An Evaluation of the Influence of Information Sources on Adoption of Agroforestry Practices in Kajiado Central sub-County, Kenya

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DECLARATION

This research project is my original work and has not been presented for a degree or any award in any other university. All accessible sources of information cited in this write-up have been duly acknowledged.

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This research project has been submitted for examination with my approval as University Supervisor.

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DEDICATION

To Chris, my youngest son the pillar of motivation that kept me going.

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ABBREVIATION AND ACRONYMS

AEZ	Agri-Ecological Zone
ASALs	Arid and Semi-Arid Lands
CIFOR	Center for International Forestry Research
DoI	Diffusion of Innovation
FAO	Food Agriculture Organization
GoK	Government of Kenya
ICRAF	International Centre for Research and Agroforestry
ICT	Information Communication Technology
IDRC	International Development Research Centre
KEFRI	Kenya Forestry Research Institute
KFS	Kenya Forest Service
KM^2	Kilometer square
Kshs	Kenya Shillings
MM	Millimeter
MoA	Ministry of Agriculture
MoEW&NR	Ministry of Environment, Water and Natural Resources
NFFP	National Forest Farming Programme
NGO	Non-Governmental Organisation
SFTP	Social Forestry Training Project
SLT	Social Learning Theory
SPSS	Statistical Package for Social Scientists
WAC	World Agroforestry Centre

ABSTRACT

Access to information on agroforestry is a key transformer to agricultural productivity. This study was undertaken to identify the Information Communication and Technologies (ICT) information sources and determine factors influencing access and use of these information sources by smallholder agroforestry farmers in Kajiado Central, Sub County. A survey of 67 respondents was analyzed using Chi-square at 0.05 level of significance to determine relationship between socio-economic characteristics of households and access to agroforestry information sources. The results showed 37.4% of the farming households used face to face communication namely; neigbours and friends, extension agents and group meeting, whereas 31.8% use mass media communication pathways and other modern ICT information sources namely; radio, television, telephone and internet are actively used to disseminate (one way) or share (receive and send feedback) information on agroforestry practices. Land size, secured land tenure, education level, monthly income and distance to the shopping centre were socio-economic factors identified and found significant and positively influencing farmers' access to sources of agroforestry information. The study recommends policy makers, planners and implementers to empower farming households through capacity building, incorporating farmer to farmer meetings and use of modern communication methods to promote agroforestry practices in Kenya.

Key words: Agroforestry, information sources, socio-economic factors

CHAPTER ONE

INTRODUCTION

1.0 Background of the Study

Globally, farmers constantly seek agricultural information to increase production and overcome challenges of reducing land productivity potential. Research institutions, Universities, Agri-firms and financial institutions are core agricultural information sources available to farmers (Onuekwusi, 2007). These institutions are essential knowledge base as they hold diverse information and agricultural research findings with relevant skills developed to improve agricultural and industrial practices.

Information on agroforestry, which is an agricultural practice and one of the traditional land use systems, has been passed from generation to generation through various dissemination methods. In the past three decades or so, Agroforestry practices has been promoted through pilot projects in Kajiado sub-County-Kenya targeting communities to embrace sustainable land use (Mohamed, 1998). Some of the agroforestry farming systems being adopted at the area of this study are alley cropping, woodlots, silvi-pasture and apiculture with trees, windbreaks, boundary planting, fodder banks, orchards or tree gardens. These practices, promoted by either the government ministries or private sector aims at conserving the environment through increasing vegetation cover, fodder and wood fuel, soil protection, enhance food security as well as mitigate negative effects of climate change (Southgate, et.al, 1996: Newell et.al 2002).

In recent year's adoption of agroforestry practices has made tremendous strides though many of the success stories appear to be confined to small areas. This infers that in terms of its wider

application there exist challenges which are not well documented. Kishor (2006), proposes that adoption of agroforestry practices like any other innovation is a process influenced by a number of both physical and social factors. Largely, agroforestry practices have been transmitted from generation to generation via traditional means through personal communication, impersonal documents e.g. mails and memos; extension agencies, face-to-face meetings, dramas and telephone calls. Lately, modern communication pathways that ranges from simple to more rich and modern tools which use Information and Communication Technologies (ICTs). In general, these modern media tools allow transmittal of complex electronic data and bulky agricultural information to wide and diverse end users as well as expanding assembly of technologies to handle information (Okyere and Mekonnen, 2012).

Adolwa (2012), noted that ICTs are relatively complex to farmers who are more educated and in a better position to utilize these tools for acquiring information efficiently and cost-effectively. This intervention can shorten distances to the centres and increase availability of information. Hossain (1998), observed that in a people-centered participation approach of communication, identification of networks of information flow provides a deeper insight into the pattern of information exchange in the farming community.

This study therefore sets out to identify the ICT information sources commonly available to small scale agroforestry farming households and extension factors influencing adoption of agroforestry practices.

1.1 Problem statements

In Kenya, agricultural research institutions, universities and colleges, public and private agro-firms as well as financial institutions generate information for farmers and stakeholders. This is the basis of policies to guide farming decisions that impact positively on the desired farming goals. Agroforestry information and practices have been informed by these institutions.

Information on agroforestry systems and practices has been derived from biophysical aspects such as soil erosion control with little attention given to farmers as sources of agroforestry information.

Vision 2030 blue-print shows growing concern among farmers engaged in tree growing and tree/crop inter-growing on-farm. This type of agroforestry system shows many challenges that include limited access to information sources and inadequate knowledge on tree/crop growing on-farms.

Few studies have been undertaken to investigate how information sources publicize information for adoption of agroforestry practices within farming communities. It is therefore of great concern that information, through ICT, on factors influencing adoption of agroforestry practices is insufficient.

Information through ICT will increase farmers' awareness of information on agroforestry practices. Consequently, many farmers do not understood extension factors that lead to agroforestry practices.

This study was undertaken in Kajiado Central sub-County to identify ICT information sources commonly available to small scale agroforestry farming households and likewise explored extension factors influencing adoption of agroforestry practices.

1.2 Objective of the study

The broad objective of the study was to identify the ICT information sources used in adoption of agroforestry practices and what factors influence use of these information sources by smallholder agroforestry farmers in Kajiado Central, Sub County.

1.2.1 Specific objectives

The specific objectives for the study are:

1. To identify ICT information sources that smallholder agroforestry farmers use
2. To determine factors which influence access and use of ICT information on agroforestry practices

1.3 Research questions

This study will seek to answer the following questions:

1.3.1 Is there relationship between ICT information sources and agroforestry practices among small scale farmers?

1.3.2. What factors affect the farmers' access to sources of ICT information?

1.4 Justification of the study

Agroforestry is a function of farming systems estimated to be practiced by 1.2 billion people globally (World Bank, 2009). It is a considerable economic and ecological importance venture

for small scale to large-scale farm holders in low, medium and high potential areas. Farmers need information on generated technologies from the research systems to apply them for agricultural production. Trees grown on-farms, be it homesteads or woodlots, are important source of diverse products and services that contribute significantly to green economy, soil erosion control, environmental conservation, food security, poverty alleviation and energy sector. Fodder trees on-farm, for instance are source of livestock feed and fuelwood across sub-humid to arid and semi-arid environments (Wambugu et al., 2011).

Despite these benefits, there is a growing shortage of fuel-wood in African countries due to excision of forests (FAO, 2011) and woodlands, over harvesting of trees and lack of knowledge on proper land use management. A study conducted by Dyszyski et al., (2009) indicates that 80 percent of households in Kenya use fuel-wood as source of energy (63.8 percent use firewood while 13.3 percent use charcoal for cooking). Charcoal amounting to 300 tones is used every month which is extremely suppressing the environment specifically the forests and woodlands. A similar study conducted by the Ministry of Education (GoK, 2002) shows that between year 2000 and 2020 fuel wood consumption is expected to rise from 35, 119, 615 tonnes to 53, 416, 327 tonnes, an indications of about 50 percent increase.

The Kenya Forestry Master Plan (1995) suggests that the future of forestry in Kenya lies on-farms. Thus the Government of Kenya through the Constitution, (2010) is necessitating consolidated efforts to plant trees and achieve 10 percent tree cover by year 2030. Such initiative supposes that public and private institutions, individuals and other development partners must engage in development of forestry as well as create awareness to promote social forestry, afforestation and reforestation programs as well as adoption of trees on-farm.

To ensure increased adoption of agroforestry practices in the tropics, it is imperative to explore and understand the interactions between sources of agroforestry information and smallholder agroforestry households. Extension service providers (agents), mass media, and innovative farmers are some of the communication channel used to disseminate information and transfer agroforestry technologies developed by formal institutions. However, little has been studied on interaction among institutions, communication channels and agroforestry practitioner despite that they play a significant role in agricultural sector. To ensure that supply of information is sufficient in quantity and of high quality, this study was undertaken to contribute more knowledge on how specified information ICT sources influence decision of smallholder agroforestry households to adopt agroforestry practices.

Findings from this study are anticipated to bring out knowledge disposition and communication gaps existing between research and practices; issues that agricultural development planner and stakeholders have to consider when promoting agroforestry practices. In addition, this study is meant to fulfill the requirement for an award of Master of Science degree.

1.5 Scope and Limitation

This study was limited to a sample of small scale agroforestry faming household within Kajiado Central sub-County.

One crucial limitation is that information on land tenure is always treated with sensitivity and some respondents decline to provide sincere answers to relevant questions. The researcher addressed this challenge through reassuring farmers of the utmost confidentiality on the data collected and the findings would strictly be used for academic purposes.

1 .6 Definition of Terms

In understanding this study, interpretation and discussion of the results, the following definitions were adopted.

