

NGONG FOREST DEPENDENCE AND HOUSEHOLD WELFARE

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DECLARATION

I, the undersigned, declare that this is my original work and has not been submitted to any other college, institution or university for academic credit

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This project has been presented for examination with my approval as the University supervisor.

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ACRONYMS AND ABBREVIATIONS

KACC	Kenya Anti Corruption Commission
KFS	Kenya Forest Service
DFID	Department for International Development
KNBS	Kenya national bureau of statistics
FAO	Food and Agriculture Organization of the United Nations
Ha	Hectare
GDP	Gross Domestic Product
NTFPs	Non-Timber Forest Products
CEEPA	Centre for Environmental Economics and Policy in Africa
CF	Community Forestry

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ABSTRACT

Rural households depend on freely-provided forest goods and services for their welfare. Household budget surveys do not incorporate forest income and as a result their impact to household income, consumption and general welfare is misunderstood. This study attempted to examine the economic contribution made by Ngong forest to rural households that surround it.

The study area that the sample was drawn from was the Kibiko Holding Ground with a population of 1,025 and 199 households. The study population was 199 households as households were the study unit. A sample size of 55 households was identified through systematic random sampling.

Results indicated that the forest resources that are mostly extracted by the households are firewood, followed by honey, poles, vegetables and finally medicinal herbs. Study results also revealed that only the count of livestock and the quintile income mattered in the extraction of forest resources. The rest of the socioeconomic factors (gender, literacy, years of education, age, family size, family composition, sickness shocks) did not matter for forest resource extraction. The extraction of absolute forest resources is highest in the top 20% (richest households). However, the share of forest resources to total household income is highest in the lowest 20% (poorest households). The estimated monthly extraction of forest resources per household was KES 5,309.

The study concluded that poorer households are more resource dependent than the rich. In addition, forest income contributes significantly towards household welfare. Hence, an effort to balance between environmental concerns and sustainable livelihoods should ensure that families living in the area are paid an equivalent KES 5,309 per month to alleviate their suffering in case they were to be translocated to other non forest areas.

KEY WORDS: *Kenya, Forest Income, Quintiles, Forest Resources, Household Income*

JEL CODES: D31, Q51, Q56, 013

1.0 INTRODUCTION

1.1 Background

Natural resources provide rural people with food, medicines, meat, honey, gums and resins, condiments and other goods that are exchanged or used for secondary processing, and contribute greatly to rural subsistence economies (Kaimowitz, 2003). In sub-Saharan Africa, forests provide rural people with timber, wood, pulp and foodstuffs, which are further processed into manufactured goods such as lumber, paper and pharmaceuticals. The provision of foodstuffs shows that forests are vital for the welfare of the rural African communities. For example, in rural areas of the Congo Basin, five to six million tonnes of bush meat are harvested each year and account for up to 80 percent of the fats and proteins consumed by local communities (CIFOR, 2012). The traditional swidden agricultural systems depend on the forests for nutrients. Forests are also source of fodder for livestock (Campbell and Luckert 2002, Kowero et al. 2003). In Sub-Saharan Africa, about 15 million people in derive their cash income from forest-related enterprises such as fuel wood and charcoal sales, small-scale saw-milling, commercial hunting and handicraft. In addition, between 200,000 and 300,000 people are directly employed in the commercial timber industry (Jumbe, B.L et al, 2005) and in some countries, the forestry sector is an important foreign exchange earner.

The general observation in the use of forests is that communities living around forests do not use forest resources in a coordinated manner and this depletes the resources faster. It is understood that poor rural peasants are the agents of this process (Cavendish, 1999). However, reliable data on forest depletion do not exist. Published data on forest resource change are simply estimates (Cavendish, 2000).

The problem of lack of data on forest and other natural resources is more acute in Africa than in other regions. In spite of the wealth of literature on the contribution of forests to poverty alleviation and food security the value of forests in household welfare is hardly integrated into national planning processes.

Quantitative analysis of household use of forest resources is limited. The use value of the full range of forest resources is also vague and scant. Given that a forest ecosystem provides a basket of highly differentiated goods and services, more empirical evidence examining household dependence on these commodities in a robust analytical framework is necessary. (Hegde, R. and Bull, G., 2005).

The low profile of forests has been as a result of lack of quantitative micro-level research of forests contribution to household welfare in past studies. Micro level analyses of the uses to which households put forests resources provides insights on the importance of the resources. These analyses help to devise policy interventions for sustainable use of forests. From this perspective, it is important to quantify forest contributions to household welfare so that these contributions can be entered into policy debates with a view to enhance forest conservation without compromising household welfare. Micro-level quantitative analysis of household's use of forest resources is important from policy, economic and ecological perspectives. (Cavendish, 2000).

The goods and services that are derived from Ngong forest by the households that live around the forest are not clearly understood. There is a lack of appreciation of the economic potential of this forest to poor households' welfare, and as a result, Ngong Forest is being lost to make way for other development activities. This study looks at households' use of this forest's

resources and attempts to put values to these resources in order to shed light on their impact to household consumption, income and general welfare.

1.2 Statement of the Research Problem

Rural households depend on freely-provided forest goods and services for their welfare. Forests provide both productive inputs and consumption goods. Since this forest resource uses are classically omitted from standard household budget surveys there is a substantial gap in our quantitative understanding of rural household incomes Cavendish, W. and Campbell, B.M. (1994). In total value terms, forest resources account for a significant portion of income of households that neighbor the forests. Household budget surveys do not incorporate forest income and as a result their impact to household income, consumption and general welfare is misunderstood. A clear analysis of their importance is needed to bridge this gap.

The current study aimed to understand why there is a general lack of appreciation of the economic potential of Ngong forest. The study aimed to shed more light on the goods and services that are derived from Ngong forest by communities living adjacent to it. Past valuation studies on the forest have focused only on goods that have a market value as a requirement of standard household budget surveys. The current study aimed to value all goods and services that are consumed by households in order to understand their impact on household income, consumption and general welfare.

Research Questions

- a. What goods and services are extracted from Ngong Forest by households that neighbor the forest?

- b. What are the estimated local prices for the forest goods and services that neighbor the forest?
- c. What are the socio-economic characteristics of the households that extract various types of forest resources?
- d. What is the contribution of forest resources to household income?

1.3 Objectives of the study

The main objective of this study was to examine the economic contribution made by Ngong forest to rural households that surround it. Specifically, the study aims to:-

- a. Identify the goods and services that Ngong Forest provides to households and their contribution to household consumption, income and welfare.
- b. Estimate the local prices for the forest goods and services that have a market value and Willingness to Pay for goods without a market value.
- c. Quantify the contribution of forest resources to household income and level of dependence by different income groups (quintiles).
- d. Identify the socio-economic characteristics of the households that use various types of forest resources and their impact on forest dependence.
- e. Draw policy implications from the findings of the study.

1.4 Significance of the Study

Past studies that have attempted to achieve the same objective include Cavendish (2000), Kabubo-Mariara and Gachoki (2008), Hedge and Bull (2005). However, the current study aims to address the research gap by extensive environmental valuation of Ngong forest which has not been done in the past. The current study brings forth both marketed and non-marketed goods and services of Ngong forest in its valuation process to bring out the real value of the forest to household welfare. Past studies have not gone to this extent and have only focused on goods that are captured by household budget surveys and left out those that are purely for consumption purposes. In addition, the level of dependence on forest resource by different income groups has been well documented for appropriate policy legislation. A comparison of households other incomes and forest income has also been well captured in the study and related resource use with various socio-demographic characteristics of the households.

Over the last decade, a useful and growing body of literature has been established that deals with forest environmental valuation, including many of the non-market values that were omitted from calculations in the past (Emerton, 2003).

The lack of this official data has left a gap in the understanding of the important contribution of the forest to households and hence has resulted in the loss of the resource towards urban development. The results of the study will shed more light on its economic value and the need to conserve and protect it. The findings of the study will also assist in drawing appropriate policy legislations in the forestry sector in Kenya.

In Africa, there are few studies that directly assess the contribution of forest-earned income to the households that neighbor forests. It can be assumed that the income from forests helps to supplement other sources of income and during periods of hardship. It is well known that forest incomes are particularly important for poor people and deprivation of access to forest resources may have serious impacts on rural household incomes both in terms of consumption and cash income generation. Therefore there is need to derive the values that are generated from forest resource extraction.

In Kenya, we find that most forested areas are inhabited by communities living around it and the households extract forest resources from those forests. However, no official statistics exist of the amount of resources that are derived and their values and contribution towards the welfare of those communities.

2.0 LITERATURE REVIEW

2.1 Theoretical Literature Review

Forests provide a wide range of benefits for poor households in terms of improving their standards of living in households engaging in high-return forest occupations through supplementing their income. There are three distinct roles of forests: safety nets, support of current consumption (coping strategy) and a pathway out of poverty through household income sustainability. The safety net role refers to the role that forests can play during periods of hardship (such as to cushion against unexpected income shortfalls due to say family illness, natural disasters etc.) and depends on household vulnerability. The second role sees forests not only as a gap-filler (complementing other incomes especially when there are seasonal food shortfalls) but also as a source of regular subsistence use (Cavendish, 2003, Vedeld et al. 2004; Angelsen and Wunder 2003, Fisher, 2004). The poverty reduction role is through diversification and specialized forest strategies adopted by households, but also provision of important environmental services which benefit local, regional, national and even global stakeholders (Vedeld et al. 2004; Angelsen and Wunder 2003).

Forest dependence and thus environmental income is relatively more important for the poor and therefore forest degradation and overuse will hurt the poor more than the non-poor. Most of the households that live next to the forests are poor households and they rely more on the forests for their survival as opposed to the rich households who are at the end of the value chain and benefit from the finished forest products and have other sources of income to rely on (Vedeld et al., 2004). The authors contribute to the literature that forests and other common pool resources contribute significantly to rural incomes and towards poverty reduction. In addition, the current study agrees with the concept that rich households extract

more forest resources in absolute terms than poor households. However, the author failed to estimate the local prices of both marketable and non marketable forest products and also failed to underscore the determinants of forest extraction by households. In particular, the author did not show the effect of shocks on the extraction of forest resources. The current study addressed this gap by employing rigorous and systematic methods of estimating local prices of both marketable and non marketable forest products and also established the determinants of forest extraction by households.

Forests resources are important natural capital to the economy. Past development efforts have primarily focused on building natural capital in general but not equal attention has been paid to how forests are used in combination with other natural assets and other livelihood assets to sustain livelihoods. This has resulted in gaps in our understanding of the contribution of forest products to sustainable livelihoods and thus poverty reduction. More efforts are needed in this area in terms of studies to show how important these natural assets are important to households and their contribution to the general economy as a whole (FAO, 2000). The study helps to understand the importance of forest resources to the economy and poverty reduction strategies. It therefore helps in coming up with appropriate policies that help to sustainably conserve forest resources for the poor. The study had various gap, in particular, the use of desk study methodology to assess the importance of forest resources in poverty reduction implies that the methodology was not econometric and nether was it rigorous. The present study bridged this methodological gap by adopting a series of econometric techniques to show the contribution of forest resources to household income. The study also had a contextual gap as it failed to reveal the extent to which forest resources are extracted by residents of Ngong Forest.

