ASSESSMENT OF FACTORS INFLUENCING UTILIZATION OF FOREST RESOURCES IN KIPINI DIVISION OF TANA DELTA DISTRICT, KENYA

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DECLARATION AND APPROVAL

This thesis is my original work and has not been presented for any degree in any other University

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ABSTRACT

Forest resource utilization poses a major challenge to the balance between fragile ecosystems and impoverished populations. Many developing economies have majority of their populations living in rural areas where they mainly depend on agriculture or on natural resources and ecosystem services for a living. With the increase in population,the demand for the forest resources and the resultant degradation are expected to increase. Many benefits can be derived from forest conservation initiatives including carbon offsets, seedlings sale and reduction in distances covered to access raw material for wooden handcrafts. Yet incidences of forest destruction by local communities are very common. This study examined the awareness of forest benefits, factors that influence utilization of forest products and attitudes of households towards conservation of forests. The analysis was conducted using different regression models. The Zero Truncated Poisson model was used to assess awareness of forest benefits while the Logit and Negative binomial models were used to examine use and intensity of use of forest products respectively. Descriptive and factor analysis methods were used to assess the attitudes of local communities towards forest conservation. The study used data collected from 150 households through personal interviews using pre-tested questionnaires. The study was conducted in Kipini division of Tana Delta district. The division has three types of forest management regimes namely, private conservancy, community and government or, more specifically, the Kenya Forest Service (KFS). The study finds average level of awareness of both direct and indirect forest benefits. Results indicate that awareness of benefits was highest in the KFS regime. The Zero Truncated Poisson regression results show that income, gender, farm size and management regimes influence awareness of forest benefits. The proportion of the respondents using products from the forest was 51%. Logistic regression results show that income, distance to the main road, regime and the occupation of the household head influence use of forest products while results from

Negative Binomial regression showed that intensity of use of forest products is influenced by regime, occupation of the household head, income and distance to the main road. Lastly, the results of the descriptive and factor analysis indicate that the local community has negative attitude towards conservation of the forests across the three regimes. The implication of the findings is that forest conservation can be enhanced by; (i)creating awareness of the direct and indirect benefits of forest conservation using easy to understand approaches such as educational tours, introduction of school clubs such as 4K clubs, model/demonstration farms, and promotional products and training (e.g. energy saving jikos); (ii) investing in infrastructure, particularly all-weather roads that will open up the area to investment by other sectors that will in turn create multiplier effects; (iii) investing in sensitization and training on commodity value addition and access to credit for projects from micro-credit institutions and government initiated funds such as youth and women development enterprise fund that will generate extra income (iv) encouraging effective community policing and community forest associations (CFAs) to guard forest borders.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

CFA	Community Forest Associations
DDP	District Development Plan
EA	Ecosystem Approach
FAO	Food and Agriculture Organisation
FLR	Forest Landscape Restoration
ICT	Information Communication Technologies
IUCN	International Union for Conservation of Nature
KFS	Kenya Forest Service
KNBS	Kenya National Bureau of Statistics
KWS	Kenya Wildlife Service
LTRF	Lower Tana River Forest
ROK	Republic of Kenya
TDDP	Tana-Delta District Development Plan
UNEP	United Nations Environmental Program
WB	World Bank

CHAPTER 1
INTRODUCTION

1.0 Background information

Forest resource utilization poses a major challenge to the delicate balance between complex-fragile ecosystems in many developing countries. Forests in such economies are major sources of livelihood for the rural communities who depend on forest resources for fuel wood, construction material and livestock grazing, among others. The extraction of biomass in the form of forest products like timber, fuel wood and fodder alters wildlife habitat and constitutes one of the most important threats to forests and wildlife (Shaanker *et al.*, 2004). At the same time, increase in the populations of communities surrounding forests increases demand for the forest resources which in turn leads to increase in degradation. Other factors associated with the increase in forest degradation broadly include demographic, economic, institutional and technological factors (Rishi, 2003; Shankeer *et al*. 2004; Dolisca *et al*, 2007; FAO, 2009).

A number of strategies are being used to address the degradation of forests and other resources. These include focusing on products and services required locally and globally and strengthening local institutions by improving on the efficiency and accountability on public sector, transparency in market institutions and an informal sector that provide increased livelihood opportunities for the poor (FAO, 2009). At the same time, many policies and scientific approaches to forest management have been proposed. One such approach is the ecosystem approach (EA), defined as 'a strategy for the integrated management of land, water and living resources that promote conservation and sustainable use in an equitable way' (UNEP, 1992). This approach is currently the most widely used concept in environmental management. The second approach that has been used in the past to manage forests is the Forest Landscape Restoration (FLR). The FLR approach aims at regaining ecological integrity and enhancing human wellbeing in deforested or degraded

landscape. These approaches have considerably changed the management of forests from the initial state-led management to the involvement of more stakeholders including neighbouring communities, community organizations operating within the areas and other relevant state agencies. Consequently, these approaches have been referred to as community-based forest management approach (McDaniel 2003; Olsson *et al*.2004; Rishi, 2007).

Forest area in Kenya is estimated to be 6.2% of the total land (WB, 2012). Forest area is defined as land under natural or planted stands of trees at least 5m in-situ whether productive or not and excludes tree stands in agricultural production systems(such as fruit plantations and agro-forestry systems) and trees in urban parks and gardens.

Kenya has the most diverse type of forests among the countries of East Africa. The forests types range from the Coastal forests, the Montane forests, Western rain forest to the Dry zone forest (Wass, 1995). Contribution of forestry to Kenya's GDP was estimated at 1.1% and approximated to 15 billion Kenya Shillings (KNBS, 2010). This value does not, however, include benefits such as provision of intrinsic alternative values e.g. cultural, spiritual and heritage values as well as ecosystem services such as erosion control and biodiversity among others.

Kenya is currently facing major challenges in forest conservation. The rate of deforestation from 1990 to 2010 was estimated at 0.3% per annum (KNBS, 2010). The use of forest products, human settlement in forests and the subsequent farming activities has been rising over time. This has accelerated extraction of forest resources and resulted in destruction of the once pristine environments. This destruction has in turn interfered with wildlife habitats and led to loss of species of different trees and wildlife (Shankeer *et al*, 2003; Owino *et al*, 2008). It has also contributed to climate change, and has been associated with food shortages resulting from reduced rainfall (Peh *et al*, 2005).

Forests in Kenya fall under different management regimes with different legal status. Majority of the closed canopy forests (forest reserves) are managed by the Kenya Forest Service under the Ministry of Forestry and Wildlife Services. Some closed canopy forests also known as national parks/ national reserves are managed by the Kenya Wildlife Service. On the other hand forests under the trust lands are managed by the local county councils in the Ministry of Local Government holding the forests in trust for the local communities. Lastly, there are some forests that are managed by private individuals or organizations under private ownership.

The forests in Tana Delta are managed under three different regimes. The Kenya Forest Service (KFS) is responsible for managing the mangroves and the tropical forests outside the private conservancy. The local community is responsible for the management of forests that fall under trust land, but outside the private conservancy. Lastly, the Kipini Wildlife and Botanical Conservancy[1] managed forests under the conservancy. These different management regimes have set rules governing forest resource extraction and forest use.

The conservancy/private regime had the strictest rules governing access and extraction/withdrawal of resources. It did not allow neighbouring communities to extract any products from the forest. The KFS, on the other hand, allows communities in the neighbourhood access to the forest and extraction of products. However, the extraction of products is limited to dead tree parts and other non-tree products. Residents can also secure a licence to cut live trees for poles or timber. In the community management regime, however, extraction of forest products is allowed subject to permission from the administrative authorities who in turn usually consult with the community elders before allowing extraction. Hence, in the first two regimes, a licence/permit is required, while in the community regime consent from authorities is the main requirement. The extraction of products such as poles in

[1]The conservancy reverted to the government in November, 2010 and is currently managed by the Kenya wildlife service in collaboration with the Kenya Forest Service.

the community regime is limited to basic needs such as construction of a house by the family. Typically only 40 poles are allowed for a house and the construction must be done within a given duration to avoid wastage of poles.

1.1 Problem Statement

Forests play many important roles in the ecosystem. They provide direct benefits to communities around them and act as habitat for various plant and animal species. Tana delta forest is one of the most unique forests in Kenya. The forest is home to numerous plants and animal species. It is host to 350 bird species; endangered marine turtles; two endangered primates namely the Tana River Red Colobus and the Crested Mangabey monkey; hippopotamus; elephants and the Nile crocodile. There are also various fish species in the coastal waters and fresh water river and ponds. The forest patches are endowed with mangrove and tropical forests especially along the Tana River. The forests are therefore important to Kenya because they comprise lowland evergreen riverine tropical forest types which are rare in Kenya and even in Africa, due to its biodiversity (Karere *et al*, 2004 and Owino *et al*, 2008). Further, Witu forest, in Kipini Division has a great potential for eco-tourism. The forest does not exist as one continuous forest block but as several blocks with one main block in Kipini location and several other pocket forests of different sizes in Kilelengwani and Ozi locations. Some of the tourist attractions offered by the forest include birdlife, mollusks, crustacea and crocodiles.

Despite its significance, the Lower Tana River Forest (LTRF) complex currently faces serious threat. Settlement into the forest has increased significantly in the last one decade owing to a number of factors (Okello, 2011). New settlers clear the forest to make way for farming. At the same time the felling of trees for timber, building material, fuel wood and charcoal has increased with the increase in demand for these products (Muoria *et al*., 2002; Luke, 2005, Owino *et al* 2008). The resultant conflicts in land use between agriculture and

forestry, and the increased extraction of tree products have complicated the conservation of the LTRF complex.

Theoretically, households are expected to conserve forests if they are aware of the benefits of doing so. In particular, it is expected that awareness of the direct and indirect benefits of conserving the forests will affect how households utilize the forests. The attitude such households have towards conserving the forest is also expected to influence its utilization. Indeed past studies (Sekhar, 2003 and Arjunan *et al*., 2006) have found a link between attitudes and natural resources conservation.

1.2 Study Objectives and Hypotheses

The general objective of this study is to assess the factors influencing the utilization of the LTR forest complex. The specific objectives were as follows:

1. To examine the factors affecting household forest benefits awareness
2. To assess factors influencing forest resources use
3. To analyze the attitudes of household towards forest conservation

This study tested the following hypothesis:

1. Education and income of the household jointly have no effect on awareness of the benefits of forests.
2. The prevailing management regime does not influence the use of forest resources.
3. The prevailing management regime does not influence intensity of use of forest resources

1.3 Study Justification

Forests are important for attracting rainfall which is important in supporting agriculture. Agriculture remains the backbone of Kenya's economy. Indeed, Kenya's vision 2030 is not attainable without the role played by forests. Forest conservation directly

benefits agriculture and tourism which are two key pillars for the achievement of economic development in Kenya (RoK, 2010). Consequently, Vision 2030 recognizes the importance of conservation of forests.

1.4 Definition of Terms

Forests: are as continuous stands of trees at least 10 meters tall with interlocking crowns (Wass, 1995)

Attitude: defined as the tendency to think, feel, or act positively or negatively towards objects in our environment such as forest conservation (Eagly and Chicken, 1993)

Forest Conservation: refers to the measures aimed at the protection and preservation of forest lands and resources

Awareness of forest benefits: is defined as the knowledge of direct and indirect products and services that are accessible through existence of forests in the environment

Use of forest resources: is defined as the extraction of forest products and services for household consumption

Intensity of use of forest products: defined as the quantity (i.e., head-loads) of fuel wood collected for household use for the period of one year

Regime: the management system responsible for the control of forest utilization and responsible for the establishment and /or the implementation of rules and regulations for access and extraction of forest products.

1.5 Organization of the Thesis

This thesis is organized into five chapters. Chapter 1 constitutes the introduction, which focuses mainly on the statement of the problem, objectives, hypotheses and the significance of the study. Review of the theoretical and empirical literature is presented in Chapter 2. Chapter 3 describes the research methodology adopted in this study and includes a description of the study area, data collection procedures and analytical techniques. Chapter 4

presents the results and discusses the study findings. Finally, summary of the major findings, conclusion and recommendation are presented in Chapter 5.

CHAPTER 2
LITERATURE REVIEW

2.1 Natural Resource Use, Conservation and Management

Natural resources form the bulk of resources that are important to many economies of the world in meeting economic and development needs. In these economies the majority of people are poor, they live in the rural areas, and they are mainly dependent on agriculture or on natural resources and ecosystem services (World Resources Institute, 2005). The utilization of natural resources as a livelihood strategy is important especially to the communities residing adjacent to these resources (Sumati, 2006).Such communities collect process and/or market various kinds of natural resources either as a predominant activity or as part of a diversified portfolio of livelihood strategies designed to spread and minimize specific risks (Norfolk, 2004).

