ESTIMATING THE ECONOMIC VALUE OF NON TIMBER FOREST PRODUCTS TO THE ADJACENT COMMUNITIES OF MARSABIT FOREST RESERVE, MARSABIT COUNTY, KENYA.

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DECLARATION

I declare that this is my original thesis work and it has not been submitted for examination in any other university to the best of my knowledge.

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This Project Thesis has been submitted for examination with my approval to the university supervisors below;

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Dr. Stephen Anyango Date

DEDICATION

I dedicate this thesis work to my wife, Mariah Matembo, my friend you are the best gift God ever gave me. You stood by me through thick and thin and have been my pillar of strength. My prince Fabian and Princess Gabriella, you are the most awesome kids and I praise Almighty God for you every day. You are the inspiration to my work and your comical stunts always me. May you grow to be the great personalities and contribute to a better world in your small ways.

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And to the Almighty God, I say a grand thank you.

ABSTRACT

Non-timber forest products are biological components of the forest ecosystem that exist in nature and are generally not cultivated and are of great importance to the forest adjacent communities due to their ability to support and sustain their livelihood practices while also contributing to forest conservation. However, understanding of their economic value by both the local communities, market forces, planners, policy makers and implementers is low thus often presenting poor economic signals on their worth. This study sought to avail information on the economic value of non-timber forest products from Marsabit forest which is important for the conservation of the forest ecosystem as a whole and enhancing the efforts of better policy formulation and decision making in the NTFPs sector. The study assessed the major NTFPs extracted by the local communities adjacent to Marsabit Forest reserve. It further estimated the economic value of these resources at the study site and determined the alternatives livelihood options proposed by the local communities to reduce the extraction levels of NTFPs from the Marsabit Forest reserve. Community focus group discussion, household survey using semi structured questionnaires and market surveys were the major tools used during the data collection process. A sample size of 96 households was determined statistically within the radius of 5km from the forest reserve and households surveyed using simple random technique. The quantities of the different products from the households were assigned an economic value by multiplying with their average market prices. The results indicate that NTFPs play an important role in the household economy of the Marsabit forest adjacent communities with key resources extracted being firewood, medicine, forage, building materials, honey, fruits, animal products. From the analysis, the estimated economic benefits accruing across the households from NTFPs

extraction is approximately **Kshs. 121,394.8/ha/year (US$ 1,214/ha/year)** with firewood, plant food products, building materials, medicine and honey being the biggest contributors. It is therefore recommended that the county government and Marsabit forest reserve management regimes give special consideration on formulating a policy that would guide sustainable harvesting of NTFPs from Marsabit forest. Information on the worth of NTFPs from the forest should also be cascaded to the local communities through available local communication mechanisms and awareness creation on how they can still create wealth without necessarily over depending on NTFPs from the Marsabit forest.

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ADC	African District Council
AFLEG	Africa Forest Law Enforcement and Governance
ASAL	Arid and Semi-Arid Lands
CBD	Convention on Biological Diversity
CFA	Community Forest Association
CITES	Convention on International Trade in Endangered Species
CoC	Cost of Collection
COP10	10th Conference of Parties
CVM	Contingency Valuation Method
DPM	Direct Pricing Method
FAO	Global Forest Resource Assessment Report
FCC	Forest Conservation Committee
FR	Forest Reserve
GoK	Government of Kenya
ITTA	International Tropical Timber Agreement
KEFRI	Kenya Forestry Research Institute
KFS	Kenya Forest Service
KWS	Kenya Wildlife Service
MEA	Millennium Ecosystem Assessment
MFR	Marsabit Forest Reserve
MNR	Marsabit National Reserve

NEMA	National Environment Management Authority
NTFPs	Non Timber Forest Products
NWFPs	Non Wood Forest Products
PA	Protected Area
TEV	Total Economic Value
UNCCD	United Nations Convention to Combat Desertification
UNFCCC	United Nations Framework for Convention on Climate Change
WTA	Willingness to Accept

1.0 INTRODUCTION

1.1 Background information

Forests constitute one of the most important earth-ecosystem resources at all levels - local, regional, national and even global (FAO, 2003). They provide a wide variety of social and economic benefits, ranging from easily quantified economic values associated with forest products, to less tangible services and contributions to society (FAO, 2010).

The livelihoods of rural societies living in and/or around forests are intimately connected to the natural resources that can be procured from these ecosystems. The diversity of wild plants within forests supply people with a range of services, such as wood for fuel, timber for construction, as well as numerous non-timber forest products (NTFPs) for food, weaving and medicines. Access to these resources is necessary for sustaining livelihood practices and preserving important cultural, commercial, and spiritual activities. However, these very natural resources that the communities are dependent upon may become depleted over time (Brown et al., 2011).

NTFP is a term that encompasses biological materials used for purposes other than commercial timber (Ndangalasi et al., 2006). They are components of the forest ecosystem that exist in nature and are generally not cultivated (Adepoju and Salau, 2007). For the purposes of this study, however, it will include all extractives, harvested within and on the edges of Marsabit forest ecosystem, which have perceived economic or consumption value sufficient to encourage their collection and removal from the forest. These resources must be those that are utilized within the household or are marketed, or have social, cultural or religious significance (Adepoju and Salau, 2007).

Despite the services they provide, natural ecosystems worldwide are under tremendous pressure (Pagiola et al., 2004). Forests are being converted to other use at an alarming rate and the increasing selective exploitation of important indigenous tree species and other NTFPs is likely to lead to loss of plant diversity, environmental functions and services that have sustained the livelihood of both the local human and wildlife populations dependent on the very forest for survival. Population growth also puts an increasing pressure on the natural resources in the country. Further deforestation may result in a lack of resources to those people who rely heavily on these resources for their daily income or food, and harm their well-being. At the same time, international demand for reducing degradation and deforestation is also increasing, stimulating conservation efforts. Effective forest conservation should hence aim to provide incentives for rural communities to reduce degradation (Schaafsma, 2012)

Information on NTFP harvesting and their value are necessary for both conservation purposes and sustainable utilization of the forest resources. For instance, the world's total forest cover in 2010 was estimated to be just over 4 billion hectares, corresponding to an average of 0.6ha of forest per capita (FAO, 2010) with the reported value of non-wood forest product removals amounting to about US$18.5 billion in 2005. Food products accounted for the greatest share. However, information is still missing from many countries in which non-wood forest products are highly important, and the true value of subsistence use is rarely captured. As a result, the reported statistics probably cover only a fraction of the true total value of harvested on-wood forest products (FAO, 2010). However, the link between the economic benefits of NTFPs and their resource base (including local availability and sustainability) and sources is poorly understood (Ndangalasi et al., 2006).

Forests in Kenya cover a total area of 37.6 million hectares out of which 2.1 million hectares are woodlands, 24.8 million are bush lands and 10.7 million are wooded grasslands. Out of the total forest cover, only 1.7 million hectares are gazetted and managed by Kenya Forest Service. A total of 9.4 million hectares of a variety of tree coverage exists on farmlands, settlements areas and urban centers (KFS, 2007).

Kenya's natural forests supply important economic, environmental, recreational, scientific, social, cultural and spiritual benefits. Some of the environmental benefits include: a) regulation of water supplies. For instance the-Kenya's "water towers"(Mt. Kenya, Mt. Elgon, Aberdares, Cherangany hills and the Mau forest water catchments) constitute bulk of Kenya's high forest; b) provision of energy through the hydro-electric power stations which are located on catchments serviced by major forest areas of vital water catchment and along major rivers. These also provide water to support for irrigation schemes that are important for agricultural sector development; and c) conservation of biological diversity, carbon dioxide sequestration and a major habitat for wildlife, which promotes tourism (KFS, 2007).

However, some of these forests have been subjected to human activities which pose severe threats to forest integrity. These threats have reduce the ability of the forests to supply forest products, serve as water catchments, biodiversity conservation reservoirs, wildlife habitats and carbon sinks. The threats, therefore, need to be controlled and forests managed efficiently and sustainably to allow for continued supply of forest goods and services.

Mount Marsabit forest ecosystem is a heritage of national and international repute. It is an important refuge for diverse flora and fauna some of which are rare and endemic with the

surrounding areas (arid lowlands) also harbouring a diverse range of ecosystems and associated biodiversity (KWS, 2014). The forest is therefore, of critical importance to sustaining life not only within the forest ecosystem, but also in the surrounding areas including Marsabit town because of its ecosystem service functions (water provision, climate regulation, carbon sequestration) and ecosystem good provision (fuel wood, grazing, medicinal plants). Rural communities living around forest areas often rely heavily on NTFPs extracted from the forest for both subsistence and cash income. These groups are often among the poorest and most deprived members of society in developing countries (Bishop, 1999). Culturally the mountain is also revered by many communities in Kenya for its religious association. In the recent past, it has become an important tourist destination.

1.2 Problem Statement

Forests support and protect a wide range of production and consumption processes such as the ecosystem service functions (e.g. water provision, climate regulation, carbon storage roles etc.) and ecosystem good provision (e.g. fuel wood, grazing, medicinal plants) which are particularly important to the adjacent communities. Extraction of the forest products generally results into either overexploitation or conservation of the resources. Marsabit forest faces a myriad of interrelated challenges that threaten its future survival and sustainability, through unsustainable rate of forest degradation as a result of complex set of external and internal factors. Recently, there has been an increase in extraction rate of forest products (timber and non-timber forest products) prompted by: a) change in lifestyle (sedentarisation of pastoralists); b) poor and weak enforcement of the conservation regulations (e.g. no gazzeted management plan to govern the resource making it become a defacto open access resource and prone to the "tragedy of the commons"); c) increased human population and increased market demands for forest products. The new income opportunities have also motivated the adjacent communities to actively engage in commercialization of the forest products. Unsustainable extraction of these resources may also lead to changes in diversity and species composition (Brown et al., 2011). The forested area has reduced drastically from 19,000ha, in the 1980s, to about 11,000ha currently, with its continuity expected to lead to severe impacts for both human beings and wildlife (Robison, 2013).

The wide range of NTFPs extracted from Marsabit forest, many of which are consumed at household level, may be undervalued by the communities, market forces, planners, policy makers and implementers. The perceived low value of these forest resources (NTFPs) may present poor economic signals on the worth of forests, and give people few incentives to

conserve forests, limit the consumption of forest resources sustainably, halt forest clearance for seemingly more profitable land uses, or to implement developments in ways that do not harm forests (Emerton, 1999). Therefore, understanding the values of non-timber forest products is a critical factor in developing policies to sustain the long-term viability of human and the forest ecosystems. Under valuation of forests products in most cases, may result in governments according low priority and resource allocation for forest conservation. For instance Governments in East Africa spend, on average, less than US$3 per hectare on managing indigenous forests - a tiny amount in comparison to their potential and actual economic importance (Emerton, 1999).

Availing information on the economic value of non-timber forest products from Marsabit forest is, therefore, likely to induce actions intended on reversing the vicious degradation cycle of Marsabit forest by reducing threats to the ecosystem, promoting sustainable forest uses, and providing affordable, environmentally friendly and sustainable alternatives to forest degrading activities.

There is also generally little knowledge regarding alternative livelihood options the local communities would be willing to accept for environmental improvement projects vs. what policy administrators think they should adopt. Choices made by the respondents for their preferred alternatives can be used to increase the attention of the citizens' preferences on environment management.

To the best of the author's knowledge, around Marsabit forest, there have been limited studies if at all done, exclusively on economic valuation of ecosystem goods and services. Arguably, this

leads to a conclusion that effective policies have been absent and opportunities missed (Ohdoko and Yoshida, 2011). This study will increase awareness in this aspect both locally and globally.

1.3 Research Question

The study was guided by the following main question: How do communities utilize and value non-timber forest products and what alternative livelihood options are local communities willing to adopt conserve the forest?

This was broken down in the following specific research questions:

1) What are the major non-timber forest products of Marsabit forest?
2) What are the values attached to the non-timber forest products by the local communities?
3) What alternative livelihood options would local communities be willing to adopt to reduce the rate of harvesting non-timber forest products from Marsabit forest?

1.4 Research Objectives

The purpose of this study was to estimate the economic value of non-timber forest products and determine the alternatives the Marsabit forest adjacent communities would be willing to adopt to conserve Marsabit forest.

The specific objectives included the following;

1) To establish the major non-timber forest products used by communities adjacent to Marsabit forest.

2) To estimate the economic values of non-timber forest products at the study site.
3) To determine the alternatives the local communities would be willing to adopt to reduce the rate of harvesting non-timber forest products from Marsabit forest.

1.5 Research Hypothesis

This research study was guided by the hypothesis that: rural poor households are disproportionately dependent on NTFPs with extraction levels determined by a number of factors such as the products characteristics, the markets in which they are sold, the demand for products, and the risks and uncertainties involved during harvesting.

1.6 Justification of the Study

Increasing attention has been paid to biodiversity and ecosystem services recently, particularly in the lead-up to the 10th Conference of the Parties (COP10) of the Convention on Biological Diversity, held in Nagoya City, Japan in October 2010. In addition, the International Science Workshop was held in Tokyo, Japan in July2011, on Assessments for Intergovernmental Platform on Biodiversity and Ecosystem. More research on biodiversity preservation has been called for in this context. While biological and ecological knowledge is essential for practical management of the ecosystem, an economic perspective has been increasingly required to confirm efficient management and to capture the preferences of local residents (Ohdoko and Yoshida, 2011).

The economic importance of East Africa forests is grossly under-estimated by many planners, policy-makers and resource managers. The low perceived value of forests is also reflected in a

series of economic policies and strategies that usually ignore forests (at the best), consider it a right to benefit from forest goods and services for free (almost always), and sometimes even actively contribute to forest degradation (at the worst). Take, for instance, the long history in the region of agricultural subsidies, which have had devastating impacts on forest cover and land use. At the same time, economic policy attention has rarely focused on promoting sustainable forest uses, or on providing low-cost alternatives to forest-degrading activities (Emerton, 1999).

Quantifying the value of forest products and incorporating them in economic analysis is important for the conservation of the forest ecosystem as a whole. This is because once the true value of the forest products is brought to light, efforts aimed at conservation and sustainable utilization of the resources will be enhanced. This will also enhance efforts of better policy formulation and decision making (Turner et al, 2003).

1.7 Study Limitations

The household survey had a number of limitations. Some respondents had recall problems as they couldn't remember exactly amounts of certain NTFPs that they had collected over a certain period of time. This may have underestimated the quantity collected and subsequently the economic value.

Valuation of animal products and pasture, which are equally important to the local communities' livelihoods, was excluded since the quantity and their price information was difficult to obtain from either market survey or any published or unpublished literature on Marsabit forest ecosystem.

There were also; constraints of time, funds and insecurity in some occasions and areas during the data collection process. However, the household survey data collected was statistically significant to draw conclusions on the study area.

2.0 LITERATURE REVIEW

2.1 Marsabit Forest Ecosystem Resources

Marsabit forest is an ecosystem of vital importance for biodiversity conservation, major water catchment area and supports the larger human population livelihoods within Marsabit County. There is a web of movements and relationships (wildlife migration, livestock movements, hydrological flows, and various types of forest resource harvesting by human beings) that tie together the National reserve, Forest reserve and the Community land with both forested and non-forested areas (Robinson, 2013).

The major wetlands in the forest include "Sorkorte Guddo" (Lake Paradise) at 1352m, "Sorkote Dhika" (at 1566m) and Bakuli springs, which is also a key water source for Marsabit Town. The drainage systems are dominated by dry seasonal water ways (locally known as "laggas") which flow only during the rains to the lowlands. Such water ways include Sagante, Boji, Ilchuta, Ilpus, Ogicho and Hulahula. Other water sources located within and around the forest reserve include several springs, surface pans, wells and boreholes. These water systems are the major source of water for domestic water supply, livestock watering and micro-irrigation schemes.

The core is a closed canopy forest that has rich volcanic soils, which are well developed with high water retention capacity making it a critical water catchment and the only source of permanent surface water in the region. The upper part of Marsabit Forest is covered by sub-humid montane evergreen cloud forest with the tree species dominating this higher canopy height being *Croton megalocarpus, Strombosia schleffleri, Diospyros abyssinica, Cassupuora matosona, Olea africana,* and *Olea capensis*. *Olea africana* is the most dominant and mostly has

lichens hanging over the branches. *Olea europea* spp *cuspidata* mainly dominates lower and slightly open canopy forest places with harsh conditions with direct sunlight such as hill tops and the forest edges and is covered by bryophytes.

Ecologically, the area is divided into two ecological zones. Agro-zone III which is mostly an arable land receives much rain and has relatively less evaporation making it suitable for horticultural and food production such as maize, beans, fruits and vegetables. The vegetation in this zone at the elevation between 600-1200m is mainly bush land and thicket dominated by *Acacia tortilis, Cordia sinensis, Sericocomposis pallida*, and *Duosperma eromphilum*. Vegetation clearance for farming activities and encroached settlement (Manyatta Jillo, Gabrra scheme, Songa, Kituruni, Karare and Hulahula) are clearly visible within this zone, with forest excisions having taken place especially on the southern slopes of the forest reserve. This has exacerbated the rate of forest degradation within the Marsabit forest ecosystem the demand for forest resources have increased with most settled farmers participating in destructive forms of land use such as cutting of wood from the forest, along the mountains lower slopes and indigenous woodlands for fuel and building purposes. These combined with minimal meaningful re-afforestation and afforestation efforts exerts a lot of pressure on the forest, affects the natural regeneration of wood resources and progressively reduce the quantity, quality and diversity of available wood species and access to these products.

Agro-zone IV towards the lowlands at elevations of 400-600m, vegetation changes from bush lands to Acacia dominated woodlands with grass cover and herbaceous plants. *Acacia sp.* or *Commiphora sp*. Dominates the middle and upper strata, while the lower strata has sandy lands stippled by patches of bushes and herbs such as *Sericocomopsis pallida, Duosperma*

eremophilum, *Indigofera spinosa* and *Blepharis linariifolia* (Xiaogang, 2005). This area is mostly suitable for sedentarized livestock rearing with the few forested areas also serving as dry season refuge/grazing areas. Between the high forest and shrub land exists woodlands. These are important grazing areas for both livestock and wildlife. They therefore act as buffer zones for the high canopy forest protecting the core forest from human activities such as firewood collection and livestock grazing. The lowlands are covered by shrub land and scrub land vegetation. This vegetation type is home to plains species such as Grants gazelle, gerenuk, dik dik, lions, and ostriches, among others.

Marsabit forest also has several key vegetation (e.g. naturally occurring wild species of Coffee *arabica* and the endemic *Rinorea convallarioides* spp. *marsabitensis*) and mammal species of conservation concern including elephants, Grevy Zebra which venture into the foothills of the forest. Both elephants and grevy zebra are listed in Appendix 1 of CITES and categorized as endangered in the IUCN red data list.

The forest is also home to other wildlife species such as carnivores including the Lion, leopard, cheetah, spotted hyena and striped hyena. These carnivores rank high as a tourist attraction in the forest and adjacent areas. They also play a significant role in controlling herbivore populations. It is also a source of fuel wood and medicinal herbs for the local communities.

2.2 Non Timber Forest Product and their importance to livelihoods

This chapter introduces the various aspects of NTFPs from their definitions, classifications and a review of literature (short description) on their importance for supporting forest-based

livelihoods. It also clarifies what definition will be adopted in this study and provides various household uses of Marsabit forest.

Interest in NTFPs began as early as during the late 1980s and the early 1990s, in conjunction with increasing global concern about environmental issues, especially deforestation, with increased attention to rural poverty, and with the emergence of the concept of "sustainable development" (Belcher, B.., et al, 2005).

The term NTFPs has no universally accepted definition and has been used interchangeably with terms such as "non-wood forest products, minor forest products" and "hidden harvest". This can be explained from the fact that studies on NTFPs are mostly carried out by experts and/or researchers from various fields of interest such as forestry, ethno botany, economic botany, natural resource economics, social development, conservation biology, protected area management, agro-forestry, marketing, commercial development, ecological anthropology, cultural geography and human ecology (Ahenkan and Boon, 2010). The various definitions will, in most cases, expound on specific species, aspects and products in line with authors focal interest.

For the purposes of this study, the term NTFPs encompasses biological materials used for purposes other than commercial timber (Ndangalasi et al., 2006) and exists naturally without private cultivation (Adepoju and Salau, 2007). It will, therefore, include all extractives, including both plant and animal products harvested within and on the edges of Marsabit forest ecosystem, which have perceived economic, cultural, social or consumption value sufficient to encourage their collection and removal from the forest. Currently in Marsabit, households use the forest for

watering and grazing livestock, fetching water for domestic purposes, harvesting forest products such as fuel wood for cooking and making charcoal, poles for construction, fodder for livestock, medicinal plants and honey (Shackleton et al., 2011).

NTFPs are classified into edibles, medicinal and dietary supplements, floral product and specially wooded products. Edibles are forest products gathered from the forest such as edible plants (fruits, fungi and juices), animal products, honey etc. The medicinal and dietary supplements include plant products (leaves, barks and roots) that are processed into medicines but are wildly harvested from the forest and traded as botanical products. Floral products are mostly used for decorative applications while specially wooded products will include handicrafts, carvings and turnings, musical instruments containers, special furniture pieces and utensils (Adepoju and Salau, 2007).

Millions of people worldwide live in or near tropical forests and savannas, and rely on these ecosystems and their services for welfare benefits of fuel, food and income with people collecting firewood, charcoal, poles, thatch materials, fruits, vegetables, honey bush meat and medicine mostly (Schaafsma, M.., et al, 2014). NTFPs are of great importance to forest dependent communities as they provide foundation and support for the development of their livelihoods. Several studies suggest that the communities, who are relatively poor, are dependent on forest product with NTFPs being a critical component in their livelihoods security especially for food security and complementary cash income through collecting and marketing them or safety net when agricultural yields are low. In fact, in some cases they contribute to local or regional economics as they may be further processed into consumer oriented products. The high dependence by the local communities can be explained in terms of the economic characteristics

of forest-dependent people and of the products themselves. Rural households tend to be poor, with low levels of financial and physical capital, remote (physically and economically), at least partially subsistence oriented and exposed to high levels of risk (Belcher, B.., et al., 2005). They also have cultural significance and value (Schaafsma, M.., et al, 2014, Sills, O.., et al, 2003, Adepoju and Salau, 2007).

