowners have the right to the fruits which the tenants could harvest for personal use, but never for sale. Without the landlord's permission they could not fell certain trees. Therefore in such a system, sustainable management of agroforestry trees may be difficult. With these arguments and believe by 100% of the respondents, it is therefore in order to say that land and tree tenure has a direct influence on the level at which farmers utilize the trees on their farms in Kesses and Kapseret.

5.4.2. Level of Education

A number of studies have shown that the level of education has a direct impact on the farmer's practice of agroforestry. This consequently impacts on level of utilization of agroforestry trees. Although Bankole & Oludayo (2012) revealed that despite the low level of education which could hinder the level of utilization of the agroforestry practices, personal characteristics such as gender and age among others play a vital role. Study results also shows that there is no significant relationship between the level of education and the awareness of agroforestry, therefore the null hypothesis was accepted. This implies awareness of agroforestry does not depend on whether a person acquires formal education or not. This shows that personal characteristics may play vital role in the awareness about the agroforestry just like those that were able to interpret pictorial agroforestry without formal education. This is also supported by Olujide and Oladele (2011).

The results of this study found out that 89.5% of respondents have various levels of education ranging from adult education, primary education, secondary education and post-secondary education while 57.9% of respondents believed that level of education has a direct impact of utilization of agroforestry trees. This implies that the respondents can adopt most improved agroforestry technologies due to their enhanced ability to acquire technical knowledge. Besides, farmers who have some level of education respondents readily to improved technology, such as application of fertilizers, use of pesticides and improved planting materials thus increasing their productivity.

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. Adekunle (2009) points out that the level of education of farmers will directly affect their ability to adapt to change and to accept new ideas. Oino and Mugure (2013) examined the level of education against the number of trees and found that there is a strong relationship between education level of the household head and tree planting. Therefore, a strong evidence that number of trees is related to household head level of education. They found that majority of the farmers with less than 10 trees had low level of formal education, while those with more than 30 trees had higher. This therefore gives a strong indication that the level of education plays a key role in tree planting and at the same time the level of utilization.

5.4.3. Gender

Gender plays a significant role in the practice of agroforestry (Ipara, 1992). According to Ipara (1992), the roles of men and women in planting tree species are distinct. Women in Kakamega, western Kenya are not allowed to plant trees due to cultural beliefs, for example a belief that "if a woman plants a tree, she will become barren". Women are constrained by taboos and beliefs (Ipara 1992). In Kesses and Kapseret, 62.3% of the respondents were females contrary to a study conducted in Vietnam which found that female headed households had fewer tree species on their farms (Catacutan and Naz, 2015). Female headed households also suffer more from labour shortages and heavier activities because these households are smaller and their households have fewer working - age members (FAO 2013).

5.4.4. Labour

Availability of labour and its cost will affect a farmer’s decision to plant or utilize agroforestry trees, or generally adopt a particular agroforestry system. Some agroforestry practices such as alley cropping are considered as labour intensive and therefore more difficult to adopt (Glover *et al*, 2013). 57.9% of the respondents believed that labour availability has a direct effect on tree planting and utilization. This study finding showed a wide variation in distribution of respondents over different age groups. This implies that there is a good source of labour in the two sub counties of Kesses and Kapseret. The findings showed more respondents above the age of 25 years and that may be an explanation that there are more adult members in

the households and hence means that more quality labour would be available for carrying out farming activities and the practice of agroforestry would not pose any problem. This is in agreement with the findings of Villano and Fleming (2004). Indeed, it supports the findings of Ajayi *et al*, (2003) who states that age is a factor that has been extensively considered as a socio-economic factor influencing the practice of agroforestry.