1.6.1 Information Source

Institutions or communication channels providing new ideas or knowledge to the information seeker (Tucker and Napier, 2009).

1.6.2 Agroforestry practices

Land use system in which woody perennials (harvestable trees or shrubs) are grown on-farm as a means of preserving or enhancing land productivity (ICRAF, 2011).

1.6.3 Smallholder agroforestry farmers

Farmers deriving their livelihoods in less than five hectares of land practicing mixed or subsistence farming (Munyua, 2009).

1.6.4 Adoption

Applications of agroforestry practice in land management for productive use

1.6.5 Socio-economic factors

These are social and economic resources that help shape the farming households decision to adopt agroforestry practices

CHAPTER TWO

LITERATURE REVIEW

2.0 Land use systems

Land is one of the important resources for production of agricultural goods and services (Karina and Dodoo, 2009). Fransel and Scherr (2002), advance that agriculture land use and management presents major development challenges throughout sub-Saharan Africa. In Kenya, degradation of productive lands and deforestation pose a serious threat to the sustainability of forestry and agricultural productivity. The changing patterns of land-use require adequate information and extension policy to effectively support farmer adoption of agroforestry.

Several studies ranging from problems in dissemination of forestry technologies in agricultural setup to adoption of tree planting on-farm and behaviour of urban agricultural et. cetra have been conducted in African and Asian continents (Kiptot, 2006). However, majority of these studies indicate that poor linkages between research and extension, civil society organizations and farmers are weak and that often the new improved technologies do not reach their intended beneficiaries (Spurk and Mak'Ochieng, 2013).

Poor work relationship between national agricultural research and extension organizations, farmers and other stakeholders in research and extension service delivery is one of the key challenges affecting the agriculture sector in Kenya. Study done by Kishor, (2006) states that like any other innovation or technology adoption, tree growing on-farm is a complicated process that is influenced by a number of both physical and social factors. Factors like farmers' age and innovations have been widely studied in agricultural scenario. For instance, in a review of 23

factors affecting the adoption of agroforestry, eight of the studies included gender as a variable (Schatz and Williams, 2009). In five of these studies, male-headed households were found to be more likely to adopt agroforestry practices than female headed households. This is social cultural limitation which can be attributed to access men have to resources and information unlike women's. Cultural limitation and methodology are therefore critical predictors for evaluation in this research study.

Evans (1988) states that previous research has often focused on biological and economic aspects of agroforestry systems rather than on participatory perspectives that are designed to increase their adoptability. However, more recent research has begun to consider socio-economic and ecological factors as they affect smallholders' involvement in agroforestry systems, though few have reported empirical results on participatory extension aspects of development (Rocheleau, 1991a). In participatory extension aspects, bottom-up approach, with an increasingly farmer-centered perspective on research, design, and dissemination is a process supposed to start from the level of the community and promote development that addresses the needs and perceptions of participants (Glendinning, 2001). Given the diverse socio-political settings in which farm forestry programmes operate in many different countries, it is likely that there can be no uniform extension design. Much along the lines of the "on-farm" research approach advocated by Scherr (1992), it is the intended participants who should, at the very least, identify and set the priorities for the information to be propagated and media to be used in farm forestry extension systems. This, in turn, means that it is essential that the strengths and limitations of existing extension systems are evaluated so as to inform future farm forestry development strategies.

2.1 Tree Growing initiatives in Kenya

Generally, high population densities, intensive cultivation, repeated subdivision of family lands and rapid decrease in land available for farming are some of the major causes of soil erosion, soil nutrient depletion, and wood fuel and timber shortages in the highland areas of Kenya. These problems, together with declining tree cover resulting from conversion of forests to settlements, are causing increasing concern about sustainable development of forests in Kenya (Rocheleau, 1991b)**.** To remedy this situation, various government and private agencies have been encouraging farmers to plant trees on their farms in small woodlots and boundary planting amongst other agroforestry practices. Thus, farm forestry (i.e. the commercial growing of trees by individual farmers on their own private land is an important land use option for conserving the environment. Farm forestry has the potential to take over a substantial part of the functions of indigenous and plantation forests (Peltorrinne, 2004).

The Government of Kenya in 1960's initiated integrated rural development intervention programmes geared towards rehabilitation and improvement of ASALs ecosystems. The vision was to produce 200 million seedlings per year for use in reforestation and on-farms tree planting. Food Agriculture Organization (FAO, 1992) together with International Development Research Centre (IDRC) and World Agroforestry Centre (WAC) formerly International Centre for Research in Agroforestry (ICRAF) concentrated on development of agro-forestry technologies. These initiatives were intensified because planting trees was viewed as an economically and culturally sound intervention to respond to scarcity of tree products, and implementation by public was crucial to beef up resources available (Mercer, et al., 1998). However, hardly was

there consideration that the rural smallholder lack information sources and skills required for sustainability of such programmes (Kanyeki, 2009).

With such inadequate knowledge, tree growing on-farms in Kenya did not roll out until late 1980´s when the Government partnered with other development partners to undertake a natural resource rehabilitation programme in Arid and Semi-Arid Lands (ASALs). Social Forestry Training Project (SFTP) whose objective was to develop tree planting technologies to improve provision of forest products and the living standards of the communities in ASALs was formulated in 1987 between Kenya and Japan governments. Kitui and Makueni Counties were identified as the focal areas of attention while neighbouring Kajiado and Machakos Counties would benefit from such technology transfer (Kigomo, 2001).

Farm forestry, a common practice amongst typically subsistence farmers was earmarked for improving agricultural production, provision of shelter for crops and livestock stock, soil and water conservation, provision of substantial environmental benefits such as water table and salinity reduction, amenities as indicated in National Farm Forestry Program 1995 (NFFP). This intervention was anticipated to cascade to other ASALs areas in Kenya.

Miyagi and Muok (1997), notes that due to lack of technical knowledge and scientific information in Kenya tree cultivation outside the gazetted forests remains poor while crop production and animal husbandry which had been established for millennia continues to benefit from incremental gains in research and practice. Munyua et al., (2009) observes that poor access to agricultural information, weak institutional capacity and coordination, inadequate markets and market information are barriers that limits farmers from attaining full agricultural production.

These observations are supported by a survey conducted in Orissa villages in India that revealed that 80 percent of small scale faming households had no idea that they could obtain technical assistance and tree seedlings from the Forest Department (FAO, 1992).

2.2 Agroforestry Practices

Agroforestry is an ancient agricultural practice which farmers have used to manage their farms on the same unit of land in time and in different arrangements for increased social, economic and environmental benefits (Leakey, 1996). This practice involves cultivation and utilization of woody perennials such as trees, shrubs or bamboos in farming systems. It is a practical and low-cost mean of implementing many forms of integrated land management, especially for small-scale producers (Leakey, 2009).

Adoption of agroforestry practices in semi-arid lands and access to relevant information sources is a key initiative to increasing trees on-farms. Understanding appropriate management and sustainable use of such resource as an alternative measures is anticipated to arrest land degradation, and increase forest cover to 10 percent as stipulated in the Vision 2030 blueprint. Eventually contribute to food security, poverty reduction, employment, improved livelihood (GoK, 2007). In many developing countries, rural populations derive a significant part of their food and other basic requirements from various trees and shrubs. Incentives to increase adoption of agroforestry practices in pastoral systems are further encouraged by ever increasing prices of food crops and meat amongst other plants and animal products. These products play a critical role in meeting the basic needs of local populations. Nonetheless, there are promising levels of agroforestry systems and technologies adoption in various regions. Some farmers are planting

both exotic and indigenous trees on their farms. This practice is expected to increase as farmers become increasingly aware of agroforestry potential to alleviate ecological and economic difficulties. Some of the agroforestry systems, benefits and challenges are discussed as follows.

2.2.1 Fodder Trees

Farmers and pastoralists have long used fodder trees and shrubs to feed their livestock. This traditional and extensive practice involves lopping off tree branches or allowing animals to browse. Studies carried out by Bekure et al., (1991), states that agroforestry systems for fodder are profitable ventures in developing countries as it reduces farm labour and increase income from livestock and crop production. In the Central highlands of Kenya, for instance, Wambugu (2001), noted that farmers plant *Calliandra calothyrsus* and *Leucaena trichandra* as fodder shrubs to feed dairy cows. Fodder trees increases milk production and can substitute the relatively expensive dairy meal, thus increasing farmers' income. Fodder shrubs also conserve the soil, supply fuel-wood and provide seeds, and bee forage for honey production. In the semi-arid areas Acacia variety is being grown on-farms in Western Africa, as well as in Ethiopia, Malawi and Tanzania for fodder and soil fertility improvement. But uptake has been minimal in parts of eastern and central Africa despite years of research and circulation of scientific publications. Combination of improved fodder grasses and Acacia trees as animal feed especially during the dry spell is an emerging trend noticeable amongst small scale farm holders in Kajiado Central Sub-County.

2.2.2 Soil fertility improvement

Soil infertility is a key problem noticeable in many farming systems throughout the sub-County. Intensified livestock rearing, soil erosion, unsystematic farming and reduced fallowing periods are some of the causes of land degradation and soil infertility.

Researchers and farmers have tried technologies such as application of manure, integration of tree species especially fodder trees namely: *Calliandra calothyrsus; Sesbania sesban; Gliricidia sepium* to increase crop yields, and conservation of dominant indigenous trees species such as Acacias which have been found to increases soil fertility and control soil erosion (Wambugu and Tuwei, 2001). The farming households lacks knowledge such as those applied in Western Kenya for instance, where farmers who treats their vegetable plots with leaves from a shrub *Tithonia diversifolia* hedges grown along field boundaries, together with small amounts of phosphorus fertilizer, to double their returns to labour (Kiptot, 2006).

