USE AND CONSERVATION OF WILD MEDICINAL FOOD PLANTS IN LOITA, NAROK COUNTY KENYA

KARIUKI, PERIS MWERU
MSC. ENV SC (KU)
BSC. ENV. SC (KU)

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This thesis on "***Use and Conservation of Wild Medicinal Food Plants in Loita, Narok County, Kenya"*** is my original work and has not been presented for any research leading to a degree award in any other University.

Signature _____ Date _____

KARIUKI, PERIS MWERU (A74/80825/2010)

Department of Land Resource Management and Agricultural Technology (LARMAT), Faculty of Agriculture, University of Nairobi, Kenya

APPROVAL

"This Thesis has been Submitted with our Approval as University Supervisors".

Signature _____ Date _____

Prof. JESSE THEURI NJOKA

Department of Land Resource Management and Agricultural Technology (LARMAT), Faculty of Agriculture, University of Nairobi, Kenya

Signature _____ Date _____

Dr. CATHERINE W. LUKHOBA

School of Biological Sciences, University of Nairobi

Signature _____ Date _____

Dr. CECILIA M. ONYANGO

Department of Crop Production and Plant Protection, Faculty of Agriculture, University of Nairobi

UNIVERSITY OF NAIROBI

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Registration Number: A74/80825/2010

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In loving memory of my parents Charles Kariuki Waweru and Mary Wangari.Kariuki.

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ABS	Access and Benefit sharing
CBD	Convention on Biological diversity
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
LCoEs	Loita Council of Elders
IK	Indigenous knowledge
ILK	Indigenous and Local knowledge
IPBES	Intergovernmental Platform on Biodiversity and Ecosystem Services
IUCN	International Union for Conservation of Nature
KEMRI	Kenya Medical Research Institute
KFS	Kenya Forest Service
KPDS	Kenya Population and Demographic Survey
KSh.	Currency abbreviation for the Kenya shilling
KSS	Kenya Soil Survey
KWG-MAPS	Kenya Working Group on Medicinal and Aromatic Plants Species
KWS	Kenya Wildlife Service
MAB	Man and Biosphere Reserve
MEA	Millennium Ecosystem Assessment
MEAs	Multilateral Environmental Agreements
MP	Medicinal Plants
MMPs	Multipurpose Medicinal Plants
NASSEP	National Sample Survey and Evaluation Programme
NTFPs	Non-Timber Forest Products
NMK	National Museums of Kenya
PCA	Principal Component analysis
THCP	Traditional Health Care Practice
THPs	Traditional Health Practitioners

WHO	World Health Organization
WHS	World Heritage Site
WMFPs	Wild Medicinal Food Plants

OPERATIONALIZATION OF WORDS

Indigenous knowledge: It refers to knowledge, innovations and practices of indigenous and local communities or society that is developed and adapted to changing environment's and passed down from generation to generation orally.

Land cover/use change: Distinct changes in land cover/use pattern over time due to anthropogenic or natural causes

Multi-purpose medicinal plants (MMPs): Medicinal plants species which have various uses including healthcare, food, fodder wood fuel and income generation. They are promoted for production on farm, focus on these plant species would contribute to biodiversity conservation, land rehabilitation and sustainable management and increase agricultural productivity.

National Sample Survey and Evaluation Programme (NASSEP): National Enumeration area as designated by the Central Bureau of Statistics (CBS) for the national census

Non timber forest products (NTFPs) Forest products of biological origin other than timber derived from natural forest or woodlands. They include food, forage, fodder, construction materials, medicines, dyes, tannins among others

Wild Medicinal Food Plant(s) (WMFP): Wild plants consumed or used for preventive, curative and nutritive purposes

Outside the forest: Area outside the boundaries of Loita Naimena Enkiyio Forest

Inside the forest: Loita Naimena Enkiyio Forest

ABSTRACT

Indigenous knowledge on wild plants in drylands is utilized by local communities in support of their livelihoods. Unsustainable use of wild plant resources and resultant loss of biodiversity and associated indigenous knowledge has been stated as the greatest threat to biodiversity conservation. This threat is attributed to habitat conversion/degradation and trade that have linked local systems with the global fraternity. This study was carried out to document indigenous knowledge, use and conservation of wild medicinal food plants in Loita Narok County, Kenya. The specific objectives were; i) document indigenous wild plant conservation practices ii) document wild medicinal food plants used by the Loita Maasai iii) assess density and population structure of selected wild medicinal food plants iv) characterize trade in wild medicinal food plants and v) propose future sustainability scenarios for wild medicinal food plant species. The study used a mixed methods research design. Open ended questionnaires were used to document wild medicinal plants and to characterize trade in medicinal food plants in Narok; for density and population structure of selected species, 40 plots nested in eight transects were used; while Landsat images were used to analyze land cover/use changes between the years 1990 and 2010. The data collected was triangulated with key informants interviews, focus group discussions and herbarium specimen data. Quantitative data collected was analyzed and presented using Microsoft excel spreadsheet while thematic and content analysis was used to analyze qualitative data. Thematic land cover ENVI5.0 was used for image classification and thematic change detection. In this study 202 plant species occurring in 141 genera and 66 families were documented as wild medicinal food plants in Loita. Indigenous knowledge on use of these species was passed on within this community through apprenticeship and traditional learning structures of the society (e.g. traditional ceremonies). Wild medicinal food plants were collected from habitats ranging from forest, grassland to bushland. There was differential use of wild medicinal food plants (WMFPs) in Loita depending on age and gender of plant users. Experts such as traditional health practitioners and herders

were more knowledgeable about fodder plants. Overall *Rhus natalensis* had the highest density 64.5. Two species had unique distributions- *Acacia nilotica* only found outside the forest while *Toddalia asiatica* was encountered within the forest. The population structure of selected wild medicinal food plant species had reverse J type curves suggesting healthy regeneration however, the species *M. africana, Osyris lanceolata* were rarely encountered. At least 106 species, mostly trees and shrubs of wild medicinal food plants were found on sale in the markets. *Myrsine africana* was scarce and *Osyris lanceolata* was illegally harvested in Loita and exported through Tanzania. The supply chain in medicinal food plants was short with one or two nodes harvester and retailer (trader). Between 1990 and 2010 the area under forest had decreased by 19.12%. Conversion of indigenous vegetation to farmland contributed more to loss of wild plants than household use and trade. The species *Zanthoxylum usambarense, Toddaliia asiatica, M. africana* and *O. lanceolata* are threatened by household use and overharvesting for trade. Urgent intervention is required for *O. lanceolata* which as the remaining population maybe depleted. Sustainable use of wild plants species and traditional lifestyle of Loita community has contributed to conservation of biodiversity in this landscape. With modernity, increased demand and changing livelihoods there is a decreasing trend of wild plant species. Indigenous land resource management strategies should be strengthened to develop people's values and positive attitude towards biodiversity conservation. There is need for integration of scientific and indigenous knowledge in use and conservation of plant biodiversity in adaptive management.

CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

Indigenous and local communities are dependent on natural resources especially plants for their welfare and survival. The natural environment has provided man with food, medicine, fodder and raw materials collected from the wild long before domestication. Intuitive indigenous knowledge was used guide on which resources, when and how to collect and process products. Today wild plants play a significant role in sustaining people's livelihoods through provision of food, medicine and income through commercialisation (Barirega, et al., 2012).

Over 80% of the population in sub-Saharan Africa depends wholly or partially on traditional medicine (WHO, 2002). In Kenya it is estimated that 20 - 30% of the population depends on traditional medicine as the only source of healthcare (Maundu et al., 2006). In many communities in eastern Africa preventive healthcare was common with no clear distinction between plants consumed as food and medicine. (Parker et al., 2007; Hamilton, 2004; Anywar et al., 2014; Onyango et al., 2014).

The practice of using wild medicinal food plants has persisted in some communities and is resurging where it had died (Fukushima et al., 2010; Feyssa, et al., 2011a). Wild plants are utilized at a subsistence level within households and also sold in markets to generate income (Petersen et al., 2012: Mc mullin et al., 2012). The trade

in wild medicinal plants has been on increased due to changing livelihoods, rural – urban migration, and scarcity of wild medicinal plants from traditional sources creating markets (Adeka et al., 2009; Muriuki et al., 2012). Indigenous plants with economic value can be a precursor to biodiversity conservation (Johns & Sthapit, 2004; Hamilton, 2004).

Land use change, habitat degradation and unsustainable harvesting practices have led to decrease in indigenous vegetation; while increased trade in wild species and commercialization of traditional medicine have significantly contributed to decline of some species in the wild (Maundu et al., 2006: Marshall, 1998). Species scarcity affects quality of life for local people whose livelihood relies on them for cultural significance, health, nutrition and income (Rukangira, 2004). The impacts of land use change and unregulated trade on wild plant diversity are unknown. Possible impacts resulting from decline of indigenous medicinal food plant species may include; loss of a source of income, employment opportunities for traditional health practitioners and traders and inaccessibility of a basic consumer good by households. The species decline may also cause economic losses to the country (Rukangira, 1998); and upset sociocultural life of people for whom these medicines have significant cultural meaning (Bukuluki et al., 2014). In drylands, use of diverse plants is important in cushioning local communities against impacts of climate variability while trade in indigenous plant species offers local communities alternative livelihoods thus increasing their resilience (Siri & Katrina, 2011).

Indigenous knowledge has played an important role in sustainable management of natural resources. Knowledge of habitats and species therein was important in designing management and utilization of habitats and ecosystems resulting in sustainable use (Msuya & Kidegesho, 2009).

Earlier work on wild medicinal food plants have mainly focused on ethnobotanical documentation, taxonomical, phytochemical and pharmacological analysis (Rukunga & Simons, 2006; Schmelzer & Gurib-Fakim, 2008; Maundu et al., 1999). Despite previous attempts at documentation and conservation there is concern over loss of Kenyan traditional medicinal knowledge and the biological resources (Kigen et.al, 2013). There is limited data on local use, trade and conservation status for wild medicinal food plants in dry lands. This study sought to fill gaps in knowledge on local use, trade, status of wild medicinal food plants to inform their conservation in Loita.

1.2 Problem Statement

Land in Loita division has been under communal tenure with semi-nomadic pastoralism as the main livelihood but it is currently in transition to sedentary agro-pastoral production system. This semi-nomadic pastoralism has supported conservation of indigenous wild species under communal ownership and management (Ongugo et al., 2011; Karanja et al., 2002). With increasing population and resultant demand for wild plant products, an impending land demarcation and

land use change threatens continued conservation of indigenous wild plant species in Loita.

Subsistence use of wild plant species in Kenya is unregulated however a permit is required to harvest and transport indigenous species products to markets. There is a growing trend in use of indigenous medicinal and food plant species as evidenced by diversity of species and number of traders in Kenyan markets (Muriuki et al., 2012;. Mcmullin et al., 2012). Few studies have focused on wild plant species use and their conservation status with a view to informing future management.

1.3 Justification for the Study

In Kenya there is limited data and information on local use, conservation and trade in indigenous wild medicinal food plants which constrains attempts in formulating policies (KWG-MAPS, 2002; Schmelzer et al., 2010). This study seeks to contribute towards this end. At the international level the Millennium Ecosystems Assessment (2005) report, recognized biodiversity conservation as important in addressing millennium development goals particularly; eradicating of poverty and health and environmental conservation. The same has been reiterated by the 2030 agenda for sustainable development goals (SDGs), which seek to end poverty, protect life on the planet and ensure prosperity for all. This study contributes to SDGs at the local level, particularly on the protection, restoration and promotion of sustainable use of

terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

1.4 Study Objectives

The overall objective was to document indigenous knowledge, use and conservation wild plants species in Loita to enhance conservation of biodiversity for sustainable human livelihoods in Loita, Narok County. The specific objectives were:

i) To establish indigenous knowledge associated with conservation and use of wild plants
ii) To identify wild medicinal food plants species used in Loita
iii) Assess density and population structure of selected wild medicinal food plants
iv) Characterize trade in wild medicinal food plants in Narok County
v) Develop future sustainability scenarios for wild medicinal food plants species in Loita

1.5 Research Questions

This research study sought to answer the following questions;

i) How significant is the use of wild medicinal foods plants in Loita?
ii) Are selected wild medicinal food plants in Loita under threat?
iii) Given the current trends, what are the likely future scenarios for indigenous wild medicinal food plants in Loita?

CHAPTER TWO: LITERATURE REVIEW

2.1 Indigenous Knowledge and Use of Wild Plants

Indigenous knowledge (IK) on plant use is influenced by the environment in which a community lives as they adapt to using what is available. Plant resources are utilized as individual plant species or vegetation communities (Thomas et al., 2009). This is especially the case for food plants as the floristic makeup contributes to selection of species (Achigan-Dako et al., 2011). Therefore knowledge and use of wild plants may vary within members of an ethnic group living at different eco-geographic regions. Indigenous knowledge on plant use is thus influenced by ecological, historical, cultural and socio-economic context of the population (Turreira-Garcia et al., 2015; Idohuo et al., 2014).

2.2 Use of Wild Medicinal Food Plants

Over time wild plants have been used as food, fodder and medicine for humans and livestock. Wild medicinal food plants also referred to as nutraceuticals or food-medicines. These are species with secondary compounds essential for body functioning and with therapeutic value in the body (Anywar et al., 2014; Feyssa et al., 2011b).

2.2.1 Overview of medicinal plants

Local communities utilize diverse food plants for their nutritional and medicinal value knowingly (Acipa et al., 2013; Bussman et al., 2006; Maundu et al.,; 2001;

Lockett et al., 2000). Analysis of nutritional composition of WMFPs species shows they contain significant amounts of nutraceuticals that boost immunity (Tairo et al., 2011; Kinyuru et al., 2012). Sometimes WMFPs consumed contain anti-nutritive factors which are toxic and may interfere with digestion and absorption of nutrients (Tairo et al., 2011). Traditionally the anti-nutritive factors are managed through washing, soaking, germination and cooking (Tairo et al., 2011; Parker et al. 2007). The Maasai community is not known to forage for food plants from the wild, this was a despised practice of the "Ntorobo" hunter gatherers (Were & Olenja, 1986) however, and they are avid users of medicinal foods.

Many traditional and rural societies rely heavily on edible wild plants for energy and micronutrients throughout the year, however their importance become more critical during periods of drought or civil unrest and knowledge of these species determines if individuals or families maintain their nutritional quality or become malnourished and succumb (Grivetti & Ogle, 2000). Among the Meru, Ibui (2007) reported that wild herbs sprung up quite easily after the rains before other crops mature supplementing farm crops. The Ng'kebootok Turkana use wild vegetables during the rainy season and fruits during the dry season (Maundu, 1994**).** In Ethiopia, wild edible fruits in East Shewa Zone of the Oromia National Regional State are available all year round thus they provide supplementary food and nutrition (Feyssa et al., 2011b).

The importance of wild medicinal and food plants like other Non-Timber Forest Products (NTFPs) are compatible with other forest production systems such as timber, recreation, wildlife management and pastoralism. Their production is therefore encouraged as part of intermediate intensity systems to meet both economic and biodiversity conservation needs (Belcher et al., 2005). Products of WMFPs are sold by local communities in informal markets as strategy to meet other household needs eke a livelihood. Besides species of WMFPs are also used for processing and preserving meat and milk amongst the Maasai in Kajiado and being rich in mineral and phytochemicals in addition to having microbial and antioxidant properties they are suitable as natural preservatives with more benefits (Onyango et al., 2014).

2.2.2 Plants medicinal and nutritional values

Bio-activity of wild nutraceutical plants species validates their use as medicinal foods and some species used as wild foods have antifungal and antibacterial properties (Parker et al., 2007; Anywar et al., 2014). In a review of chemical constituents and biological activities of the genus *Zanthoxylum*, Negil et al. (2011) reported they had larvicidal, anti-inflammatory, analgestic, antiviral and antifungal properties.

Wild plants are consumed as food medicine (Ojelel & Kakudidi, 2015) because of they are rich in micro-nutrients (Feyssa et al., 2011b) comprising of antioxidants

and anti-inflammatory compounds (Tufts et al., 2015). Medicinal and nutrient composition of selected plant species from literature are present antioxidants and anti-inflammatory potential (see table 2.1).

Table 2.1: Nutritional and medicinal values from literature

Species	**Plant Part**	**Nutritional value literature**	**Medicinal value Literature**	**References**
Acacia nilotica	Seeds	Fibre, fat, P., Vit. C. carotene, crude protein Mg & Se		Oyiye et al., 2009
	Stem	Mg, Ca, Fe. Cu, Zn		Onyango et al., 2014
Carissa spinarum	Fruits	Beta carotene, Vit. C. iron Zn, Se & Ca		Oyiye et al., 2009, Kipkemboi, 2009 Mhapatra et al., 2012.
	Roots		Anti-microbial activity Antiviral activity	Ngulde et al., 2012. Maobe et al., 2013, Tolo etal 2010.
Myrsine africana	Seeds	Mg. Ca Zn Cu, Fe Carbohydrates amino acids		Abhi et al., 2011 Onyango et al., 2014
Olea europaea ssp africana	Fruits	Mg Ca, Zn, Cu. and Fe		Onyango et al., 2014
	Leaf/ bark		Ant diarrheal properties	Amabeuko & Bamuamba 2010.
Osyris lanceolata	Stem bark & curing	Vit. C, Fe., Zn, Se and Ca		Oyiye et al., 2009
		Mg, Ca, Zn, Cu & Fe		Onyango et al., 2014
Rhus natalensis	Fruit	Beta carotene, Vit. C. Fe. Se. & Ca		Oyiye et al., 2009, Kipkemboi 2009
	Stem and root		Anti-noceptive activities	Kariuki et al., 2012.
Toddalia asiatica	Fruit eaten raw	Carbohydrates , protein Sugars iron , Na, K Mn., Zn	Anti larvicidal compounds	Gachathi 2007 Mhapatra et. al., 2012 Borah et al., 2010

Species	Plant Part	Nutritional value literature	Medicinal value Literature	References
	Stem bark & roots		Alkaloid, flavonoids saponins, steroid tannins & glycosides	Orwa et al., 2008. Gachathi, 2007 Praveena & Surivathanam, 2013.
Warburgia. ugandensis	Stem bark & roots	Mg, Ca , Cu, Fe & Zn	Anti- asthmatic properties	Onyango et al., 2014 Karani et al., 2013
Zanthoxylum usambarense	Leaves & stem		Traditional medicine	Kokwaro 2009; Dharani et al., 2010; Matu ,2013

2.3 Conservation of Wild Plants

In Kenya WMFPs are obtained from various sources including government forests, communal and private lands. Over 80% of Kenyan medicinal and aromatic plants are obtained from the drylands which have a higher relative availability of indigenous wild vegetation compared to the humid and sub-humid areas under intense cultivation. Wild populations of indigenous plant species continue to decline due to land use change, commercialization of traditional medicine and competing uses (Maundu et al., 2006; Marshall, 1998).

The demand for WMFPs products leads to unsustainable harvesting from the wild. Species with multiple uses have higher risk of depletion compared to those with a single use or no known use; probably because various plant parts are utilized for the different uses. For example species such as *Olea europaea* sub species *africana* and *Juniperus procera* in Loita were scarce in settled areas with only stumps recorded in some sites (Maundu et al., 2001).

Harvesting pressure impacts on different species is varied; a species with a narrow geographic distribution, is habitat specific and has small population is more likely to be overharvested compared to widely distributed species. Again, species resilience to harvesting pressure varies owing to its biology such as growth rate, reproductive system and life form (Schippman et al., 2006). Species that are habitat specific, slow growing and destructively harvested for the bark, roots or whole plant such as *P. africana* and *Warburgia salutaris* are most susceptible to overharvesting (Schippman et al., 2006). In addition species with cultural and economic significance risk overexploitation and population decline and hence should be given conservation priority (Hamilton, 2004).

Local use of plant species depends on availability, however for trade in the international market the stock volumes available and their quality are important factors to be considered while sourcing. In a study on resource assessment and quality variation of *O. lanceolata* in Tanzania Mwang'ingo et al. (2003) reported that some populations maybe uneconomical to harvest in terms of quality, quantity and transportation.

Adaptation strategies to shortage of indigenous wild plants by collectors and harvesters include going further distances to get the resource (Kiringe & Okello, 2005); traditional healers and housewives opt to grow them in home gardens or leave behind key species on-farm for use while land is cleared for cultivation (Feyssa et

al., 2011a) and in extreme cases when preferred species are not available, people result in use of substitutes and illegal harvesting.

Options for plant conservation are *in situ, in circa* and *ex situ* strategies. *In situ* conservation of medicinal plants may only sustain subsistence use through sustainable (Hamilton, 2004). Besides the need to conserve plants species in natural habitats (*in situ*) to retain the species genetic diversity and increase chances of survival (Rao & Kinhal, 2008). *In situ* conservation is however challenging; Cunningham and Mbenkum (1993). To avert this challenge ecosystem based approach to conservation are advocated for by the Convention on Biological Diversity (CBD) and used by Kenya Wildlife Service and the Kenya Forest Service (RoK, 2013; RoK 2014).

Ex situ conservation on the other hand involves conserving plants outside their natural habitats in gene banks and botanic gardens while *in circa* involves cultivation of the plants on farm. There are a number of challenges in domesticating wild medicinal plants. These are, lack of clear mechanisms for trade in indigenous species; slow growth rates and unfair competition in markets with products illegally obtained from the wild (Hamilton, 2004; Muriuki et.al, 2012). Successful attempts to propagate wild species with economic values have been reported in some studies (Jeruto et al., 2010, Kamondo et al., 2014, Nyamukuru et al., 2014; Raj. et al 2014.)

For effective domestication and production on farm their production must be low-cost and a better option than wild collection (Marshall, 1998) and this has slowed adoption (Muriuki et al., 2012). Herbaceous plants are easily propagated as they take a shorter time to grow compared to woody plants. Domestication protocols for some wild woody species may also not be readily available and for such species sustainable harvesting, agro-forestry and forest plantations are the proposed conservation options.

Multi-purpose medicinal plants (MMPs) of tree and shrub life forms provide a niche opportunity with multiple benefits (Lambert et al., 2005a). The choice of these MMPs is i) source of healthcare for rural and urban poor; ii) their management yields important environmental benefits and iii) in themselves they are an important component of biodiversity; iv) their collection and sale is critical to many rural households especially women v) they offer alternative employment and vi) information on source and volumes of supplies is generally unknown and incompatible with demand and effective use of these resources (Lambert et al., 2005b).

The global trade of medicinal and aromatic plants exceeds 30 billion dollars (US) per annum (Schippman et al., 2006). Thus cultivation of medicinal plants would ease cash requirements for subsistence farmers. However there is a preference by traditional health practitioners on using wild sourced medicinal plants with claims

that wild crafted medicinal plants are more potent than those cultivated. This is attributed to presence of secondary metabolites which plants need in their natural environments under particular conditions of stress and competition and which perhaps would not be expressed in monoculture conditions (Schippman et al., 2006). Active ingredients concentrations may also be lower in fast growing cultivated stock than wild stock due to slow growth rates besides being influenced by soil and environmental conditions (Schippman et al., 2006). However production for the industry requires standardization and encourages a narrow genetic range of material giving preference to cultivated materials over those that are wild crafted (Muriuki et al., 2012).

Land management and tenure systems in place promote or suppress *in-situ* conservation of biodiversity. Open access resource offers opportunities for people with limited resources (Belcher et al., 2005; Abtew et al., 2014) however one cannot exclude competitors thus there is a strong association between tenure and intensified management (Belcher et al., 2005). Most managed production for NTFPs undertaken on privately owned land or where producers have some recognized rights. While under communal ownership there can be increased pressure on wild plant resources due to unsustainable harvesting (North, 1990; Marshall, 1998; Schippman et al., 2006).

2.4 Trade in Wild Plant Species

Trade in indigenous wild species and their products allow indigenous and local communities in drylands to use their knowledge on plant resources to eke a livelihood. Urbanization has altered harvesting of wild products from being cultural and subsistence activities to an urban cash based informal economy (Petersen et al., 2012). Those involved along the chain earn a livelihood through utilization of their plant management skills. Indigenous wild plant species in Kenya such as aloes, gum Arabic, *Prunus africana*, *Centella asiatica*, *Ansellia africana* and *Cissus rotundifolia* have been exported to international markets for use in the cosmetic, aesthetic, food and pharmaceutical industries (Mathenge, 2000). Thus commercialization of indigenous wild plants provides an opportunity for adapting and expanding traditional coping mechanisms to climate and weather variabilities (Belcher et al., 2005; Abtew et al., 2014).

Globally, medicinal plants are estimated to be around 15.3 percent of flowering plants comprising of more than 70,000 plant species of which an estimated 3000 species are traded in Europe (Schippman et al., 2006). With increased incidence of terminal and non-communicable diseases demand for nutraceutical herbal remedies also marketed as natural products has increased worldwide (WHO, 2003; Schippman et al., 2006). This has opened up to rural communities diversified livelihood options at local level with an estimated trade volume of over six billion US dollars worldwide (Cunningham et al., 2004). At the regional level there is a

large inter-African trade which is sometimes illegal and outside the international controls because of the porous borders (Kamondo et al., 2014; Sharrock et al., 2014).

In Kenya statistics on volumes and values of trade are sketchy however there are records of legally exported species such as *P. africana* and *Centella asiatica* (KWG-MAPS, 2002). Trade in medicinal plants occurs in urban centres where street vendors operate daily or on market days (Muriuki et al., 2012; Waiganjo, 2013). The plant products available on sale vary between traders and markets; a survey on medicinal plants traded in major towns in Kenya (Kariuki &Kibet, 2007; Marshall, 1998). On significance of traditional foods to urban dwellers, only about 10% of traditional food plants species consumed by rural household's in Kenya get to the markets (Adeka et al., 2009).

The demand for certain species at the international level may pose a threat to their continued conservation and deny local communities their valued resource (Larsen, 2010). Unsustainable exploitation of medicinal plants is accelerated by harvesting for commercial purposes rather than household use (Hamilton, 2004; Bharucha & Pretty, 2010; Barirega et al., 2012). Trade in wild species is informal and unclear at the national level; with no guiding policy on wild plant exploitation and there are gaps on trade of wild medicinal and foods plants in Narok County.

2.5 Sustainability of Using Wild Plant Species

Conservation outcomes are context specific and are shaped by histories of a place (Galvin et al., 2015). According to the Boserup theory (1965) as population grows, land and other natural resources become scarce relative to labor and access to market. This leads to intensification of land use which in a pastoral economy, means adding cultivated agriculture to the livestock-based livelihood and this process induces institutional changes that promote innovations and private property rights. Land use change from pastoral to agricultural cultivation normally leads to reduction of biodiversity as cultivated ecosystems are mono-crops especially under intensive farming. However cases have been reported where a few key perceived important species are left on-farm in the process of domestication.

Policy regimes influence conservation approaches using economic tools such as incentives or disincentives (Chavez, 2014). Policy changes, for instance, the ban on sale of *O. lanceolata* halted the rate at which this species was being harvested and traded unsustainably and illegally in 2007 though illegal trade is difficult to control across porous international borders. Policies that would make access to wild plant materials difficult can stimulate domestication on farm and reduce pressure on wild species through cultivation (Muriuki et al., 2012; Hamilton, 2012). At the international level however strict policies may lead to collapse of trade as companies opt to obtain supplies from other countries where the rules are less stringent: for example when a ban in trade in *Pelagornium sidoides* was imposed in Eastern Cape

Province in South Africa importers moved to Lesotho where they obtained their supplies (Van Nierek, 2009).The national government policy on compulsory and free primary education in Kenya will interfere with extensive cultural ceremonies including the warrior hood period. This in Loita may gradually break transmission of indigenous knowledge and trigger change in attitude towards cultural activities, beliefs and traditional institutions.

Sustainability, in conservation of wild plant species is complex and dependent on many interacting factors which influence the outcome either positively or negatively. Sustainability has four components that need to be integrated first ecological to maintain the composition and processes of natural forest; secondly social to satisfy the socio-cultural and livelihood needs of all stakeholders; thirdly economic to provide direct and indirect benefits the resource can offer within ecological and social constraints and finally policy, to develop a framework which will enable legal management of the resources through relevant institutional structures (Geldenhuys, 2011).

Plants play a keystone role in ecosystems and economies. An ecosystem based approach to conservation is needed to halt species decline resulting from ecological degradation linked to plant cover on land (Hamilton et al., 2012). According to the Millennium Ecosystem Assessment (MEA, 2005) report, local species losses are estimated as a function of the transformation of native habitats into other categories

such as several agricultural or urban patches under four global scenarios (MEA, 2005).