Forest and tree stocks provide a reserve upon which people can fall back for subsistence and income, especially in times of crop failure, unemployment and other kinds of hardship, or to meet exceptional needs. Forest and tree foods are most extensively used to help meet dietary shortfalls during particular seasons in the year. Energy-rich tree foods such as roots, tubers, leaves, rhizomes and nuts are especially important during emergency periods such as floods, famines, droughts and wars. In addition to food, forests and trees outside forests play often a significant role in meeting the needs of the rural poor, including those related to shelter (building material) and health (medicinal plants) (FAO, 2000). The study contribution to the issues at hand is revealed by the conclusion that forests and trees outside forests play often a significant role in meeting the needs of the rural poor. However, the study failed to reveal the determinants of forest resource extraction. The study also employed a desk study methodology which is not econometric. The current study addressed these two issues by employing an econometric methodology in establishing the determinants of forest resource extraction. The current study was also specific to Kenya Ngong Forest.

Forests assist households in generating income directly through different ways namely employment in formal forest industries, small informal forest-related businesses and sale of several forest products. In addition, they assist households indirectly by providing inputs for non-forest income-generating products e.g. source of fertility for agricultural products or fodder for livestock.

Income from forests can be flexible which presents a positive feature for the rural poor. It can either be “lumpy” (e.g. through sales of mature trees planted at the period), as an opportunity for investment in building up assets); or staggered which helps in making ends meet and/or fulfilling social obligations (FAO, 2000). The literature brings out a wide range of benefits which shows the importance of forests towards the rural poor. The study

emphasizes that without forests the poor do not have a safety net to fall back on during times of hardship and therefore there is need to conserve the forests. Globally, there is a long tradition of concern about household welfare and forest dependence. The prospect of more than 300 million people the world over, especially the poor, depending substantially on forest gathering for daily subsistence and survival, cannot be a matter for policy indifference. Forest dependence can be linked to socio-economic and cultural consequences. On the economic front, there are some associated costs and benefits from using forests. The potential benefits include: daily subsistence and survival from forest product gathering, and income redistribution and poverty reduction. The potential costs include: increase in global warming emanating from carbon emissions caused by forest use and displacement and destruction of natural habitats of important ecosystem species. Socio-culturally, the benefits may include fresh water, recreational facilities, firewood, timber, medicine and the role of forestry in the local traditions and customs of the people (Fonta et al. 2010). The wide range of forest benefits highlighted by Fonta et al enriches the current study.

Arnold and Townson, (1998), in their paper say that large numbers of rural households in Africa continue to generate some of their income from forest product activities. However, much of this involvement is in labor intensive low return activities that help to provide the poor with an income safety net, but which decline once better alternatives become available. Expansion of forest product activities is likely to be concentrated on a limited number of products and services for which demand grows with rural and urban development. The paper reviews the implications of this dichotomy for support and resource management strategies.

The proportion of poor people depending on forest resources can vary according to circumstances and how livelihood patterns evolve over time. The paper outlines the categories of forest dependence which include; *Forest dwellers*, including hunter-gatherers

and swidden cultivators; *Farmers living next to forests*, who use forests as a complement to livelihood diversification (includes the landless); *Commercial users*, including small producers, traders and employees; *Consumers of forest products* among the urban poor. (Byron and Arnold (1999) and Sunderlin et al (2002)). The current study uses a different approach and does not classify forest dependence into categories but focuses more on the differentiated products and services derived from forests. The methodology was desk based which is not econometric and therefore failed to reveal the determinants of forest resource extraction.

In times of crisis, the “safety net” role of forests and trees becomes more pronounced (FAO, 2006). Poor people do not have ways of insuring themselves against periods of hardship and are therefore vulnerable. It is in times of hardship and in the absence of a welfare state that the poor look to the nearby forests and trees for the means to keep going. It therefore shows that trees and forest resources help households in the lean season i.e. between the end of one harvest and the next when food is short, or through periods of seasonal unemployment. If a sudden emergency befalls a family, trees and forests may be one of the few salvations (FAO, 2006). If the problem is sickness or infirmity, the forest may provide an affordable remedy, if cash is suddenly needed for an unexpected expense like a funeral, products from the forest may be collected and sold, or a standing tree “cashed-in” like a savings account or used as collateral on a loan. In countries such as Malawi and Mozambique and the rest of Sub Saharan African countries where HIV/AIDs has taken a hold, forest foods can help keep families going when there are no longer enough healthy adults left to produce food. The study differed in methodology as it focused its objective on the safety net role of forests in times of hardship.

The poor regularly collect goods for subsistence use from forests and from trees outside forests. They do so because they lack alternatives and because the goods can be easily and freely collected locally. Typical products collected for use at home and on the farm are: fuel wood, food and condiments, medicines, fodder, poles and thatch (FAO, 2006). . Forests and trees are often critical elements of farming systems. For the poor, forests and trees provide a way to maintain soil fertility and provide a better alternative to purchasing expensive fertilizers. In societies where bush-fallow farming is the normal way of maintaining soil fertility, trees are a critical element of the farming rotation. By maintaining a few trees on farms, poor farmers also have a way to generate some food annually without reverting to new seeds or scarce labor. Many of the tools the farmer needs to work the land or harvest its bounty have their origin in the forest and it is a cheaper option than going to the market place (FAO, 2006). Rarely do the poor manage to secure a good job or create a small business that meets all their cash needs. Poor people have to search for many ways of making small sums of cash. Millions of people supplement their household income by harvesting, processing and marketing fuel wood, baskets, honey, tools, leaves, meat, and nuts (FAO, 2006). The current study incorporates the various products and services highlighted in the paper in its methodology and research instrument. However, the difference with the current study is in its concept of focus of forests in aiding farming activities.

Forest and tree products are attractive because they are easy to access, they require little capital or technical skills, and the produce can be processed at home and sold locally. These characteristics often provide women with one of the few opportunities they have to generate income as a group visiting the forest or at home. Heavily forested regions are often remote, marginalized areas where health, education and transport services are hard to come by. The only routes out of poverty in these regions are for people to gain access to the valuable forest

products, to migrate or to hope for external investment in the local economy. The arrival of large forestry enterprises can provide opportunities for unskilled work in silviculture, harvesting and processing. The indirect benefits of forests and trees are well known to local people, all the more so when they are compromised. Forests protect fragile crops from heavy winds, they help keep terraces and slopes stable and erosion free, and they keep water sources flowing. In some communities, trees and forests are also an integral part of local cultural and spiritual identity (FAO, 2006). The findings of this literature are useful in the current study in providing more evidence that the rural households supplement their household income by extracting forest resources and boosting their farm produce through control of soil erosion and increase in water flow. However the approach differs in terms of its focus towards poverty alleviation.

Natural forests are home to human evolution and human populations that have lived there for millennia and are at a relatively low level of socio-economic development. Moreover, migrant rural populations that colonize forested areas and seek new agricultural lands are often relatively poor. Forests often serve as an employer of last resort for economically marginalized people, for example, due to skewed land distributions in the lowlands. In the course of history, forests have often served as a refuge for less powerful people fleeing oppression, conflict and war (FAO, 2003). The current study agrees with the findings in the study that natural forests since history have been a source of livelihood for human populations. It however fails to establish the determinants of forest resource extraction, a gap that is addressed by this study.

Forests have an important role to play in alleviating poverty worldwide in two senses. First, they serve a vital safety net function, helping rural people avoid poverty, or helping those who are poor to mitigate their plight. Second, forests have untapped potential to actually lift

some rural people out of poverty. These characteristics are unknown to many policymakers and planners because the safety net functions of forests are, in some respects, poorly understood and recognized. One reason for this is that the contribution of forests to poor households is largely unrecorded in national statistics, most of it being for subsistence or for trade in local markets. In addition, the lion's share of wealth from timber goes to better-off segments of society while some aspects of timber resources actually inhibit their potential to assist marginalized people. In spite of these obstacles, forests can increase their contribution to poverty alleviation, provided that decision-makers recognize and act on their potential. The literature by a FAO agrees greatly with the current study as the benefits accrued from forest resources are unrecorded and poorly understood. Therefore there is need to value these resources and officially document them in order to come up with appropriate legislation.

Emerton (2003) argues in her paper that undervaluation of tropical forest ecosystems has discriminated against their sustainable management. Forest environmental benefits have long been underemphasized or ignored altogether by planners and decision-makers because they are so hard to value, and because many lie outside formal markets and pricing mechanisms. Using traditional definitions of forest value, and employing conventional valuation techniques, there seem to be few economic benefits to be gained from sustainable forest management, and few economic costs associated with forest degradation and loss.

Over the last decade, advances in economic valuation methods have meant that forest benefits can now be much better quantified and expressed in monetary terms. A useful, and growing, body of literature has been established that deals with forest environmental valuation, including many of the non-market values that were omitted from calculations in the past. The paper reviews these methodological advances, and their application to tropical forest ecosystems in different parts of the world.

Yet, in many cases tropical forest valuation has remained a largely academic exercise. In contrast to the considerable advances that have been made in valuation definitions and techniques, there is far less progress in applying the results to real-world forest policy, planning and management. Although environmental benefits are better understood, and can be more accurately quantified, their value is still intangible to many of the public decision-makers, private landholders and resource users whose actions have the potential to influence forest status. The findings of the paper agree with the current study which highlights the need to include non market values in forest valuation exercises.

White et al (2008) in their paper look at the diversity of needs for water which are rarely understood or acknowledged. As populations and economies grow, water-related conflicts, inequities, and poverty may not only persist but are likely to increase. In order to make better decisions regarding the use and management of water, the importance of water to human society must be recognized. Generating more value from water implies greater productivity with new opportunities for equitable economic growth. Research on Water Benefits Sharing examines water uses and the values associated with those uses, both past and present, in order to understand future consequences and potentials. A key challenge is to achieve an optimal value of water use. The concept of optimal value depends on the interests and preferences of many users, who appreciate water for economic, social, cultural, environmental and political purposes. The study agrees with the current study in terms of the values of environmental resources which are used and rarely understood and acknowledged. However, their approach towards benefit sharing and poverty alleviation differs from the current study.

2.2 Empirical Literature

In their case studies, Cavendish (1997) and Campbell et al (2002) drew out some experiences on rural households and their use of forest resources. They found that households that use forest resources have livelihoods characterized by formal and informal activities. These studies also found that forests offer rural households a wide range of resources whose uses are seasonal. They are also of small market value compared to other non-forest activities. Cavendish and Campbell et al (2002) using household data from rural Zimbabwe found that woodland-based resources are important in mitigating poverty but not in lifting people out of poverty. The current study addressed this contextual gap by focusing on the Ngong Forest Area.

Using purpose-collected panel data from Zimbabwe, Cavendish (2000) finds that environmental resources make a significant contribution to average rural incomes. Poorer households depend heavily on these resources, which contribute 40 percent to their incomes. However, richer households use greater quantities of environmental resources in total. He also found considerable differentiation in the economic characteristics of environmental goods. Cavendish shows that the dependence of households on environmental income decrease as their average income rise. Although the poor tend to get more of their total income from the environment, the rich still make heavy use of natural products for income (Cavendish, 2000). The results demonstrate the economic significance of environmental resources to rural households. Surveys which ignore the contribution of environmental resources to rural households' incomes therefore miscalculate the incomes and welfare. The literature greatly contributes to the fact that the poor are more natural resource dependent than the rich, though the absolute benefits for the poor are lower. The results of the

study will greatly contribute to the current study in terms of the effects of different income levels on forest resource extraction. The main difference to the current study is the observation that while Cavendish uses panel data, the current study is strictly cross-sectional in nature as it addresses the contribution of forest resources to household income for residents living near Ngong Forest. The study by Cavendish (2000) also fails to establish the determinants of forest resource extraction, a gap that is addressed by this study.