2.2.3 Timber and Non-timber products

Farmers engaged in agroforestry practices in Kajiado Central are noted to intercrop Acacia species, *Grevilea robusta*, *Calliandra calorthysus*, *Casuarina equistefolia* and assorted fruit trees for commercial gains in timber and non-timber products. Apart from food, mainly fruits, other harvestable derived from trees on farm are fodder, fiber, herbal or medicinal harvests, oils, gums and resins, amongst others

2.2.4 Environmental benefits

Agroforestry can provide a greater range of environmental benefits notably windbreaks, shade, amenity, carbon sequestration and biodiversity compost, biomas, soil erosion control and protection against evapotranspiration. Increasing support for agroforestry-related policies;

availability of potential partners in research and development, including the World Agroforestry Centre (ICRAF), Center for International Forestry Research (CIFOR), NGOs, regional governments, the private sector and universities; and international concern for climate change are opportunities that are potential supporters of agroforestry research (Nair, 2009).

2.2.5 Challenges in Adoption of Agroforestry in Semi-Arid Lands

In Kenya, ASALs covers 80 percent of the country's landmass. These lands hold approximately 38 Million hectares, 78 percent of wooded areas, and many other unexploited resources. ASALs support about 70 percent of livestock and 20 percent of human population, and both depend solely upon the natural resource for food security and livelihoods. Van de Steeg (2009), states that although a variety of agroforestry farming systems, ranging from livestock based system to mixed farming is practiced in the ASALs, temperate and humid regions, semi-arid environment are fragile ecosystem that presents great challenge to land users. The risks come in form of uncertainties such as climate and resources base (labour, land and capital), pressure exerted by unprecedented increase in both human and livestock (Tiffen, 2003). The decision to diversify crops is a particularly challenging to farmers in semi-arid lands since these areas exhibit greater variability in annual precipitation particularly areas that are marginal for agricultural production. Changes to the timing of the growing season (onset of rains) and mid-season dry periods in particular pose significant challenges to farmers in semi-arid ecosystems (MacCord, 2014). Rainfall is the dormant climate factor affecting agricultural production in semi-arid areas. Mean annual rainfall is often below 1000mm and inadequate moisture leads to low growth of food crops and assorted tree species Akileng (2007).

In wet year's extensive soil erosion, poor precipitation and flush flood occurs. Other factors such as poverty, climatic conditions, cultural practices, land tenure, political and the remoteness of some areas, value addition and marketing of tree products is a major constraint to tree planting technologies and development.

Kaudia (1996), points out that adoption of forestry technologies by rural communities in Africa has remained at subsistence level due to lack of comprehensive extension appliance to disseminate research findings. Kiplang'at & Ocholla (2005) reports that in Kenya, communication and information sharing between agricultural researchers and extension workers is greatly curtailed by technology divide. They note that while majority of agricultural researchers are computer literate and have access to internet, email and CD-ROM databases, most of the extension workers rely entirely on printed extension materials. Their study also found that a large number of agricultural researchers use ICTs to communicate with extension workers, but only a third of the extension workers use the same format. Accordingly, they observes that the two subsystems are supposed to work more closely together in transmitting new knowledge of farm technology to farmers and also getting feedback from farmers. This is a major constraint to flow of agricultural information and services.

Kaudia (1997) point out that in semi-arid areas agro-ecological conditions constrain optimal biological productivity of trees in the short run, and the need to sustain livelihoods can undermine adoption of technically profitable innovations. Agroforestry has been promoted through pilot projects as an example of sustainable land use; however adoption by local communities is limited outside the project location. She concludes that social and economic

status of farming households has important implications for adoption and diffusion of tree planting on-farms.

Manyong et al., (2005) study found out that problem of information dissemination is associated with limitations in dissemination expectation, geographical obstacles, fragmented audience and limited economic resources. Similarly, the founder of the Green Belt Movement in Kenya and the first African Woman Nobel Peace Prize winner (2004) Prof. Wangari Maathai, noted that lack of ample extension services that taps into agroforestry science from research institutions and universities and then pass information to smallholders is the great disservice to the quest for food security in Africa. Onuekwusi and Ijeoma (2008) studies indicates that rural farmers are ready for information but the prevalent problem is non-availability and lack of access to information sources. Despite these challenges many studies show that scientists and agri-economists have completed projects that show agroforestry in many ways is beneficial practice to the user and the environment. The weak scientific knowledge base about socio-economic and technical aspects of agroforestry, the complexity of agroforestry systems and the value of local famers experience make on-farm research usually important in agroforestry (Scherr, 1991).

2.3 Information sharing

Extension and training is crucial in the development of knowledge, perceptions and attitudes about agricultural innovations. Scherr (1992) described five basic models for extension for agroforestry practices: media-based extension, commodity-based extension, training and visit, farming systems research and extension and community-based extension. As agricultural

production systems can vary considerably in nature and complexity in different settings, it is important to take these differences into account in tailoring extension interventions

2.4 Theoretical framework

There is a broad range of literature on theories regarding decision making processes, however this study was informed by the Diffusion of Innovation (DoI) Theory (Rogers and Schoemaker, 1999) and Social Learning Theory (Bandura, 1977). Rogers's model is concerned with the manner in which an innovation drifts from creation to use. It advances that behavior of an individual is a function of socio-economic and environmental factors and the objective adoption is endogenous to the sum of the interacting forces of one's situation. Theoretical and empirical literatures have shown that risk and uncertainty play an important role in the adoption of new agricultural technologies (Marra et al. 2003, Mercer 2004). This is especially true for marginal farmers in Africa, who have to manage risks on an everyday basis to secure their livelihoods. The diffusion paradigm entails adoption of innovation is a decision process, where innovation is communicated through particular channels, over time, among the members of a social system. Success of an innovation depends on certain principles, comparison of advantages of the innovation over traditional techniques, materials or conducts; compatibility with existing values; low complexity, the possibility to try out the innovation and its benefits. The adoption process is also affected by the so-called receiver variables, such as personality characteristics, social characteristics and the perceived need for the innovation.

As such, the behavior to adopt a new technology is assumed to be intentional in this model. Rogers (2003) proposes five categories of adopters namely; the innovators, early adopters, the

late majority, and the laggards. The strength of the theory is that adopters and non-adopters can be studied to identify factors that influence their adoption behavior. Surry and Farquhar (1997) in their article, "Diffusion Theory and Instructional Technology," claims that disciplines ranging from agriculture to marketing have used diffusion theory to increase the adoption of innovative products and ideas. Roger (1995) also points out that innovation creates both opportunity and uncertainty for individuals, where opportunities exist because of the comparative advantages that accrue to individuals who successfully implement an innovation, particularly if they are among the first to do so.

The Social Learning Theory (Bandura, 1977) is also an important support theory in this study. Social Learning Theory (SLT) advance that adoption is a learning process that starts with individuals, and where a relationship between an individual and source of innovation (new idea) exists. Social Learning Theory proclaims that the nature of innovation, information sources and the communication channels, the characteristics of social groups, institution or organization are elements that influence technology adoption and expansion.

For this reason, learning requires enthusiastic individuals with skills and competences, knowledge on the subject and a positive attitude towards adoption of a new idea. Apparently, significant and influential learning occurs in the context of relationships between individuals, organizations as well interaction between individuals and channels used to transfer technology to the end users. Nonetheless, it is assumed that the national institutions provides information, services and professional knowledge but relies on the media to pass on the information as well as the farmer for provision of land, labour, capital, indigenous knowledge for the implementation and adaptation of an innovation.

2.5 Conceptual framework

This conceptual framework shows typical adoption of agroforestry practice. It advances that adoption of an innovation is a process governed by function of needs. It goes through stages, with time, perception and utilization of knowledge. Agroforestry practice, like any other innovation, originates from a source, a research institution, university or agri-based firm. The innovation is then packaged and disseminated through a specific communication channel(s) which may repackage the innovation to suit the needs of the adopter. The adopter in turn makes a decision to embrace or not embrace the technology depending on various rational and physical factors. In this concept it is presumed that information source is the independent variable while influence on adoption of agroforestry practice, which is a behavior denoted by individual interest, needs, knowledge about the technology, and perceptions about perceived benefits, is the dependent variable. This behavior is governed by a set of intervening variables such as farmers age (continuous variables), as well as (categorical variables) namely gender, socioeconomic status, level of education, income, land size, land tenure, distance to information source.