2.6 Policies on Indigenous Knowledge and Biodiversity Conservation

At the international level issues of biodiversity i.e. conservation, sustainable use, and access and benefit sharing addressed under the Convention on Biological Diversity (CBD) (United Nations, 1992). The Nagoya Protocol on access and benefit sharing (ABS) (Nagoya Protocol, Article 9(3) (a) recognized the role indigenous and local communities in biodiversity and the associated knowledge (CBD, 2011). It is domesticated in Kenya through the Protection of Traditional Knowledge and Cultural Expressions Act (RoK, 2016).

The CITES convention is meant to ensure that trade does not endanger survival of populations in the wild (Mc Gough et al., 2004). It addresses species that are of conservation concern at the international level. Specifically trade in wild species threatened by international trade are regulated by CITES Convention (CITES) with species such as *Aloes*, *P. africana, Eurphobias* and *O. lanceolata* already listed in Appendix II. Post-colonial era Kenya there has been no specific policy focusing on use and trade of wild plants or for wild medicinal and food plants. However their use was retained as cultural practice promoted through heritage institutions while use of conventional medicine and introduced exotic food crops were promoted in the place of indigenous foods and development of traditional medicine.

In situ conservation of indigenous plants is managed by Kenya Forest Service under the Forest Act (RoK, 2016) guided by the Forest Policy (RoK, 2014) and the Wildlife Conservation and Management Act (RoK, 2013). However for species under threat specific measures are undertaken such as the Aloe species; there was gazettement of Wildlife Conservation and Management Regulations 2007 (LN.403) (Lubia et al., 2008) and a presidential ban harvesting and trade of *O. lanceolata* in 2007 now listed on CITES Appendix II (CoP PROP 69:2013) controlling international trade on this species in East Africa. Thus management policies in Kenya regarding commercial trade and exploitation of wild plant resources have been reactive other than proactive.

The persistence of the practice of traditional medicine was sustained through research and external intervention among them the Convention on Biological diversity (CBD) and declaration of the decade on African traditional medicine 2001-2010 by the African Union (AU). There have been various attempts in Kenya to develop policies on wild plants for example those with medicinal and aromatic value, wild foods and fiber in Kenya such as: the Draft Medicinal Plants and Traditional Medicines Policy (2009), the Draft Emerging Crops Policy (2010) and the Draft Natural Products Policy (2012). Limited data and information on popularity, conservation status and trade in medicinal and food plants which constrains attempts in formulating policy (KWGMAPS, 2002; Schmelzer et al., 2010) which this study sought to contribute towards.

In recognition of their role two policies have been developed; including the Draft Traditional Medicine and Medicinal Plants Policy (2009) which sought to regulate the conservation and commercialization of mainly plant based medicinal and aromatic plants as well as food while the draft Natural Products Policy (2012) seeks to lay down legal framework to tap indigenous knowledge and biodiversity for economic development in Kenya.

The Ministry of Agriculture on recognizing indigenous plants whose potential is underexploited and which they perceive can increase the quality and quantity of useful products has developed the draft National Emerging Crops Policy (2012). In this policy some indigenous wild species such as *Mondia whitei*, *Prunus africana* and *Ocimum kilimanjaricum* are listed as medicinal plants while *Sclerocarya birrea*, *Rubus* species and *Physalis peruviana* are listed as fruits while *O. lanceolata* is listed under other uses.

These draft policies have limited information on wild plant status and usage and most of the policies are under review to align them with Vision 2030 (RoK, 2007) and the the Constitution of Kenya 2010 (RoK, 2010); revision of these policies will require information on conservation status and trade which this study sought to contribute. The Constitution of Kenya 2010 Article 11 recognizes "Culture as the foundation of the nation and the cumulative civilization of the Kenyan people and Nation" indigenous knowledge on medicinal food plants are part of the national

heritage and this study contributes to its documentation. Further, conservation will help Kenya in realization of its National Development Plan envisaged in Vision 2030 under the social pillar on environmental conservation (RoK, 2007).

2.7 Ecology and distribution of selected wild medicinal food plants (WMFPs)

2.7.1. *Acacia nilotica*, local name (**Olkiroriti**) (figure 2.1a) is in the family Leguminosae and subfamily Mimosoideae (L.). Willd. ex Delile is small tree 2.5-14 m tall with spreading branches with a flat or rounded spreading crown. Altitude range 1 - 2300 m and flowers January to September (Beentje, 1994). Widely distributed in Kenya in Acacia woodland and wooded grasslands. *A. nilotica* germinates following rainfall in the wet season, germination is aided when seeds are disturbed by fire or pass through the digestive systems of animals according to Raj et al. (2015).

Acacia nilotica

Carissa spinarum

Myrsine africana

Olea europaea ssp africana

Osyris lanceolata

Rhus natalensis

Figure 2.1a: Photographs of selected WMFPs species

Todallia asiatica

Warburgia ugandensis

Zanthoxylum usambarense

Figure 2.1b: Photographs of selected WMFPs species

2.7.2 *Carissa spinarum* synonym *C. edulis* (Forssk.) Vahl local name (**Olamuriaki**) (Figure 2.1a) is in the family Apocynaceae. It's a shrub occasionally scrambling 1 - 6 m with grey bark and simple spines, flowers are white inside and pink to red outside in dense cymes while the fruit is red to black round or ellipsoid sometimes with a sharp apex (Beentje, 1994). In Kenya it's distributed in all the seven floral regions (K 1 – K 7) altitude 1 - 2550 m and is widespread in bushland and dry forest edges. It flowers from January to December and occurs on forest edges, bushland thickets or bushed grassland especially on rocky areas according to Beentje (1994). It tolerates most soils including black cotton soils.

2.7.3 *Myrsine africana* L. (Figure 2.1a) is in the family Myrsinaceae. Local name (**Seketeti**) and common names are Cape myrtle and African boxwood. It is a slow growing shrub upright leafy shrub 1.2-2 m, an undershrub with branches grey, brown to purple, flowers clusters amongst leaves and are greenish white to pink with crimson anthers in male flowers and the fruit globose about 5 mm dark purple to black in color (Beentje, 1994). It is widely distributed in Kenya, it is found in all the floral regions K 1-K 7 between 1500 – 3000 m (Beentje, 1994).

2.7.4 *Olea europaea* sub species *africana* local name (**Olorien**) is a tree growing to a height of up to 15 m and has a rounded crown and grey-green foliage with a bark grey to dark brown. In Kenya, it is found in inland highlands areas and is common in *Olea Juniperus-Podocarpus* forest and forest margins between 250-2500 m

altitudes (Maundu & Tengnas, 2005). The tree coppices successfully and can produce root suckers and regenerates after lopping or heavy browsing (Dharani et al., 2010).

2.7.5 Osyris lanceolata: Local name (**Olosesiai**) and common name is East African sandalwood. *O. lanceolata* is a dioecious, semi-parasitic slow growing shrub/small tree growing to a height of around 6 m. It's a multi-stemmed evergreen and hemi-parasitic. It is found growing along rocky sites, forest edges in dry forests. It is frost and drought tolerant. Its native distribution is Kenya, Tanzania and South-Africa and occurs in a variety of climatic conditions and soil characteristics in arid and semi-arid areas and is associated with rocky sites (Mwangingo et al., 2003). The species is slow growing and the national level this species has a problem establishing even under cultivation situations

2.7.6 *Rhus natalensis* Krauss local name (**Oloimisigiyoi)** in the family Anacardiaceae. Is a multi-branched tree sometimes tending to scramble up to 8 m in height and is monoecious. Bark dark grey often almost white. Flowers green-yellow with tiny flowers in loose heads fruits are oblong to bean-shaped 5-6 mm in diameter (Maundu & Tengnas, 2005). In Kenya it is widespread in wooded savanna beside rivers and in evergreen bushland and woodland and forest edges often on well drained slopes 0 – 3000 m altitude and annual rainfall of between 100-1400 mm (Beentje, 1994).

2.7.7 *Toddalia asiatica* (L.) Lam. Local name (**Ole parmunyo**)is a climbing liana or shrub 2 – 15 m the lower stem has spines on corky pyramids; branches and often under sides of leaves with hooked pricklets to 5 mm. leaflets elliptic or slightly obovate ,base cuneate apex, obtusely acuminate,3 - 8 by 1 - 3 mm long fruit orange, round 7-10 mm (Beentje, 1994). It is found in all floral regions K1 - K7 between 1 – 1450 m growing on (riverine) forest margins or secondary re growth: in the Mara and Shimba hills also in grasslands thickets (Beentje, 1994: Nabwami et al., 2007)). *T. asiatica* produces a lot of seeds it can grow in varied soils of sandy clay loam texture Nabwami et al. (2007) reported that young seedlings were rarely encountered in the natural habitat in Nsuki, Bugiri and Mabira in Uganda.

2.7.8 *Warburgia ugandensis* Sprague local name (**Osokonoi)**: A tree 4.5 - 30 m evergreen crown rounded bark smooth or scaly flowers yellow –green fruit when young ellipsoid when ripe purplish and sub globous upto 3 cm. Found occurring in dry upland forests and *Acacia xanthophloea* woodland termite hills or wooded grassland K3, K4, K5 and K6. It is widely distributed in lower and drier highland forest between 1-2000 m (Maundu & Tengnas, 2005). It is rare in Nairobi due to over-exploitation (Beentje, 1994). A widely distributed tree in lower and drier highland forests areas of East Africa, 1-2000 m. Grows well in Nairobi and in the Kakamega forest. Prefers the Kakamega, Nairobi and Limuru type of climates (Katende, 1995)).

2.7.9 *Zanthoxylum usambarense* (Engl.) Kokwaroand local name (**Oloisuki**) belongs to the Rutaceae family: A tree between 2.5 - 15 m tall with a forwarded brown and corked bark. Flowers are white or yellow and the fruits reddish. It grows at an altitude 1400 – 2500 m common at about 2000 m. More common in highlands, especially in dry forests or bushed grassland in Narok, Kiambu, Kericho, Samburu (Maundu, 1999). *Z. usambarense* seeds are recalcitrant and should be sown immediately (Dharani et al., 2010).

2.8 Conceptual Framework

The conceptual framework (Fig. 2.2) illustrates how various factors influence population dynamics of wild plants at different spatial and time scales. Factors that influence natural plant species distribution that are independent of anthropogenic activities include abiotic and ecological parameters of soil, precipitation, altitude, location on the earth's surface; other factors such as climate change and natural disturbances like wild fires, flooding or invasive species may also influence the dynamics. These factors combined have influenced the natural species distribution, abundance and structure of ecosystems.

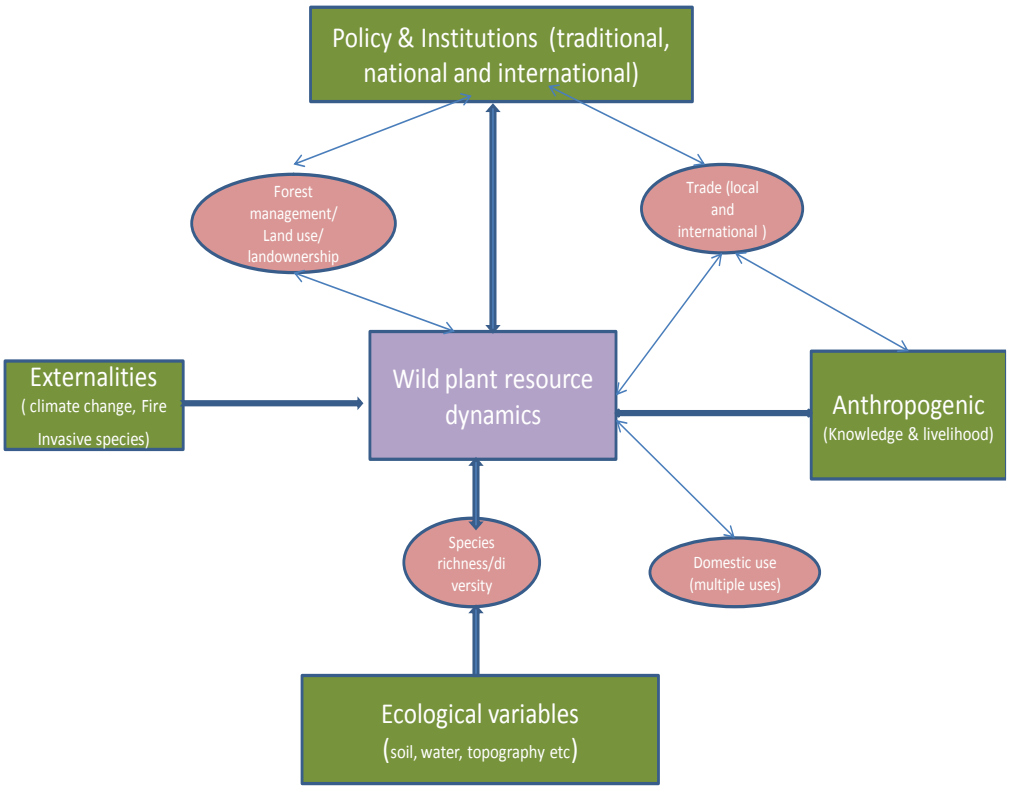


Figure 2.2: Conceptual framework on wild plant resource dynamics

Man from time in memorial has utilised plant resources for various purposes but subsistence use has less negative impacts compared to trade and land use change/habitat loss which are major threats to existence of wild species (Hamilton, 2004). However other livelihood activities such as cultivation and construction of modern structures and with increase in population even earlier sustainable activities like firewood collection are reported to lead to scarcity of species in an area, for instance use of *Olea europaea* ssp *africana* by Maasai women as the most preferred species for firewood (Maundu et al., 2001). Species with multiple purposes or are

highly preferred for a popular use also tend to get decimated from overuse as compared to the less preferred or those with no known use. Policy can be at either international or national levels or by local traditional institutions. In Loita, Loita Council of Elders (LCoE) makes decisions on use and access to forest resources through the Oloibon (Maundu et al., 2001;Karanja et al., 2002); it has a great influence in terms of designation of settlement area and communal sites for cultural activities as all land in the division is under communal ownership.

CHAPTER THREE: STUDY AREA, MATERIALS AND METHODS

3.1 Study Area

3.1.1 Geographical location

Loita - Narok South Sub-County is situated 320km south of Nairobi towards the Kenya-Tanzania border. It covers an area of approximately 1718km². It is located at an elevation of 2000-2600 meters above sea level. On the East it borders Nguruman escarpment which drops steeply from 3000 to 5000 feet to the Rift valley floor towards the Kajiado boundary and on the west are the hills and valleys which lead to the Mara fly area. On the North are the Loita plains while to the south-west is the Tanzania border (Figure 3.1).

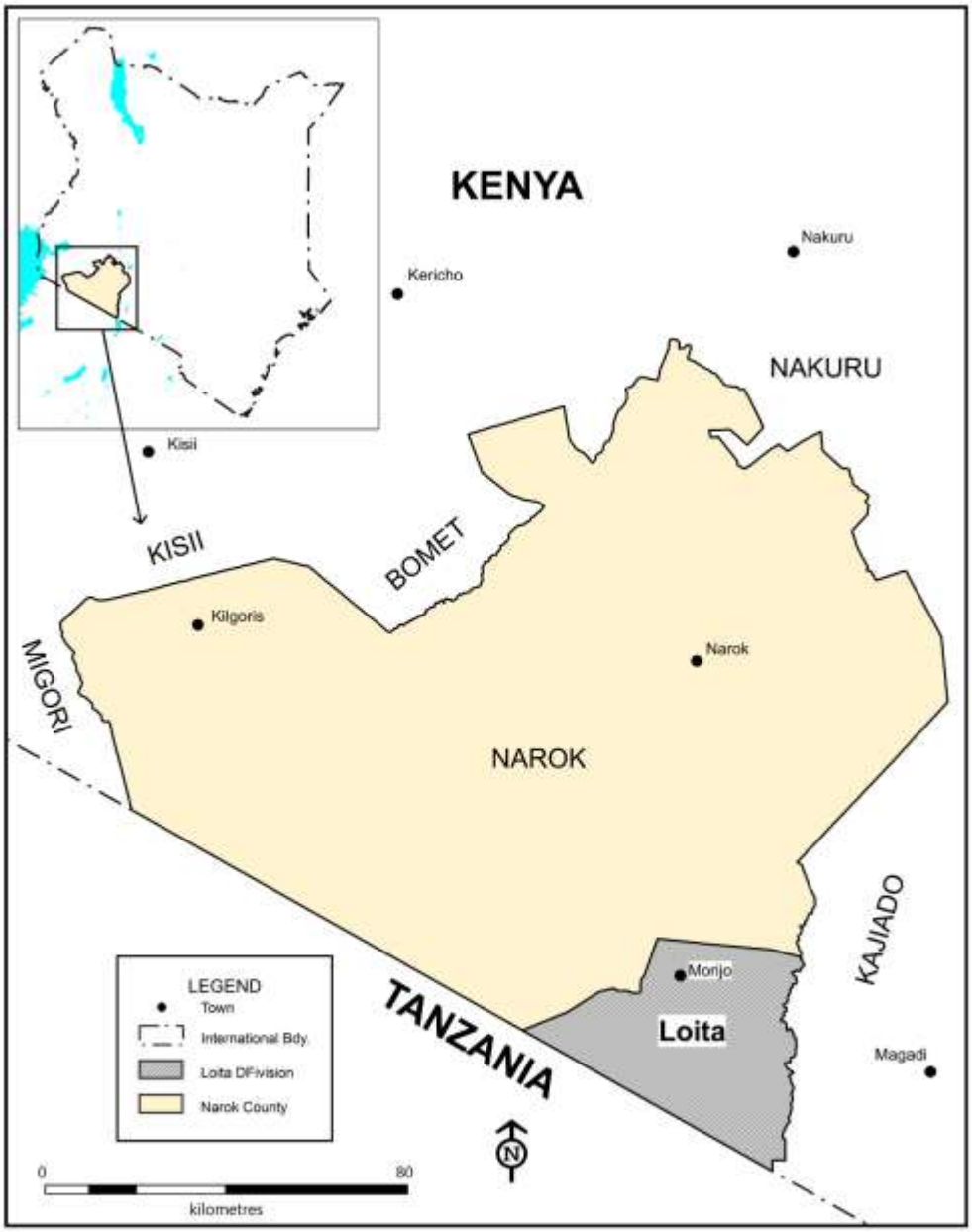


Figure 3.1: Map showing Loita Ward, Narok County (inset- map of Kenya)

3.1.2 **Climate**

Loita has a unimodal rainfall pattern. Rains occur from November to May, with April to May being the wettest months while June to October are the driest months with an average of 24 mm per month. The mean annual rainfall ranges between 600 -700 mm per year in the lowland plains and rises progressively to 1200 -1300 mm in the Loita Hills forest which is wettest part of Loita division. There is high variation and low reliability of rainfall in the plains compared to the forested area. Temperatures vary from 14 -17.4^0 C in Loita forest and 17.5-19.9^0 C in the Loita plains, evapo-transpiration rate is estimated at 1800 mm (Karenhed & Odult, 1998).

3.1.3 Soils and vegetation of Loita Division

Three types of soils dominate Loita; the soils on hills and minor scraps developed on quartize Lithosols which are generally shallow and acidic with moderate fertility. They are excessively drained shallow dark brown very friable rocky stony sandy clay loams with occasional outcrops in the environs of Entasekera, Olorte and Olemesutye (Musyoka, 1999). Under the forest dark loams have developed although in many places they are thin and have been eroded exposing the red horizons. Red or sandy loam is predominant soils in the lower forest regions. Soils in the middle level uplands developed on quartizes which are well drained, very deep dark reddish brown friable to firm, sandy to clay with humic topsoil stretching from Entasekera towards Naikara border (Fig. 3.2). On the upland plains are planosoils and vertisols. Planosols are imperfectly drained moderately deep to deep dark brown to grey firm

sandy clay to clay soils on straight or convex slopes (Jaetzold and Schmidt, 1983). The vertisols are imperfectly drained deep dark greyish brown to black firm to very firm cracking with calcerous and sordic subsoil. These soils are of moderate fertility and stretch from Olngarua through Morijo to Ilkerin areas stretching to the Kenya-Tanzanian border.

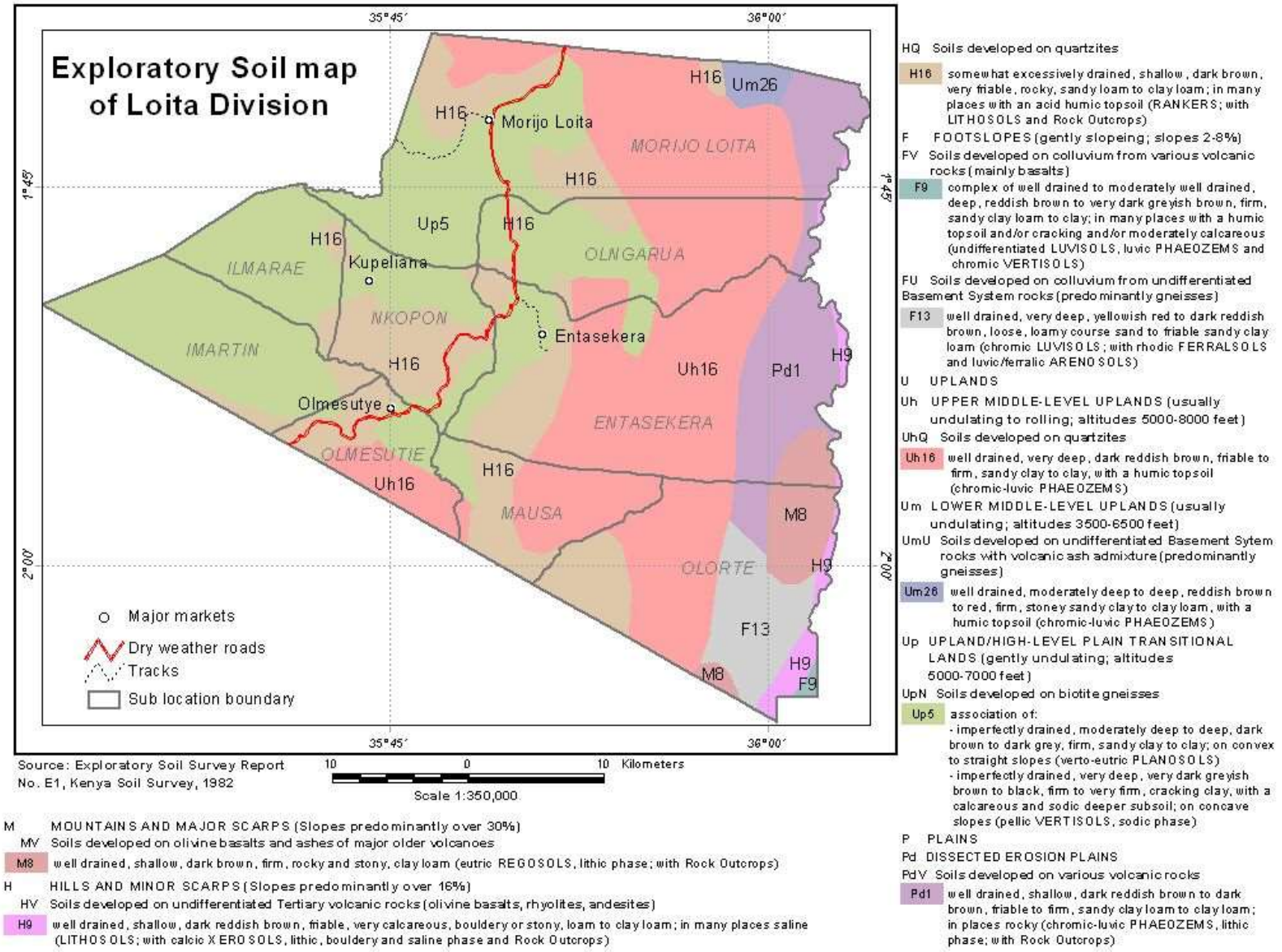


Figure 3.2: An Exploratory Soil Map of Loita Division

Source: Kenya Soil Survey (Africover Data, 2000)

Loita can be subdivided into three main ecological zones; the upland dry forest with glades and wetlands, an ever-green bush land and extensive savanna grasslands (Fig. 3.3). The forest zone is on the north eastern to south eastern direction of the division. Bushland ecological zone lies in the central part of the division running from the northern direction downwards Kenya-Tanzania border. The grassland area is on the western direction of the division extending from the Kenya –Tanzania to Ilkerin hills; open grasslands consist mainly of grasses *Themenda triandra* as the main undergrowth with annual and perennial short species with *Acacia derpanolobium* as the dominant species (Maundu et al., 2001).

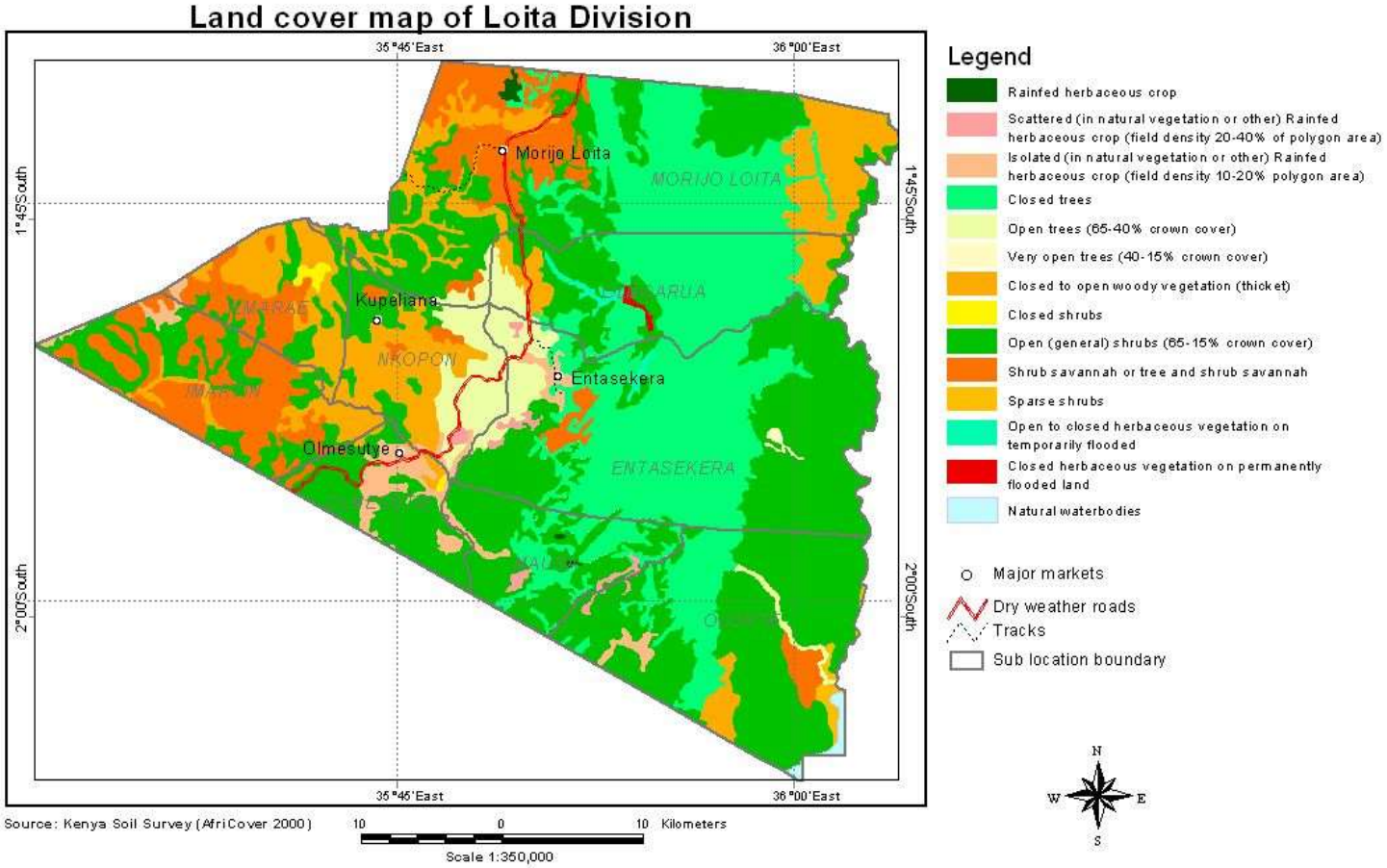


Figure 3.3: Map of the vegetation/ land cover of Loita, Narok County

Loita is a dry upland forest, within which three broad categories of plant communities can be identified: Afromontane dry conifer forest dominated by *Juniperus procera;* mid upland semi deciduous forest and mixed species low upland forest dominated by *Podocarpus latifolius, Olea capensis, Pevetta sp, Juniperus procera, Zanthoxylum usambarense, Diospyros abyssinica, Teclea nobilis* and *Warburgia ugandensis.* The closed canopy forest is intercepted by glades with grasses such as *Aristida* sp*, Sentara* sp*, Chloris gayana, Bothriochola insulpta, Cynodon dactlydon, Digitaria* spp *and Eraggrostris* species (Kiyiapi, 1999). The Eastern and Western parts of Loita forest was formerly under Cedar forests but due to grazing pressure and logging is giving way to secondary dense bush lands *Tarconathus camphoratus* with little grass cover of less than 30% and relics of stumps and aging cedar trees within the forest (Mwichabe, 1986).