Forests, among the natural resources, have potentials and limitations for improving human welfare (Angelsen and Wunder 2003). Forests improve human welfare by providing a range of resources including timber, non-timber forest resources, and recreation. Forestsalso supplement household income thus providing safety nets (Fischer, 2004, Neumann and Hirsch 2000; Pattanayak and Sills, 2001).The poor however tend to destroy the environment by cutting down forests; overgrazing and cultivating marginal lands (World Development Report, 1992).

The human activities affect soil nutrient content (Peh *et al*., 2005) which in turn affect tree growth, forest cover, birds and invertebrates (Peh *et al*., 2005; Shahabuddin and Kumar, 2006). Further, grazing, removal of dead tree branches and dry leaves from the ground alter the nutrient dynamics while constant movement of cattle and humans erode the top soil layer (Belsky and Blumenthal, 2002) and browsing by goats and sheep affect re-growth, reduce perennial cover and increase exotic annual cover (Yates *et al*, 2001).

There are various management approaches that can be used to conserve forests. These approaches take different organizational forms such as centralized management (command and control), where state agencies assume the lead role; decentralized management, where local communities are involved at varying levels; private management where private entities own and manage the resource; and co-management, where the state, local communities, and other actors share management functions, rights, and responsibilities (Meinzen-Dick *et al,* 2002; Mburu and Birner, 2007).

2.1.1 Factors influencing awareness of forest benefits

Literature on communities' awareness of the benefits provided by forests around them is scanty. However, studies on natural resource conservation and management have noted the importance of awareness and the factors that influence awareness. Theoretically it is not expected for people to participate in an activity if they are not aware of the benefits of doing so. Therefore studies relating to awareness of benefits of management and conservation were used to establish the factors that influence awareness.

Duroy, (2007) in a study on the determinants of environmental knowledge and concern found that the degree of urbanization, level of subjective wellbeing and level of income have direct influence on awareness while education, population pressure and economic affluence had no direct link. Waylen *et al* (2009) in a study on the effect of ecotourism on knowledge and attitudes found that education and income affect attitudes and awareness of environmental benefits. Ecotourism positively affected awareness especially where an individual or household member was involved in any tourism related activities such as being a tour guide. Nkonya *et al*. (2008) found that compliance with laws governing resources use was higher in groups that were aware of the natural resources management by-laws. They also found that, at the community level, awareness of locally enacted regulations

protecting privately owned natural resources was lower among isolated groups, but was improved by the presence of environmental organizations.

Past studies have also indicated that education affects awareness of forest benefits. Keane *et al*. (2010) for instance found that education affects awareness of rules and regulations. Nkonya *et al* (2008) found that well educated communities understood better the benefits of conserving trees. Their findings provide evidence that poor communities are likely to degrade resources more than well-off communities especially if there is lack of education.

Access to the village markets, infrastructure and services also influence awareness and accelerates natural resource degradation (Chomitz 1995; Agrawal and Yadama 1997; and Nkonya *et al*, 2008). These studies found that the value of natural resources increased as market access increased. They also suggest that if institutions regulating natural resources are weak or absent, access to roads and communication infrastructure decreases the transactions costs of resource harvesting thus increasing forest utilization. For example, the cost of harvesting forests closer to roads is likely to be lower than the case of harvesting forests that are farther away from the road. Law enforcement agents using the same means of transportation and communication to enforce natural resource regulations may also be challenged in remote areas with no roads. Hence enforcement of regulations in remote areas is likely to be weak. This finding is in line with that of Banana *et al*. (2001) who found that exploitation of forest resources in Uganda was less around the capital city Kampala than farther away. The authors attributed their finding to the fact that the forest department did not have enough resources to travel to remote areas to enforce forest harvesting regulations. The study further found that distance to all-weather roads was negatively associated with the level of awareness of tree planting and protection regulations, suggesting that communities farther away from all-weather roads have less access to information about these regulations.

2.1.2 Factors influencing forest use and conservation

FAO (2005) estimated the rate of forest destruction at 13 million hectares per year (for the period 1995-2005) with about 1.6 billion people relying on the forests, to some extent, for their livelihood. However, different forms of extraction may have different levels of impact (Shaanker *et al*., 2004; Shahabuddin and Kumar, 2007). Economies thus employ various resource management strategies in an attempt to address the challenge of balancing resource conservation and utilization.

The level of forest use and the degree of reliance on forest products differ across households. The factors that condition a household's reliance on a particular economic activity and on forest products in particular may vary. Past studies (Wells and Shane 2000; Bawa *et al*, 2004; Wambua, 2008 and Volker and Waibel, 2010) have pointed out that forest utilization is affected by among other factors resource endowment of the household, the household's demographic and economic characteristics, and exogenous factors such as markets, commodity prices and technologies. Hence, understanding the factors that determine household's activity choice and reliance on forest products is essential for both conservation and development-targeted policies. Determining the attributes of a household that are related to dependence on the forest will help predict which households are likely targets for conservation.

Sumati (2006) examined the socio-economic drivers of the use of fuel wood in India and found that wage labour, land size, household size, proximity of the forest from the village affects the use of forest resources. Landholding was found to be an important factor because agricultural by-products are an important substitute to forest resources. Larger land holdings were able to yield enough agricultural by-products to serve the household's fuel wood and fodder needs year-round, whereas smaller landholdings were able to take care of part of a year's supply.

Household size has also been found to have a positive effect on forest extraction (Volker and Waibel, 2010; Wambua, 2008 and Guthiga, 2008). These studies found that larger households required more fuel wood for cooking and heating and could be driven into the forest to farm as the sizes of the land diminish. Sumati (2006) also found that in larger households, crop residues, an alternative cooking fuel is sometimes burned in the fields after harvest suggesting greater preference by households for fuel wood than crop residues.

The distance between the forest and the village also affects access to the forest resources (Hegde and Enters, 2000; Karanth *et al*, 2006; Wambua, 2008 and Guthiga, 2008). This is reflected in increasing costs in terms of the time taken to gather fuel wood at village level. The above studies further found that as distance to the forest edge increases the rate of extraction decreases. This might result in a smaller proportion of the population of a village using fuel wood from the forest or in a reduction in the importance of forest as a fuel wood source overall.

Sumati (2006) argues that location determines access to markets, and hence influences the availability of commercial fuels. Villages that are close to markets but far away from the forest have a larger proportion of people using commercial fuel. Households in villages closer to the forest and to the market are likely to allocate more labor to the extraction of forest products, because forest products can easily be sold in markets. Hence households living close to a market tend to have greater incentives to exploit that income generation option. The amount, frequency and likelihood of resource collection will however, depend on the availability or lack of alternative resource collection areas, and its impact on livelihoods.

Some studies (Wambua, 2008 and Adhikari *et al*. 2004) show that education influences dependency on forests. These studies indicate that education increases income earning opportunities. Increases in income in turn lead to asset accumulation and improved welfare. When income increases, reliance on the forests, as an income source, declines. Other

studies (Cavendish, 2000; Sanders and Zeller, 2004) have also found that the poorest households suffer most from strict conservation while the rich benefit more due to improved provision of indirect benefits. Adhikari *et al*. (2004) further pointed out that higher level of education of family members makes fuel wood collection unprofitable due to higher opportunity cost of time in collection and gathering. Better education can also facilitate intelligent farm management, thus widening a household's scope of coping strategies other than forest extraction.

Gender has also been shown to affect adoption decisions at the farm level. Female farmers tend to be more likely to adopt natural resource management and conservation practices compared to the male (Dolisca *et al*., 2006; Bayard *et al*., 2007). However, a study by Bekele and Drake, (2003) found that gender was not a significant factor influencing farmers' decision to adopt conservation measures. This finding may be related to major differences between males and females in terms of access to assets, education and other critical services such as credit, technology and input supply.

2.2 Management regimes and forest use

The literature suggests that forests were in many economies mainly centrally managed with the exclusion of the local communities in the decision making process. Before being gazetted as protected, such areas were in most cases already, de jure, state property (forest or hunting reserves) although often, de facto, utilized and sometimes even under some form of management by local people. The introduction of protected areas however caused relational problems between the state and the local communities in the last few decades. This conflict has led to concerns by the governments and development agencies worldwide (Edmund and Wollenberg, 2003 cited in Matose 2006) on how best to manage forests. These concerns have, in turn, led to the need to involve the local people in the management of forests within their locality. Various participatory management approaches have been adopted widely in

many developing countries as an alternative method of managing forests. These include, (i) centralized management, where state agencies assume the lead role, (ii) decentralized management, where local communities are involved at varying levels, (iii) private management where private entities own and manage the resource, and (iv) co-management, where state, local communities and other actors share management functions, rights, and responsibilities (Meinzen-Dick *et al.* 2002; Mburu and Birner 2007). These management approaches not only define and assign property rights to various stakeholders differently, but they also guide the use of the resource and consequently determine the conservation outcomes (Meinzen-Dick and Di Gregorio 2004). The management approaches are expected to meet society needs including equitable benefit sharing, appropriate conflict resolution, economic efficiency and participatory decision-making.

The above management approaches have had both successes and failures. The centralized system failed due to the lack of participation of key stakeholders in the conservation and management of forests, weak institutional structures and capacity, outdated and weak policies and legal frameworks for forest law and governance (Ostrom, 2001; Banana *et al*., 2001, KFS, 2007). It is often also difficult for the governments to effectively monitor forests that are expansive or are scattered over very large areas without having to employ a large number of forest guards (Nkonya *et al*, 2008 and KFS, 2007). The main advantage of the centralized approach however, is that it enables equity considerations or collective interest in the common pool resources. It is also able to deal effectively with those found violating the forest laws through fines and fees if the enforcing department confine themselves to laws and consequences to violations.

The community based natural resources management (CBNRM) on the other hand has been prone to the so-called 'elite capture'. This means that their benefits are skewed towards the better off in rural society (Platteau and Gaspart, 2003). Indeed, the benefits of

some CBNRM projects (especially related to wildlife and tourism) have been peripheral to poverty reduction in rural areas at large (Songorwa, 1999). Even CBNRM initiatives that are explicitly intended to benefit the poor, such as Joint Forest Management (JFM) in India, were judged to have largely failed in this objective (Kumar, 2002). The community management approach has had the advantage that the communities are closer to the forest and therefore can easily and effectively monitor and enforce rules stipulated so long as the benefits accrue to them and can be engaged as co-managers (Sekhar, 2003).

The co-management option is being advocated for by many environmentalists and organizations although the option does not necessarily solve the state-people problems around forests but locks into complex socio-political dynamics (Li, 1996; Sivarakrishnan, 1998; Matose, 2006). The failures of co-management are mainly due to the practices and policies. The specific challenges arise from (i) unwillingness of the state to give up power over the control of resources, (ii) participation being a tag and not a practice, (iii) the limiting institutional arrangements that do not deal with each resource and the values placed on them by specific users separately and (iv) the tendency to provide blanket solutions to diverse needs of different local people in different contexts even around the state (Matose, 2006).

In Kenya, since 1957 when the first forest policy was formed, until 1994, forest management was mainly centralized and the protectionist approach was used on government land. Since 2005, however, the recognition of local communities in forest management was formalized. The enactment of the Forest Act 2005 has led to the formation of various forms of participatory approaches to forest management. Different approaches have been practised in managing forests in some areas.An example is the Kakamega forest where two main approaches (incentive based and the protectionist approaches) are used. The effectiveness of the different approaches has been found to vary depending on the locality within which they are found (Matose, 2006; Rishi, 2007 and Guthiga, 2008). A study by Guthiga (2008)

assessed the community satisfaction with the approaches used in managing Kakamega forest. The protectionist approach was found to be more highly ranked than the incentive based approaches. The implication of the study was that communities were interested in conservation despite the pressing need to extract resources from the forests.

2.3 Attitudes and Conservation

Studies show that it is important to know peoples' attitudes to be able to involve them in forest management (Infield, 1988; Rishi, 2003). An attitude is defined as a tendency to think, feel, or act positively or negatively toward objects in our environment (Eagly and Chaiken, 1993; Petty, 1995). According to Rishi (2003), understanding of attitudes towards forest conservation is one of the central concerns in social life and is vital for bringing desired change in behavior. People will participate in conservation of forests if they perceive that doing so has benefits (Nyhus *et al*., 2000 and Arjunan *et al*., 2006).

A number of studies (Fiallo and Jacobson 1995; Nepal and Weber 1995; Mehta and Kellert 1998) have examined the local communities' attitudes towards natural resources conservation. These studies find that peoples' attitudes towards conservation are influenced by the benefits or losses from the forest conservation status. Other studies indicate that local residents have a positive attitude towards to conservation (Newmark *et al*., 1993; Sekhar, 2003; Arjunan *et al*., 2006).

Some other studies have examined the socio-economic and demographic variables that predict attitude towards protected areas in developing countries (Infield, 1988; Newmark *et al*., 1993; Fiallo and Jacobson, 1995). These studies found that socio-economic variables are important correlates of attitudes though they varied in their relation to attitudes from case to case. On the contrary, Baral and Heinen (2007) found that the training received; harassment by wildlife, access to resources and satisfaction of user groups influences attitudes towards conservation instead of the socio-economic variables.