NTFPs have both a subsistence (consumed directly at household level or traded in markets) and safety net function for those that can be used during hardship or emergency periods to fill the shortfall created by agricultural shortfalls due to drought or pestilence, or when shocks hit households such as unemployment, death or disease- safety net function, which can make a difference between life and death (Belcher, B.., et al, 2005). For instance, the economic crisis of the 1980s in Africa, which resulted in the decline in the profitability of cocoa and coffee production on the international market, prompted majority of the farmers to diversify their sources of income by collecting and selling NTFPs in order to minimize the risk related to agriculture (Sunderland and Ndoye, 2004). The use of products extracted from the forest increases during dry or stressful periods which illustrates the forests function as a safety net during economic hardships. In Marsabit, it's the poorest households that sell forest products to earn income (Shackleton et al., 2011).

Studies in Ghana have estimated that 20 % of economically active population derives their income from NTFPs with 38% of households trading in them. More plant medicinal products are traded at the local markets (Ahenkan and Boon, 2010). They are the primary motivating factors for the local communities to participate in forest management and adequately reflect the society's demand upon forest resource. In the face of ecological challenges such as climate

change and economic pressures, NTFPs will significantly help forest depend communities to diversify their economies, provide inputs into the agricultural system, help households control exposure to risk of various kinds and soften the impacts of current challenges (Ahenkan and Boon, 2010; Adepoju and Salau, 2007). With proper NTFPs management, ecological, social and economic benefits will be realized.

2.3 Policies and Institutions Governing Utilization of Non-Timber Forest Products in Kenya

There are a number of national legal, policy and institutional frameworks that form the basis for a comprehensive sustainable forest management in Kenya. In this section, a number of policies and institutions responsible for enforcement of forest laws, regulations and sustainable utilization of forest products (NTFPs) have been reviewed. In Kenya, the use of forest policy to guide the utilization, management, and development of NTFPs is a relatively new concept. However, emphasis will be on the constitutional basis and provisions of the forest legislation. The section reviewed the constitutional basis and provisions of the forest legislations in Kenya and also makes mention of the international treaties and convention protocols that are commitments adopted by the country for the implementation of national forestry related policies and pin points how NTFPs could be associated with them. Policies at national level that influence NTFPs are normally aimed at fighting poverty, improving livelihood conditions and sustainable development while those at regional and international level for heritage protection and nature conservation respectively.

2.3.1 Forest Legislation

The Constitution of Kenya promulgated on 27th August, 2010 has various sections that provided for the role of government in determining access, sustainable exploitation, utilization, management and conservation of natural resources and the equitable sharing of benefits. It therefore, commits the forest administrations, agencies responsible for the enforcement of forest laws, regulations, and forest research and education institutions to formulate a harmonized legal framework in line with the spirits of the new constitution of Kenya. Equally, the new constitution brought new requirements on public participation, equity in benefit sharing and community and gender rights thereby providing a useful tool and governments commitment in promoting good forest governance and natural resource management within the country. Other set of values that the constitution of Kenya is based upon include integrity, good governance, sustainable development and social justice. It has enshrined environmental rights for all people. The key provision include chapter 4 on the bill of rights of all citizens in respect of the environment and conservation of natural resources. In part 2, on the "Rights and fundamental freedoms", section 42 of the CoK, 2010 provides that "every person has the right to clean and healthy environment, which include the right to

i) Have the environment protected for the benefits of the present and future generations through legislative and other measures, particularly those contemplated in Article 69;

ii) Have obligations relating to the environment fulfilled under Article 70.

As such, Section 69 defines the states obligations in respect to the environment which commits the government of Kenya to ensure there is sustainable exploitation, utilization, management and

conservation of environment and natural resources including NTFPs, and ensure the equitable sharing of benefits. It also commits the government to work to achieve and maintain a tree cover of at least ten percent of the land area in Kenya.

Section 69 (2) states that "every person has a duty to duty to cooperate with state organs and other persons to protect and conserve the environment and ensure ecologically sustainable development and use of natural resources". The section equally provides for both the state and its people to work together. For instance, the state shall obviously ensure the conservation (a), (b), (c), (e), and (f). Thus it must "(d) encourage public participation in the management protection and conservation of the environment" and "(g) eliminate processes and activities that are likely to endanger the environment". Those processes can then guarantee "(h) utilize the environment and natural resources for the benefit of the people of Kenya".

Decentralization of services is key as a fundamental principle of governance with powers vested in county governments as key operational unit since the constitution introduces a two-tier system of government. Section 176 (2) provides for further decentralization of functions and service provisions if its "efficient and practicable "to do so. The implication here is that it also applies to the legal and administrative contexts of forest and biodiversity conservation.

2.3.1.1 Forest Policy and Forest Act, 2005

Kenya's first policy was formulated and published in 1968 as sessional paper no.1 of 1968 to guide the forestry sector together with Forest Act (CAP 385 with revisions in 1962, 1982 and 1992). Significant progress has been made in developing and updating forest policy, law and national forest programmes as necessitated by the new constitutional dispensation. The national

policy framework on forests and their management aims to guide decision-making and provide a clear sense of direction over time. The legal framework provides a key instrument in support of the national forest policy. Together the national policy and the legal framework related to forests constitute the basis for sustainable forest management (FAO, 2010). Currently main legislations concerning forest management and conservation are the Forest Act, 2005 and draft Forest Policy, 2014.

The overall goal of the Forest policy is to improve the well-being of the people, conservation, sustainable management and utilization of forest resources without compromising the quality of life for future generations and equitable sharing of accrued benefits. Its enforcement and implementation is guided by the principles of public good, ecosystem approach, sustainable forest management, good governance, public participation, polluter and user pays, commercialization of forestry activities, ecologically sensitive and fragile areas, research, education and knowledge, livelihood enhancement with a focus on fighting poverty, indigenous knowledge and intellectual property rights and international and regional cooperation

The forest policy recognizes the critical importance of non-wood forest products to the livelihood of rural communities and has policy statements for the promotion and sustainable utilization of NTFPs, supporting the establishment of NTFPs enterprises, encouraging participatory management of indigenous forests with communities and other stakeholders, encourage local communities to establish non-wood based forest enterprises, and intensifying research and trainings in NTFPs. The policy therefore seeks to balance the needs of the people with opportunities in forest conservation, management and sustainable utilization. Through production of minor forest products (regulated through licensing system) and sustainable forest

management the policy provides an avenue to contribute towards poverty reduction, employment creation and livelihood improvement of the forest dependent communities.

The Forest Act, 2005 provides for involvement of forest adjacent communities and other stakeholders in forest conservation and management through the formation of Community Forest Associations (CFAs) while specifying privileges in relation to particular forest areas and forest produce rights in those areas. The formation Forest Conservation Committees (FCC) to advise the KFS Board on all matters relating to management and conservation of forests in each forest conservancy area is also provided for within the forest act 2005. Through this, responsibilities and powers are decentralized and devolved to local actors.

Section 34(1) of Forest Act 2005 (GoK, 2005) specifies that conservation and management of forest areas should be carried out in accordance with an approved management plan which will be based on an ecosystem approach. The planning process is expected to be participatory to ensure the plan is owned by protected area adjacent communities and other stakeholders. Stakeholder ownership and support of the plan subsequently ensures smooth implementation of proposed management measures.

The Forest Act, 2005 also recognizes that forests are the main source of fuel wood and provides essential raw materials for both wood and NTFPs. It therefore makes provisions for the management to incorporate sustainable use of forests and biological diversity. Forest uses and benefits include timber, fuel, food, and other forest products. It also commits the country to inter-sectoral development, international conventions and other agreements to form the basis for comprehensive sustainable forest management in Kenya.

However, there are no subsidiary legislations to guide the implementations of the provisions of forest policy especially the operationalization of CFAs and FCCs. The Forest Act, 2005 is also under review to bring it in line with the aspirations and spirits of the new constitution.

Other legislations concerning forest conservation and management are fairly comprehensive and spread over various Acts shown in the annexes.

2.3.1.2 Institutional Framework

The conservation of biodiversity, exploitation and management of NTFPs from the tropical forests in Kenya lies with the government agencies and ministries whose work is supported by other organizations including civil society organizations, foreign aid donors, community based organizations, NGOs and the private sector. These are involved both in policy formulation, decision making and developing implementation structures and action plans at specific sites. The diverse nature and use of NTFPs makes their sustainable management to be handled by a multitude of institutions and adequate trans-departmental cooperation within the ministries. Equally, the contribution of NTFPs to food security and poverty reduction with notable influence on socio economic and cultural potential to the forest adjacent communities makes them involved in a wide range of policies in most domains and various policy implementation structures.

Since these institutions are numerous, this section makes mentions of a few that might have great influence NTFPs policy options and implementation. Improved coordination among these agencies and interministries will be instrumental to the realization of sustainable forest

management principle. A list of other institutions can be found attached in the annexes. The following are key institutions engaged in forestry and natural resource management in Kenya;

Kenya Forest Service – It was established in 2007 under the Forests Act, 2005 with the mandate to provide for the conservation, establishment, development and sustainable management and utilization of forest resources for Kenya's social and economic development. The Forest Act, 2005 enforced by KFS provides for participatory forest management through involvement of forest adjacent communities with provisions of sustainable use of forest products including NTFPs. An improvement on the livelihoods of forest dependent communities will depend on the classification of tenure and property rights, development of processing technologies and markets for non-wood forest products most of which are envisaged within the forest Act, 2005 and Draft Forest Policy, 2014.

Kenya Wildlife Service: – This is a state corporation established in 1989 through an amendment of an Act of Parliament, Wildlife (Conservation and Management Act of 1976) CAP 376. Its overall mandate is to conserve and manage wildlife in Kenya, and to enforce related laws and regulations. It has sole jurisdiction over the 23 national parks and supervisory role on the national reserves, community and private conservancies and sanctuaries. Part of the functions of KWS as spelt out in the Wildlife Conservation and Management Act, 2013 is the formulation of policies and guidelines for the conservation, management and utilization of all types of fauna and flora, including NTFPs. It has a strong community wildlife program that provides wildlife conservation education and extension services to create public awareness and encourage communities living on wildlife rich lands, wildlife corridors and dispersal areas to practice sound land use practices part of which include NTFPs farming. KWS is also the designated national

authority charged with the administration and coordination of international environmental protocols, conventions and treaties regarding wildlife in all its aspects such as the Convention on International Trade in Endangered Species (CITES) whose role is to ensure that international trade in NTFPs (animal products and wild plant species that are endangered) is controlled. By protecting wildlife and their habitats, KWS also conserves genetic resources that could be used to develop new food crops, medicines and other products from NTFPs that are important for socio-economic development of this country. For instance, wild plants related to food crops may have genes that increase drought, flood or salt tolerance. Biotechnologists can use such genes to make important crops more resilient.

National Environment and Management Authority:-NEMA was established in 2002 under the Environmental Management and Co-ordination Act (EMCA) of 1999. It has a various core functions with the main one being coordination of environmental management activities of all other agencies and championing for environmental considerations into the country's overall economic and social development. In discharging its mandate, it is guided by the principles of public participation, cultural and social principles that were traditionally applied by local communities in the utilization of forest products including NTFPs and sustainable management of natural resources. Related functions include developing policies and plans for environmental management, environmental education and public awareness, advice and technical support to other agencies and preparation of annual state of the environment reports in Kenya.

National Museums of Kenya: - It has the mandate to enforce the Antiquities and Monuments Act, CAP 215. National Museums of Kenya oversees the management of gazzeted sites of historical importance and threatened heritage. In this cases forest management is participatory

with key decisions coming from the local community elders on sustainable utilization of forest products including NTFPs some of which are of cultural importance to the local community.

Ministry of the Environment, Water and Natural Resources:-This ministry is responsible for the formulation, analysis, review and implementation of policies that affect forest resources (NTFPs included), wildlife and conservation of water catchment areas. It also has the responsibility of overseeing forest management, restoration and agro-forestry which include promotion of NTFPs development.

2.3.1.3 International Conventions and agreements

At international level, policies affecting NTFPs are generally preoccupied with nature conservation and balance of trade within countries with very few specific actions, plans or activities geared towards NTFPs development. In fact, there is no effective international policy on NTFPs due to lack of an effective and interactive stakeholder dialogue needed to develop one. (Ahenkan and Boon 2010). A number of domains however recognize the importance of NTFPs such as their contribution to the realization of Millennium development goals 1, 7 and 8. This section reviews and summarizes a number of international conventions and agreements that relate to sustainable management and conservation of forests. It also pin points how NTFPs could be associated with them. The summary is in the table below;

Table 1: Relevant international conventions and agreements on NTFPs

International Convention/Agreement	Summary
The Convention on Biological Diversity (CBD)	This was signed on 26th July, 1994 and assures biodiversity conservation and sustainable utilization of natural resources. This contributes to the improvement of the socio-economic well-being of the forest dependent populations and NTFPs play a crucial role in this position.
World Summit on Sustainable Development (WSSD)	This summit recommended several measures to reduce poverty while protecting the environment which were elaborated in Agenda 21 for implementation. With crucial role of NTFPs in poverty reduction, Kenya is supposed to encourage their development, marketing and value addition in their respective national programs.
World Trade Organization (WTO)	Regulates trade policies and practices of member states and their products. NTFPs should be included into the tradable products within the member states and standards set on international trade in NTFPs. This will

	promote marketing and encourage NTFPs development and its contribution to the societal well-being.
Ministerial Declaration on Africa Forest Law Enforcement and Governance (AFLEG).	This declaration was made in Cameroon on October, 2003 as part of the new partnership for Africa development with an objective of commitments to member countries on forest law enforcement and development. Yaoundé, Cameroon- October 2003. Incorporating subsidiary regulation on NTFPs and their enforcement through AFLEG banner will help fill some of the gaps observed in forestry sector in most countries
Action Plan for the Environment Initiative of NEPAD	An initiative for Africa and global partners to protect and conserve the environment. Comprehensive forest resource management and sustainable utilization of resources requires consideration on both participatory management and NTFPs in an effort to fight poverty among most forest dependent populations.
Convention concerning the protection of the	NTFPs have cultural importance to most

World Cultural and Natural Heritage	traditional communities in Kenya from food to being used in some traditional ceremonies. UNESCO encourages sovereign states to conserve, adopt and put in place policies and measures judged appropriate to enhance the protection and promotion of the cultural diversity on their territory.
The Kyoto protocol and UN Framework Convention on Climate Change (UNFCCC)	The Convention on Climate Change was signed and ratified by Kenya on 30th August 1994. The convention was signed in an effort to reduce the increasing rate of climate change which is mostly influenced by anthropogenic factors. Part of the strategies includes promotion of agro-forestry (such as on farm NTFPs establishments) as part of the reforestation initiatives and awareness creation.
Convention on International Trade in Endangered Species of wild fauna and flora (CITES):	The Convention on international trade in endangered species of wild fauna and flora was signed in 1979. This is part of the international trade agreements which controls trade in animal products and wild plant species including NTFPs on member states.

International Tropical Timber Agreement (ITTA)	This agreement recognizes that NTFPs should be harvested on a sustainable basis in close consultation with the relevant stakeholders. Equally, it can influence research on forest products which include non-wood products thereby promoting their development.

Adopted from Ngome et al., 2011

The policy initiatives on NTFPs both at the national and international level, are inferred across a wide range of domains but more conservation oriented. They do not provide clear mechanisms on the livelihood opportunities that the local communities can tap and benefit from NTFPs extraction. At international level, several policies revolving around sustainable development and environmental management influence NTFPs industry either directly or indirectly especially in meeting the provisions of sustainable development goals (SDGs).

2.4 Value and Valuation of Non Timber Forest Products

Despite the importance of NTFPs in the livelihood improvement of local communities and forest conservation, the legal, policy and institutional frameworks nationally and the treaties, protocols, conventions and agreements that might influence sustainable utilization and utilization of forest products, NTFPs valuation and research has received very little attention hence poorly understood. This section, therefore, sets the background of economic valuation and reviews the different methods that have been used in valuing use values and those for eliciting economic values of NTFPs.

Value is a measure of a relationship between a subject and the object of valuation within the context (Adepoju and Salau, 2007). Economically speaking, value refers to the monetary worthiness of an asset, which lies in its role in attaining human goals or the production of some marketed commodity (Barbier et al., 2009). NTFPs have a significant assigned value in the livelihoods of forest dwelling and dependent communities (Chopra, 1993) which provides an idea of how the sector contributes to poverty alleviation and their socio-economic benefits to the forest community.

There are two types of values i.e. instrumental (utilitarian) and intrinsic values. Instrumental (or utilitarian) means that something has value because it is useful to something else while intrinsic means that something has value in and of itself, not because something else deems it valuable (Hawkins, 2003).

Valuation is the process of expressing a value for a particular action or object in a certain context in monetary terms which in this case, it represents the process of expressing a value for goods (NTFPs) derived from the forest ecosystem and express them in monetary units thereby providing an opportunity for scientific observation and measurement.

Valuations on sustainable use of habitats have been carried out with many researchers attempting to quantify the value of NTFPs, which can be calculated per hectare of forest (returns to land) or per household (returns to labor). For the first, researchers typically combine botanical or ethno botanical information with market price data to find the potential value of NTFP production. For the second, researchers;- track small samples of households with frequent visits to record quantities and prices;- rely on respondent recall of quantities and prices in household surveys, or ;- elicit values directly with stated preference methods (Sills, O.., et al, 2003).

2.4.1 Classification of Forest Values

Literature review reveals that the economic value of natural resources consists majorly of use and non-use values. A summation of use and non-use values provides the total economic value (TEV)-a framework set as a guide to facilitate the estimation of the 'total economic value of forest and its ecosystem services to society as a whole. How people use and value forests at a particular place and time, however, depends in large part on their scarcity or abundance relative to changing human needs (Bishop, 1999). Use value constitutes direct-use values (including consumptive & non-consumptive values), and indirect-use values.

Direct use values refer to ecosystem benefits that are used directly by an economic agent (e.g. human beings). They are most often enjoyed by people visiting or residing in the ecosystem itself (Pagiola et al., 2004, TEEB, 2010). They include consumptive uses (such as harvesting of food products, timber for fuel or construction, medicinal products and hunting animals for consumption); and the non-consumptive uses such as enjoyment of scenic beauty (jungles, wildlife photography, cruises, trekking etc.), Science and Education (Forest Studies) and cultural activities which do not involve physical extraction of the forest products. Consumptive uses are most likely to be priced in the markets since they are consumed directly by people. Millennium Ecosystem Assessment defined categories direct use values would fall under both provisioning and cultural services categories (MA, 2005).

Indirect use values are the benefits derived from goods and services provided by an ecosystem that are used indirectly by an economic agent (TEEB, 2010). They provide benefits outside the ecosystem itself and are normally associated with regulating and supporting services (MA 2005) such as the natural water filtration function of wetlands (which often benefits people far

downstream), climate regulation through carbon storage, gas exchange and water cycling (which benefits the entire global community by abating climate change), protection from disaster such as the storm protection function of coastal mangrove forests (which benefits coastal properties and infrastructure). Also included are supporting services such as nutrient recycling, soil fertility for agricultural productivity, habitat and biodiversity protection (Pagiola et al., 2004). These are generally public services that are in most cases not reflected in the market transaction.

Non-use values include: option values, existence and bequest values. Option value is the value of goods and services from the ecosystem that may be used in future but have the potential of being used presently either directly by oneself (option value) or indirectly by others/heirs (bequest value). Provisioning, regulating and cultural services categories (MA, 2005) may all form part of this value as long as they are not used at present but in future. For instance, people may value the option to use a forest in the future for themselves or value forest as a bequest to their children. Although such values are difficult to measure in economic term, they should be recognized in valuing the contribution of forest to human welfare (Adepoju and Salau, 2007).

Existence value refers to the value that individuals place to an ecosystem by knowing that a resource exists even if they never expect to use that resource directly themselves. This kind of value is usually also known as conservation value or, sometimes, passive use value. These values are most the most difficult to estimate and rarely valued in monetary terms since it is reflected in people's behavior. They may include the spiritual and cultural importance of a landscape or species often influential in decision making (Pagiola et al., 2004; TEEB, 2010).

2.4.2 Valuation Techniques under the TEV approach

There are several approaches for estimating nature's value with the choice of valuation methodology being determined by various conditions and factors such as what type of ecosystem good or service is being studied, data requirements and ease of use, the extent to which they have been applied in and/or their relevance to different countries, and also the theoretical validity and acceptance among economists. Total Economic Valuation framework is commonly used to derive ecosystem values from a utilitarian perspective. These values may be used in cost benefit analysis or as input to more elaborate economic models. This section discusses briefly a number of techniques that have been commonly used in economic valuation. These valuation techniques enable us to estimate in monetary terms the direct and indirect use values as well as option, quasi option, bequest and existence values. Through these, the consumer demand for a particular non-marketed benefit is expressed in monetary terms. Measurements of these values are expressed as either willingness to pay, the maximum amount a person would be willing to pay for an increment of a good, or willingness to accept, the minimum amount a person would require as compensation for the loss of an increment of a good (Hawkins, 2003; Pagiola et al., 2004).