Loita forest supports large mammals such as elephants and buffalos; it is rich in bird life and it's an important habitat for endangered species such as grey headed shrikes, hunter's Cisticola and primates including *baboons, Vervet monkey's, Colobus monkeys, Sykes* (Kiyiapi, 1999). Grasslands are home to ungulates like wildebeest, impalas and gazelles. It is a critical refuge area for wildlife from Maasai Mara game reserve and Ngorongoro Conservation area. This forest is a main water catchment for the region. Permanent rivers originating from the forest include Kanunka River draining towards Ewaso Nyiro, Olkejoarus, Olpus Are and Enkare Nanyoike

streams flowing southwards towards Lake Natron in Tanzania. Despite its biodiversity and ecological importance Loita forest is experiencing pressure from timber logging and settlement within the forest, a situation attributed to changing lifestyles and development resulting in changes in forest structure and species composition. (Karanja et al., 2002; Ongugo et al., 2011).

3.1.4 Anthropological and cultural background

The Maasai are a Nilo-Hamitic people divided into social territorial sections known as *Iloshon* (territory). Each *Olosho* (area) is occupied by a Maasai sub-tribe, and each sub-tribe is further divided into clans. There are at least 20 sub-tribes of Maasai straddling both Kenya and Tanzania. The Loita Maasai is one of the sub-tribes that occupy the southern parts of Narok County on Kenya and northern regions of Ngorongoro district in Tanzania. Though having different nationalities, Loitans across Kenya-Tanzania international boundary interact freely in trade, cultural ceremonies and even share relations. The Maasai have a remarkable process of power distribution across the community based on sections and clans which cut across territorial sections. The Loita Maasai sub-tribe has five clans *Ilukumai, Ilaiser, Ilmolelian, Iltaarosero* and *Ilmokesen,* each belonging to either black (*Orokkiteng)* or red (*Odomongi)* moieties (Zaal & Morgan, 2006).

Traditionaly, the political system and authority traditionally lies with the council of elders and age-set spokesmen and while the spiritual leader (*Oloiboni*) has authority

over cultural and religious matters of the sub tribe. The age-set structure is the fundamental organization principle of Loita Maasai; it instils values of egalitarianism, sharing and respect. Age group leaders are selected during boyhood and this position is held permanently. By virtue of their positions, the leaders are caretakers of the forest and perform ceremonies (Zaal & Morgan, 2006).

3.1.5 Land tenure and land use

Land is owned communally. When subdivision into private holdings and group ranches was being undertaken in 1970s to mid-1980s, the Loita community rejected the idea. The concept was resisted to reduce the likelihood of individuals selling land to outsiders once people acquired freehold tenure (Musyoka, 1999). From the 2009 population census Loita was estimated to have 22,873 people with a density of 14 persons per square kilometer.

Livestock keeping is the economic mainstay of the Loita people. On average each household has 40-56 heads of cattle, 40-62 sheep, and 35-57 goats (Musyoka, 1999). Gradually this community has embraced rain fed agriculture alongside livestock keeping and almost all household had a shamba of at least one acre.

3.2 Research Methodology (Materials and Methods)

3.2.1 Research design and sampling frame

A mixed methods research design was used to collect diverse data types to best understand of the research problem (Creswell, 2003). Cross sectional research design was used that relies on existing differences rather than change following an intervention and groups were selected based on existing differences rather than random allocation (Mugenda, 2008). Triangulation within and between methods was done to gather data and information (Mugenda, 2008; Hussein, 2009)This helped capture qualitative and quantitative approaches with data collected sequentially or simultaneously to better understand research problems (Creswell, 2003). There are two types of methodological triangulation between and within methods. Between method triangulation aims achieving convergent validity while within methods triangulation increases internal credibility of the research findings (Hussein, 2009). To ensure reliability and validity of results, a mixed research design was used during from data collection, analysis and interpretation.

For objective one and three, descriptive research design was employed to collect data on household use of wild medicinal and food plants and characterize trade. For objective two a cross-sectional design was used to compare density and population structure of selected species. While for objective four retrospective studies were employed including recording case histories from key informants; specimen records

from the Botanical Research and Herbarium Management Systems (BRAHMS) database in the East African Herbarium; census data and Landsat images.

The sampling frame for household survey was guided by the Kenya National Sample Survey and Evaluation Programme (NASSEP) which is based on the National population and housing census (Mugenda, 2008). Sampling units for the survey were households; individual respondent's in markets and plots within transects for conservation surveys. Surveys are concerned with describing, recording, analyzing and interpreting conditions that exist or existed (Kothari, 2004).

3.3 Data Collection Procedures and Instruments

3.3.1 Secondary data

Human population data was obtained from Central Bureau of Statistics; meteorological data from Kenya Meteorological Department office Narok and Landsat images were downloaded from GLOVIS and used to discuss land use change in Loita division. Preliminary soil map for Loita and land cover map were generated from Kenya Soil Survey (KSS) records of year 2000.

3.3.2 Primary Data

In collecting primary data from respondents the study began by a broad survey in order to generalize results to whole population. Thereafter in the second phase

focuses on qualitative open ended questions through interview schedules to collect detailed views from key informants (Creswell, 2003). Primary data was collected using questionnaire schedules, Key Informant Interviews (KII), Focus Group Discussions (FGDs), transect walks and measurement. Researcher's observation and participation in local activities during the study period April 2012 – July 2014 involved taking field notes, photographs and counts of various related aspects which were used in cross checking information obtained from household interviews and informal discussions. Detailed data collection procedures and specific instruments are discussed hereafter.

For objective one and two on documentation stratified random sampling method was used to select respondents during this study. Data was collected through household survey, key informant interviews (KII) and focus group discussions (FGDs) following Martin (1995) and Cotton (1996). The household survey was conducted using a semi-structured questionnaire (Appendix 1a). The target population for household questionnaires was approximately 4000 households in Loita (RoK, 2010) from which a sample 152 households (3.75%) was selected. To get more detailed information on WMFPs use i.e. trends of use, threats, availability and conservation initiatives KII (See Appendix Ic). Twenty three key informants were while using semi-structured interview as recommended for a homogenous population (Guest et al., 2006). *In-situ* interviews were conducted during transects walks and complemented with *ex situ* interviews (Thomas et al., 2007).

Focus group discussions were used to collect information on transmission of indigenous knowledge, habitat classification and use, and perception on land use change in Loita. Proportional piling was used to rank importance of the grassland, bushland and forest habitats by the local community by women and men from three Morijo, Entasekera and Olorte Sublocations.

Data on density and population structure of selected wild medicinal food plants was collected from eight transects within the study site inside and outside forest. The area considered as forest was within the boundaries proposed by (Kiyiapi, 1999) and what the community considers to be highland forest (*Osupuko entim).* While all other areas outside the forest which includes bush lands, riverine forests and wooded grassland where locals collect plants for use (*Oloiparag*). Plant population studies involve either sampling or census based on the dynamics of plant community, size of study area and the study objectives (Kent & Coker 1992; Peters, 1996). For this study a purposive sampling approach was chosen to assess the density and population structure of selected species. To undertake conservation surveys for this study roads/motor able tracks were used as the transect lines of one kilometer from the edge and traversing through the forest or bush lands then at intervals of 150 m - 250 m (Figure 3.4). Within each transect line five plots measuring 50 m by 20 m were laid (total 40 plots) and used to enumerate target species (Peters, 1996). In each plot, tree and shrub species abundance were recorded by counting the number of

individual stems of woody species present while to determine population structure of selected species diameter at breast height (DBH) (1.3m) was measured using a diameter tape (Philips, 1994).

To document threats, number of stumps was recorded and their basal diameter measured. Other observation recorded included; whether or not the stump was coppicing the coordinates of these plots were recorded using a GPS Garmin eTrex HC Series (2007).

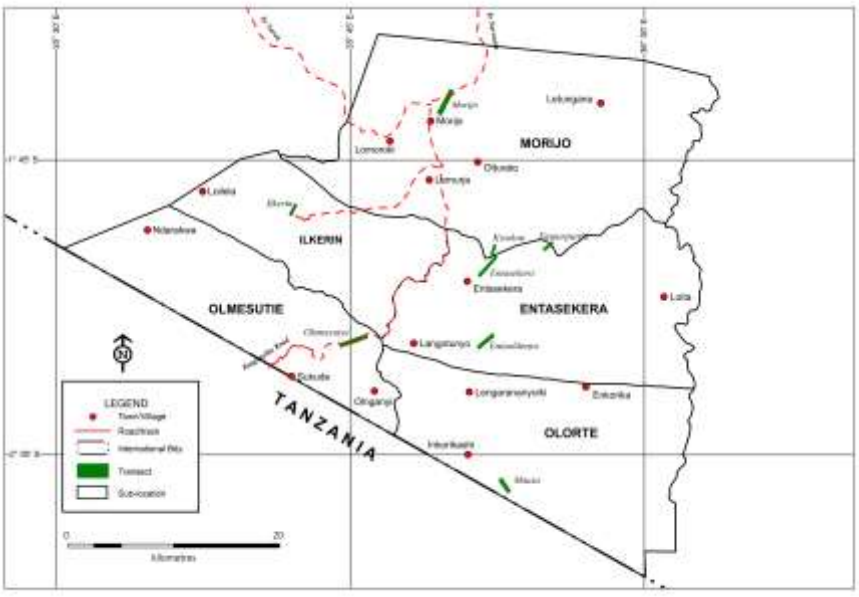


Figure 3.4 : Map of Loita showing the location of the transects and the Locations

In objective four to characterize trade in selected wild medicinal food plants semi-structured interview schedule was administered to traders within markets in Narok

(Appendix V). Using the market survey methodology described by Martin (1995) and used by Krog et al. (2006). The markets survey Loita (Entasekera, Morijo &Ilkerin), Narosura, Ololunga, Ewaso ngiro, Narok town, Ntulele and Suswa in Narok North and Narok South sub-Countys. During data collection plants were identified using local names and following (Beentje, 1994: Agnew, 2012). Voucher specimens collected were deposited at East African Herbarium for identification and reference

For objective five on scenarios of indigenous wild plants in Loita Division, data used was from objectives on local use and trade, density and population structure of selected species. It was supplemented with landsat images on land cover/ use change, herbarium specimen data on national distribution on targeted species, grey and published literature. Envisaged future scenarios were used to describe probable sustainability of WMFPs species under different tenure and management scenarios. These are: in forest namely under the current communal arrangements and as forest reserve, under communal and freehold tenure in the settled areas with livestock production and agricultural cultivation land use systems. Future scenarios were based on the current status (communal land ownership), the proposed land demarcation under communal ranch ownership for both the forest and outside the forest and with privatization of the land outside the forest and with state ownership of the forest under either the county or national government.

Landsat images for 1990, 2000 and 2010 were downloaded from the USGS website (http://glovis.usgs.gov) with a path row of 169061 and minimal cloud cover. The bands were 5, 7 and 5 for 1990, 2000 and 2010 respectively (Table 3.2).

Table 3.1 Landsat image details

Year	**1990**	**2000**	**2010**
Sensor ID	XXX09	EDC00	MLK00
Datum	D_WGS_1984	D_WGS_1984	D_WGS_1984
Path Row	169061	169061	169061
Elevation source	STRM	STRM	STRM
Spatial resolution	30m	30m	30m

3. 4 Data Analysis

3.4.1 Thematic analysis

For qualitative data from key informant interviews and focus group discussions coding, thematic and content analysis were done according to Taylor-Powell & Renner, 2003. Themes were derived from research questions focusing on aspects that were important. Coding involved assigning responses into categories or classes (Kothari, 2004).

3.4.2 Quantitative statistics

Quantitative statistics were used to analyze the data collected to generate frequencies, percentages. Data from semi-structured questions from household and market survey questionnaires were summarized using Microsoft Excel (2007) spreadsheet. Frequencies, percentages and graphs were generated and used to explain trends observed. For conservation status data frequency and density of selected species were calculated following procedures outlined by Mueller-Dombois and Ellenberg (1974) and Peters (1996) for different study sites.

Specifically,

Density = number of individuals / total area sampled and,

Frequency = number of plots in which species occur / total number of plots sampled.

Population structure of species was analysed by grouping into diameter at breast height (DBH) size classes were interpreted using histograms (Hoft et al., 1999). The results are presented in form of tables, figures and explanatory notes.

3.4.3. Preprocessing

Layer Stacking- This is used to create new multiband from the geo-referenced images of various pixels and extents. The input bands were resampled and re-projected to a common user selected output projection. Layers 1, 2, 3 and 4 are reordered to layers 4321 (RGB) and stacked together**.** Subset Data- sub-setting data was done so as to select a region of interest (Loita). A mask was used to extract the region of interest from the entire image.

Classification: Supervised classification was done where training data was provided and classification method of maximum likelihood and minimum distance and spectral angle mapper was specified**.** Change analysis: Change analysis tab was used to create an image from 1990 to 2010**.**

Export to Arcmap: Each image was exported to arcmap for further analysis. The images were converted to vector data and areas for each data calculated using calculate geometry. Using geoprocessing tools, the various physical features (Roads, roads and Shopping centers) were clipped and overlaid on each land use. Thematic Land cover maps for each year were then created in ENVI 5.0 and ENVI Ex software (ESRI, 2009) were used for image classification and thematic change detection for 1990, 2000 and 2010. Land use and land cover percentage changes were calculated.

3.5 Limitations of the Study

For the conservation surveys the terrain of Loita is rugged especially in Loita forest and some sections harbor wildlife such as buffalos and elephants. Hence sites were purposively selected during this study. This will limit generalization of these research findings to other areas.

3.6 Ethical Considerations

Prior informed consent was done before commencing the research. This was through introductory letter from the Chairman Larmat Department addressed to the County Commissioner, Narok and a copy to the Assistant County Commissioner based at Entasekera. At the local level verbal consent was given by during a meeting of the Loita Council of elders (LCoEs). During all field data a courtesy call was made to the Assistant County Commissioner and Loita Council of Elders (LCoEs). While in the field the researcher was accompanied a local research assistant and an elder.

CHAPTER FOUR: RESULTS

4.1 Introduction

In this chapter results are presented in five subsections 4.2 - 4.6. In sub-section 4.2 aspects on habitat categories, place names, indigenous knowledge transmission (IK) and indigenous plant conservation practices. In sub-section 4.3 documented wild medicinal food plants are presented. In subsection 4.4 density and population structure of selected wild medicinal food plants are presented while in sub section 4.5trade in wild medicinal food plants described and finally in 4.6 are likely future trends of selected WMFPs under different land tenure scenarios

4.2 Indigenous Knowledge and Conservation of Plant Resources in Loita

4.2.1 Habitat categorization and use amongst Loita Maasai

Three broad habitat categories were recognised during focus group discussions (FGDs) (Table 4.1). These were o*purkel* -grassland and wooded grassland: *oloiparag* -the bush land/shrub lands and *osupuko/entim* – highlands forests. This classification was based on the repondents views of vegetation cover and elevation.

Table 4.1: Landscape classification based on indigenous criteria

Local name(s)	Translation (English equivalent)	Description (elevation and vegetation)	Some plant species found growing in the habitat
Osupuko /Entim Esere	Forest /high land	Thick forest mostly found on higher elevations	Mainly high canopy trees *Warburgia ugandensis, Cassipourea* spp*, Olea africana, Prunus africana,*
Oloiparag/Osero (/plural-Isero)	Bushland and lowland forest	Bushland/woodland or degraded grassland	*Acacia tortilis, Acacia zanthophloea, Combretum* spp*., Rhus natalensis , Carissa spinarum*
Olpurkel/Iluaa/ Nkangata/Ongata	Wooded grassland	Acacia woodland	Mainly grasses, dispersed acacias interspersed by *Acacia drepanolobium*
	Open grassland	Mainly grass vegetation	Open grass land with dispersed acacias on the valleys and hills

The forest habitat was ranked first by both men and women as a source of water and wild food and number six for dry season grazing (Table 4.2). The grassland habitat was ranked first by women and second by men for cultural activities. The bushland habitat was ranked first and fourth by both men and women for wildlife/tourism purposes and for normal grazing it was ranked first by women and second by men. Both the bush land and grasslands were lowly ranked for dry season grazing; tenth by both genders for bushland, and tenth and ninth by men and women respectively for the grasslands. Focus group discussions (FGDs) revealed that the forest was a good source of wild foods (i.e. honey and fruits) followed by bushlands. The bushland was ranked higher for medicine than the forest by both genders (Table 4.2).

Table 4.2: Ranking use of habitats by men and women

Community use of habitat	**Habitat ranking during focus group discussions**					
	Forest		**Bushland**		**Grassland**	
	Men	***Women***	***Men***	***Women***	***Men***	***Women***
Cultural activities	8th	9th	9th	9th	2nd	1st
Normal grazing	10th	6th	2nd	1st	1st	2nd
Wildlife/Tourism	5th	8th	1st	4th	6th	10th
Construction	2nd	4th	3rd	3rd	4th	3rd
Food	***3rd***	***6th***	***4th***	***6th***	***5th***	***4th***
Fuelwood	8th	5th	7th	7th	7th	4th
Water	1st	1st	8th	8th	3rd	8th
Medicine	***5th***	***3rd***	***6th***	***2nd***	***8th***	***7th***
Aesthetics/ Environment	7th	10th	5th	5th	9th	6th
Dry season grazing	4th	2nd	10th	10th	10th	9th

(Note: Rank 1 is most important, 10 least important)

In Loita localities/sites are named after dominant or unique species occurring in an area currently or in the past (Table 4.3). Names of two locations Morijo (**olmorijoi-** *Acokanthera schimperii)* and Olorte (**Olorte-***Faurea saligna)* are derived from local names of dominant tree species growing in these localities.

Table 4.3: Names of localities in Loita and their corresponding plant names

Local place name	Area/locality	Local species	Species botanical
Olorte	Location	Olorte	*Faurea saligna*
Olkiloriti	***Village***	***Olkiloriti***	***Acacia nilotica***
Nkosesiai	***Village***	***Olosesiai***	***Osyris lanceolate***
Morijo	Location	Olmorijoi	*Ackonthera schimperi*
Ilkujuka	Village/school	Olkujuka	*Prunus africana*
Oltarkwai	Village	Oltarakwai	*Juniperus procera*
Iltararani	Village	Oltarara	*Acacia abysinica*
Olirien/nkoriento	***Village***	***Oloirien***	***Olea europaea ssp***
Oloorgisoyia	Village	Oloorgisoyia	*Vigna friesiorum*
Enuraelerai	Village	EmuruaElai	*Acacia xanthoploea*
Kisokoni	***Village***	***Osokonoi***	***Warburgia ugandensis***
Nkamuriak	***Village***	***Olamuriaki***	***Carissa edulis***
Oltiyani	Sacred site	Oltiyani	*Arudinaria alpine*

Note: Local plant names in bold are selected WMFP species in this project

4.2.2 Indigenous knowledge (IK) transmission

Fifty percent (50%) of the respondents reported having acquired (IK) on WMFPs from their elders while 26% acquired the knowledge hrough apprenticeship, the rest 16% during moran-hood and meat camps and 11% learnt from their peers (Table 4.4). During interviews and FGDs it was shown that IK amongst Loita Maasai was passed on throughout life along vertical and horizontal social structures differentiated by gender and age within the community (Figure 4.1).

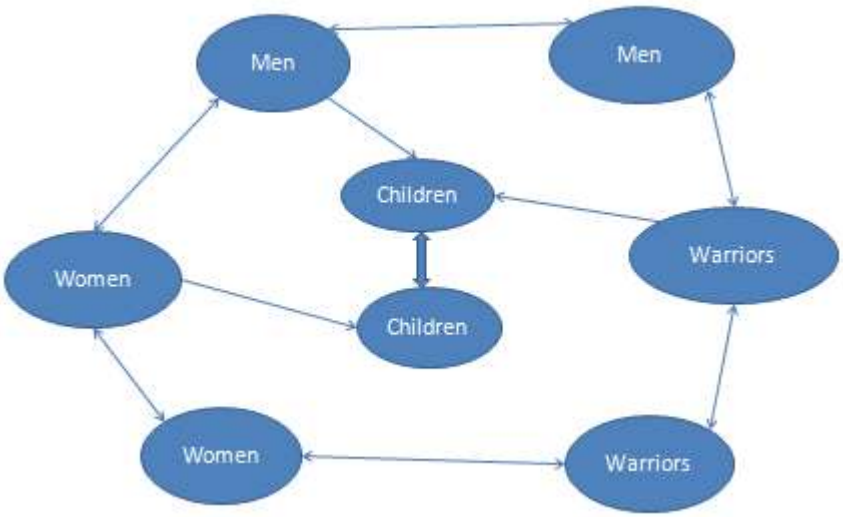


Figure 4.1: Indigenous knowledge (IK) transmission amongst Loita Maasai

Indigenous knowledge (IK) was passed on during cultural activities and ceremonies which characterize Loita Maasai through various stages in life. During ceremonies there was shared learning for age groups and inculcation of IK within and between age groups. Traditional ceremonies (manyatta- ceremonial village) lasted between one and two years. An example is the '*Eunoto Manyatta'* which started in April 2011 and ended in April 2012 (Figure 4.2a & b). Ceremonies serve as a forum for bonding and knowledge transmission especially for the participating age group. Women accompany their sons as mothers or their husbands as wives to manyattas whenever there is a ceremony. Major cultural ceremonies that each age group goes through include; *Olkipoket* (naming); *Enkipaata oolayiok* (formation of an age group which happens during boyhood before circumcision); *Nkorrenkel*a rare ceremony held twice (1974 and 2006) for the last 50 years (preparation of a junior

age group by a senior age group); *Emurata* (circumcision); *Eunoto* (warriors graduation ceremony into junior elders); *Eokoto ekule* (warriors can eat alone)*; EnkangooNkiri* (breaking food taboos by junior elders a ceremony to create a new age set (generation). Women join their husbands age sets in marriage. The women ceremony *Olamal loo nkituak* (fertility ceremony) was only attended by women.

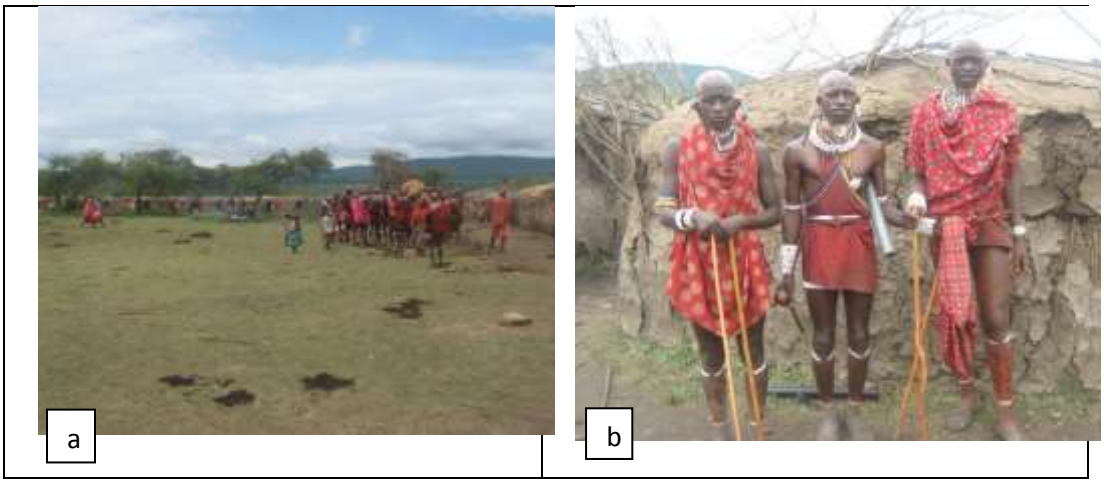


Figure 4.2: Manyatta ceremonial village. a) Shows a section of warriors' graduation to junior elder's (Eunoto manyatta) b) Shows three junior elder graduands (April, 2012)

4.2.3 Indigenous practices that enhance plant conservation amongst Loitans

The Loita Maasai have classified their landscapes into several cultural zones (Table 4.1) each had culturally differentiated use and this has supported conservation of large tracks of indigenous vegetation within the division. A traditional way of preservation /conservation was having cultural sites. Some areas/sites were sacred

and were only used for cultural/s activities. An example is Loita forest a sacred site encompassing several shrines such as *Oltukai, Oloitoktok, Oltiyani* and *Emugurrolkine.*

The Loita Maasai had sacred/cultural species it was a taboo to cut **Oreteti** *(Ficus thoningii,* the sacred species **Oltiyani** (*Arundinaria alpina)* could not be cut, it was believed that felling it would result in a drought. The highest point in Loita forest is a sacred site named by this species Oltiyani (*A. alpina).* Community members were discouraged from using species of cultural significance such as *Oloirien* (*Olea europaea* spp *africana)***, Olgigal (***Teclea simplicifolia*) and **Osinoni (***Lippia javanica***)** for ordinary purposes such as fencing and firewood. While **olmedungi** (do not cut); mainly in an area of strict preservation such as those on top of the hills with high species diversity, extraction plant materials orproducts was prohibited.

In addition it was noted that the Loita Maasai practiced sustainable harvesting of wild plant resources. A number of ways were highlighted as being used to promote sustainable use. They included the following;

i. Harvesting only what is needed
ii. Cutting only one stem from multi-stemmed tree or clump
iii. Cutting the branches instead of the main stem and
iv. Cutting tree stems at least 1½ - 2 m above ground to allow re-sprouting from the stems (i.e. Locally referred to as “allowing continuity of life”)

v. Harvesting only a portion of stem or bark at a time and after de-barking the wound is covered with soil or cow dung to avoid desiccation

vi. For roots and tubers one should only remove a few and return the soil so as not to expose the roots

vii. For firewood purposes, dead or fallen wood was the first option before felling standing trees

From observation traditional Maasai lifestyle put little demand on the environment, for example, in construction of the traditional Maasai hut (**Enkaji e modiei**), small diameter stems (withies and fitos) were used (Figure 4.3a) while tree crowns/branches are used make livestock enclosures (kraals). A new approach of splitting of timber with axes was had laos come up. (Figure 4.3b).

a)  b) 

Figure 4.3: a) Maasai house (*Enkaji*) under construction (*Nkopon*) and b) Deserted cattle enclosure (*Olkujuka*)

4.2.5 Wild plant use in Loita

Sawn stumps an indication of timber harvesting was seen within and outside the plots during this study, *Podocarpus latifolius/Podocarpus falcatus* and *Juniperus procera* species were targeted. For commercial harvesting timber was either sawn inside the forest or logs are ferried to saw mills (Fig.4.4a). Another cause of forest destruction is wild animal damage (buffalos and elephants) inside the forest mostly near watering points such as Emprupurtia swamp. All year round grazing was common inside Loita forest with permanent settlement of some families. Clearing of indigenous vegetation to establish farms was observed inside and outside the forest (Figure 4.4b).


a)


b)

Figure 4.4 a: Logging for timber inside Loita forest b) forest clearing for farmlands in Olomesutye

Timber and non-timber forest products were mainly harvested from within and around the villages to meet household needs including construction, carving, household utensils and firewood. Firewood was the main household fuel while charcoal was less common among households. The preferred species for fuel wood

was *O. europaea* ssp *Africana;* it was also used for lightingin the evenings by some households.

Tarchonanthus camphoratus and *A. nilotica* were two indigenous species with invasive tendencies observed in Morijo and Olemsutye locations.They were found mostly in degraded sites. They were found to have high regeneration from seed and coppicing from harvested stems. The species *Senna didymobotyra* and *Solanum incanum* were found along roads and foot paths. Key informants reported that when clearing land for cultivation, they left certain species on- farm such as *J. procera (*43%), *O. europaea* ssp. *africana* (30%) and *P. africana, R. natalensis* and *W. ugandensis* (13%) or these species were managed from natural regeneration. The species mentioned were perceived important as shade trees or as sources of fruits, *J. procera* and *Podocarpus* species were conserved for timber while *O. europaea* had a cultural uses. Among selected species R. *natalensis, O. europaea* and *W. ugandensis* were left on farm an indication of value and perceived.