Education also affects attitude towards conservation as demonstrated by Romanach *et al*., (2007) and Tomicevic *et al*., 2010). According to these studies, people with higher education have a positive attitude to conservation while those with low education tend to have a negative. However, there are also studies that find a negative correlation between attitude and higher education (e.g. Gadd, 2005).

Other studies have also shown that income is positively associated with environmental concern (Infield, 1988; Kellert, 1994; Pouta *et al*., 2000). One explanation for this finding is that the upper and middle income classes have had their basic needs met therefore they have a tendency to focus on the aesthetic aspects of their environment. Another view is that people with higher incomes are more accustomed to pleasant living and recreational environments hence they are more concerned with any deterioration of the environment, compared to the lower classes (VanLiere and Dunlap, 1980). However, Arjunan *et al*. (2006) found that it is those who have the least to lose that are most positive to conservation.

The land location also affects attitude to conservation (Infield, 1988; Newmark *et al*., 1993; Arjunan *et al*., 2006). In Africa, farmers with land near forests lose their crops to wildlife (Gadd, 2005). This tends to create a negative attitude and intolerance on forest conservation.

The relationship between gender and attitude is mixed. Some studies have shown that women tend to be more negative towards conservation than men (e.g. Tomicevic *et al*., 2009). Other studies have found the opposite (e.g. Arjunan *et al*. (2006). The negative attitude to conservation could be due to the fact that women are not allowed to own land and therefore cannot receive any of the benefits it brings. At the same time, it is mostly the men, who get employed in the conservation areas (Tomicevic *et al*., 2009). In a study by Lindsey *et al*. (2005) however, the women were the most positive towards conservation. It has also been found that

the younger people in society are more positive to conservation than the older (Tomicevic *et al*., 2009 and Arjunan *et al*. 2006).

CHAPTER 3
METHODOLOGY

3.1 Theoretical Framework

In the study area, markets for some of the forest products do not exist and/ or are imperfect; and if they exist, are characterized by high transaction costs. Consider a farm household that makes production and consumption decisions jointly (Singh *et al*, 1986; de Janvry *et al*, 1991), i.e., whose decisions are non-separable (ibid). This means that the household's decisions about production (use of inputs, choice of activities and desired level of production) are affected by the consumption decisions/characteristics (consumer preferences, location and demographic composition). Under these conditions, the household maximizes the utility from consumption of home produced, market and leisure goods subject to a production function and a set of constraints.

Thus, the household's utility maximization problem can be expressed in a utility function as:

$$\text{MaxU} = U(C_a, C_m, T_q - M_i, H_h \quad (1)$$

Where; C_a = consumption of home-produced goods,

C_m= consumption of market goods,

T_q = total time available to the household,

M_i = time spent on household production and off-farm wage earning (household labour supply) and

H_h = household characteristics

Subject to production constraint (Equation2), household's income constraint (Equation 3), household total time constraint (Equation 4), market constraint (Equation 5) and environment constraint (Equation 6) expressed as:

$$Q = f(K, J, A) \quad (2)$$

$$P_m C_m = P_a(f(K, J, A) - C_a) - wJ + wM_i + Y \quad (3)$$

$$T_a = L_h + M_i \quad (4)$$

$$L_h - M_i \geq 0 \quad (5)$$

$$C_a - Q \geq 0 \quad (6)$$

Where;

Q = the home output of both agricultural crops and forest products with f (.) being assumed to be increasing and concave in all its arguments

J = labour

K =capital

A = other exogenous factors that affect production including property rights, local and national policy and technology among others

P_m = price of market goods,

P_a = market price of home-produced goods,

w = wage rate and

Y= exogenous household income from non-wage and non-farm sources

The Lagrangian (L) equation for this optimization problem is given by:

$$L=U(C_a,C_m,T_a-M_i;H_h)+\lambda[P_a\{f(K,J,A)-C_a\}-wJ+wM_i)+I-P_mC_m]+\gamma[C_a-Q]+\theta[J-M_i] \quad (7)$$

The first order necessary conditions;

$$\partial L/\partial C^a=\lambda(P_a-\frac{\gamma}{\lambda})=\lambda P_a-\gamma=0 \quad (8)$$

$$\partial L/\partial T^j=\lambda(w-\frac{\theta}{\lambda})=\lambda w-\theta=0 \quad (9)$$

$$Pa\,\partial f/\partial L=w-\frac{\theta}{\lambda}=0 \quad (10)$$

In equation 8, the first order necessary conditions shows that the price (P_a) is a function of γ while in equation 9 , the first order necessary conditions shows that wage rate (*w)* is dependent on θ. This implies that as long as the market environment constraints are binding, market prices (P_a and w) cannot guide household decision-making because their market price is zero or very low in value. Instead the household is guided by shadow prices (shown in parentheses in Equations 8 and 9). Equation 10 also shows that the value of the marginal product of labour is not equal to the market wage rate. Shadow prices reflect the true opportunity cost and benefits. Households will respond to them rather than market prices while making utility-maximizing choices (Singh *et al*., 1986; de Janvry *et al*., 1991). It is the sign of γ/λ and θ/λ that determine the size of shadow prices and the relevant wage which would vary by household depending on whether a household is self-sufficient, net seller or

net buyer of a produce or labour (Sadoulet *et al*., 1995). These variations in prices and wages are caused by transaction costs in buying and selling, household preferences, production technology and access to employment opportunities. They are therefore included in the production function due to their influence on decision making in this case being maximizing utility of resource use.

Imperfections in the market here imply missing labor or credit markets. Rural labor markets are not completely developed. Although some labor transactions occur, the marginal value product of labor deviates from the market wage, implying that production and consumption decisions are non-separable. The marginal value product of labor is equated to a shadow wage that depends on household characteristics (household size and years of formal education of the household head) and other utility-related variables (collection time, distances to the forest and accessibility of the forest products).

3.2 Empirical methods used in addressing the study objectives

3.2.1 Objective 1: Awareness of forest benefits

In order to assess the number of forest products/services that the households were aware of, an exhaustive list of both direct and indirect benefits was drawn. In total 18 benefits were identified. The respondents were then asked whether or not they knew each of the listed benefits and the total number of benefits known tallied. Hence the dependent variable is the number of forest benefits/services the household indicated it was aware of. The expected response therefore ranged from zero to eighteen. No household indicated that it did not know any of the benefit of forests, thus there were no zero responses. Some households also indicated that they knew all the eighteen listed benefits.

The number of forest benefits known by the household is a count dependent variable and can therefore be analyzed using count data models. Count variable models are typically

analyzed using either Poisson or negative binomial regression (Kirui, 2011). However, when data precludes zero responses, like in the current case, the strict application of Poisson and negative binomial regression is inappropriate (Hilbe, 1998 and 2007; Long, 1997). Zero-Truncated Poisson (ZTP) or the Zero-Truncated Negative Binomial (ZTNB) models is therefore recommended. Poisson or negative binomial probability distributions that exclude zero do not sum to one hence the need for an adjustment (truncation) to the underlying distributions upon which their respective log-likelihood functions is based (Ibid).

3.2.1.1 Zero-truncated Poisson regression

Following Cameron and Trivedi (1998) the zero-truncated Poisson distribution is defined by a probability distribution function (conditional upon y>0) as:

$$P\left\langle y_i \middle| y_i \succ 0; x \right) = \frac{P\left\langle y_i \middle| x \right)}{P\left\langle y_i \succ 0 \middle| x \right)} = \frac{\mu^{y_i} \exp(-\mu)}{y_i!(1-\exp(\mu))}, y_i = 1,2,... \qquad (11)$$

Greene (2003) and Hilbe (1998) show that the log-likelihood (LL) transformation for the above zero-truncated Poisson probability distribution is given by:

$$LL(\mu; x) = y_i \log(\mu) - \mu - \log\Gamma(y_i + 1) - \log\left(1 - \left(e^{-\mu}\right)\right) \qquad (12)$$

Where: y_i= random response variable corresponding to the number of benefits known to respondent (i)

x =covariate vectors

μ =mean of corresponding Poisson distribution

Following Greene (2003), the above log likelihood expression is parameterized in terms of the linear predictor *x*. That is, $\mu = e^{x\beta}$ hence, for the above zero truncated Poisson:

$$LL(\beta; x) = y_i x\beta - e^{x\beta} - \log\Gamma(y_i + 1) - \log\left(1 - e^{(-e)}\right)x\beta)) \qquad (13)$$

Where: y=random response variable (number of benefits known to respondent)

x =vector of explanatory variables

μ =mean

β =linear predictor of random response variable

Differentiation of the above function provides the basis for calculating the robust score

$$y - \exp(x\beta) - \frac{\exp(x\beta)\exp(-\exp(x\beta))}{1-\exp(-\exp(x\beta))} \quad (14)$$

Based on the above equation, the implicit functional form of the estimated zero truncated Poisson model estimated is:

Number of forest benefits(y) =f (lnage, gender, household size, education, lnincome, lndistance to main road, group membership, regime) +e. (15)

Definition of variables used in the model and how they were measured;

Age - is a continuous variable and was measured in years. It is expected to have effect on knowledge though the direction of influence may not be determined apriori because of the effect of other factors. The older one gets, the more knowledgeable they are expected to be on issues surrounding them. However, education and exposure may also affect the level of knowledge despite how young or old an individual may be. Its direction of influence was therefore not determined a priori. The range in age was large therefore to allow for meaningful comparisons we linearized by using the natural logarithm.

Gender of household head (gender) - this is a dummy variable measured as 1=male, 0=female. Men are generally expected to be more knowledgeable about their surroundings than their female counterparts. However, findings may vary depending on how long they have been in a place and whether they have been in an area for longer periods.

Household size - this variable refers to the number of members in a given household. Information can be obtained from various sources and may be availed through different household members. Therefore households with more than one member may have more chances of getting more information especially when they are involved in different activities within and outside a given locality. It is expected that household size will have a positive effect on awareness. Children are also known to provide information on what they may have heard from their interactions through playgroups or school interactions as such the more the members the greater the likelihood of more benefits being known.

Education of the household head - this is a human capital variable and was measured in terms of the number of years of formal education. Consistent with previous studies, the value of a resource is a function of what one knows about it (Smith, 1990). Education level is expected to have a positive relationship with the awareness of forest benefits. It is expected that respondents with more years of education would be aware of many of the forest goods and services provided by the natural resources around them. Through education respondents would know and be able to understand better the ecological functions.

Income – this variable forms part of the financial capital owned by a household from all possible income generation sources that they were engaged in including remittances. It was measured as total income earned from various sources in a year (July, 2009-June, 2010). Income was hypothesized to positively influence awareness of forest goods and services. The income range was too large with some households recording no/zero incomes hence to reduce spread and allow meaningful comparisons, we linearized by using the natural logarithm.

Distance to main road **-** this was a continuous variable measured in kilometers. The accessibility of an area is determined by the kind of infrastructure available. Areas that are remote are not easily accessible with information as such it was expected that those residing

far from the division headquarters accessible by road may not have much information about benefits of forests and conservation. This variable was linearized by using natural logarithm.

Group membership - is a social capital variable and was measured as a dummy variable (1= group member, 0= Otherwise). For purposes of this study the group membership was a variable that took into consideration those groups that have a component of environment related concerns or activities such as tree planting or trainings on conservation (e.g. use of improved charcoal burner (i.e. jiko), establishing the traditional hotpot baskets and use of modern hives). Thus it was expected that this variable will have a positive effect on awareness of benefits. Presence of programs and organizations focusing on agriculture and natural resources management (NRM) has been found to increase awareness and probability of enacting NRM bylaws (Nkonya *et al*, 2008).

Regime - is a categorical variable that refers to forest management regime/ system being applied. The study categorized the management system into private, KFS and community. The private management was located in the farthest distance from the division headquarters and households were spatially distributed in that area. Access to information was therefore not easy. The KFS and community regimes were located closest to administrative offices as such any public events including environmental education fora may be easily known and attended. The effect of regimes was therefore expected to be mixed given the distances that relay the possibility of information accessibility.

3.2.2 Objective 2: Use of forest products

Use of forest products in this study refers to extraction of products from the forests e.g. fuel wood, medicinal herbs, thatching grass. To assess the use of products, respondents were asked whether they obtained any products from the forests in their neighborhoods or not. Therefore the response variable in this case was binary choice that is a "Yes" if the household collected products from the forest and "No" if it did not. The three most commonly

used approaches to estimate such binary dependent variable regression models are (1) the linear probability model (LPM), (2) the logit, and (3) the probit. They are applicable in a wide variety of fields (Gujarati, 2004).

The LPM is not used in empirical research because it violates a major rule of probabilities that requires that the sum of the probabilities be equal to unity (Wooldridge, 2002). The logit and probit models, however, guarantee that the estimated probabilities lie between the logical limit of 0 and 1 (Wooldridge, 2002). Hence, the Logit and the probit models are the most frequently used models when the dependent variable is dichotomous (Maddala, 2001; Gujarati, 2004). Gujarati (2004) argues that the Probit and Logit models are quite similar. They generate predicted probabilities that are almost identical. Aldrich and Nelson (1984) indicate that in practice these models yield estimated choice probabilities that differ by less than 0.02.