2.4.2.1 The main economic valuation techniques

Available monetary valuation techniques used to value ecosystem services fall in two categories of revealed preference and stated preferences. Revealed preference measurements are based on observing actual behavior of the informant on the preferences elicited from which it seeks. It applies majorly to goods and services traded in the market for consumptive use and include methods such as direct markets analysis, surrogate markets (e.g. travel cost method, hedonic

pricing, substitutes goods approach), cost based approaches (e.g. replacement cost method, avoided damage /cost averting behavior, cost of illness and opportunity cost method); and production function/productivity approaches.

The direct market analysis as a type of revealed preference technique can be used to value environmental goods and services trade in the markets (either local or international) thus relies on prevailing market prices. The value is estimated using market price and quantity data with possible sources of market price being statistics, socio economic survey and/or consulting relevant government officials. Those ecosystem services mostly likely to be priced in the markets and defined under the Millennium Ecosystem Assessment include provisioning (e.g. forest products including NTFPs, timber products, and animal products), cultural (e.g. some recreational values), and regulating (e.g. pollination) services. They can also be applied to other non-market services by observing how changes in provisioning services affect the prices or quantities of other non-market services. The quality checks under this market price method will include correcting any price distortions due to market imperfections or policy failure or other problems, examining changes in real prices over time when assessing market capacity and establishing appropriate functional form for demand curve (Pagiola et al., 2004; Turner et al., 2010).

Stated preference measurements (e.g. Contingent valuation, choice modelling/conjoint analysis, contingent ranking; and deliberative group valuation) are based on responses to hypothetical questions (Hawkins, 2003) and deduce people's preferences by describing a hypothetical situation. They are based on market simulation on the 'prices observed' for the goods to be valued. They value non-marked goods that do not have surrogate or related markets. The figure

below shows the correspondence between the value types and the preferred approaches of estimating nature's value;

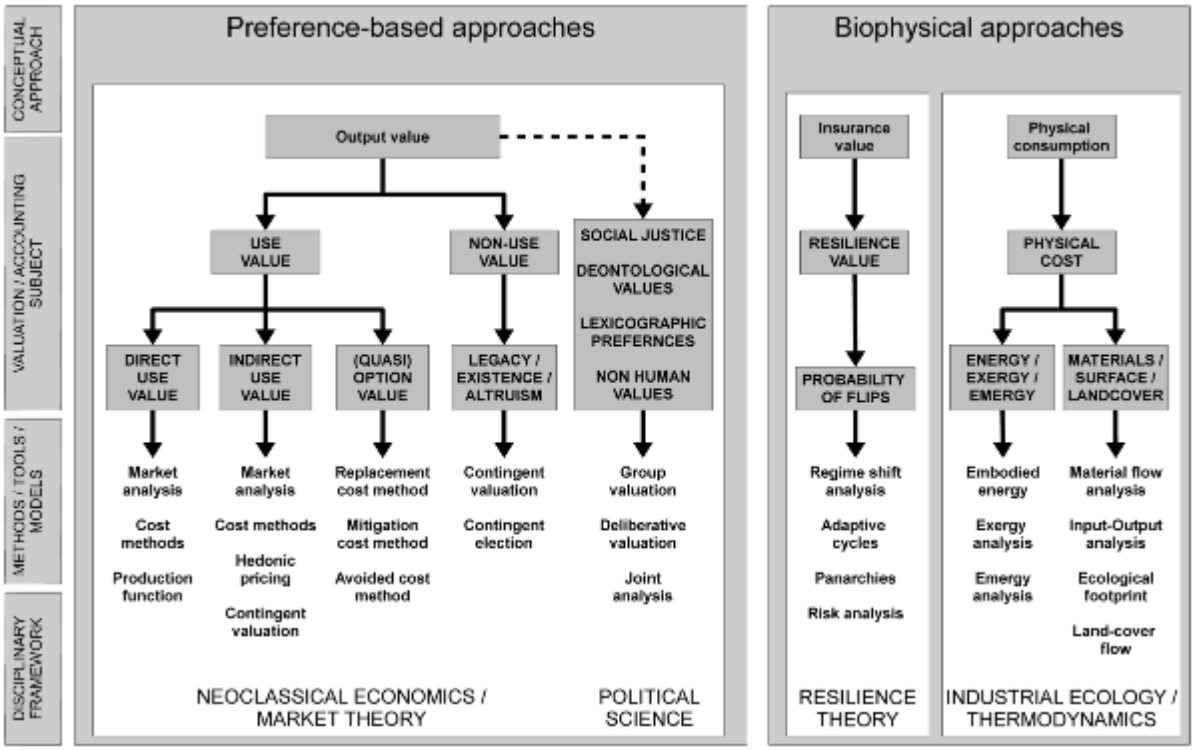


Figure 1: Approaches for the estimation of nature's value

(Source; TEEB, 2010)

For the indirect market valuation techniques, prices are derived indirectly through related factors that have a market such as household costs (cost of cleaning or repair due to pollution), avoided costs (costs that that would have been incurred if the service were absent, such as flood control), replacement costs (cost of replacing a service with a man-made system), factor income (how much a service enhances income, such as for commercial fishermen), dose response/production function (how changing an environmental service affects the production cost of a product); and

averting behavior (expenditures to defend against negative effects of pollution, such as sunscreen sales) (Hawkins, 2003; Pagiola et al., 2004; MA 2005; TEEB, 2010).

The choice of valuation method will depend on the type of ecosystem good or service that is being studied, the specific characteristics and objectives of the study with most estimating the value of stock (e.g. Peter et al.,1989, who estimated the value of NTFPs based on stock inventory) or valuing the actual service flow (e.g. Godoy et al., 2000, who valued the actual NTFP service flow from a Central American rainforest, Croitoru, 2007, who estimated annual flow of NTFP benefits for the Mediterranean region, while Adgeret al.,1995 estimated the total economic value of Mexican forest services (Hawkins, 2003; Turner et al, 2010).

2.4.2.2 Empirical review of valuation studies

This study also focuses on the economic value NTFPs and there are various approaches that have been used extensively in recent years to estimate their value as revealed by several studies on their applications. For instance, Adepoju and Salau (2007) reviewed the methods in use for economic valuation for NTFPs and noted that three methods were commonly used i.e. direct market, indirect market and non -market estimations, with the appropriate methods to be used depending on the objective of the study. The study reviewed a number of studies to determine the most common valuation techniques and methods used in valuing NTFPs.

Murphy (2005) conducted a survey to evaluate the flow of NTFPs in a district in India with the purpose of preparing an inventory of NTFPs collected, estimating the quantities gathered by locals and the forest department and estimating the income derived from the NTFPs extracted which was done using the market price and measured in kg/ha/yr. However, the valuation didn’t

consider some elements of costs in the production and distribution of NTFPs such as the labour and transport costs, which would have provided a more appropriate estimate.

Shacleton (2004) focused on the extent of use and value of NTFPs at a broad scale by using indirect use value based on farm gate prices with inputs costs considered. NTFPs were also valued based on their contribution to livelihood security especially in periods of shock, with the change or increased use being a coping strategy and the forest products providing a safety net for the households.

In all these two studies, there was an assumption that all NTFPs products were tradable while in the real sense there are some non-tradable NTFPs used mainly by households for domestic purposes e.g. thatching forest products are not traded on regular basis but can be equally be valued economically. This and non-consideration of post-harvest losses and market costs for perishable NTFPs provided ground for underestimation of NTFPs in their studies.

Chopra (1993) also estimated the value of NTFPs obtained from the tropical deciduous forest in India using a mixture of market and non-market approaches with the major approaches used being; market price, cost of alternative technology, cost of labor time in collection, loss of productivity in alternative use, secondary data on spending (Travel cost method), and experimental data. The results showed the minimum and maximum values of annual flow at US$ 219.80 and US$357.08 respectively for the both non-timber goods and services.

Emerton (1996) carried out a socio-economic survey by investigating how the local community relied and valued forest resources in Oldonyo Orok forest in Kenya. The study used the technique of ‘participatory environmental valuation’ technique which was not only used to elicit information about forest use and values at the subsistence non-market level but also to bridge the

gap between the local economic systems and cash values. The technique used pictures to represent different forest products a ‘numeraire’ (usually a commodity which forms part of the local socio-economy has wide significance as the item of value and can be easily translated into monetary amount) for valuation.

To give an idea of the value of the different forest uses and how they relate to each other and to the ‘numeraire’ counter products such as beans, seeds or stones were used and distributed between the cards with different forest activities and the ‘numeraire’ commodity. Financial value of the ‘numeraire’ commodity was then estimated and provided means of translating forest products and services into cash amounts that was calculated as an average annual amount per family. The results from the survey showed subsistence forest use value of about US$100 a year on average by the forest adjacent household in the study area. However, currently the infrastructure developments have taken place and markets become more accessible even in some remote parts of this country with most tradable forest products or closely related substitutes reaching the market. Using the common methods of market prices while incorporating input costs, WTP or WTA and other non-market techniques to determine their value would be ideal today.

Kiplagat (2006) also carried out a survey on the consumption of NTFPs in Kakamega forest by investigating the importance of the forest as a ‘common resource’ to the surrounding households. The study specifically sought to (i) identify the sources of NTFPs within Kakamega forest and assess the role of consumption within household; (ii) quantify NTFPs sources from the forest for household consumption and; (iii) assess the extent to which Kakamega forest is a ‘common resource’ by estimating economic value of NTFPs directly accruing to resident communities.

The study used approaches that utilize marketing prices such as direct market price methods, cost of collection method to estimate the value of time expended in gathering NTFPs and direct substitutes method to infer value on close direct substitutes that have market prices. The results showed that NTFPs accrued a total value of Kshs. 6,326 per year for the direct pricing method and Kshs. 14, 426 for the cost of collection method.

In Tanzania, Schaafsma (2014) carried out a socio economic study on valuation of the NTFPs in the Eastern Arc Mountains of Tanzania. Using 'bottom up' approach the study sought information on the actual household behavior from multiple locations over a wide spatial scale with the aim of developing a spatially explicit and transferable household production function. The approach involved several step: (i) estimating the household 'production' function of NTFPs collected; (ii) transferring this function across the total study area; (iii) aggregating household level extraction over all households in the study area and; (iv) turning the NTFPs quantities into economic values. The results showed the total value flow of actual extracted NTFPs is estimated at US$ 42 million per year equivalent to US$18 per capita per year

This approach is advantageous since the annual flow of ecosystem values (rather than a projection of underlying potential stock) are analyzed reflection the actual benefits accruing to local communities. It is also based on micro-level data about individual decision making and the factors that affect how much to collect thereby capturing values as perceived by local communities and effects of household characteristics that influence decision to collect NTFPs such as time, labor and other costs involved in collection, capital, access to markets and demand, transport options and the potential gains to the household budget of selling NTFPs (Schaafsma et al., 2014)

This study borrowed several approaches that have been applied by scholars in estimating the value of NTFPs. The study applied direct market price method (DPM) in estimating commercially traded NTFPs. Since the products were mostly sold in the local market (Marsabit) or at the neighbours, the study assumed that the prices were not dependant on transport cost hence did not vary significantly across the study area. Through observing the quantity of the various NTFPs traded and multiplying their respective market prices, their respective economic values values were determined.

3.0 METHODOLOGY

This chapter outlines the theoretical framework that was used to guide the study and the conceptual framework which shows the interrelationship between the different variables under study. It also describes in detail the study site, methods used to accomplish the study such as the sampling procedure, data collection and data analysis and presentation.

3.1 Analytical Framework

3.1.1 Theoretical Framework: Forest Transition Theory

This study has its theoretical underpinnings on the theory of forest transition. Mather (1990), proposed the concept of "forest transition" as a way of predicting the changes in forest cover in response to economic developments, industrialization and urbanization trends over time (Agrawal et al., 2013). The theory was derived from the modernization theory by way of notions about environmental Kuznets curves (the theory predicting a bell-shaped relationship between deforestation and income) - which shares the assumptions in economic activities, resource use, and environmental impacts during the course of industrialization, population growth and urbanization (Perz and Skole, 2003).

The forest transition theory predicts that forest cover will exhibit a U-shaped curve overtime, portraying an initial decline in forest cover due to deforestation which is later reduced, offset and outweighed at some point by new forest expansion and recovery (Agrawal et al., 2013; Perz and Skole, 2003). This is illustrated below:

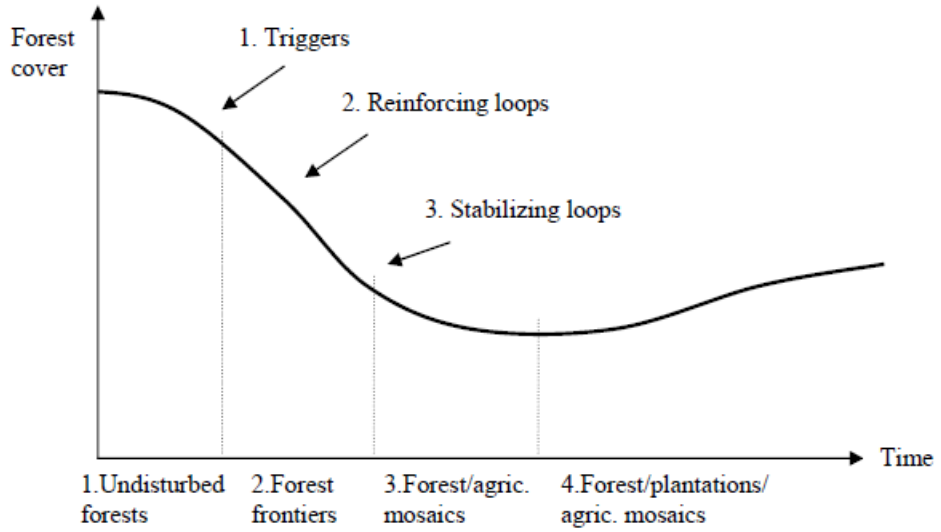


Figure 2: Forest transition theory (Source, Angelsen, 2007)

The movement along the forest transition curve can be seen as the result of three sets of forces. The first stage, of relatively undisturbed forest, is characterized by passive protection: This is the period prior to agricultural or industrial revolution where forests were protected passively because the forest area has poor infrastructure and market access, there is little demand for land on which they stand, and is therefore inaccessible for commercial exploitation since extracting forest products is economically unviable (Angelsen, 2007; Argawal et al., 2013).

A set of triggers (force 1) starts the deforestation process, with factors such as opening up the infrastructure, technological changes, new market opportunities, agricultural developments, population increase, immigration all of which can trigger the decline in forest cover.

The effect of these is likely to be accelerated by a set of reinforcing loops (force 2) such as rise in prices of agricultural products, improvements in processing facilities or improved access to forested areas leading into the second stage, the forest frontier which experiences increased

deforestation rates since existing customary tenure arrangements are in adequate bulwarks against demand pressures (Angelsen, 2007; Argawalet al., 2013).

High levels of deforestation lead to forest scarcity, which – together with other socio-economic and political forces - initiate and/or strengthen a set of stabilizing loops (force 3), leading into the third stage of forest/agricultural mosaics. These stabilizing loops will eventually dominate; taking us into the fourth stage of reforestation termed the forest/plantation/agricultural mosaics (Angelsen, 2007). As these factors unfold, forest transition theory posits an increase in forest cover overtime (Argawal et al., 2013).

3.1.2 Relevance of Forest Transition theory to the study area

NTFPs are mostly a common property resource that the local communities gain significant benefits from accessing them. The extraction of the forest goods generally results into either overexploitation or conservation of the resources. Marsabit forest faces a myriad of interrelated challenges that threaten its future survival and sustainability, through unsustainable rate of forest degradation as a result of complex set of external and internal factors. Recently, there has been an increase in extraction rate of forest products (timber and non-timber forest products) prompted by change in lifestyle (sedentarisation of pastoralists), poor enforcement of the conservation policies, increased human population and better access to markets for forest products. The new income opportunities have also motivated the adjacent communities to actively engage in commercialization of the forest products. Unsustainable extraction of these resources may also lead to changes in diversity and species composition (Brown et al., 2011). The forested area has reduced drastically from 19,000ha, in the 1980s, to about 11,000ha

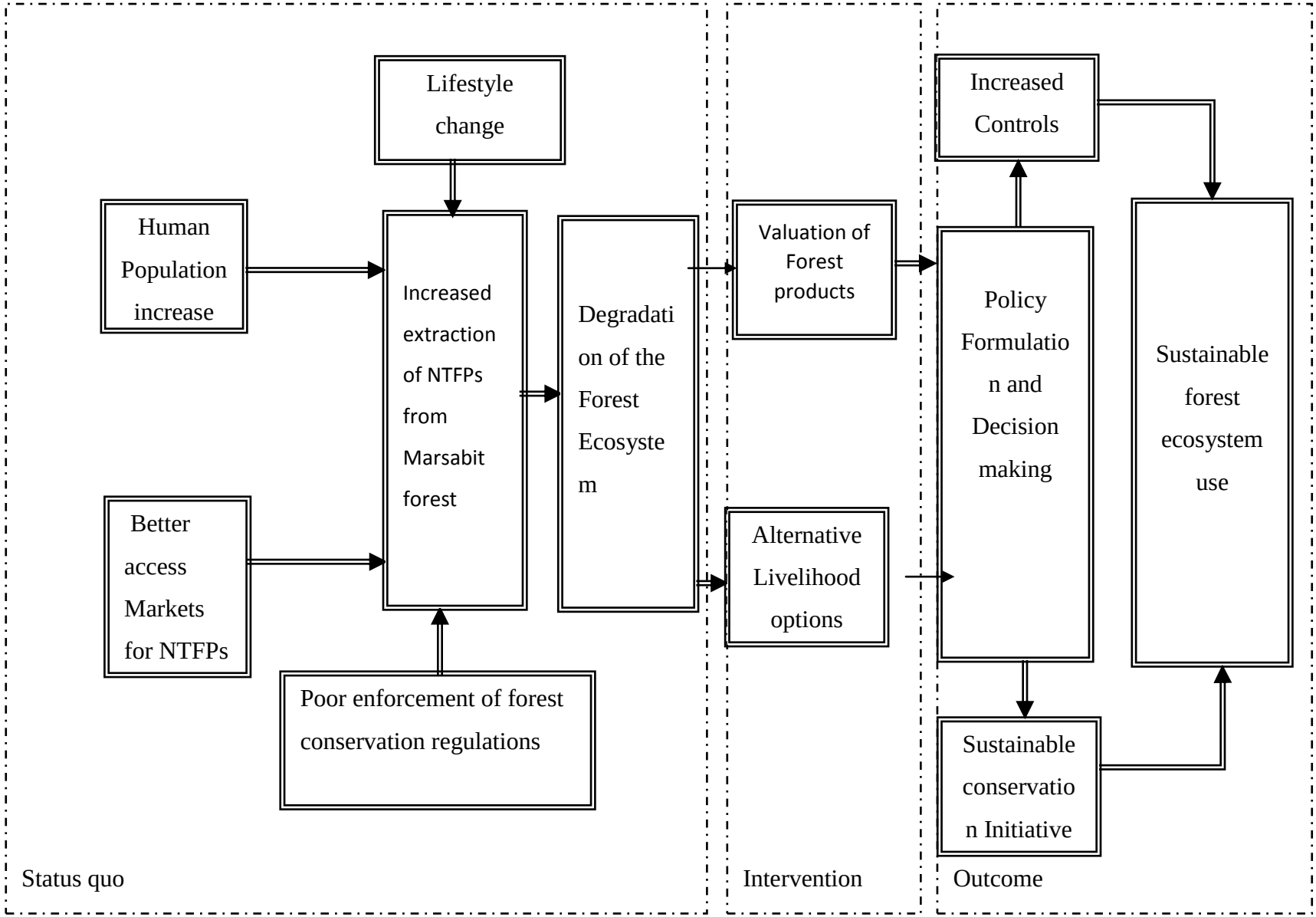
currently, with its continuity expected to lead to severe impacts for both human beings and wildlife (Robison, 2013).

3.1.3 Conceptual Framework

The conceptual framework (Figure 3.1.3) the relationship between independent and dependent variables. It clearly shows the status quo, interventions and expected outcome. Many factors directly influence decline in forest cover. These include Lifestyle change, human population increase, better access markets for NTFPs and poor enforcement of forest conservation regulations. The massive settlements around Marsabit forest reserve as a result of increased population have led to increased land fragmentation and subsequent environmental degradation. The demand for forest resources has increased with most settled farmers contributing to increased extraction of NTFPs to meet their livelihood needs. A shift from nomadic pastrolism to a more sedentary lifestyle has necessitated livestock incursion into Marsabit forest reserve especially during the dry seasons when the communities living adjacent to the forest reserve have exhausted their communal grazing areas. This livestock incursion with associated overgrazing has contributed to the degradation of the forest ecosystem.

KWS and KFS jointly manage the Marsabit Forest reserve with each having its own access rules and such overlapping mandates leads to the violation of access and forest resource use. The lack of consensual vision of the desired state of Marsabit forest, its roles in terms of the services delivered to the local communities have profound effect on the required optimal monitoring and enforcement of the regulatory conservation laws.

Figure 3: Conceptual Framework



3.2 Methods and Study Design

3.2.1 Study Site

The study was carried out on households around Marsabit forest reserve, in Northern Kenya (Figure. 5) targeting the predominant communities of Rendille, Borana and Gabbra. Marsabit forest reserve is on an extinct Holocene shield volcano with forested hills and several craters (Lake Paradise and" Sokorte Diko") shrouded in mist and fog with high moisture levels and cool temperatures throughout the year than the surrounding lowland areas which have semi arid and arid conditions. The extinct volcano area covers approximately 2100 km² and is surrounded by expansive low lying arid plains formed from weathered lava flow. The volcano rises almost a kilometer above the surrounding arid plains to summit a summit of 1694m with an elliptical shape about 45 km(NW-SE) and 70 km (NE-SW) in diameter.