During household survey, respondents reported that some species were becoming rare for the following reasons: overuse 52.7%; land use change 36%; trade 5.4%; and other reasons 6%. Over-use and land use change were highlighted as main factors contributing to depletion of wild plant resources. Traditionally, Loita Maasai livelihoods had largely been based on semi-nomadic pastoralism but gradually changed, 86% of respondent's practised agro-pastoralism and only 14% practised pure pastoralism. Households had made 'shambas' from cleared

bushlands (1>10 acres). Open grasslands were reserved for communal grazing and cultural activities while homesteads were constructed on the edge bushlands and grasslands. Fifty eight percent of the respondents were aware that WMFPs products were on sale in local markets and had purchased *M. africana.* Over half of the respondents (63.3%) were aware of species under government protection such as *O. lanceolata, J. procera, P. latifolius* and *Aloe* species. This information was relayed to them through chief barazas.

4.3 Wild Medicinal and Food Plants (WMFPs) Documented in Loita

Introduce section

4.3.1 Wild medicinal and food plants (WMFP) species used in Loita

The 202 plant species documented as wild medicinal and food plant species (WMFPs) in Loita were spread in over 66 families and 141 genera (Appendix II). The family with the highest number of species was Leguminosae (26) followed by Compositae (14) and Euphorbiaceae (10). The genus *Acacia* had the highest number of species (11) followed by *Euphorbia* (5) species (Appendix 2). The scientific, local names plant parts used and uses are presented in Appendix 2.

4.3.2 Nomenclature of traditional plant names

Two or more species shared a name for example enkamai refers to both *Ximenia caffra* and *Ximenia americana.* The fruit of both species *s* is Olamai (Appendix 11)**.** The fruit thus is bigger than the shrub as the prefix **"ol"** is higher in naming than "en". Also a general term could also be used to describe a group of species with similar characteristics e.g. for herbs as *Justicia.* A name could also refer to a plant part (fruit, leaf or stem), stage of growth i.e. seedling or sapling or mature plant; or singular or plural of the plant.

To differentiate between species in the same genus colour maybe used e.g Elarai naibor (white) (*Acacia kirkii)* and Elarai nanyoike (red) *refers to A. seyal*: Olchartuyiani orok/narok (black) *refers to Ochna holstii* while Olchartuyiam Oibor

(white) is *Ochna ovata*. Or the use of the species or where the species occurs e.g engumi entim for (*Vangueria apiculata*) which mostly occurs inside the forest or Olobaiye tiongata (*Bersama abyssinica*) meaning found on the edge of the grassland. Naming could also be according to use for instance Olkinya sirkon (donkey) for *Cadaba farinosa* meaning eaten by donkeys. This makes the use of local names complex and caution needs to be practised in documentation. More examples may be accessed in (Appendix II).

4.3.2 Life forms and plant parts of WMFP species documented

Documented WMFP comprised of trees (31.6%), herbs (28.7%), climbers and lianas (3.9%) and shrubs (35.6%) (Fig. 4.5). Besides use as WMFPs these species had other purposes such as wood fuel, construction, ceremonial, spiritual and cosmetic purposes (Appendix 1).

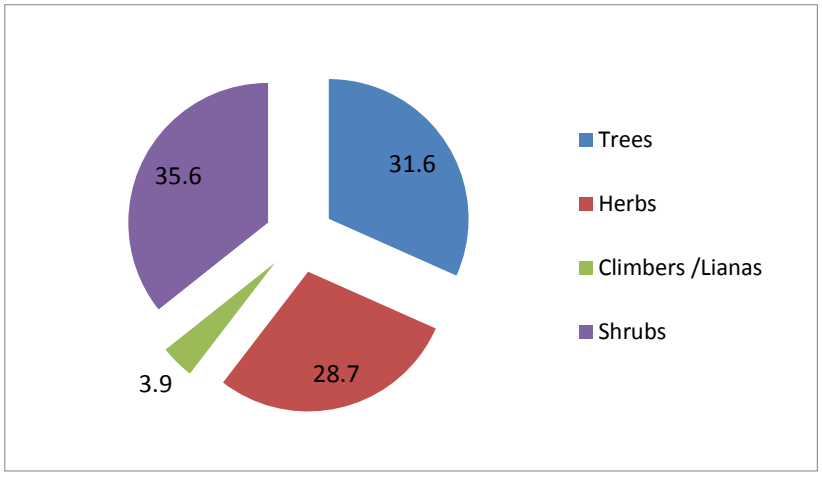


Figure 4.5: Life forms of wild medicinal food plants

Medicinal plants were 58.6% while food plants were 41.4%. The most utilised plant parts were roots and stems. As food, fruits were the most utilised parts while for medicinal purposes roots were more popular. Tubers and plant exudates were mostly used as food (Figure 4.6). Inner bark, gull, gum fruits and tubers are collected for food purposes during famine and dry seasons. While stem and stem bark, root and root bark were more utilised as medicinal and regularly accompanied by soup; leaves and sap were mostly used for topical application while flowers and sap were used to induce vomiting.

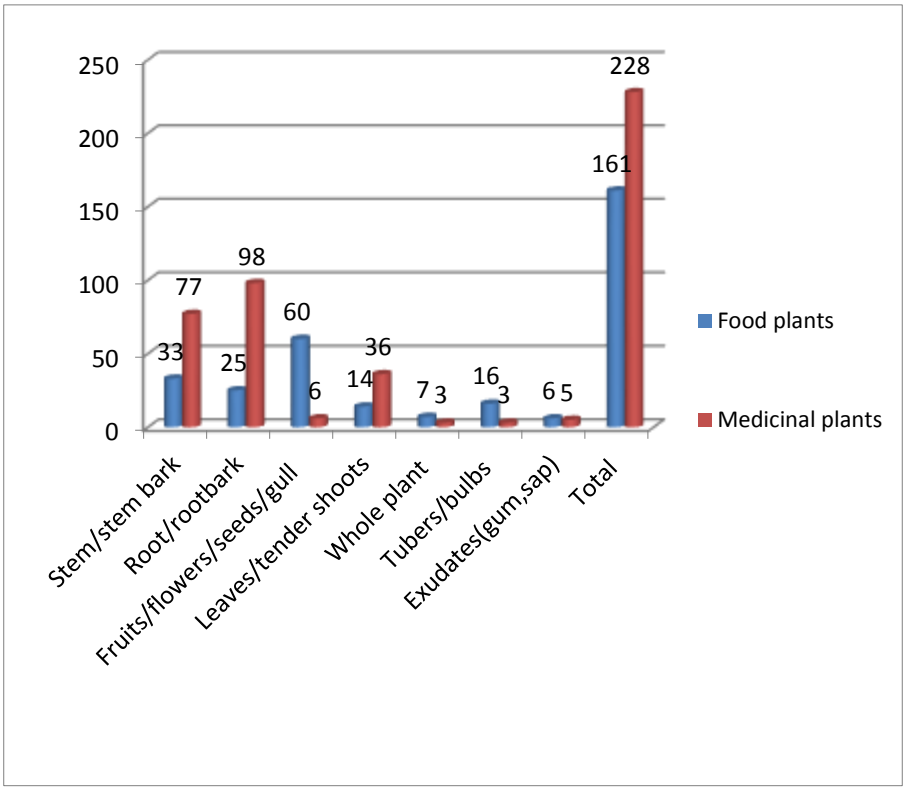


Figure 4.6: Different plant parts used as food and medicine

Of the 202 species documented, 64% had both medicinal and food use while 29% were medicinal and 7% were used as food only. Wild food plants in Loita including fruits, gum, tubers and inner bark are harvested and consumed in the field. Wild vegetables were harvested and cooked for consumption at home also sold in markets. Herbal "teas" which were normally boiled, were consumed singly for example *O. lanceolata, A. nilotica* and *M. africana.* Fermentation of traditional brew utilized the roots of *Aloe* species and mature fruit of *Kigelia africana*. Other plant products were in-cooperated into foods (mainly meat) and soups.

Customarily, a number of herbs are boiled together in water to make a concoction consumed and accompanied by soup. For the morans this drink is called "*entoroniki***"** and they consume it to quench thirst in place of water. Plant species used for curative and preventive purposes are barks, roots, seeds, stems and whole plant parts for herbaceous species. Wild plant species used for curative purposes are mostly boiled. External application includes poultice once heated over fire for example *Kalanchoe* species for swellings, joint and muscle pains. Plant exudates such as sap, gums and resins are applied directly on wounds, skin rashes, ears or eyes. Some wild medicinal food plants products that are consumed after processing. The preferred accompaniments include milk, soup, porridge, tea, water and fat while honey is used as a sweetener.

4.3.3 Species utilized by different gender/age groups in Loita

Results indicate that all members of the community had a role to play in the harvesting and preparation of WMFPs 72%, while 18% considered it a responsibility for women, 12% men and 2% children. Women were responsible for collecting and preparing products used by fellow women and prepared at home, they were assisted by children especially in collection of vegetables. Men and warriors were in charge of collecting specialised plant products used by men, prepared and consumed outside the house. As one respondent observed "it is awkward for women to harvest *Rhamnus prinoides* consumed by warriors (RQ9). Results revealed that some species such as *Carissa spinarum* were used by all groups while specific gender i.e. women, men, children and warriors used specific species more often. Categories of people with special needs such as postnatal and convalescence had specific species for their conditions (Table 4.6).

Species such as *Philosephalus curviflorus* and *Asparagus falcatus* were used by children (Table 4.6). There was overlap of plant species used by men and warriors with species such as *Rhamnus prinoides, Rhamnus staddo, Acacia nilotica* and *Trimelia grandifolia*. Some species such as *Acacia abyssinica* and *A. gerrardii* were used by both women and nursing mothers (post-natal care). The species *T. asiatica* and *W. ugandensis* being the most popular for medicinal purposes.

Table 4.6: Species commonly used by different groups/gender (n = 152)

Group /Gender	Rank	Species	Frequency	Percentage
Children	I	*Rhus natalensis*	**86**	**56.5**
	II	*Philosephalus curviflorus*	**63**	**41.4**
	III	*Osyris lanceolate*	**43**	**28.2**
	IV	*Ximenia Americana*	**43**	**28.2**
	V	*Olinia rochetiana*	**39**	**25.6**
Women	I	*Acacia gerrardii*	**75**	**49.3**
	II	*Acacia drepanolobium*	**34**	**22.4**
	III	*Osyris lanceolate*	**33**	**21.7**
	IV	*Carissa. Spinarum*	**27**	**17.8**
	V	*Combretum molle*	**27**	**17.8**
Post natal	I	*Acacia gerrardii*	**72**	**37.5**
	II	*Carissa spinarum*	**46**	**30.3**
	III	*Acacia drepanolobiumremove*	**27**	**17.8**
	IV	*Acacia abysinica*	**26**	**17.1**
	V	*Teclea simplicifolia*	**18**	**11.8**
Warriors	I	*Rhamnus prinoides*	**65**	**42.8**
	II	*Albizia amara)*	**53**	**34.9**
	III	*Acacia nilotica*	**32**	**21.1**
	IV	*Polystachia adansonie*	**30**	**19.7**
	V	*Trimelia grandifolia*	**30**	**19.7**
Men	I	*Acacia nilotica*	**28**	**18.4**
	II	*Trimelia grandifolia*	**27**	**17.8**
	III	*Rhamnus prinoides*	**25**	**16.4**
	IV	*Scurtia myrtina)*	**25**	**16.4**
	V	*Turrea abyssinica*	**24**	**15.7**
The sick	I	*Toddalia asiatica*	**60**	**39.5**
	II	*Warburgia ugandensis*	**38**	**25**
	III	*Rhoicissus tridentata*	**29**	**19.1**
	IV	*Olea europaea* ssp.	**21**	**13.8**
	V	*Aloe* spp.	**18**	**11.8**

In the Loita community consumption of wild medicinal food plants was common as a lifestyle habit. Some wild vegetables such as *Urtica dioica* though abundant in abandoned livestock kraals were unpopular and consumed during drought and

famine. Species used WMFPs were reportedly poisonous such as *Albizia anthelmintica* normally used as de-wormer but overdose causes body weakness and could lead to death. Fruits of *Acokanthera schimperii* are eaten when ripe but are poisonous when unripe. Though these species are common in the no cases of poisoning were reported indicating that indigenous knowledge (IK) on use of WMFPs was inculcated early in life.

4.3.4 Competing uses of selected WMFPs in Loita

From the 202 species documented details in Appendix II, nine species in eight families prioritised based on the popularity of use as medicinal food plants in Loita division were selected for detailed survey. These were *Warburgia ugandensis, Olea europaea* sub species *africana, Osyris lanceolata, Carissa spinarum, Myrsine africana, Toddalia asiatica, Zanthoxylum usambarense, Acacia nilotica* and *Rhus natalensis* (Table 4.7). These species had multiple uses; *O. europaea* had the highest number of uses among themas ceremonial tree, for construction, lighting, wood fuel and as a dye besides its use as WMFPs (Table 4.7).

Table 4.7: Commonly used WMFP species in Loita

Scientific name	Family	Lifeform	Uses					
			F	Mh	Ml	FF	CT	PC
Carissa spinarum	**Apocynacea**	**S**	**X**	**X**		**X**	**X**	**X**
Toddalia asiatica	**Rutacaea**	**T/L**	**X**	**X**		**X**	**X**	
Warburgia ugandensis	**Canellaceae**	**T**	**X**	**X**		**X**	**X**	
Zanthoxlyum usambarense	**Rutacea**	**T**	**X**	**X**		**X**	**X**	**X**
Myrsine africana	**Myrsinacea e**	S	X	X	X	X		
Acacia nilotica	**Leguminosa e**	T	X	X		X	X	
Olea europaea sub species *africana*	**Oleaceae**	T	X	X		X	X	X
Rhus natalensis	**Anacardiac eae**	T	X	X		X	X	
Osyris lanceolata	**Santalaceae**	T/S	X	X		X	X	X

Key Table 4. : **X**- Used as. Life forms: **S**- shrub: **T**-Tree: **L**- Liana
Uses: **F**- food or drink (nutrition): **Mh**-Human medicine: **Ml**-ethnoveterinary **FF**- Fodder or forage: **CT**- Construction or making tools **PC**-Perfumeor cosmetics/curing

4.4 Density and Population Structure of Selected WMFP Species

4.4.2 Density and frequency of selected wild medicinal food plant species

Rhus natalensis had the highest overall density of 64.5 stems per hectare while *O. lanceolata* had the least with four stems per hectare. *Todallia asitaica* occurred only in the forest while *A. nilotica* was found outside the forest (Table 4.8).

Table 4.8: Population density of selected WMFPs

Selected WMFPs species	Density outside forest/hectare	Density within the forest/hectare	Overall density /hectare
Osyris lanceolata	6.1	1.2	4
Zanthoxylum usambarense	17	11.2	14.5
Warburgia ugandensis	2.27	50	22.5
Carissa spinarum	33.9	11.2	24.3
Toddalia asiatica	0.0	65.3	27.8
Olea europaea ssp. *Africana*	23.5	56.5	37.5
Acacia nilotica	67.8	0.0	39
Rhus natalensis	100	16.5	64.5

Olea europaea ssp *africana* had the highest overall frequency (0.65) followed by *R. natalensis. Mrysine africana* (0.2) and *O. lanceolata* (0.12) had the lowest frequency showing uneven distribution in study sites (Table 4.8). *Olea africana* had a frequency of 0.52 outside the forest and 0.82 inside the forest reflecting uniform distribution (Table 4.9). *Acacia nilotica* was only found outside the forest while *T. asiatica* was only encountered inside the forest while *Olea africana* occurred both places.

Table 4.9: Relative frequency of selected WMFPs

Species	Frequency outside forest	Frequency inside forest	Overall frequency
Osyris lanceolate	0.17	0.05	0.12
Zanthoxylum usambarense	0.39	0.53	0.45
Warburgia ugandensis	0.09	0.88	0.43
Mrysine africana	0.29	0.13	0.2
Carissa spinarum	0.43	0.41	0.43
Toddalia asiatica	0.0	1	0.43
Olea europaea spp *africana*	0.52	0.82	0.65
Acacia nilotica	0.61	0.0	0.35
Rhus natalensis	0.74	0.35	0.45

4.4.3 Population structure of selected species in Loita

For the nine selected species the diameter at breast height (DBH) was measured and used to draw the population structure of each species. The lowest size class 0-10 cm basal diameter size classes representing seedlings and saplings had the highest number of stems for most species (Fig 4.7). *W. ugandensis* displayed a normal reverse J-curve population structure with more stems in the 0-10 cm size classes and decreasing in the larger size classes however no stems were recorded between 40 - 60 cm DBH size class and largest stems were 90 - 100cm. The biggest stems encountered were 100 cm and below (Fig. 4.7). *Olea europaea* ssp. *africana* had an un-even population structure pattern. The highest number of stems occurred in the 1 10 cm diameter size class followed by at the classes 41 – 50cm, 61 - 70 cm and 81 - 90 cm. No stems were recorded in the diameter size classes 101 - 110 cm

and tbetween121 -140 cm (Fig. 4.7). Only a few *Olea* stems were recorded in the largest dbh size class was140-150 cm.

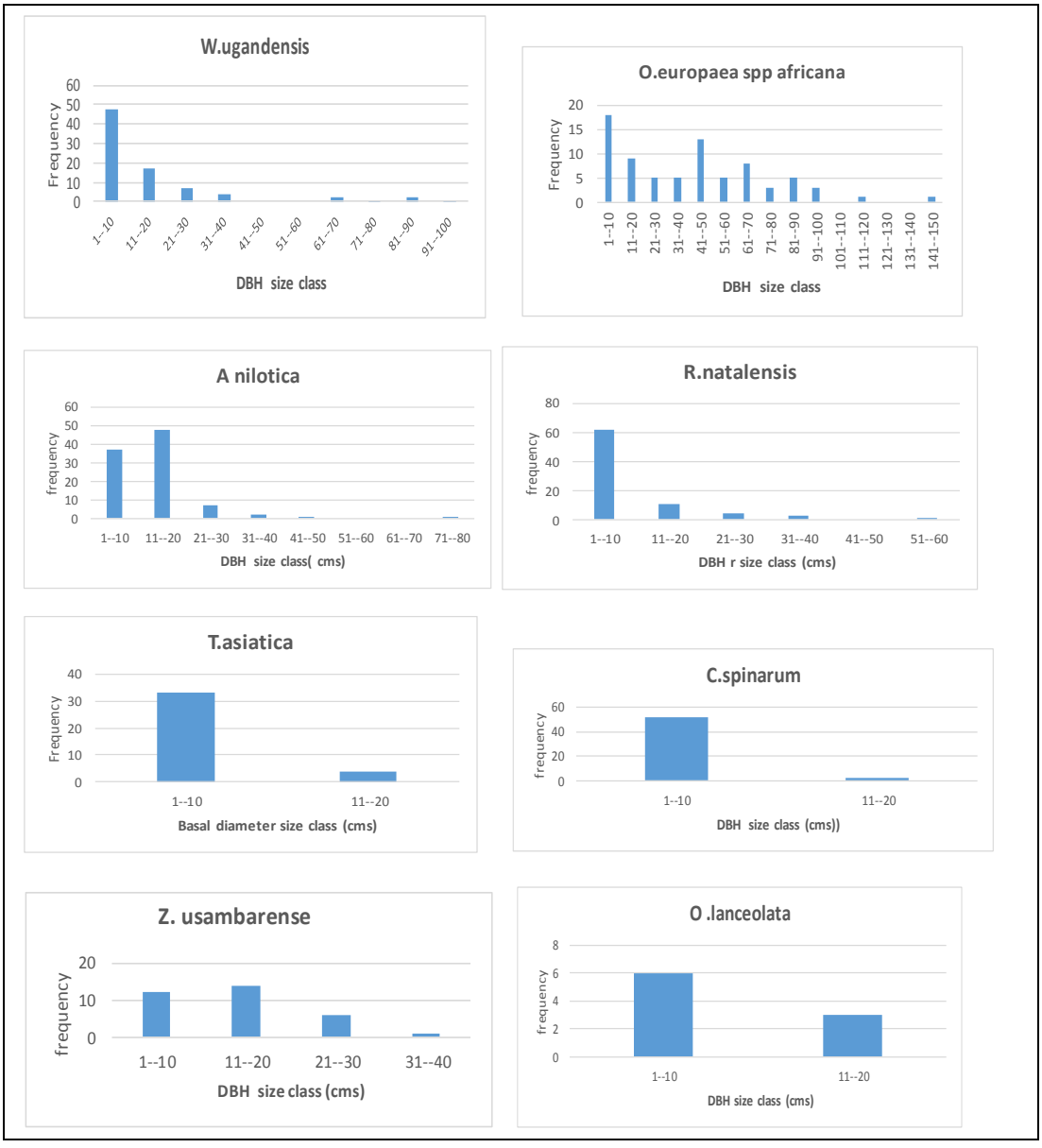
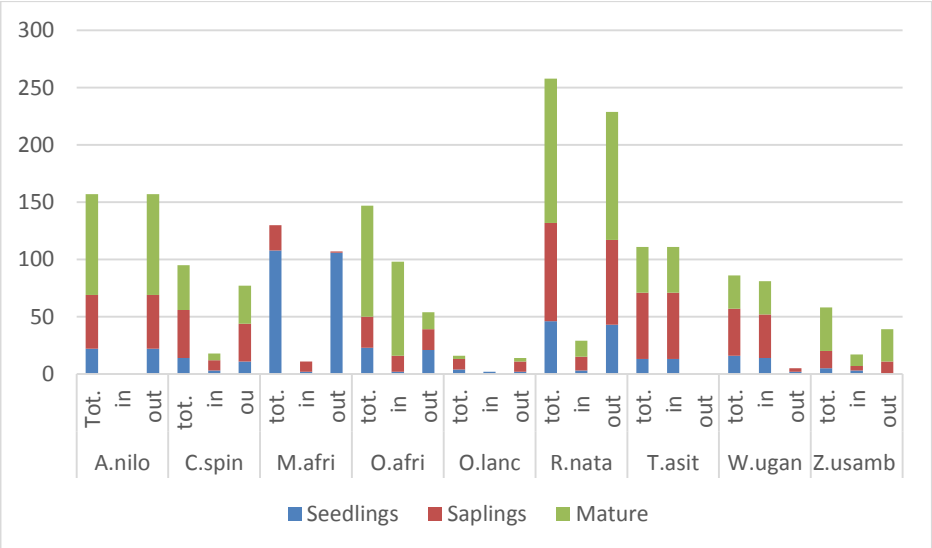


Figure 4.7: Population structure pattern of selected WMFP species in Loita

Acacia nilotica, Z. usambarense and *R. natalensis* stems in Loita had diameters of 40 cm and below while *T. asiatica, C. spiram* and *O. lanceolata* species had no stems recorded above 20 cm size class (Figure 4.7). Fewer numbers of stems in the 0 -10 cm diameter size class lower for *A. nilotica* and *Z. usambarense* compared to the 11 - 20 cm basal size class. There were low numbers of stems for the selected species (trees) recorded between 11 - 40 cm size classes for *O. europaea* ssp *africana. R. natalensis* displayed a normal reverse J-curve found at the 0 - 10 cm, diameter size class. *Toddalia asiatica*, *C. spinarum* and *O. lanceolata* stems recorded were 1-20 cm (Fig. 4.7). Selected WMFPs had more seedlings outside the forest while more mature trees were found in the forest. *Toddalia asiatica* and *Z. usambarense* had fewer stems in the seedlings category compared to the saplings and mature stems (Figure 4.8).



Key: Tot- total, in- inside the forest, out outside the forest. A.nilo- *A.nilotica*, C.spin, *C. spinarum*, M.afri. *M. africana*, O.lanc. *O. lanceolata*, R.nat. *R. natalensis*, T.asit. *T.asiatica*, W.ugan. *W. ugandensis* & Z.usamb. *Z. usambarense*

Figure 4.8: Seedlings, saplings and mature stems of selected species Loita

4.4.4 Harvesting of wild plants species in Loita

Only (11%) of the stumps were found in the forest plots while 89% were found outside the forest. The basal diameter of stumps ranged from below five centimeters (5 cm) to 121 cm (Figure 4.9). Most stems were below 20 cm basal diameter and were mainly found outside the forest. However absence/presence of stumps are indicative of recent extraction as older stump could have decomposed or coppiced. Stumps of *O. europaea* ssp *africana*, *Podocarpus* species, *J. procera* and *W. ugandensis* had large diameter stumps.

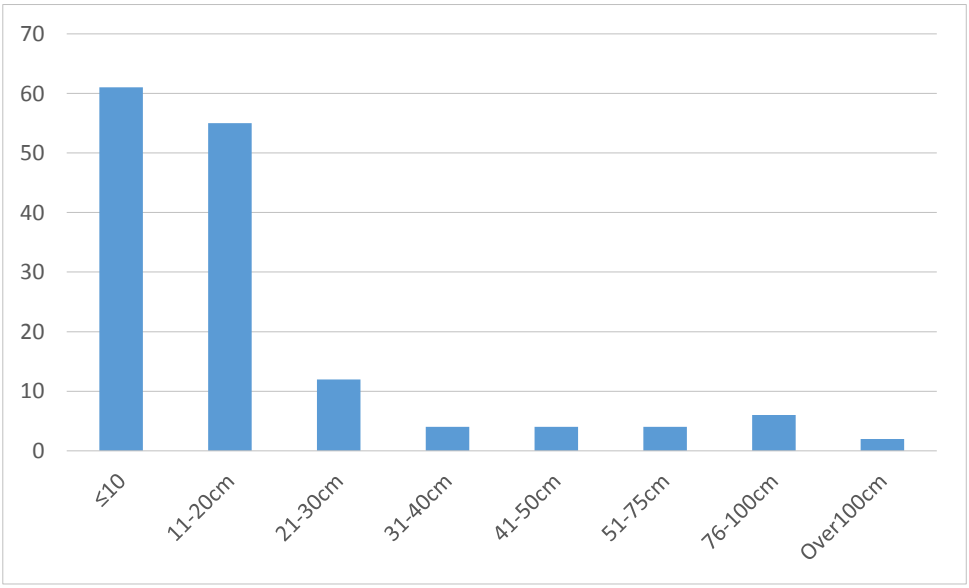


Figure 4.9: Basal diameter size class of stumps recorded (Number of stumps Y-axis, stump diameter X-axis stumps)

Stumps of 22 species were positively identified with the highest number of stems belonging to the species *O. africana* followed by *C. molle* and *R. natalensis* (Fig. 4.10). Of the stumps encountered 62% were coppicing.

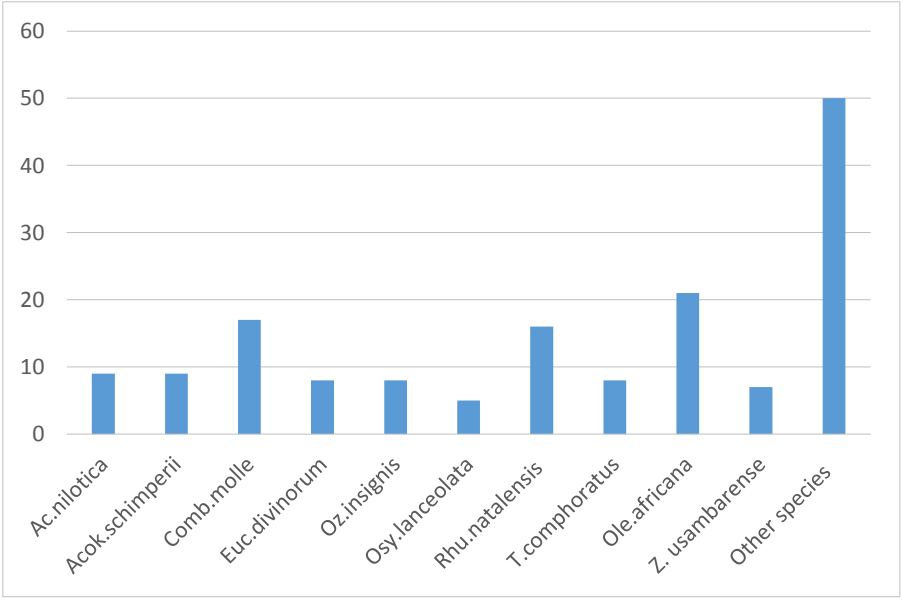


Figure 4.10: Plant species with ≥ 5 stumps

4.5 Trade in Wild Medicinal Food Plants

4.5.1 Characteristics of wild medicinal food plants (WMFPs) markets in Narok County

Wild medicinal food plant (WMFP) markets were found along major roads near administrative centres. The products were displayed in the open next to livestock selling's sheds or within food markets. Traditional health practitioners (THPs) sold herbal products in kiosks, which also served as 'clinics' for consultation by clients. Sixty three percent (63%) of the traders indicated that WMFPs trade was high during markets days while (37%) reported no difference in sales. The highest number of WMFPs traders recorded in a day and in one market was 25 in Suswa (Table 4.10).