5.4.5. Farm Size

When the farm size is large farmers tend to adopt agroforestry technologies more easily and vice versa. Substantial efforts are required to domesticate new and underutilized tree species, to increase their cultivation on smallholder farms, and to develop market infrastructures. 96.5% of farmers in Kesses and Kapseret believe that farm size has direct implications on utilization of agroforestry tree species. A lot of studies have found a direct relationship between land, labour and capital. A study conducted in Ainabkoi, Uasin Gishu County by Busienei (1991) revealed that there were competing uses of land, labor and capital. This was due to the fact that farmers in the area use most of their farms for subsistence farming and non-perennial cash crops such as wheat, and maize. In this view therefore, most invested the available resources into crop farming sidelining tree planting. The same author proceeds to say that coincidence of tree planting with the time when the agricultural crop farming had the highest pressure on labor demand was another miscalculation by the farmers. Another study observed that there is a strong relationship between size of land and the number of trees planted on the farm. The relationship showed a strong evidence that number of trees is related to size of land (Oino and Mugure, 2013).

This study found an average of 1.5 acres as the land holding by the farmers in Kesses and Kapseret, which concurs with the study by Busienei (1991) that tree domestication will be competing with subsistence farming.

5.4.6. Information and Training

Farmers need more information and training for agroforestry relative to other agricultural activities. Extension strategies, including field schools, exchange visits and farmer training, are effective ways of disseminating agroforestry information. The extent of general smallholder farmer extension services is declining (Kiptot and Franzel, 2014). The study by Busienei (1991) concluded that lack of information in

agroforestry was a bottleneck to tree planting. The author argued further that, agricultural extension officers concentrated on crops and animal production, while on the other hand, forest extension officers embarked on tree planting activities only.

The above argument brings to our attention the fact that, no extension agent is fully equipped with technical knowledge on agroforestry components. Ipara, (1992) observed that poor extension services with respect to the train and visit method coupled with understaffing were bottlenecks to agroforestry technology adoption by women in Vihiga division. The same was revealed by ICRAF (1992) who argued that extension services training are centered on crop based curriculum, and many agricultural extension workers are not familiar with trees and shrub species that could fit in an agroforestry system. These agriculture trained extension agents have little knowledge on agroforestry trees with respect to their vernacular names, ecology, propagation, management and uses. On the other hand, forestry extension workers tend to view tree species from a purely “forestry" point of view, and neglect the needs and constraints identified by farmers.

Most of the respondents cited faulty extension services, with inadequate follow up visits or insufficient time for training and advice. This was also observed by Bueno (1978). 80.7% of the farmers in Kesses and Kapseret Sub counties believe that there is a direct influence of extension services on utilization of agroforestry trees as recommended by Oino and Mugure (2013) who stated that there is a need for the government and other development agencies to intervene by providing information and training to farmers who are ignorant of the benefits of engaging in agroforestry farming.

5.4.7. Access to Markets

Kumar’s (2006) review study of Asian agroforestry argues that in order for agroforestry to be a viable livelihood option in many parts of Asia, there is need for institutionalized channels of support to market access. Market assessment and strategic marketing of agroforestry products is essential for agroforestry enterprise success (Shamsuddin and Mehdi, 2003). Looking for a market only in times of surplus is problematic (FAO, 2005). For many agroforestry tree products, markets are poorly structured and coordinated (Roshetko *et al,* 2007). According to this study, 62.3% of farmers believe that access to reliable market for agroforestry tree products

directly affects its utilization. Poor, unstructured markets results in low and unstable returns to farmers and high prices for buyers of tree foods, which limits their consumption.

Problems often cited by producers include the absence of a collective bargaining system, poor transport infrastructure, and the involvement of multiple intermediaries in the supply chain, all of which act to reduce farm prices. All these affects the level of utilization of agroforestry tree species. Roshetko *et al*, (2002), hypothesises that commercial opportunities exist for farm communities to transform their traditional agroforestry systems towards market orientation. Traditional management approach produces small quantities of many products primarily for household consumption with limited market sales. Roshetko *et al*, (2002) states that replicable and efficient extension approaches should be designed to reach motivated and innovative farmers who are committed to improving their incomes by increasing the production and market access for their agroforestry products. This study therefore found that poor and unstructured markets have a direct effect on availability and utilization of agroforestry products.

5.5. Effects of socio-economic factors on agroforestry trees

Correlations between availability, utilization and socio-economic factors using Pearson's coefficient of correlation showed significant positive relationships at 99% level of confidence, showed that 1% change in availability of agroforestry trees leads to 87.7% change in the effects of Socio-economic factors, while 1% change in utilization of agroforestry trees leads to 85.4% change in the effects of socio-economic factors hence indicating that availability of agroforestry trees has a higher level of association with the effects of socio-economic factors (87.7%) than with their utilization (78.6%).