It is located 560km north of Nairobi in ASAL region approximately between latitude 2º 19' North and 37º 59´ East occurring at 1865m metres above sea level (RoK, 2011). It falls within Marsabit County which borders Samburu County to the south, Turkana County to the west, Wajir County to the east and Isiolo County to the north east. The following locations adjacent to Marsabit forest reserve in Central and Gadamoji Divisions (of Saku Constituency) were selected: Karare, Songa, Jaldesa, Nagayo, Jirime, Dakabaricha , Hulahula , Kituruni and Dirib Gombo locations to represent the major ethnic diversity of forest product usage (Figure 3.2).

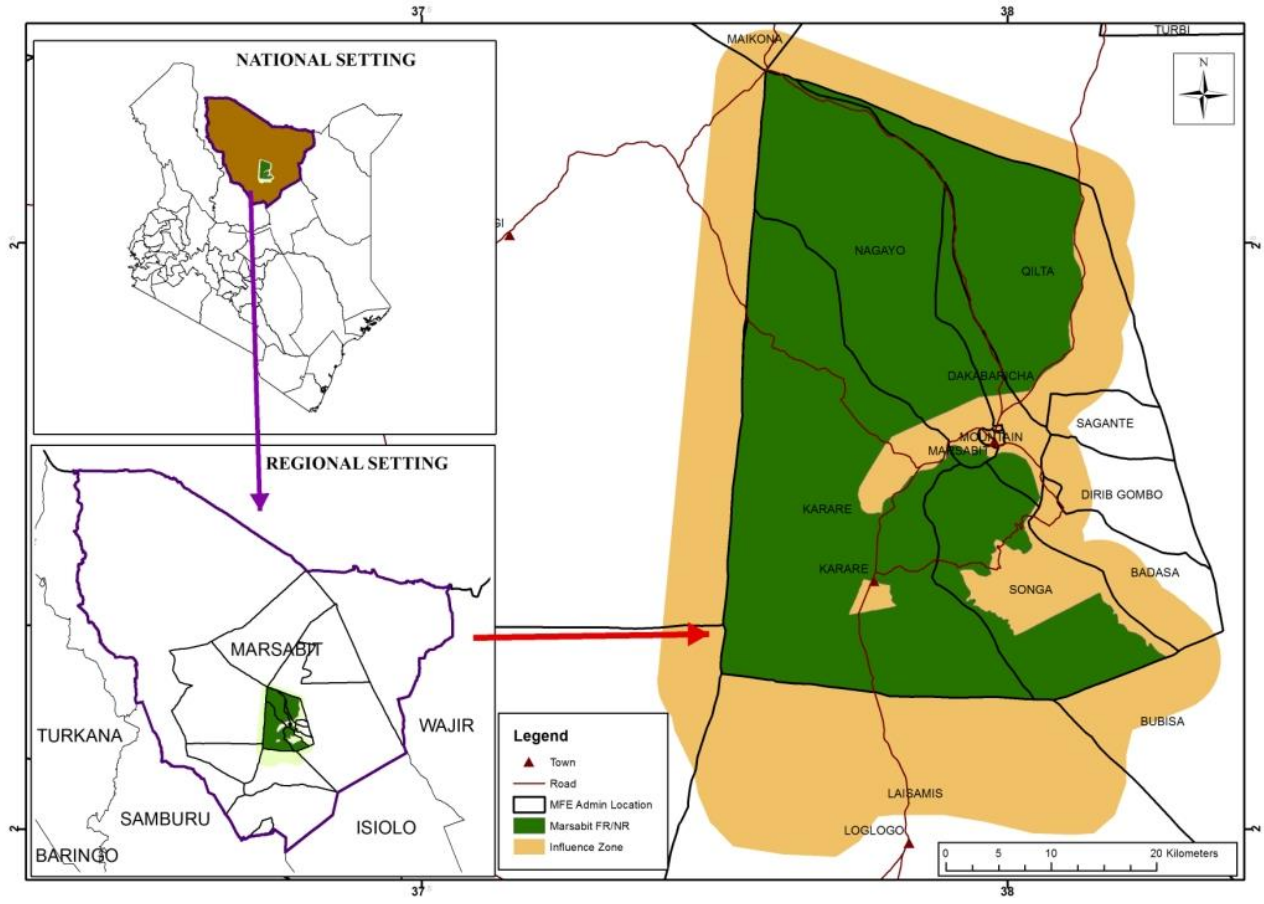


Figure 4: Map of Marsabit Forest Ecosystem (Kenya Wildlife Service, 2015)

Marsabit forest has an equatorial climate with rainfall and temperature very different from the lowlands surrounding. The forested area benefits from its high elevation and receives a mean annual rainfall of approximately 800mm annually, compared to 300mm in parts of the nearby lowlands (those parts below 800m) (Robinson, 2013), due to the variation in altitude. It also experiences bimodal rainfall patterns with the long rains being experienced between March-May (with peaks in April) and the short rains between October and December (with peaks in November). The driest period is between August and September. The mean maximum temperature ranges between 26-28°C and the mean minimum temperature between 14–16°C.

July and August are the coldest months with temperatures below 15ºC while the other months of the year have little variation in temperature.

Marsabit County has only one gazetted forest, Marsabit forest reserve, which is administered and managed initially under section 21 of the Forest Act, 2005 with the Kenya Forest Service (KFS) as the competent authority. It was declared a Forest Reserve through a proclamation no. 20 of 6th April, 1927 and included in the schedules of gazzeted government forest reserves through proclamation no. 44 of 1932. An area of 1,552km² was gazetted as National Reserve with a smaller area of 157km² (15,280 ha –boundary plan no.75/14) designated as a Forest Reserve (Robinson, 2013). According to the CoK, 2010, Article 62 (1) (g), Marsabit Forest Reserve (state forest) and Marsabit National Reserve (government game reserve) which overlaps the forest reserve, is categorized as public land. Under Article 62 (3), this category of lands are held by the national government in trust for the people of Kenya and administered on their behalf by the National Lands Commission.

About 54, 822 persons up from 46, 502 as per the 2009 population census (RoK,2010) reside in Saku Constituency as indicated in the table above with an estimated population of 16,213 (CGoM, 2015) living around the Marsabit forest reserve which is within the Central and Gadamoji divisions (Marsabit Central) in Saku Constituency. This is the most densely populated area of the constituency due to the humid and sub humid mountain climate which provides the communities with opportunities to practice agro-pastoralist livelihood and trade. High population densities within the constituency are also found in permanent and semi permanent settlements, around water sources and where markets and other social amenities are found.

Majority of the community members who are settled adjacent to the Marsabit forest reserve intensively depend on forest resurces for their livelihood needs.

The communities surrounding the study area are predominantly Rendille, Gabbra and Borana. However, other inhabitants within the town area include smaller ethnic groups of Burji, Turkana, Samburu, Sakuye, Somali, Ameru and other migrants. The high human population concentration is visible in Marsabit town which could be as a result of rural-urban migration of pastoralist, better infrastructure, business and employment opportunities. There are several permanent settlements found around the forest reserve with temporary structures often set up during the extreme dry periods since it is the dry refuge zone for the pastoralists in the region. Traditionally, the Burji communities were farmers while the rest have a pastoralist background, recently changing and adopting agro pastoralist practices.

Karare, Hulahula, Kituruni and Songa locations are mainly inhabited by the Rendille, a Cushitic ethnic group. Majority of the people in Karare are the so called Ariaal, a sub-group of the Rendille, who speak the Nilo-Saharan Samburu language of the Samburu Nilotes with whom they cohabit. Traditionally they are nomadic pastoralists, tending to sheep, goats and cattle.

Borana is the dominating ethnic group in the remaining locations of Jirime, Jaldesa, Mountain, Dakabaricha and Nagayo within the study area. They speak Boran, which is part of the Cushitic branch of the Afro-Asiatic language. Borana are pastoralist and are cattle keeping.

In Jaldesa and Songa locations, subsistence agriculture is practiced and food crops like maize, Sorghum, millet, beans, and fruits and vegetable crops are grown. Cash crop farming is also important with the principal crop cultivated being *Catha edulis* (Khat). This agricultural

production is mainly undertaken close to the Marsabit forest reserve because of the fairly productive soils and moderate amount of rainfall that it attracts.

The Gabbra, camel herding nomads also are settled at around Gabbra scheme village in Jaldesa location. They also speak Oromo and Boran. In addition to Camels, they stock goats and cattle.

3.2.2 Sampling procedure and data collection

The study employed both primary and secondary methods in gathering data on the utilization, value of NTFPs to households and proposed alternative livelihood options by the local communities adjacent Marsabit Forest Reserve. Secondary data collection included literature review of relevant published and unpublished reports in the study area. Primary data collection methods included household survey, focus group discussion, and a market survey.

Focus group discussions (FGDs) were used to get qualitative information from local community with 9 village meetings undertaken. The discussions involved getting community knowledge about the forest products and usage, insight on the importance of the non-timber forest products in the livelihoods of the local communities, environmental changes that have taken place overtime, attitudes and perceptions towards conservation of the Marsabit forest reserve and the alternative livelihood options they would be willing to adopt to limit the extraction rate of NTFPs from the Marsabit forest to a sustainable level. It also helped arouse their interest and expectations on its conservation and sustainable use.

Purposive sampling was used and participants selected based on their knowledge on the use of forest products in and around Marsabit Forest Reserve. This helped in targeting those who have experience and relevant information on the topic of discussion while also ensuring that all

community groups were represented. The FGDs comprised of 8-12 participants who included medicine men and women, village elders, livestock keepers, and other forest users belonging to the major communities of Borana, Gabbra and Rendille.

Household Surveys using semi structured questionnaires constituted the primary means of collecting quantitative information on the key indicators cutting across key objectives of the study. The questionnaires were designed to capture in-depth insights into people-forest relationship since it concerned forest products usage. It also helped in identifying the major NTFPs, their frequency of usage and dependence. The questionnaires also captured household demographic and socio-economic information. Prior to the interviews, the questionnaires were pretested to control validity and modifications were made where necessary to enhance its ability in addressing relevant study issues.

The sampling frame list for villages and households within the selected villages closer to and within the 5km radius from the Marsabit forest reserve was derived with the help of the local chiefs and sub chiefs in the respective villages. Stratified sampling methodology was used in selection of villages adjacent the Marsabit forest reserve. A total of 9 villages were selected.

Once the sample villages were selected, a fixed number of sample households to be interviewed per village were selected using simple random sampling approach ensuring that the sample population interviewed was representative of the study area. The villages were selected with probability proportional to population size such that villages with larger number of households had higher chances of selection. In each household, house hold heads (either men or women) or any other senior member of the family whenever the household head was not present at the time

of research were interviewed based on their knowledge, experience and skills to provide reliable information on forest resource use.

The household survey sample size was determined statistically so as to avoid bias in the results and ensure that all elements of the population have an equal chance of being interviewed (Cifor, 2012) using a standard formula that applies to wherever simple random sampling technique is involved (Freund and Williams, 1983).

$$n = \frac{z^2(pq)}{d^2}$$

Where*:* $n =$ sample size, *z*=statistical certainty usually chosen at 95% confidence level *(i.e.* 1.95 for 95% confidence level or for an error risk of 5%), *p* = estimated level/coverage to be investigated, usually *p* = 0.5 is chosen, *q* = (1-*p), d* = precision desired, expressed as a fraction of 1, usually *d* = 0.1 is chosen. With a confidence level 95 percent and a confidence interval of 10% percent, a sample based on the above approach, the sample size required for the study was calculated as:

$$n = \frac{(1.96)^2(0.5x0.5)}{(0.1)^2} = 96$$

Due to constraints of time, funds and insecurity in some occasions during the data collection process questionnaire were administered to 78 household heads by the enumerators, a number that is statistically significant to draw conclusions for the study area. The household survey was conducted in the month of June, 2015 by nine trained enumerators, one from each location for ease of acceptability and interpreting the questions to the respondents in their native language.

Training focused on their understanding the objectives of the study, and the data collection instruments, and how to conduct interviews.

A market survey was carried out at the local market (Marsabit town) to establish the non-timber forest products in trade and their monetary value. The study applied direct market valuation in estimating commercially traded NTFPs. This relied on the prevailing local market prices for the traded NTFPs whose value was determined by multiplying the quantity data with their respective market prices. Since the products were mostly sold in the local market (Marsabit) or at the neighbours, the study assumed that the prices were not dependant on transport cost hence did not vary significantly across the study area.

Observations during the entire duration of the research provided information that could not be captured using the questionnaire and FGDs discussions. It also helped in cross checking information gathered by the questionnaires and FGDs community meetings.

3.2.3 Data analysis and presentation

The data collected was both quantitative and qualitative, and as such, was collated and verified in order for inferences, judgments and conclusions made to be as accurate as possible.

Quantitative data collected from the communities during market survey and household surveys using semi structured questionnaire was entered in Microsoft Excel spread sheet and transferred to SPSS software (version 22.0) for analysis according to the structured set of questions. The responses were numerically coded for the ease of computer entry and quantitative analyses to get descriptive statistics in terms of distribution tables, mean and standard deviations and graphical

presentations. The qualitative information collected from focused group discussions was used to support the quantitative information. The output of the field data collection and surveys are presented under findings with all the data presented in the summarized form of tables, graphs and pie charts

4.0 RESULTS AND DISCUSSION

This chapter starts with the descriptive statistics of explanatory variables used gathered during the study. It then engages in discussion of the results which combined analysis both the quantitative and qualitative information gathered to provide a comprehensive explanation of the findings, and finally conclusion and recommendations of the study.

4.1 Descriptive Statistics of the Sample Population;

Descriptive statistics for the variables used during the analysis are presented below;

4.1.1 Socio-economic Characteristics

Table 2: Gender of Respondents

Variables	Description	Frequency	Percent
Gender	Male	28.9	37
	Female	49.1	63

Female respondents formed the highest proportion of interviewees during the study with 63% compared to 37% male respondents (Table 4.1). This could be due to the fact that most males might have migrated to foras (grazing areas) in the lowlands or in Marsabit town and other urban centers in search for employment opportunities due to availability of employment offered by the county government systems and other institutions, business opportunities supported by relatively good communication and transport networks. They leave women at home to manage other household tasks such as taking care of children, the elderly and the sick. In addition majority of

the women are also left with small number of livestock and farms to tend to. The conditions at the rural areas are not favorable for any meaningful economic activities due to the harsh climatic conditions, poor infrastructure (roads and communication networks), poor markets for local products, poor social infrastructure such as health facilities and inadequate water supplies.

Table 3: Age of Respondent

Variables	Description	Frequency	Percent
Age of respondents	21-30 years	21.7	27.8
	31-40 years	21.7	27.8
	41-50 years	18.4	23.6
	51-60 years	10.8	13.9
	>60 years	5.4	6.9

The respondents had an average age of 40.92 with minimum and maximum ages being 22 years and 80 year respectively with a majority of the respondents being between ages 21-40 years across the sampled households (Table 4.2) representing the most productive age groups within the study area.

4.1.2 Education of Respondents

The literacy levels within the sampled community population are low probably due to limited education facilities within the study area and the agro-pastoralist nature of the targeted communities. About 68% of the respondents have never been to school, 18 % attained primary

level, and 11% attained secondary education with only 3% having attained having already graduated from the tertiary institutions (Table 4.3).

Table 4: Respondents education level

Variables	Description	Frequency	Percent
Level of education	No formal education	53.1	68.1
	Primary	14.1	18.1
	Secondary	8.7	11.1
	Tertiary	2.1	2.8

4.1.3 Household Size and duration of stay

The household size findings are as indicated above with majority of the respondents indicated having between 5-8 persons in their households (Table 4. 4). The mean household size is six members (6.4) across all villages sampled with the smallest household having two (2) members, and the largest had twenty (20) members.

Table 5: Household size

Variables	Description	Frequency	Percent
Household size	1-4 persons	16.2	20.8
	5-8 persons	52.0	66.7
	9-12 persons	6.5	8.3
	13-16 persons	2.2	2.8
	17-20 persons	1.1	1.4

Most of the settlements within the study area (rural population) are characterized by manyattas which are sparsely distributed, with majority of the households being either temporary or semi-permanent structures mostly made of wood and mud structures with majority of the respondents having stayed in the area for about 30 years (Figure 4.1). The residential structure scenario however changes as one approaches the Marsabit town where settlements are more and homes in close proximity to each other. Here, mostly semi-permanent to permanent structures exist and includes both residential, commercial and administrative units and institutions.

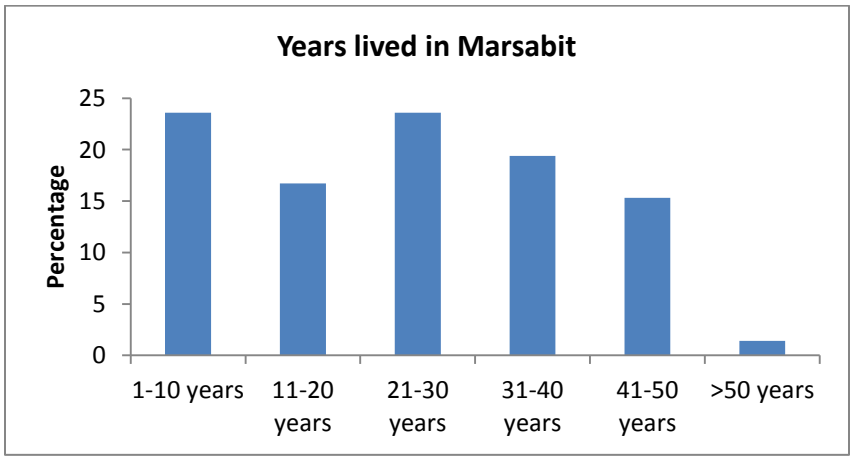


Figure 5: Duration of stay within the study area

4.1.4 Economic Activities

Table 6: Source of Income

Variables	Description	Frequency	Percent
Source of income	Food crop farming	75.6	97.1
	Cash crop farming	22.3	28.6
	pastoralism	75.3	96.6
	Charcoal burning	39.0	50.0
	NTFPs	4.6	5.9
	Business	55.0	70.6
	Salaried employment	37.1	47.6
	Wages	5.2	79.2

Majority of the sampled respondents cited pastoralism and food crop farming as their important economic activity and livelihood strategy. They largely keep goats, sheep, cattle, camels and donkeys which are complemented with subsistence food crops such as maize, sorghum, millet, beans, fruits and vegetables as the main crops. Cash crop farming is also important economic activity cited by 28.6% of the respondents, with the principal crop cultivated being *Catha edulis* (Khat). This agricultural production is mainly undertaken close to the Marsabit forest reserve because of the fairly productive soils and moderate amount of rainfall that it attracts. Proceeds from business (70.6%) and salaried employment (47.6%) are also important source of income to most respondents and the remainder citing charcoal burning (50.0%), wages from unskilled labor

(79.2%), and non timber products such as firewood (mainly harvested and traded by women) as their main source of income being cited by only 5.9% as a dependable source of income (Table 4.5). This is because majority of the NTFPs are consumed directly at household level and rarely traded.

4.2 Major Non Timber Forest Products extracted from the Marsabit Forest Reserve

From the focus group discussions and household survey it was clear that the local communities in the study area have very close relationship and high dependence on Marsabit Forest Reserve for their livelihood practices. This dependence is substituted mainly with food crop farming of maize, sorghum, millet, beans, fruits and vegetables as the main crops. The key most important resources use that the Marsabit Forest Reserve provides to the communities across all the sampled areas include water, firewood, medicine, forage, building materials, fresh air, honey, fruits, animal products and sacred sites (Table 4.6). Therefore, the value that these communities attach to the Marsabit forest is evident and no significant variation in household utilization of the forest products across the sampled population was observed. The ecological services such climate regulation and water provision from the numerous water ways (laggas) and catchments were also sighted as important during the focused group discussions.