The main difference between the logit and probit models is in the nature of their distribution which is captured by Cumulative Distribution Function (CDF). Probit has a normal distribution while logit has a logistic distribution which has slightly fatter tails than the normal distribution. The choice of probit versus logit regression therefore depends largely on the distribution assumption one makes. In practice many researchers choose the logit model because of its comparative mathematical simplicity (Kirui, 2011).

In this study, a logistic regression model is used to assess factors affecting the use of forest products by households.

3.2.2.1 Logistic Regression

Following Maddala (1983, 2001), the probability, *p*, that a household uses forest products is given by:

$$P = \frac{e^{z}}{1 + e^{z}} \qquad (16)$$

Central to the use of logistic regression is the logit transformation of p given by Z

$$Z = \ln\left(\frac{p}{1-p}\right)^2 \quad (17)$$

Where;

$$Z = Z(f, d, a) + \varepsilon \quad (18)$$

Z is a latent variable that takes the value of 1 if the household used forest products and 0 otherwise, $\boldsymbol{f}$ is a vector of farmer characteristics, $\boldsymbol{d}$ is a vector of farm level variables, $\boldsymbol{a}$ is a vector of asset endowment variables, and ε is the stochastic term assumed to have a logistic distribution. The empirical model estimated contains the following variables (letters in parenthesis indicate related category variables from the conceptual model):

1) Farmer specific variables (***f***) = age, gender

2) Farm specific variables (*d*) = distance to the forest from household, household size and distance to market

3) Asset endowment variables (*a*):

   i. Financial asset (income)

   ii. Human capital (education)

   iii. Social capital (group member)

Based on the above equation, the logistic regression model estimated in implicit functional form becomes;

Use of forest products (Z) = f (lnage, distance from forest, farm size, household size, lnincome, market distance, occupation, education, group membership and regime) + e (19)

Definition of variables used in the model and how they were measured;

Use of forest products - this was a binary choice variable (1=a household extracts products from the forest and 0=otherwise) that established whether a household collected any products from the forest or not. It covered the period between June 2009 and July 2010.

Age - defined as above.Age was expected to have a negative effect on use of forests considering majority of respondents were in their youthful stage.

Distance from forest edge – this was a continuous variable measured in kilometers. The proximity to the forests makes households inherently dependent on them due to accessibility and availability of the resources. Distance from forest affects access to the forest for getting forest products and also increases costs in terms of time spent to walk to the forest and to gather fuel wood and other products in the forest. This might result in a larger proportion of the population of a village using fuel wood from the forest. Distance from the forest edge was expected to negatively influence respondents' decision to use resources.

Land size – this was a continuous variable measured in acres. Land holding is a form of physical capital that a household possesses. It is expected that the likelihood of resource use would be less for households with large tracks of land. Households with more land are likely to have access to farm fuel in the form of crop residue or fallow/unutilized land areas/ area of land under trees or grow trees on their land and therefore they are likely to be less dependent on fuel wood from the forest.

Household size – refers to the number of members in a given household. Household size was expected to positively influence use of forest products. Households with many members are expected to need more fuel wood for cooking and for construction of houses.

Income – this variable forms part of the financial capital owned by a household from all possible income generation sources that they were engaged in including remittances. It was measured as total income earned by household from various sources in a year (July, 2009

- June, 2010). Households working in non-farm jobs such as business or salaried employment should depend less on the forest for their income and will consequently need to clear less forest to meet their needs. When households diversify their income generating activities other than depending on forest products their tendency to rely on forests are likely to decline. This can slow down economic pressure to extract products from forests for sale to support their families; or generate resources that can be used to purchase inputs such as fertilizers; labor saving technologies or investments in activities that promote sustainable practices in natural resources management.

Distance to market - Was measured in kilometres. Respondents in villages closer to market places are more likely to allocate labor to the extraction of forest products, such as medicinal herbs, seeds and nuts for sale in the local market. Hence households living close to a market have greater incentives to extract and sell forest products as their income source. Thus market distance was expected to negatively influence the use of forest products.

Education – was measured as the number of years a respondent spent in formal schooling. The number of years of education of a respondent influences their level of understanding and decision making ability. A respondent with more years of formal education is likely to have access to alternative employment opportunities hence reducing the level of dependency on forest due to possibility of access to alternative fuel sources.

Regime – was measured as a categorical variable as earlier defined. The regimes influence the level of resource use through lack of enforcement and ill-defined property rights and corrupt governance structures. Therefore regime was expected to negatively influence use of forest products.

3.2.3 Intensity of use of forest products

In order to assess the factors affecting the degree of use of forest products, this study specified the dependent variable as the number of head-loads harvested by a household in 2009/10. It therefore used the Poisson and the negative binomial regression models to isolate the determinants of the degree of use because the dependent variable is a count data variable. These count variable models are suitable for dependent variables that are countably finite. Count data are non-normal and hence are not well estimated by OLS regression (Maddala, 2001). The key models normally used to analyze count data include the Poisson Regression Model (PRM), the Negative Binomial Regression Model (NBRM), the Zero Inflated Poisson (ZIP) and the Zero Inflated Negative Binomial (ZINB). Poisson and negative binomial regression models are frequently used in estimating models with nonnegative integer dependent variables (Greene, 2008). The ZIP and ZINB regression models are specifically used to account for the frequency of zero counts (i.e. when there are more zeros than would be expected in either a Poisson or Negative Binomial Model). The study identified only few zero counts therefore never warranted the need for ZIP and ZINB. The results of NBRM is discussed in this study since the response variables were nonnegative integers and the Poisson regression model, which was the first stage in analyzing count data, displayed over-dispersion.

Pearson chi-square ratio test (Pearson chi-square divided by degrees of freedom) was conducted to check whether Poisson model fitted the data well. Under this test, under-dispersion or over-dispersion occurs when the ratio is less than 0.8 or greater than 1.2 respectively. In that case, the negative binomial is recommended (Wooldridge, 2002 and Greene, 2008). In this study, the test detected over-dispersion hence negative binomial regression model (NBRM) was applied. NBRM model has the additional advantage in that it relaxes the Poisson regression model's assumption of equivalence of mean and variance.

Following Greene (2008), the negative binomial model is written as:

$$E(y_i|x_i,\varepsilon) = \exp(\alpha + X'\beta + \varepsilon) \quad (20)$$

The model requires that;

$$\text{var}\left(y_i|_{xi}\right) = [1 + \alpha\exp(X'\beta)]\exp(X'\beta) \quad (21)$$

Where *X'* is a vector of explanatory variables similar to those included in the model, the β refers to the variable coefficients and α is the constant.

Hence the estimated NBRM is specified as:

Number of head-loads (Z) = f (lnage, gender of household head, regime, distance from forest, household size, lnincome, occupation, lnfsize, education, group membership) + *e* (22)

These variables are as previously defined in Section 3.2.2 above

3.2.4 Objective 3: Attitude towards forest conservation:

To analyse the peoples' attitude towards an issue, two main approaches used include descriptive statistics and inferential statistics. The descriptive statistics includes summing up of the responses and obtaining a score or using the percentage of respondents in a given Likert scale category (Shibia, 2010)or scale averages for the particular question responses (Dolisca *et al*, 2007 and Rishi , 2007). The second method uses factor analysis (Dolisca *et al*, 2007). Some studies use a combination of descriptive statistics and inferential approaches (Dolisca *et al*., 2007).

In this study, a combination of descriptive and inferential statistics was used to examine household's attitudes towards conservation. Descriptive statistics (percentages and mean scores) were used to describe respondents' attitude towards forest conservation. On the other hand, factor analysis was used to identify latent dimensions underlying the different variables that measured respondents' attitudes towards conservation. Responses to twelve

five-point Likert-type scale items were subjected to a principal component factor analysis with Varimax rotation. The factors were subjected to the Kaiser-Meyer-Oklin and Bartlett's test (KMO and Bartlett's test) to determine the sampling adequacy. According to the test, samples that score above 0.7 are considered reliable for policy-related decision-making while those below 0.7 are considered unreliable. The above procedures were adopted for this study and used to discuss the attitude towards forest conservation.

3.3 Sampling Procedure and data

This study used data collected from households in Kipini Division of Tana Delta District. The division has three locations namely Kipini, Ozi and Kilelengwani. Each location is further divided into two sub-locations. Each sub-location has several villages of varying household populations.

Multi-stage sampling technique was used to select a representative sample from the population for interviews. First, the three locations (namely Kipini, Kilelengwani and Ozi) were purposively selected. This was because each location represented a different forest management regime namely; KFSmanagement (part of Kipini Location) and whole of Kilelengwani location; the community management (Ozi location) and the private/ conservancy management (part of Kipini Location). A list of all villages in each location was then obtained with the help of the local administrators (i.e. Location heads, village heads and agricultural extension officers). The villages were clustered into two categories based on proximity to the forest. Six of the villages selected were close to the forest (distance of 0-5km) while the other four villages were far from the forest (distance 6-10km). A total of ten villages out of seventy villages were selected. A list of all households in the selected villages was then drawn with the help of the respective village heads, area agricultural extension officer and some members of the village.

The population sizes of each of the locations were used to arrive at the number of households interviewed in each location. Hence the study sampled the respondents from the locations using the population proportions (that is, probability proportionate to size sampling technique was used). The division statistics based on the 2009 census estimates showed that Kipini location had 12918 people (approximately 4000 households) while Kilelengwani location had 8000 people (approximately 2500 households) and Ozi location had 2185 people (approximately 400 households). This procedure resulted in 72 households in Kipini location, 48 households in Kilelengwani location and 30 households in Ozi location. Overall 150 respondents/ households were interviewed.

Data was collected in each of the households through personal interviews using a pre-tested questionnaires (see annex). The household head or spouse was selected for interview in each case. The data collected included household/ respondent characteristics and location characteristics.

3.4 Study Area

Tana Delta district in Tana River County is one of the newly created districts carved out from the larger Tana River district and has three divisions namely Garsen, Tarasaa and Kipini. Rainfall is low, bi-modal and erratic. The mean annual rainfall ranges from between 300mm to 600mm. The long rains occur in April-May and the short rains October- November (Tana DDP, 2005-2008). The rainfall in the district is of convectional type. The main economic activities in the region are crop farming and fishing. Livestock is also kept by few people in the community due to tsetse fly infestation. Various crops are grown including rice, maize, pulses, bananas etc.

CHAPTER 4
RESULTS AND DISCUSSIONS

4.1 Characterization of the respondents

The results of the descriptive statistics (Table 4.1) show that age of the respondents ranged from twenty to one hundred years, with the mean age being 44 years and the mean household size was 4 members. The overall mean of fuel wood head-loads collected was 178 per year and the regime with the largest mean of head-loads was community regime (309 head-loads/year) while that with the lowest mean of head-loads was the KFS regime (112 head-loads). Mean years of formal education was 6.8. Of the interviewed households, 117 (78% percent) were males while 33 (22 percent) were females. Mobile phones were owned by seventy eight respondents (52 percent).

Distance to the main road was on average, 23.8 kilometers indicating that most households were located in the interior. The mean number of forest benefits known to respondents was about 11. Of the 150 respondents, 125 (83.3 percent) were practicing farming as their main occupation. Results also showed that 72 (48 percent) of the respondents belonged to a group(s) that engage in conservation activities. Household mean income per annum was Ksh. 21814.06. The respondents in the KFS regime had the highest incomes compared to those from the community and Private/ Conservancy regime.

There were significant differences between variable responses in the three regimes with respect to farmer-specific, farm-level and asset endowment characteristics. Specifically, there were significant differences in number of forest benefits known to respondents, distance to the main road and market and ownership of land. When comparisons were made between different regimes, significant differences were observed in farm sizes, distance to the main road, the forest and the market, years of education and land ownership among respondents in the conservancy/reserve regime and those from the KFS regime. Significant differences were also observed when the respondents from the community regime and the conservancy regime

were compared. These differences were significant in the case of incomes, farm sizes and distances to the market.