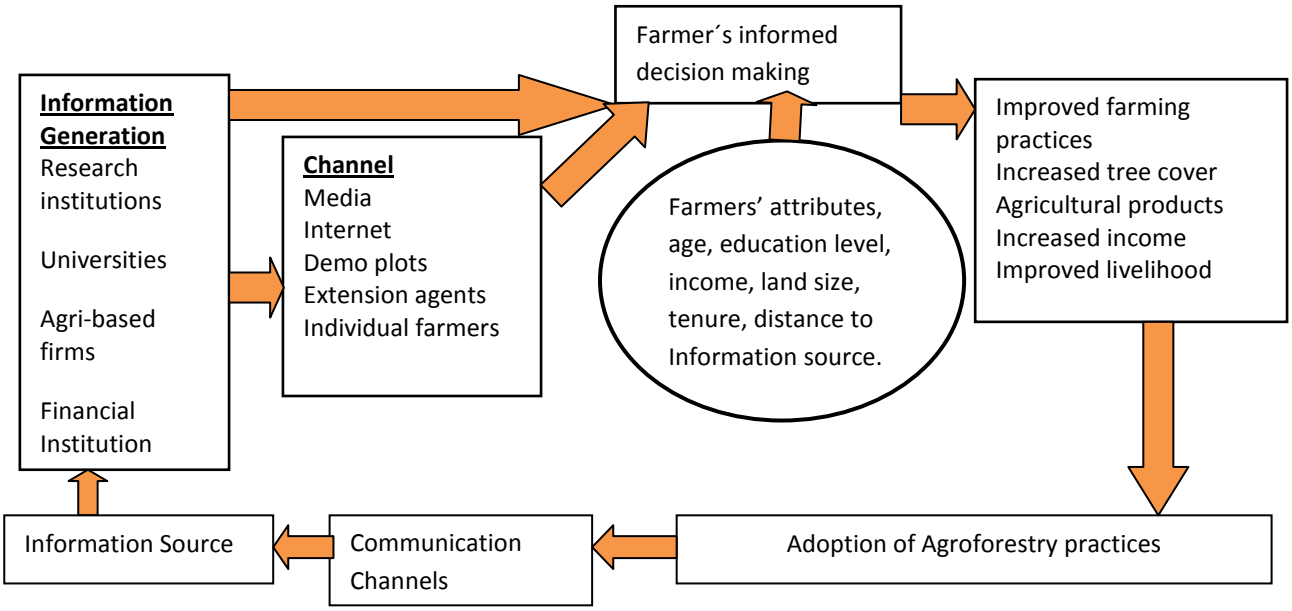

Figure 1: Conceptual framework on information sources and their influence (Adapted from Coulibaly Lingani et al., 2011)

Once the adoption takes place the outcome could result into enhanced farming practice, and the benefits are increased tree cover and agricultural products, cash income, and improved livelihood. The user may continue using the technology or discontinue. In both instances feedback are given through the appropriate information channel. This information exchange is best validated by farmer's feedback through extension agent to researchers, media or social fora.

One of the challenges in assessing farmers´ use and preferences for agroforestry information stems from a common failure in the literature to distinguish between information sources and channels. Tucker and Napier (2001), states that information sources generates and provides the content or expertize of interest to the information seeker, while channels are methods or vehicle by which information or technology is communicated or transferred from one point to the other.

This study identified information sources as research institutions, universities and tertiary colleges, government agencies, corporative bodies that conduct research and disseminate research findings. Around 65 channels that include: publications such as farm magazines; mass media; internet; extension agents; farmer to farmer meetings; seminars; demonstration gardens; on-farm trials; agricultural shows to name but a few are regarded as communications tools.

It is evident from the literature that information is key input in agricultural development and that agricultural extension plays an important role in enhancing information flow between the source and the end user. The main users of agricultural information include the researchers and research managers, extension workers, transfer agents that include the NGOs, farmers, policy makers, trainers, consultants, bankers and the business community as a whole.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

This chapter presents an overview of the methods used in this study. Areas covered include; research design, population, sample and sampling techniques, data collection and analysis.

3.1 Study area

The study was carried out in Kajiado Central sub-County in the southern part of the Great Rift Valley. The sub-County covers approximately 21,105 Km^2. It is divided into five administrative divisions namely: Central, Bissil, Namanga, Elangata wuas and Ildamat (GoK Development Plan, 2008 - 2012). The sub-County neighbours Mashuru to the East, Republic of Tanzania to the South West, Loitoktok sub-County to the South East, Makueni sub-County to the North East, Isinya Sub-County to the North and Kajiado North Sub-County to the North West.

About 50 per cent of the Sub-County lies in semi-arid zones (zones AEZ-V, 37 per cent under AEZ-IV and 80 per cent under AEZ II-IV (Jaetzold and Schimdt, 1983). Only eight percentage of the sub-County's land is classified as having some potential for rain-fed cropping (zone IV). This makes Kajiado one of the ASALs sub-County's in Kenya. The rainfall pattern is bi-modal with long rains falling in between March and May and the short rains falls between October and December. Annual maximum rainfall is estimated at 1,250mm per annum while much of the Sub-County receives between 500 to 800 mm average annual rainfalls.

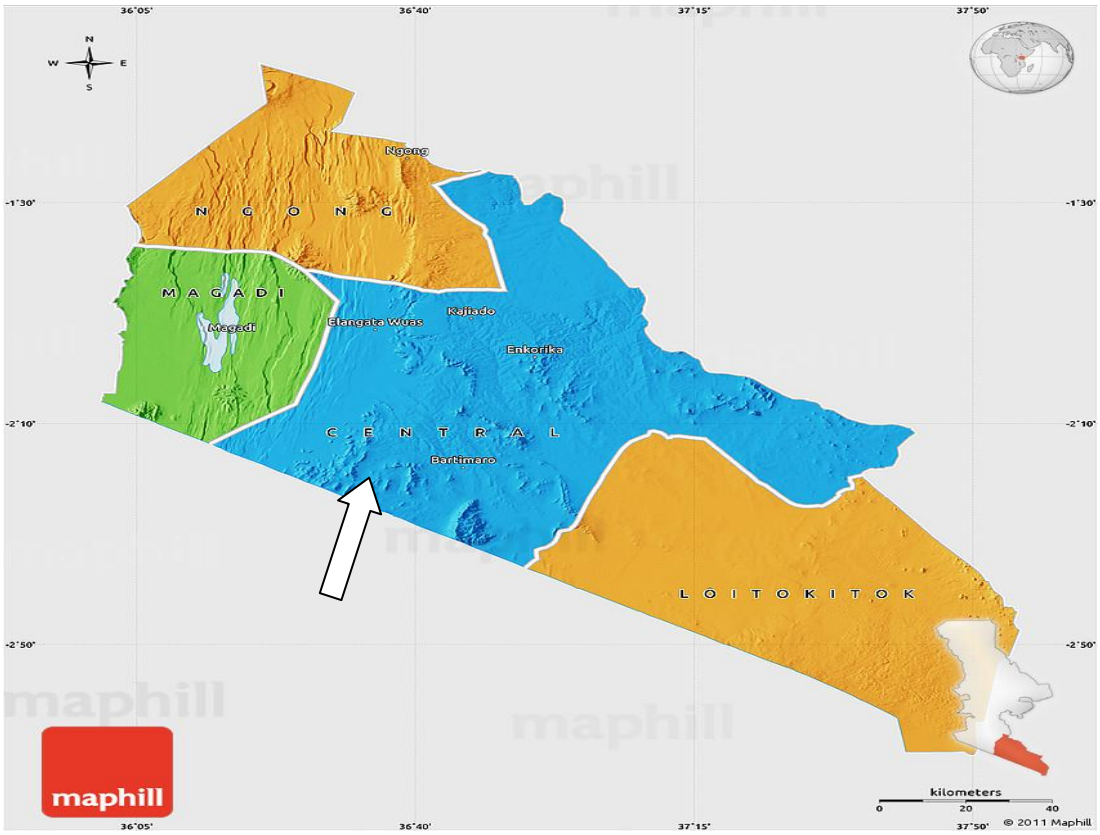

Figure 2: Map of Kajiado Central sub-County *(Source: Maphill.com 2014*)

This sub-County is purposively selected as the study location because it is one of the anticipated ASALs areas in Kenya where tree growing technologies was supposed to cascade during Phase (I) of Social Forestry Training Project. The project was formulated in 1987 between Kenya and Japan governments, had Kitui and Makueni sub-County as focal points and neighbouring Kajiado sub-County also adopt developed tree planting technologies to improve provision of forest products and the living standards of their communities (Cheboiwo et al, 1997). The sub-County has erratic change in land use, dynamic agricultural and livestock productivity, poverty, low incomes and a varied tropical climate (GoK DDP, 2005). Initially, majority of the land in this sub-County was communally owned by Maasai pastoralist who engaged largely in livestock

production, but lately the land is being subdivided into individual small farm holdings. The new land use arrangements coupled with social and economic changes has put the community in a form of transition lifestyle as land is changing from rural to peri-urban state ((Ochuodho, 2001). This new land system, aggravated by recurrent drought presents distinctive problems to the farming community and the existing natural resources.

For instance, indigenous tree species that once dominated the place, some conserved as fodder banks for use during dry spell are now being threatened by land degradation, cutting for charcoal production, and clearance to pave way for structures or other uses. This diverse shifting of farming system provides a good entry for the study.

3.2 Research Design

This study used a non-experimental research design where a survey was done (Mugenda and Mugenda, 2003) to measure responses from small-scale farming households practicing agroforestry within Kajiado Central sub-County. Primary data on household level were collected using semi close ended structured questionnaires through a period of three month in April and June 2014.

3.2.1 Sampling and Sample size

Population for this study was 201 smallholder households registered by Kenya Forestry Service as active farmers. A sample size of (n = 67) was achieved using a simple random sampling method (Cochran, 1977). The formula used is as follows:

$$n_{srs} = \frac{N\hat{p}_{srs}\hat{q}_{srs}}{\frac{d^2}{1.96^2}(N-1) + \hat{p}_{srs}\hat{q}_{srs}}$$

where

n_{srs} = sample size

N = population size

$\hat{p}_{srs}$ = the estimated proportion

$\hat{q}_{srs} = 1 - \hat{p}_{srs}$

d = desired absolute precision

$$n_{srs} = \frac{201(0.9)(0.1)}{\frac{0.06^2}{1.96^2}(201-1) + (0.9)(0.1)} = \frac{18.09}{0.2774} = 65$$

Respondent were selected using snowball sampling method. They gave multiple referrals; however, only one subject was recruited among them. These households are sparsely distributed within the sub-county's density of 22 Km^2 (GOK, 2009). Thus, the choice of the new respondent was guided by factors such as social networks, accessibility and the level of farmer's willingness to respond.