Table 7: Key benefits from the Marsabit forest to communities at Village level

Benefits from the forest	Village								Total
	H	K	B	SK	D	N	J	DG	
Rain attraction	X	X	X	X	X	X	X	X	8
Dry season grazing grounds	X	X	X	X	X	X	X	X	8
Firewood	X	X	X	X	X	X	X	X	8
Building materials	X	X	X	X	X	X	X	X	8
Medicinal herbs	X	X	X	X	X	X	-	X	7
Climate regulation (different from the lowlands)	X	-	X	-	X	X	-	X	5
Water catchment from shallow wells/ water points for domestic & livestock use	X	X	-	X	X	X	X	-	6
Salt licks sites for livestock,	X	X	-	-	-	-	-	-	2
Cultural & prayer sites for circumcision and prayers e.g. L.Paradise, Sorkote, Il-Chuta wells, Boji springs and Karsa wells	X	X	X	X	-	-	X	-	5
Wildlife habitat	X	X	X	X	X	-	-	X	6
Honey harvesting	X	X	-	X	X	-	-	-	4
Farming at the forest edge due to Fertile soils	X		-	-	-	-	X	-	2
Food plant such as wild fruits	X	X	-	X	-	-	-	-	3
Tourist attraction sites such as L. Paradise	X	X	X	-	X	-	-	X	5
Timber for making livestock watering troughs, milking cans, Ploughing equipments (Ginda) and calabashes	-	X	-	-	X	-	-	-	2
Employment opportunities	-	-	X	-	X	-	-	X	3
Control of soil erosion					X	X	-	X	3
Total	14	13	10	10	14	9	7	10	

Note*: H=Hulahula; K=Karare; B=Badassa; SK=Songa/Kituruni; D=Dakabaricha; N=Nagayo; J=Jirime; DG=Dirib Gombo*

Marsabit Forest Reserve offers a number of extractable resources utilized by the different communities within and around the forest. About nine extractable resources utilized directly by the communities at household level (Figure 4.2)

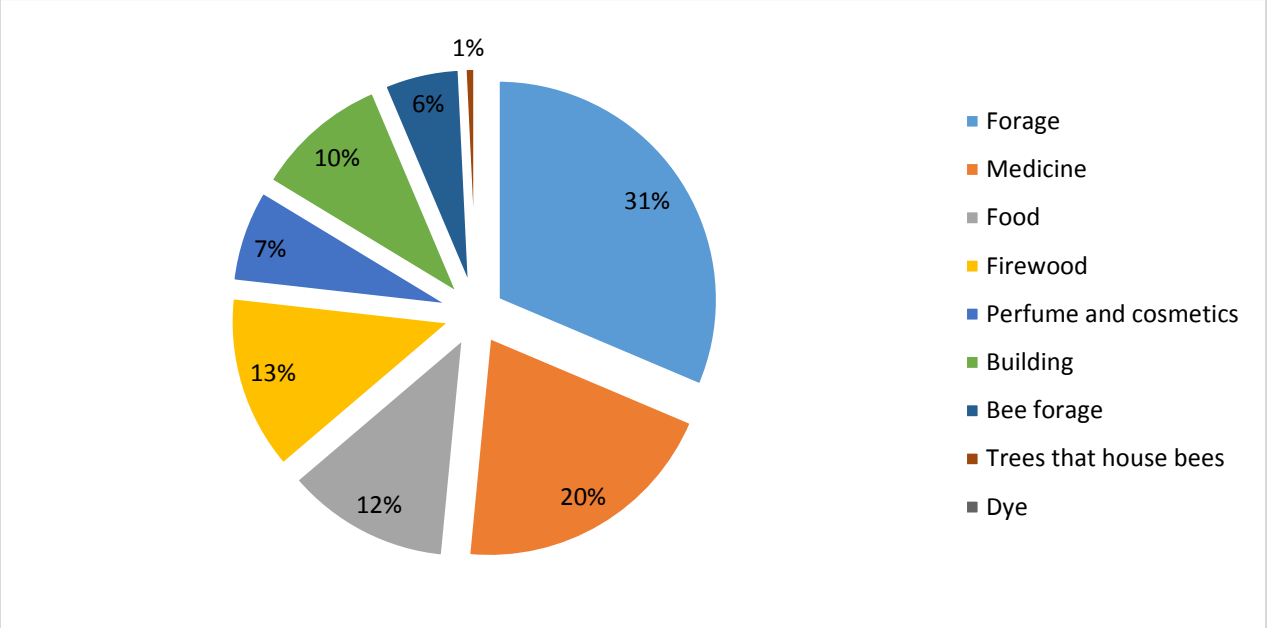


Figure 6: Extractive resources utilized from Marsabit forest

4.2.1 Firewood

The study revealed that all the households interviewed depend on the forest reserve for firewood which is either extracted for direct local consumption or sold at the Marsabit market. Firewood is the main energy used for cooking within the study area although its use is not efficient as the communities still use the traditional open hearth system meaning cooking energy needs to be comprehensively addressed within the area. Also, the rapidly increasing urban populations especially in Marsabit town as a result of immigration for increased employment opportunities offered by the devolved governance system has resulted in increased demand for fuel wood way

above the sustainable production levels of the Marsabit forest reserve A total of 22 firewood species were recorded (Figure 4.3) with members of the community knowing which species are the best to use.

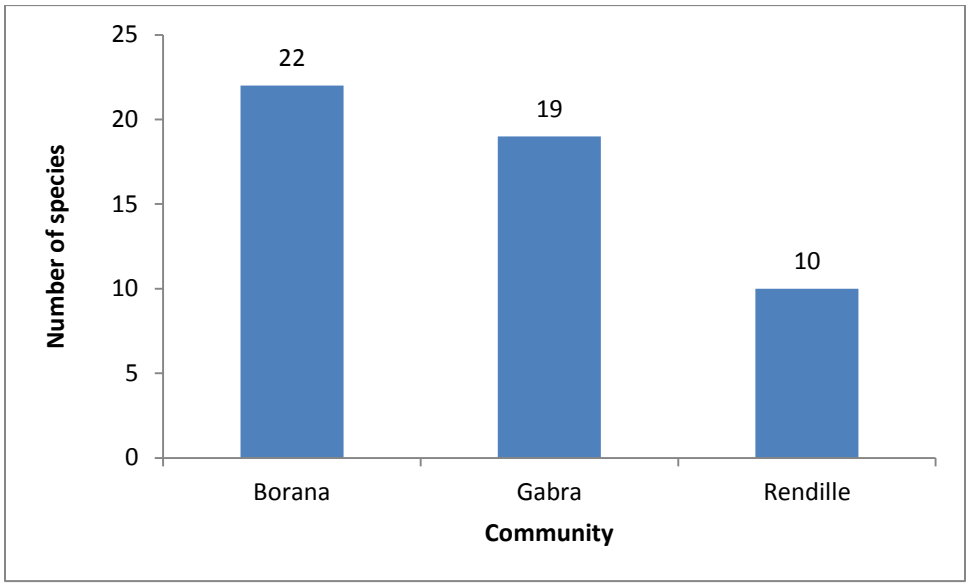


Figure 7: Number of firewood species utilized by each community

The choice of a species depends on how it lights, smokes when its wet, stays longer, gives better heat output in addition to others uses such as to smoking the milk gourds (to keep the milk fresh). The locals cited harvesting mostly dry dead wood, although some cut branches of several trees. *Olea europaea* sp. *africana* was identified among the most important firewood species because their high market value and energy output (Table 4.5). Selective harvesting of this species threatens the forest integrity due to its ecological significance, low germination rate and poor seedling ability (Kirubi, 1998). There exists a permitting system in place enforced by KFS that controls access to the forest and collection of firewood. However, most local

communities do not seek for these permits, thus over harvesting firewood which has a significant contribution to degradation of the forest cover noticeable along the forest edges.

Table 8: Top 10 common Firewood species utilized by communities around the Marsabit Forest

Local species name	**Scientific Name**
Ejers(Borana); Lng'eriyoi (Rendile)	*Olea europea* spp. *africana*
Mokhof (Borana); Loberbeneyo (Rendille)	*Croton macrostachyus*
Lokho (Borana); Ltunturi (Rendille)	*Diospyros abysssinica*
Karra (Borana); Nchipiliwa (Rendille)	*Strychnos henningsii*
Madderqotte(Gabra)	*Cordia sinensis*
Korkore (Borana)	*Tarenna graveoleus*
Ltepes (Rendile)	*Acacia sp*
Lolayei (Rendille)	*Ziziphus mucronata*
Lgiribuk(Rendille)	*Flueggea virosa*
Sabas (Gabra)	*Acacia mellifera*

Most of the respondents take between 2.1-5 hours (Figure 14) per trip in search of this precious commodity with averagely each household harvesting 2 backloads per trip with the average time being 3.4 hrs. More firewood products during rainy seasons with harvesting rates having increased compared to the past as revealed the interviewees who cited population increase as the major reason. However some women have adapted and use any species that is available close by.

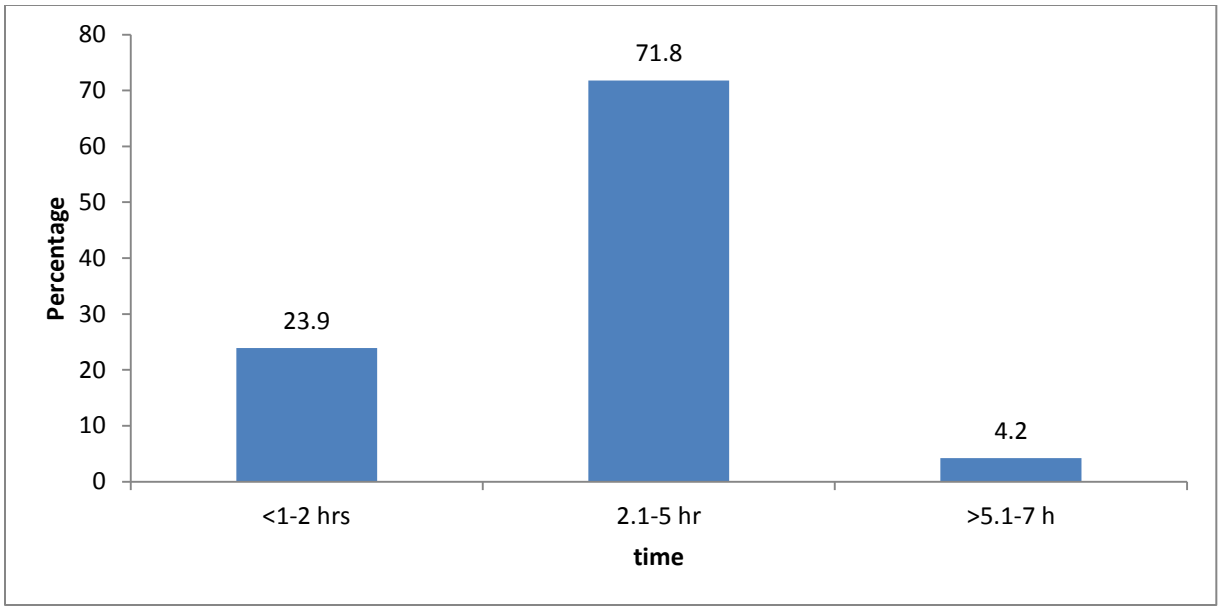


Figure 8: Time taken to and from harvest location

4.2.2 Forage

The local community livestock depend on free access to pasture and fodder as there are no grazing plans in place with the gazing ground resources being utilized both by the communities from within Marsabit County and other migrant pastoralists. The grazing plans are systems that ensure controlled grazing patterns by the community members using their traditional knowledge in rangeland management during both dry and wet seasons and also managing influx of migrants from other communities during extreme hardship periods. Both grass and tree species (Table 4.8) are grazed mainly by the Sheep, goats, camels, donkeys and cattle. The palatable trees species are grazed upon mainly during the dry season when there is limited forage supply at the communal grazing areas. The community provided the local names for the species with preference of species was being based on availability, palatability and nutritional value. Within the forest during the dry season, pasture utilization involved physical grazing in the forest and

some pastrolists prune high branches from trees to feed their livestock. Livestock grazing within the Marsabit forest is a contributing factor to biodiversity loss and forest degradation due to overgrazing associated with large livestock numbers. Livestock also trample on regenerating tree species and destroy them, and also accelerate soil erosion as trampling loosens up the soil.

Table 9: Common Forage species utilized by communities around the Marsabit Forest

Local Names	**Scientific name**
Lkawa (*Rendille*)	*Bothriochloa insculpata*
Maderqotte (Gabbra)	*Cordia sinensis*
Barrat (Gabbra)	*Blepharis sp.*
Ejers (Borana/Gabrra); Lngeriyoi (Rendile)	*Olea europaceae* spp. *africana*
Lperisiwas/Lperesi (Rendille)	*Themeda triandra*
Qayyo (Borana/Gabbra)	*Commelina benghalensis*
Buyyo (Borana/Gabbra)	*Eragrostis caepilosa*
Dekha (Borana/Gabbra)	*Grewia tenax*
Lonoro (Rendille)	*Eragrostis ciliaris*
Ntalaguani (Rendille)	*Aristida kenyensis*
Idho (Borana/Gabbra)	*Paspilidium desertorum*
Larapasi (Rendille)	*Cynodon nlemfuensis*
Irikurme (Rendille)	*Cenchrus ciliaris*
Loyeti (Rendille)	*Glycine wightii*
Lesholo (Rendille); Taphata (Borana)	*Bauhinia tomentosa*
Doqh (Gabbra)	*Cadaba glandulosa*
Qorqodha (Gabbra)	*Cadaba sp.*
Ntereoni (Rendille); Makhdhima (Borana)	*Ochna insculpata*
Sigiit (Samburu)	*Blepharis maderaspatensis*
Qadhu (Gabbra)	*Cadaba rotundifolia*
Adhei (Gabbra)	*Salvadora persica*

The possibility of overgrazing in some areas is real and this is compounded of migrants from other communities both within and outside the Marsabit County during extreme hardship periods threats the ecosystem integrity. Also the presence of fixed water points in various localities encourages settlements with most of the temporary structures set up during the extreme dry periods since Marsabit forest reserve is a dry refuge zone for the pastoralists in the region. This acts as agent for overgrazing and land degradation. Most of the respondents take between 2.1-5 hours (Figure 4.5) to the grazing grounds and watering points, with most of the grazing within the forest reserve taking place during the dry season which could affect the regeneration of fodder yielding vegetation

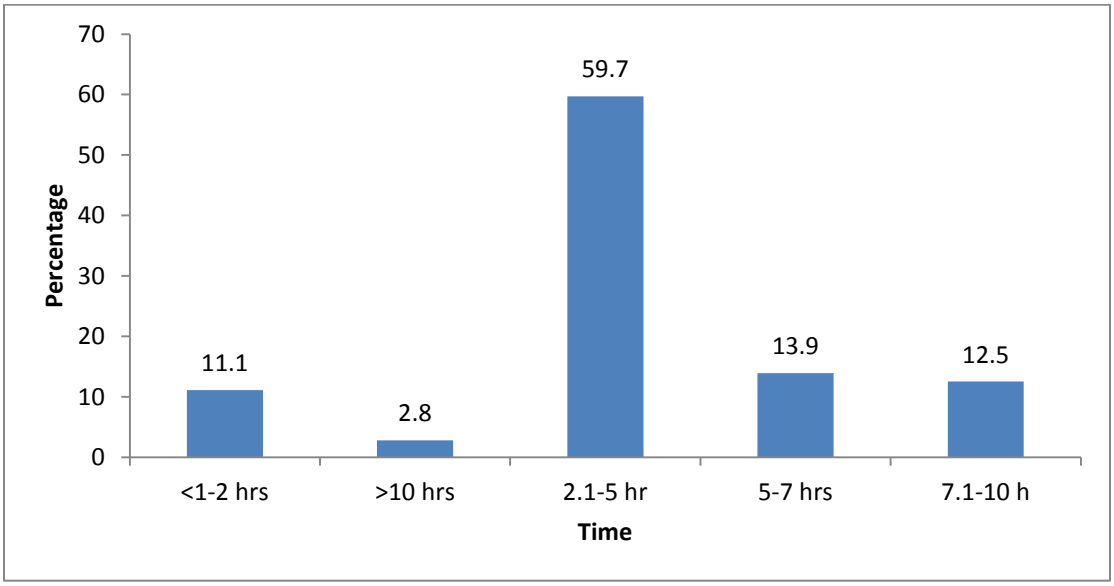


Figure 9: Time to forage location within Marsabit forest reserve

4.2.3 Medicinal plants

Many plants species are used as medicines for both human and livestock diseases with majority of the respondents taking less than 2 hrs to the harvest location (Figure 4.6). Some of the important human diseases in the study area treated with these medicinal plants include: malaria, fever, aches and pains, pneumonia, flu, coughs, diarrhea, sexual transmitted diseases (STDs) (Figure 4.6). For animals, the diseases include: yellow fever, mastitis, and retained placenta. The recommended dosage is normally a handful of leaves, or few pieces of root, rhizome, stem or bark (Table 4.9). They are either used fresh or dry, chewed, or soaked, boiled in water, in soup, and the decoction taken as tea.

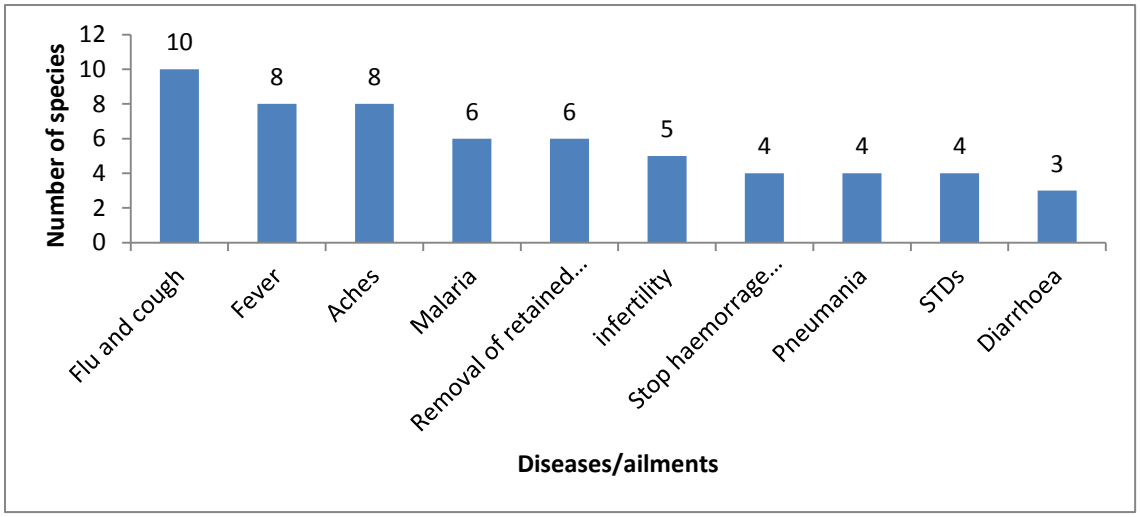


Figure 10: Human diseases treated and managed using plants

Table 10: Common Medicinal products within Marsabit forest Ecosystem and their uses

Local Name	Scientific name	Disease/Ailment
Amares (B); Legirgir (R)	Acacia breyispica	Whooping cough
Anona (B); Lperi (R)	Trichlia emelica	Stomach upsets
Ejers (B); Lng'eriyoi (R)	Olea europeae spp. africana	Cough; malaria
Mokhof (B); Loberbeneyo (R)	Croton macrostachyus	Cough; common cold
Thatesa (B); Lmakutikuti (R)	Clerodendrum myricoides	STDs
Dagams (B); Laparmunyo (R)	Toddalia asiatica	Tooth ache ailments; malaria
Qorre (B); Lasarmai (R)	Harrisonia abyssinica	Common cold, malaria
Karra (B); Nchipiliwa (R)	Strychnus henningsii	malaria
Mique (B); Lgiyai (R)	Teclea hanangensis	Removal of placenta
Lkirantus (R)	Plumbago sp	Stomach upsets; constipation
Lbukoyi (R)	Terminalia sp.	Yellow fever
Ntulelei (R)	Solanum incanum	Diarrhoea
Ltepes (R)	Acacia sp.	Common cold

Key; B=Borana; R=Rendille; STDs=Sexually Transmitted Diseases

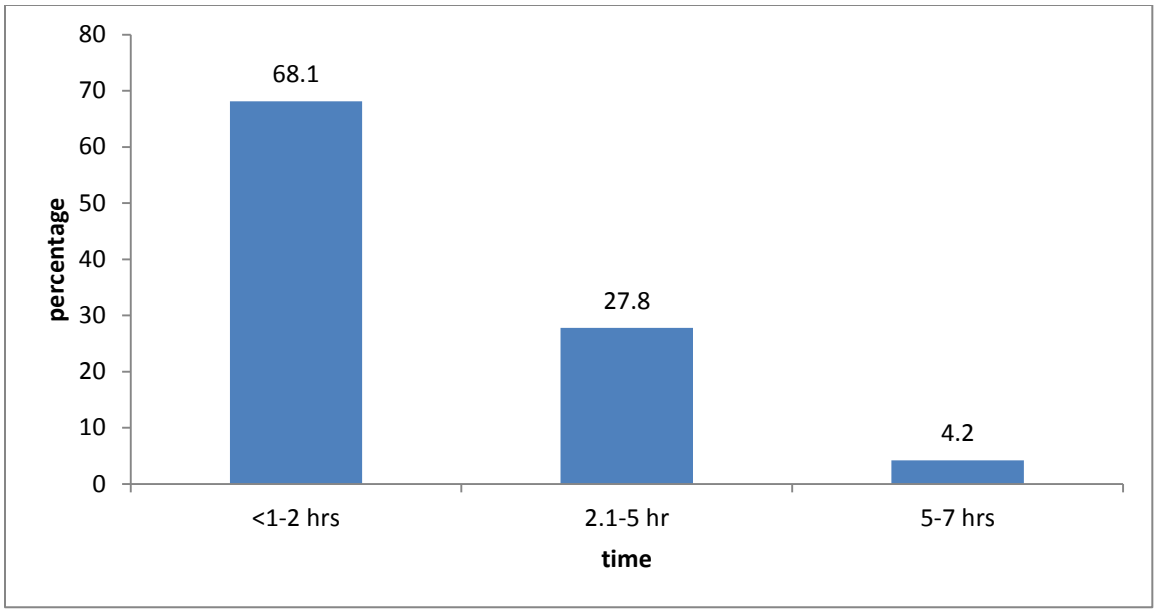


Figure 11: Time to and from harvest location for medicinal products

4.2.4 Food Sources

The sampled population indicated food also as an important resource obtained from the forest reserve. Fruit (both wild and domesticated) is the main (Table4.8) part utilized as food by both human and animals. This is followed by roots, leaves and gums. Fruit trees species were ranked based on their availability during the dry season, source of vitamins, and the juice is sometimes sold in the market. Domesticating high-value tree species to produce marketable forest products is one way of strengthening this source of income and of improving the nutritional value for rural poor households.