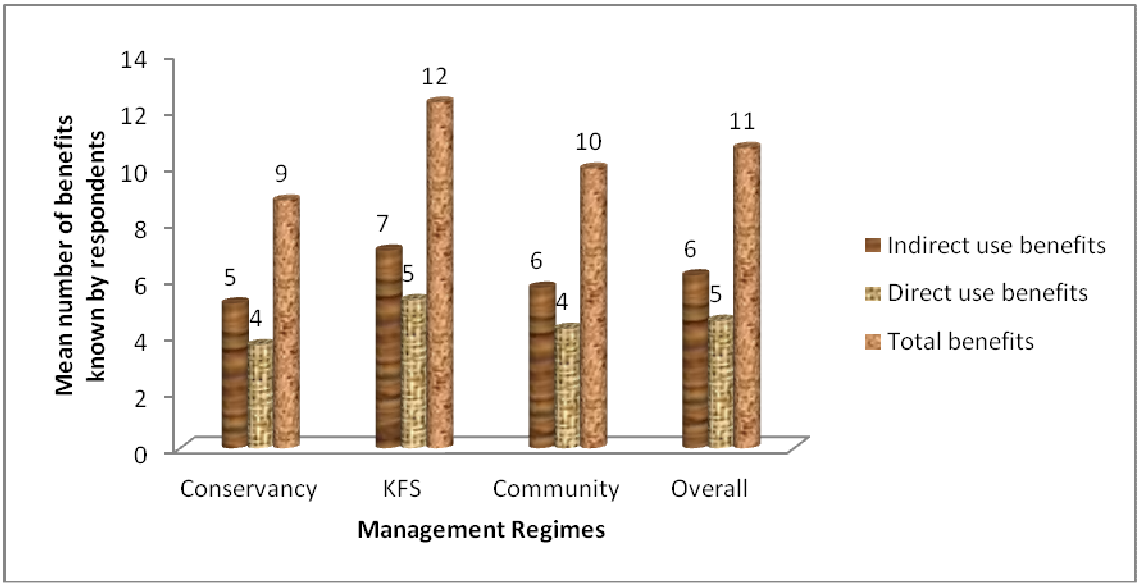
Table 4.1 Summary statistics of variables used in the regressions

	Private		KFS		Community		Overall	
Variable	**Mean**	**Std. Dev**	**Mean**	**Std. Dev**	**Mean**	**Std. Dev**	**Mean**	**Std. Dev**
Gender of household head (1=male 0=female)	0.8	0.38	0.7	0.44	0.8	0.4	0.8	0.42
Age of household head (years)	44	11.75	45.1	11.21	41.1	17.65	44	12.71
Household size (count)	4.3	2.15	3.9	1.98	3.7	2.66	4	2.17
Forest benefits known (count)	8.8	3	12.3	5	9.9	5	10.7	5
Group membership (1=Yes, 0=No)	0.6	0.5	0.4	0.5	0.3	0.49	0.5	0.5
Group members with farm forest (count)	0.48	0.5	0.29	0.46	0.19	0.4	0.34	0.48
Total income of household ('000)	27.1	34.0	22.4	33.2	9.5	13.0	21.8	31.5
Total land size (acres)	7.9	4.78	9.6	4.1	5.8	3.63	8.3	4.47
Main occupation of household head	0.9	0.32	0.8	0.41	0.8	0.37	0.8	0.37
Distance from forest (km)	3.3	2.06	4	2.37	1.9	0.58	3.4	2.17
Use forest products (1=Yes, 0=No)	0.5	0.5	0.4	0.49	1	0.2	0.5	0.5
Distance to the market (km)	13.6	6.65	8.3	5.97	1.5	0.51	9	7.03
Distance to main road (km)	28.7	5.18	18.9	5.05	27.3	1.51	23.8	6.62
Education (Years)	6.2	4.21	7.8	3.84	5.4	4.26	6.8	4.14
Quantity of fuel wood head-loads collected per annum ('00)	2.04	3.14	1.12	4.12	3.09	3.66	1.78	3.77
Land under trees (acres)	1.1	1.38	1.4	1.51	1	1.21	1.2	1.42
Own mobile phone (1=Yes, 0=No)	0.5	0.5	0.6	0.49	0.3	0.49	0.5	0.5

4.1 Awareness of forests benefits

Figure 4.1 presents the results of analysis of awareness of forest products and services. The benefits households were aware of ranged from one to eighteen. Awareness was highest in the KFS regime (mean=12 benefits) and lowest in the Private/ Conservancy (mean=9 benefits). This is probably because the division offices where majority of educational programmes are carried out were closer to the KFS regime.

Figure 4.1 Forest benefits (direct and indirect use) known by respondents



The result of the zero truncated Poisson regression model estimated to determine the factors influencing awareness of forest benefits are shown in Table 4.2. The results indicate that education does not affect the expected number of forest benefits a household is awareness of. This may be due to low education level as shown in the descriptive statistics. It however shows that income has a significant effect on the expected number of benefits known to a household. The results of Wald test (combined effect of education and income) however found education and income have a joint statistically significant effect on the expected number of forests benefits the household was aware of. The joint test yielded a p-value of 0.011. The null hypothesis that education and income jointly do not influence awareness of forest benefits was therefore rejected at 5% level of significance.

Results also show that gender influences the number of forest benefits known to respondents. The expected number of benefits known by male respondents was higher by 0.18 relative to the number of benefits known by female respondents.

The households with more farm land were aware of more forest benefits compared to those with less farm land. Land is a capital asset and is often used as an indicator of the

wealth status of households. The wealthier a household is, the higher the likelihood of acquiring more information especially where the access to information is limited by resource endowment. In this study, households which were more capital (land size) endowed knew slightly more benefits by 0.15 times relative to those who were less endowed.

The management regime also influenced the expected number of benefits known to respondents. The expected number of benefits known by a respondent in the KFS and the community regimes was higher compared to the respondents in the conservancy/private regime. The expected number of benefits was 0.33 and 0.18 times higher for the KFS and the community regimes, respectively compared to the conservancy/reserve. Respondents in the community and KFS regimes were much closer to the administrative offices hence to sources of public information.

Table 4.2 Zero truncated poisson regression results of the determinants of awareness of forest benefits

Dependent Variable=number of forest benefits known	**Coefficient**	**P- Value**
Log of age	0.06	0.644
Gender	0.18	0.043[b]
Education level	0.01	0.521
Occupation	-0.04	0.648
Log of household size	0.10	0.152
Log of income	0.04	0.000[a]
Log of farm size	-0.15	0.000[a]
Group membership	-0.04	0.465
Log of distance to main road	-0.14	0.357
Regime		
KFS	0.33	0.000[a]
Community	0.18	0.072[c]
Constant	2.15	0.000
Number of observations	150	
Wald chi2(11)	148.34	
Prob> chi2	0.0000	
Pseudo R2	0.1285	

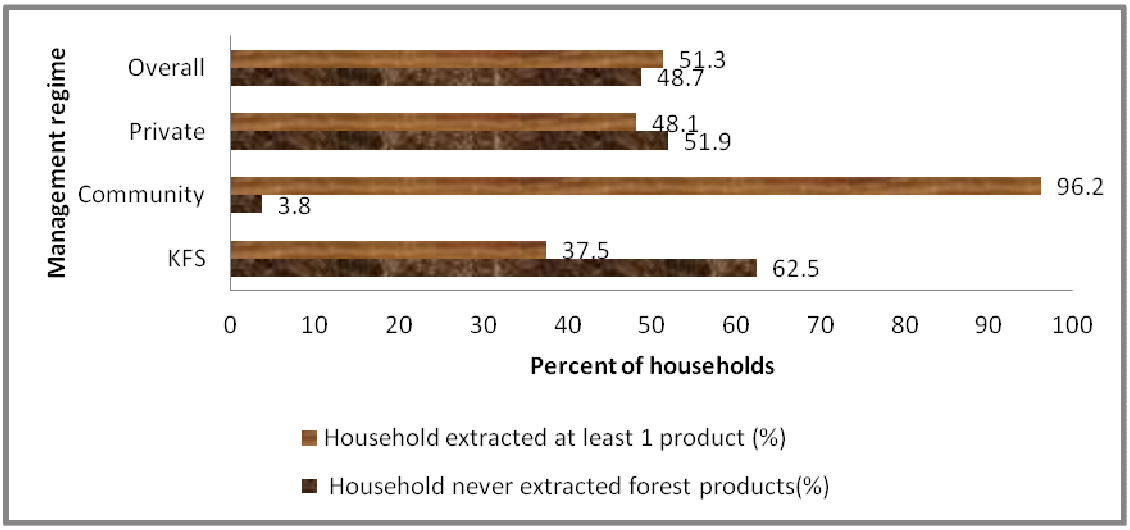
*NB: p-value significance level **a** refers to 1%, **b** refers to 5% and **c** refers to 10%*

4.2 Factors affecting the use of forest products

In order to assess the use forest products by the households, respondents were asked whether they ever extracted products from the forest between June 2009 and July 2010 (Figure 4.2). Although forests were within the reach of most households (from .01km to 10 km distance) only 51% of the households surveyed extracted products from them. The mean number of years for formal education was six among those who extracted products and seven years among non extractors of forest products.

The use of the forest products differed among the different regimes. The community regime had the highest percent of extractors of forest products (96%) followed by Private (48%) and the KFS regime (38%).

Figure 4.2 Use (Extraction) of forest products by households (N=77)



The forest products used by the households were fuel wood, charcoal, poles, medicinal herbs and thatching grass (Table 4.3). Of all the users of forest products, 94% used fuel wood while other products were used by less than 40% of the households. The least extracted product was thatching grass which was used by 5% of the households.

Table 4.3 Types of forest products extracted by households

Products extracted	Number of users	Percent among product users
Fuel wood	72	93.5
Charcoal	13	16.9
Medicinal herbs	14	18.2
Poles	27	35.1
Grass	4	5.2

In order to examine factors explaining the use of forest products, a binary dependent variable that takes the value of 1 if the respondent extracted a product from the forest and 0 otherwise was used to fit a logit regression model. The results of the fitted regression model are shown in Table 4.4. The Likelihood Ratio (LR) test statistic shows that the model fitted the data well (p-value = 0.0003).

Table 4.4 Factors affecting the use of forest products: Logistic regression model

Dependent Variable (1=Use 0=non use)			Marginal Effects	
	Coefficient	P-Value	Coefficient	P-Value
Gender	0.44	0.415	0.08	0.411
Natural logarithm of household size	0.05	0.920	0.01	0.920
Education (Years of formal education)	0.01	0.834	0.00	0.834
Natural logarithm of distance to forest	0.25	0.218	0.05	0.207
Natural logarithm of income	0.09	0.049[b]	0.02	0.043
Natural Log of farm size	0.15	0.708	0.03	0.707
Natural log of distance to main road	-1.57	0.084[c]	-0.29	0.075
Regime				
Private/ Conservancy	-4.07	0.000[a]	-0.46	0.000
KFS	-5.16	0.000[a]	-0.67	0.000
Occupation	1.30	0.032[b]	0.24	0.022
Constant	6.33	0.062		
Number of observations	150			
Wald chi2(9)	32.64			
Prob> chi2	0.0003			
Pseudo R2	0.2306			
Log pseudo-likelihood	-79.9588			

*Note: p-value significance level **a** refers to 1%, **b** refers to 5% and **c** refers to 10%*

Contrary to the second hypothesis, the results of this study indicate that the prevailing management regime influences use of forest products. Results show that belonging in the

Private/ Conservancy regime or KFS regime reduces the likelihood of using forest products other factors constant. The households that are close to the KFS or the conservancy/private forest regime are less likely to use forest products relative to the households in the community regime. These findings show that regime plays a critical role in determining the decision to use forest products. Indeed, the type of management regime determines the scope of monitoring and enforcement of rules.

The study findings also reveal that there is a negative and significant relationship between distance to main road and likelihood of using forest products. This suggests that the further the distance to the main road, the less likely the use of forest products. Infrastructure is expected to influence the ease of accessing places and facilities such as markets. Therefore, if distances to such facilities are large, the likelihood of extracting forest products for sales may be less.

Results further show that main occupation of the household head influences the use of forest products. The households practising farming as the main occupation were more likely to use the forest products than those whose main occupation was non-farm. In addition, the results showed that income influences the use of forest products. Increase in income has positive influence on likelihood of forest product use. This finding is in line with the findings of Hedge and Enters (2000) that indicated that higher income groups utilize more forest resources than the lower income groups when no forest use restrictions are in place. However, it is in contrast with findings of most past studies (Cavendish, 2000; Sanders and Zeller, 2004; Shackleton and Shackleton, 2006; Wambua, 2008) which suggest that as incomes increase the likelihood of dependence on forests declines. The probable reason for the positive relationship is the lack of alternatives for fuel wood in the study area due to remoteness. Households have to cover long distances to get kerosene or cooking gas, making the use of fire wood more attractive.

4.3 Intensity of use of forest products among households

The factors that influence the extent to which households use forest products was assessed by estimating both Poisson and Negative Binomial regression models. The dependent variable was the quantity of fuel wood collected (measured by the number of head-loads). The results of both models are presented in Table 4.5. The mean deviance and the Pearson chi-square ratio (the Pearson chi-square value divided by its degrees of freedom) were used to assess the degree of fit of the Poisson model. The estimated Deviance and Pearson ratios are shown below:

Deviance/df = 4167.773/141= 29.56

Chi-square/df =4382.065/141= 31.08

From these results, both ratios are significantly greater than 1indicating that there is evidence of over-dispersion. Hence the Poisson model does not fit the data well. Consequently the discussion below is based on the results of negative binomial regression model. The Likelihood Ratio test of the model (NBRM) has a p-value of 0.000 showing that the model fits the data well.