Table 4.10: Markets of WMFPs, market day and number of traders

Market	Livestock market day	Highest number of WMFPs traders
Loita (Morijo)	Monday	2
Narosura	Wednesday	4
Ewasongiro	Saturday	8
Narok	Sunday	15
Ntulele	Tuesday	4
Suswa	Wednesday	25

4.5.2 Characteristics of wild medicinal food plant species (WMFPs) traders

Results showed that during marketing, 55% of the traders were mobile i.e. without a stationary point while 45% had a fixed location i.e. either a shop or a fixed stall/point within the market. Mobile traders acted as harvesters, who supplied herbal products to stationary traders on market days after which they sold remaining

products. Mobile traders moved from one market to another during livestock markets days. Trade in WMFPs was carried solely by 75% of the traders while 22.5% worked jointly as a family enterprise and only 2.5% reported working in partnership. Only five percent (2) of the traders were members of the National Traditional Health Practitioners Association (NATHEPA). Traders were also members of welfare groups such as Kadet – World Concern, Ikisaruni networking association (INA) a merry go round group, Imeshuki Networking Association (INA) and Ilkeremisho Farmers Association.

Trader's age ranged between 23 - 74 years with the youngest being 23 years and the oldest was 74 years. The average age of the traders was 48 years. WMFPs trade was dominated by men at 85% while women constituted only 15%. When the trade was a family enterprise, women were left in charge of stalls while men went for new supplies or to sell products in other markets. The results indicated that 65% of the traders had no formal schooling). Most of the traders (87.5%) used indigenous knowledge acquired through apprenticeship and warrior hood or meat camps while only 12.5% had attended seminars for training on modern techniques. Though all the traders acknowledged the need to have license to operate their business only 5% were registered with the social services department and had permits to collect products from government forests.

Sixty percent (60%) of the traders engaged in WMFPs trade fulltime while 40% engaged in the trade part-time. Trade in medicinal plants in Narok started in the 1980s and respondents had engaged in the trade for between one and thirty two (32) years (Fig. 4.11). The number of WMFPs traders had increased over the last three decades, 57% of traders interviewed had engaged in WMFPs trade in the last ten years while only 5% had been trading for over 30 years (Fig. 4.11).

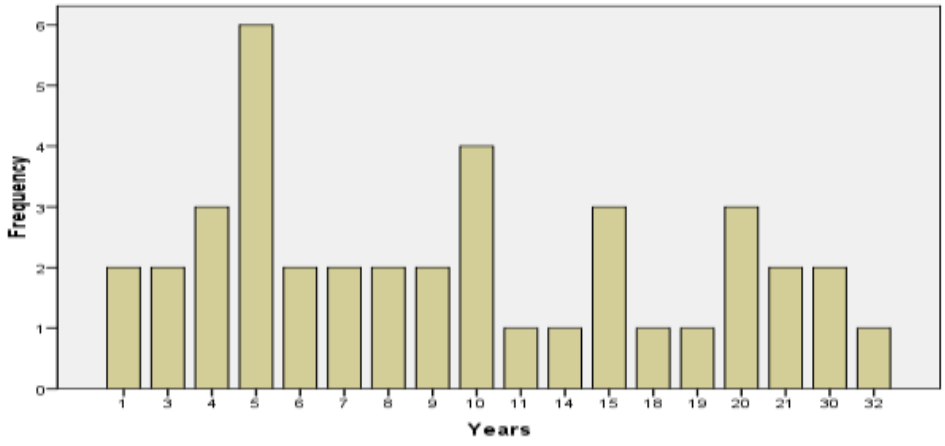


Figure 4.11: Numbers of years the respondents had been engaged in WMFPs trade up to year (2012) (n==40)

Entry into trade or reasons for joining WMFPs trade were varied; some traders In herited the business from parents or relatives (57.5%), others were traditional health practitioners (THPs) (32.5%) and only 10% were engaged in the trade solely as a source of income (Box 4.1). Those who had inherited the practice as THPs had embraced sale of the products besides the practice.

Box 4.1: Excerpts of responses to the question "how did you start/get into WMFPs trade?

i)	"Drought and famine of 2009 wiped my livestock; I was left with nothing to sustain myself and resorted to selling WMFPs in the markets (RESP 16).
ii)	"I was jobless after warrior hood and started trading in medicinal plants to earn a living" he started as a harvester then fully engaged in the trade (RESP 30).
iii)	"This trade needs no capital to start, only indigenous knowledge and experience which I already had from warrior hood" (" RESP. 6, Olitipis market)
iv)	"I grew up learning from wilderness as a herd's boy and interacted with herbalist who introduced me to the trade" (RESP.20, Ololunga market).
vi)	"I was inducted into WMPs trade by my father who was herbalist" (RESP 28).
vii)	"I was a harvester who used to supply *M. africana* (seketet) to the traders in the market and on realising the opportunity fully engaged in trading in WMFPs (RESP.22)

4.5.3 Challenges facing wild medicinal food plant (WMFPs) traders

Challenges encountered by the traders included, harassment by County officers for those without permits, long distances to harvest products and exposure to extreme weather conditions (sunshine, heat, rain, cold, wind and dust). The traders also reported lack of capital (to expand business, process and package products), negative publicity and attitude by people, client complaints when not cured. Challenges directly related to WMFP trade were competition, low profit margins, bargaining by customers and product scarcity for some species, language barrier for non-Maasai customers and inaccessibility of harvesting sites during the rainy season. The number of traders had increased over time hence competition for customers especially over the last ten years (Fig. 4.11). Despite these challenges

traders were optimistic with 70% indicating that WMFPs trade had a future. Other options besides WMFPs were farming crops 27.5%, livestock keeping 15% and other businesses 35%. Examples of other businesses were livestock trade or diversifying the products to include handicrafts and other non-timber products such as honey.

The main clients of WMFPs in Narok County markets were the households, livestock herders and hoteliers (butcheries and hotels where soup is sold). It was reported that species popularly used by households for example *M. africana, W. ugandensis* and *T. asiatica* and were scarce and therefore bought from the market. Three categories of users were identified; first are those who use WMFPs as a cultural practice (37.5%) at home, the second category resort to WMFPs when conventional medicine is not working or not available (35%) and the third category only use WMFPs because it's the only available form of healthcare accessible to them (27.5%). The customers of WMFPs were conversant with products used at home. For WMFPs used for curative purposes they consulted THPs on administration and dosage. Preference and use of WMFPs by consumers was based on believe in their efficacy and accessibility. Statements such as "medicinal plants are free from chemical additions "(RESP 6, Suswa market); and ii) "medicinal/soup species cures and are effective" (RESP.7, Oletipis market). Over two third of traders (67%) reported that they always advised customers on how to use WMFPs bought even if not requested while 30% said they advise on request. According to the

traders 65% of customers of WMFPs know the species they want to buy while 20% consulted traders and 15% sometimes enquired.

4.5.4 Sustainability of sourcing WMFP products from the wild

Results indicated that almost all WMFP species on sale in surveyed markets in Narok were collected from the wild. According to 72.5% of the traders, wild stocks of WMFPs were declining while 27.5% reported that wild stocks were still available. Only 17.5% were aware that there were seedlings of WMFPs in nurseries though none had planted. Some traders expressed willingness to plant *Z. usambarense* and *M. africana* species.

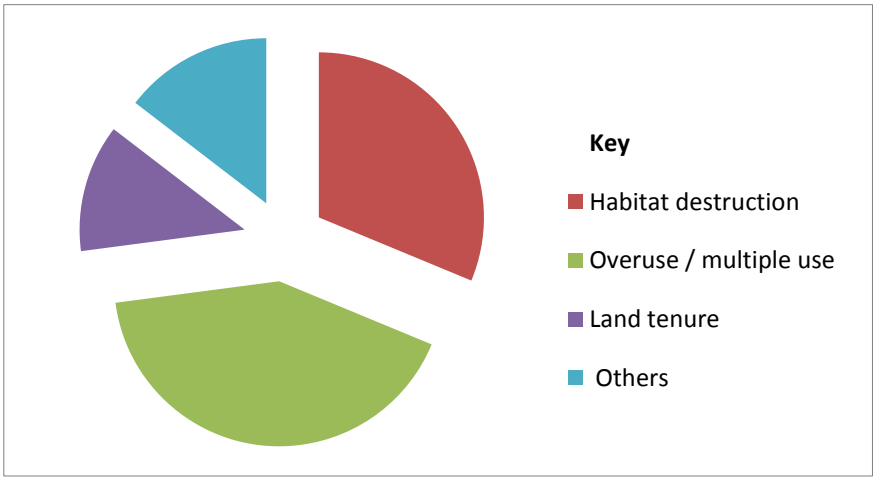


Figure 4.12: Causes of declining wild stocks of WMFPs in Narok

4.5.5 Pricing of WMFPs in the markets

Pricing of medicinal products depended on the species and value addition on product after harvesting. Value addition included semi-processing by drying and grinding.

The average price of ground WMFP products was KES 400 per kilogram. Unprocessed plant parts, dry or wet stems or roots were normally sold as a bunch/heap. Approximate cost ranged between Kenya shillings (KES) 100-150 per kilogram for all species. Because of the competition traders resulted in using different tactics including 0unstandardized scales (containers/packets) to disguise and attract customers to buy their products. Customers bargained while procuring WMFPs products or requesting for a top up ("nyongeza") which traders accepted to make sales.

The highest number of species on sale by one trader was 65 while the lowest had four. Most traders had between 10 - 30 species on display for sale, this was 65% of the traders interviewed (Figure 4.13).

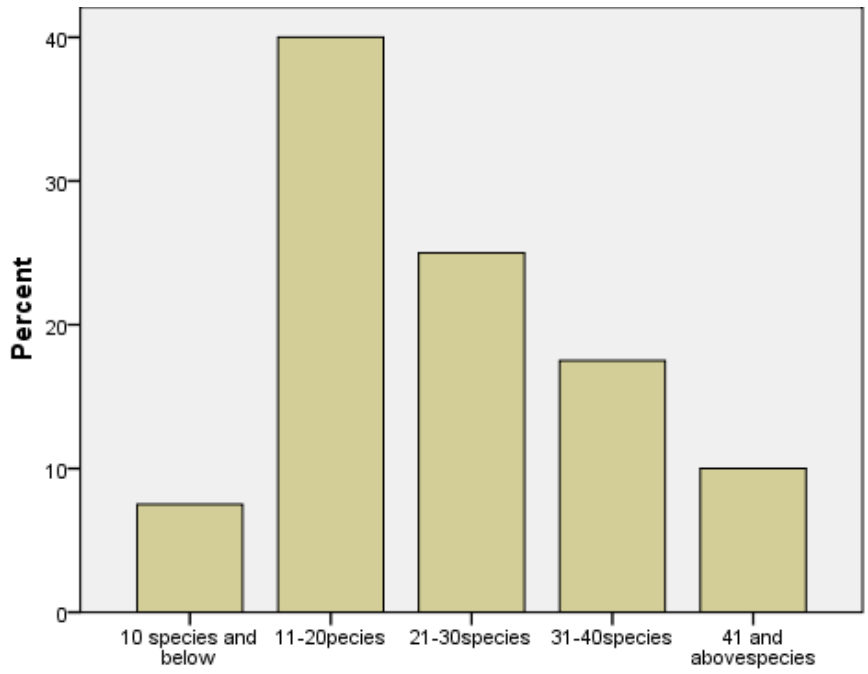


Figure 4.13: Number of WMFP on sale in markets (Y-axis percentage number of traders and X-axis number of species)

4.5.3 Diversity of WMFPs species sold in markets

In Narok markets, 106 plant species were recorded. They were spread in 46 families, with 26 families having one species, nine families' had two species and three families' three species each, these accounted for half of the species in the markets, the other families had four species and above (Appendix III). The family Leguminosae had the highest percentage (16%) followed by Compositae (Asteraceae 5.7%), Eurphorbiaceae and Solanaceae had 4.7% the genus Acacia had highest number of species with eleven species (Appendix III). Shrubs had the highest number of species followed closely by trees while climbers and herbs had only a few species (Fig.4.14).

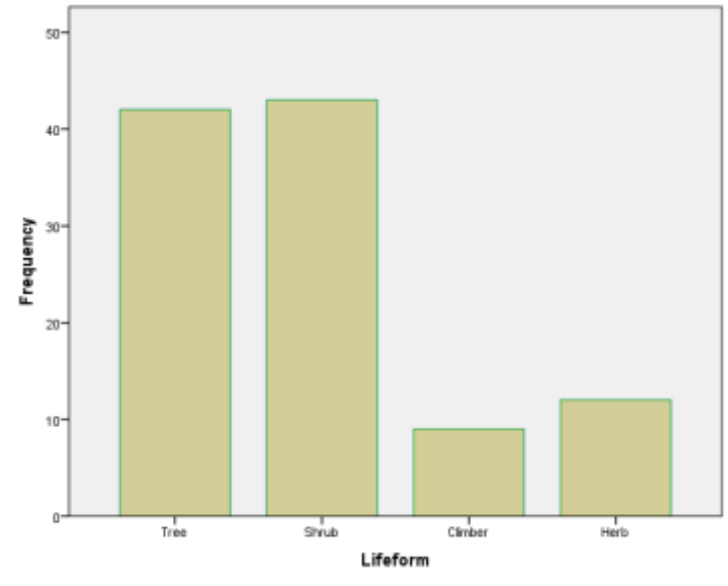


Figure 4.14: Growth habit/life form of wild medicinal food plants sold in markets

This study recorded 106 WMFP species on sale in the markets (Appendix III). Different parts of a plant species were sold in markets for example A. *gerrardii* roots and stem bark; *Kigelia africana* (fruit and roots); *Balanites aegyptiaca* (fruit and bark) and *Aloe secundiflora* (roots and leaves). Roots, root bark and tubers accounted for 45% of the parts sold, and stem and stem bark accounted for 39%, leaves and shoots 8.78% while whole plants and exudates accounted for 0.67% of the products in the markets (Fig. 4.15 & Appendix III).

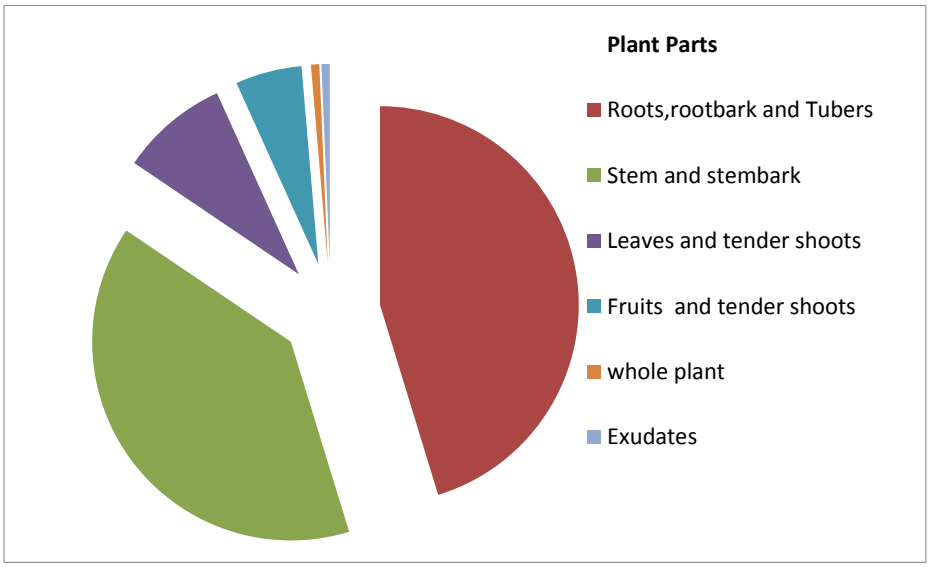


Figure 4.15: Plant parts wild medicinal food plants (WMFPs) sold in markets

4.6 Scenarios of WMFPs Conservation in Loita

4.6.1 Habitat trends

There was no consensus among key informants on whether the grassland habitat was increasing (48.8%) or decreasing (34.7%). Over half of the key informants (69.5%) indicated that area under bushland had increased; while 78.2% of key informants were of the opinion that area under forest habitat had decreased and only 22.8% reporting no change (Table 4.11). In Loita cultivation started in the 1960s, became popular in the 1970s and by 1990s (Fig. 4.16).

Table 4.11: Habitat trends in Loita as perceived by Key Informants (KI) (N=23)

Habitat category	No change	Increased	Decreased
Grassland	18.9% (4)	48.8% (11)	34.7(8)
Bushland/woodlands	0%(0)	69.5% (16)	30.4(7)
Forest	22%(5)	0% (0)	(78.2)18

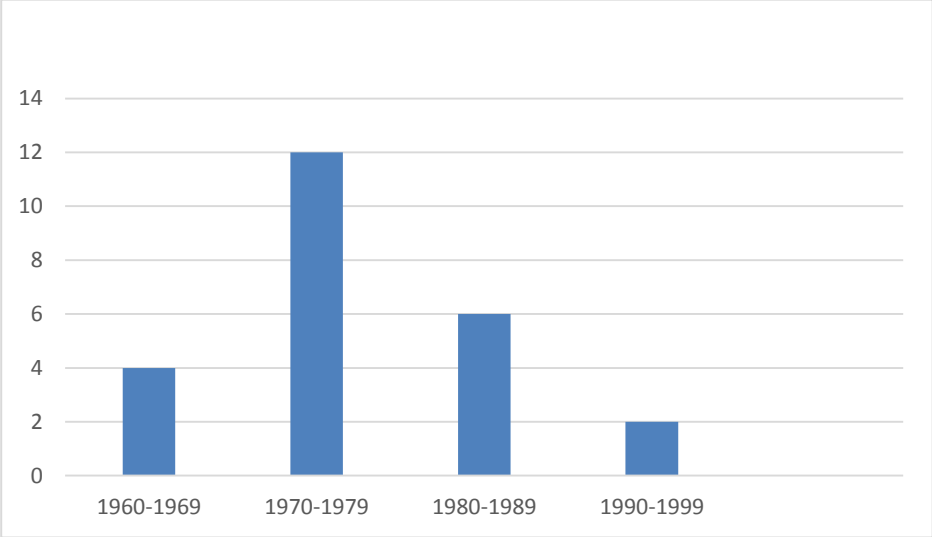


Figure 4.16: Years when key informants started cultivating crops

4.6.2 Landsat image analysis for Loita

The dominant land cover/use types in Loita include forest, grassland and bushland; with cropland and settlement emerging as other land cover/use types. Permanent settlement in villages, market centers and establishment of public facilities such as schools and health centers were increasing. Between 1990 and 2000, area under forest increased while area under grasslands decreased. However from the 2000 area

under forest and grassland decreased while area under bush land and cropland increased. From 1990; area under bush land increased more rapidly compared to cropland (Fig. 4.17 & 4.18). Forest area decreased from 55,267ha to 44,699 ha between 1990 and 2010. . Grassland had reduced to 65,797 ha by 2010.

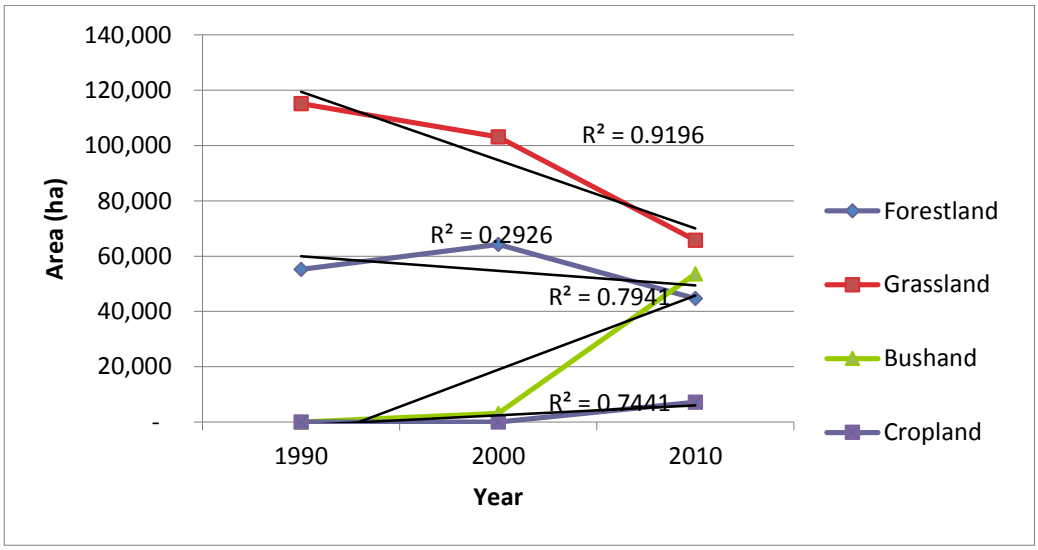


Figure 4.17: Land cover/land use trends for Loita for the years 1990, 2000 and 2010

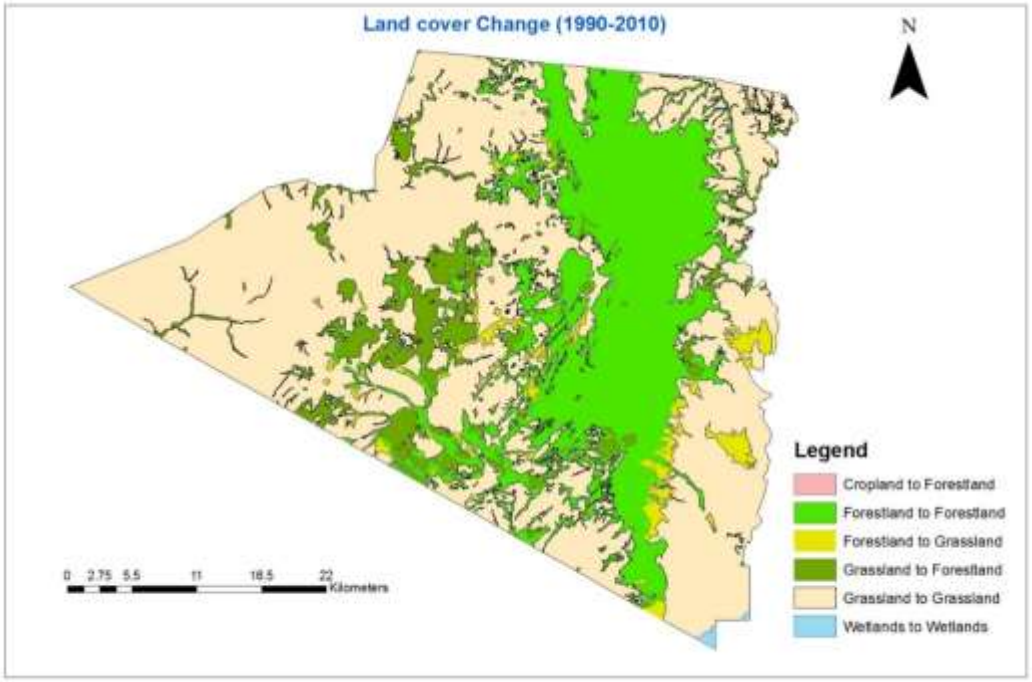


Figure 4.18: Map showing land use/cover changes in Loita 1990 - 2010

4.6.3 Human population trends in Loita

Human population in Loita had increased gradually with more men than women (Table 4.12). There was a rapid increase recorded between the years 1989 - 1999 and 1999 - 2009 time periods than years prior when human population density was almost constant (Table 4.12).

Table 4.12: Human population in Loita from 1969 to 2009

Year	Male	Female	Total population	Number of Households	Density/Km^2
1969	3246	3110	6356	*	5
1979	3336	3031	6367	1048	4
1989	5056	5247	10303	2148	5
1999	7912	7645	15557	3106	9
2009	11648	11225	22873	4409	14

*Not included in the census

Source: Central Bureau of Statistics records national census data for 1969, 1979, 1989, 1999 and 2009

4.6.4 Abundance and trends of selected WMFPs

The abundance of *O. europaea* ssp. *africana*, *O. lanceolata*, *T. asiatica* and *W. ugandensis* had decreased in the past and this trend was expected to continue unless measures were taken to halt the trend. For the species *Rhus natalensis, A. nilotica* and *C. spinarum* species there was a gradual decrease, this trend was expected to continue (Table 4.13).

Table 4.13: Key informant perceptions on abundance of selected species (N=23)

Period	1980's (past)		Current (2010's) (present)		2040's (projected)	
Species	**Abundance %**	**Rare %**	**Abundant %**	**Rare %**	**Increase %**	**Decrease %**
O. lanceolata	100	0	64	36	0	100
O. europaea ssp africana	92	8	24	76	0	100
M. africana	100	0	36	64	28	72
R. natalensis	100	0	96	4	42	60
W. ugandensis	80	20	48	52	16	84
A. nilotica	96	4	68	32	40	60
C. spinarum	96	4	92	8	40	60
T. asiatica	96	4	60	40	8	92
Z.usambarense	76	24	44	56	12	88

In general decreasing abundance of selected WMFPs in Loita according to key informants was caused by land use change and adoption of cropping as a supplementary means of livelihood. Selected WMFP however had specific factors that uniquely affected them coupled with habitat degradation to partially explain individual species trends (Table 4.14.)

In Loita the abundance of selected species was declining. Though there is perceived ability of the species *C. spinarum, R. natalensis* and *A. nilotica* to withstand utilization and habitat degradation. Future scenarios of these species would be

influenced by land use/cover change, human population trends, climatic factors and trade (Table 4.14).

Table 4.14: Perceived reasons for declining trends of selected species

Species	**1st**	**2nd**	**3rd**	**4th**
O. lanceolata	Trade	Overuse	Habitat destruction	Weak policy enforcement
O.europaea ssp. africana	Multiple uses (local)	Trade	Habitat destruction	Local protection cultural value
M. africana	Trade	Poor harvesting methods	Overuse	Habitat destruction
R. natalensis	Habitat destruction	Abundant in bushlands	Poor harvesting methods	Habitat destruction
W. ugandensis	Local use	Habitat destruction	Unsustainable harvesting	Good regeneration
A. nilotica	Over-harvesting	Habitat destruction	Few local uses and high regeneration	Not in high demand in trade
C. spinarum	Trade	Local use	Abundant even on degraded sites	Wide distribution and easy regeneration
T. asiatica	Habitat destruction	Local use	Low occurrence naturally	Trade
Z. usambarense	Habitat destruction	Local use	Low occurrence naturally	Trade

CHAPTER FIVE: DISCUSSION

5.1 Introduction

This study was carried out between July 2012 and April 2014. It set out to document indigenous knowledge, use and conservation of wild plants species in Loita to enhance conservation of biodiversity for sustainable human livelihoods in Loita, Narok County. The findings are discussed under five subsections 5.2 - 5.6. In subsection 5.2 indigenous plant conservation practices are discussed; in section 5.3 significance of documented WMFPs is discussed; in subchapter 5.4 continued availability of selected WMFPs is discussed using density and population pattern of selected WMFPs; subchapter 5.5 characteristics of trade in WMFPs presented and finally subsection 5.6 is a discussion on likely future trends of wild plant species under different land tenure scenarios.

5.2 Indigenous Knowledge (IK) and Practices on Conservation of Wild plants

5.2.1 Indigenous habitat categorization and use

Habitat classification amongst the Loita Maasai followed seasonal availability and use of resources. Loita forest was reserved for dry season grazing. Loita forest was locally referred to as s (*Osupuko/Entim* i.e.highland/forest) this was most likely because dense forests were mostly found on higher elevation such as hills, plateaus or ridges. The forest was mainly used for dry season grazing and cultural activities. The forest habitat was the main source of timber (*Podocarpus* sp. & *J. procera*), wild honey and medicinal plants such as *T. asiatica* and *Z. usambarense.*

O*loiparag* comprised bush land and disturbed lowland forests on hills, degraded edge forest patches on ridges and valleys. This habitat had a high diversity species and life forms (tree, shrubs, herbs and climbers). It served as a source of timber and non-timber forest products to adjacent villages. *Olpurkel* (grassland) is mostly on flat and gently sloping plains. Species found growing in this habitat were *Acacia drepanolobium* on the plains while *Euphorbia candelabrum* grew along the valleys and edible tuber *Ipomoea latifolia* (Oloiropiji) and *Stathosema propinquum* (ole kule) .Traditionally the grassland habitat was maintained by fire and intensive grazing.