Table 11: Common food (Edible plant) species used by the different communities

Local Name	Scientific name
Bururi (Borana); Lkoromosio (Rendile)	*Vangueria madagascariencis*
Ejers (Borana); Lng'eriyoi (Rendille)	*Olea europea* spp. *africana*
Kurra (Borana); Lmoron (Rendile)	*Dovyalis abyssinica*
Kara (Borana); Nchipiliwa (Rendille)	*Strychnus henningsii*
Jajab (Borana); Santaiti (Rendille/samburu)	*Berchemia discolor*
Lgiribuk (Rendille)	*Flueggea virosa*
Nchode (Rendille)	*Hoslundia opposita*
Dekkha (Borana)	*Grewia tenax*
Lupupoyi (Rendille)	*Grewia Villosa*
Garse (Gabbra)	*Dobera glabra*
Adhei (Gabbra)	*Salvadora persica*
Lolayei (Rendille)	*Ziziphus mucronata*
Nkereyok (Rendille)	*Bridelia taitensis*
Lamurei (Rendille)	*Carissa edulis*

4.2.5 Building Materials and household stuffs

Several plant species are used for building mainly as small rafter, poles, roofing and making household stuffs (Table 4.11) while constructing houses which is more widespread in the study area with majority of the sampled population taking between 2.1 to 5 hrs (Figure 4.7) to the harvest location within the forest reserve. This is however not done daily but on need basis. *Olea europaea* ssp. *africana* commonly known as *Ejer* (Borana) and *Lng'eriyoi* (Samburu/ Rendille) is the most preferred timber species because the wood is hard and termite resistant. *Cordia spp*, locally known as *Madderqotte* (Gabra) is also regarded as good timber. The harvesting of these species is however strictly prohibited. Some of the species used to make household stuff and

farm equipments include *Dovyalis abyssinica* and *Erythrina buritti*. Some of the products including housing and households stuff made from these species are indicated (Annexes)

Table 12: Common Plant species used for building Materials

Local Name	Scientific Name	Use
Ejers (Borana); Lng'eriyoi (Rendille)	*Olea europea* spp. *africana*	Poles and roofing
Kara (Borana); Nchipiliwa (Rendille)	*Strychnus henningsii*	Building poles
Makhdhima (Borana); Ntheroni (Rendille)	*Ochna insculpata*	Poles
Kurra (Borana); Lmoron (Rendile)	*Dovyalis abyssinica*	Farm implements (York for digging)
Bururi (Borana); Lkoromosio (Rendile)	*Vangueria madagascariencis*	Roofing
Lokho (Borana)	*Diospyrus abyssinica*	Poles and roofing
Dirri (Gabbra)	*Phyllanthus somalensis*	Building, but very poisonous to camels
Korkore (Borana)	*Terenna graveolens*	Poles and roofing
Lekiri (Rendille)	*Dichrostachys cinerea*	Building poles
Madderqotte (Gabbra)	*Cordia sinensis*	Building poles, furniture and making camel saddle
Lecholo (Rendille)	*Bauhinia tomentosa*	Building poles
Jajab (Borana)	*Berchemia discolor*	Building poles
Mique (Borana); Lgiyai (Rendille)	*Teclea hanangensis*	Poles and roofing
Lgiribuk (Rendille)	*Flueggea virosa*	Building poles
Lolayei (Rendille)	*Ziziphus mucronata*	Building poles
Nkereneyok (Rendile)	*Bridelia taitensis*	Building poles
Qadhu (Gabbra)	*Cadaba rotundifolia*	Making camel bells
Lngorochi (Rendille)	*Erythrina buritti*	Making household stuff (Gourds & troughs)

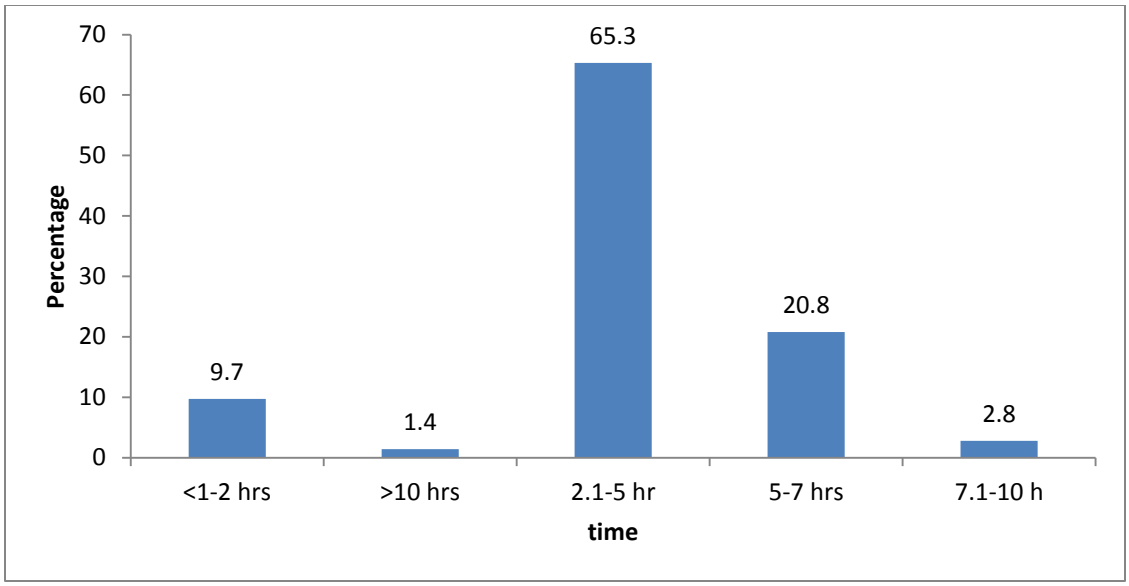


Table 13: Time to harvest location for building materials

4.2.6 Honey

The sampled population mainly Rendille community obtain honey from the forest reserve as few of them practice bee farming. Three types of honey: *Lotoro* (hive and stone stinging bees), *Lchebi* (from smaller bees and used as antibiotic) and *Wanaa* (from underground bees). A number of tree species were associated with bee forage and housing of bees mostly such as Ltepes (*Acacia sp*), Nchode (*Hoslundia opposita*), Lmakutikuti (*Clerodendrum myricoides*), Lperi (*Trichilia emelica*) and Lng'eriyoi (*Olea europea* spp. *africana*)

4.2.7 Animal products

Elephant is an important cultural animal for all the communities interviewed. It is symbolic to prosperity and strength. There are several cultural practices attributed to this animal (Table 4.12) with other animals species hunted by the locals too (Table 4.13) which are poached on need

basis with the majority of the locals taking around 24 days (Figure 4.8) in search of the preferred species. However, the respondents noted that the poaching trend and practice has reduced due to the stiffer penalties enacted in the new Wildlife Conservation and Management Act, 2013.

Table 14: Cultural values attributed to elephants

Practices	**Uses**
Marriage	Dung from baby is used together to start the first fire in a newlywed home.
Prosperity	The tusk and tail is used to blessed children to be as strong as an elephant. The placenta/after birth is believed to bring blessings of prosperity and hence it's placed in homestead.
Weather prediction	Movement of elephants from the forest towards the lowlands indicates rains are about to start.
Security	When elephants leave the forest and stay around homestead indicates the presence of poachers

Table 15: Animal products and their uses

Animal	Part	Uses
Colobus monkey	Skin	Worn during marriage ceremony
Buffalo	Skin	Used to make necklace worn during marriage ceremony
Rhino	Horn	Used as an alternative to elephant tusk when blessing children
		Used for prayers when a new moon is sighted
		Used to blessed the leader of an age-set
Rhino	Tail	Used to make traditional whips
Antelope	Horns	Used for digging holes to bury placenta/afterbirth
Lion	Skin	Used in marriage ceremony
Greater Kudu	Horn	Used for prayers when a new moon is sighted
Ostrich	Feathers	Used during circumcision

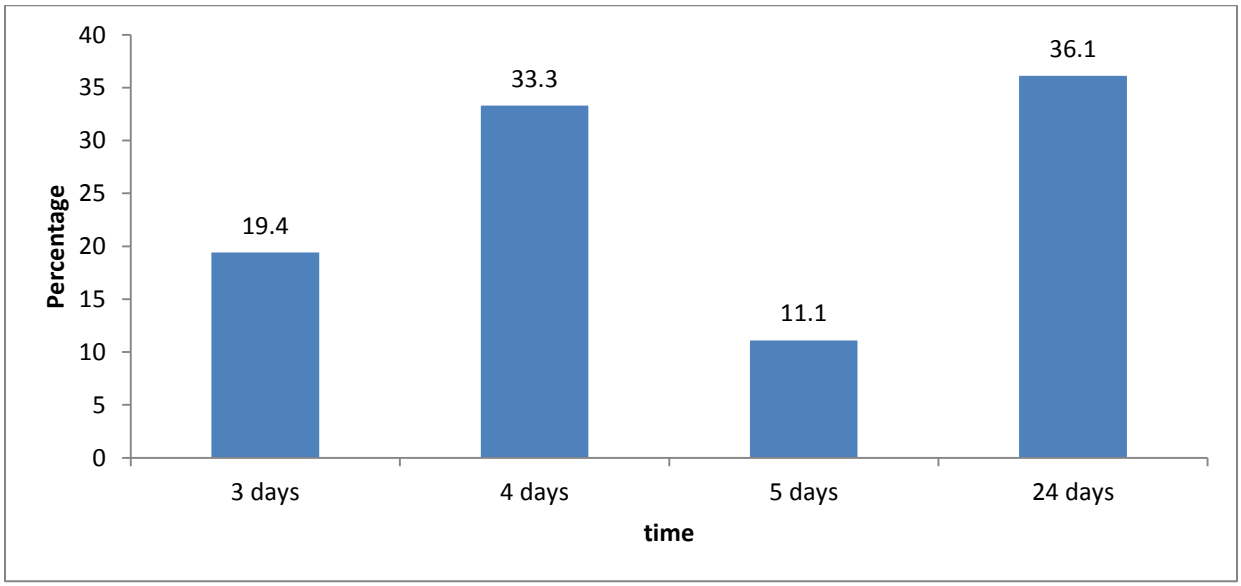


Figure 12: Time taken to hunting Wild animals

4.3 Economic Value of Non Timber Forest Products from Marsabit Forest to adjacent households

The use categories as given by respondents during household survey were: food, medicinal, fodder, building, cultural, firewood, dental hygiene and dye. In terms of community knowledge on the forest resource uses, medicinal plants had the highest number of species (27) and followed by fodder with 17 species (Figure 4.9).

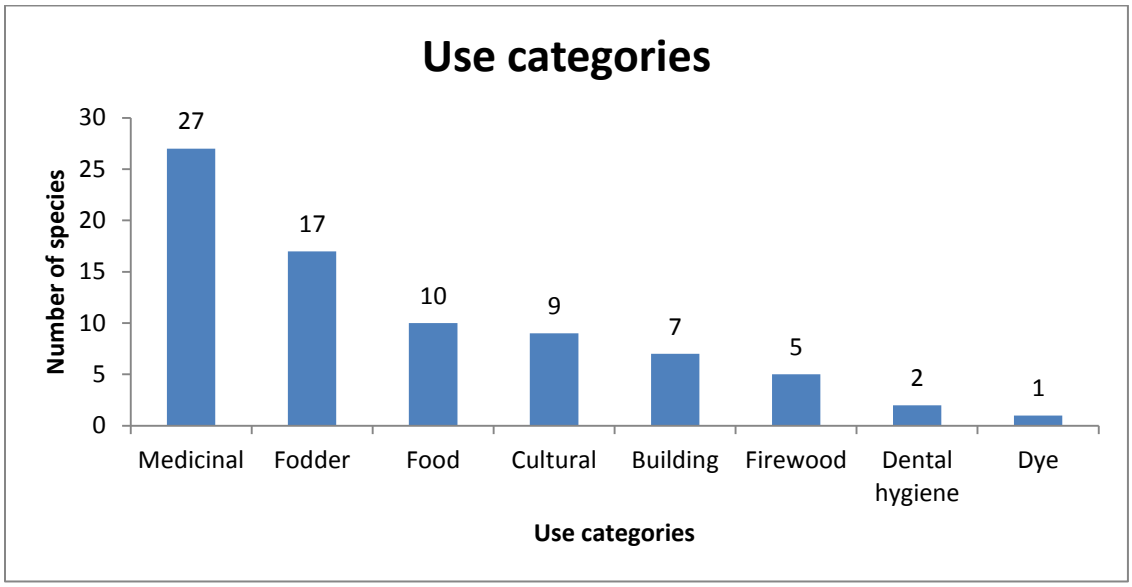


Figure 13: Knowledge of uses of plant species in the forest by local communities

To get information on the economic value estimates of the NTFPs collected by the households, mean quantities of the various NTFPs collected by sample households were determined to reflect the quantities extracted per household from the area of interest. The quantities of NTFPs extracted were determined on monthly basis but then extrapolated through the year to get the quantities collected per annum by households. Price information was determined from the

market survey was carried out at the local market in Marsabit for the NTFPs traded. Firewood was the main product on trade and the survey revealed that a backload of firewood is between Kshs 500-700 depending on the season of harvest, with the mean price trading at Kshs. 600. The price range for medicinal products per stick was estimated at Kshs. 100 with women in the market mostly being vendors and gets their products from those who collect them from the wild. The average prices for plant food species honey and building materials which are traded occasionally was based at Kshs.400, Kshs. 600 and Kshs. 300 per unit of measurement respectively. Since the products were mostly sold in the local market (Marsabit) or at the neighbours, the study assumed that the prices were not dependant on transport cost hence did not vary significantly across the study area. The figures were then assigned an economic value by multiplying the quantities by the market price.

Table 16: Quantities and Economic Value of NTFPs Collected from the Marsabit Forest Reserve

NFPs	Unit	Average quantity per household/year	Average market price/unit	Estimated Annual value/household/year (Kshs)
Firewood	Backloads	92.16	600	55, 296
Plant food	Kgs	172.8	400	69,120
Building Materials	poles	221.28	300	66,384
Medicine	sticks	418.56	100	41,856
Honey	Ltrs	756.4	600	453,840
Total				**686,496**

It should be noted that it was difficult for the enumerators to measure then weight or volumes of some NTFPs such as firewood, building materials and medicinal species collected since there is no clear conventional methodology of getting those measurements. The enumerators were advised to inquire on the number of back loads, poles and sticks respectively per trip from the harvesting location and not the weights or volumes. The measurements provided are therefore estimates made by the interviewer and interviewee.

Also note that for NTFPs such as pasture and animal products which are not traded on regular basis, price information was difficult to obtain both from the market survey or any published or unpublished literature. Therefore all valid responses were "when needed" and "directly consumed" respectively (Table 4.14) and their estimated economic value to households could not be determined.

Table 17: Average harvest amount per trip

Non forest product	Minimum	Maximum	Mean
Plant food species (Kgs)	1	50	3.60
Medicinal species (sticks)	1	60	8.72
Honey (ltrs)	2	60	15.76
Building materials (number of poles harvested)	2	10	4.61
Firewood species (backload)	1	10	1.92
Animal products	"when needed"		
Forage species	"directly consumed"		

100% of the sampled population indicated to have used most of the forest resources at some point either from buying or selling from the market or some consuming them directly from the harvest location at household level (Figure 4.10).

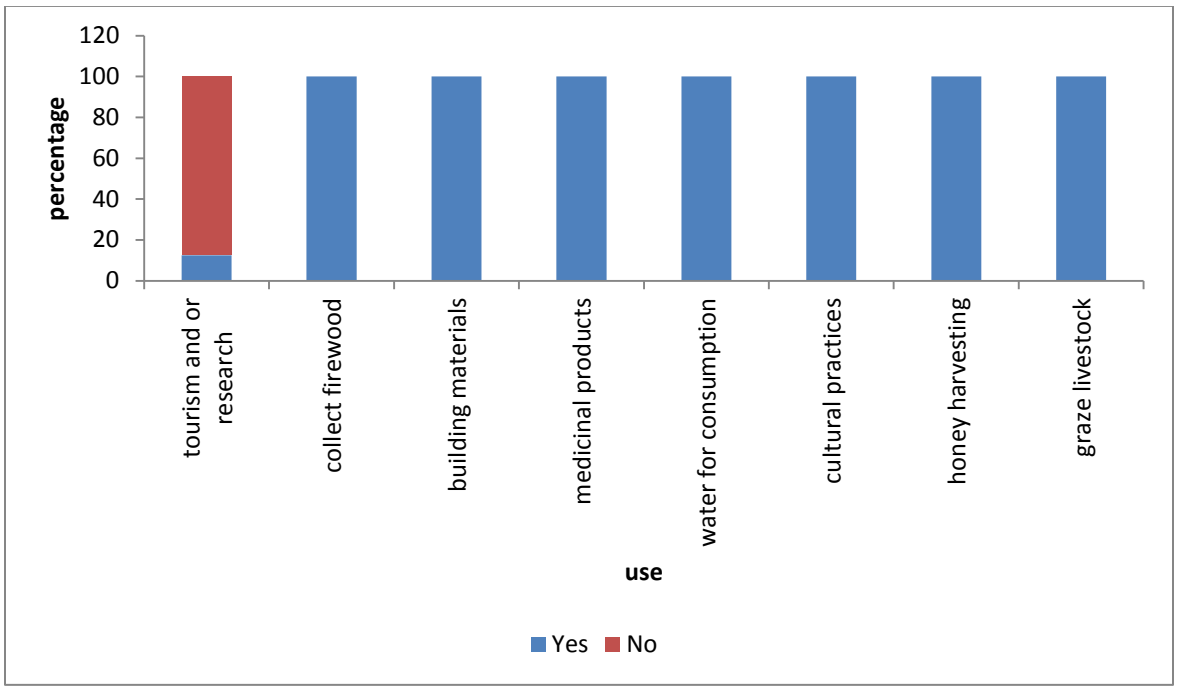


Figure 14: Household use of NTFPs

The quantities and estimated economic values per household were then aggregated over the entire household population within the study area using recent population census statistics, to include even the non surveyed households while estimating the total quantities of NTFPs extracted from the Marsabit Forest Reserve. With Marsabit central having a population of 16,213 (CGoM, 2015) living around the Marsabit forest reserve (15,280 ha), an assumption of 6 persons per household (as informed by this study) was made to get around 2,702 households within the study area whose livelihoods depend on Marsabit forest resources.

Table 18: Aggregate quantities and economic value of NTFPs from Marsabit forest reserve

NTFP	Unit	Estimated annual value/household/year	Average households utilizing NTFPs	Estimated annual value/ha/year in Kshs (000,000)
Firewood	Backloads	55,296	2,702	9,778.1
Plant Food	Kgs	69,120	2,702	12,222.7
Building materials	Poles	66,384	2,702	11,738.9
Medicine	Sticks	41,856	2,702	7,401.5
Honey	Litres	453,840	2,702	80,253.6
Total				**121,394.8**

Summing up the direct use values and diving them by the area of Marsabit forest reserve (15,280 ha) to get value per ha, the estimated annual economic benefits of NTFPs extracted by households living within the 5km buffer of Marsabit forest reserve was approximately **Kshs. 121,394.8 million/ha/ year or US$ 1,214/ha/year** at 1US$ for Kshs. 100 exchange rate **(CBK, 2015)** with this figure including both tradable and NTFPs (honey, firewood, building materials and medicine) consumed directly at household level (Table 4.15). However, animal products and pasture was which are equally very key to the local communities is excluded from the above figure since by the time the study was being undertaken, their price information was difficult to obtain from both market survey or any published or unpublished literature on Marsabit forest ecosystem.

4.4 Alternative Livelihood Options

Based on household survey, field observations and focus group discussions conducted during the study, the local communities benefit from the a wide range of ecosystem services such as water and climate regulation as well as ecosystem good provision function of the forest such as firewood, fodder, building materials, honey, and building materials. The findings also indicate that the local communities especially the elders are aware that the Marsabit forest environment has changed greatly from overtime and are aware of some of the possible causes of these changes citing human related pressures such as unsustainable utilization of natural resources such as firewood collection, livestock incursion into the forest which has altered the vegetation structure, population increase which has led to encroachment on forest boundaries, and climate change evidenced by prolonged droughts and erratic rainfall patterns. The household survey carried out within the study area revealed that indeed local communities are aware of the alternatives that they would be willing to engage in to improve the environment of Marsabit forest indicating the citizens' preferences on environment management (figure 4.11).

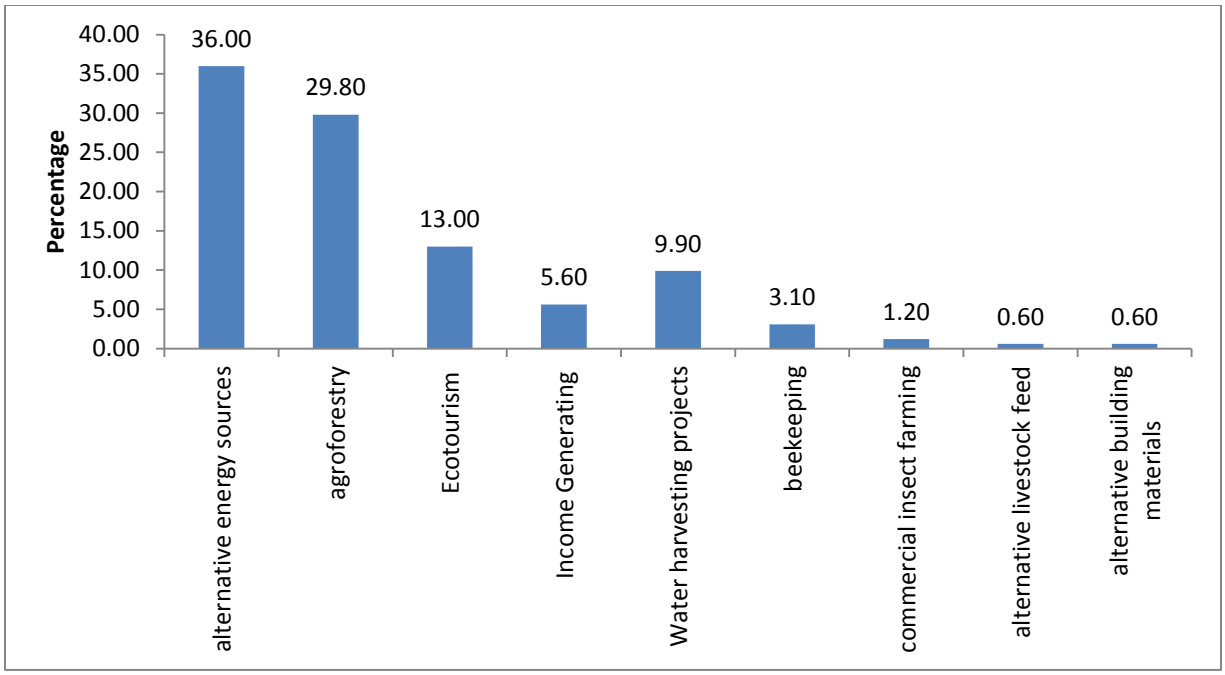


Figure 15: Proposed alternative livelihood options

Introducing these alternatives and capacity building the local communities through consistent awareness creation and training by the policy implementers will create an enabling environment where wealth is created without over utilization of the natural resources thus reducing pressure from the Marsabit Forest reserve. This can also be viewed as a way of spreading risk of food insecurity and coping with the changing nature of hazards within the Marsabit forest ecosystem brought about by the effects of climate change. The choice and acceptability of proposed livelihood strategies will of course differ between the different communities adjacent to the Marsabit forest reserve due to various factors such as the interests and cultural background of land owners, expected economic gains, land ownership status, agro-ecological attributes and interests of the surrounding Protected Area management, tourism investors and other local government agencies.

