UNIVERSITY OF NAIROBI

INSTITUTE FOR DEVELOPMENT STUDIES

"Socio-economic factors influencing the intensity of households' adoption of agroforestry practice: A case study of Shibuye Location, Kakamega-East District."

By

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A Research Project submitted as a partial fulfillment for the award of a Master of Arts Degree in Development Studies.

November, 2008

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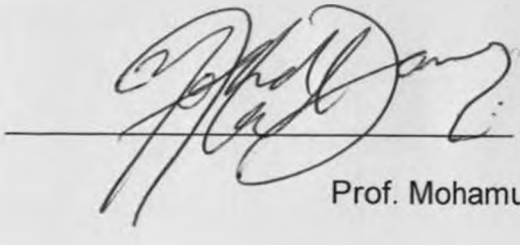
Declaration

I declare that this project paper is my original work and has not been submitted for a degree award in any other university.

Date 25/11/2008

Okioma M. Moraa

This project has been submitted for examination with our approval as University Supervisors.



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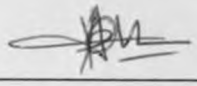

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Dedication

To Justus and Edwin

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As I come to the end of my M.A course in Development Studies, I stand to thank all persons and organizations who have helped me achieve this noble course.

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My gratitude to all, those named and unnamed. God Bless you!

List of Acronyms

AFSs	Agro-forestry Systems
CARPA	Christian Agroforestry Related Professionals Association
CBOs	Community Based Organizations
CBS	Central Bureau of Statistics
CFIA	Community Forestry Intergrated Activities
BIOTA	Biodiversity Analysis Transfer for Africa
FAO	Food and Agriculture Organization
GHGs	Green House Gases
GoK	Government of Kenya
GOs	Governmental Organisations
ICIPE	International Center of Insect Physiology and Ecology
ICRAF	International Centre for Research in Agroforestry
IDRC	International Development Research Centre
IPCC	Inter-Governmental Panel on Climate Change
IPCKF	Intergrated Project on Conservation of Kakamega Forest
NGOs	Non-Governmental Organizations
KAAD	Katholischer Akademischer Auslander-Dienst
KACOFA	Kakamega Community Forestry Association
KARI	Kenya Agricultural Research Institute
KEEP	Kakamega Environmental Education Programme
KEFRI	Kenya Forestry Research Institute
KNBS	Kenya National Bureau of Statistics

KREDP	National Agroforestry Program in Kenya
SPSS	Statistical Package for Social Sciences
UNFCCC	United Nations Framework Convention on Climate Change

Abstract

Agroforestry is commonly defined as the deliberate integration of trees with agricultural crops and/or livestock either simultaneously or sequentially on the same unit of land (Alavalapati and Mecer 2004). Though agroforestry is an age old practice, it has continuously been proposed as one of the sustainable environment models.

Agroforestry had been promoted widely in Shibuye Location due to its vicinity to the Kakamega Forest. However, there was a realization that though agroforestry was widely promoted in the area, there were varying degrees of adoption with intensive practices and non-intensive practices.

The objective of this study was therefore to determine the socio-economic factors which influenced agroforestry adoption intensity among small holder farmers in Shibuye Location in Kakamega-East District.

The study used both quantitative and qualitative methods of data collection and the data obtained was analyzed by using both quantitative and qualitative methods. Descriptive statistics and logistic regression models were used in presenting the findings of the study.

The study found out that, agroforestry adoption intensity was influenced by a number of factors including age, education level, off-farm income, the problems experienced by the farmer and the sub-location of the farmer. Other factors found to influence agroforestry adoption included, the size of land and the presence of extension services. The study concluded that, age influenced other factors such as land ownership and land use decisions. It also concluded that education level was important in skill application, calculation of long term benefits as well as a source of employment which could provide

necessary income for investment in agroforestry. Off-farm income, on the other hand, significantly influenced agroforestry adoption intensity as farmers who had more off-farm income could afford the necessary inputs such as seedlings, fertilizers, planting tubes and pesticides. Off-farm income was also found to influence farmers' choices as those who had off-farm income chose to keep off from intensive agroforestry practice. Problems that farmers experienced also influenced adoption intensity as they demotivated farmers to venture into intensive agroforesty. The sub-location also influenced adoption intensity, as sub-locations near the forest benefited from community forestry intergrated programmes.

Although majority of the people in Shibuye location had 3 acres of land and below, it was found out that intensive agroforestry adopters tended to have larger and more pieces of land compared to non-intensive adopters. Extension services also benefited intensive agroforestry adopters more than non-intensive adopters

The study recommended that:

There is need to educate farmers on the importance of agroforestry in natural resource management, improve the role of extension officers, come up with more community agroforestry projects, provide farmers with the necessary farm inputs and need for a concrete Agroforestry Policy in the Country.

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CHAPTER 1

1.1 Background

Throughout history, human beings have been vulnerable to climate-related hazards. Climate variability and extremes wreck havoc to both natural and social systems (Lasco, R.D. et al. 2008). It is widely expected that forest cover plays a vital role in the mitigation process of climate change as it forms a carbon sink for green house gases (GHGs), which are responsible for climate change. It is generally estimated that the African continent as a whole is least prepared in dealing with the effects of climate change

In the 1960s and early 1970s, there was increasing concern that forested lands in the tropics were under severe pressure from increasing population and land use practices. With the identification of problems facing forestry, it was recognized that agriculture needed to accommodate forest preservation. Bene et al. (1977) recognized that the key issue lay at the interface of forestry and agriculture due to human encroachment into forests as a result of increased population. It is, however, not evident if the word "agroforestry" was coined at that juncture in reference to that interface. However what is most important is that the work of Bene and co-authors culminated in the institutionalization of the "age-old practice" of cultivating tree species and agricultural crops in intimate combination, with the creation of International Council for Research in Agroforestry (ICRAF) (Steppler, 1987).

The first years of operation of ICRAF were dedicated to understanding the interface between forestry and agriculture. It was then clear that, some degree of diversity of the practice of agroforestry might have been in use throughout the world. This led to the first publication of an approximate classification of various agroforestry systems (AFSs) by

Nair (1985), with recognition of the existence of an array of AFSs world wide (Steppler, 1987).

Due to the potential impacts of climate change on the environment as a result of increasing concentration of (GHGs) in the atmosphere, the world community established the Intergovernmental Panel on Climate Change (IPCC) in 1988. The responsibility of IPCC was to undertake an assessment of the science, impacts, adaptation, and mitigation options in relation to climate change. The IPCC (1988) affirmed the importance of agroforestry in mitigating the effects of climate change especially among rural populations who mostly depend on agriculture as the source of their livelihood (Karani, 2004).

The prospects of agroforestry increased further during the 1990s as scientists and policy makers recognized the potential for applying various forms of agroforestry systems (AFSs) to problems such as soil erosion, rising salinity, surface and ground water, pollution, increasing green house gases and biodiversity losses in temperate zones and in developing economies (Alavalapati and Mercer, 2004).

1.1.1 Agroforestry

Alavalapati and Mercer (2004) considered agroforestry as the deliberate integration of trees with agricultural crops and/or livestock either simultaneously or sequentially on the same unit of land. To these authors, this has been an established practice for centuries. Nair, (1993), concurs with this argument that cultivation of trees and agricultural crops in intimate combination with one another is an ancient practice throughout the world. It is therefore not an invention, neither is it a new concept in practice. Torres and Raintree

(1983), in defining "agroforestry" stressed on the aspects of deliberate combination of trees with crop plantations or pastures or both.

1.1.2 Agroforestry systems

The words, "systems", "practices', and "technologies" are often used synonymously in agroforestry literature. Nair (1993) made a distinction between them; agroforesty system is a specific local example of a practice as characterized by environment, plant species and their arrangement, management and socio-economic functioning. Agroforestry practice denotes a distinctive arrangement of components in space and time. On the other hand, agroforestry technology refers to an innovation or improvement usually through a scientific intervention to either modify an existing system or practice or develop a new one. In agroforestry literature and in practice, the three concepts are interrelated, and are often used interchangeably. In the literature on adoption of agroforestry, the three terminologies have been used synonymously (Nair, 1993), in discussing the uptake and acceptance of agroforestry either as a system, as a practice or as a technology. In this study, the word "system" denotes the categorization of the various agroforestry practices, which will be analysed as the "forms of agroforestry"

1.1.3 Agroforestry in Kenya

In Kenya, there are imminent effects of climate change such as changing hydrological cycles, extreme temperatures and uneven and unexpected climatic extremes. However, in spite of the important role that forests play in the livelihood of the forest adjacent

people and the nation as a whole, loss of forest through deforestation and degradation has continued to take place at an alarmingly high rate (Guthiga, 2007).

Kenya currently has less than two percent forest cover remaining. With increasing population there is an increased demand for wood products as well as agricultural land. These demands pose a significant threat to the remnant of existing forest cover. Introducing and promoting agroforestry systems can provide an alternative by supplying both wood products and environmental services to the communities. Agroforestry systems can provide farmers with tangible benefits, such as timber products, fruits, wood fuel, medicinal extract, and provide fodder (among other benefits). In addition, agroforestry systems can also play a significant stabilization role by reducing erosion, improving soil fertility, moderating water infiltration rates and in reducing the pressure exerted on remnant natural forests (Karani P. 2004).

According to FAO (2006) forest cover estimates, Kenya lost 62,000 ha of its forest cover between year 2000 and 2005. The current trend of forest loss can be explained by excessive pressure on agricultural land that has led to encroachment of forests, policy framework that makes forest products from public forests cheaper than those from private forests, exclusion of the local peoples needs in the conservation process, a generally weak enforcement capacity of the management authorities, and a legal framework that makes it easy for legal excision to be made by government without consultation of other stakeholders.

In an attempt to address these problems, the Government of Kenya enacted a new law; Forest Act 2005. The new law which came into effect in February 2007 envisaged more participation of forest adjacent communities in forest management in the form of joint-

management with the government through community forest associations. The new law also emphasized the role of agroforestry in forest conservation (Guthiga, 2007).

1.1.4 Study site description

In the Entire Western region, Kakamega Forest, which was a remnant of the Congolian Rain Forest which once stretched from Western Africa to Eastern Africa, played a very vital role in the livelihoods of the people in the region. However, the effects of climate change had been experienced widely as a result of degradation of the Forest. In a survey of 15,000 forest adjacent households, 84% of them were found to use the forest as a source of at least one basic commodity, with grazing and wood fuel collection being the most prevalent activities (ICIPE, 2004).

According to the 1999 population census, the locations within 5 km radius to the forest had a total population of about 376,169 people (GoK, 2000). According to GoK, (2000) the projected population growth between 1999-2010 indicated that the population was to continue growing at an average rate of about 3%, which was slightly above the average national growth rate of 2.6%.

The area had an average population density of 461 people per km^2, which made it one of Africa's most densely populated rural areas (GoK 2001). It was also estimated that the number of people in then Kakamega district who would earn less than a dollar per day would account for over 57% of the population (GoK 2001). Over 90% of the people who lived in the rural areas of Kakamega depended on agriculture either directly or indirectly. The people were dependent on growing crops such as tea, sugar cane, maize, beans, sweet potatoes as well as keeping cattle on increasingly small pieces of

land which were due to continued sub-division through inheritance. Due to small land sizes people tended to intensively use their land for crop cultivation without providing for fallow period which could allow the soil to regain its fertility. This in combination with low use of other inputs such as inorganic fertilizers had led to a decline in productivity and falling farm incomes (Ogutu, 1997).

Shibuye Location which is adjacent to the Kakamega forest, and was characterized by high population growth. However, encroachment to the forest for basic commodities highly threatened the existence and continuation of the forest. The Government together with several NGOs and CBOs had embarked on forest preservation and conservation by involving the forest adjacent communities in forest management. Agroforestry had been promoted widely among the community adjacent to the forest with the aim of reducing human pressure on the remaining forest reserve. These efforts had been coordinated by ICIPE, ICRAF, KARI and KEFRI, where selected community groups had been trained on agroforestry techniques, and could in turn train others in the community as well as distribute tree seedlings for on-farm tree planting (ICIPE, 2004).

1.2 Problem statement

The effects of climate change were imminent in Kenya, especially with the shrinking forest cover, which was estimated at 2 per cent, far below the internationally expected standard of 10 per cent by the year 2004 (ICIPE, 2004). This was an indication that agroforestry was very vital in the process of increasing forest cover, important in mitigating the effects of climate change.

In Kakamega East District, Kakamega Forest played a very vital role in the livelihood of the people (a huge part of the forest fell in this forest). However, the overall size of the forest had been shrinking rapidly due to human population growth, land use practices and increased resource extraction over the decades. The people around the forest were generally poor and used the forest resource to supplement their small incomes from farming. Despite being protected by the state, local communities were dependent on the forest for their basic needs such as fuel wood, charcoal, building materials, fruits, mushrooms, traditional medicine, game meat, grazing land and timber (Guthiga and Mburu, 2006). This forest was also an important watershed for some rivers such as Yala and Isiukhu that flow through the District into the Lake Victoria. However, the exploitation of the forest, had taken place in a haphazard, wasteful and uncontrollable manner such that it was not only steadily diminishing the forest resource, but its capacity to recover was also being destroyed. The main challenge in forest management was therefore that of reconciling the extraction needs of the poor population that lived around the forest with the conservation interests.

The rural populations who mainly depended on agriculture as a source of their livelihood, were most vulnerable to the effects of climate change in Kakamega District. The agricultural sector was experiencing dramatic changes. These were reflected in wide fluctuation in socio-economic imbalances such as low domestic food production (food insecurity), poor living standards; as well as ecological imbalance which included uneven hydrological circle, increased soil erosion and surface run off, soil infertility and acute shortages of forest products. Given the deteriorating agricultural production, the

principle issue was not how to stop forest depletion, but how to manage the forest resource.

A major concern among environmentalists was how to provide an alternative form of securing livelihoods through increased productivity among the population living around the forest as well as how they would ensure a sustainable strategy for managing the forest resource. Farmers had therefore been encouraged to grow trees and shrubs in their farms together with other crops and livestock rearing. A lot of efforts towards the promotion of agroforestry technology had therefore taken place in Kakamega. An example of this was through the Intergrated Project on Conservation of Kakamega Forest (IPCKF), which began in the year 2000. This was a consortium of several Organizations, NGOs and CBOs headed by ICIPE (ICIPE, 2004). Most of these efforts has promoted agroforestry with the aim of preservation and conservation of the Kakamega Forest. However, this institutional approach by the various organizations had promoted agroforestry as a scientific package ignoring the socio-economic embeddedness in agroforestry adoption by farmers. This led to varying degrees of adoption of agroforestry with intensive practices and non-intensive practices among farmers. Therefore, though various efforts were aimed at promoting agroforestry in Kakamega, a detailed assessment on the factors that influenced agroforestry adoption intensity at the household level was yet to be done. This study therefore examined the socio-economic factors influencing agro-forestry adoption intensity by individual household farmers in Shibuye Location in Kakamega-East District.

1.3 Research questions

The study was guided by the following overall research question:

What socio-economic factors determined household's agro-forestry adoption intensity in Shibuye location?

The study's specific research questions included:

1. What factors determine the number of trees planted by small holder farmers in the area?
2. What factors determine the types of agroforestry (forms of agro-forestry) practiced by households in the area of study?
3. What social and/or economic factors promoted or hindered farmers' adoption of agroforestry among small holder farmers in the area.

1.4 Research objectives

Overall objective

The overall objective of the study was:

To understand the socio-economic factors which influenced household's agroforestry adoption intensity in Shibuye Location.