To explore the role of forest in household welfare in Kenya, Kabubo-Mariara and Gachoki (2008) used primary household data collected from Nakuru district and supplemented by a community survey. Their results suggest that forests play an important role as safety nets that cushion households during periods of hardship. The results also suggest that forests play an important role as a gap-filler (complementing other incomes especially when there are seasonal food shortfalls), a source of regular subsistence and in poverty reduction. The results further suggest that both the poor and the less poor derive a substantive share of incomes from forest activities and that forests are not necessarily poverty traps for rural households. They concluded that forest policies need to take into account tradeoffs between forest extraction and forest degradation and also consider targeting of households in forest use and management depending on household heterogeneities in both current and permanent incomes.

Kabubo-Mariara and Gachoki (2008) and Hedge and Bull (2005) noted that environmental resource use may be positively and significantly influenced by gender. Particularly, female-headed households may collect significantly less environmental products than the male-headed households. More established households may also tend to extract more environmental resources than younger families. Older families may tend to have a greater knowledge and familiarity with the geography, seasonality, and quality and quantity of resource availability in their surroundings, and as a result will be in a better position to

extract resources. Similarly, the probability of young families participating in the sale of environmental products may also be less. Size of household, number of household members below 16 years and above 65 years, number of disabled adults, and migration may also positively affect the use and sale of environmental resources. The shock variable for sickness, from a hypothetical point of view may be found to significantly increase environmental resource use. Kabubo-Mariara and Gachoki (2008) and Hedge and Bull (2005) methodology is in line with the current study by using descriptive statistics and econometrics to assess the share of forest income to the total income. They further divide the households into quintiles to show the level of dependence among various income groups towards forest resource extraction. The gaps found in Kabubo-Mariara and Gachoki (2008) and Hedge and Bull (2005) that this study addressed is the use of a more detailed identification of forest products. While the two reviewed studies classify the forest products in less than 4 categories, the current study used a more detailed approach of capturing all the individual forest products

According to Fonta and Ichoku (2010), many rural households in Nigeria depend on forest extraction for daily sustenance yet, very little is known about the impacts of forest income on the distribution of household total income, and hence, on poverty in general. He carried out a study using Gini and poverty decomposable techniques, and found out that forest income reduces both income inequality and poverty in rural Nigeria. Further, Heckman's 2-step estimation of the determinants of forest income indicated that the decision to participate in forest extraction increases with more access to community forest areas; larger and poorer households; membership in forest management committees, and decreases with higher educational attainment and higher transfer income earnings. Likewise, forest income was found to be positively and significantly related to male-headed households, poorer heads of household and households that have more access to forest resources outside the community

forestry areas. Furthermore, simulations revealed that poverty and income inequality can be reduced in rural Nigeria through policies that can; stimulate increased earnings from minor forest resources, assist households to earn income from alternative sources such as agriculture and commerce other than forest gathering. The study differs with the current study in its methodology and approach as it uses Gini and poverty decomposable techniques to assess the impacts of forest income on the distribution of household total income, and hence, on poverty in general.

Fisher (2004) used a monthly survey of 99 households conducted in three villages in southern Malawi between June 1999 and August 2000. All of the sample households used firewood for cooking and heating, and 75% engaged in forest occupations including sales of firewood and charcoal and employment by the logging industry. Home-consumed firewood and earnings from forest-based occupations constitute substantial shares of household income. On average, sample households earned about 30% of their income from forests. For the sample households the Gini coefficient was computed and decomposed by six income sources: farm, forest, wage-work, self-employment, transfers, and remittances. The analysis shows that forest income reduced measured income inequality by 12% during the year of the study. This reflects a pattern in which firewood collected from adjacent forests represents an important input to household income for all sample households. The main policy implication of the study is that forests may have a role in poverty alleviation in Malawi, but to reduce economy-environment tradeoffs, careful targeting and a mix of forest-based and other approaches to poverty alleviation is necessary. The study differs in approach from the current study towards its focus on poverty alleviation and income inequality across households.

Narain and Van't veld (2005) in their paper mention the work on village commons in India in 1986 based on data from 82 villages, found that poor rural households on average derived 9 to 26% of their income from common property natural resources, while rich households derived 1 to 4% of their income from this source. The study suggested that the commons in India, however degraded, were important to the livelihoods of the poor. The study agrees with the current study in its concept of comparing forest resource use with income levels.

Other recent studies provide us with a sense of the continued contribution of environmental income. World Bank (2007) mention in their literature review of a micro study of two villages in the forested middle hills of Nepal which found a wide difference in environmental income from non-timber forest products, based on the type of property rights held over the commons. In one village, where there was a community management user group, environmental income contributed some two percent of income to the poorest (lowest quartile) and one percent of income to the richest households. In another village, where there was no formal user group but looser informal rules over the commons, twenty percent of the income of the poor and fourteen percent of the income of the richest households) came from the commons. While other reasons, such as access to markets and employment, may contribute to this significant difference in environmental income, rules of access were the most important factor. The current study borrows greatly from the study in terms of environmental income contribution across quintiles.

Kamanga, Vedeld and Sjaastad (2008) did a study in Malawi among rural dwellers in one of the densely populated districts called Chiradzulu. The study found out that out of 160 households interviewed forest income constitutes around 15% of total income, non-farm income contributed 47% and agriculture contributed 28%. People were found to be extremely poor with 97% having incomes less than one dollar a day. The poorest segment

depends more on forest income than the least poor group, but the medium income group exhibits the highest dependence. Fuel wood constitutes the major source of such income followed by fodder. The incomes mainly support current consumption. People with better access to the forest reserve have higher total income, forest income, and relative forest income. As revealed through a Gini-coefficient analysis, forest resources have an important income equalizing effect across rural households. A particular group of resource poor farmers (8.1% of sample), with little access to agricultural land and a high representation of female heads, derives an average of 65% of their income from the forest. An important policy lesson is that restricting people's access to forest resources can have substantial effects on household livelihoods and welfare, and would serve to increase income inequalities in the area. Livelihood researchers should now recognize the substantial income from forest resources. The results of this study greatly enriches the current study with regards to the level of forest extraction among the various income groups but differs in its use of Gini-coefficient analysis which looks at the effect of forest resources in reducing income inequalities across households.

Hegde and Bull (2006) did a study in Mozambique to look at the economic shocks and *Miombo* woodland resource Use. The household level study in environmental resources from the *miombo* woodlands make significant contributions to household economies in rural Africa. The results demonstrate that environmental resources act as a crucial safety net against income shocks, related to health shocks and fire damage. This highlights the need for incorporating the *miombo* woodlands as part of poverty reduction strategies in Africa. Linkages between income levels and *miombo* resource use are complex. Poorer households tend to use *miombo* resources for subsistence, while richer households use them for cash income. There is a lot of emphasis on female-headed households in rural Africa, in view of

their vulnerability to hardships. They had anticipated that, owing to limited resources and alternatives, female-headed households would extract more environmental resources in relative terms than male-headed households, in view of limited requirements of capital and skills for extraction of environmental resources. But, it turned out to be the opposite case in GNP area. It re-emphasizes the vulnerability of female-headed households to hardships given that limited social security measures are in existence in the developing world and highlights the need for increased livelihood security to female-headed households. The findings of the study are very useful to the current study as it analyses the effect of household characteristics on forest resource extraction. The empirical model used in the study is borrowed to enrich the current study. In addition, the level of resource extraction between poor and rich households analysis used in the study also enriches the current study. The use of income quintiles to analyze the level of forest resource extraction between various income groups is also useful to the current study.

Kajembe, Mwenduwa, Mgoo and Ramadhani (2000) studied the role of gender-based local knowledge in utilization of wild foods and other non-wood forest products for household food security in Tanzania. The study aimed at generating useful knowledge for advocacy, policy making and training. The specific objectives of this study were firstly, to assess issues of accessibility and dependency on wild foods and other non-wood forest products for household food security in the country, secondly, to examine the difference between women's and men's local knowledge with regard to collection, processing and utilization of wild foods and other non-wood forest products, and thirdly, to identify potentials and problems/threats with regard to availability of non-wood forest products for household food security. The study revealed that there exists ascribed local knowledge between men and women on selection, preparation, utilization, storage and even consumption of wild foods.

Furthermore, the study has revealed that non-wood forest products are of vital importance as tools for coping with food shortage and famines. The nutritive value of most wild foods is good and sometimes better than domesticated expensive foods. The study differs in methodology as it focuses only on gender as a factor that affects forest resource extraction while the current study incorporates additional socio-economic variables in addition to gender.

Jumbe, Bwalya and Husselman (2005) in their report analyze the extent to which dry forests contribute to rural livelihoods and the national economy in Zambia. They used data collected from a household survey conducted in eight sites in three of the nine provinces, and secondary data from the Central Statistical Office and the Forestry Department. They learnt that forest products contribute on average twenty point six percent of total household income (subsistence and cash) in the eight sites, and are the second or first ranked source of income in five of the eight sites. There are large differences among poor and not so poor in total income and in forest income share. Several products contribute significantly to rural livelihood and the national economy. Most notably, charcoal and firewood provide seventy percent of the country's energy needs. There are possibly a quarter of a million honey producers in the country deriving an income from forests. A wide range of wild foods are common in rural diets, providing essential vitamins and minerals; more than ten leafy vegetable species, twenty mushrooms and thirty five caterpillars. Forests provide revenue for the government from taxes, fees, royalties and other charges levied on forest-based activities although the relative importance is small given that the majority of forest users extract low-value products from forests mainly for subsistence uses and only a small part of the trade is recorded. From their analysis, they find that forests are recognized to have an important poverty mitigation function but are not a means alone to get people out of poverty. The

methodology used in this study is similar to the current study however, the focus on poverty alleviation of forest resources is not done in the current study. Similar aspects on this study and the current study include the analysis of forest income share among various income groups.

Dhakal (2001) in his paper on the study of Chitwan National Park in Nepal found that the access of forest resource to the poorest of the poor and poor group is lesser than those who are medium and elite group. A significant number of respondents reported that they have no access of sufficient firewood, timber and grass for construction purposes. Women are found to extract more forest resources than the males and children, so they should be oriented how, when and in what volumes can they use the forest product. The study by Dhakal (2001) is similar to the current study by focusing on the level of forest extraction across the various income groups.

The basic economic rationale for conserving Mount Kenya Forest is that it provides a stream of goods and services, which generate economic benefits and support economic activities that accrue to the global community, the Kenyan economy and the livelihoods of the people who live around the forest. The total quantified gross benefits of conserving Mount Kenya Forest are worth US\$ 77 million a year composed of local forest utilization, local cultivation of forest land under shamba system arrangements, other licensed utilization of timber and non-timber forest products, tourist and recreational values, government revenues and watershed catchment protection benefits. Together these economic benefits support a range of employment, income and subsistence opportunities at local, national and international levels (Emerton 1999).