CHAPTER SIX
CONCLUSIONS AND RECOMMENDATIONS

6.1. Conclusions

This study makes the following Conclussions;

(i). In Kesses and Kapseret Sub Counties, trees were available on the farms for use. Despite this, factors like existing government policies, cultural restrictions and lack of capacity by relevant government institutions to enforce the law on utilization of agroforestry trees were a constraint to respondents' use of trees.

(ii). On utilization of agroforestry trees in Kesses and Kapseret Sub Counties, trees are used by farmers for fodder for livestock, timber and fuel wood. Agroforestry trees also act as a substitute income for purchased products, agroforestry trees increase income thus alleviating poverty and agroforestry trees are used as fertilizers' by farmers.

(iii). Level of education, availability of labour, household security, land and tree tenure, farm size, access to market and availability of information and training are socio-economic factors that influence the availability and utilization of agroforestry trees in Kesses and Kapseret Sub Counties.

(iv). Various socio-economic factors among them gender, level of education and land tenure hinder accessibility to management and use of agroforestry trees. Gender plays different roles in a community and hinders the management and utilization of agroforestry trees. Level of education whether formal or informal, leads to change in knowledge. Management skills and extension services of agroforestry trees affects the manner in which agroforestry trees are managed and utilized. Household security and Land tenure are important factors in planting, management and utilization of agroforestry tree species. Security of tenure over land cultivated stimulates the farmers' commitment to protect and develop the area owned, Land area influence farm income and agroforestry systems produces cash income through marketing of tree products.

6.2. Recommendations

6.2.1. Recommendations for management/Farmers

i. There is need for promotion of appropriate agroforestry technologies in Kesses and Kapseret sub counties to increase agroforestry production and raise farmers'

income. There should also be efforts to continuously encourage farmers to get involved in agroforestry activities.

ii. Communities should be empowered to recognize and tackle socio-economic factors that influence participation of farmers in agroforestry practices, hence influencing the availability and utilization of agroforestry trees. This would ensure successful local involvement.

iii. There is need for agroforestry to be part of integrated rural development programme to meet more of the farmers' basic needs than it presently does.

iv. Technical assistance is also needed to facilitate the spread of agroforestry practices. Adequate information is required to keep farmers abreast of current trends and development in the practices of agroforestry.

v. Provision of economic incentives by the Forest Service to farmers participating in agroforestry practices should be considered.

vi. Farmers should be encouraged to venture into agroforestry by relevant government agencies so that they can benefit from improved crop yields and additional income from sales of tree products.

vii. The development of agroforestry policy should not be confined to the agricultural or forest sectors to have a place of its own. Required reforms should include targeting tree and land tenure and how farmers obtain the trees they plant, and the recognition of agroforestry as an investment option. This therefore calls for reforming unfavourable regulations, legal restrictions and restrictive financial mechanisms that inhibit the practice of agroforestry; clarifying land-use policy goals and regulations; elaborating on new policies that acknowledge the role of trees on farms in development; and strengthening farmer access to markets for tree products.

6.2.2. Recommendations for further Research.

Future research should focus on verifying the implications of the dimensions developed in this study, and also enhance the generalizability of the findings by undertaking similar studies in other counties in Kenya. The current study only looked at the state of agroforestry at a point in time in Kesses and Kapseret Sub counties. Further studies focusing on the types of tree species grown in Kesses and Kapseret Sub counties over a longer period of time and their effect on the availability and use should be done.