As hypothesized the management regime influences the intensity of use of forest products. The relationship between the regimes and the quantity of forest product used is not only negative but also statistically significant. This implies that the expected number of head-loads of fuel wood decreases by 0.48 and 0.77 for the private and the KFS regimes, respectively. The decrease in expected number of head-loads of fuel wood collected is lower in the private regime probably because of challenges of monitoring the expansive borders by an inadequate number of staff. The hypothesis that management regime does not influence the intensity of use of forest products was therefore rejected.

Results also show that household income influences the level of use of forest products. An increase in household income by ten percent increases the expected number of

head loads by 5% holding other model variables constant. This result corroborates that of Hedge and Enters (2000) who found that the higher income groups utilize more forest resources than the lower income groups when no forest use restrictions are in place. However as in the case of the binary model results, the findings contradicts those of other studies (Cavendish, 2000;ShackletonandShackleton, 2006 and Wambua, 2008) which reveal that as incomes increase the likelihood of dependence on forests declines.

Table 4.5 also shows that distance to the forest increases the expected number of head loads of fuel wood collected. Hence, there is higher use of forest products among households that are further away from the forest edge. If the distance to the forest were to increase by a kilometre, the expected number of head-loads would increase by 0.27, holding other factors constant. This finding however contradicts those of other studies on forest products extraction by households (Thapa and Chapman, 2010; Karanth *et al*., 2006 and Hedge and Enters, 2000). Their studies found that the closer households are to the forest the greater the probability of extracting products. Fuel wood is a basic need for households and cannot be easily substituted with other sources of energy in remote villages due to distances and costs to access alternatives. Thus households are willing to travel as far as it takes to collect fuel wood. Another possible reason for going to further distances to collect forest resources is that people in that area may not easily identify the residence of people from far. Although the reporting may be done, apprehending the person may not be as easy as a resident whose home is known.

The main occupation of the household head also significantly influences the quantity of fuel wood collected. The expected number of head-loads of fuel wood collected is higher by 0.72 for households whose main occupation is farming relative to those who have other activities as the main occupation other things constant.

Table 4.5 Determinants of intensity of use of forest products: Poisson and Negative binomial regression results

Dependent Variable= Quantity of fuel wood head-loads collected	Poisson Regression		Negative Binomial Regression	
	Coefficient	**P-value**	**Coefficient**	**P-value**
Log of age	-0.45	0.106	-0.11	0.739
Gender	-0.28	0.152	-0.19	0.325
Occupation	0.36	0.132	0.72	0.000[a]
Household size	-0.07	0.095	-0.06	0.348
Log of income	0.03	0.044	0.05	0.018[b]
Log of farm size	0.20	0.041	0.12	0.198
Log of collection frequency	0.58	0.000	0.94	0.000[a]
Log of distance to forest	0.27	0.006	0.25	0.089[c]
Regime				
Conservancy/Private	-0.20	0.395	-0.48	0.082[c]
KFS	-0.75	0.003	-0.77	0.003[a]
Constant	4.09	0.000	1.38	0.218
Number of observations	150			
Wald chi2(10)	508.58			
Dispersion	Mean			
Log pseudo-likelihood	-432.19			
Prob> chi2	0.000			
Lnalpha	-0.387			

*Note: p-value significance level **a** refers to 1%, **b** refers to 5% and **c** refers to 10%*

4.4 Attitude towards forest conservation

In order to assess households' attitude towards forests conservation, respondents were asked a series of questions that cover different aspects relating to forest conservation. These were in Likert scale format with the scale ranging from strongly disagree and strongly agree (i.e. on a scale of 1 for strongly disagree to 5 for strongly agree). Points were added from each statement and divided by the highest sum to calculate a score in percentage terms. The mean score of all respondents was 54.07±10.30. If a respondent scored above the mean score then they were considered to have a positive attitude based on the stated scale range 1-5 with 5 being strongly agree (positive statement). For purposes of statistical analysis respondents with neutral and negative attitudes were grouped together. The finding was that only 10% of the respondents had a positive attitude and 56% were on the borderline. The results of the

analysis of responses to the statement are as shown in Table 4.6. The results show that 20% of the respondents received some form of education and training on forest conservation and 50% had been educated on fuel wood conservation methods. The communities' time value for conservation activities was low. Results also show that 48% of the respondents attended meetings and were enrolled in groups focusing on environmental conservation as also indicated in Table 4.1.

Regarding the stakeholder involvement in forest conservation initiatives and management 41% of the respondents knew about the existence of partnerships between the local communities, the KFS and the NGO's working with farmers within the area while 53% were aware of existence of forest surveillance in the community. Almost one-half (45%) of the respondents indicated that consultations among stakeholders on forest related activities was a positive contributor to forest conservation. However, studies conducted in other countries reveal that, where community members and other stakeholders are involved in environment management, the laid down strategies can be achieved given the local area conditions (Rishi, 2007).

The respondents' personal commitment to forest conservation was also considered in the study. Majority of respondents (75%) expressed their interest in learning about forests conservation. Overall, 67% of the respondents were willing to support efforts to protect the forest and about one-half of the respondents (51%) indicated that they would invest their time and finances in conservation efforts.

Table 4.6 Attitude towards forest conservation

Attitudinal views/Dimensions	Percent of households within the response				
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Importance of forest conservation	18	46	2	20	14
Tree nursery mgt and farm forestry	6	20.7	6	54.7	12.7
Methods of fuel wood conservation	5.3	26.7	8.7	50	9.3
Honey production techniques	11.3	46	5.3	34	3.3
Interaction with forest officers	4	38.7	12.7	36	8.7
Community surveillance	7.3	28.7	6	52.7	5.3
Consultations on forest related activities	3.3	34	6	45.3	11.3
Partnerships with other stakeholders	11.3	36.7	9.3	41.3	1.3
Confidence in future user rights	12.7	23.3	18.7	38	7.3
Interest in knowledge acquisition	2.7	3.3	4	74.7	15.3
General support for conservation activities	1.3	9.3	8.7	66.7	14
Labour and monetary contribution	8	28	10	50.7	3.3

Factor analysis was used to identify latent dimensions underlying the different variables that measured respondents' attitudes. Responses to the 12 five-point Likert-type scale items were subjected to principal component factor analysis. Factor analysis was selected to create measurement scales. In order to develop these scales, exploratory factor analysis with Varimax rotation was employed. The objective was to obtain fewer dimensions that reflected the relationships among these inter-related variables. An Eigen-value greater than one rule was applied in identifying the number of factors. The variables that had large loadings on the same factors were grouped together. Factor loadings value of 0.50 and above is normally considered good and significant. The analysis produced a solution with five factors that accounted for 75.2% of the total explained variance as shown in Table 4.7.

Table 4.7 Results of exploratory factor analysis

Factor and item description	Factor loading
Factor 1:Education and knowledge on conservation	
We have been educated on importance of forest conservation	.792
We have received training on tree nursery development and farm forests use	.808
We have been informed on use of fuel conservation methods to conserve forests	.794
We are confident of land-use rights in the long term	.639
Factor 2:Interaction and application of knowledge	
We have changed our honey production techniques to minimize tree species losses	.982
There is consultation regarding forest related activities and forest conservation	.981
Factor 3:Social and economic commitment	
There is surveillance between community and forest guards regarding forest use	.629
There is partnership between the community and other stakeholders on forest conservation	.879
Am willing to invest my resources in terms of time and finances to protect forest destruction	.540
Factor 4:Personal initiative	
Am interested in knowing more about what to do regarding forest conservation	.822
Am willing to support conservation practices that will ensure forest protection	.826
Factor 5:Consultation and goal achievement	
We have interaction with forest guards thus conservation is now achievable	.902

The Kaiser's overall measure of sampling adequacy obtained was 0.68, which borders on the recommended threshold of 0.7 suggesting that the data is marginally appropriate for factor analysis. Four attitude variables concerning education and knowledge of conservation were loaded on factor 1 with the cross-correlation coefficients of 0.792, 0.808, 0.794 and 0.639. This factor accounted for 28.7% of the total variance and was termed ‘education and knowledge of conservation’ because these variables involve awareness of conservation practices by local people. Higher scores and positive responses on this factor revealed a general need for promoting education on conservation practices.

Factor 2 had cross-correlation coefficients of 0.982 and 0.981. Because these variables imply application of acquired knowledge and interaction among stakeholders, factor 2 was then labeled ‘interaction and knowledge application and accounted for 15.7% of the total variance.

Three attributes (namely, surveillance, partnership and investment) were loaded on Factor 3 with cross-correlation coefficients of 0.629, 0.879 and 0.540. These attributes focused on social and economic issues. Hence Factor 3 was termed 'social and economic commitment'. It accounted for 11.4% of the total variance.

Factor 4 had cross correlation coefficients of 0.822 and 0.826 and these variables were labeled 'personal initiative' and it accounted for 10.8% of the total variance and the fifth factor which represented the achievement of the goal on conservation had a cross correlation coefficient of 0.902. It was termed 'consultation and goal achievement' and it accounted for 8.4% of the total variance. The cumulative percent of variance for all the factors explained was 75.2.

The findings on the attitude questions show that majority of the respondents had negative towards conservation (90%). The findings suggest the need for information on conservation; desire to know more (75%); willingness to support conservation activities (66%), and labour and financial contributions (51%).

CHAPTER 5
SUMMARY AND RECOMMENDATIONS

5.1 Summary

The natural resource base is critical in developing countries because farmers, fishermen, and cattle herders all earn their livings from the use of such renewable natural resources as land, water, air, forest, grazing areas, irrigation water, plants, and animals. Concerns about the degradation of these resources have stimulated scholars and environment related organisations to study the reasons for degradation. The destruction of natural capital has huge implications for livelihoods, poverty alleviation, and food security. It also has major implications for sustainable development and the commercial use of these resources.

This study assessed households' awareness of forest benefits, decision to use forest products, attitudes of farmers on forest conservation, and effect of regime on use of forest products. Regression techniques were used to examine conditioners of awareness, decision to use and the degree of use of forest products. In particular, the study used a Zero truncated Poisson regression to assess the degree of awareness of forest benefits, Logit regression to assess the factors influencing use of forest products and Negative binomial models to examine the factors affecting the intensity of use of forest products, respectively. The study used descriptive analysis and exploratory factor analysis to assess the attitudes of farmers on conservation. The data used was collected through personal interviews using pretested questionnaires from 150 households in Kipini division of Tana Delta district. The area was purposively selected to represent the three existing regimes that govern forest product utilization namely, the KFS, community and private management systems.

The study found that the factors influencing awareness of forest benefits include gender of the household head, amount of land owned by a household (a proxy for wealth), prevailing regime and income of household. The study specifically found that education on its own did not have a significant effect and this may have been due to the low levels of

education of households in the area. However, income was found to have a significant effect on awareness. Education and income jointly had a significant effect on awareness of forest benefits. The null hypothesis that education and income jointly have no effect on awareness was rejected. The study concluded that income and education of the households significantly impacted on the expected number of forest benefits known by a household.

The study also found that the factors explaining the use of forest products include household income, distance from the household to the forest, regime and occupation of the households head. The study particularly found that the prevailing management regime (which determines the laws on use of products, effectiveness of enforcement of laws and monitoring of forest borders and activities) had an inverse relationship with the decision to extract products from the forest. The further a household was from the forest in the KFS or Private regime the lower the likelihood of extraction of forest products. The null hypothesis that prevailing management regime does not influence use of forest products was rejected. The study concluded that prevailing management regime have a significant role in determining extraction of forest products.

The study further found that occupation of the household head, household income, distance from household to the forest and prevailing regime explain the intensity of use of forest products. Specifically, the study found that prevailing management regime had an inverse relationship with the expected number of fuel wood head-loads collected by a household in the KFS and the private regimes compared to the community regime. The study concluded that the type of management system used in the conservation of forests affects the level of forest product utilization by the surrounding community.

Lastly, this study found that the attitude of the community members towards conservation was mostly negative. This finding was contrary to our expectations. It is probably because as results indicate, most household heads do not have education on

importance of forest conservation and also did not regularly attend forest conservation meetings organized by local leaders, NGOs and environmental agencies.

5.2 Recommendations

The study findings indicate that majority of the respondents have low level of education. The low level of education has implications on various fronts including collecting, analyzing and understanding information relating to conservation. There is need therefore to invest in both formal and informal education of households in the study area. Formal education raises awareness of benefits of conserving the environment while the informal education can greatly change households' attitude towards forest conservation. Other strategies for educating households on importance of conservation may include environmental awareness campaigns and the provision of seedlings for tree nursery development; using approaches/ models that are easy to understand such as educational tours, introduction of school clubs such as 4K club, model/demonstration farms, and promotional products and training (e.g. energy saving jikos).