2.3 Overview of Literature

Theoretically, Forests provide a wide range of benefits for poor households. They supplement income to those involved in high return forest occupations. They have 3 roles; safety nets, support of current consumption and a pathway out of poverty. Most of the households that rely on forests are poor households as opposed to the rich households. The categories of forest dependence include; Forest dwellers, farmers living next to forests, commercial users and consumers. Millions of people supplement their household income by harvesting, processing and marketing fuel wood, baskets, honey, tools, leaves, meat and nuts.

Empirical literature review has looked at case studies worldwide that draw some experiences on rural households and their use of forest resources. They found out that households that use forest resources have livelihoods characterized by formal and informal activities. Cavendish and Campbell et al (2002) using household data from rural Zimbabwe found that woodland-based resources are important in mitigating poverty. (2000) using purpose-collected data in Zimbabwe found that forest resources contribute 40% to their average incomes. Kabubo-Mariara and Gachoki (2008) used primary household data collected from Nakuru District. They found that forests play a role as safety nets, as a gap-filler, a source of regular subsistence and poverty reduction. (2000) , Kabubo-Mariara and Gachoki (2008), Hedge and Bull (2005) all use descriptive statistics and econometrics to assess the share of forest income to the total income.

Fonta and Ichoku (2010) did a study in rural Nigeria. Forest income was found to be positively and significantly related to male-headed households, poorer heads of households and households that have more access to forest resources outside the community forestry areas. Fisher (2004) used monthly survey of 99 households in three villages in southern Malawi. He found out that sampled households earned about 30% of their income from

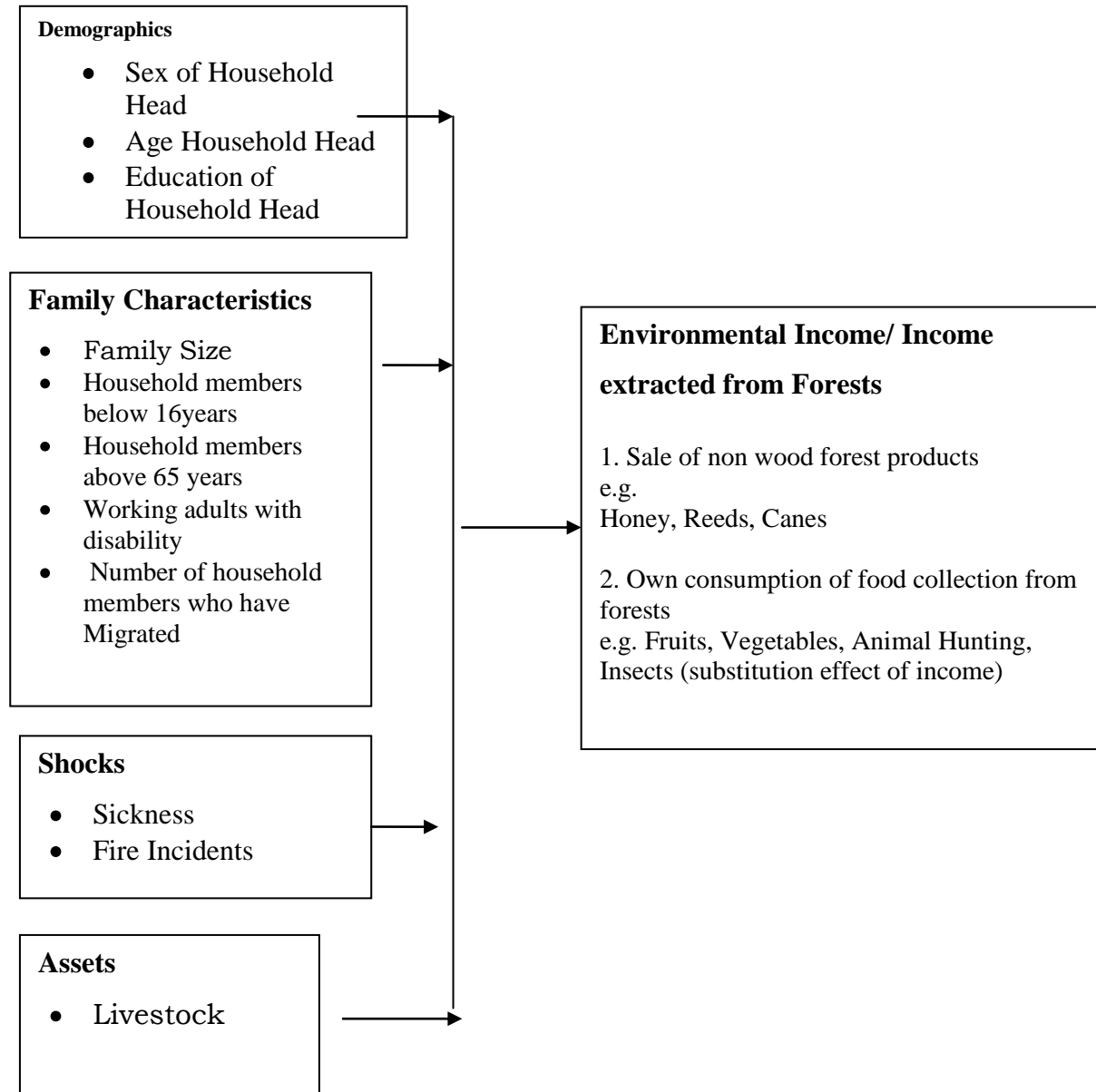
forests. Forest income reduced measured income inequality by 12% during the year of study. N.C. Jodhas work on village commons in India in 1986 (Jodha 1986) found that poor rural households derived 9 to 26% of their income from natural resources. Chettri-Khatttri (2007) in his study in two villages in Nepal found that in one village, environmental income contributed some 2% of income to the poorest (lowest quartile) and 1% of income to the richest households. In another village where there was no formal user group but looser informal rules over the commons, 20% of the income of the poor (and 14% of the income of the richest households) came from the commons. Kamanga Vedeld and Sjaastad (2008) did a study in Malawi among rural dwellers in one of the densely populated districts called Chiradzulu. The study found out that out of 160 households interviewed forest income constitutes around 15% of total income, non-farm income contributed 47% and agriculture contributed 28%. Hegde, R. and Bull, G. (2006) did a study in Mozambique to look at the economic shocks and *Miombo* woodland resource use. The household level study in environmental resources from the *miombo* woodlands make significant contributions to household economies in rural Africa. Kajembe, Mwenduwa Mgoo and Ramadhani (2000) studied the role of gender-based local knowledge in utilization of wild foods and other non-wood forest products for household food security in Tanzania. The study aimed at generating useful knowledge for advocacy, policy making and training. Jumbe, Mulenga Bwalya and Husselman (2005) in their report analyzed the extent to which dry forests contribute to rural livelihoods and the national economy in Zambia. Dhakal (2001) in his paper on the study of Chitwan National Park in Nepal found that the access of forest resource to the poorest of the poor and poor group is lesser than those who are medium and elite group.

In Kenya, there are few studies that directly assess the contribution of non-timber forest products to households that neighbor forests. No official statistics exist of the amount of resources that are derived and their values and contribution towards the welfare of those communities. The studies that have been conducted in Kenya include Kabubo-Mariara (2008) and Emerton (1999).

2.4 Conceptual Framework

Independent variables
variables

Dependent



Developed from Hedge and Bull (2005); Kabubo-Mariara and Gachoki (2008); and Cavendish (2000)

The above conceptual framework shows the factors that affect environmental Income or income extracted from Forests. These include: age of household head; education level of household head; gender of household head; household size; Household members below 16years; Household members above 65 years; Working adults with disability; Number of household members who have Migrated and household wealth and shocks such as fire and sickness.

Age of the household head (in years) is expected to capture the extent to which household labour allocation changes over the life-cycle of the head of the household. Young households may be clearing more forest to build up a sufficient amount of cropping or pasture land. Age may also be expected to reduce forest dependence as older people may have less time and physical strength to engage in forest activities and also because the age of the household head is related to the household's experience in managing common resources as well as accumulation of social capital.

Education of the household head is expected to lead to extraction of fewer forest resources since education opens up alternative employment opportunities and diverts people from subsistence agriculture and gathering activities. Education, like age may be a cultural factor where going to the forest is considered backward and not for the elderly or the well educated.

Gender of the head is included to test whether access to and income from forests is significantly different between male-headed and female-headed households. It is expected that women participate more in common property resources than men and may be more involved in gathering activities than men.

Household size (number of household members) is expected to have a direct link with forest dependence because gathering activities are labour intensive. A larger household therefore has more labour to spread across various collection activities and such households may derive more resources from the commons.

Household members below 16years shows the extent of dependants in the family and is expected to increase the family's reliance on forest income;

Household members above 65 years shows that most of the family members are not in the productive age bracket and are termed as dependants and therefore increasing the likelihood of the family relying on forest income;

Working adults with disability reduces the ability of the family to engage in other productive income generating activities hence more reliance on forest income.

Number of household members who have migrated reduces the extent of reliance on forest income as they search for more income generating opportunities elsewhere.

Households better endowed with assets in this case livestock holdings are expected to benefit more from forests because forests are an important source for animal fodder .

Sickness and fire (the two shocks introduced in the model) affected the use and sale of environmental resources. Hedge and Bull (2005); Kabubo-Mariara and Gachoki (2008); and Cavendish (2000)

3.0 METHODOLOGY

The data for this study was collected from Ngong forest neighbors. Ngong forest was chosen because of communities living adjacent to it. The forest itself is located 10km west of the capital city Nairobi (KFS, 1999). It is rich in biodiversity and the inventory shows that it is home to 120 bird species, 35 mammal species and numerous insects, reptiles, amphibians and fish.

The focus of the survey was to study the extent to which households extract forest resources. Quantitative data was collected using a structured questionnaire (see Appendix). The questionnaires were administered through face-to-face interviews to households living adjacent to Ngong forest. It was established during the pilot study that all households extract resources, however during the main study, 20% of households (11 households) interviewed did not extract forest resources from Ngong forest. The data collection instrument was structured in such a way as to capture a wide a range of environmental goods and services as possible and also to capture the contribution of forest resources to household income and poverty alleviation. The data collection instrument also captured income from other sources for comparison purposes.

The study drew experiences from past studies and literature review. The survey followed the methods of Cavendish (2000), Kabubo-Mariara and Gachoki (2008), Hedge and Bull (2005) with some modifications to suit our situation. Cavendish (2000) notes that his survey instruments lead to unique empirical results which standard household budget surveys cannot capture (e.g., value of collected wild fruits, poles, etc.). The most significant modification was the listing of all possible forest products as opposed to aggregating them into 4 categories as done in Cavendish (2000), Kabubo-Mariara and Gachoki (2008), Hedge and

Bull (2005). This made it possible to conduct a detailed analysis of the forest resources extraction (in terms of prices, quantities and respective percentage contribution) to the overall forest extraction.

3.1 Sampling

The study involved a household survey of households living next to Ngong forest. The study area has the villages of Kibiko, Emanyatta, Ngong Township, Bul Bul, Karen, Rongai, Kiserian and Matasia. This study narrowed down to the enumeration areas of Kibiko Area (Kibiko Holding Ground) and involved a random sample of 55 households (see calculation below).