4.4.1 Alternative Sources of Energy

Promotion of alternative sources of energy had the number of proposals at 36% by the respondents from the household survey results of this study. The results also indicate that firewood is the main energy used for cooking within the study area, affirming a study conducted in 2006 within the area which showed that that 98.5% of households use firewood from Marsabit forest, while only 1.5% uses other sources of energy (Ramat G, 2006), reflecting heavy reliance on traditional biomass energy primarily at household level. Currently, Marsabit central within Saku constituency has a population of 16, 213 (CGoM, 2015) living adjacent to the forest reserve, especially in Central and Gadamoji divisions. This population uses firewood daily to meet their energy needs and due to the steady population increase, energy consumption is slowly increasing. They use low efficiency combustion means such as the traditional open hearth system or open fires which have important social, health and environmental implications.

One of the few available interventions is promotion of improved cook stoves (energy saving cook stove) which will mitigate the negative effects of traditional biomass energy use particularly indoor air pollution that is linked to respiratory diseases and also reduce the pressure from Marsabit forest through efficient utilization of fuel wood by the local community. These energy stoves are designed to reduce heat loss, increase combustion efficiency and attain higher heat transfer. Other necessary technologies that could should be promoted by the government and relevant stakeholders include but not limited to promoting efficient charcoal production technologies, and promoting uptake of energy saving sources such as briquettes, biogas, solar and wind energy within the local communities will be reduce the pressure on the Marsabit forest ecosystem and also support other poverty alleviation activities.

4.4.2 Agro forestry

The respondents proposing agro-forestry practices stand at 29.8% and this will be of significance since it will ease the community dependence on the Marsabit forest. Trees can be grown in homesteads as on farm woodlots, along farm boundaries and on crop fields. This reduces the pressure on the forest as the number of community members extracting building materials and firewood will be greatly reduced thus reducing the forest degradation levels. Equally, commercial tree farming should be encouraged for farmers to embrace tree farming as an economic activity. This could through promoting high value and fast growing trees on secured parcels of land and with improved technology.

From field observation during the research period, a number of tree species were observed to grow well along the community lands such as *Gravellia robusta, Croton megalocarpus*, and *Eucalyptus cammudelensis* which are an important source of timber for house construction. Fodder trees such as *Leucaena leucophala, Cassia seamea, Cordia abyssinica and Vangueria acutiloba* are also common. Common food trees whose products are sold in local market during season include *Mangifera indica, Citrus sinensis* and *Moringa stenopetala* whose leaflets have high nutritional value (Price 2002) especially vitamins A, B, C and calcium. The recommended tree species (Marsabit Forest Ecosystem Conservator, 2015) include; Fruit tree (e.g. mango various varieties, papaya, Oranges and jack fruit), multipurpose tree species (e.g *Grevellia*, *Eucalyptus* clones, *Markamia lutea*), fast growing *Acacia mensii* (wattle tree) and *Acacia albida*, *Mellia azadrachta*, and *Melia volkensi* on the drier area of the ecosystem, *Siena* species, (*spectabilis* and *siemea*) for ornamental purpose and *Moringa Oelifera* for fodder and vegetable

4.4.3 Ecotourism

Ecotourism proposals from respondents ranked by 13.0 % with the potential for ecotourism and ethno tourism within the study area being relatively high due to the existence of rich cultural heritage as well as natural tourist attraction sites in the area. The promotion of these lucrative enterprises will encourage the local communities' involvement in conservation of the Marsabit forest ecosystem as they would derive direct benefits and income. Potential tourism programs to be promoted among the local communities include tour guiding services, walking and camel ride safaris due to the impressive scenic features and wilderness climate of the area, ethno tourism activities such as showcasing cultural heritage through establishment of cultural villages at the communities' home base and sale of traditional artefacts. The establishment of community based conservancies and eco-lodges is also an important ecotourism option where the communities set aside an area for wildlife conservation and they in turn provide tour and accommodation services to visitors through independent self management programs.

4.4.4 Water harvesting projects

Promoting water harvesting as supplementary water source for domestic and livestock consumption was proposed by 9.9% of the respondents. This also heavily featured during the focused group discussions where participants proposed that water should be piped from the Marsabit forest to the community areas. They sighted that this would minimize livestock incursion into the forest reserve thus reducing pressure and allowing regeneration of the vegetation, reduce conflict between livestock and wildlife while competing for water and it would also improve the water sources and wildlife habitat. Several water sources from the

Marsabit forest (Table 4.14) were identified by the communities during focused group discussions.

Table 19: Water sources and community access

Water Source	Community Access
Il-Chuta wells	Songa, Ilpus and Kituruni communities
Bakuli Springs	Kituruni community and Marsabit town residents
Hula hula wells	Hula hula and Parakishon communities
Samachalle (Songa) springs	songa, Ilpus and Sagante communities
Karsa/Sagante wells	Badassa, Sagante, Gabbra scheme and Boru haro communities
Burji springs	Badassa and Gabbra scheme communities
Lagga Mohamed springs	Karare and Kituruni community
Fifty deep wells	Karantina, Hulahula and Jirime communities

The locals proposed rehabilitation of these water supply systems to ensure that water piped from the forest reaches the communities at the respective villages. Check dams should also be constructed at several designated points to augment natural water from the forest thus regulating storm runoff and enhancing infiltration and aquifer recharge. This would be a cost effective way of harvesting surface water run-off although cost benefit analysis should be carried out to qualify it.

4.4.5 Income Generating Activity Projects

Income Generating Activity projects were proposed by 5.0% respondents. The communities within the study area have limited sources of income with firewood collection and trade being a major source of income for a large number of women from the forest adjacent communities.

Firewood collection, especially cutting of saplings destroy the structure and forest regeneration process. Provision of income generating activities with potential markets for local communities to diversify their income sources will reduce the dependence of communities on the forest. The communities should however be assisted in developing and implementing business plans for the selected IGAs and linking them up with financial institutions and donor agencies for loans. Potential eco-friendly IGAs include bead making, beekeeping , aloe vera farming, acacia species farming, poultry farming, commercial insect farming (e.g. apiculture, butterfly farming and sericulture) and other acceptable and viable enterprises.

4.4.6 Commercial Insect Farming

Commercial insect farming is a well developed industry in Kenya and on global scale but is largely untapped in Marsabit. These are unique ventures with a potential to enhance conservation of the ecosystem. Insects for instance play an important role in maintaining ecological processes such as pollination. With proper community training, beekeeping can be used to mitigate human elephant conflict and its practice using traditional beehives is a non-capital intensive investment. Silkworm farming (Sericulture) and butterfly farming are a source of income to many in Kenya such arabuko sokoke and Kakamega forests adjacent communities. The market for silk is readily available with demand for silk fibre used for making finer silk fabrics increasing day by day. Local markets include ICIPE, the Export Processing Zone (EPZ) in Athi river, Pendeza weaves in Kisumu, Spin weavers in Nairobi and various local cottage industries.

Aloe vera farming is increasingly being viewed as important wealth creation and biodiversity conservation measures of sustainable development initiatives for that can be embraced by local

communities especially women who normally tap the aloe sap. The plant has high medicinal value hence product increasingly used for value addition in juices, soaps and beauty products.

Acacia species are known to grow in the arid and semi arid areas for it gum which can be used in adhesives, pharmaceuticals, inks, confections and other products. The plant grows naturally on the lowland slopes of the Marsabit forest ecosystem with the local communities known for utilizing their gum arabic product as an adhesive but the potential for its export has never been exploited. The potential market includes Middle East and Asia. The activity is economically feasible since it is a non capital intensive investment.

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

This study contributes to numerous studies and discussions on NTFPs harvesting and their contribution to the livelihoods of the forest adjacent communities in the East African region. In the analysis, the study has used both market and consumption based data to illuminate the relative importance of NTFPs to the local communities. The study finding s establishes both the monetary, social-cultural and ecological benefits accruing to the local communities from wide range of Marsabit forest ecosystem services. It is evident that NTFPs are an important source of income and livelihood strategy to the Marsabit forest adjacent communities who depend largely on agriculture and intensive forest products utilization for their survival. From the analysis, the estimated economic benefits accruing across the households from NTFPs extraction is approximately **Kshs. 121,394.8 million/ha/year** with firewood, plant food products, building materials, medicine and honey being the biggest contributors.

However, the economic value of fodder, though not included in this figures since it was difficult to obtain their quantity and price information, should not be ignored as it plays a vital livestock nutritional role especially during the dry periods when the communities living adjacent to the forest have exhausted their communal grazing areas. This also implies that in most cases, accurate estimation of NTFPs economic benefits is difficult to obtain since many NTFPs are not traded regularly but consumed directly at household level resulting to mostly underestimation of the total economic value.

Although these forest resources have a high value to the local communities, their extraction by the locals is mostly for subsistence rather than large scale commercial purposes with hundreds of plant species used regularly to meet their daily needs indicating that community access to the Marsabit forest is an important feature held dearly by the forest adjacent communities. Therefore, the Marsabit forest protected area management regimes should give special consideration to local resource use in their decision making and policy development. The support or failure of a protected area is largely dependent on the support accorded by the local communities since they form an integral part of conservation by deriving social, cultural and economic benefits from the forest. This cooperative relationship needs to be pursued to ensure that the values of the protected area are maintained.

The information about use, dependence and vulnerability should not only be kept at national or county level but also cascaded down to the local communities through the available local communication mechanisms. Awareness on the values of Marsabit forest reserve among the local communities should be enhanced as it can contribute to reduction of pressure on the forest resources as well as increase support for their management and conservation. When the local communities are aware of the resources being conserved and their environmental, economic and social values, they are more inclined to render their unwavering support for their conservation.

Marsabit forest being a gazetted forest suggests that NTFPs harvesting is restricted (with most legal collectors obtaining permission and licenses for the KFS management). Imposing stricter forest access and the forest product collection without providing alternative options would affect the daily livelihoods and harm the well being of the forest adjacent communities who heavily rely on these forest resources. This calls for sustainable forest management programs coupled

with other mechanisms that actively involve the local communities and provide alternative livelihood options so as to gain support for the conservation efforts in the Marsabit forest reserve. Kenya has embraced participatory forest management (PFM) as an approach towards achieving sustainable management. In this approach the local communities and other stakeholders participate in the management of forest resources as provided in the Forest Act, 2005 which recognizes the participation of communities in sustainable management and conservation as critical. The forest policy considers this engagement as essential to poverty reduction, employment creation and improvement of livelihoods. Therefore, the Marsabit forest adjacent communities need to be encouraged to form and register a community forest association (CFA) as a vehicle of enabling them to legally participate in all aspects of forest management that includes conservation, protection and utilization.

A policy on sustainable NTFPs harvesting and coordinated multi-sectoral interventions involving the forest, wildlife, energy and agricultural sectors is also required. Forest enrichment practices and setting up NTFPs harvesting levels and cycles have been introduced in various areas (Ndalangasi et al., 2006). Various opportunities exist in the Marsabit forest reserve and adjacent lands for enhancing livelihoods through forest based enterprises. This may include intensification of farm forestry for commercial production and sale of wood fuel, commercial honey production, ecotourism, commercial seedling production and tree/fruit farming, commercial insect farming e.g. apiculture, butterfly farming and sericulture. This will improve community livelihoods and create employment and income opportunities through use of forestry related products. It will however require massive awareness creation and capacity building to the local communities on how they can still create wealth without necessarily over utilizing the natural resources available

thus reducing pressure on the Marsabit forest reserve. A cost benefit analysis is however key in the whole process since it is a delicate tradeoff between ecology and socio-economic objectives.

5.2 Recommendations

The results provide a basis for improvement in the design and strategies of the management of the Marsabit forest reserve. For effective conservation and sustainable management of Marsabit forest, the following are recommended:

Clear regulations on the consumptive use of forest resource needs to be developed and disseminated to the local communities. Equally, harvesting of forest products should be allowed under the coordination and control of KFS, CFA and EMCs.

Further forest management decentralization under the participatory forest management arrangements is needed as well. This could be through a memorandum of Agreement (MOA) for the management of the forest reserve between KFS, KWS, local communities through CFA and county government of Marsabit is needed specifying the obligations of each party. The MOA should be entered in line with sections 36 (1) and 41 (3) of the Forest Act, 2005 and section 35 (3) of the Wildlife Conservation and Management Act, 2013.

Regulations and guidelines to allow livestock grazing during extreme droughts should be developed. However, in the mean time, proper identification and improvement of grazing pastures in the community land, provision of alternative water sources outside the forest reseve for the communities to meet their water deficit, and developing sound grazing guidelines would be instrumental in forestalling the forest degradation.

Alternative livelihood sources and incentives should be promoted to the forest adjacent communities especially by encouraging farm forestry and commercial production of other NTFPs through forest based enterprises for increased income and employment.

Further research studies recommended will include:

Studies on revenue sharing mechanisms through PES like REDD+ is needed. Provision of economic benefits remains one of the immediate and tangible benefits the community members should accrue from conservation efforts. These will advice in the development of sound policies that have potential for local communities to derive benefits from sustainable forest management.

A cost benefit analysis on the proposed livelihood options would be key since it's a delicate tradeoff between ecological and socio-economic objectives.

A value chain analysis of NTFPs would also be ideal for comparison purposes with the findings of this study. The approach should take into account environmental, socio-institutional and economic aspects to indicate the value. This would be critical in empowering actors in the chain and informing regulators, policy makers and development agencies to make sustainable interventions.

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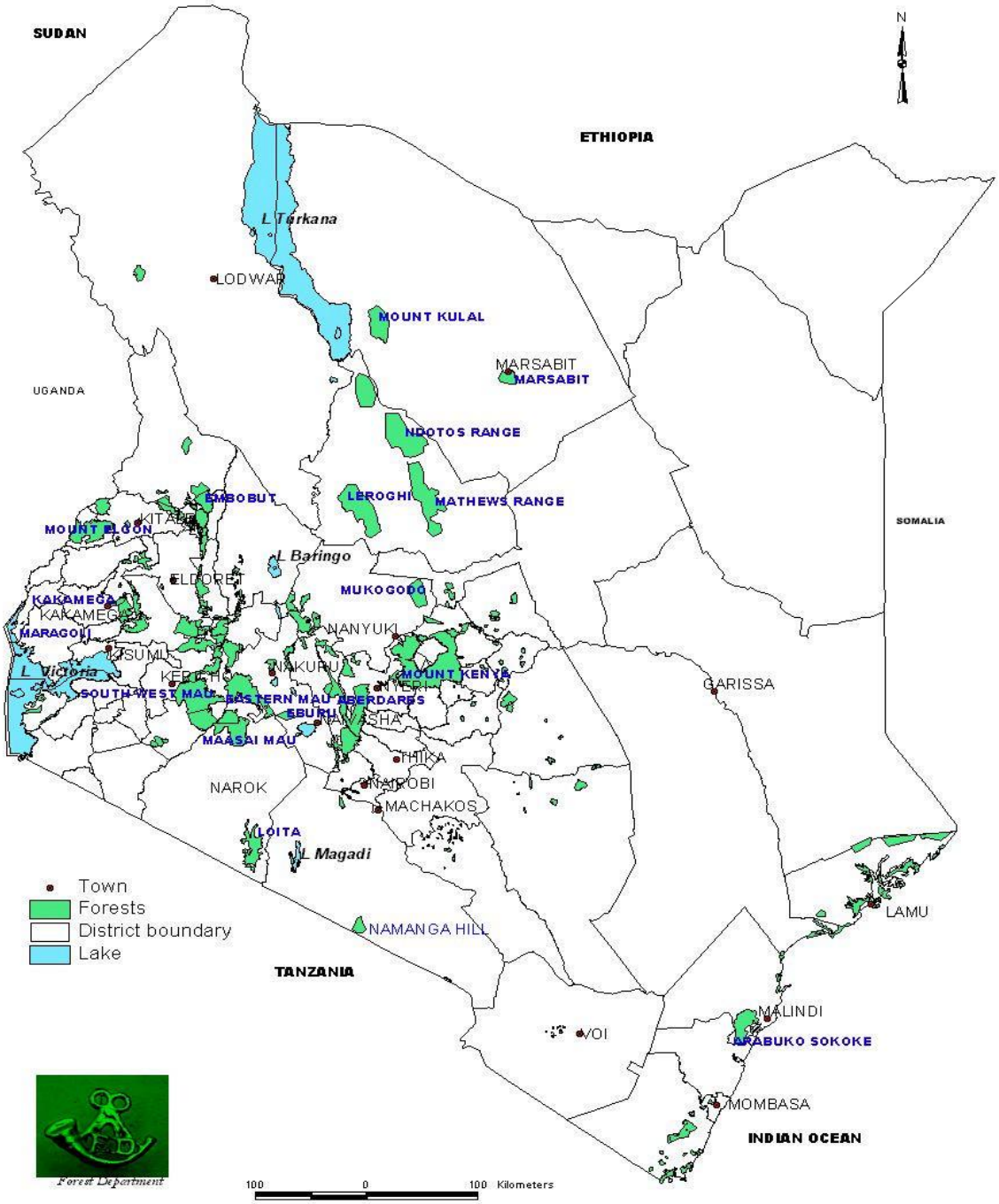
7.0 APPENDICES

APPENDICE 1: Forest blocks in Kenya



APPENDICE 2: Other legislations concerning forest conservation and management

Year	Legislation
1915	Government Lands Act. CAP 280 (revised, 1984)
1939	Trust Land Act. CAP 288, Laws of Kenya (revised 1970)
1957	Forest Policy (White Paper No.1 of 1957, revised as Sessional Paper No.1 of 1968)
1962	Forests Act. CAP 385, Laws of Kenya (revised 1982, 1992)
1963	Registered Land Act. CAP 300, Laws of Kenya
1963	Agriculture Act. CAP 318, Laws of Kenya
1963	Local Government Act. CAP 265, Laws of Kenya (revised 1998)
1967	Land Control Act. CAP 302, Laws of Kenya
1968	Land Adjudication Act. CAP 284, Laws of Kenya
1968	Land (Group Representatives) Act. CAP 287, Laws of Kenya
1968	Land Acquisition Act. CAP 295, Laws of Kenya
1975	Statement on the Future of Wildlife Management Policy in Kenya (Sessional Paper No. 3 of 1975)
1989	Fisheries Act. CAP 378, Laws of Kenya (revised 1991)

1999 Environmental Management and Co-ordination Act No. 8, Laws of Kenya

2002 Water Act. CAP 372, Laws of Kenya

2005 Forests Act. Number 7, Laws of Kenya

2005 Forest Policy (Sessional Paper No. 9 of 2005)

2005 Draft National Policy on Water Resources Management and Development (Sessional Paper No. 1 of 1999) Fisheries Policy

2009 National Land Policy (Sessional Paper No. 3 of 2009)

2009 Trustees (Perpetual Succession) Act. CAP 164, Laws of Kenya

2011 Draft Wildlife Policy

2013 Wildlife Conservation and management Act, 2013

APPENDICE 3: Useful plants from Marsabit Forest and the surrounding

Species (family)	**Local name**	**Habit**	**Uses**
Capparis tomentosa (**Capparaceae**)	*Ogora-galla* (Borana); *Leturdi* (Rendille)	S	Medicinal
Strychnos henningsii (**Loganiaceae**)	*Kara*(Borana); Nchipiliwa (Rendille)	T	Medicinal and fodder
Boscia angustifolia (**Capparaceae**)	*Lororoi* (Rendille)	S	Medicinal and fodder
Croton macrostachyus (**Euphorbiaceae**)	*Mokhof* (Borana); *Leberbeneyo* (Rendille)	T	Medicinal
Plumbago sp. (**Plumbaginaceae**)	*Lkirantus* (Rendille)	S	Medicinal and appetizer
*Trichilia emetica (**Meliaceae**)*	*Lperi* (Samburu); *Anona* (Borana)	T	Medicinal and dye
Berchemia discolor. (**Rhamnaceae**)	*Santaiti* (Samburu); *Jajab* (Borana)	S	Food/Fruit tree
Clerodendrum myricoides (**Verbenaceae**)	*Lmakutkuti* (Rendille); *Thatesa* (Borana)	S	Medicinal
Asparagus flagellaris (**Asparagaceae**)	*Argeg* (Rendille); *Sereti* (Borana)	S	Cultural and household stuff
Bauhinia tomentosa (**Fabaceae**)	*Lesholo* (Rendille); *Taphata* (Borana)	S	Fodder
Acacia brevispica (**Fabaceae**)	*Legirgir* (Rendille);	S	Medicinal