Traditional habitat classification in Loita was on the basis of topography/ altitude, dominant species/or unique species and/or vegetation cover or a combination of these factors. This is similar to conventional ecological classification (Beentje, 1994; Schmidt, 1991; Kiyiapi, 1999). Similarity between indigenous and conventional habitat classification offers an opportunity for these two knowledge systems to complement each other. Despite similarities disparities exist attributed to indicators used in each knowledge system (Mapinduzi et al., 2004)

Use of dominant species or unique species names as place names was common in naming localities Loita. Since place names remain even when species are depleted they can be used to reconstruct environmental history in adaptive management

(Schmidt, 1991; Babai & Molna'r, 2013; Aswani & Lauer, 2014). Indigenous ecological knowledge thus can be used as a parallel knowledge alongside science, as starting point where other knowledge is non-existent, be complementary to scientific knowledge where they are similarities or can be integrated with scientific knowledge or be validated through science. The idea of building synergies between science and local and indigenous knowledge is in the initial work program for the United Nations (UN) new organ the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES). Under which the indigenous and local knowledge taskforce seeks to ensure integration of indigenous and local knowledge with science (Thaman et al., 2013).

5.2.2 Indigenous knowledge (IK) transmission

Indigenous knowledge on WMFPs was well entrenched in the lifestyle and livelihoods of the communities thus ensuring continuity. In Loita transmission of indigenous knowledge on WMFPs happened alongside other learning processes in the community. Knowledge was transmitted vertically and horizontally along the social fabric. Learning was during ceremonies in manyattas where intergenerational learning took place across gender and age groups. Experiential learning occurred when performing daily chores. Transmission of indigenous knowledge in Loita was similar with other communities (Gakuubi & Wanzala, 2012; Kaya, 2014; Tuirera–Garcia et al., 2015). For specialized knowledge such as traditional medicine, midwifery and divination, learning was through apprenticeship. Disparities in

knowledge could thus be linked to gender and responsibilities (Ojelel & Kakudidi, 2015; Thongam et al., 2016). With declining platforms for such indigenous knowledge to be transferred there is expected to be a decline in knowledge with time (Thongam et al., 2016; Terrawatu, 2005).

5.2.3 Indigenous wild plant conservation practices

Traditional conservation practices involved sustainable harvesting procedures and setting aside areas for preservation. They were deeply ingrained in belief systems and influenced behavior in private and public with threats of social repercussions. Traditional sustainable conservation practices in Loita included, harvesting some stems from a multi-branched tree, after removal of some roots and cover-up and partial bark removal to allow continuity of life of harvested plant. In the past traditional beliefs and taboos succeeded in modifying behavior of community members unlike in modern times where harvesters can deplete resources without care of sustainability (Shangali et al., 2008; Msuya & Kideghesho, 2009; Tshisikhawe et al., 2012).

Concept of preservation traditionally practiced in conservation of sacred/cultural sites and controlled use of certain species resulted in conservation of wild species in Loita. Cultural sites including **Oltiyani** and **Oltukai** and hilltops such as **ole megili** and **ole medungi** were areas of strict preservation where no extraction was permitted. Sites with cultural significance were revered and traditionally protected

by the community (Nyamweru, 2012; Ojelel & Kakudidi, 2015). However with mordernity, changes in governance and the belief systems there are changes (Vooshar, 1998).

Seasonal use of the grassland, bushland and forest habitats allowed regeneration of wild plant resources. This shows that conservation was effectively ingrained in the community life. These practices were enabled by low demand from a small population, poor technology and limited access to markets. This indicates potential of traditional plant conservation practices to guide biodiversity conservation (Camacho et al., 2015).

5.3 Wild Medicinal Food Plants Use

5.3.1 Diversity of plants species used as WMFPs

The diversity species documented in use as WMFPs in Loita is an indicator of high resilience. This diversity is comparable to other studies (Ojelel & Kakudidi, 2015; Gakuubi & Wanzala, 2012; Turreira-Garcia et al., 2015). This diversity could be because the Loita community live in an enclosed area from pre-colonial times which had poor road network, bound by the Nguruman escarpment on eastern side, Tanzania boundary on the South and to the south west by Maasai Mara game reserve. In addition among the Maasai communities it is only the Loita sub-tribe

with Laibon and an active traditional governance system through the Loita council of elders (Kariuki et al., 2016).

Fruits were the most utilized plant part food, while for medicinal purpose the commonly utilized parts were roots and root bark followed by stem and stem bark. For species documented with a primary use as food, a high percentage excluding herbal teas and vegetables were consumed raw as reported elsewhere (Ojelel & Kakudidi, 2015). Consumption of food in the raw state is sometimes encouraged as some nutrients may be lost during processing (Chauhan et al., 2015). There is concern however in that some species at certain times are poisonous or requiring special processing or moderation in consumption (Feyssa et al., 2011a).

5.3.2 Indigenous/folk taxonomy

Species documented in Loita had many local names, different names were given for the seedling, mature tree and fruit of the same species; one name could be used to refer to a group of species, plant names could be likened by terms such as its smell or one name referring to many species and one species could have many names e.g. Ololiondoi/Olturuj – *Olea capensis.* Complexity of Maasai local names was earlier noted by Maundu et al. (2001). For example amongst the Loita Maasai Acacia species had specific names while among the Kikuyu plant species from this same genus were given one name (Gachathi, 2007). This maybe because this was a dryland species rarely found in the highlands. Thus indigenous plant naming is

influenced by various factors and descriptive names are common in folk taxonomies (Gakuubi & Wanzala, 2012; Nahashon, 2013; Otieno et al., 2015).

5.3.3 Use of wild medicinal food plants (WMFPs)

For the Loita Maasai use of WMFPs was as routine in soup or as herbal tea or wild vegetables while fruits, gum bark and tubers are consumed while out in the field. The findings that the Loita community does not consider consumption of wild plants as source of food or main meal concurs with other studies (Were & Olenja, 1986; Parker et al, 2007). However in times of food shortage when milk production was low WMFPs would be consumed as snacks, to quench thirst and hunger while in the field. Wild plants were additives to their diet or supplementary for example wild fruits and gum. The use of wild plants thus contributes to household food security especially in times of scarcity and to bridge periods of food shortage (Ibui, 2007; Shumsky et al., 2014; Salih & Ali, 2014).

Due to seasonal/opportunistic use, WMFPs are not mainstreamed or recognized as important in contributing to household food security or primary healthcare (Ojelel & Kakudidi, 2014; Salih & Ali, 2014; Boedecker et al., 2014; Feyssa et al., 2011a). They have therefore remained as minor foods whose use or role may not even be recognized. There is need therefore to promote WMFPs for nutrition especially essential vitamins and micronutrients found these wild medicinal food plants.

5.3.4 Significance of Wild Medicinal Food Plants

Plant life forms of documented species were herbs, lianas, shrubs and trees. Medicinal plants such as *T. asiatica* and *W. ugandensis* were used by all groups depending on the ailment. WMFPs are part of Loita landscape where this community lives and relies on them for their livelihoods. Besides, they also had multiple uses in the household such as lighting, wood fuel, fodder, construction, carving and making handicrafts. Therefore like all biodiversity WMFPs in Loita play a crucial role and should be conserved for posterity as part of their tangible and intangible heritage.

The efficacy and safety of medicinal plants has been of major concern and this has hampered development of traditional medicine. Positive validation of claims by traditional healers through science are gradually facilitating change attitude and this explains increased popularity and increased demand of natural products worldwide (Kigen et al., 2013). Traditional medicine has been hailed in holistic management of terminal illness in the elderly and in home healthcare of terminally ill patients. Use of WMFPs has a scientific and practical utility of linking biodiversity, ethnobotany and pharmacology in search of viable and evidence based interventions to address community health (Tufts et al., 2015). Literature on selected WMFPs have displayed nutritional, antioxidant and anti-inflammatory activities indicating potential use of these plants as nutraceuticals and management of health conditions (Acipa et al., 2013; Okach et al., 2013; Anywar et al., 2014). Use of WMFPs is

engrained in the culture, thus their use as potential foci for local food security, livelihoods and plant conservation (Tufts et al., 2015).

5.4 Density and Population Structure of Selected WMFP Species

Population structure of trees and shrubs has significant implication on their sustainable use.

5.4.1 Density and population structure of *Acacia nilotica*

In Loita *A. nilotica* was found outside the forest with a high density and low frequency (Tables 4.7 & 4.8). Dominance of *A. nilotica* outside Loita forest may have been due to its ability to withstand browsing. Besides the seeds are able to tolerate burning, a management strategy used by pastoral communities to maintain the grassland habitat. *Acacia nilotica* was dominant occurring in thickets along Tanganyika road between Entasekera junction and Olemesutye shopping centre. Raj et al. (2015) reported that A. *nilotica* grows well in alluvial and black cotton soil.

Acacia nilotica pattern suggested good regeneration although according to Raj et al. (2015) it grows to a stem diameter of over 50 cms under cultivation in India. A major threat for *A. nilotica* is land clearance for agriculture. Effect of current use are neutralized as *A. nilotica* invades degraded grasslands and abandoned farms. However this trend may reverse as more bushland is converted permanently into farmland. Currently the threat to *A. nilotica* species is charcoal production even in other parts of Narok County (Robert, 2005). It is a by-product of land clearing and

is facilitated by good road connection to markets. The observation that *A. nilotica* can be invasive agrees with other studies (Reichard &Seedbacker, 2009) and thus can be used rehabilitating degraded areas (Raj et al., 2015).

5.4.2 *Density* and population structure of *Carissa spinarum*

Density of *C. spinarum* was higher outside the forest than within the forest. The distribution was almost even in the two sites. Population structure of *C. spinarum* displayed a good reproduction with most stems at the lowest size class with dbh below 20 cm. From field observation *C. spinarum* was found growing in the bush lands outside the forest and on the edge of forest glades. Seeds of *C. spinarum* are orthodox and being edible the fruits are dispersed by birds and primates allowing for its widespread distribution. Despite reported harvesting and trade during the pilgrimage to Loliondo in neighboring Tanzania (Malebo & Mbwambo, 2011; Senzota, 2012). This maybe because *C. spinarum* is not habitat specific. *Carissa spinarum* has beautiful flowers and fruits abundantly, its thorny and climbing nature make it attractive for live fencing and boundary marking as a conservation approach, as it regenerates after lopping and browsing (Dharani et al., 2010). This would ensure its availability for household use of fruits and roots for medicinal purposes within proximity of the homesteads.

5.4.3 Density and population structure of *Myrsine africana*

Mrysine africana herb and was rare with low frequency. It was popularly used for human and ethno-veterinary medicine. Local use and scarcity was evidenced by sale in markets within Loita. Scarcity of this species may have resulted from overharvesting of fruits leaving behind non-viable seeds for future establishment. This could have been aggravated by habitat degradation as from field observation *M. africana* occurred under open canopy of large trees, rocky dry sites, forest edges and disturbed sites as undergrowth vegetation.

5.4.4 Density and population structure of *Olea europaea* sub species *africana*

Among selected WMFP species *O. africana* had the highest density per hectare and the highest overall frequency. Population structure pattern of *O. africana* indicated good recruitment. The sudden drop of stems over 10 cm diameter. *Olea ssp africana* could have resulted from overharvesting as it had multiple uses. The persistence of this species may be attributed to its cultural value hence used it sparingly, its ability to resprout from stumps and from seed and favorable environment. However, Maundu et al. (2001) reported low density of saplings of *O.* ssp *africana* in the 1990s and this could explain the multimodal distribution pattern. A similar finding was reported for *Olea capensis* in the same genus (Tsingalia, 2010). The preference for *O.* Ssp *africana* as fuelwood would continue but the use as a source of lighting may reduce as other options such as kerosene, electricity and solar are adopted by households. With depletion of sources outside forest and inaccessibility of the forest

with increased distance other alternatives may be used lowering demand and resulting in its re-establishment from natural regeneration.

Olea ssp *africana* is a highly valued species that has been targeted and depleted for woodcarving in Eastern Kenya, carvers in Wamunyu reported outsourcing from other areas including Maasai land, Narok (Mutinda, 2014). Because of its high timber value *O. africana* is a priority tree for cultivation and planting material has been cited as a challenge *in circa* (Dharani et al., 2010).

5.4.5 Density and population structure of *Osyris lanceolata*

Low density of O. *lanceolata* species was recorded during this study with diameter mainly below 10 cm. Under natural conditions and in unexploited stands higher densities have been reported (Mwangingo et al., 2003). *Osyris lanceolata* pattern in discontinuous recruitment and absence of representative individuals in higher size classes. This could be as a result of excessive harvesting of stems/or a period of poor reproduction and recruitment overtime and poor establishment (Peters, 1994). In Loita this was as result of illegal harvesting reported in Loita from the year 2000 (Kamondo et al., 2014; Sharrock et al., 2014). The major concern is the unsustainable harvest for export as the heartwood is targeted for international trade and this doesn't allow regeneration. Local use on the other hand was low scale as only the stem bark was harvested allowing the stumps to resprout.

Gathara et al., (2014) reported that *R. natalensis* was a good indicator of this species. *Osyris lanceolata* is dioecious and host dependent hence its challenge species to propagate, recently successful vegetative propagation by marcoting was reported (Kamondo et al., 2014). Successful plantation establishment of this species would endear it for agroforestry as there is already market.

5.4.6 Density and population structure of *Rhus natalensis*

Rhus natalensis had a higher density and frequency outside the forest. From field observation it thrived better in bushlands as a secondary species. Population structure of *R. natalensis* displayed a good recruitment of seedling and saplings in the first two size classes then a decrease in the middle size classes indicating poor establishment into mature trees. This could be due to disturbance of its habitat.

Because *R. natalensis* was a popular fruit for children it was left on farm for shade, placing beehives. However clearing of indigenous vegetation for agricultural expansion would eventually decrease its availability.

5.4.7 Density and population structure of *Toddalia asiatica*

Toddalia asiatica had a high density and even distribution inside the forest. It was only found in the forest, this showed it is a forest species and degradation of forest would result in its depletion in Loita. Population structure pattern of *T. asiatica* showed a moderate to low reproduction. Recorded stems were mainly below the 10

cm size class. This pattern shows fair regeneration but poor establishment. *Toddalia asiatica* is a forest species and could be a pioneer species which relies on canopy openings in the forest.

Toddalia asiatica is used by most communities in eastern Africa (Gachathi, 2007; Orwa, 2008; Kokwaro, 2009). The popularity and rise of herbal products are likely increase pressure in Loita as they move further to harvest in remaining stands. It was highly ranked on the national list during the Conservation Assessment and Management Planning (CAMP) workshop in 2005 (Kariuki & Simiyu, 2005). This species is sparsely distributed in the natural habitat and widely used by other communities for medicinal purposes (Schmelzer et al., 2008). Demand in markets outside Loita are likely to deplete this species in Loita (Kariuki & Kibet, 2007; Mcmullin et al., 2012). According to Nyamukuru et al. (2014) propagation trials of *T. asiatica* exhibited high dormancy and low synchrony of seed emergence.

5.4.8 Density and population structure of *Warburgia ugandensis*

Warburgia ugandensis had a medium to high density and was mainly found in the forest. This showed that *W. ugandensis* grew in the two sites (outside and inside the forest) but had been depleted outside. *Warburgia ugandensis* pattern indicated a good regeneration and recruitment with an inverted J-shaped curve. High number of seedlings and saplings in the forest in canopy openings where old stems of this species indicated good recruitment. Absence of stems in middle size classes

indicates period of intense harvesting or unfavorable environmental conditions for regeneration. Other studie shave reported stable populations of *W. ugandensis* (Okul, 2014). An aphid attack on *W. ugandensis* its fruit was reported and this concurs with Okul (2014).

Warburgia ugandensis is a hardwood widely used as timber, for poles fruits for food though bitter and medicinal purposes. From other studies it was popularly traded elsewhere in Kenya (Kariuki & Kibet, 2007; Muriuki et al., 2012). Despite not being listed in CITES *W. ugandensis* in Kenya is a species of conservation concern (Kariuki & Simiyu, 2005; Mcmullin et al., 2014) with reported challenges in propagation (Nyamukuru et al., 2014). Two species *Warburgia salutaris* and *W. ugandensis longifolia*in the same genus are of conservation concern (Nahashon, 2013; Otieno 2014).

5.4.9 Density and population structure of *Zanthoxylum usambarense*

Zanthoxylum usambarense had a low density overall in Loita with more stems found outside the forest but higher frequency inside the forest. *Zanthoxylum usambarense* pattern showed low reproduction and fair recruitment into the lower size classes. This pattern was indicative of poor regeneration and establishment. This could have resulted from past overharvesting of reproductive trees, lack of pollinators or environmental challenge on reproduction and establishment of the species. From

field observation the stumps of *Z. usambarense* coppice and establish into stems under favorable environmental conditions.

Zanthoxylum usambarense species had multiple uses in Loita. The species has been mainly cleared in areas adjacent to homesteads and standing trees had either some branches removed or stem debarked indicating high use intensity. Due to the low density and decreasing population structure this species is of conservation concern in Loita. Despite *Z. usambarense* being ranked among the national priority medicinal plants in Kenya (Kariuki & Simiyu 2005) no propagation or genetic improvement studies have been undertaken. It is proposed for management through natural regeneration and coppicing (Dharani et al., 2010).

5.4.10 Summary Density and Population structure of selected species in Loita

A higher density of species *O. europaea, W. ugandensis* and J. *procera* was recorded in the forest transects compared to the bushlands and woodlands (Maundu et al., 2001). Species population structure is dynamic and sensitive to changes in regeneration and disturbance. This signifies a stable self-maintaining population for *W. ugandensis, R. natalensis, T. asiatica, C. spinarum* and *O. lanceolata* stems.

The species *W. ugandensis, O. europaea* subsp *africana, Z. usambarense* and *A. nilotica* were missing out on some size classes and appeared to have peaks and valleys. According to (Peters, 1994) that is a typical population structure of a species

that experiences sporadic or irregular seedling establishment but level of regeneration is sufficient to maintain population. This distribution is common in late secondary species that depend on canopy gaps for regeneration or a population temporarily interrupted through excessive harvesting of seed, establishment of fruits or direct physical damage or lack of pollinators or dispersal agents (Peters, 1994).

5.4.11 Conservation of wild plant species

Patterns of biodiversity distribution have largely defied explanation due to many interacting local driving forces, anthropogenic, ecological and abiotic factors (Dornelas, 2010). In Loita the selected species had varied patterns of population structures, density and distribution.The high density of stumps outside the forest may have been due to proximity to homesteads; wood products needed by households such for construction and firewood were collected from habitats neighbouring homesteads. Distance to the forest hindered the women who were mostly responsible for house construction and firewood collection from sourcing materials inside the forest if readily available outside the forest. Lower size class diameter of stumps reflects stem sizes used for construction in Loita. Utilization of wood products would have led to reduced productivity. Partial harvesting through debarking or lopping branches may hamper seed production while browsing may stunt some species as reported in studies (Maundu et al., 2001; Neelo et al., 2013; Okul, 2014).

Whether a stump re-sprouts or not was dependent on the species, age and stump size.Amongst the selected species *O. europaea* ssp *africana*, *O. lanceolata* and *R. natalensis* stumps were found coppicing. Lower size classes for stumps of > 60 cm basal diameter. *O. europaea* ssp *africana*, aggressively coppiced despite the stump size while sawn stumps of *Podocarpus* species did not resprout. Coppicing of stumps in dryland helps the plants persist, young coppice shoots utilize the established root system of the mother plant (Mwavu, 2007) and stump regeneration is an indicator of resilience (Geldenhuys, 2004).

Traditional grazing patterns had changed, with some areas previously covered by indigenous wild vegetation converted into farmland. With reduced range area, rotational grazing previously practiced would be limited subjecting seedlings and young coppice shoots of palatable species to browsing by livestock (Neelo, et al., 2013). In Loita the situation could be compounded further by migratory and resident wildlife (Borer & Seabloom, 2014).

Due to relative availability of diverse plants species in Loita within proximity respondents were ignorant of the conservation status of WMFPs. This was because of ease of access from the neighborhood for most species or use of alternatives... Perception on conservation moderates and determines the behavior, responses and levels of support from the community (Njoroge et al., 2010). Options for ensuring continued conservation of important WMFPs are ecosystem based approaches, they

include agroforestry and live fences to reduce pressure on wild stocks (Hamilton et al., 2012). In Loita this approach would apply for *C. spinarum* and *M. africana* species.

5.5 Wild Medicinal Food Plants Trade

5. 5. 1 Characteristics of wild medicinal food plant (WMFPs) markets

Wild medicinal food plants trade (WMFPs) in Narok was informal. Traders displayed their products in open areas while traditional health practitioners (THPs) used clinics. WMFPs trade were a new product, unlike farm produce and livestock which had designated sale sections in markets allocated by the County government. This ad hoc operation of WMFP markets has been reported for wild plant products (Orwa et al., 2008; Petersen et al., 2012; Waiganjo, 2013). However in regions where traders are organized negotiate with the county governments for space (Kariuki & Kibet, 2007).

5.5.2 Characteristics of WMFPs traders

All traders interviewed were Maasai, the dominant community in Narok County. In addition traders identified ethno-species with Maasai vernacular names. The use of local names of ethno species in markets is common in wild medicinal plants trade (Barirega et al., 2012; Otieno et al., 2015). Besides herbal medicine from the Maasai community is popular in Kenya with traders traversing other Counties to sell products (Kariuki & Kibet, 2007).

In Narok WMFPs trade was dominated by men as reported in other studies (McMullin et al., 2012; Waiganjo, 2013; Orwa et al., 2008; Nahashon, 2013; Otieno et al., 2015; Akbulut & Bayramoglu, 2013). Dominance of males in WMFPs trade in Narok however, contradicts other findings in (Barirega et al., 2012; Macia, 2005).

Traditionally, trade in WMFPs was relegated to the elderly, but during this study average age for respondents was 48 years. This showed that there was recruitment of the younger generation allowing continuity of the practice. Similar observations were made by Mcmullin et al. (2012) and Waiganjo (2013) who noted that this allowed transmission of knowledge. Although most engaged in WMFPs trade as result of unemployment or loss of other forms of livelihood (Waiganjo, 2013; Barirega et al., 2012). With sustainable harvesting and value addition along the market chain, trade in WMFPs can be used to revitalize local health and traditions while at the same time diversifying livelihoods.

Over half of the traders had no formal education indigenous knowledge transmission was ongoing and it equipped traders with knowledge and skills required to practice this trade. Low levels or lack of formal education among traders was reported by (Waiganjo, 2013). Lack of formal education could partially explain why WMFPs trade was informal (Barirega et al., 2012). Lack or low levels of formal education deprived WMFP traders from Narok opportunities to sell products. This was observed in Suswa market with Maasai traders from Tanzania well versed in Swahili

language selling packaged products. However it was noted that use of the local language is a tactic of protecting indigenous knowledge (IK) from bio-prospectors and external people from engaging in the trade (Msuya & Kideghesho, 2009). It also gives an edge to locals over external traders.

Knowledge and the practice of WMFPs was acquired through apprenticeship and inheritance. This ensures that knowledge is passed through the family and the trade was protected. Induction of relatives into the trade is common in marketing of herbal products and herbal practice (Orwa et al., 2008; Tshisikhawe et al., 2012; Akbulut & Bayramoglu, 2013).

Trading in WMFPs in Narok has been in existence in 1980. Evolution of the trade partly explains changing means and diversification of sources of revenue by the Maasai community. Existing indigenous knowledge gives an edge to locals in this business. Changes in dry lands such as increase in population, land demarcation and privatization have negatively affected pastoral livelihoods. This has been aggravated by weather variability and as an adaptation locals sought to diversify their activities and trading in WMFPs is one such option (Mcmullin et al., 2012; Abtew et al., 2014).

Increase in WMFPs traders over the last thirty years could be explained by external factors. Internationally, “the Chiang Mai declaration” in 1978 was the first formal

recognition of the essential role of medicinal plants in primary healthcare. In Kenya, it coincides with policy developments in the area namely establishment of the Centre for Traditional Medicine at Kenya Medical Research Institute (KEMRI) in 1985. Recognition of traditional healers by the Department of Culture in the 1990s; and 2001 declaration of the Decade for African Traditional Medicine by the African Union 2001 - 2010. Since then, 31st August became the day of African Traditional Medicine celebrated in Kenya and supported by World Health Organization (WHO) through Ministry of Health and Department of Culture.

5.5.3 Taxonomic spread and lifeforms of WMFPs products in markets

In Narok County, 106 plant species were recorded in the markets these species were spread in 46 families. The family Asteraceae had the highest number of species followed by Fabaceae, Solanaceae eight while Cactaceae, Lamiaceae and Rosaceae had seven species each. The number of species on display in the markets ranged from four to sixty-five, more than twice the number reported by (Muriuki et al., 2012). The variance could have been as a result of the category of vendors since as the trader's advance they tend to specialize. The diversity of species in Narok number compares with other studies (Marshall, 1998;; Petersen et al., 2012; Macia et al., 2005).

Products traded in the markets were mainly sourced from shrubs and trees. This maybe because of their availability throughout the year. In addition herbs,

succulents and lianas were bulky to transport and challenging to preserve. The most popular plant part sold by traders were roots followed by stem and stem bark. The roots are the most commonly sold plant part in markets (Tshisikhawe et al., 2012; Mcmullin et al., 2012; Muriuki et al., 2012). Harvesting stem bark and roots is detrimental for woody species whose regeneration is slow (Petersen et al., 2012; Tshisikhawe et al., 2012).

5.5.4 Sale of WMFP products

Storage, packaging and dispensing of WMFPs products in plastic bags and unhygienic containers was health concern. This is because the products maybe expose to contamination (Ngari et al., 2013; Keter et al., 2016). The informal nature of this trade, non-uniform quantities of products sale and lack of standard products resulted in non-uniform prices. Overall the selling price of products depended on value addition on the product and the species. Scarce species such as *M. africana/Rapanea melanophloes* seeds attracted higher selling price. Pricing factors of WMFPs in Narok agreed with findings by Mcmullin et al. (2012) and Thsisikhawe et al. (2012).

On international trade in WMFPs sometimes raw materials are disguised as timber and are not detected at exit points (Nahashon, 2013). This distorts the pricing and in many cases ensures that products sold illegally fetch a marginal price in comparison to their real value in external markets.

Lack of proper record keeping challenges quantification of monetary benefits and thus contribution of WMFPs in this study and elsewhere (Barirega et al., 2012; Muriuki et al., 2012). However despite the informal nature of the trade in WMFPs have potential to contribute to household incomes indicated by the fact that traders engage in the practice and appreciate its contribution to household income.

5.5.5 Challenges of WMFPs trade

All WMFPs products on sale were collected from the wild except *A. indica.* Pastoral land use in Narok and communal ownership of land in the past allowed continued availability of WMFPs in the landscape freely. However this may be hampered by privatization and conversion of land use conversion to agriculture. Wild sourcing of NTFPs is a common practice in developing countries where policy on traditional medicine is not clear and products are sold at the retail level in informal markets. Wild medicinal plant products are considered minor forest products in government forests and harvesters are allowed to collect at no charge (RoK, 2014). It has been postulated that relative availability of products in the wild discourages investment in on-farm production (Hamilton, 2004; Muriuki et al., 2012). This is in addition traders and consumers preference of wild harvested products (Kariuki & Kibet 2007: Mcmullin et al., 2012). Ecological sustainability of illegally harvested plant species was questionable even within protected areas for species of conservation concern (Petersen et al., 2012).

However with formalization and development of the natural products industry final end processers would prefer farm materials (Muriuki et al., 2012). . Species in high demand would be scarce in the wild which could trigger domestication and production for the market. Scarcity of *O. lanceolata* and *M. africana* in Loita may have resulted because of its trade be because of trade (Hamilton, 2004; Nahashon, 2013). Assessment of all aspects of medicinal plant markets is difficult to achieve with certainty according to Cunningham et al. (2006).