The enumeration area of Kibiko Holding Ground was sampled because it is adjacent to the forest and depends heavily on the forest. Kenya Forest Service (KFS) restricts these residents from entering the forest, however, fence vandalism has been the greatest challenge to the protection of Ngong Forest. From a quick glance of the area, the communities engage in livestock keeping with most of them getting pasture from the forest and growing of crops such as maize and beans. In addition, the women get firewood both bought and stolen from the forest and the men harvest building materials for construction purposes. The pilot study was conducted on 25th June 2012 with 4 households in Kibiko ward 1 of Ngong Forest and 4 questionnaires filled.

Sample

According to the Kenya National Population and Housing census (Republic of Kenya, 2009), the population of the study area (Kibiko Holding Ground) was 199 households in 2009 (see

Table 3.1). Given the time and resources at the disposal of the researcher, it was untenable to do a census and hence sampling was the viable alternative.

The study area that the sample was drawn from was the Kibiko Holding Ground with a population of 1,025 and 199 households. The calculation of the sample was achieved through the use of Cochran (1963) formula which is also quoted in Israel (1992).

Formula for Calculating a Sample

$$n = \frac{N}{1 + N(e)^2}$$

n = Sample size

e = the desired level of precision (margin of error) (The margin of error is taken to be 10% for economical expediency purposes).

$$n = \frac{199}{1 + 199 (0.1)^2}$$

n = 55.55

A systematic random sampling approach was used to select the sample size from the sampling frame. The sampling technique was random since the researcher generated a random number in excel(random number between 1 and 199). This random number was the starting point of sampling given a sampling frame of 199 households. After identifying the starting point, every fifth household was selected until 55 households were exhausted. The ratio used to select the 55 households was 55/199=27%. Therefore, every fifth household in the sampling frame was selected.

The 55 households were identified using the sampling frame obtained from the Kenya National Bureau of Statistics. The chief or the sub-chief of the area acted as the reference point for clarification purposes in cases where a household had migrated into or out of the study area. This approach was necessary because the data from Kenya National Bureau of Statistics may not be up to date.

3.2 Valuation Procedure of Ngong Forest Resources

Household questionnaires were administered which were modified from the Income, Consumption and Expenditure (ICE) type. The modification that was made was to include forest resource values in addition to other household income.

Questionnaires integrated quantitative environmental resource use data with household economic data in the research. Efforts were made to translate the questionnaire to the local dialect of the interviewed households to ensure that they understood the questions well (Cavendish, 2000).

The questionnaires were designed to cover a period of 3 months (January to March 2012) to ensure the best recall period of forest and non forest incomes that were gained by the households for resources that were seasonal or small.

The forest resource use and non-forest income data were valued and aggregated using standard principles for households involved in both market and non-market activities, to produce household income accounts (Grootaert, 1982).

The first step was to identify which goods and services are traded in the market. The prices represent expenditures saved or potential income from forest resource utilization. However, households were able to place direct values on goods and services that they sold at the market

place such as charcoal, honey, reeds and bamboo. The prices were compared with the official market prices that exist for those goods and services.

The total value of a resource was arrived at by summation of all reported prices of households' extraction of a particular resource. The quantity of a resource was arrived at by summation of all households reported quantity of that resource. The average selling prices were arrived at from dividing the total value of a resource with its quantity. If households' reported values are usable, aggregate unit values should look like prices.

For goods that did not have market prices, the study used substitute goods approach to value the goods. The value of natural resources, which are non-marketed or which are used directly by the households were approximated by the market price of similar goods or the value of the next best alternative or substitute good. For example, firewood that was not marketed was approximated with the market price of its alternative charcoal. Other substitute goods such as wild vegetables were compared with cultivated vegetables; value of wild birds captured was compared with chicken; value of game animals captured was compared with that of farm animals.

The study used the contingent valuation approach to value goods that were non-marketed. The first step was to ask the respondents about their understanding of Ngong Forest, whether they are familiar with geographical area and the goods and services that it provides and its value. The respondents were presented with a hypothetical situation of a loss in Ngong forest to give way for urban development whereby they would lose all its benefits.

The survey identified a bidding vehicle where respondents were asked open ended questions on the amount they were willing to pay for Ngong forest to be retained and not converted for other uses. The respondents were not helped in their answer by the interviewers. From the

respondent's answers, the last step was to get the mean Willingness to Pay to aggregate non-marketed environmental income for all the 55 households in the survey. The willingness to pay price for a commodity was summed up across the sample 55 households to get the aggregate value of a resource. The quantity of a resource was arrived at by summation of all 55 households reported quantity of that resource. The average WTP price was arrived at by dividing the summed Willingness to Pay price with the summed up quantity. For instance, if household X_1 extract 2kgs of grass at a non marketed price of KES 200 per kg and household X_2 extracts 1 kg of grass at non marketed price of KES 300. Then the total quantity extracted is 3kgs and the sum value is KES 700. On average, each container is $700/3= 233.33$.

3.3 Data Issues

The study identified the goods and services that Ngong Forest provides to the households that neighbor the forest. The identification of the goods and services was obtained from past studies that have attempted to achieve the same objective such as Cavendish (2000), Kabubo-Mariara and Gachoki (2008), Hedge and Bull (2005). Additional resources that are unique to Ngong Forest were obtained from the Village Elders and the forest office manning Ngong Area. Cavendish (2000), Kabubo-Mariara and Gachoki (2008), Hedge and Bull (2005) followed a different classification altogether namely; fuel, fodder, construction material and other forest products. The current study used a more detailed approach by identifying all forest products that are either consumed or sold by households. The results are displayed in units such as bales, kilograms, wheelbarrows etc.

The next step was to establish the local prices for the forest goods and services that have a market value. Households were asked to report the price of products sold. Where the product is non-marketed, households were asked to place a price they would be willing to pay for a

product, if they were to buy the same. Past studies that have attempted to achieve the same objective include Cavendish (2000) for Shindi Ward in Southern Zimbabwe. The environmental resources were valued through economic transactions which were either the households' reported prices or at local market prices. Therefore the methodology used was households' own reports of both the quantity and total value of their resource utilizations. The environmental resources were valued and aggregated in a consistent manner for households involved in both market and non-market activities to produce household income accounts (Cavendish, 2000).

The socio-economic characteristics of the households that use various types of forest resources were identified. This was derived from section A of the questionnaire (see Appendix). Past studies that have attempted to achieve the same objective include Hedge and Bull (2005) who assessed the socioeconomic determinants of forest resource extraction.

Model

Hedge and Bull used a linear regression to measure how various social economic characteristics of households affect the use of environmental resources. According to Hedge and Bull (2005), the linear model established that gender, established versus young households, sickness (Number of times a household saw/visited a doctor) and fire (the two shocks introduced in the model) affected the use and sale of environmental resources.

Following Hedge and Bull (2005) the model for environmental income can be written as:

$$Y_i = f(X_i, Z_i, e) \text{ ----- (i)}$$

Where

(Y_i) is Environmental income

(X_i) is socio-economic characteristics

(Z_i) is Shocks

(e) is error term

The explicit linear model can be written as follows;

$$Y_i = b_0 + b_1 X_i + b_2 Z_i + e \text{ ----- (ii)}$$

Where Y represents household environmental income; X is a vector of socio-economic variables such as (a)gender of head of household (genderHH), (b) age of head of household (ageHH), (c) Literacy of head of household (LiteracyHH),(d)Number of education years of head of household(EducationHH), (e)size of household (sizeHH),(f) Household members below 16years (below16years), (g)Household members above 65 years (Above65Yrs), (h)working adults with disability (disabledadults), (i) Number of household members who have Migrated(MigrationHH), (j) and Number of times a household saw/visited a doctor (Sickness) (k) count of livestock with b representing their parameters; Z a vector of dummy variables representing shocks; and ϵ is the error term. Hedge and Bull (2005) included two shocks (fire and sickness) that would increase the likelihood of household exploiting forest resources.

The current study adapted the model by Hedge and Bull (2005). Y , the per capita environmental income in this study was derived from part B and C of the survey

questionnaire. The following modification was necessary: One shock (sickness) was used instead of two because the likelihood of the occurrence of a fire is less than that of sickness in Ngong Forest. Sickness was measured as the number of times a household visited a doctor

An ANOVA test was used after categorizing the households into five income groups/quintiles just like Cavendish (2000). The ANOVA (a parametric test) tested whether there is any significant difference in the forest income to total household income across the five quintiles. The results are displayed in Table 5.6 in Chapter 5.

To address endogeneity problem, correlation analysis was conducted to reveal the extent of endogeneity problem. Count of livestock had the highest endogeneity resulting from omitted variable bias.

4.0 STUDY AREA

Ngong Forest is an indigenous forest located near Nairobi city. It is located at an altitude of 1767 meters above the sea level and about 6km west of the capital city Nairobi. The forest is about 538 hectares. Ngong Forest comprises 80% indigenous forest and the rest exotic Eucalyptus plantations. The forest lies within latitude -1.316667 and longitude 36.733333. The forest was gazetted in 1932. It is rich in biodiversity and biodiversity inventories shows that it is home to 120 bird species, 35 mammal species and numerous insects, reptiles, amphibians and fish. Some sections of the forest have been leased to different organizations for a period 99 years each as shown below: (Kenya Forest Service, 2009/10)

The population of Ngong Town is about 60,000 persons. The current estimated population growth rate in the District is 4.5% per annum and life expectancy at birth is 43 years. While the population is predominantly Maasai, the area around Ngong is mainly cosmopolitan and is also occupied by non-Maasai groups such as the Kikuyu, Kamba, Luo and Somali who invaded the area for farming activities (2009 Kenya Population and Housing Census, 2009). Land adjudication and sub-division of group ranches has led to individual land tenure that has contributed to land sales to other people and opened the area to farming communities from other parts of the country. The proximity to Nairobi has also attracted high migration to the area. The land, which comprises of medium and high agricultural potential areas has been sold on and thus pushed the local pastoralists to drier parts of the District such as Magadi and Kajiado. The rapid human population growth has also led to competition with wildlife over resources in the District.

Due to the current drought situations in Kenya, most of protected areas are currently under siege by cattle and livestock bringing in a clear conflict of interest between conservationist

and pastoralists (Wildlife Direct Newsletter, 2009). In Ngong forest, large herds of cattle are continuously witnessed grazing inside and at the edges of the forest.

The high population, poverty and ignorance of the importance of forests among some of the households have been the main challenges in conserving the forest (Wildlife Direct Newsletter, 2012). Ngong forest, like any other natural setting has suffered from exploitation. To minimize the rate of exploitation, an electric fence was erected to cover a total of 600ha (Wildlife Direct Newsletter, 2012). Many of the residents view the forest as their only source of livelihood, not even the electric fence can deter them. They dig under it and sometime cut wires to gain access to the forest.

As part of sustainable utilization and benefit sharing, the local communities who have joined hands to conserve Ngong forest are issued with permits to collect dry fire wood. However intruders sneak into the forest targeting indigenous hard wood trees especially the silver oak. Currently, logging is on the rise, with the opening of the Nairobi Southern By pass which cut across the forest making the forest vulnerable and easily accessible.