The specific objectives were:

1. to investigate the factors which determined the number of trees planted by small holder farmers in the area of study
2. to identify the factors which determined the types of agroforestry (forms of agro-forestry) that households practiced in the study area.

3. to determine the social and/or economic factors which promoted or hindered the adoption of agroforestry among small holder farmers in the area.

1.5 Justification

Agroforestry had for long been recognized as one of the sustainable development models throughout the world due to the benefits brought about by this technology, not only to the environment, but also to the economy, the society and to the livelihoods of the people who practiced it. This study was important in enlightening on the various considerations that could be made in the propagation of the technology, which was aimed at enhancing environmental sustainability as well as in contributing to sustainable livelihood of the local populations.

This study would provide insights on the need for development practitioners who worked directly with rural communities especially in areas of mitigation of environmental stresses by understanding local communities' aspects which influenced their decisions in the adoption of agro-forestry as one of the technologies in the mitigation of climate change and in the management of natural resources. A better understanding of socio-economic factors influencing the development of optimal technologies could facilitate wider participation and cooperation between farmers, extension workers and scientists, to optimize agroforestry technologies for widespread uptake and diffusion to enhance rural livelihoods (Reed, 2007).

The study offers appropriate policy recommendations on the practice of agro-forestry by rural communities as a way of incorporating them in natural environment management.

CHAPTER 2

2.0 LITERATURE REVIEW

The uptake of agroforestry technology is more complicated than that of annual crops. This is because of the multi-component and the multi-years through which testing, modification and uptake of these technologies take place.

Lwayo and Maritim (2000), in their report of a study on the socio economic factors affecting farmers' decision to adopt farm forestry in Busia District in Western Kenya, argued that, individual characteristics of the farmer influenced the decision to adopt farm forestry. A household survey conducted in 1997/1998, in which 200 respondents were interviewed showed that education level, age and land size were strong determinants of agroforestry adoption. A multivariate logistic analysis was applied in establishing the influence of these personal characteristics of the household head in terms of how they influenced a farmer's decision to adopt farm forestry. The study further indicated that non-farm income (income from different sources other than the farm) which included trade, employment, casual work, credit, relatives, friends and other miscellaneous sources, had no significant influence on a farmer's decision to adopt farm forestry. According to these authors, decision on adoption was not based on income as the seedlings were cheap and in some instances, were provided free by various organizations which promoted agroforestry in the District. These authors found out that the decisive factors in adoption of agroforestry revolved around the household. These factors included the individual characteristics as well as the general household characteristics such as land size. Though this study considered land size as an

important factor in adoption decision in agroforersty, other important land characteristics such as land topography and ownership were not considered. This study aimed at filling this gap by considering other aspects of land such as topography and ownership in adoption of agroforestry in addition to the land size. The study by Lwayo and Maritim (2000) did not find any significant relationship between income (both on-farm and off-farm) and decision on adoption of farm forestry. However their study concentrated on factors influencing adoption only, while this study further addressed the factors which influenced the choice of adoption intensity by the farmers. Thus, farmers chose varying degrees of adoption which was determined either as intensive or non-intensive adoption of agroforestry.

According to International Development Research Centre (IDRC) (2000), work in Kenya's Semi-arid Eastern Kenya, agroforestry was found to play an important role in many farmers' economic strategies. According to IDRC, a study in Embu by ICRAF in 1999, which aimed at testing a model for inter-institutional collaboration in agroforestry research established that there was need in focusing on farmers needs and demands in the promotion of agroforestry. The study established that there were socio-economic factors which drove farmers to adopt agroforestry techniques. Though this study did not focus on individual household factors in agroforestry adoption, it established a link between farmers' views on agroforestry and institutional promotion of agroforestry. Although the study pointed out that economic demands played an important role in the adoption of agroforestry, it ignored the role of individual characteristics of farmers as well as the household characteristics which, may have influenced farmers to make

adoption decision. In this respect the approach of the study by IDRC differed from this study. At the same time, this study aimed at establishing the factors which affected the varying degrees of adoption as opposed to adoption and non-adoption. However, a point to note is that the ecological zones of the two studies differed greatly because this study was done in high rainfall areas, while the study by IDRC was done in Semi arid areas of Eastern Kenya in Embu.

Rahim, et al. (2005), in their study on adoption of gum agroforestry in Sudan, distinguished between adopters, non-adopters and abandoners (those who take up the technology and later leave it). Their study focused on various variables which included, farm size and ownership, age education level and income. The study used primary data that was obtained from a farm-level survey in Western Sudan and applied a bivariate probit model to analyze the process of gum Arabic adoption and subsequent abandonment. Empirical results from the survey data summarized the socio-economic and institutional factors influencing adoption or abandonment of gum arabic and the bush-fallow system. This study found out that, both farm size and size of inherited land were positively associated with adoption and continued adoption as farmers with small holdings gave more priority to the production of food crops. It was observed that some abandoners stated insufficient land as a reason for discontinuity of gum agroforestry. On the other hand, farmers with large holdings were found to be in better position to follow the traditional gum rotation, while only farmers with large holdings and stable ownership were said to adopt gum agroforestry. The results of their study indicated that non-adopters were younger than the adopters and abandoners. At the same time, there

were more adopters in the older generation of farmers. This is because young farmers expected to have access to other sources of income such as wage labour. Their study found out that, non-adopters appeared to have had the highest average of formal education. Extension and credit services were also found to bear a positive sign in explaining the likelihood of adoption of agroforestry. This indicated that intervention in propagation of the technology to farmers played an important role in adoption. The study also indicated that higher percentage of adopters of gum agroforestry received credit services. According to this study off-farm income in the household had an effect on abandonment of agroforestry as this represented competing activities and source of wealth. At the same time, source of market was an important determinant of adoption or non-adoption of agroforestry practices. From this study, it was found out that, farmers who lived further away from the market were more likely to adopt and continue adopting gum agroforestry.

The study did not hypothesize a significant relationship between family size and adoption of agroforestry. However, family size was seen to be a proxy of household labour supply which could influence adoption. On the other hand, larger families were seen to have more persons to feed, and hence could strive to secure food requirement through giving priority to food production as opposed to tree production and thereby influencing non-adoption. Though Rahim et al. (2005) conducted their study in Sudan; the approach that was used by these authors was similar to the approach that was used in this study. Many studies of adoption of agroforestry do not focus on non-adoption and abandonment of agroforestry technologies. The fact that non-adoption and abandonment have not been taken into consideration, is an assumption that adoption of

these technologies is an irreversible process, which is not the case. The study by Rahim, et al. (2005) therefore contributed to a new understanding of the evolution of agroforestry systems, since it focused not only on the adoption of gum trees but also on the abandonment of the same technology by farmers who adopted it in the past. Analysis of this aspect provided additional insights in identifying factors that stimulate adoption, non adoption and abandonment of agroforestry technologies. The aspects of extension and credit services were considered to play an important role in adoption of new technologies. The study by Rahim et al. (2005) looked at this aspect which was seen to influence adoption of gum agroforestry in Sudan. Though the methodology taken by Rahim et al. (2005), was similar to the methodology that was taken in this study, the two differed in the approach because, the former focused on factors influencing adoption, non-adoption and abandonment of agroforestry, while the latter focused on factors influencing the intensity of adoption. At the same time, the former used bivariate probit model in analysis, while the latter used multivariate logit model.

According to a study that was carried out in Zambia on factors influencing the adoption of agroforestry (fertility tree systems), (Ajayi et al. 2008), found out that, the factors which influenced farmers' adoption decision fell on four broad categories; those which exerted- positive influence on farmers adoption decisions; negative impact; ambiguous or no direct effect; systematic influence on all types of households in a given community and spatial locations. The study by these authors in collaboration with farmers and researchers from different national and international institutions led by ICRAF, found out that, the different types of agroforestry technologies addressed specific human and

environmental needs in Southern Africa region. This study did not only look at factors which influenced adoption but also the various systems of agroforestry practiced in the Southern Africa region. These systems were aimed at improving people's livelihoods as well as in addressing human and environmental issues. An important aspect elicited by this study by these scholars was that of connecting agroforestry and livelihoods, which was also a point of focus in this study. However this study differed from that of Ajayi et al. (2008) in that the former did not focus on a particular form of agroforestry as did the latter. It, however, focused on factors which influenced the intensity of adoption as opposed to adoption and non-adoption of agroforestry.

A study by Ajayi, (2006), in Zambia revealed that, the key criteria in assessing the level of "adoption" of agroforestry technologies were: good management (timely weeding and pruning) of agroforestry fields, density and mix of tree species planted, the number of years of continuous practice of agroforestry and the size of land area that a farmer had allocated to agroforestry. This therefore implied that, different degrees of 'adoption" of agroforestry technologies could be identified. The author discussed the various agro-forestry technologies that were practiced by farmers as well as the varying degrees in the adoption of agro-forestry. The study established that, there was need to look at policy issues that could help to promote agro-forestry, based on problems experienced in the adoption of various technologies. This study in Zambia elaborated on the criteria in assessing the level of adoption in agroforestry. It therefore gave insight as to what one should look for in assessing the level of adoption. The study by Ajayi, (2006), looked at varying degrees of adoption as opposed to adoption and non-adoption. At the

same time, the study elaborated on factors which determined the various degrees of adoption including, timeliness in management, the density and the mix of trees as well as the size of land dedicated to agroforestry. In this aspect, the study by Ajayi, (2006) was similar to this study which sought to establish the factors which determined the intensity of adoption of agroforestry. However, the study by Ajayi, (2006), differed from this study in that the former did not address individual and household factors, which were the main focus in this study in relation to the intensity of adoption.

Alavalapati and Nair, (2001), argued that, a variety of economic and policy issues such as profitability, household benefits equity, sustainability, soil conservation, environment services, management of inputs and outputs, gender and institutions (property rights for example) influenced the nature and magnitude of AFSs adoption. Their study, focused on the benefits of agroforestry to the household and also to the society. Aspects such as income generation to the household as well as conservation issues played a role in adoption decision by a farmer. Due to the institutional approach in promotion of agroforestry in Kakamega District ,in which agroforestry has been promoted mainly as a natural resource conservation strategy, it was expected that, farmers could be motivated to adopt agroforestry because of the various benefits that were expected from the various agroforestry systems and technologies. The approach that was taken in this study differed from the study by these authors in that, the latter focused on benefits of agroforestry which motivated farmers to make adoption decision. The former however took a more holistic view by including individual explanatory and institutional variables in explaining the magnitude of adoption either as intensive adoption or non-intensive

adoption. In addition aspects of conservation of natural resources and benefits accrued from agroforestry were also important variables as it was in the study by Alavalapati and Nair, (2001).

Adesina et al. (2000) in their study which was based on a household survey in the Southwest Cameroon observed that educated farmers were found to have greater likelihood of adopting conservation technologies. It was therefore expected that education could influence adoption or non-adoption depending on the opportunities available or not available. These authors found out that off-farm work positively influenced adoption of agricultural technologies such as agroforestry, as off farm incomes allowed farmers to meet the inherent costs of new technologies such as seeds, fertilizer and hiring of labor. This therefore implied that off-farm income could influence adoption or non-adoption of agroforestry. The various variables that the study by Adesina et al. (2000) looked at such as education level and off-farm income were also important variables in this study. However, the former focused on adoption and non-adoption while the latter focused on the intensity of adoption.

Most of the literature on adoption of agroforestry presents adoption as an irreversible process. However, several authors as discussed above have observed that, there are factors which are associated with adoption while there are factors which influence non-adoption. This study further looked at the factors which influenced varying levels of adoption as opposed to adoption and non-adoption. It therefore looked at intensive adoption and non-intensive adoption as opposed to establishing the differences

between adopters and non-adopters in terms of various factors such as land characteristics (size, ownership/tenure and topography) and other individual household characteristics (age, gender and education level). Other intervening variables could also play an important role in determining the level of adoption. These include income (off-farm and on-farm) as well as external influences such as market, policy issues and rules and regulations on agroforestry.

2.1 Theoretical framework

2.1.1 Agroforestry decision-making model

Koppelman and French (1996), proposed a framework for understanding agroforestry decision making at farm house level where the farm household was used as the primary unit of analysis. In this framework, it was conceived that each household had unique set of socio-economic and biophysical conditions which influenced decision-making in the adoption of agroforestry. These conditions together constituted **on-farm factors**. It was, however, noted that the household was not the only level in a hierarchy of decision-making. For example, if one disentangled the household into individual members, it was possible to analyze individual characteristics such as age, gender, education level etc. and their impact on decision making in agroforestry.

These conditions included: The *social setting* which included the household setting and composition; Cultural setting in which the farm household was guided by the norms and values of its members; Traditional practices such as traditional production and management practices. When the farming system is sustainable this factor is no

problem. It can, however, become a problem if the continuation of the traditional system causes serious ecological degradation. On the other hand *economic conditions* included the farmer's economic endowment and the level of control over his land. A farmer with secure tenure was much more likely to think of long-term production and conservation activities than were sharecroppers or migrant laborers. It was noted that, subsistence farmers typically had different aspirations from market-oriented or commercial farmers. Hence, economic factors were considered to play an important role in adopting new farming technologies such as agroforestry.

Biophysical conditions were, for the most part, considered to be beyond the direct control of the farm family. These conditions included climate, soil characteristics and topography. These were seen to have major influence on selection of crops and the farming system. Koppelman and French (1996) argued that based on the interaction between biophysical, social and economic conditions, the farm household made decisions on whether to adopt a particular form of agroforestry as well as the level of adoption. This therefore led to the process of farm management decisions. Hence based on market information, the household decided on the amount of land and what labour was to be allocated to a certain commodity as well as other considerations such as the price of seed, input of pesticides and fertilizer and so on.

Given the above investment and market decisions, a farmer also made choices regarding management of the production process. These decisions related to the management of perennial crops for wood fuel, stabilization of slopes and terraces,

provision of dry-season fodder for livestock, and spatial arrangement of wood fuel trees so that they do not interfere too much with food crop production. Conservation practices such as contour planning, vegetative erosion control, wind breaks and gully control all require additional labor and investment. Koppelman and French argued that all these farm household decisions were influenced by information from outside. Which were referred to as off-farm factors.

In this model, Koppelman and French (1996) proposed that, farm families needed market information for making investment and marketing decisions. However, even though not all farmers did detailed cost-benefit analyses, they usually made a budget "in heads". Farmers sought market information from other farmers, middlemen, and, if possible, producers associations, retailers, wholesalers, processors, and manufacturers, though access of a small farmer to market information was considered poor and at the same time, a competitive market was not always present.