3.2.2 Data Collection

Primary data comprising respondents demographic attributes; age, gender, level of education, monthly income, and land size; socio-economic factors; and information sources sought by farmers and extension agents to access information on agroforestry practices was collected. Similarly, secondary data consisting of information from literature, reports from relevant sources was referred to.

3.2.3 Instruments of data collection

Data collection procedure started with a semi-structured interview with key informants, a focus group discussion with 11 farmers practicing agroforestry, followed by administration of a semi-structured open and closed ended questionnaire (Appendix. 1). The questionnaire was pre-tested before administration.

3.2.4 Data Analysis

Data were analyzed using Statistical Program for Social Scientists (SPSS). Descriptive statistics were employed in results presentation which is in tables, graphs and charts.

CHAPTER FOUR

RESULTS

4.0 Introduction

Analysis from 67 households responses were collated into descriptive statistics (mean, median, frequencies, percentages, and standard deviation) using SPSS (version 21). Qualitative treatment of data involved the use of frequency distributions. Chi-square was used to determine statistical significance between the study variables whose operations definition and measurement are indicated (Table 4.1).

Table 4.1: Definition of variables

Concept	**Independent Variable**	**Description**
Access	Access to information	Interaction with information source
	Adoption of Agroforestry practices	Land use pattern where integration of trees on-farm as agroforestry systems is observed
	Income	Average Monthly income (Ksh)
	Intervening variable	
	Continuous variables	Age (Age in years)
	Categorical	
	Gender	Male or female
Socio-economic factors	Land size	Acreage
	Land tenure	Ownership and years of occupation
	Education level	Highest academic qualification
	Distance to nearest shopping centre	Kilometer
	Income	Monthly
	Dependent	Farmers decision making

4.1: Social and Economic Characteristic

4.1.1: Gender Distribution

The respondents were 67 smallholder agroforestry farmers where 49 (71.4 percent) 19 (28.6 percent) were male and females respectively (Figure 4.1). However, this should not be interpreted to mean males are more than females. Maasai communities are patriarchal and male member have the autonomy to responds to family issues.

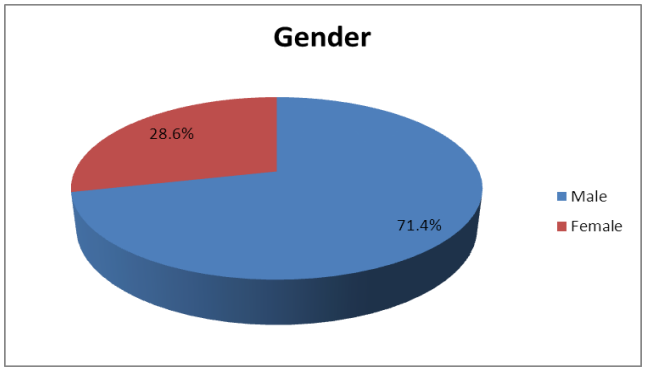

Figure 4.1: Distributions of respondents by gender

4.1.2 Respondents age

The results below indicates a median age of the sample to be 30- 39 years of age (Table 2)

Table 4.2: Age composition of respondents

Age	Frequency	Percentage
20 yrs or under	5	8.1
21-29	11	16.1
30-39	15	22.6
40-59	29	43.5
60 or above	9.7	7

4.1.3 Education level

Respondents were asked to indicate highest level of education. The result show 21 percent was un-educated while 27 percent had attained primary level education while the majority 39 percent had attained secondary education and 13 percent had tertiary education. The level of education is wanting since only 13 percent have attained tertiary education or above.

Table 4.3: Highest Education level

Education level	Frequency	Percentage
Uneducated	14	21
Primary	18	27
Secondary	26	39
Tertiary and above	9	13
Total	67	100

4.1.4 Household membership

Analyses of household membership indicate 95.2 percent male and 91.9 female members are active whereas inactive males and females were 96.7 percent and 91.5 percent respectively. Since the p-value is smaller than $\alpha=0.05$ we conclude that there is a significant relationship between house membership and decision to adoption of agroforestry practices.

Table 4.4: Members per household

Household members	Gender of household members	Members per household according to gender and level of activeness					
		0 – 5 (%)	5 – 10 (%)	10 – 15 (%)	Above 15 (%)	Total (n)	Total (%)
Active members	Male	95.2	4.8	0.0	0.0	62	100
	Female	91.9	6.5	1.6	0.0	62	100
	Total Number	66.1	29.0	3.2	1.6	62	100
Inactive members	Male	96.7	3.3	0.0	0.0	61	100
	Female	91.5	8.5	0.0	0.0	59	100
	Total Number	79.3	12.1	8.6	0.0	58	100

Test statistics; χ^2= 24.600; d.f = 6; p = 0.00

4.2 Presence of trees on-farm

Results indicate respondents planted trees to demarcate land (30.2 percent), ornamental (15.1 percent), fruit orchard (13.4 percent) and windbreaks (12.3 percent) as presented by Figure 4.6.

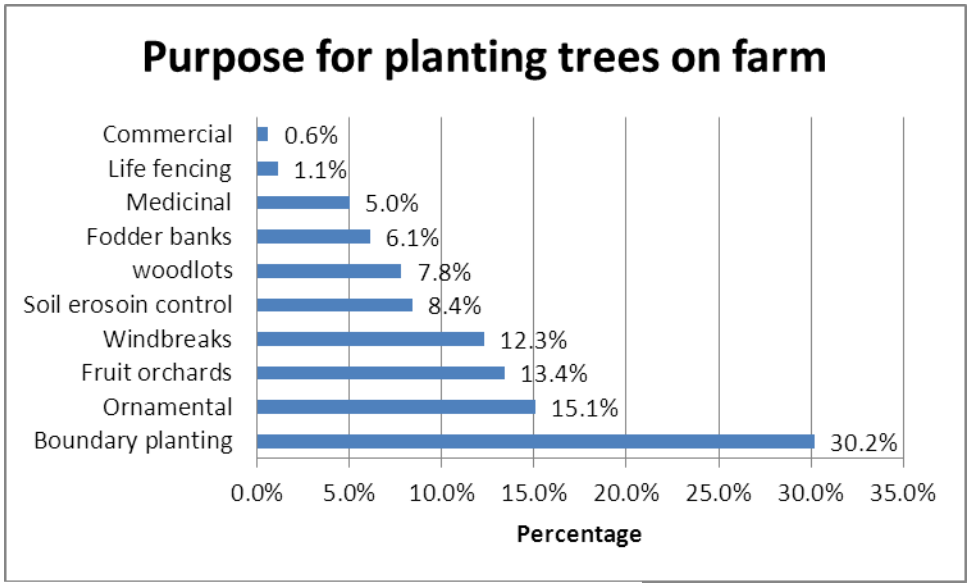

Figure 4.2: Purpose of tree planting

4.3 Information sourcing

Respondents were asked to state whether they seek experts guidance while adopting tree planting on farm. The results show 77.3 percent sought guidance from forest and agriculture experts. It can be concluded that uptake of tree planting is positive and it is being undertaken with appropriate and necessary guidance.

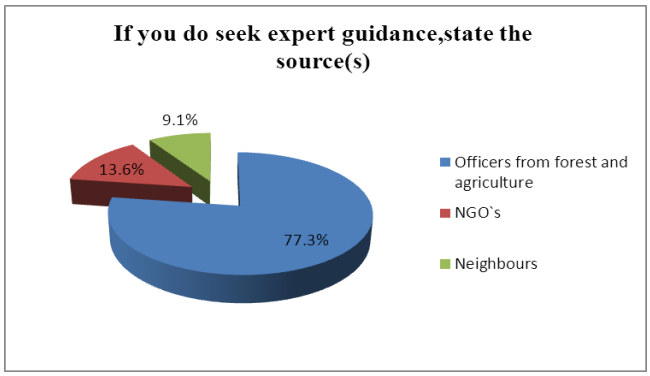

Figure 4.3: Consultancy and source

4.3.1 Primary information sources

To identify primary information sources that smallholder farming households use, respondents were asked to indicate institutions they interact with on agroforestry practices. Result shows research institutions are the most sought primary information source by farmers (Table 4.5). The table indicates 15.4 percent and 34.6 percent of the respondents said they most often or often respectively use it as a source of information. Financial institutions is the least sought after source of information with the majority (45.3 percent) stating they didn't use it at all followed by 37.7 percent who said they seldom used it. Since the p-value is less than α=0.005 we conclude that there is indeed an interaction between farmers and the information sources.

Table 4.5: Interactions with the information source

Source of information	How often do you interact with the information source						
	Most often	Often	On average	Seldom	Not at all	Total (n)	Total (percent)
Research institution	15.4	34.6	11.5	30.8	7.7	52	100.0
Universities	1.9	15.4	32.7	19.2	30.8	52	100.0
Agri-based firms	3.8	24.5	30.2	37.7	3.8	53	100.0
Financial institutions	0.0	5.7	11.3	37.7	45.3	53	100.0
Test statistics; χ^2= 67.931; d.f = 12; p = 0.000							

4.3.2 Reason for interacting with information source

Result shows universities are the most sought after with 57.1 percent due to credibility and 28.6 percent due to appropriateness. Research institutions follow with 30.6 percent of the respondents indicating credibility and 57.1 percent due to appropriateness. Since the p-value is less than α=0.05 we conclude that there is statistical significance meaning that indeed farmers do interact with information sources and they have positive reviews as to why they interact.