Gender was found to have a significant influence on awareness of forest benefits. The majority of the respondents were mainly male by gender. This may have contributed to the statistical significance in awareness. In majority of marginalized communities the women are not usually vocal especially on questions related to family. To reach out to the females who are in such areas policies that target women participation should be encouraged. The male spouses can be encouraged to attend such forums to allay any fears. Also alternative approaches can be run with men involvement as support and security.

The distance to the forest edge was found to be a significant contributor to the use of forest products indicating that households that extract forest products come from far and wide. This finding suggests the need for more effective monitoring and control of forest borders. The number of KFS and KWS ground staff needs to be increased to effectively deal

with illegal utilization of the forest. An alternative approach may include community policing and community forest associations (CFAs) using youths to assist with guarding the forest borders. This is especially because the borders are quite expansive and the number of staff on the ground is quite thin making monitoring and enforcement almost impossible. This may provide a source of employment for the youth and in turn would reduce the high unemployment levels in the area. Youth employment has the additional advantage of stemming charcoal burning which is mostly done by the younger members of the community. Secondly, investing in infrastructure particularly in all-weather roads is an option that can open up the area to investment by other sectors and is likely to enhance the speed with which guards can catch up with law-breakers and also enhance communication regarding conservation. Infrastructure in turn may create multiplier effects including investments in hospitality industry thus create more non-farm employment opportunities.

The majority of households relied on farming as the main occupation which was found to have a significant effect on utilization of forest products. To minimize on the dependence on forests there is need to invest in sensitization and training on commodity value chains which could boost income. Secondly, there is need for provision of accessible credit to households for crop intensification. This will ensure that households have increased food supply and also increased crop residue to use as fuel wood instead of relying on the forests all-year-round as well as reducing expansion of agricultural land into forest demarcated areas. The government provision of youth and women development enterprise fund a positive approach toward development; however the accessing of these funds is limited in most cases by lack of awareness by households and bureaucracies. The challenge with access to these funds can be addressed to minimize complaints on credit inaccessibility.

Diversification of activities that can help generate income in the area would also act as an incentive to reduce reliance on forest products. Vocational training on income

generating activities and increasing access to credit and/or micro-enterprise loans can help shift income sources from forest utilization to other non forest related small businesses. These findings therefore indicate the need for policymakers and the private sector to invest in activities that will generate other sources of income.

The study was limited in obtaining a sufficient sample of households who extracted forest products due to the timing. During the survey period there were fears of households being ejected from their residential areas due to forest destruction especially in the private regime. Furthermore, the size of the sample used was constrained by budget as it was difficult to obtain larger sample size across a wide range of geographical area. However, use of a smaller and focused sample permitted rigorous exploration of the research objectives which translated into better understanding of aspects regarding awareness and use of forest resources.

Since the study centred on forest benefits awareness and the utilization of forest resources, as factors that would determine forest conservation, other factors such as human wildlife conflict contribution were not explored. Management of the private regime has since year 2011, been reverted to the KFS. The effectiveness of this change can be further explored.

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Annex 1: Table of difference in respondent characteristics by regimes

	Mean Difference (I-J)						Standard. Error						Significance					
	Conservancy		KFS		Community		Conservancy		KFS		Community		Conservancy		KFS		Community	
	(J) REG		(J) REG		(J) REG		(J) REG		(J) REG		(J) REG		(J) REG		(J) REG		(J) REG	
Dependent Variable	KFS	Comm	Conserv	Comm	Conserv	KFS	KFS	Comm	Conserv	Comm	Conserv	KFS	KFS	Comm	Conserv	Comm	Conserv	KFS
Gender	0.1	0.0	-0.1	-0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.698	1.000	0.698	1.000	1.000	1.000
Age	-1.1	2.9	1.1	4.0	-2.9	-4.0	2.3	3.1	2.3	2.9	3.1	2.9	1.000	1.000	1.000	0.516	1.000	0.516
occupation	0.1	0.0	-0.1	-0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.523	1.000	0.523	1.000	1.000	1.000
Household size	0.5	0.6	-0.5	0.2	-0.6	-0.2	0.4	0.5	0.4	0.5	0.5	0.5	0.720	0.675	0.720	1.000	0.675	1.000
Awareness of benefits	-3.47543*	-1.1	3.47543*	2.3	1.1	-2.3	0.8	1.1	0.8	1.1	1.1	1.1	0.000	0.926	0.000	0.086	0.926	0.086
Group member	0.2	0.3	-0.2	0.1	-0.3	-0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.285	0.113	0.285	1.000	0.113	1.000
Total income	4749.5	17641.7	-4749.5	12892.2	-17641.7	-12892.2	5654.9	7463.5	5654.9	7109.6	7463.5	7109.6	1.000	0.058	1.000	0.215	0.058	0.215
farm size	-1.6	2.1	1.6	3.767*	-2.1	-3.767*	0.8	1.0	0.8	1.0	1.0	1.0	0.113	0.119	0.113	0.001	0.119	0.001
Distance to forest	-0.7	1.39327*	0.7	2.04359*	-1.39327*	-2.04359*	0.4	0.5	0.4	0.5	0.5	0.5	0.254	0.016	0.254	0.000	0.016	0.000
dist. to main road	9.802*	1.4	-9.802*	-8.360*	-1.4	8.360*	0.9	1.1	0.9	1.1	1.1	1.1	0.000	0.608	0.000	0.000	0.608	0.000
distance to market	5.285*	12.038*	-5.285*	6.753*	-12.038*	-6.753*	1.0	1.4	1.0	1.3	1.4	1.3	0.000	0.000	0.000	0.000	0.000	0.000
Education (years)	-1.6	0.8	1.6	2.421*	-0.8	-2.421*	0.7	1.0	0.7	0.9	1.0	0.9	0.090	1.000	0.090	0.030	1.000	0.030
phone Ownership	-0.1	0.2	0.1	0.3	-0.2	-0.3	0.1	0.1	0.1	0.1	0.1	0.1	1.000	0.446	1.000	0.086	0.446	0.086

Note: **implies the mean difference is significant at the 0.05 level.*

Annex 2: Partial correlation for Awareness of forest benefits

Dependent variable=Number of benefits known to respondent (hhawareness)	Log of age	Gender of household head	Main occupation	Log of household size	Log of income	Log of farm size	Group membership	Log of distance to main road	Forest regime	Phone ownership	Log of distance to the forest
Log of age	1	0.086	0.071	0.196	0.091	0.237	-0.070	-0.031	-0.115	-0.082	-0.028
Gender		1	0.117	0.180	-0.029	0.080	0.036	0.094	-0.064	0.121	-0.241
Main occupation			1	-0.082	-0.035	-0.159	-0.075	0.030	-0.053	-0.240	-0.161
Log of household size				1	0.494	0.322	0.131	0.068	-0.223	0.048	0.026
Log of income					1	0.160	0.198	0.214	-0.308	0.033	-0.069
Log of farm-size						1	0.234	-0.373	-0.189	0.181	0.143
Group membership							1	0.011	-0.175	0.363	-0.044
Log of distance to main road								1	-0.183	-0.12	-0.299
Forest Regime									1	-0.11	-0.037
Phone ownership										1	-0.019
Log of forest distance											1

Annex 3: Partial correlation for forest product use

Dependent variable=whether household used product or not	**Gender**	**Main occupation** (Whether farming or not)	**Log of household size**	**Log of income**	**Log of farm size**	**Forest Regime**	**Phone ownership** (Whether household owns a phone or otherwise)	**Log of distance to the forest**
Gender	1	0.093	0.208	0.028	0.089	-0.066	0.146	-0.248
Occupation		1	-0.105	-0.061	-0.142	-0.109	-0.241	-0.152
Log of household size			1	0.543	0.318	-0.191	0.089	0.004
Log of income				1	0.151	-0.239	0.091	-0.095
Log of farm-size					1	-0.166	0.174	0.140
Forest Regime						1	-0.074	-0.042
Phone ownership							1	-0.033
Log of distance to forest edge								1

Annex 4: Partial correlation for intensity of use of forest products

Dependent Variables=Quantity of head loads collected	Gender	Household size	Community regime	KFS regime	Conservancy regime	Occupation	Education (years)	log of farm-size	log of age	lndist	cfreq
Gender of the head	1										
Household size	0.184	1									
Community regime	0.032	-0.039	1								
KFS regime	0.020	-0.076	0.132	1							
Conservancy regime	0.040	0.047	-0.265	-0.254	1						
Main occupation	0.106	-0.093	0.014	0.041	0.170	1					
Education(years)	0.225	0.014	-0.157	0.046	-0.064	-0.147	1				
Log of farm-size	0.078	0.336	-0.365	0.082	-0.026	-0.159	0.097	1			
Log of age	0.092	0.235	-0.166	-0.222	0.123	0.064	-0.276	0.236	1		
Log of distance to forest	-0.248	0.029	-0.199	0.045	0.022	-0.154	-0.055	0.143	-0.030	1	
Collection frequency	0.133	0.046	0.049	-0.043	0.309	-0.056	-0.099	-0.021	0.102	-0.016	1

Annex 5: Household Questionnaire

ASSESSMENT OF FACTORS INFLUENCING UTILIZATION OF FOREST RESOURCES IN KIPINI DIVISION, TANA DELTA DISTRICT, KENYA

Household Questionnaire

(The questionnaire to be administered to household head or spouse)

Date: **DD/MM/YYYY**_____

HH Name _____

Respondent(s) name _____

Phone Number _____

Identifying Variables:

Enumerator: _____ **ENUM** _____
Division: _____ **DIV** _____
Location: _____ **LOC** _____
Sub-Location: _____ **SUBLOC** _____
Village: _____ **VIL** _____

Regime: 1=KFS 2=Community 3=Private/ Reserve **REG** _____

Section 1: Forest Product Use

Table 1: Forest use

Did your household use any of the following products (period between February and July 2010)	What was the main product source	What is the alternative source of the product	If source of product is forest, how far is it from homestead	What is the purpose of the product? 1=Home use 2=Sale 3=Both	Does the purpose influence the quantity and quality collected? 1=Yes 0=No	What is the means of transport for the product from source to your home/ sale point
Fuelwood						
Charcoal						
Medicinal herbs						
Timber						
Fodder						
Poles						
Boat materials						

Source: 1=Own woodlot/farm forest 2=Govt Forest 3=Market 4=Private lands 5=Community forest

Means of transport: 1=Walking 2=Bicycle 3=Cart 4=Motorbike 5= Vehicle

Please indicate your collection of products in the table below

Table 2: Forest products obtained (*Household and sale separate columns*)

Forest Product	trips per month	Time spent per trip(Hrs)	HH mem involved 1=Head 2=Spouse 3=Sons/Daughters 4=Hired worker	Total Labor cost (Kshs)(*if you hire labor for collection*)	Qty per trip	Units *See codes below*	No. of month collected in the last 6 months	Permit cost*(if you paid and for what period*)
Building material								
Poles								
Timber								
Boat material								
Medicinal plants								
Fruits								
Fodder								
Firewood								
Charcoal								
Grazing								
Other specify								

Codes: 1=kg 2=90 Kg bag 3=50kg bag 4=numbers 5=Head load 6=Bundles 7= other (specify_____

Section 2: Rules and Regulations

1. Are there any formal rules governing the harvesting/collection of these products?

1.Yes0. No

2. Are there any informal rules governing the harvesting/collection of these products? 1.

Yes0. No

Table 3: Rules and regulations

Type of rule 1=Formal 2=Informal	What are the rules existing	Who is responsible for the formulation 1=Govt 2=Community 3=Tradition/Culture 4=Other (specify_____)	What are the punishment/penalties for violation of rules

Informal Rules: 1.Forests are divine and should not be destroyed 2. They are our heritage they are to be preserved 3. Belief that interference result into a curse 4. They are water catchments which need protection 5. Preserve for cultural activities 6. Other (Specify) _____

Formal Rules: 1. Govt restriction 2. Community restriction 3. Cutting trees requires permission/permit

4. Trees along the riverbed are govt property, no cutting 5. Other (specify) _____

Source: 1.Govt 2. Community 3.Govt and Community 4. Tradition/ Culture 5. NGO 6. Other (specify) _____

Penalties: 1. Pay fine 2. Ex-communication 3.Jail 4. Plant a given number of trees 5.Other (Specify) _____

4. Have there been challenges with obedience to these rules? 1. Yes 0. No

5. What challenges does your household face?

_____

_____ .

6. Have you developed any ways to overcome these challenges?1. Yes 0. No

7. If yes, what ways have you developed to overcome the challenges?

_____

_____

Section 3: Forest Cover Trends

1. What has been the general trend tree cover on forestland in this area?

1. Increased 2. Declined 3. Remained the same

2. What factors in your view have contributed to the trend mentioned above?

1. Education and training by organisations 2. Awareness campaigns by different ministries 3.Lack of adequate land for cultivation 4. Wildlife and human conflicts 5. Better price 6. Traditional norms 7.Govt protection 8.Community protection 9. Individual's resolution to abide by rules 10. Other (specify) _____

3. If answer for **qn 1 above is declined,** has this impacted on your livelihood?

1. Yes 0. No

4. How has this impacted your livelihood? 1. Lack of firewood 2.Lack of herbs 3.Lack of poles and timber 4.Declining water sources 5.Other _____

5. Have any ways/plans been developed to reverse the trend? 1.Yes 0.No

6. If yes, name some of things that have been done? 1. Education and training 2. Awareness campaigns 3. Behavioural change 4.Micro-credit loan programs 5. Organization campaigns for collective action 6.Other (specify...)