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APPENDICES

APPENDIX I: Tree species Available on farms in Kesses and Kapseret Sub counties

Species	English Common Name	Local Name (Nandi)	Uses	No. of Households		Percent (%)		Percent (%) Total
				Kesses	Kapseret	Kesses	Kapseret	
Eucalyptus grandis	Blue Gum	Chebarusyot	Shade tree for crops, ornamental, bee forage, timber fuelwood, charcoal, Edge trees.	41	55	36.0	48.2	84.2
Cuppressus lusitanica	Cypress		Live Fencing, Shade, ornamental, timber, fuelwood, Edge trees.	53	39	46.5	34.2	80.7
Grevillea robusta	Silky Oak	Chepkumiat	Shade tree for crops, ornamental, bee forage, timber fuelwood, charcoal, Edge trees.	31	40	27.2	35.1	62.3
Acacia mearnsii	Wattle tree	Ketitab Ulaya	Backs, ornamental, bee forage, timber fuelwood, charcoal, Edge trees.	21	24	18.4	21.1	39.5
Olea africana	Olive	Emdit	Furniture, Charcoal, Posts, Windbreaks, Shades, Ornamental, Edge trees, Fuelwood,	24	20	21.1	17.5	38.6
Acacia tortilis		Sesyat	Charcoal, Shade, Soil improvement, Posts, Fuelwood.	22	18	19.3	15.8	35.1
Prunus africanum	African Plum	Tendwet	Timber, Charcoal, Posts, Windbreaks,	15	24	13.2	21.1	34.2

			Shades, Ornamental, Edge trees, Fuelwood,					
Eriobotrya japonica	Loquat	Lakwas	Fruits, Posts, Bee foraging, ornamental, Fuelwood, windbreaks, Timber, Charcoal,	21	17	18.4	14.9	33.3
Sesbania sesban			Fuelwood, fodder, Nitrogen Fixation, shade, windbreaker,	24	12	21.1	10.5	31.6
Acacia lahai	Red Thorn	Chebitet	Shade, Fencing posts, bee foraging, Charcoal, Fuelwood,	13	21	11.4	18.4	29.8
Fraxinus pennsylvanica	Mexican ash tree		Charcoal, Timber, Ornamental, Fencing posts, Edge trees,	22	9	19.3	7.9	27.2
Juniperus procera	Pencil Cedar	Tarakwet	Fencing Posts, Timber, Fuelwood, Shade,	24	4	21.1	3.5	24.6
Casuarina equisetifolia	Whistling Pine		Fencing posts, firewood, erosion prevention, windbreak, Timber, Edge tree.	8	18	7.0	15.8	22.8
Persea americana	Avocado	Avokado	Fruits, Charcoal, Fuelwood, ornamental,	11	11	9.6	9.6	19.3
Citrus Sp	Oranges		Fruits, Fuelwood, Bee foraging, Shade, Windbreaks,	7	13	6.1	11.4	17.5
Pisidium guajava	guava	Maperiat	Fruits, Posts, Bee foraging, ornamental, Fuelwood, windbreaks, Timber, Charcoal,	4	15	3.5	13.2	16.7
Pinus patula	Pine	Chebunduki	Live Fencing,	13	5	11.4	4.4	15.8

			Shade, ornamental, timber fuelwood, Edge trees.					
Dombeya goetzenii		Silibuet	Soil improvement, shade, fuelwood, poles, Fencing Posts, Bee foraging, Charcoal.	11	7	9.6	6.1	15.8
Syzygium guineense	Waterberry	Lamaiywet	Fruits, Charcoal, Fuelwood, ornamental,	8	9	7.0	7.9	14.9
Croton macrostachyus	broad-leaved croton	Tebeswet	Fuelwood, charcoal, fence posts, poles, shade tree for crops, wind protection, soil conservation, ornamental, bee forage, edge trees.	7	9	6.1	7.9	14
Leucaena leucocephala	white lead tree		fuelwood, timber, shade and windbreaks, as well as fodder and nitrogen-rich green manure	4	10	3.5	8.8	12.3
Croton megalocarpus	Croton	Masineitet	Fuelwood, charcoal, fence posts, poles, shade tree for crops, wind protection, soil conservation, ornamental, bee forage, edge trees.	7	6	6.1	5.3	11.4
Acacia abyssinica	Umbrella tree	Sertwet	Shade, Fencing posts, bee foraging, Charcoal, Fuelwood,	9	4	7.9	3.5	11.4
Mangifera indica	Mango		Fruits, Posts, Bee foraging, ornamental,	5	7	4.4	6.1	10.5