5.6 Scenarios for Conservation of Wild Plant Species

5.6.1 Changes in land cover/land use in Loita

Based on environmental history there was an increase in bushlands and reduction of forest habitat. This trend was expected to continue as the community transited to an agro-pastoral livelihood. The reduction in forestland could have been due to habitat degradation, land use conversion into cultivated agriculture, increase in population and livestock in Loita landscape overtime. Expansion of cultivated agriculture is a major cause of depletion of wild plant resources in Narok County with increased land adjudication (UNEP, 2009). The shift in cover however maybe universal change in vegetation structure that shifted towards bush cover (Roba & Oba, 2008).

5.6.2 Probable future scenarios of land tenure and likely land use/cover trends in Loita

Future land tenure and land use scenarios would be influenced by changing livelihoods, population increase, infrastructural development and leadership within Loita as a social cultural and political unit. Loita is dynamic with different layers of leadership: the age-set leaders, clan leaders, spiritual leaders and emerging forces of local elite form internal forces. State law is expressed through government representatives such as assistant chiefs, chiefs, sub-county commissioners and public officers.

Land issues in Loita are complex especially Loita forest as demonstrated historically by the failed International Union for the Conservation of Nature (IUCN) project and Narok County Council proposal to convert Loita community forest into a game reserve in the early 1990's. These two cases were supported by opposing groups within Loita which led to failure of these two attempts at external interventions. This affirms that in Loita leadership is a complex heterogeneous entity with actors with their own histories, relations and they don't always agree on the path to follow when confronted with outside interventions according to Kronenburg-Garcia (2015).

Future scenarios of land tenure will affect continued conservation of wild plant biodiversity including WMFPs within the Loita landscape. Communal ownership coupled with the semi-nomadic pastoral livelihood have supported conservation of

large tracks of indigenous vegetation. Despite the Loita community's' refusal to subdivide land into group ranches in the 1970's, the desire to demarcate land is imminent. Future proposals on tenure will most likely be informed by previous experiences and lessons learnt These are; i) internal differences between the groups in Loita ii) lessons learnt from Maasai Mara game reserve and Maasai Mau forest in Narok North and iii) the experiences in Kajiado County on formation and collapse of group ranches iv) the Ilkisonko Maasai eviction from Serengeti National.. The options available for the local community would be the status quo with communal ownership of all land in Loita; establishment of group ranches, one in every administrative location and forest as a communal group ranch for all and; privatization of the area outside the forest and government ownership of the forest.

(i) Scenario one: Communal ownership of all land and forest by Loita community. This scenario is the current status in Loita. However desire to demarcate land is evident with reported boundary disputes in Narok courts and opposition experienced during demarcation of locational boundaries. Land grabbing was reported with some families strategically positioning themselves in prime areas in different locations including settling inside the forest. Traditional leadership and the Loita Council of Elders (LCoEs) were slow in enforcing rules on use of forest and other resources amongst fellow Loitans (Kariuki et al., 2016).

However there is a tendency towards privatization of land in Loita and concern over the fate of communal spaces such as manyattas. In 2012 the local community through LCoEs and the National Museums of Kenya documented and mapped cultural sites within Loita. Three of these sites, Ole Ntrarakwai, Emururwai and Naibala cultural sites were gazetted as National Monuments under the Heritage and Museums Act2006 (RoK, 2018). Thus there is an ongoing shift from communal tenure towards privatization (Kronenburg-Garcia, 2015; Kariuki et al., 2016).

Other than ecological and economic values Loita forest to the locals, it has cultural and religious value for larger Loita Maasai, across Tanzania. It could thus be gazetted as a site of biocultural importance and nominated for consideration globally as a World Heritage Site (WHS) or Man and Biosphere Reserve (MAB). This would ensure continued use of the forest by local community and legal recognition thus deflecting internal and external pressures. Traditional management practices would be strengthened though with new meaning and use such as cultural tourism destination (Nyamweru, 2012). Indigenous and local communities have successfully managed biological and genetic resources using indigenous systems (Nyamweru et al., 2008; Mutta et al., 2009; Msusya& Kideghesho, 2009).

(ii) Scenario two: Communal ownership of all land in Loita as group ranch for every location and communal ownership of the forest as a ranch owned by Loita community. Administrative boundaries of land outside the forest were demarcated

at the locational level however the forest boundaries were not marked. Under this scenario each location would become a group ranch owned by families living therein. Loita forest would be a communal group ranch accessible to all. This was the initial attempt to land demarcation in Loita, it marked transition from communal land ownership to group ranches. If adopted this scenario would continue to support pastoralism by enhancing livestock mobility and accessibility of range resources in different habitats. However lessons learnt on group ranches elsewhere (Rutten, 2008) would help in mitigating the negative experiences of group ranches sub-division.

Establishment of conservancies in Loita was proposed by Loita Development Foundation (LDF) Loita Development Foundation (LDF) is a Non-Governmental Organistaion (NGO), initiated a programme to support livestock production and marketing. Exchange visits by some community members supported by LDF to Laikipia and Samburu Counties. However the idea of setting up Eco-lodges in the forest as proposed by LDF was not approved by the Loita community and investors withdrew funding. Establishment of community conservancies in Kenya has gained momentum Supported by the Wildlife Management and Conservation Act (2013). In Loita the grassland, bushlands and forest in Loita are inhabited by a variety of wildlife (Maundu et al., 2001; Kiyiapi, 1999). However this scenario would be unlikely following the recent disputes between locals and management of

neighboring Shompole conservancy and Kamorora ranch in 2014 and their resultant destruction (Ogada, 2016).

(iii) Scenario three: Private ownership of the land outside the forest and government ownership of the forest (Narok County Government or the National Government under KWS/KFS). In this scenario either the County government or National government would manage the forest as a game reserve or national park respectively. Individual titling and eventually private ownership of land outside Loita forest would become a likely option in Loita. This has been motivated by internal and external pressures under current state of communal ownership though land registration had not commenced (Kronenburg-Garcia, 2015: Kariuki et al., 2016). Titling of land would open up the area to external investors and more diverse livelihoods including commercial cultivation as reported in Kajiado (Rutten, 2008: Munyasi et al., 2012; Kronenburg- Garcia (2015).

This scenario would also commoditize land and make it available for intensive agriculture by external investors endangering livestock rearing the main livelihood for Loitans. Increase in population would also lead to increased livestock numbers and reduced mobility accelerating habitat degradation and eventual loss of indigenous plant resources and livelihoods. Similar reports have been documented in neighbouring Kajiado County (Rutten, 2008; Wangui, 2008, Munyasi et al., 2012).

Demarcation of forest boundaries and government ownership of the forest would be opposed by the local community (Obare, 2003). Loita forets is of interest to Kenya Wildlife Service (KWS), although not gazetted, rangers are permanently stationed at Entasekera protecting mega fauna. It is unlikely that the national government would be allowed by Narok County government to acquire Loita forest unless under a co-management arrangement. The option of converting Loita forest into a game reserve from previous experience with the Narok County would be opposed. This is despite the County's interest in converting Loita into a game reserve to generate additional revenue. This may not be feasible with new Constitution of Kenya (2010) that allows for registration of community land. Besides ownership by government has not always led to better conservation of wild plant resources as compared to the community (Mutta et al., 2009). However the Forest Conservation and Management Act (2016) and Forestry Policy (2014) partnership through Community Forest Associations (CFAs) with Kenya Forest Service (KFS) through a joint forest management plan.

In these three scenarios of land use/ tenure indigenous wild plants would continue to decrease to meet demands of a rising population and changing lifestyles. More land will be opened up for settlement and cleared for cultivation as well as meet needs of the community members. The gravelling of the Tanganyika road connecting (Narok – Narosura - Entasekera-Olomesutye –Tanzania) and installation of electricity to all primary schools in Loita are major developments observed in the

years (2013 - 2016) in Loita would likely have profound outcomes with better road connection to Narok. These developments would also open up Loita division for illegal harvesting of timber and non-timber forest products by outsiders as well as open up market for agricultural produce from Loita (Ometto et al., 2011; Chavez et al., 2014).

These will be compounded by external policies such as i) the compulsory basic education ii) national initiatives such as laws against female circumcision which will gradually dilute the elaborate cultural activities. For example the period of moranhood was 7-10 years but has now been reduced. During the study it was observed that school going boys (warriors) were exempted from elaborate cultural activities and would only participate in the manyatta activities during school holidays. It is expected that formal schooling would interfere with the traditional and experiential learning and eventually interfere with transmission of indigenous knowledge (IK). At national level the Constitution of Kenya 2010 recognizes community ownership thus helping communities such as Loita continue to own land communally. The Convention Biological diversity (CBD) through article 8j recognizes the role of indigenous knowledge in conservation of biodiversity which is further strengthened through the Nagoya protocol which Kenya is signatory (CBD, 2011). Loita is a dynamic area socially, politically and ecologically. The eventual outcome maybe a combination of the three scenarios with modifications

not already envisaged as the local community adapts to change (Fernadez-Liamazares et al., 2015; Galvin et al., 2015).

5.6.3 Likely future scenarios for selected species in Kenya

Herbarium specimen data revealed that selected species were widely distributed in different floral regions in Kenya (Fig. 5.1). However some of the recorded sites have undergone land use change to agriculture or urban developments. With Kenya having less than 2% of indigenous forest cover under government protection and species occurring outside protected areas where the population is high and there is a likelihood that these species are threatened by land pressures in floral region K3 Central highlands and floral region K5 Nyanza where population density is high and there is intensive agriculture. In the arid and semiarid zones (ASALs) floral regions K4 (Lower Eastern) and K6 (Maasai land)) population is gradually moving and adopting irrigated cropping in areas formerly supporting semi-nomadic pastoralism. Selected species are under pressure from land use change as a result of urbanization and expansion of agricultural in their native habitats nationally.

As population increases, the demand for more land for cultivated agriculture and settlement will increase and put pressure on indigenous plant resources within and outside protected areas. Hence the need to adopt new approaches for conservation to offset these pressures such as agroforestry, farm forestry, herbal gardens and live fencing for useful species at the local level. For continued conservation Galvin et al.

(2015) proposes biocultural approaches to conservation which would increase the adaptive capacity, in-cooperate more stakeholders and resources while integrating different worldviews and resource management frameworks as the basis for multiple knowledge thus increasing options and likelihood of long-term success in conservation.

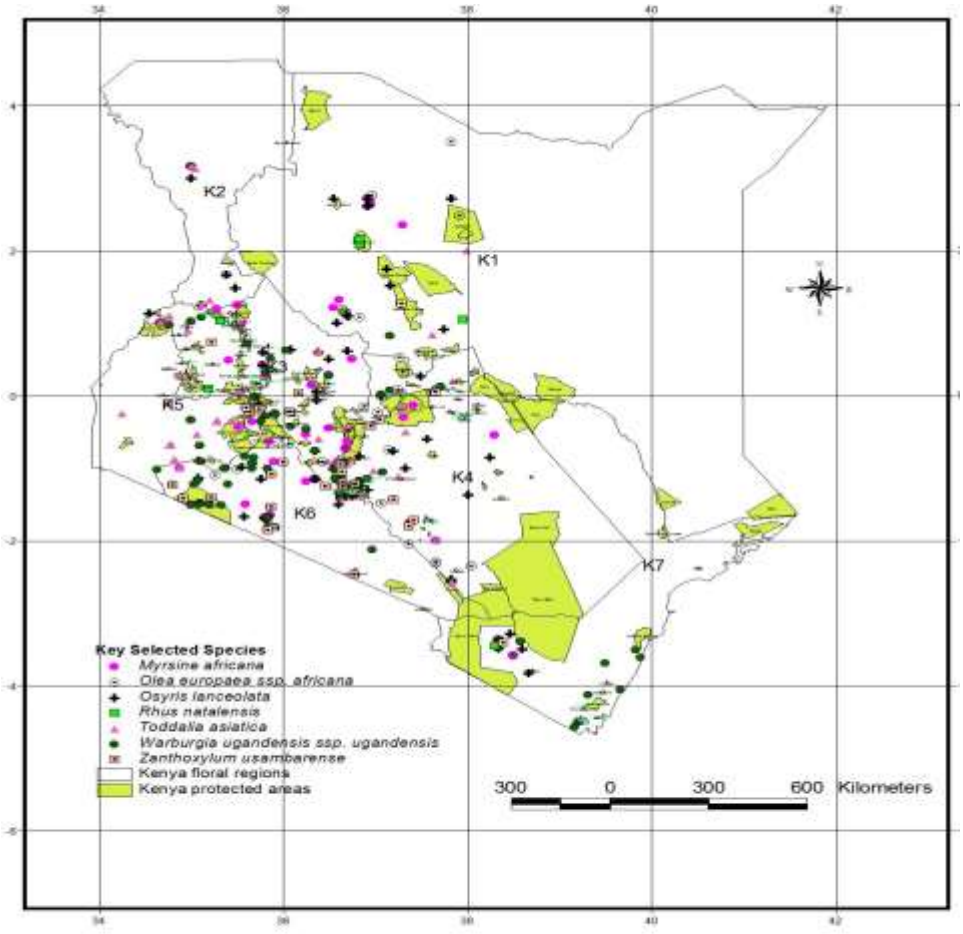


Figure 5.1: Map showing distribution of selected species over Kenya floral regions and designated conserved areas

The trends of species in Loita will depend on their preferred habitat. The area under forest is on the decrease, continued conservation of plant species found in this habitat will depend on ability to halt this trend. Species that can withstand habitat degradation will tend to increase initially as the bushland increases but will even out and reduce as this habitat is converted into agricultural land.

CHAPTER SIX: SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

6.1 Summary of Findings

6.1.1 Indigenous conservation practices

Traditional Loita Maasai nomadic pastoralism livelihood and plant use practices have supported biodiversity conservation. With changing livelihood, reduced forums for inculcation of IK due to reduction in intensity and frequency of cultural activities may result indecline indigenous knowledge and biodiversity.

6.1.2 Use of wild medicinal food plants (WMFPs)

Two hundred and two (202) species were documented as WMFPs species comprising of herbs, lianas, shrubs and trees life forms. Plant parts used included fruits, roots, tubers, gum, leaves, bark and stems. The species were utilized by different gender/age groups. The diversity of species used ensured an all year round supply of WMFPs enhancing healthcare and nutritional security of the community.

6.1.3 Selected species density and population structure for sustainable harvesting and use.

Selected WMFPs occurred inside and outside the forest except *T. asiatica* which was only found in the forest and *A. nilotica* which was only found in plots outside the forest. *Z. usambarense*, *O. lanceolata* and *M. africana* were rare. Indigenous

wild plant species in Loita were found to withstand local use through regeneration by seed, coppicing and root suckers making them resilient under low pressure.

6.1.4 Trade in wild medicinal food plants

Species in trade were under threat due to selective and unsustainable harvesting driven by external and international markets as observed for the case *Myrsine africana* and *Osyris lanceolata* species respectively.

6.1.5 Future Scenarios

Under the communal ownership there is expected to be a decline in the role of traditional institutions in management of forest which may lead to increased permanent settlement and degradation. This would be accelerated by ongoing developments in Loita such as the grading of the Tanganyika road, connection of electricity and construction of modern structures and use of technology in harvesting timber. Under the group ranches scenario there is expected decreased settlement in the forest and better controlled use of resources under each ranch due to territoriality. Due to diversified livelihood into ecotourism there would be decreased cultivation agriculture hence reduced land use conversion. Under private ownership of land outside the forest and joint forest management there would be rapid decline of indigenous vegetation resulting from increased cultivation outside the forest. Within the forest, degradation may be halted through eviction of those living permanently inside the forest and improved forest management with technical

support under a Memorandum of understanding (MoU) between the community and County /National governments.

6.2 Conclusions

The objectives of this research study were; documentation of IK on conservation practices and identification of wild plants and wild medicinal food plants, assessing the density and population structure of selected species of WMFPs, characterizing trade of WMPs and developing sustainability scenarios for conservation of WMFPs have been achieved and the research questions answered. The following conclusions are drawn from this study:

- Indigenous knowledge and conservation ethics are deeply engrained in the way of life of traditional Loita Maasai has supported plant biodiversity conservation including WMFPs. The cultural setting and pastoral livelihood allowed for interaction with the physical environment and learning from an early age of the inhabitants. Special occasions in the community life cycle allowed for transmission of indigenous knowledge supported by traditional institutions.
- For the Loita Maasai community, use of WMFPs is a way of life. These plants species are consumed periodically, routinely, by chance and/or on need, for preventive, curative, cultural/ religious purposes according to gender/age group. Traditional use of some species has been validated through science in published literature.

- Two species *M. africana* and *O. lanceolata* were threatened. *Myrsine africana* by overuse, habitat degradation and local trade while *O. lanceolata* is threatened by illegal international trade. Selected WMFPs population stuctures showed resilience overall under traditional use.
- Trade in WMFPS in Narok is evolving and traders operate informally. There was a gradual increase in trader's overtime from the 1980s. Entry into the trade seems to be prompted by loss of their traditional livelihood of livestock rearing through drought.
- Future scenarios of will be decline selected WMFPs in Loita. This decline will be influenced by land use change overall, trade in targeted species, politics of land tenure and local community institutions and infrastructural developments.

6.3 Recommendations

Continued conservation of indigenous plant species in Loita will be a challenge in the face of increasing population, changing livelihoods and land tenure scenarios amidst globalization. To avert likely negative impacts on biodiversity and livelihoods there is need to create awareness at the local level on the importance of biodiversity conservation to empower community members to make informed choices.

I) Thorough documentation of Loita Maasai culture for posterity including tangible and intangible heritage. This would include a vegetation inventory of the landscape. An output of this research as a draft Loita Maasai ethnobotanical dictionary which will be enriched.

II) Conservation initiatives *in situ* for all species using ecosystem based approaches.Production on farm or *in circa* initiaves targeting heavily utilised species such as *O. lanceolata, M. africana, T. asiatica* and *Z. uzambarense* plant species.

III) To address the challenge of sustainable harvesting by the traders it is recommended that trader's form an association through which they can be trained on sustainable harvesting, value addition and marketing of WMFP products to fetch better prices.

IV) Loita forest has various cultural sites within it and is often used by the Loita community living in Kenya and Tanzania. For continued use there is need for gazetment of Loita forest National Monument and/or listing it internationally as a World Heritage Site (WHS) or Man and biosphere Reserve (MAB) under UNESCO.

V) Because of the current encroachment of the forest there is need to dvelop a forest management plan for Loita forest to include all forest users and control ad hoc utilisation and permanent settlement within the forest.

6.4: Recommendations for Further Research

I. Nutritional, phytochemical and toxicological evaluation of concoctions and recipes of products used traditionally used as WMFPs to inform/validate traditional use.

II. A detailed ethno-biological study in the Loita landscape and including establishment of long-term monitoring plots.

III. Trails on conservation through either enrichment planting and/or domestication of plant species threatened by local use such as *M. africana*, *Z. usambarense, O. lanceolata* and *T. asiatica* within Loita for continued use.

IV. Value chain analysis of species sold outside Narok to establish the economic value of the trade and if feasible recommend it as an economic activity.

V. Study on the political ecology of Loita. Loita is a dynamic socio-ecological landscape with an active traditional governance system and the state officials working in harmony. There exisist local functions but community are united against external interference.

As baseline for the above articles published from this research are published in Appendix V.

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APPENDICES

APPENDIX I: RESEARCH TOOLS

Appendix IA: Household Questionnaire

Part 1: Background in information

Interview No ---------- Date ---------- Interviewer ---------
Age: ---------- Gender: ----------
Years of schooling: ----------
Community: ---------- Location ----------Division ----------
Status in the community ---------- (Adult /Parent/ Healer /Other (state)
Occupation: ----------

Part 2: Household use of Medicinal Foods (Plants MFPs)

1. If yes to the above question which NTFPs are collected and used by members of your household?(Fruits; vegetables; Oils; tubers; gum; bark; stems; shoots; flowers) other specify ----------
2. Please list names of all indigenous plant species consumed by your household either as food or medicine in **Table 1.**

   Table 1. List of plants utilizesd as food or medicine in your household.

Species local name	Part used as food	Part used as medicine (indicate if used for livestock or human)	Other uses of the same species

   Key: Plant parts: Rhizomes, bulbs, roots, bark, leaves, fruits, flowers, seeds, and gums stem bark, root bark,

3. Of the plant species listed in table 1, please rank the **ten most important MFPs in order of importance** in table 2. (The most preferred being number one (1)):

Table 2. Ranking of the ten most important MEPs in order of importance

Local species name	Plant part	Who consumes (warriors/ men /women/, children/all)	Other uses: (wood fuel, carving, ceremonies)	Availability in months or the /season.	Abundance/ scarce	In markets (Yes / No.)
1						
2						
3						

4. Of the ten species ranked in Table 2, please list the **five most preferred species as food** and indicate the frequency of consumption as **Food plants** by your Household in the table 3.

Table 3.List of the five most preferred species as a food

No.	Medicinal Food (species name)	Time of the year (months)	Days	Frequency	Measure	Method of preparation / accompaniment	Intended Purpose
1							
2							
3							
4							
5							

Legend

Time of the year = Dry season/ Wet season specify month if possible: Days= Number of days in a week

Frequency = Usual number of times in a day: Measure =Amount (glass, spoon, handful etc)

Method of preparation: Boiling, drying, burning etc soaking etc (with soup, milk, plain etc.)

5. Of the above ten species (Refer to table 2) please indicate the frequency of consumption of these species as **Medicinal** by your Household in the **table 4**. Table 4. Frequency of consumption of these species as **Medicinal** by your Household

No.	Medicinal Food (species name)	Time of the year (months)	Days	Frequency	Measure	Method of preparation / accompaniment	Intended Purpose
1							
2							
3							
4							
5							

Legend: Time of the year = Dry season/ Wet season specify month if possible: Days= Number of days in a week

Frequency = usual number of times in a day: Measure/Amount: Mug glass, spoonful, handful etc)

Method of preparation: Boiling, drying, burning etc soaking etc (with soup, milk, plain etc.)

6. Are there any Medicinal food plant species that are **restricted** to certain groups/categories of people? Please list **at least five** most important species for the groups in the table 5.

   Table 5. Medicinal food plant species reistricted to certain groups/category of people

Category	Species 1	Species 2	Species 3	Species 4	Species 5
All people					
Children					
Adults					
Men					
Warriors					
Women					

Post and prenatal					
Convalescence (Sickly)					
Other group Specify					

7. Indigenous Knowledge and Conservation

1. How did you acquire knowledge on use of medicinal food plants?
2. Who is responsible to collect prepare and manage wild edible plants in your household?

Explain your answer: ----------

3. Which habitats are the MFP species are mostly collected from?
4. Are any of the species sold or bought in the markets? (Yes /NO)
5. If yes which ones (LIST)
6. Are there species which were used ten years ago and are no longer available or are very scarce? (Yes /No)
7. If yes to the question above please list them ----------
8. If yes what are the reasons for their decrease? Please list ----------
9. In your assessment are these medicinal foods plants under any threat (Yes/No). If yes to which species and what threats?

Species local name	Threats	Species local name	Threats

10. How are medicinal food species managed by your household to ensure continued availability?
11. What conservation activities are practiced?
12. Do you plant or protect any of these MFPs species? (Yes /No)
13. If yes which species and how do you protect them?
14. What recommendation would you give to ensure the continued availability of these plants?
15. Are there any **traditional rules governing** the use of these species in your community? Explain your answer.

16. Are you aware of any plant species under government protection and how did you know about it? Explain your answer ----------

17. What medicinal food plants are consumed during the **drought and famine periods** by your household community? Please list at least five species; ----------

18. Are there any **restrictions hindering accessibility** of wild medicinal food plants in the community?

19. Do you cultivate any food crops (Yes/No) and if yes which ones?

20. How else does your family obtain food?

Appendix I B: Market Survey Questionnaire

Date: Market: Interview No.
Interviewer:

Section A: General Information

Name: Trader Type
Name of Company: Address
Age: Gender:
Ethnicity Education (Years of schooling)

Section B: Inventory of Medicinal and Food plants species sold in the Markets

1. Please list the local names of the different plant species you sell for use either as medicinal or food?

Species name	Habit	Source	Habitat	Collector	Season	Part used a food	Part used as medicine

Key:

Habit: Tree/ shrub/climber/liana/herb/fungus /other specify
Source: Name of the area/place it originates
Habitat: Riverine/bush land/ forest/grassland/woodland/farm /other specify ---
Collector: Self/ Harvesters/ Family members/Company/
Season: Dry season/ Rainy season or actual months in the year
Part used as food or medicine: Rhizomes/ bulbs/ roots/ bark/ leaves/ fruits/ flowers/ seeds/ and gums/ stem bark/ root bark/other specify-------Comments:

Section C: Trade Patterns

1. How did you begin trading in medicinal/food plants?
2. How many years have you been in the trade? ----------
3. Are you a member of any Network or trader organizations? (Yes/No)If yes which one ----------
4. Do you trade throughout the year or seasonally? Explain your answer
5. How do you determine the prices of the products?(Species /ailment/ buyer/ quantity/ rarity/buying price) Other ----------
6. Do you trade always in this market? (Yes/No)
   If No name the other markets you also trade in ----------
7. Do you work alone? Yes/ No

If No who are your partners and where are they based----------

8. Of the species listed in table one above please list on the table the **ten (10) most important** species in your trade?

No.	Local name Trade name	Origin	Plant part	Product Form	Quantity	Price	Use
1							
2							
3							
4							

9. Are there any substitutes for the above species? (Yes/No) If yes name them
10. What challenges do you face being a MP/MF trader?
11. Is trade in NTFP linked with any other? (Livestock, market days)
12. Are there competing trade routes?
13. Does this trade have a future? (Yes/NO)

If No what are your other livelihood options? ----------

Section D: Species Volumes and Prices

1. Of the ten species in table above please fill in the table below trade units, amount and price for both buying and selling price and indicate whether you do any value addition.

Sp No.	Trade unit	Amount and buying price (Ksh)		Approximate amount sold per week		Processing	Selling price (Ksh)	
		Lowest	Highest	lowest	Highest		Highest	Lowest
1								
2.								
3.								
4.								

Key: Rhizomes, bulbs, roots, bark, leaves, fruits, flowers, seeds, and gums stem bark, root bark,

Trade Unit: Per kg, Number, per pile, per glass, in bundles

Section E: Supply

i) How do you obtain your plant products? (Collects myself/Harvesters/Processor/Wholesaler/ middlemen)

ii) Where do they originate/are they sourced from? And in what habitat Specific locality name – Forest/bush land/ grassland/ cultivated)

iii) What factors influence the supply or availability of these species in the market?

iv) In the table below list the **scarcest** species with **high demand**?

Species name	Use /Condition	Species name	Use /Condition

v) Have the products been processed or do you process them yourself?

Section F: Demand/Consumption

i) Who are your main customers?

a) General public b) Street sellers c) Traditional healers d) Livestock herders e) Hoteliers F) others specify ----------

Briefly describe them age, ethnicity

ii) Where do they come from? Specify region and ethnicity ----------

---

iii) Do your customers know the plant species they want by name or you prescribe for them? (Yes/No) Explain your answer----------

iv) Do your customers ask for you to prescribe the herbs for an ailment and dosage?

(Yes /No) Explain your answer ----------.

v) Do you tell customers how to use the material? 1) yes 2) No 3) Yes & No/ or some

vi) How readily do customers accept the prices?(1) Bargain 2) Accept given prices

3) Leaves if price is high)

vii) Why do customers come to your shop to buy?

1) Want herbal medicine 2) Could not be cured by other means

3) Other medicines are expensive 4) Other reason specify ----------

viii) Would your customers be willing to buy planted varieties of plants? Yes /No

If No why explain ----------

Section G: Plant conservation

i) In your opinion are stocks in nature declining? Yes/No

If yes what are the possible reasons for this? ----------

ii) What would you propose to ensure the plants are available in the future?

iii) Are any of these species being grown in nurseries? Yes/No if Yes which ones ----------
---

iv) What are the traditional systems of ensuring sustainable use?
v) Have you been trained on sustainable harvesting and by whom?
vi) Do you require any permit to collect/operate your business?

Appendix IC: Guiding Questions for Key Informant Interviews

Part 1: Background in information

Interview No. ---------- Date ---------- Interviewer ----------
Age: ---------- Gender ----------
Years of schooling ----------
Community ---------- Location ----------
Division ----------
Status in the community ----------
Occupation----------

Part II General Plant usage

1. Briefly describe the use of plants in the community (various uses and frequency of usage)
2. Please rank the various uses of wild plants in order of importance in this community?
3. Describe the usage of plants in the community for the last 30 years (Has the use of plants changed over time and if Yes why?
4. How is knowledge on plant use passed on and by whom?
5. Please list down the five most important plant species for this community and for each give reasons.