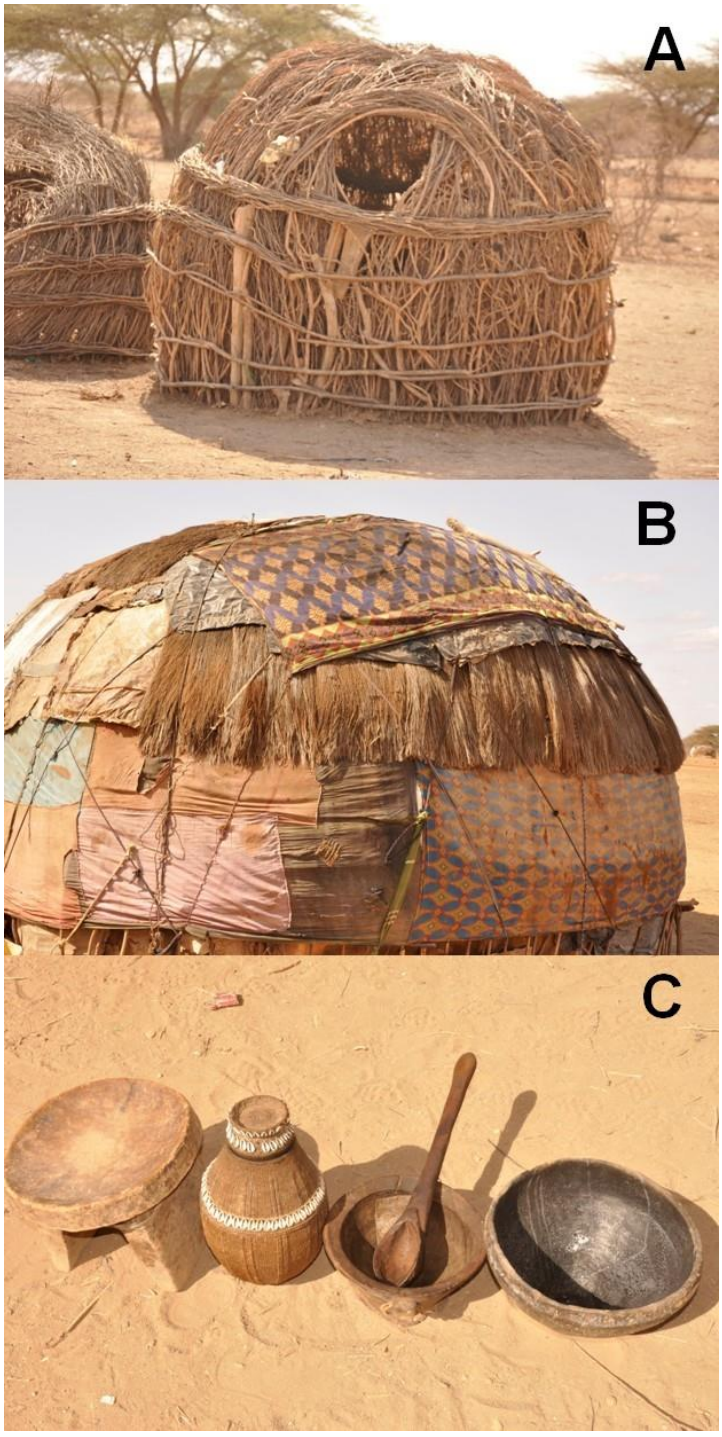
Species (family)	Local name	Habit	Uses
	Amares (Borana)		
Teclea hanangensis **(Rutaceae**)	*Lgiyai* (Rendille); *Mique* (Borana)	S	Medicinal
Olea europaea ssp. *africana* (**Oleaceae**)	*Ejer* (Rend/Borana); *Lng'eriyoi* (Samburu)	T	Medicinal, Fodder, Building, Firewood, Cultural, Food
Ochna insculpta (**Ochnaceae**)	*Ntheroni* 1 (Rendille); *Makhdhima* (Borana)	S	Building and fodder
Erythroxylum emarginatum (**Erythroxylaceae**)	*Ntheroni* 2 (Rendille)	S	Medicinal
Dovyalis abyssinica (**Flacourtiaceae**)	*Lmoron* (Rendille); Kuraa (Borana)	S	Food (Edible fruits) Farm implements (York for digging)
Cissus quadrangularis (**Vitaceae**)	*Lolonto* (Rendille); *Chopisodhi* (Borana)	C	Medicinal
Blepharis maderaspatensis (**Acanthaceae**)	*Sigit* (Samburu)	S	Fodder (main forage in the forest)
Clausena anisata	*Elmatasia* (Samburu); *Sissa* (Bor)	S	Dental hygiene, Cultural (circumcision) and furniture (Sleeping mat)
Harrisonia abyssinica (**Simaroubaceae**)	*Lasarmai* (Rend); *Qorre* (Borana)	S	Medicinal
Cyperus alternifolius L. (**Cyperaceae**)	*Eladhu* (Borana); *Hoss* (Rendille)	Sd	Cultural (circumcision)
Toddalia asiatica (L.) Lam. (**Rutaceae**)	*Laparmunyo* (Rendille); *Dagams* (Borana)	S	Medicinal and energy booster
Cadaba rotundifolia Forssk. (**Capparaceae**)	*Qadhu* (Gabra)	S	Fodder and making camel bells
Dobera glabra (**Salvadoraceae**)	*Garse* (Gabra)	S	Food and medicinal

Species (family)	**Local name**	**Habit**	**Uses**
Euphorbia tirucalli (**Euphorbiaceae**)	*Qursnamdima* (Gabra)	S	Cultural (prevention from evil eye)
Salvadora persica L. (**Salvadoraceae**)	*Adhei* (Gabra)	S	Fodder, dental hygiene, food (edible fruits)
Acacia mellifera (**Fabaceae**)	*Sabas* (Gabra)	T	Fodder, firewood
Blepharis sp. (**Acanthaceae**)	*Baratt* (Gabra)	S	Fodder
Cababa glandulosa (**Capparaceae**)	*Doqh* (Gabra)	S	Fodder
Cadaba sp. (**Capparaceae**)	*Qorqodha* (Gabra)	S	Fodder, cultural (evil eye) and smoking milk gourds
Cordia sinensis (**Boraginaceae**)	*Maderqotte* (Gabra)	T	Building, Furniture, Fodder; making camel saddle and Cultural (marriage)
Phyllanthus somalensis (**Euphorbiaceae**)	*Dirri (*Gabra*)*	S	Building; however very poisonous to camels
Acacia sp. (**Fabaceae**)	*Ltepe (*Samburu); *Kholia (*Rendille)	T	Medicinal
Barleria sp. (**Acanthaceae**)	*Sucha* (Rendille)	S	Cultural (marriage and evil eye)
Carissa edulis (Forssk.) (**Apocynaceae**)	*Lamurei* (Rendille)	T	Food (fruits edible) and medicinal
Solanum incanum (**Solanaceae**)	*Ntulelei* (Rendille)	S	Medicinal
Erythrina burttii (**Fabaceae**)	*Lngorochi* (Rendille)	T	Cultural (circumcision and prayers) and household stuff (gourds and troughs)
Ziziphus mucronata (**Rhamnaceae**)	*Lolayei* (Rendille)	S	Food (fruits edible), firewood and building
Bridelia taitensis (**Euphorbiaceae**)	*Nkereneyok* (Rendille)	S	Food (fruits edible), firewood, building and wood smoked to clean

Species (family)	Local name	Habit	Uses
			milk gourds
Cyphostemma sp. (**Vitaceae**)	*Rareiti* (Rendille)	C	Medicinal
Flueggea virosa (**Euphorbiaceae**)	*Lgiribuk* (Rendille)	S	Food (fruits edible), firewood, building
Sphaeranthus ukambensis (**Asteraceae**)	*Lekemaa* (Rendille)	S	Medicinal
Terminalia sp. (**Combretaceae**)	*Lbukoyi* (Rendille)	S	Medicinal
Grewia villosa (**Tiliaceae**)	*Lupupoyi* (Rendille)	S	Food (fruits edible) and medicinal
Ormocarpum trichocarpum (**Fabaceae**)	*Logoita* (Rendille)	S	Medicinal
Osyris lanceolata (**Santalaceae**)	*Losesiyai* (Rendille)	S	Medicinal
Combretum molle (**Combretaceae**)	*Lelmaroroyi* (Rendille)	S	Smoking the milk gourds (keeps the milk fresh)
Cenchrus ciliaris (**Poaceae**)	*Irikurme* (Rendille)	G	Fodder
Bothriochloa insculpta (**Poaceae**)	*Lkawa* (Rendille)	G	Fodder
Cynodon nlemfuensis (**Poaceae**)	*Larapasi* (Rendille)	G	Fodder
Glycine wightii (**Fabaceae**)	*Loyeti* (Rendille)	C	Fodder
Withania somnifera (**Solanaceae**)	*Lukuru* (Rendille)	S	Medicinal

Key: T = tree; S = shrub; Sd = sedge; G = grass; C = climber

APPENDICE 4: (A) is an animal pen for goats, (B) is a typical Gabra house and (C) is household stuff made from plants



APPENDICE 5

UNIVERSITY OF NAIROBI

SURVEY ON THE VALUE OF NTFPs TO THE FOREST ADJACENT COMMUNITIES OF MARSABIT FOREST RESERVE.

HOUSE HOLD SURVEY INSTRUMENT

CONSENT STATEMENT

(The following statement must be read to every respondent)

May I have a minute of your time?

Mr Steve Kamerino, a student at the University of Nairobi is conducting a study on Economic value of non-timber forest products to the communities adjacent Marsabit forest Reserve. The student would therefore like to obtain information from the communities living around the Marsabit forest like you. The information is being collected for academic purposes only and there are no personal benefits or risks to your participation.

The information you give will be treated with confidentiality and will not be shared to third parties. The interview takes approximately 45 minutes. You may terminate the interview at any

point if you do not wish to proceed. If you would like to know more about this study, please contact Mr Steve Kamerino at 0720 869 449.

Consent Granted: *YES: Proceed with interview*

NO: Thank the person and look for next respondent. You are required to keep this questionnaire whether the respondent agreed to participate or not.

SECTION A: QUESTIONNAIRE IDENTIFICATION

Item	**Name / Number**
Division Name	
Location Name	
Village Name	
Household Number	
Ward Name	
Constituency Name	
Sub county Name	
County Name	

Date of interview ……..

Name of interviewer …….

Questionnaire number……. Tel

no…….

Start time…….. End time……..

SECTION B: HOUSEHOLD CHARACTERISTICS INFORMATION

I would like to ask you some questions about yourself. This will help me understand why respondents' opinions may differ. ***Please be assured that your answers are anonymous and all information collected is confidential***

Interviewee Information **Question 1**				
Name of the respondent: (optional)				
Age of the respondent:				
How long have you lived in this area? (Years)				
Type of residence:	Temporary		Permanent	
Question 2 What is your gender (Tick as appropriate)?				
01. Male 02. Female				
Question 3 How many people live in your household, including yourself?				
Question 4 Level of education in years?				
01. Never went to school				

02. Primary	Years…….
03. Secondary	Years…….
04. Diploma	Years ……
05. Certificate	Years…….
06. University degree	Years……
07. Post-graduate degree	Years ……

Question 5

Are you a member of any conservation or social group (Tick the appropriate category?

01. Environmental organisation	
02. Tourism industry	
03. Agricultural industry	
04. Other (specify)…….	

Question 6 Economic Activities and Livelihoods

What are the main source of income (including subsistence)? (please rank from the most to least)

1= very important; 2=important; 3= intermediate (alternative); 4= least (last option)

01. Food crop farming	
02. Cash Crop farming	

03. Pastoralism (Livestock keeping)	
04. Charcoal burning	
05. NTFPs Harvesting	
06. Business	
07. Salaried employment	
08. Wages from manual or casual labour	
09. Timber logging	
10. Other (specify) ……..	
Question 7 What is the distance in km from your place of residence to the Marsabit Forest Reserve?	
Question 8 What is the distance in km from your place of residence to the nearest market (Marsabit town)?	

SECTION B: KNOWLEDGE OF THE MARSABIT FOREST ECOSYSTEM

I would like to know how familiar you are with the Marsabit Forest Ecosystem and the services it provides

Question 9: Do you or any of your family members visit the Marsabit Forest Reserve to extract the following goods/services?

Goods/service	Yes	No	If Yes, Frequency/Month (No. of trips undertaken)	Distance to the Forest Reserve		
Collect firewood						
Collect building materials						
Collect Medicinal products						
Fetch water for domestic consumption						
Tourism and or /researchers						
Cultural practices						
Honey harvesting						
Grazing livestock				No. cattle	No. shoats	No. donkeys

Question 10

a. In a scale of 1 to 5, do you agree that the Forest provides the following services to the community?

Fully disagree (1)		Disagree (2)	Don't know (3)	Agree (4)	Fully agree (5)
01. Climate regulation					
02. Water Provision & Rain attraction					
03. Dry season refuge (for both water, food and fodder)					

04. Tourism, Recreation, Research and Education					

Question 11. Think about the status of Marsabit forest reserve. Which box do you think best describes the condition of the forest reserve terms of degradation? (Please tick one box)	
01. Heavily degraded	
02. Somewhat degraded	
03. Good State	
04. Excellent state	

Question 12: What destructive utilization activities occur within Marsabit forest ecosystem?

1.

2.

3.

4.

5.

Question 13: Who is responsible for it? Local community….. Migrants from outside……..

Both……..

Question 14: Does culture influence sustainable utilization of forest resources? Yes No

If yes,

how……

……

SECTION C: NON TIMBER FOREST PRODUCT UTILIZATION

Question 15. **15a: Firewood Species : Rank as** 1= very important; 2=important; 3=intermediate (alternative); 4=least (last option)		
i. Are you aware of the specific firewood species that are harvested from Marsabit forest? (if yes, name them)	Yes	No
ii. Do you or any of your family members harvest, consume or trade firewood from Marsabit Forest? (If yes, name and rank them)	Yes	No

	Species (Rank)	Parts Used	Harvest	Consume	Trade (state the market)
	1.				
	2.				
	3.				
	4.				
	5.				
	6.				
	7.				
	8.				
iii.	How often do you harvest/ consume/trade in the firewood per month (days/month)?				
iv.	what is the average harvest /consumption/ traded amount per trip (kg/head lots)				
v.	How much (Kshs.) do you sell/buy the firewood species per kg/ head lot?				
vi.	How much time do you take to and from the harvest location?				
vii.	What season is the product mostly harvested/consumed/traded?		Apr May June	July Aug Sept	Oct Nov Dec
viii.	How much is harvested/consumed /sold		More	Same	Less

compared to the past?			
ix. Why?	Less available for harvest	less demand by buyers	Other (Specify)

Question 15. **15b: Plant Food species : Rank as** 1= very important; 2=important; 3=intermediate (alternative); 4=least (last option)				
i. Are you aware of the specific plant species used for food that are harvested from Marsabit forest? (if yes, name them)		Yes		No
ii. Do you or any of your family members harvest, consume or trade plant food products from Marsabit Forest? (If yes, name and rank them)		Yes		No
Species (Rank)	Parts Used	Harvest	Consume	Trade (state the market)
1.				
2.				

3.				
4.				
5.				
6.				
7.				
8.				
iii.	How often do you harvest/ consume/trade in the food species per month (days/month)?			
iv.	what is the average harvest /consumption/ traded amount per trip (kg/head lots)			
v.	How much (Kshs.) do you sell/buy the food species per kg?			
vi.	How much time do you take to and from the harvest location?			
vii.	What season is the product mostly harvested/consumed/traded?	Apr May June	July Aug Sept	Oct Nov Dec
viii.	How much is harvested/consumed /sold compared to the past?	More	Same	Less
ix.	Why?	Less available for	less demand by buyers	Other (Specify)

	harvest		

Question 15. **15c: Forage Species : Rank as** 1= very important; 2=important; 3=intermediate (alternative); 4=least (last option)				
i. Are you aware of the specific forage species used that are harvested from Marsabit forest? (if yes, name them)		Yes		No
ii. Do you or any of your family members harvest, consume or trade forage products from Marsabit Forest? (If yes, name and rank them)		Yes		No
Species (Rank)	Parts Used	Harvest	Consume	Trade (state the market)
1.				
2.				
3.				
4.				
5.				

6.				
7.				
8.				
iii.	How often do you harvest/ consume/trade in the forage species per month (days/month)?			
iv.	What is the average harvest /consumption/ traded amount per trip (kg)?			
v.	How much (Kshs.) do you sell/buy the forage species per kg?			
vi.	How much time do you take to and from the grazing location?			
vii.	What season is the product mostly harvested/consumed/traded?	Apr May June	July Aug Sept	Oct Nov Dec
viii.	How much is harvested/consumed /sold compared to the past?	More	Same	Less
ix.	Why?	Less available for harvest	less demand by buyers	Other (Specify)

Question 15. **15d : Medicinal species : Rank as** 1= very important; 2=important; 3=intermediate (alternative); 4=least (last option)				
i. Are you aware of the specific plant species of medicinal importance that are harvested from Marsabit forest? (if yes, name them)		Yes		No
ii. Do you or any of your family members harvest, consume or trade medicinal species from Marsabit Forest? (If yes, name and rank them)		Yes		No
Species (Rank)	Parts Used	Harvest	Consume	Trade (state the market)
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
iii. How often do you harvest/ consume/trade				

	in the medicinal species per month (days/month)?			
iv.	What is the average harvest /consumption/ traded amount per trip (kg)?			
v.	How much (Kshs.) do you sell/buy the medicinal species per kg/?			
vi.	How much time do you take to and from the harvest location?			
vii.	What season is the product mostly harvested/consumed/traded?	Apr May June	July Aug Sept	Oct Nov Dec
viii.	How much is harvested/consumed /sold compared to the past?	More	Same	Less
ix.	Why?	Less available for harvest	less demand by buyers	Other (Specify)

Question 15. **15e: Building species : Rank as** 1= very important; 2=important; 3=intermediate (alternative); 4=least	

(last option)				
i. Are you aware of the specific plant building species that are harvested from Marsabit forest? (if yes, name them)		Yes		No
ii. Do you or any of your family members harvest, consume or trade plant food from Marsabit Forest? (If yes, name and rank them)		Yes		No
Species (Rank)	Parts Used	Harvest	Consume	Trade (state the market)
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
iii. How often do you harvest/ consume/trade in the food species per month (days/month)?				
iv. What is the average harvest /consumption/				

	traded amount per trip (kg)?			
v.	How much (Kshs.) do you sell/buy the food species per kg/?			
vi.	How much time do you take to and from the harvest location?			
vii.	What season is the product mostly harvested/consumed/traded?	Apr May June	July Aug Sept	Oct Nov Dec
viii.	How much is harvested/consumed /sold compared to the past?	More	Same	Less
ix.	Why?	Less available for harvest	less demand by buyers	Other (Specify)

Question 16. **16a: Animal Products : Rank as** 1=Available; 2=Scarce; 3= Rare		
i. Are you aware of the Animal species products that are harvested from Marsabit forest? (if yes, name them)	Yes	No

ii. Do you or any of your family members harvest, consume or trade animal products from Marsabit Forest? (If yes, name and rank them)		Yes		No
Species Harvested (Rank)	Parts Used	Harvest	Consume	Trade (state the market)
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
iii. How often do you harvest/ consume/trade in the animal products per month (days/month)?				
iv. What is the average harvest /consumption/ traded amount per trip (kg)?				
v. How much (Kshs.) do you sell/buy the food species per kg/ head lot?				
vi. How much time do you take to and from				

	the harvest location?			
vii.	What season is the product mostly harvested/consumed/traded?	Apr May June	July Aug Sept	Oct Nov Dec
viii.	How much is harvested/consumed /sold compared to the past?	More	Same	Less
ix.	Why?	Less available for harvest	less demand by buyers	Other (Specify)
x.	Availability of the species products	Available	Scarce	Rare

Question 17: Honey

Source of honey(wild /traditional/ modern beehives)	Main tree species associated with bees	No. of bee hives	Location of the honey to the Forest Reserve	Quantity harvested (Kg/visit)	Frequency of harvest(days/month)	Method of harvest	Season of harvest	Uses of honey(Rank)	Is the product traded? (if yes, state the market)

1=food; 2=medicinal; 3=source of income; 4=cultural practices

Question 18: Are they any Cultural beliefs (values) that the community attaches to Marsabit Forest? Yes…… No…..

If yes, Specify.

Species (Local name/common name)	Belief

Question 19: Are they any Special products (e.g. soil, minerals, salt, dye, etc.) found within Marsabit Forest Reserve? Yes…….. No……, I don't Know…….. If yes, complete the table below;

Type of product	Location in the Forest Reserve	Usage	Quantity Harvested	Frequency of harvest	Season of harvest
1.					
2.					
3.					

Question 20: Are there any other uses of the Marsabit Forest Reserve that you are aware of?

……

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……

……

Question 21: Alternative Livelihood options

21 a) Have any alternative livelihood options/ strategies been introduced in the community?

Yes……. No ……..

Did they succeed? If yes, why?

.....

If No, why?

.....

21b) Is there difference in accepting alternative livelihood options among age groups?

If yes,

why.....

.....

If no,why?.....

21 c) Would you be willing to adopt alternative livelihood option strategies? Yes……

No……..

If yes, what alternative livelihood options would you be willing to participate in?

1.

2.

3.

4.

5.

22. Any other information that you would like to add?

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THANK YOU SO MUCH FOR YOUR TIME AND COOPERATION

APPENDICE 6: Work-plan

ACTIVITY\MON	**Jan**	**February**	**March**	**April**	**May**	**Jun**	**July**
Proposal Writing and Defense **(2015)**							
Data collection **(2015)**							
Organization and Data Analysis **(2015)**							
Thesis Writing and Submission **(2015)**							

APPENDICE 7: Budget

	ITEM	**Details**	**COST**
	Travel costs	Vehicles, fuel, Drivers, Escorts	200000
	Survey administration	Enumerators recruitment and trainings enumerators, pre-testing survey instruments, survey administration	50000
	Contingencies		25,000
	Grand Total		**275, 0000**