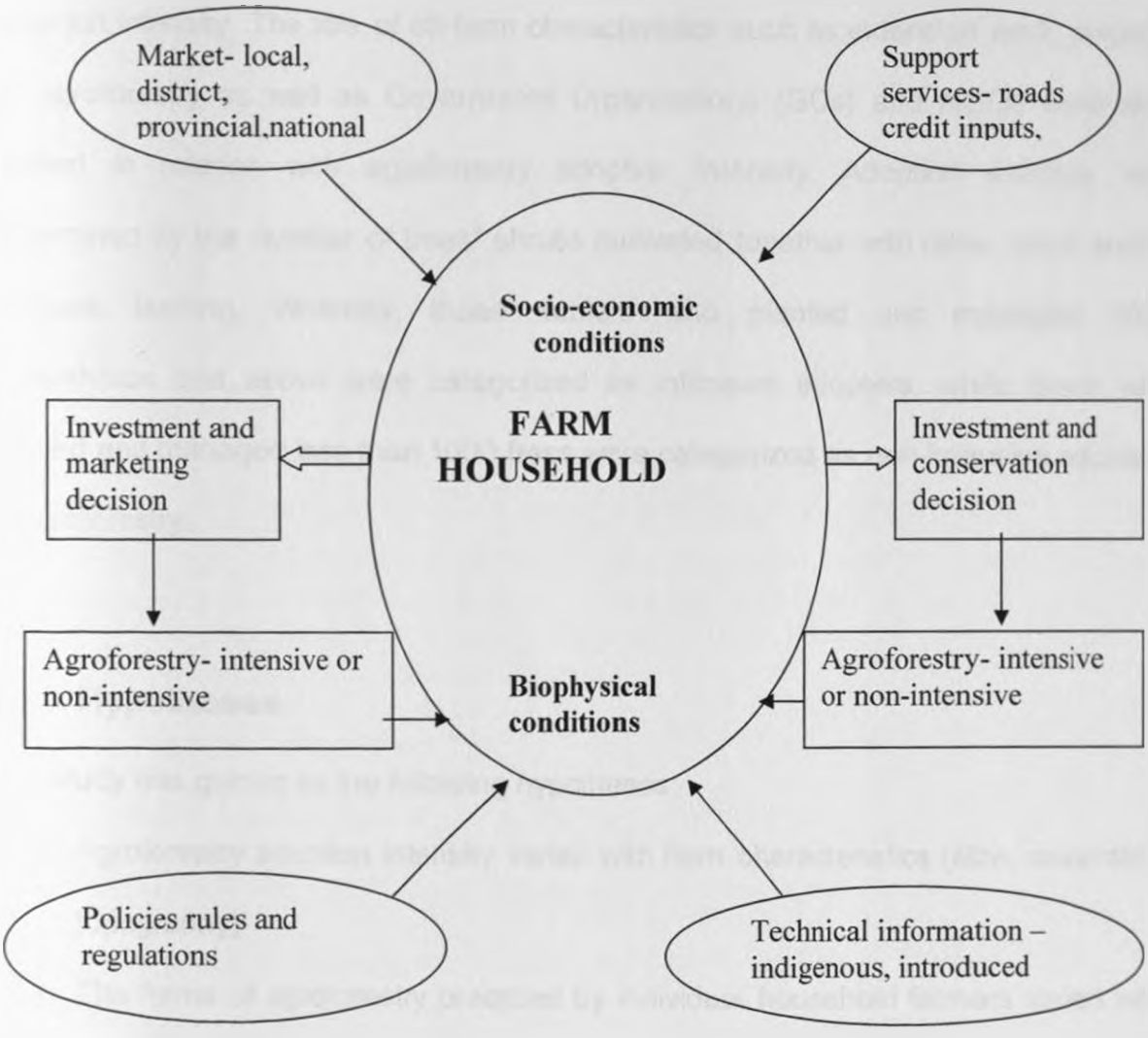
According to this framework, household decisions were also affected by policies, rules, and regulations that were enforced by the state and community. These were implemented either at the local or the national level. For example, transportation of wood fuel and charcoal was subject to stringent regulations. However, apart from formal legislation and policies, there were traditional customs and practices that governed management of agricultural lands. User rights were also seen to be particularly important for farmers.

Koppelman and French (1996) proposed that, external support services were often needed to take advantage of market and production opportunities. Lack of roads for purchase of production material and transport of farm produce to the market was seen to be a clear constraint in some locations. Depending on the extension strategy and readiness of the farm household to respond to market forces, different support services were said to play important roles in adoption process. In some instances, farmers associations and cooperatives were said to have played an instrumental role.

The two authors further argued that, information on different aspects of growing crops such as propagation techniques, plant protection, nutrient requirements and harvesting technologies had effect on adoption processes. This information could be provided from sources such as successful farmers, researchers, extension workers and private industry

The theoretical framework by Koppelman and French (1996), presented a summary of the factors that influenced a household's agroforestry adoption characteristics. A combination of the on-farm factors and off-factors influenced a farmers management decisions in adoption of agroforestry. Therefore based on these factors, a farmer adopted agroforestry practices based on the factors that surrounded the farm household as well as the factors that influencd the farm household from outside. The interaction between all the factors discussed above is presented in figure 1 below.

Figure 1. Agroforestry decision-making model



Adapted from Koppelman and French (1996)

This study applied the theoretical framework by Koppelman and French (1996), by investigating the various on-farm characteristics such as the individual household characteristics such as, age, gender and education level and socio-economic aspects of the household such as income, land size and land ownership in relation to agroforestry adoption intensity. The role of off-farm characteristics such as extension work, projects on agroforestry as well as Government Organizations (GOs) and NGOs were also studied in relation with agroforestry adoption intensity. Adoption intensity was determined by the number of trees/ shrubs cultivated together with other crops and/or livestock farming. Whereby, those farmers who planted and managed 1000 trees/shrubs and above were categorized as intensive adopters, while those who planted and managed less than 1000 trees were categorized as non-intensive adopters of agroforestry.

2.2 Hypotheses

This study was guided by the following hypotheses:

1. Agroforestry adoption intensity varied with farm characteristics (size, ownership, topography)
2. The forms of agroforestry practiced by individual household farmers varied with their resource base and livelihood strategies.
3. Agroforestry adoption intensity was likely to be influenced by age gender and education level of the household head.

2.3 Operationalization of variables

Hypothesis 1:

Agroforestry adoption intensity varied with farm characteristics

Dependent variable: Adoption intensity.

This was determined by the number of trees a farmer had planted and managed in his or her farm, where, 1000 trees and above was categorized as intensive adoption and less than 1000 trees was categorized as non-intensive adoption.

Independent variables: farm characteristics (land size, ownership and topography).

Land size was determined by the total area of land that a farmer owned in acres, ownership by who controlled the farm while topography was determined by whether the land was flat, sloppy or valley bottom.

Hypothesis 2:

The forms of agroforestry practiced by individual household farmers varied with their resource base and livelihood strategies.

Dependent variable: agroforestry forms.

This was determined by niche of where the trees were planted.

Independent variables: livelihood strategies and resource base

Livelihood strategies was determined by the sources of survival by farmers, while

Resource base was determined by the land, as above, and off-farm and on-farm income.

Off-farm income (income from other sources other than the farm in Ksh).

Farm-income (income accrued from farm activities in Ksh).

Hypothesis 3:

Agroforestry adoption intensity was likely to be influenced by age and education level of the household head.

Dependent variable: adoption intensity: (as in hypothesis 1).

Independent variables: age (household hold head or representative in years)

Gender, whether one was male or female, labeled as 1 for male and 2 for female.

Education level, (formal level schooling), measured as primary level, secondary level and university/college.

Family labour measure by number of persons available for farm work.

CHAPTER 3

3.0 METHODOLOGY

3.1 Site selection

This study was done in Shibuye location, Shinyalu Division in Kakamega-East District (A new District curved from the former Kakamega District). The former District had a favorable climate with rainfall varying between 1,000 mm per annum in the northern parts of the district to 2,400 mm per annum in the southern part (GoK,2001). The climate in the District and by extension, the area of study was therefore suitable for the growth of various crops, livestock rearing and tree planting.

The study area was located near the Kakamega Rain Forest. The land under gazetted forest, covered an area of about, 28,199.72 hectares. The forest provided wood fuel as well as sawn wood for construction and furniture. Illegal felling of trees for domestic use and the systematic exploitation by saw millers was, therefore, prominent in the forest. This therefore implied that without corresponding to the existing replanting program, land was susceptible to erosion and could lead to environmental degradation. Environmental conservation was thus one of the major challenges that faced the district and agro-forestry was encouraged as a way of reducing the demand for the wood fuel from existing forests (GOK, 2002).

Due to the environmental concerns which related to the degradation of Kakamega forest, agroforestry was widely promoted in many parts of Kakamega District including Shibuye location which bordered the forest to the south; hence the area was suited for the study.

3.2 Target group

The study targeted households, extension officers (in agriculture, environment and forestry departments) community leaders (sub-chiefs) and NGOs. A semi-structured questionnaire was administered to hundred (100) households where the household head (man) or a representative (woman or older son or daughter over twenty (20) years) were the main respondents in the household survey. Key informant interviews were administered to three (3) extension officers from each of the above mentioned departments in the District. Other key informant interviews were administered to four (4) community leaders (sub-chiefs) and two NGOs, (Kakamega Environmental Educational Programme (KEEP) and Isukha Heritage) and one CBO, Kakamega Community Forestry Associaltion (KACOFA). The interviews conducted were guided by checklists prepared for each category of informants' interviews.

3.3 Sampling frame

The study used multistage and purposive sampling designs. Multistage sampling, which is one of the probability sampling procedures, enabled the researcher to select respondents for the household survey. This sampling design involved the selection of study subjects in stages. The method utilized random sampling procedures and this ensured that the researcher captured the heterogeneity that existed in the target population pertaining to factors influencing the adoption intensity of agroforestry as well as the various forms of agroforestry practiced in the study area. In this study, the sampling procedure began at the location level whereby Shibuye location was purposively selected due to its location, which was near the forest and agroforestry had

been promoted widely in the area. The second stage entailed selecting sub -locations to be studied while the third stage entailed selection of villages to be studied in every sub-location while the fourth and last stage entailed selection of specific households from every village that was selected in the third stage. This sampling design, therefore, involved four sampling stages.

The Location (Shibuye) was selected purposively at the first stage. The second stage of sampling involved listing down all the sub-locations in the location and establishing the enumeration boundaries of the 4 sub-locations. The third stage involved random selection of 15 households from each sub-location and purposive selection of 10 intensive agroforestry farmers through snowball method. Sampling procedures were done with the help of a KNBS statistical Officer in the District. A total of 100 households selected formed the sample for the household survey, from whom the semi-structured questionnaire was administered. At the same time, 4 community leaders (sub-chiefs) at the second stage were included for the community leaders' key informant interview. Purposive sampling was also used to select the three officers/ extension workers for the key informants' interviews. In this sampling design, one officer from each department, (forestry, environment and agriculture) in the district was purposively selected for the key informants interview. The three officials were chosen based on the criteria of involvement in environment and natural resource management among the rural populations in Kakamega District. A prior visit to the forestry, agricultural and environment departments in the district enabled the researcher to purposively select the three officials as the key informants and scheduled the dates and timings for the interviews. The aim of key informants' interview was to ensure that the researcher

obtained information on agroforestry from agricultural, forestry and environmental points of view with the aim of complementing the information from the household survey as well as filling in the gaps that were left by the survey method.

3.4 Methods of data collection

This study used triangulation methods in data collection. This entailed a combination of various methods of data collection. These methods enabled the researcher to collect quantitative and qualitative data pertaining to the research question(s).

A semi-structured questionnaire with open and close ended questions was designed for the households' survey. Open-ended questions were designed to help the researcher in getting the respondents' views regarding the problem under study, while the close ended questions provided alternatives from which the respondents selected from the given set of responses. A household survey was used in obtaining the required information on the social and/or economic factors which determined households' adoption intensity of agroforestry practice, the various forms of agroforestry practiced by households as well as the benefits of agroforestry to the households. The survey method was appropriate in that it enabled the researcher to obtain wide variety of views from the sample.

On the other hand checklists were used to collect information from key informants. Key informant interviews were conducted to obtain information on the forms of agro-forestry practiced as well and in obtaining information on the benefits of agroforestry practice to the households. The use of key informants in data collection was important in that this method facilitated the collection of in-depth information on key issues. In this study it

was important because there were some information on the forms and benefits of agro-forestry that could only be obtained from the experts such as officials in the agricultural, environment and forestry departments in the district, who were involved in the promotion of this practice among the rural populations. In-depth interviews with community leaders (sub-chiefs) were also conducted in obtaining information on factors which promoted or hindered the adoption of the practice, as well as the benefits of the practice to the households in the study area.

Participant field observation method was also used in obtaining information relevant to the study. Under this method, direct observation in the individual household farms facilitated the researcher to obtain information on the forms of agroforestry that were practiced by households. This method aimed at filling in the gap left by the structured interviews and key informant interviews. It therefore enabled the researcher to get information on aspects that were not expressed by the respondents or key informants relating to the research questions.

In addition, photographing was used to show the forms of agroforestry the farmers were involved in as well as other agroforestry information pertaining to research questions.

The combination of the various methods facilitated in obtaining credible information on the factors which influenced the adoption intensity of agroforestry practice, the forms of agroforestry practiced as well as the factors which promoted or hindered the adoption of the practice among household farmers in Shibuye Location in Kakamega-East District.

3.5 Methods of data analysis

The data collected comprised both quantitative and qualitative data. The data obtained was coded and fed into Statistical Package for Social Sciences (SPSS) computer programme from which descriptive statistics such as the mean, the mode and the median were obtained in relation to various variables under study. These included; the age, education level, income (off-farm and on-farm), and farm characteristics (land size, ownership and topography). Frequency tables, percentages, cross-tabulations and summary tables were derived from these statistics which were used to show the various sample characteristics in relation to the adoption intensity of agroforestry practice in the study area. These statistics were used to draw conclusions regarding socio-economic factors influencing the adoption intensity, the forms of agroforestry widely adopted by farmers and the benefits that households derived from the practice.

On the other hand, inferential statistics were also used to enable the researcher in making inferences pertaining to the various variables and the adoption intensity of agroforestry practice. Regression analysis was used to explore factors such as age, gender, education level, on-farm income, off-farm income, land size, etc. in relation with the agroforestry adoption intensity. A multinomial logistic regression model involving the choice between intensive and non-intensive agroforestry was used in analyzing factors which determined the choice of the intensity of agroforestry practiced.

3.5.1 Model specification:

The model that was used stated that, the probability of agroforestry adoption intensity being chosen was dependent upon a number of factors.

Its functional relationship was given as,

$$A_i = f(X_j, Y_k)$$

Where A_i =0 if intensive agroforetry was chosen

= 1 if non-intensive agroforestry was chosen

and X_j = explanatory individual variables; j=1,2,...,7

X_1= age of the household head in years

X_2= gender of the household head (male or female)

X_3 = level of education (education, primary level, secondary level and university/college)

X_4= farm labour (number persons available for farm work).

X_5= amount of farm income (Ksh)

X_6= amount of off-farm income (Ksh)

X_7= farm size (in acres)

Y_k= explanatory institutional variables; k= 1,2,3.

Y_1= extension officer (extension officer available or not available)

Y_2= Agroforestry projects in the area (agroforestry projects available or not available.

Y_3= GOs or NGOs offering agroforestry extension services (GOs or NGOs available or not available

Qualitative data obtained from the key informants' interviews was analyzed by thematic analysis of the information derived. The various themes that emerged included: forms of agroforestry practiced by farmers, benefits of agroforestry, factors promoting

agroforestry and factors hindering agroforestry. The combination of quantitative and qualitative data analysis methods enable the researcher to make various conclusions pertaining to the socio-economic factors which influenced the adoption intensity of agroforestry practice in Shibuye location in Kakamega-East District.

3.6 Problems encountered in the field

The field survey had targeted household heads. However, there were instances where the household heads of the sampled households were not present at the time of the interview. In this case, the researcher interviewed representatives of the household heads. A major problem experienced due to this phenomenon was that; in some instances the representatives did not have all the information that the researcher had intended to get from the household heads.

Another major problem encountered in the field pertained to the sampling procedures. The researcher had intended to interview both intensive and non-intensive agroforestry adopters. However the original sampling frame that the researcher intended to use became problematic due to the nature of the study, hence the researcher had to change the original sampling frame which led to prolonging of work, which had financial implications in the study.

CHAPTER 4

4.0 ANALYSIS AND RESULTS

This chapter presents the study findings based on the survey data and other information obtained from the field through key informants' interviews. It presents findings on the demographic and socio-economic characteristics of the respondents, and further presents findings on the research questions in relation to socio-economic factors influencing the agroforestry adoption intensity in the study area.