Table 4.6: Reasons for interacting with the information sources

Source of the information	Reasons for interacting						
	Credibility (%)	Appropriateness (%)	Accessibility (%)	Ease to use (%)	Not sure (%)	Total (n)	Total (%)
Universities	57.1	28.6	2.0	0.0	12.2	49	100.0
Research institution	30.6	57.1	0.0	0.0	12.2	49	100.0
Financial institutions	20.0	2.2	20.0	4.4	53.3	45	100.0
Mass media	6.8	0.0	81.8	6.8	4.5	44	100.0
Agri-based firms	6.1	30.6	57.1	0.0	6.1	49	100.0
Individual farmers	4.1	6.1	87.8	2.0	0.0	49	100.0
Internet	2.0	2.0	20.0	70.0	6.0	50	100.0
Extension agents	0.0	2.1	93.6	2.1	2.1	47	100.0
Test Statistics; χ^2= 549.346; d.f = 28; p = 0.00							

4.3.3 Communication Channels

The result shows frequency and percentage communication channels that they commonly use to access information on agroforestry practices (Table 4.7). The results show 15.6 percent used neighbours and friends as channels of communication, 13.8 percent used group meetings, while 13.5 percent and 13.1 percent used ICTs information sources radio, television, 6.6% and telephone 4.8%.

Table 4.7: Communication channels used in agroforestry

Channels	Frequency	Percentage
Neighbour and friends	45	15.6
Group meetings	40	13.8
Radio programmes	39	13.5
Agricultural publicity events	38	13.1
Agricultural publications/reports	31	10.7
Extension agents	23	8.0
Internet and blogs site	20	6.9
TV news and related programs	19	6.6
Research centers demos	19	6.6
Telephone	14	4.8
Church	1	0.3
Total	**289**	**100.0**

4.4 House type

The respondents were asked to indicate the type of house they own. The results (Figure 4.11) show 72 percent live in a semi-permanent houses, with 22.8 percent living in permanent houses and only 3.5 percent in temporary houses. The data actually signifies a scenario of a community undergoing transition or newly established in the area.

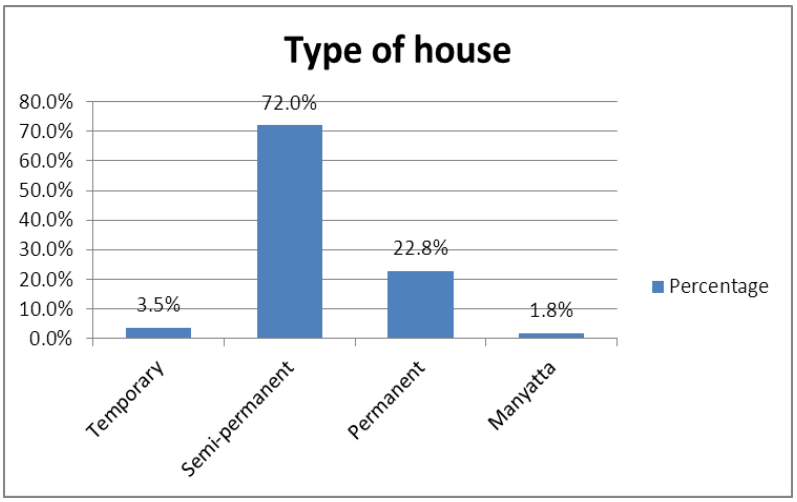

Figure 4.4: Respondents types of houses

4.4.1: Land tenure

Study show 52.6 percent are residing in family owned land, 45.6 percent singly owned, while 1.8 percent is on rental basis. The results indicate most of the land is a family entity.

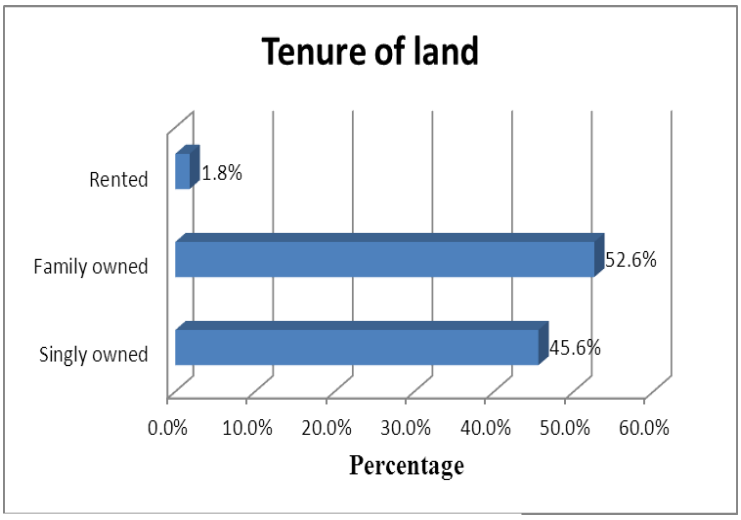

Figure 4.5: Tenure of land

4.4.2 Period of settlement

Majority of respondents 58.6 percent indicated they have settled in the land between 10 to 29 years. 24.1 percent have settled within less than 10 years. Only 1.7 percent said they have settled on the land for 50 years or beyond. The results show recent settlement with majority of the residents 82.7 percent have settled within a period of less than 30 years. Majority of the population is middle aged which can be attribute period being recent since people legally acquire land once they attain 18 years and above.

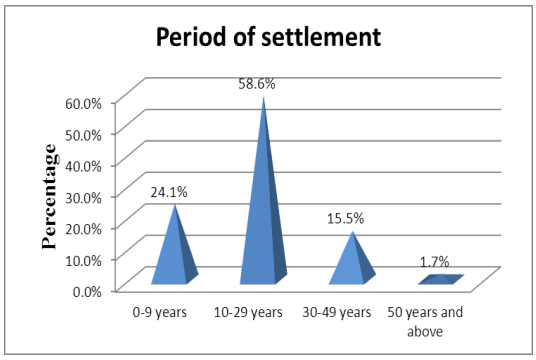

Figure 4.6: Period of settlement

4.4.3 Land ownership

Around 37.3 percent own 5 acres, 10.2 percent and 6.8 percent own 3.5 and 2 acres respectively. The rest 3.4 percent and 5.1 percent own between 0.33 and 1.5 acres of land.

4.4.4 Monthly income

The result show majority of the respondents 55.2 percent earn monthly income between 10,000 and 50,000 Kenya shillings, whereas 44. 8 percent earn less than 10,000 Kenya shillings. The level of income is unsubstantial since no one earns more than 50,000 Kenya shillings per month.

4.4.5 Distance to the shopping centre

The findings in this survey revealed 41.4 percent of the respondents resided between 2 and 5 Kilometers from the shopping centres and 37.9 percent resided in between 6 and 9.9 kilometers. Those nearer the shopping centre represent 10.3 percent and only 1.7 percent resides more than 20 km from the nearest shopping centre.

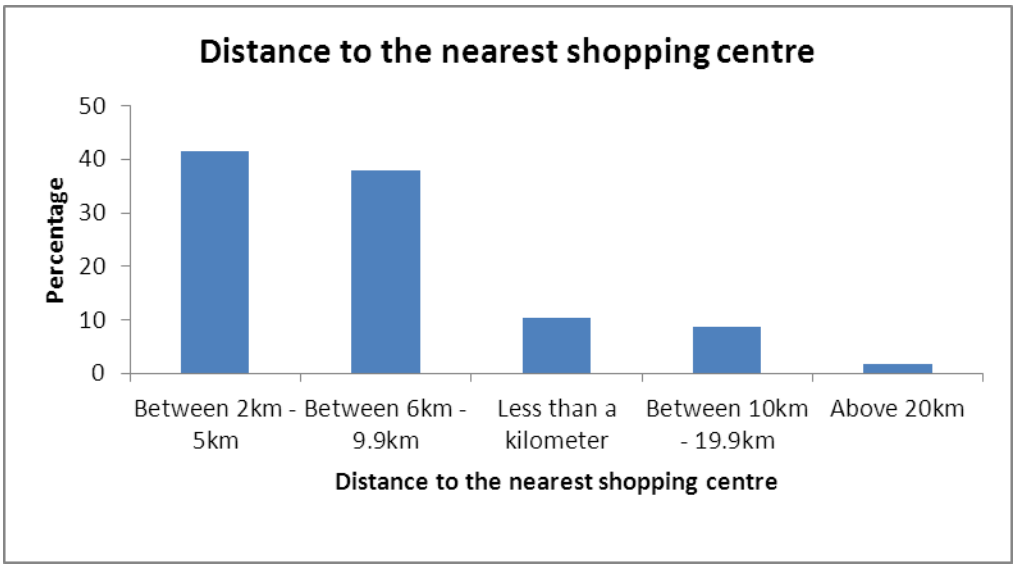

Figure 4.7: Distance to the nearest shopping centre

4.4.6 Livelihood improvement

When asked whether tree planting has improved their livelihood, the Likert scale show 42.1 percent agree it has, and similar percentage are either definite it has or they are probable it has improved. Those unsure are 14.8 percent and only 1.8 percent said it's possible it hasn't. It can be concluded therefore that since 84.2 percent of the respondents have indicated positively thus adopting agroforestry technologies improves quality of life.

4.4.7 Benefits

Findings from this study revealed that 44.1 percent of the respondents benefited with firewood and shade, whereas 24.7 percent with boundary marking and fence, and 13 percent with construction materials. Other benefits (Table 4.6) include fruits, windbreak, soil erosion control, source of income and fodder for animals.