The Maasai community is the most dominant pastoral community in the area. They measure their wealth in terms of herd sizes which on average numbers in hundreds. During the dry seasons, the Maasai pastoralists are allowed to graze in specific areas of the Ngong Forest after being issued with permits by the Kenya Forest Service. To guard against degradation, only limited herds are allowed. This limitation is however not honored by the herders who cunningly invite their relatives and friends to join in. This implies that the forest is hosting up to three times its normal carrying capacity. The result is aggressive competition for the limited forest space and resources. (Wildlife Direct Newsletter, 2012)

In the past, Ngong Forest was finely distributed. As time and events changed, the forest kept on being encroached to satisfy human beings needs. With no one to save the forest, some hectares had already been poached and turned to residential buildings. The late Imre Loeffler fought hard the grabbing of Ngong forest land. He got together a group of trustees and it was a very difficult job but they managed to salvage the forest and all the title deeds that had been allocated to the land grabbers. The title deeds were cancelled and given back to the trustees. Now the forest is saved and not only is it a beautiful place to go but it acts as a carbon sink to absorb the pollution emitted by cars and industry in the city of Nairobi. (Wildlife Direct Newsletter, 2012)

The Ngong catchment area runs from Dagoretti forest through Jamhuri Park and joins Ngong tributary within Kibera slums. From this point of confluence, the river flows into Nairobi Dam, through Nairobi West suburbs as Ngong River, across Mombasa road and traverses through the Industrial area before joining Nairobi River below Njiru shopping centre. After this confluence the river then becomes Mathare and Nairobi tributaries system commonly called Nairobi River. The forest is also crucial water tower that sustains the Athi River; the second largest river in Kenya and a water catchment area for Nairobi province which has suffered extensive damage in the last 12 years compromising the water supply to city residents. (Wildlife Direct Newsletter, 2012)

Some of the common mammals found within the Ngong Forest include Duiker, African Hare, Black-faced Vervet Monkey, Bushbuck, Black-and-White Colobus Monkey, Dikdik, Sykes Monkeys, Unstripped Ground Squirrel, Black-tipped Mongoose and White-tailed Mongoose (Nature Kenya, 2004).

In the past, Ngong Forest has been hived off by politicians and the affluent members of the society. The losses of the forest were documented in Ndungu Report which was made public and recommendations made for the revocation of titles. Various politicians have also been in the news for charges on graft by Kenya Anti Corruption Commission (KACC) on illegal acquirement of Ngong forest (Kenya Forest Service, 2011)

The importance of Ngong forest to individuals, household and the economy of Kenya needs to be officially documented. The study will bring out in detail the resources that are derived and hence put an accurate value to those resources. This will in turn ensure appropriate legislation is formulated towards conserving it.

5.0 RESULTS

Descriptive Statistics: Demographic and Socio Economic Characteristics of Households around Ngong forest

The study inquired into the demographic characteristics of the respondents with an aim of describing their composition in the data set. The socio-economic characteristics of all sampled households are presented in Table 5.1. The data reveals a rather high ratio of female headed households, at 49% of all household in the sample.

The statistics also indicate that the mean age of household heads was 55.1 years; a figure that is not far from the legal retirement age. More than half (56%) of household heads indicated that they were literate. However, the average years of education was 5.1 which implies that majority of the household heads had primary level of education. The average years of education reported in this study are less than the average years reported in Kabubo-Mariara and Gachoki (2008) of 7.42 years but higher than the one reported in Hedge and Bull (2005).

A high proportion (90%) had the intention of participating in sale of forest products. The shock variable indicated that each household got sick and visited the doctor 2.1 times in the last three months.

On average, each household had 6.2 members which is higher than 5.39 reported in Kabubo-Mariara and Gachoki (2008) and 5.75 in Hedge and Bull (2005).

The mean livestock holding was 51.7. However, owing to the high skewness of this variable, the median of 14 heads of livestock was a better measure of livestock holding than the mean.

Table 5. 1: Descriptive Statistics of Sampled Households

n=55 households	Mean	Median	Std. Deviation	Skewness ¹	Min	Max
Head of household (Yes=1,No=0)	.65	1.00	.480	-.668	1	2
Male or female headed Household(Yes=1,No=0)	.51	1.00	.505	-.037	1	2
Age head of Household	55.1	52.0	19.3	0.2	24	98
Literacy of head of household (Yes=1, No=0)	.56	1.00	.501	-.264	1	2
Household Head years of education	5.1	4.0	5.3	0.6	0	16
Family size	6.2	5.0	4.0	2.3	1	25
Family members less than 16 yrs	2.3	2.0	2.6	2.3	0	15
Family members over 65yrs	0.7	0	0.8	1.5	0	4
Count of family members with disability	0.1	0	0.3	3.4	0	1
Count of family members migration	0.2	0	0.6	4.4	0	4
Count of number of times sick	2.1	0	3.5	1.9	0	12
Count of livestock	51.7	14.0	150.3	6.3	0	1,085
Intention of Selling food products (Yes=1, No=0)	0.9	1.0	0.3	(3.4)	0	1

Source: Survey Data 2012

Table 5.2 shows a summation of the benefits of goods and services for a period of 3 months.

A total of KES 875,928 worth of forest resources were extracted from Ngong Forest for a period of 3 months. This translated to an average of KES 15,926 per household for three months. This further translates to a monthly extraction value of KES 5,309 per household.

20% of households (11 households) interviewed did not extract forest resources from Ngong forest. This monthly forest extraction is above the minimum government wage requirement for unskilled workers in the agricultural sector which stood at KES 4,854.35 for the year 2013. The value of monthly extraction was however lower than the general minimum wage

¹ The nature of the skewness of livestock is leptokurtic, which further implies lack of normal distribution of the variable. A skewness of 6.3 is over and above the rule of the thumb of ± 2 . So, it may further imply that there are outliers to the right of the mean. For instance, maximum reported figure of livestock of 1085 by itself is an outlier given that the mean is about 14.

for general labourers which stood at KES 9,024.10. This further implies that forest resources form a significant proportion of household income assuming that majority of the household heads were in the general labourer category. The forest resources that are mostly extracted by the households are demonstrated by its percentage value in relation to the total forest resources. Firewood (30%) is the most valued and the most extracted resource followed by honey (27%). Poles (18%) are the third most important forest resource, and the fourth most important resource is vegetables (9%). The fifth most important forest resource is medicinal herbs (7%).

Table 5. 2: Identification of Goods and Services Extracted from Ngong Forest

Forest Resources	Units of measurement	Sum of Quantity	Sum of total value extracted	Percentage Contribution to Total Extracted Resources	Mean extraction per household(3 months)	Mean monthly extraction per household ²
Fruits	Bundles	11	KES 510	0%	KES 9	KES 3
Vegetables	Bundles	1273	KES 77,590	9%	KES 1,411	KES 470
Bamboo	Feet	5	KES 15,000	2%	KES 273	KES 91
Poles	Feet	1155	KES 157,150	18%	KES 2,857	KES 952
Grass	Grazing	1273	KES 44,250	5%	KES 805	KES 268
Firewood	Headload	1427	KES 265,010	30%	KES 4,818	KES 1,606
Animals	kgs	25	KES 2,300	0%	KES 42	KES 14
Charcoal	kgs	5.5	KES 6,200	1%	KES 113	KES 38
Mushrooms	kgs	2.5	KES 160	0%	KES 3	KES 1
Rabbits	kgs	5	KES 1,600	0%	KES 29	KES 10
Reeds	kgs	1	KES 100	0%	KES 2	KES 1
Honey	Litres	721	KES 240,580	27%	KES 4,374	KES 1,458
Medicinal herbs	Litres	372.25	KES 65,478	7%	KES 1,191	KES 397
Grand Total		.	KES 875,928	100%	KES 15,926	KES 5,309

Source: Survey Data 2012

² Not all the resources are available throughout the year, in order to capture resources that were seasonal or small in quantity, the questionnaire was designed to cover a period of 3 months

Table 5.3a shows the local prices of goods and services that Ngong forest provides to the households neighbouring the forest. The average local selling prices were arrived at from dividing the total value of a resource with its quantity. The total value of a resource was a summation of all households' extraction of a particular resource. For instance, the value of fruits for each of the 55 households was summed up to arrive at the figure of KES 510. Since different households applied different prices to fruits, it was logical to divide the summed value of a resource with its summed quantity. The selling price of fruits at the time of study was KES 46 per bundle. Vegetables were selling at KES 61 per bundle. Bamboos were selling at KES 3000 per feet. Poles were selling at KES 136 per feet. Firewood was selling at KES 186 per headload. The local prices of the rest of the forest resources are given in table 5.3a.

Table 5.3a: Estimation of the local prices for the forest goods and services

Forest Resources	Units of measurement	Sum of Quantity	Summed value of a resource for all 55 households	Per unit price
Fruits	Bundles	11	KES 510	KES 46
Vegetables	Bundles	1273	KES 77,590	KES 61
Bamboo	Feet	5	KES 15,000	KES 3,000
Poles	Feet	1155	KES 157,150	KES 136
Grass	Grazing	1273	KES 44,250	KES 35
Firewood	Headload	1427	KES 265,010	KES 186
Animals	Kgs	25	KES 2,300	KES 92
Charcoal	Kgs	5.5	KES 6,200	KES 1,127
Mushrooms	Kgs	2.5	KES 160	KES 64
Rabbits	Kgs	5	KES 1,600	KES 320
Reeds	Kgs	1	KES 100	KES 100
Honey	Litres	721	KES 240,580	KES 334
Medicinal herbs	Kgs	372.25	KES 65,478	KES 176
Grand Total		.	KES 875,928	.

Source: Survey Data 2012

Table 5.3b shows the forest resources that households were able to place a market price and those that households could not place a market price.

Table 5.3b: Category of Forest resources with Market price and Non market price

Forest Resources	Units of measurement	Market price	Non market price
Fruits	Bundles	X	X
Vegetables	Bundles	X	X
Bamboo	Feet	X	
Poles	Feet		X
Grass	Bundles (Grazing)		X
Firewood	Headload		X
Animals	Kgs		X
Charcoal	Kgs	X	
Mushrooms	Kgs		X
Rabbits	Kgs	X	X
Reeds	Kgs	X	
Honey	Litres	X	X
Medicinal herbs	Kgs		X

Source: Survey Data

Results in table 5.4 reveal the total household income which is KES. 1,573,052.00 (summation of forest and non forest income) divided into 5 equal groupings (quintiles). Using spss software, KES. 1,573,052.00 is divided into 5 equal groups of 11 households each. Total income was subdivided into quintiles to show levels of poverty. The first quintile was for total income with a range of 0 to KES 6,496, 2nd quintile for income range of KES 6,497 to kes 10,616, 3rd quintile KES 10,617 to kes 23,869.33, 4th quintile of KES 23,870 to KES 43,112, and 5th quintile of income of above KES 43,112.

Table 5.4: Income quintiles

Percentiles	20%	6496.00
	40%	10616.00
	60%	23869.33
	80%	43112.00

Source: Survey Data; 2012

Table 5.5 shows the mean monthly forest resource extracted by a household was KES 5,308.65. The combined monthly forest income for the 55 households was KES 291,976. The

highest monthly source of income was livestock income at KES 6,053.15 followed by forest income at KES 5,308.65, skilled income at KES 4,164.24, other non forest income at KES 3,963.64, unskilled labour income at KES 1,527.58, crop income at KES 1,115.21 and remittances at KES 1,086.67.