4.1 Socio-economic characteristics of the respondents

4.1.1 Economic activities

The study indicated that farming was the main economic activity among the people of Shibuye Location. Hence most economic activities revolved around the farm. Majority of those interviewed 81 respondents (81%) carried out crops growing, livestock rearing and tree growing in their farms, while 14 respondents (14%) carried out crops and tree growing only, and only 2 respondents (2%) carried out tree growing and bee keeping. Only one respondent (1%) each carried out crops growing and livestock only, tree growing only, and tree growing and fish keeping. The study therefore revealed that most farmers grew crops, trees as well as reared livestock in their farms.

4.1.1.1 Types of crops grown

Majority of those interviewed 62 respondents (62%) grew subsistence crops such as maize, beans, bananas, potatoes and vegetables. However, 33 respondents (33%) grew subsistence crops as well as cash crops, such as sugar cane, tea and coffee. Of the remaining number, 4 respondents (4%) grew subsistence crops and livestock

fodder, mostly nippier grass, while only 1 respondent (1%) did not grow any type of crop in his farm.

4.1.1.2 Types of livestock reared

A big majority of the respondents interviewed, i.e. 85 (85%) kept livestock while only 15 respondents did not keep any type of livestock. Of these, 39 respondents (39%), reared cattle only, while 27 respondents (27%) reared cattle and chicken only and 9 respondents (9%) reared cattle, sheep and chicken. Other 6 respondents (6%) reared cattle, chicken and pigs, while 2 respondents (2%) reared chicken only, and only 1 respondent (1%) each reared goats only and cattle and pigs. The study therefore revealed that cattle were the most common type of livestock reared by farmers in Shibuye location, as data indicated that of the 85 respondents who reared livestock, 82 respondents reared cattle. Table 1 below presents the summary of the farm activities undertaken by the households.

Table 1

Farm activities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Crops and livestock	1	1.0	1.0	1.0
	Crops and tree growing only	14	14.0	14.0	15.0
	Crops, livestock, trees	81	81.0	81.0	96.0
	crops, livestock, Trees, bees	2	2.0	2.0	98.0
	Tree growing only	1	1.0	1.0	99.0
	crops, livestock, Trees, fish	1	1.0	1.0	100.0
	Total	100	100.0	100.0	

Source: Field data 2008

4.2 Agroforestry adoption

Almost all the respondents interviewed 99 (99%) had planted trees/ shrubs in their farms. Only 1 respondent (1%) had not planted any tree in her farm. Majority of those interviewed, 55 (55%) had planted exotic woody perennial trees together with fruit trees. At the same time, 16 respondents (16%) had planted exotic woody perennial, fruit and ornamental trees, while 13 respondents (13%) had planted exotic woody perennials, indigenous and fruit trees. Of the remaining respondents, 12(12%) had planted exotic woody perennial trees only, while only 3 (3%) had planted exotic woody perennial and fodder trees only. Most of the exotic woody perennial trees planted were the *gravellia and the eucalyptus species* commonly known as the *blue gum*. The most common fruit trees grown were the avocado, mango and pawpaw. The fodder tree grown by the few farmers was the imported *calliandra* which was introduced to farmers by ICRAF. A point to note, however, is that, there were indigenous trees in the local Isukha language such as *mutere, murembe, lusui, musine, shikhuma, musunsu and mushereshere*, that were common in almost all households. However, the respondents indicated that, these trees grew by themselves without the farmers necessarily planting them. The study therefore indicated that the exotic woody perennials were the most preferred types of trees by farmers.

4.2.1 Forms of agroforestry

The forms of agroforestry practiced by farmers were determined by considering the niche of where the trees/shrubs were planted. The study indicated that farmers practiced varied forms of agroforestry. At the same time, various forms were practiced in combination. The study indicated that, 50 respondents (50%) planted trees on

borders, on separated plots as woodlots and around the homestead, while 17 farmers (17%) planted trees on farm borders and around the homestead only. Of the remaining, 7 farmers (7%) each planted trees on the river bed only and around the homestead, while 5 farmers (5%) each planted trees on the farm borders only, as woodlots only and inside the farm with other crops together with the area around the homestead. Observations in the field indicated that farmers who had larger pieces of land practiced diversified forms compared with farmers with smaller pieces of land. According to the District Agricultural Officer and the District Forestry Extension Officer, the forms of agroforestry varied according to land sizes and investment capabilities of the farmers.

4.2.2 The uses of trees

There were varied uses of trees in the study area. The study found out that the most common use of trees in Shibuye Location was as a source of firewood. All the respondents who planted trees used them as a source of wood fuel. At the same time, 71 respondents (71%) indicated that trees were a source of income through selling them as timber, wood fuel or as logs, while 62 respondents (62%) indicated that trees were a source of food for their families through the fruits harvested from fruit trees. Trees were also used as building materials either as timber, posts or rafts, where 53 respondents (53%) indicated that they used the trees as a source of building materials. Only 5 respondents (5%) used the trees as a source of fodder for the livestock, while 3 respondents used the trees as a source of herbal medicine. Hence the study indicated that, trees were highly valued by farmers as they were a source of income, food as well as other uses such as building, fencing and as a source of medicine. At the same time, the various uses of the trees by the farmers determined the forms they practiced.

4.3 Socio-economic factors determining agroforestry adoption intensity

4.3.1 Demographic characteristics and agroforestry adoption

The various demographic characteristics that were considered in this study included gender of the household head, age of the household head and marital status.

4.3.1.1 Gender

Among the Luhya community, where the study was carried out, husbands are the household heads. However, where the husband is deceased, the widow becomes the head of the household. In this study, majority of those who were interviewed, 79 respondents (79%) were male, while 21 respondents (21%) were female. Of the female respondents, 6 (6%), were widowed and were automatically the heads of their households. One female respondent, (1%), was single and it was therefore not outright that she was the head of the household as she could have been a representative of the household head who could have been away at the time of the interview. A point to note, however, is that, of the 79 male respondents, 3 respondents were single, and stayed in the households of their parents. This therefore suggested that they were not heads of households but representatives. Hence in total, it was presumed that, the study interviewed 82 respondents (82%) who were heads of households, while 18 respondents (18%) were representatives of the household heads. This is because there were absentee heads of households who worked in towns while other household heads were out of the households at the time of the interview.

The influence of gender in agroforestry adoption was not outright as the study interviewed more males (household heads) compared to females. However, the study

also indicated that tree planting was mostly the domain of men. Table 2 below shows that majority of respondents (74%) indicated that the male (husband) made decisions pertaining to tree planting.

Table 2

Tree planting decisions

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male (husband)	74	74.0	74.0	74.0
	Female (wife)	3	3.0	3.0	77.0
	Both (husband and wife)	12	12.0	12.0	89.0
	Husband, wife and children	3	3.0	3.0	92.0
	son	8	8.0	8.0	100.0
	Total	100	100.0	100.0	

Source: Field data 2008

4.3.1.2 Marital status

Majority of those interviewed, 87 respondents (87%), were married, while 9 respondents (9%) were widowed and 4 respondents (4%) were single. Among those who were single, 3 respondents (75%) were male while only one respondent (25%) was female. However, of those who were widowed, majority, 6 respondents (66.7%) were female, while 3 respondents (33.3%) were male. Of the 4 respondents who were single, 3 respondents (5.1%) practiced non-intensive agroforestry, while only one respondent (2.4%) practiced intensive agroforestry. At the same time, of the 87 married respondents, 51 (86.4%) practiced non-intensive agroforestry while 36 respondents (87.8%) practiced intensive agroforestry. Of the 9 widowed respondents, 5 (8.5%) practiced non-intensive agroforestry while 4 respondents (9.8%) practiced intensive

agroforestry. The study therefore indicated that, there were no significant differences between non-intensive and intensive agroforestry adopters in terms of their marital status as shown in table 3 below.

Table 3

Marital status * agroforestry adoption intensity Crosstabulation

			agroforestry adoption intensity		Total
			below 1000 trees	1000 trees and above	
marital status	single	Count	3	1	4
		% within marital status	75.0%	25.0%	100.0%
		% within agroforestry adoption intensity	5.1%	2.4%	4.0%
		% of Total	3.0%	1.0%	4.0%
	married	Count	51	36	87
		% within marital status	58.6%	41.4%	100.0%
		% within agroforestry adoption intensity	86.4%	87.8%	87.0%
		% of Total	51.0%	36.0%	87.0%
	widowed	Count	5	4	9
		% within marital status	55.6%	44.4%	100.0%
		% within agroforestry adoption intensity	8.5%	9.8%	9.0%
		% of Total	5.0%	4.0%	9.0%
Total		Count	59	41	100
		% within marital status	59.0%	41.0%	100.0%
		% within agroforestry adoption intensity	100.0%	100.0%	100.0%
		% of Total	59.0%	41.0%	100.0%

Source: Field data 2008

4.3.1.3 Age

The age of the respondents varied greatly. Of the 100 respondents interviewed, 28 respondents (28%) were aged between 41-50 years, while those who were aged between 31-40 years were 22 respondents (22%). Those who were aged above 60

years were 21 respondents (21%) while those who were aged between 51-60 and 21-30 were the least with frequencies of 16 respondents (16%), and 13 respondents (13%), respectively. This information is presented in the table below in table 4.

Table 4

Grouped age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	21-30	13	13.0	13.0	13.0
	31-40	22	22.0	22.0	35.0
	41-50	28	28.0	28.0	63.0
	51-60	16	16.0	16.0	79.0
	above 60	21	21.0	21.0	100.0
	Total	100	100.0	100.0	

Source: Field data 2008

There was no direct relationship between agroforestry adoption intensity and age since different ages were involved in both intensive and non-intensive agroforestry practices. However, the study indicated that there were more young farmers who practiced non-intensive agroforestry compared with the older ones. In the age group of 21-30 years, there were 10 respondents (76.9%) who practiced non-intensive agroforestry, while in the same age group only 3 respondents (23.1%) practiced intensive agroforestry. At the same time, in the age group of 31-40 years, 16 respondents (72.7%) practiced non-intensive agroforestry, while in the same age group; only 6 respondents (27.3%) practiced intensive agroforestry. However, the study revealed that, majority of those who practiced intensive agroforestry, 32 respondents (77.3%) were aged above 41 years.

According to District Agricultural officer (one of the key informants), age was a key factor in agroforestry adoption as trees were considered part of permanent investment in the farm given the long maturation period entailed. Tree planting was therefore controlled by the owner of the land mostly the head of the household.

Table 5

grouped age * agroforestry adoption intensity Crosstabulation

			agroforestry adoption intensity		
			below 1000 trees	1000 trees and above	Total
grouped age	20-30	Count	10	3	13
		% within grouped age	76.9%	23.1%	100.0%
		% within agroforestry adoption intensity	16.9%	7.3%	13.0%
		% of Total	10.0%	3.0%	13.0%
	31-40	Count	16	6	22
		% within grouped age	72.7%	27.3%	100.0%
		% within agroforestry adoption intensity	27.1%	14.6%	22.0%
		% of Total	16.0%	6.0%	22.0%
	41-50	Count	16	12	28
		% within grouped age	57.1%	42.9%	100.0%
		% within agroforestry adoption intensity	27.1%	29.3%	28.0%
		% of Total	16.0%	12.0%	28.0%
	51-60	Count	6	10	16
		% within grouped age	37.5%	62.5%	100.0%
		% within agroforestry adoption intensity	10.2%	24.4%	16.0%
		% of Total	6.0%	10.0%	16.0%
	above 60	Count	11	10	21
		% within grouped age	52.4%	47.6%	100.0%
		% within agroforestry adoption intensity	18.6%	24.4%	21.0%
		% of Total	11.0%	10.0%	21.0%
Total		Count	59	41	100
		% within grouped age	59.0%	41.0%	100.0%
		% within agroforestry adoption intensity	100.0%	100.0%	100.0%
		% of Total	59.0%	41.0%	100.0%

Source: Field data 2008

The study indicated that most young people considered planting trees only after they had acquired their own pieces of land either through inheritance or through other means such as buying. It is from this point of view that age was said to determine agroforestry adoption intensity. At the same time, the officer, pointed out that, many young people preferred "white color" jobs compared to agriculture and hence could not invest in agricultural activities such as agroforestry. The study therefore revealed that, agroforestry adoption intensity tended to increase with age. This was however influenced by other factors such as, land ownership/tenure which went along with land decision powers. Hence, one gained power over land upon acquiring land tenure rights which came with age as one received family land inheritance.

4.3.2 Agroforestry adoption intensity and land characteristics

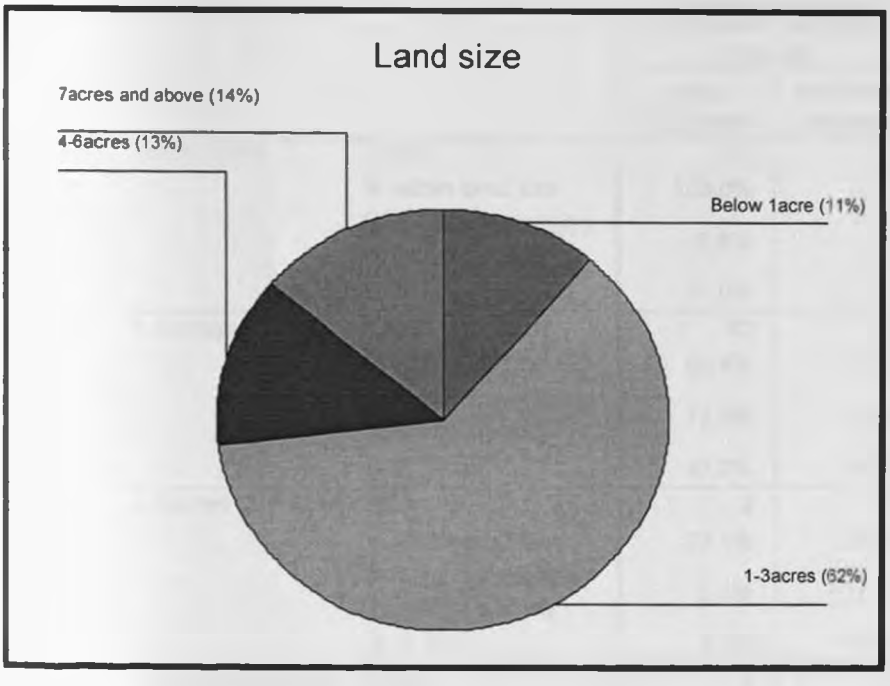
The study indicated that the people of Shibuye Location were generally agriculturalists. Land was therefore an important asset and an important factor of production. Some land characteristics that were important in this study included: ownership, size, topography and land use decisions. The researcher had hypothesized that, agroforestry adoption intensity varied with farm characteristics such as size, topography, ownership and number of plots owned by the farmer.

4.3.2.1 Land size

Land size was considered as an important aspect in any agricultural activity. The land size generally indicated the amount of available resource to be exploited. In this study, majority of those interviewed, 62 respondents (62%) owned between 1-3 acres of land, while 13 respondents (13%) owned between 4-6 acres. Only 14 respondents (14%)

owned 7 acres and above. However, 11 respondents (11%) owned below 1 acre. Hence a big majority, 73% owned below 3 acres of land. This presents the picture of highland areas which are characterized by scarcity and predominant small-holding agricultural activities. Chart 1 below presents data on land size distribution.