Table 4.8: Areas that trees planting have improved households livelihood

Benefits	Number	Percentage
Firewood and shade	41	44.1
Boundary marking and fencing	23	24.7
construction materials	13	14
Source of fruits	7	7.5
Windbreak	3	3.2
Soil erosion control	3	3.2
Source of income	2	2.2
Fodder for animals	1	1.1
Total	**93**	**100**

4.5 Information seeking

Research institutions were ranked as the most sought after source of information as indicated by 38.8 percent of the respondents whereas the universities are sought by 26.8 percent, agri-based farms with 22.4 percent and financial institutions with 12 percent of respondents.

Table 4.9: Institution mostly sought after as information sources

Primary information source	Number	Percentage
Research institutions	26	38.8
Universities	18	26.8
Agri-business firms	15	22.4
Financial institutions	8	12.0
Total	**67**	**100.0**

4.5.1 Communication pathways levels of influence

This study found neighboring farmers, extension agent and group meetings were highly influential communication channels, followed by ICTs (Table 4.10). Since the p-value is less than α=0.05 we conclude that there is statistical significance and the level of influence by the communication pathways is significant.

Table 4.10: Communication pathways/channels level of influence

	Levels of influence						
Communication pathways/channels	Very low influence (percent)	No influence (%)	Low influence (%)	High influence (%)	Very high influence (%)	Total (n)	Total (%)
Extension agents	0.0	2.0	18.4	69.4	10.2	49	100.0
Neighbours	0.0	2.0	2.0	36.7	59.2	49	100.0
Radio	2.1	4.2	50.0	35.4	8.3	48	100.0
Manual/guides	26.1	45.7	19.6	8.7	0.0	46	100.0
Telephone	0.0	54.3	37.0	8.7	0.0	46	100.0
Group meetings	0.0	2.2	26.1	50.0	21.7	46	100.0
Television	13.3	22.2	48.9	13.3	2.2	45	100.0
Journals	81.0	14.3	4.8	0.0	0.0	42	100.0
Newsprints	7.3	56.1	26.8	7.3	2.4	41	100.0
Test Statistics; χ^2= 503.461; d.f = 32; p = 0.00							

4.5.2 Perception of agroforestry practices

Majority of the respondents 80.8% view agroforestry as normal farming system followed by those who think its adoption that will increase agricultural productivity, tree cover and livelihood. People receive moderate to minimal feedback from agricultural research institutions. Since the p-value is less than α=0.05 meaning the relationship is significant and we conclude that persons do indeed get positive feedback from research institutions.

Table 4.11: Opinion of respondent on agroforestry influence decision making

Description on the statements that influence decision making	Decision						
	Strongly disagrees (%)	Disagree (%)	Neither agrees nor disagrees	Agrees (%)	Strongly agrees (%)	Total (n)	Total
Agroforestry is a normal farming system	0.0 %	8.5 %	10.6	55.3	25.5	47	100
Adoption of agroforestry practices increases agricultural productivity	0.0	4.4	20.0	64.4	11.1	45	100
There is an opportunity to improve my skills on trees growing	4.4	0.0	15.6	75.6	4.4	45	100
I am eager to share information with others	0.0	2.4	16.7	78.6	2.4	42	100
I am an information seeker	0.0	2.4	16.7	81.0	0.0	42	100
I get feedback from the agricultural institutions	2.4	24.4	36.6	36.6	0.0	41	100
Test Statistics; χ^2= 90.747; d.f = 28; p = 0.00							

4.5.3. Issues hampering effective adoption of tree growing on farm

To overcome agroforestry challenges 31.3 percent recommend agricultural institutions to provide training on tree management and nursery practices, followed by 20.9 percent who recommended provision of seedling due to water shortage. A host of other recommendations that can be seen in the above table were mentioned.

Table 4.12: Hindrances to adoption of agroforestry practices

Issues agricultural institutions need to consider so that farmers can effectively adopt tree growing on farm	Frequency	Percentage
Provide training on tree management and nursery practices/tools	21	31.3
Provide water for seedling and water shortage	14	20.9
Control of termite attacking trees	7	10.4
Supply quality tree seeds at the nearest shopping centre	6	9.0
Resolve animal wildlife conflict	5	7.5
Browsing of seedlings	2	3.0
Demarcation of farming land into individual plots	1	1.5
Provide tree seedlings during rainy season	1	1.5
Provide marketing of trees product	1	1.5
Establish tree nursery near Namanga town	1	1.5
Control soil erosion and charcoal burning	1	1.5
Mulching	1	1.5
Land tenure	1	1.5
Soil fertility improvement	1	1.5
Tree identification	1	1.5
Empowerment	1	1.5
Delivering information in a manner understandable by farmers	1	1.5
Holding field days and establish trial sites in the village level	1	1.5
Total	**67**	**100.0**

4.6 Research question 1

To determine relationship between the information sources and adoption of agroforestry practices within smallholder agroforestry households, the responses derived from 5 Likert Scale were tabulated and presented in percentage. The result show Chi-square value χ^2=0.932, probability p = .818 (α=0.05). This means there is no statistical significance between source of information and adoption of agro-forestry practices; that is, the adoption of agro-forestry practices is not dependent on whether farmers interact with institutions or not. This could be associated with the low education level and that secondary information sources are more influential.

Table 4.13: Comparison of relationship between information sources and adoption of Agroforestry practices

Source of Agro-forestry information	Do you seek expert guidance while planting trees on your farm			
	Yes (%)	No (%)	Total (n)	Total (%)
Research Institutions	81	19	26	100
Universities	88	12	17	100
Agri-business firms	77	23	13	100
Financial Institutions	100	0	1	100
Test statistics: χ^2=0.932; d.f. =3; p=0.818				

4.7 Research question 2

To determine whether socio-economic factors affect farmers' access to the sources of ICT information, a cross tabulation using Chi-square significant (α=0.05) shows a significant relationship between sources of agro forestry information and level of education, tenure of land, land size, net monthly income, and distance to the nearest shopping centre.

However there is no significant relationship between the type of house and period of settlement and access to information sources (Table 4.14). Chi square formula is as follows:

$$\frac{(\text{Observed} - \text{Expected})^2}{\text{Expected}}$$

Table 4.14: Relationship between socio-economic factors and access to information sources

Socio economic factors	**Chi-Square**	**df**	**Asymp. Sig.** (a=0.05)
Level of education	10.429[a]	3	.015
Type of house	5.778[a]	4	.216
Tenure of land	11.097[a]	2	.004
Period of settlement	6.786[a]	3	.079
Land size (acreage)	47.019[a]	30	.025
Net monthly income	9.514[a]	1	.002
Distance to the nearest shopping centre	10.827[a]	4	.029
Other farming practices/animal husbandry	26.782[a]	12	.008

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.0 Discussion

This study found out the major sources of information for smallholder's agroforestry farmers are local research institutions, universities, agro-firms and financial institutions influencing adoption of agroforestry practices. Farmers access information from neighbours and extension service providers. Mass media communication pathways and other modern ICT information sources are actively used to disseminate (one way) or share (receive and send feedback) information. Churches, chief's barazas (community meetings) and agricultural companies are significant information sources in some locations.

Farmers' income, education level, land size and tenure are some of the socio-economic factors explored by this study. These factors present the economic activity and the economic classes within a society and indicate the stage of development of farming and agroforestry practices integration within the households.

Research has shown that social differentiation, based on a number of socio-economic factors rather than age and gender is more pronounced to influence household decision making (Wangui, 2003; Franzel, 1999). As would be expected, those who live in poorer communities, in deprived areas are often without access to the best information, than those in richer communities.

Education is among the most essential socio-economic factors. Education farmers gain skills, knowledge and motivation, three key elements necessary for improving livelihood actively involved in economic decision-making processes. Educated farmer can assess agroforestry

information through diverse pathways and help to improve their overall performance in agriculture production. Hence, education level directly correlates to the influence of adopting agroforestry practices. The relationship between education and access to information sources indicates significant at .015 compared with α=0.05 level of significance. This shows that formal education is a vital aspect in the farmer's decision to adopt agroforestry and the fact that literate farmers would be adopters. Formal education would therefore be a critical factor in influencing the effectiveness of the farmer's participation in farm forestry.

Land size may influence adoption of new technology. Land ownership was also noted to have a major effect on the access to information on adoption of agroforestry practices. The results suggest that land capacity, secure land tenure rights the tendency of seeking information and adopting agroforestry practices.

The results from this study show that family's financial status can boost or impede access to information and adoption of agroforestry practices. The income incorporates earning by the household from farming activities, employment, income from other sources, and business.
Obviously, a well up farming household has the financial capacity to buy seedlings, attend meetings or seminars on agroforestry at far distances, hire labour and obtain information through assorted pathways unlike households with low-incomes.

Judging from the analysis, the Chi-square showed that income from other sources was non-significant (α = 0.239) of 0.05 level of significance. These other incomes though critical in the decision-making framework, do not affect the farmer’s ability to access information on adoption

of agroforestry. This could be attributed to the fact that tree seedlings are sometimes cheap and organizations promoting agroforestry in the region issue them free of charge.

Table 4.9 and 4.13 shows the farming household's links with primary information sources. This knowledge showcases relationship of economic and social issues. Around 70 percent of the households in the sub-County fall in the low income category earning less than Kshs 9,000 per month. This low-income group comprises poor farmers most of them owning less than three acres of land and cannot support expensive technologies. Therefore this is the income group that needs to be targeted to adopt agroforestry practice to improve their livelihood.