Table 5. 5: Descriptive statistics of household income

	N	Mini	Max	Sum	Mean	Std. Deviation
Forest income	55	0	82,200.00	291,976.00	5,308.65	12,596.69
Crop Income	55	0	13,333.33	61,336.67	1,115.21	2,664.72
Live stock income	55	0	30,000.00	332,923.33	6,053.15	8,736.28
Unskilled labour income	55	0	15,000.00	84,016.67	1,527.58	3,080.62
Skilled income	55	0	30,000.00	229,033.33	4,164.24	7,571.79
Craft and small scale enterprise income	55	0	45,000.00	296,000.00	5,381.82	10,486.65
Remittances	55	0	20,000.00	59,766.67	1,086.67	3,651.03
Other non forest income	55	0	93,333.33	218,000.00	3,963.64	14,857.58
Total Non Forest Income	55	400	139,833.00	1,281,077.00	23,292.30	28,881.49
Total Income	55	400	141,403.00	1,573,052.00	28,600.95	32,290.66

Source: Survey Data; 2012

Results in table 5.6 indicate the contribution of absolute forest income to absolute total income. The presentation format was adapted from Cavendish (2000). The lowest 20% (the poorest of households) extracted a monthly forest income of KES 835.15 per household, followed by the households in the 20% to 40% quintile with a monthly extraction of KES 1,358.79 per household, 40% to 60% with a monthly extraction of KES 1,731.82, 60% to 80% with a monthly extraction of KES 4,501.14 per household. The top 20% household (the richest households) had a monthly extraction of KES 18,116.36 per household. Overall, all households extracted a mean monthly income of KES 5,308.65 per household.

The findings imply that the extraction of absolute forest resources (actual cash flows) is highest in the top 20% (richest households). The findings agree with those in Cavendish (2000). The poorest households had the least absolute mean extraction of forest resources. . The justification of these is that they may have fewer capacities to extract forest income such as having less livestock for grazing (however, the results do not necessarily hold when we refer to percentage contribution of forest income to total household).

Table 5.6: Extraction of forest income and non forest income across quintiles

Income Sources	Lowest 20%	20% to 40%	40% to 60%	60% to 80%	Top 20%	All households	Anova-f stat
Forest income	835.15	1,358.79	1,731.82	4,501.14	18,116.36	5,308.65	4.707(0.03)
Total Non Forest Income	2,115.15	6,712.12	15,129.09	27,595.45	64,909.70	23,292.30	20.431(0.00)
Crop Income	142.42	227.27	774.55	1,404.55	3,027.27	1,115.21	2.388 (0.063)
Livestock income	112.12	1,969.70	4,554.55	8,140.91	15,488.48	6,053.15	8.125(0.000)
Unskilled labor income	569.70	1,024.24	1,663.64	2,246.97	2,133.33	1,527.58	0.582(0.677)
skilled income	636.36	1,412.12	4,681.82	6,000.00	8,090.91	4,164.24	2.105(0.107)
Craft and small scale enterprise income	439.39	1,978.79	1,227.27	6,045.45	17,218.18	5,381.82	7.001(0.000)
Remittances	215.15	100.00	530.30	2,242.42	2,345.45	1,086.67	1.026(0.403)
Other non forest income	-	-	1,696.97	1,515.15	16,606.06	3,963.64	2.871(0.032)
Total Income	2,950.30	8,070.91	16,860.91	32,096.59	83,026.06	28,600.95	56.517(0.000)

Source: Survey Data; 2012

Results in table 5.7 indicate that forest income contributes 18.6% to the total household income. The highest contributor to total household income was livestock resource at 21.2%. The lowest contributor to total household income was remittances at 3.8%. However, forest income contributes 28.3% to the lowest 20% (the poorest households), 16.8% to the 20% to 40% household group, 10.3% to the 40% to 60% group, 14.0 % to the 60% to 80% group and 21.8% to the top 20% group. The findings imply that the share of forest resources to total

household income is highest in the lowest 20% (poorest households). The findings agree with those in Kabubo-Mariara (2008) that the poorest groups derive a much larger share of income from forests compared to other groups while it does not agree with those in Cavendish (2000) which found that the share of forest income to total household income is highest in the top 20% households (the richest households).

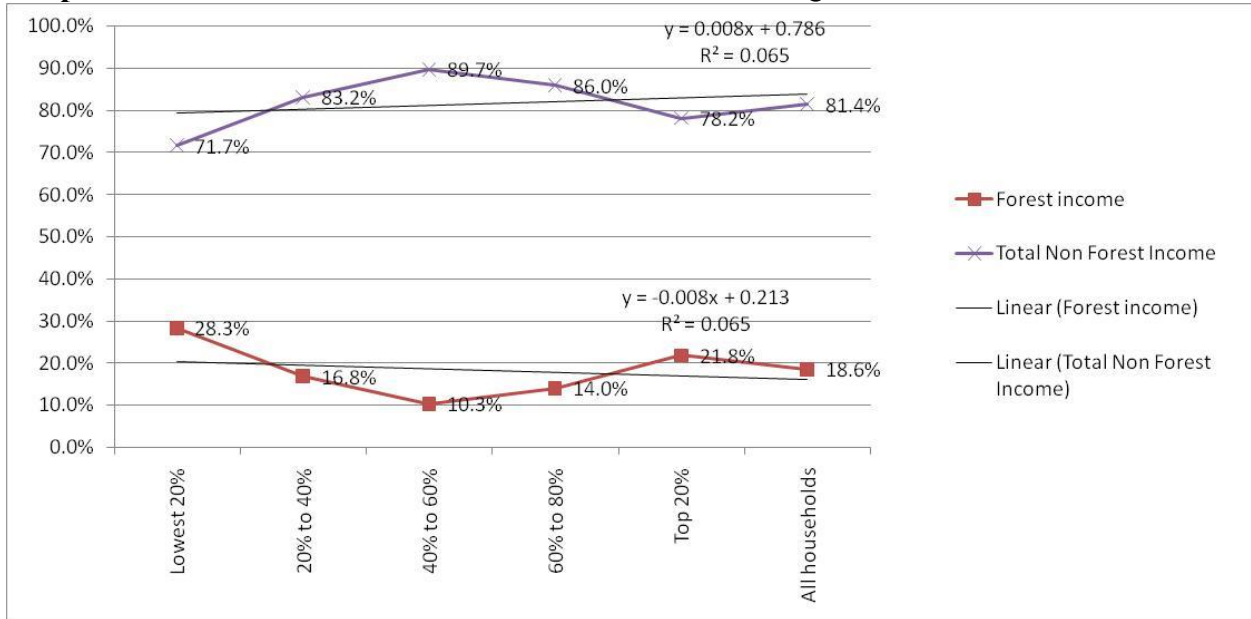
Table 5.7: Extraction of forest income and non forest income across quintiles

Income Sources	Lowest 20%	20% to 40%	40% to 60%	60% to 80%	Top 20%	All households
Forest income	28.3%	16.8%	10.3%	14.0%	21.8%	18.6%
Total Non Forest Income	71.7%	83.2%	89.7%	86.0%	78.2%	81.4%
Crop Income	4.8%	2.8%	4.6%	4.4%	3.6%	3.9%
Livestock income	3.8%	24.4%	27.0%	25.4%	18.7%	21.2%
Unskilled labor income	19.3%	12.7%	9.9%	7.0%	2.6%	5.3%
Skilled income	21.6%	17.5%	27.8%	18.7%	9.7%	14.6%
Craft and small scale enterprise income	14.9%	24.5%	7.3%	18.8%	20.7%	18.8%
Remittances	7.3%	1.2%	3.1%	7.0%	2.8%	3.8%
Other non forest income	0.0%	0.0%	10.1%	4.7%	20.0%	13.9%
Total Income	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Source: Survey Data; 2012

A graphical display indicated in graph 5.1 of forest income and non forest income across the 5 quintiles indicates that total non forest income is an increasing function of the household quintile. Results also indicate that forest income is a decreasing function of the household quintile.

Graph 5. 1: Forest Income and Non Forest Income across Quintiles



Source: Survey Data; 2012

6.0 ANALYSIS OF THE RESULTS

6.1 Correlation Analysis

Correlation analysis is important in identifying multicollinearity issues. The study first conducted a Pearson bivariate correlation analysis (See Annex 2) so as to see which social economic characteristics were significantly correlated to each other. Age of household head was negatively but significantly correlated with absolute forest income ($r=-0.306$, p value $=0.023$). The correlation between count of number of livestock and absolute forest income is positive and significant ($r=0.878$, p value $=0.000$). The high correlation between count of livestock and forest income is an indicator of endogeneity.

Variables that had a correlation coefficient of above 0.5 were identified to suffer from multicollinearity. The literacy of head of household and head of household years of education were collinear as indicated by correlation coefficient of 0.752. Family members less than 16yrs and family size were highly correlated and therefore were collinear. This was supported by a correlation coefficient of 0.701. Family members over 65 yrs and age of head of household were collinear as indicated by a correlation of 0.515. The implication of multicollinearity is that it distorts the significance of individual variables. It also implies that having two collinear variable in one equation does not improve the r squared (model goodness of fit) as well as the F value (overall model significance). It is therefore best to estimate regression equations after omitting one of the collinear variables.

6.2 Regression Analysis

Linear regression method was used to investigate the determinants of household forest income.

It was noted that the model could be suffering from endogeneity. A suitable instrument for the endogenous variables was however, not readily available. In this regard, the results of the OLS method used should be interpreted with caution. This is because OLS can produce biased and inconsistent parameter estimates.

The best way to deal with endogeneity concerns is through instrumental variables (IV) techniques. The most common IV estimator is Two Stage Least Squares (TSLS). It works by finding a variable that is correlated with the explanatory variables but not correlated with the error term. The variable is the instrument. The more highly correlated the instrument is with the explanatory variables while uncorrelated with the error term, the greater the efficiency of the instrument.

The first stage “cleanses” the endogeneity from the variables we are worried about. By using predicted values based on genuinely exogenous variables only, we obtain the exogenous part of their variation. The second stage uses a variable that is now exogenous thanks to the first stage, and so the bias disappears. Interpretation of parameters and hypothesis testing can all take place as usual, following the same procedures as OLS

The selection of all variables to be included in the study was informed by the conceptual framework. However, variables that were multicollinear were not included in the regression analysis. Quintile income as a variable was selected to take into account the effect of the various income levels on forest income.

Table 6.2: Regression Coefficients (P values are in parenthesis)

Variables ³	Coefficients of Regression
Male Headed Household	538.27 (0.76)
Age of Head of Household	-9.91 (0.85)
Family Members over 65years	
Literacy of Head of Household	432.55 (0.81)
Years of Education (Household head)	
Family Size	-234.38 (0.33)
Family Members Less than 16yrs	
Count of Family Members with Disability	-313.71 (0.93)
Number of Family Members Out migrated	993.82 (0.46)
Count of Number of Times Sick	158.53 (0.56)
Count of livestock	69.18 (0.00)
Quintile income	1731.95 (0.02)
(Constant)	-2509.36 (0.54)
R-squared	0.810
F statistic	21.268 (0.000)

Source: Survey Data, 2012

The regression equation eliminated multicollinearity by excluding Family Members less than 16 years as it was highly correlated with family size. The equation also excluded family members with over 65 years as it was highly correlated to Age of Head of Household. Furthermore, Household Head Years of Education was also excluded as it was highly correlated to Literacy of Head of Household.