Chart 1



Source: Field data 2008

The study indicated that all the 11 respondents (100%) who owned below 1 acre of land, practiced non-intensive agroforestry indicating that small land sizes curtail agroforestry practices. At the same time, out of the 62 respondents who owned 1-3 arces of land, 43(69.4%) practiced non-intensive agroforestry, while 19 respondents (30.6%) practiced intensive agroforestry. On the other hand, out of the 13 respondents who owned 4-6 acres of land, 10 (76.9%) practiced intensive agroforestry while only 3 respondents (23.1%) practiced non-intensive agroforestry. At the same time, out of the

14 respondents who owned 7 acres and above, 12 respondents (85.7%) practiced intensive agroforestry while only 2 respondents (14.3%) practiced non-intensive agroforestry.

Table 6

land size * agroforestry adoption intensity Crosstabulation

			agroforestry adoption intensity		
			below 1000 trees	1000 trees and above	Total
land size	Below 1acre	Count	11		11
		% within land size	100.0%		100.0%
		% within agroforestry adoption intensity	18.6%		11.0%
		% of Total	11.0%		11.0%
	1-3acres	Count	43	19	62
		% within land size	69.4%	30.6%	100.0%
		% within agroforestry adoption intensity	72.9%	46.3%	62.0%
		% of Total	43.0%	19.0%	62.0%
	4-6acres	Count	3	10	13
		% within land size	23.1%	76.9%	100.0%
		% within agroforestry adoption intensity	5.1%	24.4%	13.0%
		% of Total	3.0%	10.0%	13.0%
	7acres and above	Count	2	12	14
		% within land size	14.3%	85.7%	100.0%
		% within agroforestry adoption intensity	3.4%	29.3%	14.0%
		% of Total	2.0%	12.0%	14.0%
Total		Count	59	41	100
		% within land size	59.0%	41.0%	100.0%
		% within agroforestry adoption intensity	100.0%	100.0%	100.0%
		% of Total	59.0%	41.0%	100.0%

Source: Field data 2008

The data therefore revealed that though there were more intensive agroforestry adopters who had larger pieces of land, there were also non-intensive agroforestry

adopters in the same category and vice versa. However, the data indicated that those with larger pieces of land were more predisposed to practicing intensive agroforestry. This was because, those who had larger pieces of land had more space to plant more trees compared to those with smaller sizes of land. Table 6 above presents the summary of the relationship between land size and agroforestry adoption intensity.

The study further indicated that, majority of those who were non-intensive agroforestry adopters, 48 respondents (81.4%), owned only one plot of land, while the majority of those who were intensive adopters, 25 respondents (61%), owned two or more plots of land.

Table 7

Actual number of plots owned * agroforestry adoption intensity Crosstabulation

			agroforestry adoption intensity		
			below 1000 trees	1000 trees and above	Total
actual number of plots owned	1	Count	48	16	64
		% of Total	48.0%	16.0%	64.0%
	2	Count	8	7	15
		% of Total	8.0%	7.0%	15.0%
	3	Count	2	7	9
		% of Total	2.0%	7.0%	9.0%
	4	Count		4	4
		% of Total		4.0%	4.0%
	5	Count	1	4	5
		% of Total	1.0%	4.0%	5.0%
	6	Count		2	2
		% of Total		2.0%	2.0%
	7	Count		1	1
		% of Total		1.0%	1.0%
Total		Count	59	41	100
		% of Total	59.0%	41.0%	100.0%

Source: Field data 2008

The number of plots therefore increased the resource base which could be exploited by investing in intensive agroforestry activities. Table 7 above presents summary information on the relationship between land plots and agroforestry adoption intensity.

4.3.2.2 Land ownership system

From the 100 respondents interviewed majority (75%), occupied and owned family land, while 19 respondents (19%) occupied and owned both family land as well as private land. Only 6 respondents (6%) occupied and owned land that was purely private. Family land was acquired through inheritance from the family, while private land was acquired through buying. The data further indicated that out of the 6 respondents who owned purely private land, 5 respondents (83.3%) were non-intensive agroforestry adopters while, only one respondent (16.7%) was an intensive agroforestry adopter. At the same time the data indicated that, out of the 75 respondents who owned family land 49 respondents (65.3%) were non-intensive agroforestry adopters while 26 respondents 34.7% were intensive agroforestry adopters. However, of the 19 respondents who owned family and private land, 14 respondents (73.7%) were intensive agroforestry adopters while only 5 respondents (26.3%) were non-intensive agroforestry adopters. This therefore indicated that, ownership of family and private land increased the resource base at the farmer's disposal for investing in agricultural activities such as agroforestry. Table 8 below presents the summary on the relationship between land ownership system and agroforestry adoption intensity.

Table 8

Land ownership system * agroforestry adoption intensity Crosstabulation

			agroforestry adoption intensity		
			below 1000 trees	1000 trees and above	Total
land ownership system	Private	Count	5	1	6
		% within land ownership system	83.3%	16.7%	100.0%
		% within agroforestry adoption intensity	8.5%	2.4%	6.0%
		% of Total	5.0%	1.0%	6.0%
	Family	Count	49	26	75
		% within land ownership system	65.3%	34.7%	100.0%
		% within agroforestry adoption intensity	83.1%	63.4%	75.0%
		% of Total	49.0%	26.0%	75.0%
	private and family	Count	5	14	19
		% within land ownership system	26.3%	73.7%	100.0%
		% within agroforestry adoption intensity	8.5%	34.1%	19.0%
		% of Total	5.0%	14.0%	19.0%
Total		Count	59	41	100
		% within land ownership system	59.0%	41.0%	100.0%
		% within agroforestry adoption intensity	100.0%	100.0%	100.0%
		% of Total	59.0%	41.0%	100.0%

Source: Field data 2008

An aspect of land which is closely related with land ownership is land use decision capability. This pertains to making decisions on how land is allocated for various farm activities as well as the control of the produce from the farm. This aspect is closely related with land ownership and land tenure.

Majority of those interviewed 61(61%) indicated that, male (husband) made decisions on land use, while 25 respondents (25%) indicated that, both male (husband) and female (wife) made decisions on how land was used. However, 7 respondents (7%)

indicated that it was the female who made decisions, while other 3 respondents indicated that decisions were made by the male (husband), female (wife) and children. Other 4 respondents (4%) indicated that decisions were made by sons. Where decisions were made by the female (wife) or sons, the household head male (husband) was absent or deceased. Table 9 below presents frequencies on who made decisions on land use.

Table 9

Land use decisions

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male (husband)	61	61.0	61.0	61.0
	Female (wife)	7	7.0	7.0	68.0
	Both (husband and wife)	25	25.0	25.0	93.0
	husband, wife and children	3	3.0	3.0	96.0
	sons	4	4.0	4.0	100.0
	Total	100	100.0	100.0	

Source: Field data 2008

Land use decisions was an important aspect in agroforestry. This was because; planting of trees was considered a long term land use activity which was considered an important land use decision aspect. Majority of those interviewed 74 (74%) therefore indicated that male (husband) made decisions on tree planting, while 12 respondents (12%) indicated that both husband and wife made the decisions. Only 3 respondents (3%) each indicated that tree planting decisions were made by female (wife) as well as husband, wife and children. However, 8 respondents (8%) indicated that tree planting decisions were made by sons. The study therefore indicated that tree planting was

related to land tenure and control over land through the power to decide on how land was used. Refer to table 2 on page 41 for this analysis.

4.3.2.3 Land topography

The study indicated that land topography had an influence in agroforestry adoption intensity.

Table 10

Land topography * agroforestry adoption intensity Crosstabulation

			agroforestry adoption intensity		
			below 1000 trees	1000 trees and above	Total
Land topography	flat	Count	30	11	41
		% within Land topography	73.2%	26.8%	100.0%
		% within agroforestry adoption intensity	50.8%	26.8%	41.0%
		% of Total	30.0%	11.0%	41.0%
	sloppy	Count	22	22	44
		% within Land topography	50.0%	50.0%	100.0%
		% within agroforestry adoption intensity	37.3%	53.7%	44 0%
		% of Total	22.0%	22.0%	44 0%
	flat and sloppy	Count	7	8	15
		% within Land topography	46.7%	53.3%	100.0%
		% within agroforestry adoption intensity	11.9%	19.5%	15.0%
		% of Total	7.0%	8.0%	15.0%
Total		Count	59	41	100
		% within Land topography	59.0%	41.0%	100.0%
		% within agroforestry adoption intensity	100.0%	100.0%	100.0%
		% of Total	59.0%	41.0%	100.0%

Source: Field data 2008

The study indicated that out of the 41 intensive adopters, 22 (53.7%) had sloppy lands while out of the 59 non-intensive adopters, 22 (37.3%) were on sloppy lands. On the other hand, 11 respondents (26.8%) of the intensive adopters had flat land, while 30

respondents (50.8%) of the non-intensive adopters had flat land. For those who had flat and sloppy land, the study indicated that 8 respondents (19.5%) were intensive agroforestry adopters while 7 respondents (11.9%) were non-intensive agroforestry adopters. The study therefore found out that agroforestry was more intense in the sloppy topography compared to the flat topography this was an indication of use of intense agroforestry practices in conservation measures such as prevention of soil erosion. Table 10 above presents a summary on land topography in relation with agroforestry adoption intensity.

4.3.3 Agroforestry adoption intensity and education level

The data collected indicated that, 46 respondents (46%) had primary level of education, those with secondary level of education were 30 respondents (30%), while 16 respondents (16%) had attained some professional training in colleges or universities. However, 8 respondents (8%) had no education at all.

Among the 46 respondents who had attained primary level education, 30 respondents (65.2%) were male, while 16 respondents (34.8%) were female. At the same time, among those who had attained secondary level education, 29 respondents (96.7%) were male and only 1 respondent (3.3%) was a female. Among those who had attained professional training in universities or colleges, 15 respondents (93.8%) were male while only 1 respondent (6.3%) was a female. However, majority of those who had no education at all, 5 respondents (62.5%) were male, while 3 respondents (37.5%) were female.

Table 11

Education level * sex Crosstabulation

			sex		
			Male	Female	Total
Education level	no education	Count	5	3	8
		% within Education level	62.5%	37.5%	100.0%
		% within sex	6.3%	14.3%	8.0%
		% of Total	5.0%	3.0%	8.0%
	primary level	Count	30	16	46
		% within Education level	65.2%	34.8%	100.0%
		% within sex	38.0%	76.2%	46.0%
		% of Total	30.0%	16.0%	46.0%
	secondary level	Count	29	1	30
		% within Education level	96.7%	3.3%	100.0%
		% within sex	36.7%	4.8%	30.0%
		% of Total	29.0%	1.0%	30.0%
	university/college	Count	15	1	16
		% within Education level	93.8%	6.3%	100.0%
		% within sex	19.0%	4.8%	16.0%
		% of Total	15.0%	1.0%	16.0%
Total		Count	79	21	100
		% within Education level	79.0%	21.0%	100.0%
		% within sex	100.0%	100.0%	100.0%
		% of Total	79.0%	21.0%	100.0%

Source: Field data 2008

Generally, the data indicated that there were more males who had attained secondary level of education and universities/colleges compared to females. However, majority of the females interviewed 16 respondents (76.2%) had attained primary level of education. The summary information of the education level of the respondents in relation to their gender is presented in table 11 above.

The effect of education on agroforestry adoption intensity was not direct as there were farmers with different levels of education in both intensive and non-intensive agroforestry practice. However, the study revealed that majority of the intensive

agroforestry adopters had either attained secondary level education or had acquired some form of professional training in universities or colleges.

Table 12

Education level * agroforestry adoption intensity Crosstabulation

			agroforestry adoption intensity		
			below 1000 trees	1000 trees and above	Total
Education level	no education	Count	8		8
		% within Education level	100.0%		100.0%
		% within agroforestry adoption intensity	13.6%		8.0%
		% of Total	8.0%		8.0%
	primary level	Count	36	10	46
		% within Education level	78.3%	21.7%	100.0%
		% within agroforestry adoption intensity	61.0%	24.4%	46.0%
		% of Total	36.0%	10.0%	46.0%
	secondary level	Count	13	17	30
		% within Education level	43.3%	56.7%	100.0%
		% within agroforestry adoption intensity	22.0%	41.5%	30.0%
		% of Total	13.0%	17.0%	30.0%
	university/college	Count	2	14	16
		% within Education level	12.5%	87.5%	100.0%
		% within agroforestry adoption intensity	3.4%	34.1%	16.0%
		% of Total	2.0%	14.0%	16.0%
Total		Count	59	41	100
		% within Education level	59.0%	41.0%	100.0%
		% within agroforestry adoption intensity	100.0%	100.0%	100.0%
		% of Total	59.0%	41.0%	100.0%

Source: Field data 2008

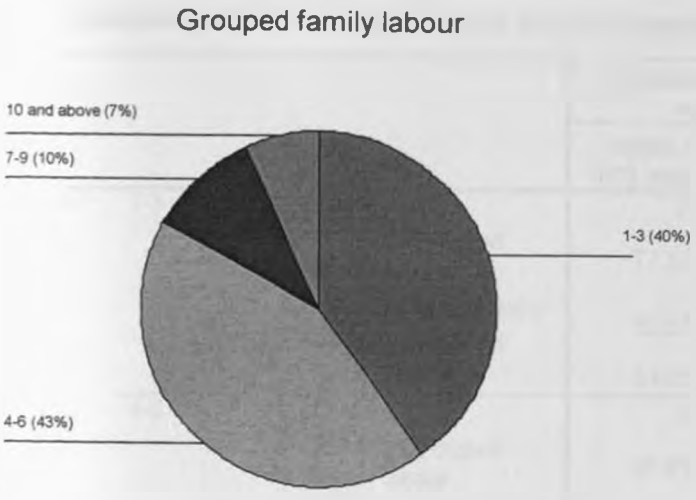
The data indicated that 17 respondents (56.7%) of those who had attained secondary level education and 14 respondents (87.5%) of those who had attained some form of training in universities or colleges were intensive agroforestry adopters. On the other

hand, majority of the non-intensive agroforestry adopters had either attained primary level education or no education at all, where 8 respondents (100%) of those who had no education at all, and 36 (78.3%) of those who had attained primary level education were non-intensive adopters. The study therefore revealed that those who had not gone to school did not appreciate intensive agroforestry. This implied that though education was not a panacea to non-intensive agroforestry practices, education level influenced the practice of a farmer through skills, long term calculation of benefits as well as a source of off-farm income through formal employment and hence acquisition of necessary finance for investment in agroforestry. Table 12 above presents a summary of the relationship between education level and agroforestry adoption intensity.

4.3.4 Agroforestry adoption intensity and family labour

Family labour forms an important component of factors of production in many rural areas where agriculture is the main economic activity. In this study, 43 respondents (43%) indicated that they had family labor that ranged between 4-6 persons, while 40 respondents (40%) had family labor that ranged between 1-3 persons. At the same time, 10 respondents (10%) had family labor that ranged between 7-9 persons, while only 7 respondents (7%) had family labour of 10 persons and above. The study therefore revealed that majority of the households 83 (83%) had family labour of 6 persons and below, while only 17 households (17%) had family labour of 7 persons and above. The summary information on the state of family labour is presented in chart 2 below.

Chart 2



Source: Field data 2008

In this study it was not easy to determine the influence of family labour on agroforestry adoption intensity. This was because; it was presumed that there were other intervening variables that played part. These included the land size, income, as well as the possibility of use of hired labour by the farmer. Hence, the study revealed that, family labour does not necessarily influence agroforestry adoption intensity. This is because according to the data, adoption intensity did not seem to vary according to family labour. The summary information on family labour and agroforestry adoption intensity is given on table 13 below.