			Fuelwood, windbreaks, Timber, Charcoal,					
Acacia melanoxilon	Sally wattle	Kanunga	Shade, Posts, bark, Fuelwood, Timber,	5	4	4.4	3.5	7.9
Warburgia ugandensis	Uganda greenheart	Sogeet	Medicinal, timber, charcoal, shade,	4	4	3.5	3.5	7
Calliandra calothyrsus	Calliandra		fodder, Nitrogen Fixation, shade, windbreaker, Fuelwood,	1	7	0.9	6.1	7
Annona cherimola	Castard Apple	Chesiru	Fruits, Fuelwood, Bee foraging, Shade, Windbreaks,	3	4	2.6	3.5	6.1
Polyscias kikuyuensis	Parasol Tree	Soiyet	Ornamental, Shade, Fuelwood.	5	0	4.4	0.0	4.4
Cordia abyssinica	Sudan Teak	Samutet	Posts, Bee foraging, ornamental, Fuelwood, windbreaks, Timber, Charcoal,	3	1	2.6	0.9	3.5
Spathodea campanulata	African tulip Nandi Flame	Sebetaiyat	Posts, Bee foraging, ornamental, Fuelwood, windbreaks, Timber, Charcoal,	0	3	0.0	2.6	2.6

APPENDIX II: Questionnaire

Serial number:

|___|___|___|___|___|___|

SURVEY QUESTIONNAIRE
Interviewer Name;

Interviewer number; Date of interview **(DD/MM/YYYY)**

|___|___|___|___|___|___| |___|___|___|___|___|___|___|___|

Respondent's name;

Respondent cell phone number **(Record without the initial zero);**

|___|___|___|___|___|___|___|___|___|___|

Quality Checks:

❑ .1. Edited by Interviewer ❑ .2. Researcher checked

Sub County name;

Setting;

❑ .1. Urban ❑ .2. Rural

Location name;

1. **INTRODUCTION**:

Good morning/ afternoon / evening. My name is Julius Rotich from University of Eldoret, a Masters student conducting research study in this area. I'm conducting a survey on opinions relating to **Availability and Utilization of Agroforestry Trees: Socio-Economic Perspectives in** Kesses and Kapseret Sub Counties. Your answers will be used for research purposes only. There is no right or wrong answer to what I ask. Are you willing to take a survey?

❑ .1. Yes ❑ .2. No

SELECTED RESPONDENT DEMOGRAPHICS

2. Gender;

❑ .1. Male ❑ .2. Female

3. Age;

❑ .18 – 24 Years ❑ .35 – 44 Years

❑ .25 -34 Years ❑ .45 + Years

Actual age

|___|___|

4. Religion

- ❑ . a. Catholic
- ❑ . b. Catholic Charismatic
- ❑ . c. Mainstream Protestant (ACK, Methodist, Presbyterian, AIC)
- ❑ . d. Evangelical Protestant
- ❑ . e. Other Christian
- ❑ .f. Muslim
- ❑ .g. Hindu
- ❑ .h. Buddhist
- ❑ .i. No religion
- ❑ .j. Other (specify)

5. Other (specify) ***Record other for the question above.***

6. Highest level of education **completed**

❑	.1. No formal schooling	❑	.5. Secondary school education
❑	.2. Some primary education	❑	.6. Post-secondary
❑	.3. Primary education	❑	.7. College education
❑	.4. Some secondary education	❑	.8. University education

7. Employment Status

❑	.1. Working full-time (About 40Hrs per week)	❑	.6. Housewife taking care of home full time
❑	.2. Working part-time (Less than 40hrs per week)	❑	.7. Student
❑	.3. Casual/piece jobs	❑	.8. Self Employed
❑	.4. Unemployed	❑	.9. Other employed
❑	.5. Unemployed Pensioner		

8. Other (specify) ***Record other for the question above***.

QUESTIONS REALTING TO SOCIO ECONOMIC BENEFITS OF AGROFORESTRY TREE SPECIES

9. In your opinion, what is the most serious problem facing you today **[SINGLE RESPONSE]**

- ❑ .1. High cost of living
- ❑ .2. Lack of employment
- ❑ .3. Poor leadership
- ❑ .4. Corruption
- ❑ .5. Climate change related problems
- ❑ .6. Other (Specify)

10. Other (specify) ***Record other for the question above***.

11. **(i).** Thinking of your welfare now compared to before you started using agroforestry tree products; do you feel better, worse or about the same?