5.1. Conclusion

Results from this study concludes that farmers in Central Kajiado access agroforestry information and practice agroforestry systems in form of boundary marking, home gardens, woodlots, pasturelands and alleys cropping is observed (Wambugu et al., 2001). Adoption of agroforestry practices appear to be bound up with the provision of information from multiple sources, individuals and organizations both government and NGOs. It is easier to acquire information on agroforestry practices from primary information sources namely research institutions, universities, agri-based firms and financial institutions. However, use of secondary sources: farmer to farmer meetings; neighbours and extension agents; communication channels such as mass media, are the most frequent information sharing method used with minimal ICTs-social media. This indicates a farmer-led extension which concurs with Franzel et al., (1999, 2002), and Kiptot et al. (2006) observations in which farmers are the principal agents of change in their community and help disseminate the new technology to other farmers.

The uptake of tree planting is positive and it's being done with appropriate and necessary guidance. Nonetheless, improving the livelihood income of the farming households is a challenge. The results of the study shows that indeed information sources and socio-economic factors of farming household increases adoption of agroforestry **(**Kiplang'at & Ocholla, 2005**),** thus poor education, low household income, long distance to shopping centre can lead to low access of information on agroforestry practices.

5.2 Recommendations

This case study demonstrates that adoption of agroforestry practices is far more complex than simply transferring information and providing planting materials. Building institutional capacity to promote and sustain innovation and adoption process is supreme prerequisite for effective agricultural production.

In order to improve smallholder agroforestry household's participation in agroforestry, focus should be more on farmer-to-farmer dialogue. Results have shown that direct interpersonal interactions between neighboring farmers and contact with extension personnel are playing a significant role. Similarly, use of potential pathways to disseminate agricultural technologies, and consideration of ways to improve the performance of the knowledge and information systems is crucial. This suggests that agroforestry practices should be strengthened by promoting regular farmer-to-farmer meetings, engaging mass media and integration of emerging ICTs.

Although several agents have motivated and raised awareness on the importance of agroforestry practices, there is need for intensification of extension services to educate the farmers on better

nursery management practices for sustained production. Assisting farming households to link with information sources is optimal to increase production in a competing land use systems. Additionally, institutional support through incentives such as subsidies, technical support and creation of market opportunities would boost private investment in seedling production and tree growing.

Formal education is vital in promoting adoption of agro forestry practices in the area through educating farmers on its importance and the risk of deforestation. Attention should be focused on farmers over 49 years who are mainly the decision-makers in most households.

The study has produced evidence that each of the socio-economic variables studied should be addressed at levels in which it affects the farmer's decision to adopt farm forestry. For instance secondary information sources such as community group meeting are effective pathway for intervention. Adoption of agroforestry practice techniques therefore need to be optimized using multidisciplinary approach including supporting community structures and systems that will enhance awareness creation, and economic empowerment. The government working jointly with other development partners should put in place clear policies to promote farm forestry and alleviate poverty (Pretty, 1995). Consequently, implementation of these policies should be cascaded to the grass root level. Promotion of farm forestry will help to reduce the imbalance in the market of forest products such as timber, poles and posts.

The findings suggest that agricultural institutions should engage more in participatory on-farm research as it helps in developing intervention strategy in extension as well as realistic assessment of technologies transfer. The information sources and extension agents should use

relevant media to communicate and disseminate information, rather than use of excessive media or training sessions of which may be ineffective to the intended audience. Selection of such media has to depend on the farmer typology and level of education. The communication skills of the extension agent require improvement because as seen in the study contact with information sources alone does not initiate adoption or the change process.

Finally, the fact that data was captured from a sample of households registered by government agency has made it impossible to draw a firm conclusion. A close observation showed that some households declined to respond on land issues and incomes as well. I cannot conclude that all other households with more land acreage also follow the same pattern. Further studies therefore are recommended to verify other variables not measured as they may prove important in predicating technology adoption. The studies should be done using a wider ecological unit at the County level and farming households owning more land.

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APPENDICES

APPENDIX 1

QUESTIONNAIRE FOR INFORMATION ON AGROFORESTRY PRACTICES

Questionnaire No. …… Date ……

Interviewee Name …… sub-County……

Location…… Administrator……

Introduction

My name is Stephen Gitonga. I am a post graduate student pursuing MSc. degree at the University of Nairobi. Currently, I am doing a study to evaluate how information sources influence adoption of agroforestry practices on farms. In this regard, I kindly request you to honestly fill this questionnaire. Your responses will be treated as confidential and used entirely for academic purposes. Thank you in advance.

Instructions

For questions that require a written response, please type/write your response in the space provided next to the questions.

Section I. Household biological data

1. Gender

   1). Male [ ] 2). Female [ ]

2. Age

   1). 20 yrs or under [ ] 2). 21-29 [ ] 3). 30-39 [ ] 4). 40-59[ ] 60 or above[ ]

3. Nature of household headship

   1. Male headed [ ] 2. Female headed [ ] 3. Single parent [ ]

4. Level of education

1. Tertiary and above [ ]
2. Secondary level [ ]
4. Primary level [ ]
5. Un-educated [ ]

5. Household size

	Household members	Male	Female	Total No.
1	Active members			
2	Inactive members			

6. If you plant trees on your farm, tick the purpose in correspondence with observable agroforestry practice

1. Ornamental [ ]
2. Boundary planting [ ]
3. Woodlots [ ]
4. Fruit Orchards [ ]
5. Soil erosion control [ ]
6. Windbreaks [ ]
7. Fodder banks [ ]
8. Others (Specify)……

7. Do you seek expert guidance while planting trees on your farm?

1. Yes [ ] 2. No [ ]

8. If Yes, please state the sources……..

Section II Information sources

9. Where do you seek information about agroforestry?.....

10. Please state socio-economic factors which influence farmers' access information on tree growing on-farm……

11. Please indicate how you think the following channels influence decision making on adoption of agroforestry. (5 = Very High Influence, 4 = High Influence, 3 = Low Influence, 2= No Influence, 1= Very Low Influence)

Code	Communication channels	5	4	3	2	1
1	Radio					
2	Television					
3	Books					
4	Journals					
5	Telephone					
6	Meetings					
7	Extension agents					
8	Neigbours					

12. How often do you interact with the following information sources?
(Most often, Often, On average, Seldom, Not at all)

Source	Most Often	Often	On average	Seldom	Not at all
Research Institution					
Universities					
Agri-based firms					
Financial Institutions					

13. Which of the listed communication channels do you use commonly to access information on agroforestry practices?

a) Agricultural publications [ ]
b) Telephone calls [ ]
c) Agricultural publicity events [ ]
d) Visiting Research demo plots [ ]
e) Listening to Radio programs [ ]
f) Watching TV programs [ ]
g) Web based content [ ]
h) Meetings [ ]
i) Interacting with Extension agents [ ]
j) Consulting neighbor [ ]
k) Others (specify)……

Section III. Social Economic data

14. What type of house do you live in?

1. Temporary [ ] 2. Semi-Permanent [ ]
3. Permanent [ ] 4. Other (specify) ……

15. What is the tenure of this land?

1. Singly Owned [ ] 2. Family Owned [ ] 3. Rented [ ]

16. How long have you settled in this land?

1) 0-9 year [ ] 2) 10-29 years [ ]
3) 30-49 years [ ] 4) 50 years and above [ ]

17. What is your net monthly income?

1 = less than KShs. 9999 [ ] 2 = 10,000 – 49,999 [ ]
3 = 50,000 – 99,999 [ ] 4 = 100,000 and above [ ]

18. Distance to the nearest shopping centre in Kilometres?

1. Less than a Km [ ] 2. Between 2 and 5Km [ ] 3. Between 6 and 9.9Km [ ]
4. Between 10 and 19.9Km [ ] 5. Over 20km [ ]

19. Has tree planting on farm improved the quality of your life?

1. Definitely yes [ ] 2. Probably Yes [ ] 3. Uncertain [ ]
4. Probably No [ ] 5. Definitely No [ ]

20. Explain your answer to question 24 above: sale of products eg timber, rafters,etc

21. What issues do agricultural based institutions need to consider so that farmers can effectively seek information on tree growing on farm?

a……
b……
c……

Thank you for taking time to complete this questionnaire

APPENDIX 2

PICTURES TAKEN DURING THE SURVEY

Plate 1: The author (right) with Maasai target community (focus group) in Kajiado sub-county

Plate 2: Boundary planting indicating adoption of agroforestry practices

Plate 3: Author collecting data from a respondent through questionnaire and semi-structured interview

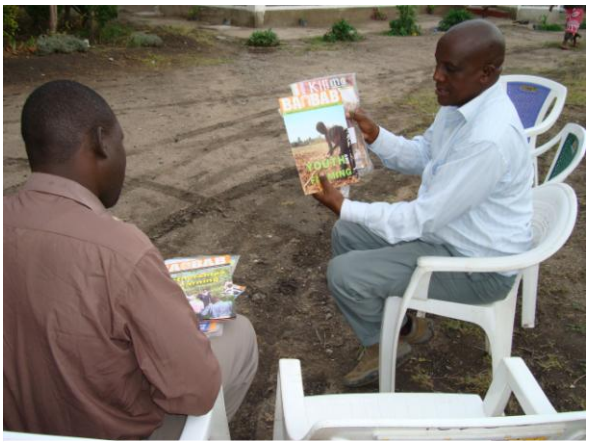

Plate 4: A Respondent displaying some of publications on agricultural practices that he receives from different organizations

Plate 5: Demonstration of briquette making during a farmers' field seminar **(**meeting**)**

Plate 6: Livestock keeping is a key socio-economic activity in the County

Plate 7: Adoption of agroforestry practices by farmers in Namanga as illustrated through intercropping

Plate 8: Mrs. Yiale, a farmer at Kajiado, pointing a remnant of tree seedling browsed by roaming animals