Table 13

grouped family labour * agroforestry adoption intensity Crosstabulation

			agroforestry adoption intensity		
			below 1000 trees	1000 trees and above	Total
grouped family labour	1-3	Count	31	9	40
		% within grouped family labour	77.5%	22.5%	100.0%
		% within agroforestry adoption intensity	52.5%	22.0%	40.0%
		% of Total	31.0%	9.0%	40.0%
	4-6	Count	21	22	43
		% within grouped family labour	48.8%	51.2%	100.0%
		% within agroforestry adoption intensity	35.6%	53.7%	43.0%
		% of Total	21.0%	22.0%	43.0%
	7-9	Count	4	6	10
		% within grouped family labour	40.0%	60.0%	100.0%
		% within agroforestry adoption intensity	6.8%	14.6%	10.0%
		% of Total	4.0%	6.0%	10.0%
	10 and above	Count	3	4	7
		% within grouped family labour	42.9%	57.1%	100.0%
		% within agroforestry adoption intensity	5.1%	9.8%	7.0%
		% of Total	3.0%	4.0%	7.0%
Total		Count	59	41	100
		% within grouped family labour	59.0%	41.0%	100.0%
		% within agroforestry adoption intensity	100.0%	100.0%	100.0%
		% of Total	59.0%	41.0%	100.0%

Source: Field data 2008

4.3.5 Agroforestry adoption intensity and off-farm income

Off-farm income referred to the proceeds that a farmer got from other sources other than the farm. Majority, (70%), of those interviewed indicated that they had off-farm

income, 25 respondents (25%) indicated that they did not have off-farm income while the remaining 5 respondents (5%) did not report on off-farm income. Of the 70 respondents who had off-farm income, 26, got their off-farm income from casual labour, 14 got from remittances, 12 got from businesses while 7 got from formal employment. Other sources of off-farm income included pensions, shared dividends, *jua-kali* artisanry as well as stone/sand harvesting and brick-making. Of those who had off-farm income, 40 respondents (57.1%) were non-intensive agroforestry adopters while 30 respondents (42.9%) were intensive agroforestry adopters. Though there were more non-intensive agroforestry adopters who had off-farm income compared to intensive agroforestry adopters, the study indicated that there were varying differences among the intensive and non-intensive adopters in terms of the amount of off-farm income.

The data indicated that out of the 70 respondents who earned between 500-1000 off-farm income, 24 respondents (88.9%) were non-intensive adopters, while only 3 respondents (11.1%) were intensive adopters. At the same time, out of the 7 respondents who earned 1001-1500, 6 respondents (85.7%) were non-intensive adopters while only 1 respondent (14.3%) was an intensive adopter. However, out of the 10 respondents who earned between 1501 and 2000, 6 respondents (60%) were intensive adopters while 4 respondents (40%) were non-intensive adopters. On the other hand, out of the 26 respondents who earned above 2000, 20 respondents (76.9%) were intensive adopters while only 6 respondents (23.1%) were non-intensive adopters. The study therefore revealed that, though there were more non-intensive adopters who had off-farm income compared to the intensive adopters, intensive adopters tended to have more off-farm income compared to non-intensive adopters. Table 14 below

presents a summary of the relationship between off-farm income and agroforestry adoption intensity.

Table 14

Amount of off-farm income/month * agroforestry adoption intensity Crosstabulation

			agroforestry adoption intensity		
			below 1000 trees	1000 trees and above	Total
Amount of off-farm income/month	500-1000	Count	24	3	27
		% within Amount of off-farm income/month	88.9%	11.1%	100.0%
		% within agroforestry adoption intensity	60.0%	10.0%	38.6%
		% of Total	34.3%	4.3%	38.6%
	1001-1500	Count	6	1	7
		% within Amount of off-farm income/month	85.7%	14.3%	100.0%
		% within agroforestry adoption intensity	15.0%	3.3%	10.0%
		% of Total	8.6%	1.4%	10.0%
	1501-2000	Count	4	6	10
		% within Amount of off-farm income/month	40.0%	60.0%	100.0%
		% within agroforestry adoption intensity	10.0%	20.0%	14.3%
		% of Total	5.7%	8.6%	14.3%
	above 2000	Count	6	20	26
		% within Amount of off-farm income/month	23.1%	76.9%	100.0%
		% within agroforestry adoption intensity	15.0%	66.7%	37.1%
		% of Total	8.6%	28.6%	37.1%
Total		Count	40	30	70
		% within Amount of off-farm income/month	57.1%	42.9%	100.0%
		% within agroforestry adoption intensity	100.0%	100.0%	100.0%
		% of Total	57.1%	42.9%	100.0%

Source: Field data 2008

According to the District Forestry Extension Officer (one of the key informants), one factor that limited farmers adoption of agroforestry was lack of enough capital needed for the agroforestry investment. The officer revealed that, only those who could access the required inputs such as seedlings, fertilizers, planting tubes and pesticides ventured into intensive agroforestry. Hence, off-farm income played a vital role in agroforestry investment.

4.3.6 Agroforestry adoption intensity and institutional characteristics

The institutional characteristics that were evaluated in this study included the presence of extension services, the role of NGOs and GOs, the role of community projects and the role of culture.

The study indicated that, there were limited extension services either from the agricultural, environment or forestry departments in the District. Majority of the respondents, 80 (80%) indicated that they had never been visited by any extension officer while 20 respondents (20%) indicated to have had some visit by the extension officer. However, among the 20 respondents who had been visited, 17 respondents were intensive agroforestry adopters while only 3 were non-intensive adopters. This therefore implied that 41.5 % of the intensive agroforestry adopters had some form of extension services while, 94.9% of the non-intensive agroforestry adopters had not experienced any extension services in their farms. Though majority of the intensive adopters (58.5%) had not experienced any extension services, the study indicated that the intensive adopters benefited more from the extension services compared to non-

intensive adopters. Table 15 below presents a summary on the relationship between availability of extension services and agroforestry adoption intensity.

Table 15

Presence of extension officer * agroforestry adoption intensity Crosstabulation

			agroforestry adoption intensity		
			below 1000 trees	1000 trees and above	Total
Presence of extension officer	yes	Count	3	17	20
		% within Presence of extension officer	15.0%	85.0%	100.0%
		% within agroforestry adoption intensity	5.1%	41.5%	20.0%
		% of Total	3.0%	17.0%	20.0%
	no	Count	56	24	80
		% within Presence of extension officer	70.0%	30.0%	100.0%
		% within agroforestry adoption intensity	94.9%	58.5%	80.0%
		% of Total	56.0%	24.0%	80.0%
Total		Count	59	41	100
		% within Presence of extension officer	59.0%	41.0%	100.0%
		% within agroforestry adoption intensity	100.0%	100.0%	100.0%
		% of Total	59.0%	41.0%	100.0%

Source: Field data 2008

The data collected on the role of NGOs and GOs indicated that majority of the respondents (71%) did not know any such organizations working on agroforestry promotion in the area. However, of the 27%, who knew such organizations 17 respondents (63%) were intensive agroforestry adopters. This indicated that though there were numerous GOs and NGOs promoting agroforestry in the area, majority of the local people were not aware of them. This suggested non-involvement of the local

people in such initiatives. However, of the few that knew them, majority practiced intensive agroforestry. Table 15 below presents a summary relationship between the presence of GOs and NGOs and agroforestry adoption intensity.

Table 16

Presence of GOs or NGOs on agroforestry * agroforestry adoption intensity Crosstabulation

			agroforestry adoption intensity		
			below 1000 trees	1000 trees and above	Total
Presence of GOs or NGOs on agroforestry	yes	Count	10	17	27
		% within Presence of GOs or NGOs on agroforestry	37.0%	63.0%	100.0%
		% within agroforestry adoption intensity	17.5%	41.5%	27.6%
		% of Total	10.2%	17.3%	27.6%
	no	Count	47	24	71
		% within Presence of GOs or NGOs on agroforestry	66.2%	33.8%	100.0%
		% within agroforestry adoption intensity	82.5%	58.5%	72.4%
		% of Total	48.0%	24.5%	72.4%
Total		Count	57	41	98
		% within Presence of GOs or NGOs on agroforestry	58.2%	41.8%	100.0%
		% within agroforestry adoption intensity	100.0%	100.0%	100.0%
		% of Total	58.2%	41.8%	100.0%

Source: Field data 2008

In Shibuye Location, community projects played a vital role in promoting agroforestry among farmers. Community projects revolved around coming together of farmers who formed village projects. The village projects came together to form an umbrella community organization which promoted agroforestry in the whole of the District.

Another role of these community projects was to ensure protection of the Kakamega forest which was done through planting and care of trees in the forest. According to Samwel Kutwa of Jitegemee Self help Group, Kakamega Community Forest Association (KACOFA), which is a conglomeration of several self help groups, had greatly helped local farmers in agroforestry practices. Prominent agroforestry farmers such as Gabriel Tendwa, Joseph Muliro and Thomas ingaso (refer to photos in the appendix taken and printed with respondents consent) had benefited from such local initiatives. Another important local initiative was that of the establishment of Isukha Heritage (a local NGO). According to the Chairman Mr. Mathew Marende, the local NGO had been on the front line in promoting agroforestry not only through education but also through provision of seedlings to farmers and institutions. Other community initiatives that had played a vital role in promoting agroforestry included Kakamega Environmental Education Programme (KEEP) and Biodiversity Analysis Transect for Africa (BIOTA)- East Kakamega forest initiatives

Culture as an institution played a vital role in agroforestry practice among the people of Shibuye. The people of this location belong to a Luhya sub-group known as the Isukha people. Trees had a lot of cultural meaning hence there were cultural issues that related to tree planting. The role of culture was examined through asking if traditional rules and beliefs affected agroforestry practice where; 1 indicated "yes" and 2 indicated "no". According to this study cultural issues included, traditional rules, beliefs and practices. One traditional rule in relation to agroforestry was that, women were not allowed to plant trees. This rule was strictly followed and hence women were not allowed to plant trees hence only men could do so. Some beliefs of tree planting beliefs mostly revolved

around the planting of indigenous trees where most indigenous trees were not planted around the homestead for fear of bad omen. Though culture was found to play a vital role in agroforestry practice it was not found to influence the intensity of the practice. At the same time, the intrinsic meaning of the cultural beliefs, rules and practices was not examined in this study.

4.4 Analysis of the socio-economic factors influencing agroforestry adoption intensity among farmers.

The previous sections of the chapter presented a discussion of the findings in relation to the characteristics of the households and the various socio-economic factors in relation to agroforestry adoption intensity. This section further gave a detailed analysis of these factors according to the model specification presented for analysis in (section 3.5.1).

4.4.1 Multinomial logistic regression analysis of the socio-economic factors determining the agroforestry adoption intensity.

A multinomial analysis of various household, social and economic factors was done to ascertain their effect on the choice between intensive and non-intensive agroforestry practices.

The functional relationship estimated was given as:

$A_i = f(X_j, Y_k)$

A_i is a dichotomous dependent variable where;

A_i =0 if intensive agroforestry was chosen

= 1 if non-intensive agroforestry was chosen.

The independent variables were defined as follows:

AGE1	actual age of the household head in years
AMTININC2	Amount of off-farm income in Ksh
EDUCTION	The level of education of the household head measured in – no education, primary level, secondary level and university/college level
SEX	Gender, 1 if male and 2 if female
FMINCOM2	Actual amount of farm income in Ksh.
PLOTS2	Actual number of farm plots owned
FAMLABR2	Actual number of family labour
RULES	Regulations on agroforestry, 1 if "yes", and 2 if "no".
BELIEFS	Traditional beliefs on planting of trees, as a dummy variable where, 1 if "yes" and 2 if "no".
LANDSIZ2	Actual land size in acres
PRJTAF	Availability of projects on agroforestry, measured as a dummy variable where, 1 if "yes" and 2 if "no".
GONGO	Availability of GOs or NGOs working on agroforestry, as a dummy variable where, 1 if "yes" and 2 if "no".
AMTFINC2	Amount of off-farm income in Ksh
PROBS	Problems experienced by farmers in agroforestry practice measured as a dummy variable in whether farmer experienced problems or not

SUBLOCAT Sub-location measured in locations near the forest (*Virhembe and Mukhango)* and locations away from the forest (*Shiasaba, and Shingodo).*

In this analysis, X_j represented independent household variables namely, age of the household head, gender of the household head, level of education, family labour (persons available for farm work in the household), amount of farm income, amount of off-farm income, and farm size (in acres). Y_k represented independent explanatory institutional variables namely, presence of extension services, agroforestry projects in the area, and the presence of GOs and NGOs and the role of culture. The results of this analysis are presented as model 1 below:

Model 1

Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	20.597			
Final	.000	20.597	12	.057

Pseudo R-Square

Cox and Snell	.702
Nagelkerke	1.000
McFadden	1.000

Likelihood Ratio Tests

Effect	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	.000[a]	.000	1	1.000
AGE1	.000[a]	.000	1	1.000
AMTFINC2	.000[a]	.000	1	1.000
EDUCTION	.000[a]	.000	1	1.000
SEX	.000[a]	.000	1	1.000
FMINCOM2	.000[a]	.000	1	1.000
PLOTS2	.000[a]	.000	1	1.000
FAMLABR2	.000[a]	.000	1	1.000
RULES	.000[a]	.000	1	1.000
BELIEFS	.000[a]	.000	1	1.000
LANDSIZ2	.000[a]	.000	1	1.000
PRJTAF	.000[a]	.000	1	1.000
GONGO	.000[a]	.000	1	1.000

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

a Maximum number of iterations were exceeded, and the log-likelihood value and/or the parameter estimates cannot converge.

Parameter Estimates

agroforestry adoption intensity		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
below 1000 trees	Intercept	13.420	423824.2	.000	1	1.000			
	AGE1	-.621	10549.853	.000	1	1.000	.538	.000	[a]
	AMTFINC2	-1.24E-04	.375	.000	1	1.000	1.000	.479	2.086
	EDUCTION	-8.443	90867.580	.000	1	1.000	2.155E-04	.000	[a]
	SEX	18.573	81131.867	.000	1	1.000	1.2E+08	.000	[a]
	FMINCOM2	8.452E-04	4.313	.000	1	1.000	1.001	2.132E-04	4697.769
	PLOTS2	3.302	107293.3	.000	1	1.000	27.160	.000	[a]
	FAMLABR2	7.102	11677.054	.000	1	1.000	1214.780	.000	[a]
	RULES	12.297	69852.941	.000	1	1.000	219026.3	.000	[a]
	BELIEFS	3.897	45479.286	.000	1	1.000	49.237	.000	[a]
	LANDSIZ2	-9.894	27722.229	.000	1	1.000	5.047E-05	.000	[a]
	PRJTAF	15.393	167346.7	.000	1	1.000	4841016	.000	[a]
	GONGO	-20.900	212748.2	.000	1	1.000	8.384E-10	.000	[a]

a. Floating point overflow occurred while computing this statistic. Its value is therefore set to system missing.

Source: Computed from field data 2008

A reduced model is presented below where some of the variables considered not influential were dropped from the model above, while others were included to note the changes. The variables dropped in the second model included, SEX, FMINCOM2, RULES, BELIEFS. According to the descriptive statistics, these variables did not seem to influence agroforestry adoption intensity and thus were dropped in the second model. The variable added was LANDTOPO. This was because, descriptive statistics indicated that agroforestry adoption intensity was more intensive in sloppy topography compared with flat topography.