- ❑ .1. Better
- ❑ .2. Worse
- ❑ .3. About the same
- ❑ .4. REFUSED TO ANSWER
- ❑ .5. NO REPLY

(ii). Why do you think so? Explain

12. (i). Farm Size (Acres) ☐

(ii). Who owns the land

- ☐ .1. Husband
- ☐ .2. Wife
- ☐ .3. Family
- ☐ .4. Communal
- ☐ .5. Other *(Specify)*

13. Other (specify) ***Record other for the question above***.

(iii). Do you receive extension services?

☐ .1. Yes ☐ .2. No

14. If Yes (specify the service provider) ***Record 'YES' for the question above***.

- ☐ .1. NGOs and Private firms
- ☐ .2. Ministry of Agriculture (MoA)
- ☐ .4. Forest Department (KFS)
- ☐ .4. Research Institutions (KEFRI, KARI, MU etc)

QUESTIONS ON THE AVAILABILITY AND OF UTILIZATION OF TREE

15. Looking a few years back;

a. (i). What can you say about the general tree cover in Wareng Sub County? Has it increased, decreased or remained about the same?

- ☐ .1. Increased
- ☐ .2. Decreased
- ☐ .3. Remained the same
- ☐ .4. Other (Specify)

16. Other (specify) ***Record other for the question above***.

(ii). Please explain your answer in Q2. a (i).

b. (i). What can you say about the tree cover on farms? Has it increased, decreased or remained about the same?

- ☐ .1. Increased
- ☐ .2. Decreased
- ☐ .3. Remained the same
- ☐ .4. Other (Specify)

17 Other (specify) ***Record other for the question above***.

(ii). Please explain your answer in Q2. b (i).

c. (i). What about tree planting? Has it increased, decreased or remained about the same?

❑ .1. Increased ❑ .3. Remained the same

❑ .2. Decreased ❑ .4. Other (Specify)

18. Other (specify) ***Record other for the question above***.

(ii). Please explain your answer in Q2. c (i).

19. Are there any cultural restrictions that affect your planting, harvesting and using the trees in your farm?

❑ .1. YES ❑ .4. DK **[DNRO]**

❑ .2. NO ❑ .5. NR **[DNRO]**

❑ .3. RTA **[DNRO]**

20. If Yes (specify) ***Record 'YES' for the question above***.

21. Are there any policy restrictions that affect your planting, harvesting and using the trees in your farm?

❑ .1. YES ❑ .4. DON'T KNOW

❑ .2. NO ❑ .5. NO REPLY

❑ .3. REFUSED TO ANSWER

22. If Yes (specify) ***Record 'YES' for the question above***.

23. How much do you agree or disagree with the following statements regarding the right to plant or use the trees available in your farm? **[READ OUT STATEMENT]**

24. What food stuff for consumption do you get directly from the trees?

No.	Tree Species	Food Stuff	Volume / Annum	Price per tonne (KShs)

25. Please fill the table below

STATEMENT	AGREE	DISAGREE	DON'T KNOW	NR/ RTA
1. Any member of the family can plant trees.	❑	❑	❑	❑
2. Any member of the family can harvest trees.	❑	❑	❑	❑
3. Any harvesting of trees require a permit from the government	❑	❑	❑	❑
4. I have the right to use all the trees within my farm	❑	❑	❑	❑
5. I benefit from all the trees in my farm	❑	❑	❑	❑
6. I still have space to plant more trees	❑	❑	❑	❑
7. I'm willing to plant more trees on my farm	❑	❑	❑	❑
5. The cultural restrictions are still deep rooted within the community	❑	❑	❑	❑

No.	List Kinds of Tree Species Available on Your Farm	Uses per species	Volume of product per annum	Price of Product per Tonne (KShs)	Number of trees on farm
1.		1.			
		2.			
		3.			
		4.			
		5.			
2.		1.			
		2.			
		3.			
		4.			
		5.			
3.		1.			
		2.			
		3.			
		4.			
		5.			
4.		1.			
		2.			
		3.			
		4.			
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