7. Who are the main players (e.g NGO, govt depts., community) who have been at the forefront of these plans?

_____ .

8. Have these plans/ways been implemented?1.Yes 0=No

9. If yes, have they made any changes in the forest cover? 1. Yes 0. No

10. What challenges have mentioned players faced in carrying out their plans?

_____

_____

11. Please comment on the results?

_____

_____

Section 4: Community's Role in Forests Use

1. Has the community played any role in forests trends described above? 1. Yes 0. No

2. If yes, what role? 1=Control logging 2=Control charcoal burning
3=Tree nursery management 4=Re-afforestation 5= Report fire out break
6= Monitoring and reporting illegal activities 7=Punishing(Sanctioning) lawbreakers
8=other (specify)_____

3. Have they made any plans to handle matters relating to destruction by either outsiders/ insiders (disobedient community members)? 1. Yes 0. No

4. What plans has the community put in place?

_____

___

5. Have they succeeded or failed in their plans? 1. Yes 0. No

6. What challenges have they faced in this process of carrying out the plans?

_____

_____

7. Have these challenges deterred their onward progress? 1. Yes 0. No

8. Comment on your answer above?

_____

_____ .

Section 5: Management and Conservation of Forest Resources

Ask the following questions on every type of forest existing in the area

Table 4: Forest management

Forest type 1=Natural forest 2=Farm forestry 3=Plantation forestry 4=Other (Specify)	Who manages this forest	As an individual what is your role in the management of this forest?	What is the role of the local community in the management of this forest? *(Same codes as previous column)*	Does this community, have partnership agreements with the forestry department 1=Yes2=No 3=Not sure	If yes, what are the arrangements/agreements
FTYPE	**WMGT**	**IROLE**	**CROLE**	**PARTY**	**AGRMENT**

Whomgt 1=Forestry Department/National Forestry Authority/KWS/KF 2= local authority/community 3= Individual 4=NGO/CBO 5= Other (specify) _____

Irole/Crole0=No role 1=Control logging 2=Control charcoal burning 3=Tree nursery management 4=Re-afforestation 5= Report fire break out 6= Monitoring and reporting illegal activities 7=other specify_____

Agreement1=Controlled/Seasonal use 2=Tree planting 3=Monitoring and reporting illegal activities 4= Other (Specify___)

What is your opinion about the following organizations/departments participating in the management of forests?

Table 5: Management opinion

Type of organization	Role in forest management	What is your opinion about their role in the management of forests? 1= working very well 2= working well 3= just satisfactory 4= not satisfactory 5= totally ineffective
Forest Department/ Kenya Forest Services		
NEMA		
Kenya Wildlife Services		
Local Authority/ Local KFS		
N.G.O. e.g. Nature Kenya		
Community Forest Association		
Others(Specify)_____		

ROLE1=lobbying 2=Monitoring3=conservation 4= tree planting 5=capacity building 6= awareness campaigns 7=other (Specify) _____

Section 6: Land Use and Food Security

The following questions concern the profile of your land for crops, livestock etc (s) NB: *area should be in acres*

1. How many acres in total land holding do the household own? Tacres _____

Table 6: Farm Profile

Farm ID	**Size in acres**	**Area under crops**	**Grazing Area**	**Area under trees (farm forest)**	**Idle/ Unused land**	**Tenure status** 1=with title 2=without title 3=rented in	**Mode of acquisition** 1=Bought 2=Gift 3=Inherited 4= Rented in 5=trust land 6=Other (Specify_____
1.Homestead							
2.							
3.							
4.							

2. Did this household have any cropping activity during MAIN CROP season?
   1=Yes 0=No
3. Did this household have any cropping activity during SHORT CROP season?
   1= Yes 0=No

Table 7: Food security

	Maize	Bean	Bananas /plantain	Cassava	Pigeon peas
1. During which month did you harvest this staple crop (**Months**)					
2. Did your stocks of harvested crops from last season last household needs until the following season **(1=Yes 2=No)**					
3. If **NO** to **Q2** above, for how many months was the harvest enough to meet the household needs?					
4. During which month(s) did you have to buy this staple? (**Months**)					
5. How much (kg) did you buy to meet the deficit?					
6. How much (kg) did you borrow or receive as gifts?					
7. What was **the main** source of money used to buy the food items **(Source)**					
8. How much food aid (specify unit) did you receive during the year (including food for work)?					

Months				**Source**	
1. January	4. April	7. July	10. October	1. Sale of other crops	4. wage employment
2. February	5. May	8. August	11. November	2. Sale of livestock	5. Non-wage job
3. March	6. June	9. September	12. December	3. Remittances	6. Other, specify…….

Section 7: Awareness and Use of Information Communication Technologies (ICT) and Services in Agriculture and Forestry

1. Are you aware of a project in this area that uses ICT for farming/forestry information?
   1. Yes 0. No
2. If YES to Q1, what is the name of the project? ……
3. What ICT technology does the project use in providing information to farmers/households?
   1. Mobile phone 2. Television 3.Radio 4.CD Rom/Video 4. Internet/email
5. Other……
4. Are you a member of the project? 1. Yes 0. No
5. If NO to Q4, do you use any information from the ICT project? 1. Yes 0. No
6. If you use information from the ICT project, how do you obtain that information?
   1. Spouse member 2. Neighbour 3. Friend 4.Other .....5. N/A

Section 8: Mobile Phone-Based Money Transfer

1. Are you aware of mobile phone-based money transfer methods? 1. Yes 0. No
2. If YES to Q2, which of the mobile phone-based money transfer methods you are aware of?

   1. M-PESA 2.ZAP 3.YU-CASH 4.Other (Specify……) 5. Don't know
3. How did you first hear of mobile phone - based money transfer methods? [*circle all that applies*]
   1. Radio 2. TV 3. Newspaper 4.Friends 5.Family members
   6. Receiving money 7.Extension officer 8.Other (Specify ……)
3. What is the distance (Km) to the nearest mobile phone-based money transfer agent_____
4. Have you ever used the mobile phone - based money transfer methods? 1. Yes 0. No
5. If yes to Q5, which of the mobile phone-based money transfer service do you use?
   1. M-PESA 2. ZAP 3. YU-CASH 4.Other (……) 5. Do not know

5b. How many times did you use the mobile phone-based money transfer services in the last 12 months (June 2009 to July 2010)? A. Receiving_____ B. Sending _____

6. For what purpose(s) did you send the money in the last 12 months?
   1. Payment of hired labour for product collection 2.Settle debts (purchased products)
   3. Payment for transport (products collected) 4. Other (specify_____)

7. Did you use a mobile phone to contact any buyer/seller of forest products in the last 12 months? 1. Yes 0. No
8. If yes what activity was it? 1. Buying 2. Selling
9. Has the use of mobile phone increased your accessibility of forest products? 1. Yes 0.No
10. Has the use of mobile phone increased your marketing of forest products?
    1. Yes 0.No
11. If yes how ?

_____

_____.

Section 9: Demographic Characteristics of Household Members

(*We are interested in knowing the members of your household since they assist in farming and other household chores such as water, fuelwood collection and also live with you in the household etc).*

Table 8: Household Characteristics

Mem No.	Name	Sex 1=male 2=female	Age in years	Marital status (*codes below)*	Highest level of education (*code below)*	Number of years in school	Relationship to head *(codes below)*	Main Occupation *(see code)*

Marital status 1=Monogamous Married, 2=Polygamous Married, 3=Single, 4=Separated, 5=Divorced, 6=Widow or Widower, 7=Never Married

Education Level 1=None 2= Primary 3=Secondary 4=Middle-level college 5=University 6= others (Specify) _____

Relation to head 1=Head, 2=Spouse, 3=Son/Daughter= 4=Father/Mother 5=Sister/Brother 6=Grandchild, 7=other relative (Specify) 8=Worker 9=Other Non-Relative

Occupation 1=Farming 2=Casual labour 3=Employed 4=Family business 5=self-employed 6=Student 7=none 8= other (specify) _____

Section 10: Income Sources

How much income, did your household receive from other sources in the last cropping year apart from credit?

Table 9: Income

Sources	Amount in Kshs	Earning member 1=head 2=spouse 3=child 4=relative
Rented out land		
Sales of crops (harvested)		
Sale of livestock products		
Sale of livestock		
Sale of own trees		
Merry go rounds		
Casual village labour		
Regular employment		
Pension income		
Business income		
Rented property (buildings, assets etc)		
Dowry		
Remittances		
Other specify_____		

Section 11: Household Membership in Groups

1. Is anyone in this household a member of a group? (1=Yes 0=No)

2. Indicate in the table below the type of group/ organization

Table 10: Group Membership

Name of mem	Type of group 1=Business 2=Farmer 3=Self-help/credit 4=Merry-go-round 5=Women 6=Family/clan 7=Comm. Forest Assoc. 8=Other (specify)	Group activities	Number of meetings per month	Year joined	Fee needed for entry 1=yes 0=no	Benefits 0=none 1=education and training 2=credit 3=labour sharing 4=market access 5=resource access 6=other	Leadership position held

Activities 1=marketing 2=tree planting 3=soil and water conservation 4=financial services 5= farming 6=monitoring forest use 7=Forest mgt role 8= Other (specify)
Leadership 0=Ordinary member 1=Chairman 2=vice-chair 3=Secretary 4=vice-secretary 5=organising secretary 6=Treasurer 7=Vice-treasurer 8=Other (specify)

Section 12: Awareness of Forest Benefits (Direct and Direct Use)

For this section read out to the respondent the benefits and tick those they are aware of on the list. Then ask respondents to rank the benefits you have ticked in order of importance

Table 11: Forest benefits

DIRECT BENEFITS	Tick (√) if they are aware	Rank by importance 1=Not important 2=Neutral 3=Very important
1.Fuelwood		
2.Charcoal		
3.Herbs and aromatic plants		
4.Poles		
5.Wood for boat making		
6.Hunting animals and gathering fruits		
7.Timber		
8.Fodder		
9. Other specify (…)		
INDIRECT BENEFITS	Tick (√) if they are aware	Rank by importance(as above)
9.Grazing Livestock		
10. Flood control		
11.Soil Conservation		
12.Improve air quality (sequester carbon)		
13. Provide place to observe nature(eco-tourism)		
14.Water catchment		
15.Habitat for plant and animal(biodiversity)		
16.Honey production		
17. Provide place for relaxing (recreation)		
18.Provide place for worship		
19. Climate stabilization		
20. Other specify (…..)		

Section 13: Household Attitude on Forests Conservation

For each of the following statements please state your view

1=Strongly agree 2=Agree 3=Neutral 4=Disagree 5=Strongly Disagree

1. We have been educated on the importance of conserving forests. [ ]

2. We are confident of land use rights in the long term. [ ]
3. Forest guards are very harsh and biased therefore we cannot agree on appropriate conservation approaches. [ ]
4. We have been trained on role of trees in soil and water conservation. [ ]
5. We have resolved to use improved methods of fuel use to conserve trees. [ ]
6. I am willing to supportconservation practices that will ensure forests are protected. [ ]
7. I would like to learn more about what I can do to conserve the forests. [ ]
8. I am willing to contribute my resources including my time to guard the forests in this locality.[]
9. We are encouraged by the contribution of NGO in assisting to conserve forests by hiring of community forest guards, training on methods on fuel conservation methods. [ ]
11. The community and the forest guards are working together in surveillance. [ ]
12. There is no consultation on forest related activities between community and forest officers. [ ]
13. We have changed our honey production technique to the use of recommended hive types e.g. top bar and log hives. [ ]
14. There is good rapport between the community and the NGO therefore the forest conservation aspirations are being realized.

Section 14: Regime

1. Has the management regime (Community or KFS or Conservancy) of this forest influenced your use of the forest resourcesin any way? 1. Yes 2. No
2. If yes, in what way?

   1. Restricted on the resources to collect. 2. Trained on ways to minimize fuel wood use and maintain own woodlots. 3. Limited frequency of collection of the resources 4. Having meetings on ways alternative income generation activities 5. Introduction of payment for resources collected 6. Other (Specify) _____
3. Have you benefited from the existence of this regime? 1. Yes 2. No
4. How have you benefited?

   1. Time saving through reduced fuelwood use
   2. Trained on various environment conservation measures e.g. farm forestry.

3. Better and safe ways of honey production
4. Equipped with skills for community service
5. Skills for income generation.
6. Conservation and management benefits
7. Other (Specify_____)

5. Do you have any additional issues or comments on the management regime?

_____
_____