Model 2

Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	94.477			
Final	52.242	42.235	9	.000

Pseudo R-Square

Cox and Snell	458
Nagelkerke	.614
McFadden	447

Likelihood Ratio Tests

Effect	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	54.960	2.718	1	.099
AGE1	54.281	2.039	1	.153
AMTFINC2	58.569	6.327	1	.012
EDUCTION	57.848	5.606	1	.018
LANDSIZ2	53.162	.920	1	.337
PLOTS2	53.308	1.066	1	.302
LANDTOPO	52.365	.123	1	.726
FAMLABR2	52.508	.266	1	.606
PRJTAF	53.268	1.025	1	.311
GONGO	52.619	.377	1	.539

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

Parameter Estimates

agroforestry adoption intensity		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
below 1000 trees	Intercept	4.519	2.889	2.446	1	.118			
	AGE1	-4.32E-02	.031	1.889	1	.169	.958	.900	1.019
	AMTFINC2	-4.36E-04	.000	4.003	1	.045	1.000	.999	1.000
	EDUCTION	-.964	.467	4.255	1	.039	.381	.153	.953
	LANDSIZ2	.149	.234	.404	1	.525	1.161	.733	1.838
	PLOTS2	-.413	.452	.834	1	.361	662	.273	1.605
	LANDTOPO	.151	.433	.122	1	.727	1.163	.498	2.717
	FAMLABR2	-7.41E-02	.143	.267	1	.605	.929	.701	1.230
	PRJTAF	.887	.871	1.037	1	.308	2.427	.441	13.373
	GONGO	.608	.980	.384	1	.535	1.836	.269	12 543

Source: Computed from field data 2008

A final model was derived where the variables, AGE1, EDUCTION, AMNTFINC2, PROBS and SUBLOCAT were analyzed. The variables PROBS and SUBLOCAT were included as the descriptive statistics indicated that, more non-intensive agroforestry adopters experienced problems compared with intensive agroforestry adopters. On the other hand, there were more intensive agroforestry adopters in some sub-locations compared to others.

Thus the final model derived from the analysis was presented as:

$A_i = f$(actual age of farmer in years, the level of education, amount of off-farm income, the problems experienced and the locality of the farmer).

The results of this analysis are presented below:

Model 3 – Final model

Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	94.477			
Final	41.589	52.888	5	.000

Pseudo R-Square

Cox and Snell	.535
Nagelkerke	.718
McFadden	.560

Likelihood Ratio Tests

Effect	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	79.506	37.917	1	.000
AGE1	47.969	6.380	1	.012
AMTFINC2	61.932	20.343	1	.000
EDUCTION	49.390	7.801	1	.005
PROBS	47.622	6.033	1	.014
SUBLOCAT	51.955	10.366	1	.001

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

Parameter Estimates

agroforestry adoption intensity		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
below 1000 trees	Intercept	17.154	5.045	11.560	1	.001			
	AGE1	-7.93E-02	.035	5.240	1	.022	.924	.863	.989
	AMTFINC2	-9.76E-04	.000	7.979	1	.005	.999	.998	1.000
	EDUCTION	-1.311	.583	5.052	1	.025	.270	8.595E-02	.846
	PROBS	-.366	.167	4.788	1	.029	.693	.499	.963
	SUBLOCAT	-1.556	.608	6.552	1	.010	.211	6.410E-02	.695

Source: Computed from field data 2008

This model was appropriate as all the variables were statistically siginificant at less than 5%. This implied that all the variables included in this final model were relevant in explaining the choice between intensive and non-intensive agroforestry practices among farmers.

The model obtained a McFadden statistic of 0.56. This shows that the model derived was good and statistically acceptable as it explained more than half of the model's choices.

The analysis excluded some factors indicated as determinants of adoption intensity in the descriptive statistics, namely, land size, number of plots, gender and extension services.

The model indicated that the variables: actual age of the household head, level of education, amount of off-farm income, the problems experienced by the farmer and the locality (sub-location) of the farmer had influence on the choice between intensive and non-intensive agroforestry practice where the decision rule was established at 5% significant level. This was the best model derived from the multinomial regression analysis as other factors such as land size, number of plots, gender, and institutional characteristics did not seem to explain the choice between intensive and non-intensive agroforestry practices.

The results of the parameter estimates established the magnitude, direction and the level of significance for each variable analyzed. The significant statistic was used to determine significance of the estimated parameters for each explanatory variable.

The coefficient of AMTFINC2 was negative and statistically significant at 0.5%. The negative coefficient indicated that falling off-farm incomes encouraged farmers to practice non-intensive agroforestry as they could not purchase the inputs required for intensive agroforestry. Although descriptive statistics indicated that there were more

non-intensive agroforestry adopters who had off-farm income compared to intensive agroforestry adopters, the intensive adopters seemed to have more off-farm income compared with non-intensive adopters. Thus a farmer with more amount of off-farm income practiced intensive agroforestry as the farmer could afford the required inputs such as fertilizer, seedlings, planting tubes as well as hiring of outside family labour with the off-farm income.

The parameter estimates of the variable SUBLOCAT indicated a negative coefficient and was statistically significant at 1%. The analysis showed that agroforestry adoption intensity varied with sub-locations. The analysis results implied that farmers in particular sub-locations were inclined to intensive agroforestry compared to others. According to the District Forestry Extension Officer, the Farmers in *Mukhango* and *Virhembe* Sub-locations benefited more from Community Forestry Integrated Activities (CFIA) compared to the other sub-locations such as *Shiasaba* and *Shingondo* which were further from the forest. This was also confirmed by *Samwuel Kutwa* one of the community leaders of Kakamega Community Forestry Association (KACOFA).

The parameter estimates for the variable AGE1 had a coefficient with a negative sign and was statistically significant at 2.2%. Thus the age of the farmer significantly influenced the intensity of agroforestry adoption. The analysis indicated that older farmers were more likely to practice intensive agroforestry compared with younger ones. This affirms the descriptive statistics which indicated that, there were more older farmers who practiced intensive agroforestry compared to younger ones. As discussed this could be influenced by land ownership characteristics, which in turn influenced land use decisions among which includes tree planting decisions.

The parameter estimates for the variable EDUCTION was also negative and statistical significant at the 2.5% level. Thus the level of education significantly influenced the probability of the farmers' choice of agroforestry adoption intensity. The results of the analysis therefore indicated that, farmers with low levels of education were not inclined to practicing intensive agroforestry. The implication was thus that, education was an important component in the adoption of agroforestry as farmers with higher levels of education could apply appropriate knowledge and skills in the practice of agroforestry. This confirmed the descriptive statistics which indicated that the level of education determined the choice of intensity of agroforestry practice.

The coefficient of the variable PROBS was also negative statistically significant at the 2.9% level. The analysis thus indicated that the types of problems experienced by farmers influenced the intensity of agroforestry adoption. The implication of this finding was that problems such as, insufficient land, insufficient inputs, insufficient labour and other problems such as weather problems and diseases negatively influenced the agroforestry adoption intensity. A farmer who experienced more problems in agroforestry practice chose to abandon intensive agroforestry and turned to non-intensive agroforestry.

4.5 Summary of the respondents' views and recommendations

The study indicated that the people of Shibuye location highly valued trees as they were important in every day use. Most views of the respondents revolved around issues which would encourage farmers to plant more trees in their farms as well as issues on how to solve problems which hinder agroforestry practice. Most respondents (44%)

indicated that trees were important in social and economic lives of the people as they were a source of income, firewood and it was a source of rain. Other views that related to this therefore indicated the need for the farmers to plant more trees in their farms. It was also indicated that farmers were concentrating more on exotic trees and ignoring the indigenous trees which were equally good and economical. On enforcement of agroforestry by relevant authorities, it was indicated that corruption contributed to deforestation in high rates.

In the light of the above views, the recommendations suggested by respondents were:

- Need to educate farmers by organizing education forums
- Need to provide farmers with necessary inputs such as seedlings, fertilizer and planting tubes.
- Need to have extension officers who could visit farmers in their farms and
- Need to have a clear policy on agroforestry.

Tables 17 and 18 below presents summary frequency of the views of the respondents on agroforestry and recommendations given by respondents respectively.

Table 17

Farmers views on agroforestry

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	trees are important eg source of rain, income	44	44.0	44.4	44.4
	People in the area and also sell	17	17.0	17.2	61.6
	Enforce more on tree planting	17	17.0	17.2	78.8
	agroforestry is not wide Spread	4	4.0	4.0	82.8
	agroforestry contributes in environmental Conservation	5	5.0	5.1	87.9
	farmers should be encouraged to plant indigenous trees also	10	10.0	10.1	98.0
	agroforestry prevents forest destruction	2	2.0	2.0	100.0
	Total	99	99.0	100.0	
Missing	System	1	1.0		
Total		100	100.0		

Source: Field data 2008

Table 18

Farmers recommendations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	government should support farmers with inputs	22	22.0	22.0	22.0
	Enlighten more on tree planting eg trhough barazas	31	31.0	31.0	53.0
	enforce laws on tree planting and cutting	7	7.0	7.0	60.0
	prevent the cutting of trees from the forest	1	1.0	1.0	61.0
	reintroduce tree planiting days to encourage agroforstrt	2	2.0	2.0	63.0
	remove cultural hinderances, eg women to be allowed to plan	4	4.0	4.0	67.0
	extension officers should visit and advise farmers	13	13.0	13.0	80.0
	inputs should be availed eg tubes, fertilizers etc	5	5.0	5.0	85.0
	people should start own nurseries to reduce cost	2	2.0	2.0	87.0
	introduce quick growing varieties of trees	4	4.0	4.0	91.0
	Enhance market for tree products	5	5.0	5.0	96.0
	formation of govt sponsored groups to assist farmers	2	2.0	2.0	98.0
	control the sale of trees - this will affect the enviornment	2	2.0	2.0	100.0
	Total	100	100.0	100.0	

Source: Field data 2008

CHAPTER 5

5.0 CONCLUSIONS AND RECOMMENDATIONS

This chapter presents a brief summary of the findings which were presented in the light of the research question and hypotheses. The study aimed at determining the socio-economic factors which influence agroforestry adoption intensity among farmers in Shibuye location in Kakamega-East District. The site chosen for the study was appropriate given the underlying motives for the promotion of agroforestry in the area, that is, the preservation and conservation of the Kakamega Forest in which two of the sub-locations bordered the forest.

5.1 Summary

The study thus indicated varying degrees of adoption whereby the researcher categorized them into two; Intensive agroforestry adoption and non-intensive agroforestry adoption, as determined by the number of trees a farmer had planted in his or her farm. The former applied to farmers who had planted and managed 1000 trees and above while the latter applied to farmers who had planted and managed below 1000 trees.

The study analyzed various variables and their influence on agroforestry adoption intensity and found that there were individual, social, economic and cultural factors that influence agroforestry adoption intensity among farmers in the study area.

The study, however, found out that different factors had varying influence, positively or negatively. Descriptive statistics were used to discuss various factors and the data

presented using cross-tabulations, frequency tables and charts. In addition, logistic regression models were employed in the analysis in order to emphasize on the factors found to prominently influence agroforestry adoption choice among farmers.

5.1.1 Factors influencing adoption intensity among farmers

Individual personal characteristics

Among the individual personal characteristics analyzed, age was the only variable that was indicated as influencing adoption intensity among farmers. The study indicated that there were older farmers who practiced intensive agroforestry compared to younger ones. The logistic regression analysis also indicated that age significantly influenced adoption intensity. Other information derived indicated that age was a major factor in determining adoption intensity as it influenced other variables such as land ownership and land use decisions. Tree planting thus revolved around who owned land and who made decisions on how land was to be used. The older generation seemed to have more control over land.

The effect of education

The study found out that the level of education significantly influenced adoption intensity. The descriptive statistics indicated that majority (75.6%) of the intensive agroforestry adopters had secondary level education or some professional training. The logistic regression analysis also revealed that education was a significant determinant of agroforestry adoption intensity among farmers.

The effect of family labour

Although literature presented family labour as an important factor of production in agricultural activities among rural communities, the study found out that it did not influence agroforestry adoption intensity. The descriptive statistics as well as the logistic regression analysis indicated no significant relationship between family labour and agroforestry adoption intensity.

The effect of land size, topography and ownership.

The study indicated that majority (75%) owned 3 acres of land and below. The study also indicated that the difference between intensive adopter and non-intensive adopters in terms of land size was negligible (7.4%) as 53.7% of the intensive adopters owned four acres of land and above and 46.3% of the intensive adopters owned 3 acres of land and below. Though descriptive statistics revealed that there were more intensive adopters who owned larger pieces of land, the logistic regression model indicated that agroforestry adoption intensity did not vary with land size as hypothesized. On the other hand, land topography was found to influence agroforestry adoption intensity as indicated by descriptive statistics. On the other hand, the analysis of land ownership characteristics indicated that, there were more intensive agroforestry adopters who owned extra private land in addition to family land compared to non-intensive adopters. This was seen to increase the resource base for investment in agroforestry.

The effect of off-farm income

The descriptive statistics revealed that there were more non-intensive adopters who had off-farm income compared to the intensive adopters. However, intensive adopters tended to have more off-farm income compared with non-intensive adopters. This

indicated that, agroforestry adoption intensity varied with off-farm income. The logistic regression analysis also indicated that off-farm income significantly influenced agroforestry adoption intensity.

The effect of institutions

The institutions analyzed in this study included; the role of extension services, community projects in the area, the role of NGOs and GOs and the effect of culture in agroforestry. The descriptive statistics indicated that, the role of institutions in agroforestry was limited. Majority of the respondents indicated that there were limited extension services in the area. However, majority (85%) of those who had been visited by an extension officer in their farms were intensive adopters. Most farmers indicated that the visit by extension officers was mainly done on request by farmers.

At the same time, majority (71%) of the respondents did not know any NGOs or GOs promoting agroforestry in the area. As in the case of extension services, most of those who knew some of the NGOs and GOs promoting agroforestry in the area were intensive adopters. The main NGOs promoting agroforestry in the area were Christian Agricultural Related Professionals Association (CARPA), Isukha Heritage and International Centre for Insect Physiology and Ecology (ICIPE).

On the other hand, the main GOs that promoted agroforestry in the area included Kenya Forestry Research Institute (KEFRI) and Kenya Agricultural Research Institute (KARI).

5.1.2 Summary of problems, views, and recommendations

Problems

The major problems experienced by farmers included: insufficient land, lack of proper inputs such as fertilizer, seedlings and planting tubes. Other problems indicated included, lack of an established market for tree products, theft of trees and destruction of young seedlings by rodents and other animals. The problems that farmers experienced were indicated to influence agroforestry adoption intensity. The final model derived from logistic regression analysis indicated that the problems experienced by farmers significantly influenced the intensity of adoption as the various nature of problems experienced de-motivated farmers to planting more trees.

Views

The major views of farmers revolved around the realization of the importance of agroforestry in the area. Some main views included; the need for farmers to plant more trees, the social, economic and cultural importance of trees and what promotes or hinders farmers from practicing agroforestry.

Recommendations

Given the main problems and views of farmers, the main recommendations rotated around solving of the problems and fulfillment of the aspirations of farmers in the practice of agroforestry. The main recommendations included: Provision of necessary inputs such as seedlings, planting tubes and fertilizers, improvement of the role of extension officers in order to advice farmers on agroforestry techniques and skills, market enhancement and control in order to protect farmers from exploitation by wood traders..

5.2 Conclusions

The study affirmed that though farmers in Shibuye location widely adopted agroforestry practices, there existed varying degrees of adoption; intensive agroforestry adoption and non-intensive agroforestry adoption. The study analysed the various factors which influenced agroforestry adoption intensity in the study area and reached the following conclusions:

Agroforestry adoption did not vary with land size, land topography or landownership as hypothesised. The also study revealed that there were various forms of agroforestry practiced by farmers. These were seen to depend on factors such as land size and off-farm income. Farmers with larger pieces of land and more off-farm income diversified the forms of agroforestry they practiced compared with those who had smaller pieces of land and less off-farm income. Such farmers with larger pieces of land and more off-farm income diversified the forms of agroforestry by planting trees in woodlots, farm borders, inside the farm with other crops as well as around the homestead. On the other hand, farmers with smaller pieces of land and less off-farm income limited their forms to planting trees on the borders and around the homestead or homestead and on farm borders only. According to key informants interviews and observations in the field, the forms of agroforestry practiced by farmers varied with resource base. At the same time, the uses of trees by farmers varied greatly. Those who planted trees for commercial purposes had planted trees as woodlots while those who planted trees for home consumption planted trees on borders, around the homestead and on river beds. Thus the forms of agroforestry practiced by farmers also varied with livelihood strategies.