The results in the regression analysis indicated in Table 6.2 had the coefficient of determination (r squared) of 0.810 indicating that 81% of the variations in forest income were explained by the independent variables. An F-statistic of 21.268 and a p-value of 0.000 were indicated. Quintile income and count of livestock were the only variables to have a positive and significant relationship with forest income. A rise in total household income from one quintile to another leads to an increase in forest income extraction by 1731.95 units, this implies that the extraction ability improves with the level of income. An increase in livestock

³ Variables adapted from Hedge and Bull (2005)

by one unit leads to an increase in forest extraction by 69.18 units. This implies that a rise in household wealth has a positive effect on the extraction of forest resources. This implies that the extraction ability improves with the level of income.

The results confirm that count of livestock and quintile income mattered in the extraction of forest resources. The rest of the socio-economic factors such as gender, literacy, years of education, family size, family composition, sickness either display insignificant or the unexpected signs. Results by Kabubo-Mariara and Gachoki (2008) are consistent with our results.

The results of the above regression analysis show which social economic group need to be targeted. In this case, households with more livestock extract significantly more forest resources. Poverty levels as shown by quintiles also need targeting incase of any compensation once the households are relocated.

7.0 CONCLUSIONS AND POLICY ISSUES

7.1 Conclusions

From the study the forest resources that are mostly extracted by the households are firewood, followed by honey, poles, vegetables and finally medicinal herbs. The average local selling prices of fruits was KES 46, vegetables KES 61, bamboos KES 3000 per feet, poles KES 136 per feet and firewood KES 186 per headload.

The study concluded that only the count of livestock mattered in the extraction of forest resources. The rest of the socioeconomic factors (gender, literacy, years of education, age, family size, family composition, sickness shocks) displayed insignificance or the unexpected signs hence age and sex of the household head do not seem to matter for resource extraction.

The extraction of absolute forest resources is highest in the top 20% (richest households) and the poorest households had the least absolute mean extraction of forest resources. The share of forest resources to total household income is highest in the lowest 20% (poorest households). This therefore indicates that non forest income is an increasing function of the household quintile and forest income is a decreasing function of the household quintile.

7.2 Recommendations and Policy Implication

The monthly extraction of forest resources per household was KES 5,309. This shows that forest income is quite significant and contributes towards household welfare. Hence, an effort to balance between environmental concerns and sustainable livelihoods should

ensure that families living in the area are paid an equivalent KES 5,309 per month to alleviate their suffering in case they were to be translocated to other non forest areas.

The communities living around the forest should be enabled to benefit from the financial resources/ forest proceeds to enable them realize the value the forest thus change their perceptions towards these resources. For instance, the forestry and natural resources departments should emphasize and strictly enforce a community association policy for extraction of forest resources. This would avoid the problem of over extraction and the challenges brought about the tragedy of commons.

In addition, there needs to be a policy on livestock use of forests as an increase in livestock resources leads to an increase in forest use extraction. Consideration needs to be given to those households with livestock since an eviction would mean their livestock will be highly affected and of course in a negative way. Policy concerns should be to introduce zero grazing among the households. As it was noted, the average livestock holding was very high, and this implies that the animal husbandry practice could be a threat to Ngong Forest ecosystem.

Poorer households rely more on the forest and should therefore be aided by the Government to diversify their income generating activities in order to avoid their reliance on Ngong Forest thereby preserving the ecosystem.

7.3 Areas of further study

Further areas of study should include a comparative study with other forests areas. For instance, studies on the contribution of Mau Forest to the households should be conducted so as to inform government policy on how to compensate the evictees of the Mau forest.

In addition, similar studies should be conducted on Aberdare forest and the Mt Kenya forest owing to the environmental and sustainable livelihoods. Other forests around the country that have a larger number of rural population such as Kakamega Forest and Cherangany Hills should be targeted for similar studies.

7.4 Limitations of the study and emerging issues

Some of the respondents' especially old women were not willing to disclose information regarding the use of forests due to fear of the reprisal from their husbands. This made it difficult to collect some information in some homesteads where husbands had already left for work. Most men had left for work at the time of collecting information. This made it difficult to get information especially on family incomes which are mostly operated by men like tax business.

The community members fear the government officials especially the police and forests guards who they claim harass them when they access the forest. It had caused a lot of fear and mistrust by members of the community towards government officials especially KFS. Although restrictions have been placed by KFS on the forest, fence vandalism has been the greatest challenge to the protection of forest.

Some respondents who used to practice the Shamba system inside the forest way before the government stopped them requested that they be allowed to start practicing that again. Culture and traditional beliefs especially in the Masaai community also hindered the collection of information especially the family size and number of livestock which was essential in the economic livelihood study.

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ANNEX 1: TABLE OF VARIABLES

Variable	Explanation	Symbol
Environmental income	<p>It includes the:-</p> <ul style="list-style-type: none"> • Sale of Non Wood Forest Products e.g. Honey, Reeds, Canes • Own Consumption of Food Collection from Forests e.g. Fruits, Vegetables, Animal Hunting, Insects (substitution effect of income). 	Y_i
Socio – economic variables	<p>They include the following variables</p> <ul style="list-style-type: none"> • Gender of Household Head (genderHH) • Age of Household Head (ageHH) • Literacy of Household Head (LiteracyHH) • Size of Household (sizeHH) • Household members below 16years (below16years), • Household members above 65 years (above 65) • Working adults with disability • Number of household members who have migrated (migrationHH) • Sickness • Count of Livestock 	X_i
Quintiles	A statistical value of a data set that represents 20% of a given population. Or whereby a sample or population is divided into fifths	
Multicollinearity	It exists when two or more independent variables are perfectly or highly correlated.	

ANNEX 2: CORRELATION TABLE

N=55	Forest income	Male or female HH	Age of HH	Literacy of HH	HH years of education	Family size	Family members less than 16yrs	Family members over 65 yrs	Count of family members with disability	Count of family member migration	Count of number of times sick	Count of livestock
Forest income	1											
Male or female headed Household	0.158 (0.25)	1										
Age head of Household	-.3068* (0.023)	-.284* (0.036)	1									
Literacy of HH	-0.012 (0.93)	0.163 (0.235)	-.277* (0.041)	1								
HH years of education	0.025 (0.858)	0.261 (0.055)	-.390** (0.003)	.752** (0.000)	1							
Family size	0.044 (0.75)	-0.146 (0.287)	0.212 (0.12)	0.03 (0.83)	-0.046 (0.736)	1						
Family members less than 16yrs	-0.009 (0.946)	-0.149 (0.276)	-0.061 (0.66)	0.034 (0.804)	0.025 (0.855)	.701* (0.000)	1					
Family members over 65 yrs	-0.156 (0.255)	-0.168 (0.221)	.515** (0.000)	-0.038 (0.785)	-0.078 (0.57)	.266* (0.049)	-0.012 (0.93)	1				
Count of family members with disability	-0.075 (0.588)	-0.005 (0.971)	-0.092 (0.503)	0.105 (0.444)	0.194 (0.155)	0.229 (0.093)	.291* (0.031)	-0.058 (0.673)	1			
Count of family member migration	0.086 (0.531)	0.11 (0.423)	0.037 (0.788)	0.131 (0.339)	0.109 (0.429)	0.126 (0.358)	-0.109 (0.427)	0.208 (0.128)	0.014 (0.918)	1		
Count of number of times sick	-0.188 (0.17)	-0.12 (0.384)	.326* (0.015)	-0.166 (0.225)	-0.15 (0.273)	0.056 (0.685)	0.113 (0.41)	0.300* (0.026)	.269* (0.047)	0.021 (0.882)	1	
Count of livestock	.878** (0.000)	0.094 (0.495)	-0.265 (0.05)	-0.102 (0.46)	-0.096 (0.488)	0.081 (0.556)	0.01 (0.942)	-0.134 (0.329)	-0.081 (0.558)	0.04 (0.77)	-0.171 (0.213)	1

*. Correlation is significant at the 0.05 level (2-tailed).

** . Correlation is significant at the 0.01 level (2-tailed).

Parentheses indicate the P values

Source: Survey Data; 2012

ANNEX 3: QUESTIONNAIRE

Questionnaire Number.....

Household No: _____

Date of survey: ___ / ___ / 2012

Village: _____

Name of interviewer: _____

A: HOUSEHOLD INFORMATION			
A1	Name of respondent		
A2	Is the respondent the head of the household?	1=Yes , 0=No	
A3	Is the household male or female headed	1=MHH, 0=FHH	
A4	Age of head of household		
A5	Is the head of household literate?	1=Yes, 0=No	
A6	How many years education did HH complete?		
A7	Total number of people in the HH		
A8	How many members are 16 years old or less		
A9	How many members are 65 years old or less		
A10	How many of the adults in the HH between ages of 16 and 65 are unable to work?(disability e.t.c)		

A11	How many household members have migrated in the last three months?	
A12	What were the reasons for migration?(identify each case)	<p>1=to work;2=for school;3=to help other HH;4=to relieve strain on this HH;5=stayed behind when this HH moved;6= marriage;7=death of parent/caretaker;8=other(specify above)</p> <p>/___/___/___/___/</p>
A13	How many times in the last 3 months have members of the household had to use the services of a doctor?	
A14	Total livestock (goats and cows) owned	

PARTICIPATION OR NON PARTICIPATION IN SALE OF ENVIRONMENTAL/FOREST PRODUCTS

1. The following statement assesses the likelihood of participation or non participation in the sale of forest products. Please state whether you agreement or disagree with the statement.

a) I mostly sell forest products rather than use them for own consumption

i) Yes

ii) No

B. FOREST RESOURCE UTILIZATION

Kindly indicate the QUANTITY of forests resources derived from Ngong forest in the following categories for the last 3 MONTHS

Forest Resources	Units of measurement	Quantity
Vegetables		
Fruits		
Insects		
Rabbits		
Antelopes		
Honey		
Mushrooms		
Edible leaves		
Edible roots		
Medicinal herbs		
Grass		
Reeds		
Rushes		
Canes		
Leaves		
Other resources		

C. FOREST RESOURCE VALUATION

From the list of forest goods listed in B, kindly attach the MARKET price of the good OR the market price you would be willing to pay if not traded in the formal market

Forest Resource Use	Market Price per unit	WTP price
Vegetables		
Fruits		
Insects		
Rabbits		
Antelopes		
Honey		
Mushrooms		
Edible leaves		
Edible roots		
Medicinal herbs		
Grass		
Reeds		
Rushes		
Canes		
Grass		
Leaves		
Other resources		

D. HOUSEHOLD INCOME

D1	Indicate below the income obtained from the following sources for the last 3 months						
Months	Crop income	Livestock income	Unskilled Labor income	Skilled Labor Income	Crafts and Small scale enterprises	Remittances	Other non forest related income
November							
December							
January							
Total							
D2	How much of your household's income is spent on food per month?					Ksh	
D3	During the last 1month, did you or any member of your Household borrow money?			1=Yes; 2=No			
D4	What were the main reasons to borrow money? PLEASE RECORD THE 2 MAIN REASONS: 1= to buy food; 2=to pay for health care; 3=to pay for funeral; 4=to pay for other social events; 5=to avoid selling assets; 6=to buy agric input; 88=other reason(SPECIFY)					/_/_/_/_/ 88=other -----	
D5	From whom did you borrow money? 1=Friends/relatives; 2=Bank/NGO; 3=Money lender; 88=other(SPECIFY)					/_/_/ 88=other	

Thank You for Your Time