In addition the study found out that the age and level of education of the household head significantly influenced agroforestry adoption decision. The results of the logistic regression analysis indicated that age and education level of the farmer significantly influenced the choice of agroforestry adoption intensity.

In summary, the socio-economic factors found to influence agroforestry adoption and choice of intensity include: age, the level of education of the household head, the amount of off-farm income, the nature of problems experienced by the farmer in agroforestry practice and the administrative sub-location where the farmer lived.

5.3 Policy Recommendations

The study came up with the following recommendations:-

1. There is need to educate farmers on the importance of agroforestry in natural resource management.
2. The role of extension officers should be revitalized to ensure that farmers are correctly advised on agroforestry techniques.
3. There is need to come up with community agroforestry projects whereby the community land could be set aside for agroforestry. This will ensure increased community responsibility in agroforestry practice.
4. There is need for the government to provide farmers with the necessary farm inputs which would motivate them to plant more trees in their farms.
5. There is need for a concrete Agroforestry Policy in the Country which would guide the relevant officials in promoting agroforestry among farmers.

5.4 Areas for further research

Though agroforestry is an age old practice, there is need to conduct more research on the role of culture in agroforestry. The study found out that there were cultural traditions, rules and beliefs which revolve around tree planting but were not further pursued by the study. There is need to understand the inter-relationship which exists between culture and agroforestry among African communities. There is also need to explore community agroforestry practice. Most studies have focused on the farm household as the unit of analysis. Community agroforestry practices among rural communities should be further explored since it may play a major role in increasing the size of forest cover which is steadily diminishing.

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APPENDIX 1

Questionnaire

General information

Date of the interview_____

Name of the sub-location _____

Household identification number _____

Interviewer: _____

Background information

1. Sex of the respondent
   a. Male ( )
   b. Female ( )
2. Age of the respondent_____(years)
3. Marital status
   a. Single ( )
   b. Married ( )
   c. Widowed ( )
   d. Separated/divorced ( )
4. What is your education level?
   a. No education ( )
   b. Informal education ( )
   c. Primary level ( )
   d. Secondary level ( )
   e. University/ college ( )
5. How many people are available for farm work in your household, including yourself? _____(persons)
6. Do you experience farm labour shortage in your household
   a. Yes ( )
   b. No ( )
7. What activities do you carry out in your farm?
   a. Crop growing only ( )

b. Livestock rearing only ( )

c. Crop growing and livestock ( )

d. Tree growing ( )

e. Crop growing, livestock rearing and tree growing( )

f. Other (specify)_____

8. Do you grow crops in your farm

a. Yes ( )

b. No ( )

9. If yes, Specify

_____

_____

Do you keep livestock in your farm?

a. Yes ( )

b. No ( )

10. If Yes, which ones,?

_____

_____

11. How is land owned in your village?

a. Private ( )

b. Communal ( )

c. Other(specify)_____

12. Who makes most decisions on land use in this household?

a. Male (husband) ( )

b. Female (wife) ( )

c. Both (husband and wife ( )

d. Other (Specify) _____

13. Who makes decisions on tree planting activities in this household?

a. Male (husband) ( )

b. Female (wife) ( )

c. Both (husband and wife) ( )

d. Husband, wife and children ( )

e. Other (specify)_____

14. How many farm plots do you have?_____(plots)

15. What is the field setting of your plots?

a. Consolidated into single block ( )

b. Separated ( )

16. What is the estimated total area (in acres) of your entire farm plot(s)?

_____(acres)

17. What is the estimated proportion of the total land cultivated every season?

a. Entire land ( )

b. Half portion ( )

c. Less than half ( )

d. More than half ( )

18. How did you acquire the land for the plots above?

a. Given by village leaders ( )

b. Bought ( )

c. Inherited from family ( )

d. Hiring basis ( )

e. Other (specify)_____

19. What is the topography of your farm plot(s)?

a. flat land ( )

b. sloppy land ( )

c. valley bottom ( )

20. Do you get surplus farm produce for sale in the market?

a. Yes ( )

b. No ( )

21. If yes, what do you sell?

a. Crops ( )

b. Livestock products ( )

c. Tree products ( )

d. Crops, livestock and tree products ( )

e. Other (Specify)_____

22. What is the estimated monthly income from your farm (in Ksh, 000)?

_____(Ksh)

23. Do you have another source of income apart from farming (off-farm income)?

a. Yes ( )

b. No ( )

24. If yes, what is the source of the income?

a. Formal employment ( )

b. Casual labour ( )

c. Remittances ( )

d. Other (specify)_____

25. Specify the total amount of off-farm income above (in Ksh ,000)

_____(Ksh)

Adoption of Agroforestry

26. Do you have trees/shrubs planted in your farm?

a. Yes ( )

b. No ( )

27. If yes what types of trees/shrubs have you planted?

_____

_____

_____

28. Where have you planted the trees/shrubs?

a. On farm borders ( )

b. Inside the farm with other crops ( )

c. On separate plot/portion (woodlots) ( )

d. On grazing field ( )

e. Around the homestead ( )

f. Other (specify) _____

29. Why do you plant trees/shrubs in your farm as specified above?

a. For supply of fuel wood ( )

b. For supply of fodder for livestock ( )

c. For supply of timber products ( )

d. For decoration and beauty ( )

e. For fruits/food ( )

f. For prevention of soil erosion ( )

g. Other (specify)_____

30. Where did you get the idea of planting trees together with other crops in your farm?

a. From extension officers(agricultural/environment/forestry) ( )

b. From village meetings ( )

c. From other farmers ( )

d. Other(specify)_____

31. When did you start planting trees in your farm?

_____

32. About how many trees have you planted and manage in your farm?_____trees

33. How do you use the trees/ shrubs in your farm?

a. Sell tree products ( )

b. Feeding of animals ( )

c. Wood fuel ( )

d. Source of food ( )

e. Other (specify)_____

34. Where do you get tree/seedlings for planting in your farm?

a. From extension officer (agricultural/environment/forestry)( )

b. Buying ( )

c. Friends/relatives ( )

d. Other (specify)_____

36. What problems do you experience in the practice of planting trees together with crops or livestock keeping?

_____

_____

Institutional characteristics

37. Is there any agricultural/environment/forestry extension officer serving in your village/area?

a. Yes

b. No ( )

38. If yes, how often does she/he visit you?

a. Rarely

b. Often

c. Very often ( )

39. Has the officer ever advised you on agroforestry practices?

a. Yes ( )

b. No ( )

40. If yes did you understand the advices that were given?

a. Yes ( )

b. No ( )

41. Is there any project in this area that supports farmers in growing of trees?

a. Yes ( )

b. No ( )

42. If yes, have you got any support in your field?

a. Yes ( )

b. No ( )

43. Are there any organizations (government or non-governmental) offering agroforestry extension services in this area?

a. Yes ( )

b. No ( )

44. If yes specify these organizations

_____

_____

45. Are there any bylaws concerning the cutting down of trees in this village?

a. Yes ( )

b. No ( )

46.If yes, what do(es) they/it state concerning agroforestry

_____

_____

47.How do you rate the performance of these bylaws in promoting agroforestry?

a. Effective ( )

b. Not effective ( )

48.If not effective, what should be done to make them more effective?

_____

_____

49.Are there any socio-cultural beliefs on tree planting or afforestation in this village?

a. Yes ( )

b. No ( )

50.If yes, specify these beliefs

_____

_____

51.How do you rate the performance of these rules in promoting agroforestry?

a. Effective ( )

b. Not effective ( )

52.If not effective, how can they be made more effective?

_____

_____

53.What are your views on agroforestry practice in this area?

_____

_____

54.What are your recommendations to improve agroforestry practice in this area?

_____

_____

End, Thank you for your cooperation.

APPENDIX 2

Checklist for Key informant interview with District Environment/forest/agricultural officers.

1. For how long have you worked in the district as a .....
2. For how long has agroforestry been promoted in the district?
3. What are the current agroforestry extensions approaches being used in the area (Shibuye) location?
4. For how long has agroforestry been promoted in this area?
5. What was the target group in the promotion of agroforestry in the area?
6. What are the systems of agroforestry that have been promoted?
7. Which are the systems widely adopted by farmers, and for what reasons?
8. What are the tree species/ types of preferred by farmers, and for what reasons?
9. Why do some farmers fail to adopt agroforestry practices?
10. What are the benefits of agroforestry in this area?
11. What extension approaches do you think are appropriate in promoting agroforestry in this area
12. What constraints do you face in implementing agroforestry extension work?
13. What do you recommend to be done for the success of agroforestry practices in this area?
14. How do you compare agroforestry practices in the district and where you have worked before?
15. What are your recommendations relating to promotion of agroforestry in the area?

End; **thank you for your cooperation!**

APPENDIX 3

Checklist for key informant interviews with community leaders- (sub-chiefs).

1. Is there any agricultural/environment/ forestry work in your area of governance?
2. What activities does (do) he/they promote?
3. Has there been any government involvement in afforestation activities in this village?
4. If yes what type of involvement?
5. Are there any NGOs involved in afforestation in this area?
6. If yes how have they been involved?
7. Are there any projects which promote agroforestry in this area?
8. Who has been the target group in the promotion of agroforestry in this area?
9. In your opinion, is agroforestry widely adopted by farmers in this area?
10. What are the main reasons for the current rates of adoption?
11. Does the village have any bylaws relating to agroforestry and afforestation?
12. If yes, what do they advocate?
13. How do you rate its effectiveness in achieving what they are intended?
14. Is there any committee in the village government concerned with afforestation or agroforestry
15. If yes, what are its main roles?
16. What are the benefits of agroforestry to farmers in this area?
17. What constraints do farmers face in adopting agroforestry practices in this area?

End of the interview; thank you for your cooperation.

APPENDIX 4

Checklist for NGOs and CBO

1. What is your involvement in the promotion of agroforestry in the area?
2. For how long has your organization been involved in agroforestry work in the area?
3. How do you rate agroforestry practices in the area?
4. What challenges do farmers face in agroforestry practice?
5. How are you involved in helping farmers in solving these problems?
6. What is the future of agroforestry practice in the area?
7. What are your recommendations regarding agroforestry practices and promotion in this area?

End, Thank you for your cooperation.

APPENDIX 5

Photos

Trees planted on farm borders

Trees planted along the river bed

Traditional eucalyptus intercropped with maize

Imported Eucalyptus intercropped with maize and beans

Indigenous trees woodlot

Indigenous trees intercropped with other crops

Trees on a pasture land

Eucalyptus woodlot

A community leader explains about community tree nursery

Mr Joseph Muliro - A prominent agroforestry farmer in his tree

Mr. Thomas Ingaso - A prominent agroforestry farmer in his tree

Mr Thomas Ingaso explains about fodder tree known as *Calliandra*

Mr. Mathew Marende explains to research assistant, Silvia, about traditional herbal trees

Mr. Gabriel Tendwa - A prominent agroforestry farmer in his farm

One of the BIOTA workers in the Kakamega forest tree planting program

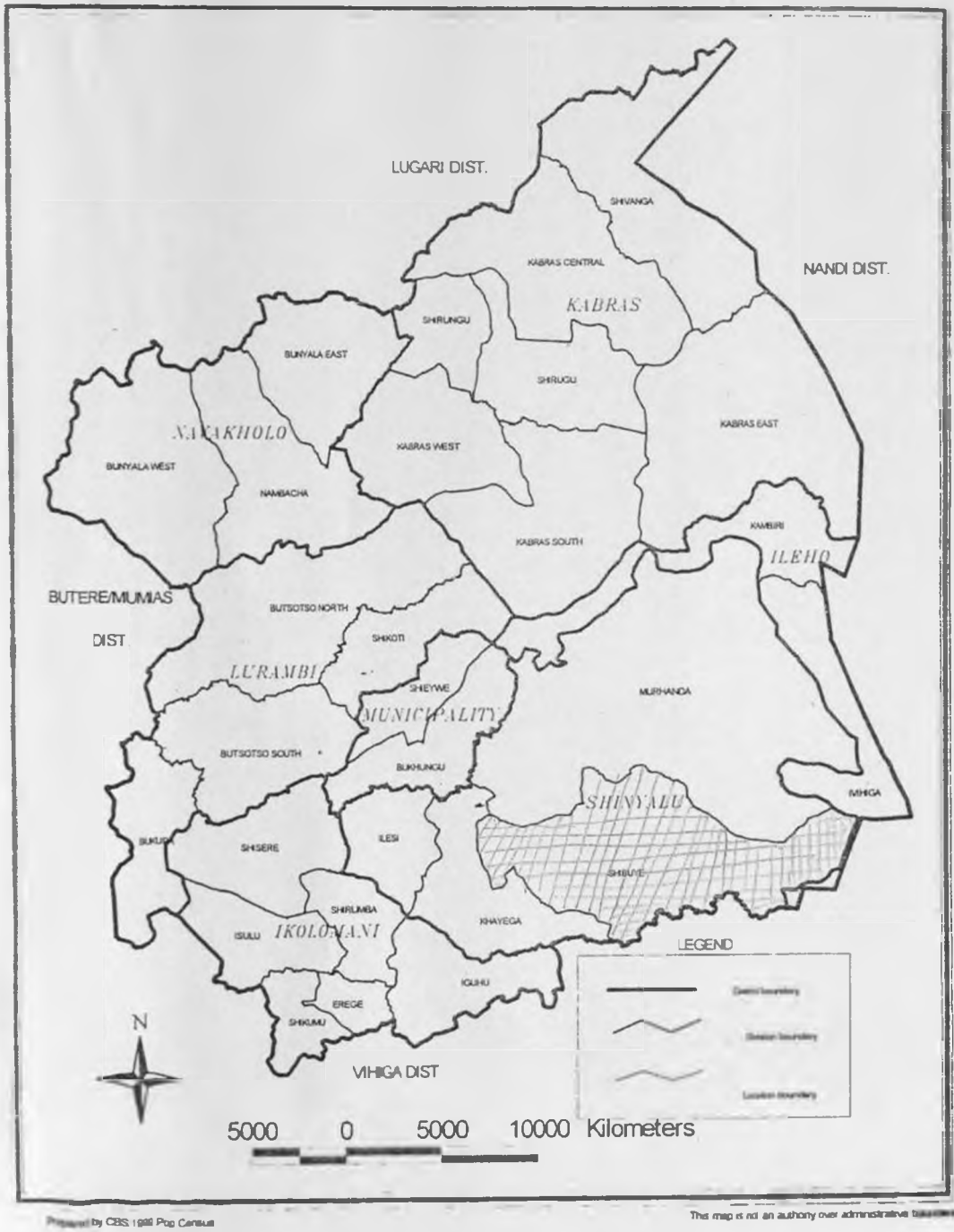
Mr. Samuel Kutwa of KACOFA in the community tree nursery

Mr. Mathew Marende explains about Isukha Heritage agroforestry initiatives

Mr. Gabriel Tendwa - A prominent tree trader at his farm

APPENDIX 6

KAKAMEGA DISTRICT: Administrative boundaries



Prepared by CBS 1999 Pop Census

This map is not an authority over administrative boundaries