Plants species name	Reason /importance

Part III: Medicinal Food plants

6. In the table below, please list down the ten most important wild medicinal and food plants for your community?

Species	Habit (Herb, shrub, climber trees, vine etc)	Plants part used as food	Plant part used as medicine	Habitat where found	Frequency of occurrence (rare, intermediate &frequent	Quantum of extraction (large, medium or small)
1.						
2.						

Part IV Use of Plants for food and medicine

7. How does the community consume Medicinal food plants curative medicine or preventive medicine? Discuss with examples.

8. How does the use of other exotic foods compare with the use of indigenous wild foods?
Use advantages (aspects giving favour to the consumption of the food)

9. In the community which groups normally utilise the indigenous MFPs more? Discuss

(Women, men, children, warriors/ poor/rich/ Christians/ cultural etc)

Part V: Climate variability

10. What are the local indicators of climate variability?
11. How do people respond to these climatic/weather changes i.e adaptation strategy in terms of use of MFPs)
12. Please list down five species of food species that the community utilises as food during the

i) Dry season?
ii) In time of extreme famine or drought.

Part VI: Domestication/ Plant conservation and Management

13. What management practices are done for these species?
14. Are any of these species domesticated and at what level (wild/ semi-wild/ cultivated /kept?)
15. Is there planting of indigenous species in this area?
17 By whom and where do they get the seeds or seedlings?
18. In your opinion are stocks in nature declining?
19. If yes what are the possible reasons for this?
20. What would you propose to ensure the plants are available in the future?

Appendix Id: Field Inventory Data Sheet for Conservation Status Surveys

Date: Location / Block:
Plot No. GPS Readings
Slope/elevation
Soil type

General Information

General description of the plot:
Dominant species: 1. 2. 3.
Vegetation cover: Tree% Shrub% Herbs%
Distance from the main road and/or motor able path: ----------

1. Species inventory 50m by 20m plot

species	No. of seedlings	No. of saplings	No. Mature trees	Comments

2. Key species population structure 50by 20m plot

Plant species selected for the study	Basal diameter	Diameter 1.3m	Height	Any comments

3. Threats indication

Stumps:

Species	Basal diameter	Regenerating yes/no	Estimated age

4. Other human activities

Human activity	**Size**	**age**	**Other comment**
Charcoal making			
Fire/ burning			
Sawing			
Indications of extraction Root bark stem			
Firewood			
Farming/cultivation			
Tracks			
Hunting snares			
Wild animal dung			
Invasive species			
Exotic species			

Other comments --

APPENDIX II: WILD MEDICINAL FOOD PLANTS DOCUMENTED IN LOITA DURING HOUSEHOLD SURVEYS

List of MFPs documented during the household survey in Loita use landscape for this table. Indicate headings for all subsequent pages

Family	**Genus**	**Species**	**Local name (singular)**	**Local name (Plural)**	**Name of plant part**	**Life form**	**Part used as food**	**Part used as human medicine**	**Live stock use**	**Other uses**
Leguminosae	*Acacia*	*abyssinica*	**Oltarara/ oltaraarani**	**iltararani**		T	bark /seeds	stems bark	bark leaves	sweeten tea
Leguminosae	*Acacia*	*drepanolobium*	**Oluaai/oluai**	**iluaa, ntubu**	**iluaa/intubu**	S	gull/fruits	roots	Browse leaves	fencing
Leguminosae	*Acacia*	*gerrardii*	**Osisika /Olng'ong'uenyi**	**sisikan/ ilngweny**		S	inner bark	bark, roots	bark, roots	fencing, beer
Leguminosae	*Acacia*	*hockii*	**Encharpalani**	**Incharpaln**		T			leaves	forage goats
Leguminosae	*Acacia*	*kirkii*	**Olerai nanyokie**	**Ilera naanyokie**		T	Inner bark, gum	bark	leaves	forage goats
Leguminosae	*Acacia*	*mellifera*	**Oiti orok**	**iit orook**		T	Barks	barks		Fencing
Leguminosae	*Acacia*	*nilotica*	Olkiroriti	Inkirorit		T	inner barks	barks	leaves	fencing/carving
Leguminosae	*Acacia*	*senegal*	**Oiti orok**	ilt-orok		T		Barks	leaves	Fencing

Family	Genus	Species	Local name (singular)	Local name (Plural)	Name of plant part	Life form	Part used as food	Part used as human medicine	Live stock use	Other uses
Leguminosae	*Acacia*	*seyal*	**Olerai**	**ilera**		T	Inner bark, gum	bark	leaves	Woodfuel
Leguminosae	*Acacia*	*tortilis*	**Oltepesi**	**Iltepes/ intepes**		T	seeds, barks	roots bark resine		fencing, carving
Leguminosae	*Acacia*	*xanthophloea*	**Olerai**	**ilera**		T	inner barks	barks	pods	Charcoal
Leguminosae	*Acacia*	*nubica*	**Oldepe**	**oldepe/ ildepen**	**oldepe/ ildepen**			bark and roots		Fencing
Apocynaceae	*Acokanthera*	*schimperi*	**Olmorijoi**	**Ilmorijo**	**Ilmorijo/ emorijo**	T	fruits	root/ stems	leaves	woodfuel , fencing, arrowhead poison
Bombacaceae	*Adansonia*	*digitata*	**Olmesira, olmisira**	**ilmisirani**		T	fruits	bark		
Leguminosae	*Albizia*	*amara*	**Olperelongo**	**ilperrelongoi**		T		root , stem		Firewood
Leguminosae	*Albizia*	*anthelmintica*	**Olmugutan**	**Imugutani**		T		roots, bark	bark	woodfuel, fencing
Leguminosae	*Albizia*	*gummifera*	**olasiti**	**ilasit**		T		bark	bark	woodfuel, fencing, beehives
Rosaceae	*Alchemilla*	*rothii*	**Olng'erioi**	**Ilngerio**	**Ingerio**	S	tuber		leaves	quench thirst
Aloaceae	*Aloe*	*kulalensis*	**Osuguroi loombokush**		**Isuguro loombokishi**	S	roots	stem, Sap	stem sap	
Aloaceae	*Aloe*	*secundiflora*	**Osuguroi**	**Isuguro**			roots	stem, Sap	stem sap	make local brew

Family	Genus	Species	Local name (singular)	Local name (Plural)	Name of plant part	Life form	Part used as food	Part used as human medicine	Live stock use	Other uses
Aloaceae	*Aloe*	*volkensii*	**Osuguroi**	**Isuguro**		S	roots	stem/leaves	Sap	make local brew
Amaranthaceae	*Amaranthus*	*graecizans*	**Inkuyek**	**Nyanyi**		H	leaves/ tender shoots	leaves		fodder
Amaranthaceae	*Amaranthus*	*hybridus*	**Interere**	**Nyanyi**		H	leaves	leaves		fodder
Gramineae	*Arundinaria*	*alpina*	**Oltiyani**	**Iltiyan i**		T	tubers	leaves, stem		Ceremonial
Asparagaceae	*Asparagus*	*africanus*	**Oiti**	**Iit**	**Ilkiaar enkure (tuber)**	H	tuber			
Asparagaceae	*Asparagus*	*falcatus*	**Kilak-iolker**		**kilaki-ilkera**	H	tuber			make sieve
Asparagaceae	*Asparagus*	*racemosus*	**Olomei**	**) Ilomee**	**Ilkiaar enkure (tuber)**	H		stem(marrow)		make sieve
Balanitaceae	*Balanites*	*aegyptiaca*	**Engoswa**	**Ngoswani**			fruit	fruit; Steam bath	root bark	Fencing
Basellaceae	*Basella*	*alba*	**Osuyai**	**isuyan**		H	leaves		shoot	fencing
Berberidaceae	*Berberis*	*holstii*	**Olekikuuni**	**lekiku uni**		S		stem,bark		Fencing
Capparaceae	*Cadaba*	*farinosa*	**Olkinya sirkon**	**Olkinya sirkon**		S		leaves		
Capparaceae	*Capparis*	*fascicularis*	**Olokordodai**	**Ilokordoda**		S	root	bark		fencing

Family	Genus	Species	Local name (singular)	Local name (Plural)	Name of plant part	Life form	Part used as food	Part used as human medicine	Live stock use	Other uses
Apocynaceae	*Carissa*	*spinarum*	**Olamuriaki**	**Ilamuriak**	**Ilamuriak/ Nkamuriaki**	S	fruit	root	leaves	fencing
Rhizophoraceae	*Cassipourea*	*malosana*	**Osonjoi/Olariooi**	**Isonjo/Ilariio**		T		barks, roots		Timber
Celastraceae	*Catha*	*edulis*	**Olmiraa**	**ilmiraani**		T	leaves/shoots			
Vitaceae	*Cissus*	*quadrangularis*	**Osurkutiti**	**isutkurt**			whole plant	Stem	stems	
Vitaceae	*Cissus*	*rotundifolia*	**Olararіet**	**Ilararіet**			whole plant	Stem	stems	
Rutaceae	*Clausena*	*anisata*	**Olmatasia**	**Ilmatasian**		S		leaves		branches used as beddings/deodrant
Capparaceae	*Cleome*	*gynandra*	**Isakeet sakeet**	**sakeet**			leaves	seeds		
Verbenaceae	*Clerondedrum*	*myricoides*	**Olmakutkut / Nagou ingoyoyiok**	**imakutukutu**				root stem	leaves	
Cucurbitaceae	*Coccinia*	*grandis*	**Oltulet lolowuam**	**iltuleta loolowuarak**		C	fruit	root/ leaves		
Combretaceae	*Combretum*	*molle*	**Olmaroroi**	**Ilmaroro**		T	barks	barks	leaves	wood fuel,fencing, carving,
Combretaceae	*Combretum*	*apiculatum*	**Olmaroroi**	**Ilmaroro**			bark			

Family	Genus	Species	Local name (singular)	Local name (Plural)	Name of plant part	Life form	Part used as food	Part used as human medicine	Live stock use	Other uses
Burseraceae	*Commiphora*	*africana*	**Osilalei**	**Isilale**		S	gum/resine	barks, roots	leaves	chewing gum, fencing
Burseraceae	*Commiphora*	*eminii*	**Enkooma**	**inkoomani**		T	barks	barks		Tea
Burseraceae	*Commiphora*	*schimperi*	**Oloilupai**	**Iloilupa**		S		roots		handles for branding animals
Boraginaceae	*Cordia*	*monoica*	**Oseki**	**Isek**	**Isek**	S	fruits/roots	stem, leaves	leaves	timber stools, ceremonial
Crassulaceae	*Cotyledon*	*barbeyi*	**Olmasiligi**	**imasilig**		H		stem	leaves	ceremonial use
Scrophulariaceae	*Craterostigma*	*pumilum*	**Olenyawaitie**	**Ilenyewaitie**				stem, barks		breast problems
Leguminosae	*Crotalaria*	*agatiflora*	**Intualan/Eyimiyim**	**ntualan**		H				
Euphorbiaceae	*Croton*	*dichogamus*	**Oloibor benek**			S		roots		disinfectants on alcohol guards
Euphorbiaceae	*Croton*	*macrostachyus*	**Enkoyiapasei**	**nkoyiapase**		S		tap root	leaves	toiletry TP
Euphorbiaceae	*Croton*	*megalocarpus*	**Olmergueit**			T		barks		wood fuel, fencing
Euphorbiaceae	*Croton*	*menyharthii*	**Enchani olpurkel**			S		root		
Gramineae	*Cynodon*	*dactylon*	**Inkujit**		**Nkujit**	H				
Cyperaceae	*Cyperus*	*blysmoides*	**Ingotot**	Ilngohutiugot	Ilngohutiugot		tuber			

Family	Genus	Species	Local name (singular)	Local name (Plural)	Name of plant part	Life form	Part used as food	Part used as human medicine	Live stock use	Other uses
Vitaceae	*Cyphostemma*	*cyphopetalum*	**Olorrondo/ Olorrodoi**	**Ilorrondon**		H	whole plant	leaves/barks		Woodfuel
Solanaceae	*Datura*	*stramonium*	**Olpaleki /empaleki**		**olpaleki**	S	roots, bark	leaves (burned)		
Leguminosae	*Desmodium*	*repandum*	**Eikom**	Eikom		H		leaves		
Sterculiaceae	*Dombeya*	*burgessiae*	**Osupukiai Orok**	**isupukia orok**		T	roots-human			cleaning milking jugs, construction, carving
Sterculiaceae	*Dombeya*	*rotundifolia*	**Osupukiai oibor**	**isupukiaoibor**		T	barks, roots			milking jag cleaner, bark for ropes used in construction
Sterculiaceae	*Dombeya*	*torrida*	**Osupukiai oibor**	**Isupukia iobor**				barks, roots		milking jag cleaner, bark for ropes used in construction
Flacourtiaceae	*Dovyalis*	*abyssinica*	**Olmorogi/ Olmorog**	**Ilmorog**	**Ilmorog**	S	fruits	roots/ stem	leaves	fencing woodfuel,soup
Flacourtiaceae	*Dovyalis*	*macrocalyx*	**Olmorogi/emorogi**	**Ilmorog**	**Ilmorog**	T	fruits	roots	leaves	fencing , woodfuel
Dracaenaceae	*Dracaena*	*ellenbeckiana*	**Olekidong'o/ ole-mudango**	**Ilekidongo**		S		tuber,roots	sap	wounds cases

Family	Genus	Species	Local name (singular)	Local name (Plural)	Name of plant part	Life form	Part used as food	Part used as human medicine	Live stock use	Other uses
Asclepiadaceae	*Dregea*	*schimperi*	**Enkorriabiti**	**Nkorrimbitin**			fruits	root barks		
Meliaceae	*Ekebergia*	*capensis*	**Olmokorionko**	ilmokorinkoni		T	barks	roots		fencing/building houses
Celastraceae	*Elaeodendron*	*buchananii*	**osoket**	**isoket**		S	fruits		stem , bark	very poisonous /acaricide
Leguminosae	*Eriosema*	*shirense*	**Ilaikuinyo**	**Laikuinyo**		H	tuber, shoots			quench thirst
Leguminosae	*Erythrina*	*abyssinica*	**Oloponi**	**ilopon**		T		roots		carving, seeds jewellery
Ebenaceae	*Euclea*	*divinorum*	**Osojo/Enkinyei/olchaniorok**	**sojon/inkinye/Ikeek-orok**	**ilmelang enkima**	T	fruit	root	bark	wood fuel, fencing
Euphorbiaceae	*Euphorbia*	*candelabrum*	**Olpopong'i**	**Ilpopong**		T		roots	latex, bark	troughs
Euphorbiaceae	*Euphorbia*	*gossypina*	**Oloilei oibor**	**iloile**		S		roots	latex	
Euphorbiaceae	*Euphorbia*	*schimperiana*	**Enkoilei**	**Nkoile**		H			fodder	
Euphorbiaceae	*Euphorbia*	*tirucalli*	**Oloilei orok**	**iloile**		S			sap	fodder
Euphorbiaceae	*Euphorbia*	*ugandensis*	**Oltangararian**	**entangararian**		S		**root**		

Family	Genus	Species	Local name (singular)	Local name (Plural)	Name of plant part	Life form	Part used as food	Part used as human medicine	Live stock use	Other uses
Convolvulaceae	*Evolvulus*	*alsinoides*	**Enkoninipus**	**loninin pusi**		H		root		Fencing
Proteaceae	*Faurea*	*saligna*	**Olorte**	**Ilortei**		T	fruit, sbark	bark		firewood, nector
Moraceae	*Ficus*	*cordata*	**Osukunua**	**isukunuani**		T	fruits	barks		Ceremonial
Moraceae	*Ficus*	*sycomorus*	**Olng'aboli**	**ingaboli**	**ilngabolo**	T	fruit	bark, roots		Fencing
Moraceae	*Ficus*	*thonningii*	**Oreteti/eretet i**	**iretet**	**iretet**	T	fruit, gum& sap	barks		sacred/ ceremonial
Flacourtiaceae	*Flacourtia*	*indica*	**Oloireroi**	**iloirero**		S	bark	roots		Fencing
Labiatae	*Fuerstia*	*africana*	**Enkoitodoraik**	**Enkoitodoraik**		H		leaves		
Rubiaceae	*Gardenia*	*volkensii*	**Entakurukuriet**	**Intakurikurieti**	**ntakkurieti**	T	fruit, tuber			fencing ,stirring stick, closing cow gates
Asclepiadaceae	*Gomphocarpus*	*stenophyllus*	**Entiakuleti**	**Ntiakulet**		H	fruits	roots, sap		make fly whisk, ceremonial, canning stick
Tiliaceae	*Grewia*	*bicolor*	**ositeti**	**Isiket**	**Esitet**	S	fruits	roots	forage	ceremonial, making bows
Tiliaceae	*Grewia*	*similis*	**Enyaligwai**	**Ilnyaligwa**	**ilterria**	S	fruit	roots	forage	

Family	Genus	Species	Local name (singular)	Local name (Plural)	Name of plant part	Life form	Part used as food	Part used as human medicine	Live stock use	Other uses
Compositae	*Gutenbergia*	*cordifolia*	**naing'ong'undeyo**	**Naing'ong'undeyo**		H	leaves	whole plant	leaves	
Umbelliferae	*Heteromorpha*	*trifoliata*		**Enkuyiaine**		H	stem	stem bark	fodder	Fodder
Malvaceae	*Hibiscus*	*flavifolius*	**Enkarrani**	**Nkarran**		H				used in witchtcraft, make portable doors
Celastraceae	*Hipocratea*	*goetzei*	**Erisa**	**Risan**	**Risan**	H	whole plant	whole plant		fencing & house construction
Compositae	*Hirpicium*	*diffusum*	**Entoish**	**Entoish**		H	fruit	leaves		
Labiatae	*Hoslundia*	*opposita*	**Ole murran**		**Ilemurran/lole murran**	H		stem, root		warriors perfume
Hydnoraceae	*Hydnora*	*abyssinica*	**Erukunyi**	**erukunyi**	**erukunyi**	H	tuber			
Acanthaceae	*Hypoestes*	*forskaolii*	**Olkekeyiet**	**Olkekeyiet**		H			fodder	
Leguminosae	*Indigofera*	*lupatana*	**Enkoroyi**	**nkoroyin**		S			forage	Toothbrush
Convolvulaceae	*Ipomoea*	*longituba*	**Enchiliwa**	**Enchiliwa**	**Enkopepia**	S	tuber			
Convolvulaceae	*Ipomoea*	*oenotherae*	**Iloiropiji**	**Iloiropij**		H	tuber			
Convolvulaceae	*Ipomoea*	*lapathifolia*	**Oloiropiji**	**Iloiropij**			fruit, tuber	roots		

Family	Genus	Species	Local name (singular)	Local name (Plural)	Name of plant part	Life form	Part used as food	Part used as human medicine	Live stock use	Other uses
Cupressaceae	*Juniperus*	*procera*	**Oltarakwai**	**Ntarakwa**		T	bark, stem	root & stem bark	bark stems	timber/building material, posts, woodfuel
Acanthaceae	*Justicia*	*elliotii*	**Olosida**	**Olosida**		H			forage	
Acanthaceae	*Justicia*	*nyassana*	**Olosida**	**Olosida**		H	leaves	Human		
Bignoniaceae	*Kigelia*	*africana*	**Oldarpoi**	**ildarpo**		T	fruit			make local brew
Compositae	*Kleinia*	*gregorii*	**emasiligi kiti**	**Imasilig**		H		roots /leaves		
Cucurbitaceae	*Lagenaria*	*abyssinica*	**Oltulet**	**iltuleta**		C	leaves		leaves	beer bottles, snuffbox
Cucurbitaceae	*Lagenaria*	*siceraria*	**Oltulet**	**iltulet**		C		Leaves		milking jug
Anacardiaceae	*Lannea*	*schweinfurthii*	**Orupante**	**orupante**		T	roots, barks	roots bark		fencinga
Verbenaceae	*Lantana*	*trifolia*	**Olmakirikiriaine**		**Nkayakuj**	S	fruits	root, stem		ceremonial , traditional rituals
Labiatae	*Leonotis*	*mollissima*	**Olbibi**	**Imbibii**				Roots	roots	nector
Labiatae	*Leonotis*	*nepetifolia*	**Olbibi**	**ilbibii/olbibi**		H	flowers	Roots		
Labiatae	*Leucas*	*grandis*	**Olbibi**	**Imbibii**			tuber,whole plant	leaves	roots	nectar
Verbenaceae	*Lippia*	*javanica*	**Osinoni**	**Sinonon**		S				**mattresses/fencing**
Verbenaceae	*Lippia*	*kituiensis*	**osinoni orok**	**Sinonon**		H				

Family	Genus	Species	Local name (singular)	Local name (Plural)	Name of plant part	Life form	Part used as food	Part used as human medicine	Live stock use	Other uses
Celastraceae	*Mystroxylon*	*aethiopicum*	**Olodo nganayioi**	**Loodo nganayio**	**Iloodo nganayio**		fruits	Barks		Dye, carving, woodfuel
Celastraceae	*Maytenus*	*senegalensis*	**Olaimurunyai**	**Ilaimurunya**		S	roots	Roots		used in soup
Cucurbitaceae	*Momordica*	*friesiorum*		**Esumeita**		C	tuber, gum	roots		dewormer
Myrsinaceae	*Myrica*	*salicifolia*	**Olkitoloswa**		**ilkitoloswani**	S	tuber	Root		muscle building soup by morans
Myrsinaceae	*Myrsine*	*africana*	**Eseketeti**	**seketek**	**ioodwa**	S	fruits	roots, seeds	seeds	making beds
Oleaceae	*Olea*	*capensis*	**Ololiondoi**	**iloliondo**	**iloliondo**	T	stem			cermonial , timber
Oleaceae	*Olea*	*europaea spp africana*	**Oloirien/ Enkoirien**	**Nkoirienito**	**Ilosiyio**	T	fruits	Bark	forage	smoking calabash, ceremonial
Oliniaceae	*Olinia*	*rochetiana*	**Olkirenyi**			S	fruits	roots, leaves, stem		woodfuel, fencing
Santalaceae	*Osyris*	*lanceolata*	**Olosesiai/ Enkosesiai**	**ilosesia**		S	bark	barks, roots		fencing
Oxalidaceae	*Oxalis*	*latifolia*	**Enkaisiijoi, enkayakuji**	**nkaaisiijo**		H	flowers, whole plant	leaves, roots		

Family	Genus	Species	Local name (singular)	Local name (Plural)	Name of plant part	Life form	Part used as food	Part used as human medicine	Live stock use	Other uses
Anacardiaceae	*Ozoroa*	*insignis*	**olokunonoi**	**ilokunono**	**ilokunono**	T		Bark		
Sapindaceae	*Pappea*	*capensis*	**Olkisikong'u/ oltimigomi**	**Ilkisik onyek / iltimigom**		T	fruits	Barks	forage	wood fuel, carving, fencing
Asclepiadaceae	*Periploca*	*linearifolia*	**Osinantei**	**osinandei**		H	stem, leaves	roots barks		perfumery, dowry bracelet, fencing
Palmae	*Phoenix*	*reclinata*	**Oltukai**	**Iltuka**		T	barks	Roots		milking jugs cleaner, ceremonial
Loranthaceae	*Phragmanthera*	*usuiensis*	**lmigaru-kewon**			S	stem	stem ,roots		
Solanaceae	*Physalis*	*peruviana*	**Ilnasi**	**ilnaasi**	**Ilnaasi**	H	fruits	roots		
Phytolaccaceae	*Phytolacca*	*dodecandra*	**Entiang'aras**	**ntiangaras**		S	shoots, roots	roots	leaves	acaricide
Leguminosae	*Piliostigma*	*thonningii*	**Olbukoi**	**Ilbuko**		T	barks	Roots		
Anacardiaceae	*Pistacia*	*aethiopica*	**Oltangotua**	**Iltangotwani**		T		Bark		wood fuel
Loranthaceae	*Plicosepalus*	*curviflorus*	**Entaretoi**	**Ntareto**		S	fruits	whole plant	whole plant	used bathe new born babies
Plumbaginaceae	*Plumbago*	*zeylanica*	**Olngeriantus**	**Ilngeriantusi**		H	Root	leaves, roots		decoration purposes

Family	**Genus**	**Species**	**Local name (singular)**	**Local name (Plural)**	**Name of plant part**	**Life form**	**Part used as food**	**Part used as human medicine**	**Live stock use**	**Other uses**
Orchidaceae	*Polystachya*	*adansoniae*	**Olangunguai**	**Ilangungwa**			roots/ bulb	leaves		strong stimulant for warriors,jugs, cans
Rosaceae	*Prunus*	*africana*	**Olkujuk**	**Ilkujuka**		T		Roots	bark	fencing, woodfuel
Compositae	*Pseudognaphalium*	*luteo-album*	**Olekiushin**	lolekinshin		H	Root	shoots , tuber	shoots , tuber	
Compositae	*Psiadia*	*punctulata*	**Olabaai**	**olabaai**		S		roots leaves	roots	fencing, construction
Myrsinaceae	*Rapanea*	*melanophloeos*	**Oseketeti**	**Loodwa**	**iseketet**	S	seeds	Seeds	seeds	woodfuel
Rhamnaceae	*Rhamnus*	*prinoides*	**Olkonyil**	**Ilkonyilin**		S	root	stem, bark roots		wood fuel, fencing
Rhamnaceae	*Rhamnus*	*staddo*	**olkokola/Enkonkola**	**Nkonkolani**		S	fruits	Roots	leaves	fencing, stirring stick
Vitaceae	*Rhoicissus*	*revoilii*	**Olkilenyai**	**Ilkilenya**				Roots	roots	
Vitaceae	*Rhoicissus*	*tridentata*	**Olkilenyai**	**ilkilenya**		H	tube, fruits, gull	stem,sap		
Acanthaceae	*Ruellia*	*patula*	**Esonkoyo**		*****	H	stem	stem	leaves	perfume
Anacardiaceae	*Rhus*	*natalensis*	**Olmisigiyioi**	**Ilmisigiyio**	**ilmisigiyio**	T	flowers, fruits	Barks	forage	carving, wood fuel, fencing

Family	Genus	Species	Local name (singular)	Local name (Plural)	Name of plant part	Life form	Part used as food	Part used as human medicine	Live stock use	Other uses
Anacardiaceae	*Rhus*	*vulgaris*	**Olmungushi***	**Ilmungush**	**Ilmungush**		fruits	stems, roots, bark		bark herbal tea
Rubiaceae	*Rubia*	*cordifolia*	**Olng'eriantus loontoyie**		**Loninin**	S		Roots		make sweeping brooms
Rosaceae	*Rubus*	*apetalus*	**Olayakuji**		**Ilayakuj**	S	roots	Roots		
Rosaceae	*Rubus*	*keniensis*	**Enkayakuji**	**Nkayakuj**	**Nkayakuj**	S	fruits, whole plant			bedding (mattress)
Salicaceae	*Salix*	*subserrata*	**Olemudong'o**	**iolemudongo**		S	inner barks/roots	Barks	stem, leaves	removes placenta
Salvadoraceae	*Salvadora*	*persica*	**oremit/ Eremit**		**Iremito**	S	fruit	roots/ stem-bark	fodder	fencing, toothbrush , wood fuel
Dracaenaceae	*Sansevieria*	*parva*	**Oldupai**	**Ildupa**		H	stem			cermonial, sewing
Dracaenaceae	*Sansevieria*	*suffruticosa*	**Oldupai**	**Ildupa**		S		stem, roots		construction
Asclepiadaceae	*Sarcostemma*	*viminale*	**Oloilei**	**nkoile**		H	fruits, inner bark	roots	fodder	
Lamiaceae	*Satureia*	*biflora*	**Enkaloshoo**			S	leaves	Leaves		
Araceae	*Sauromatum*	*venosum*	**Endupai-sampu/Enkauraki**	**Ildupa sampin/nkaurak**		H	rhizomes	leaves		ceremonial
Anacardiaceae	*Schinus*	*molle*	**Olmiti**		*	T	Leaves	Barks		timber

Family	Genus	Species	Local name (singular)	Local name (Plural)	Name of plant part	Life form	Part used as food	Part used as human medicine	Live stock use	Other uses
Oleaceae	*Schrebera*	*alata*	**Oliala/oiala**	**iliala**		S	inner bark, tuber	stem roots		teeth problems
Anacardiaceae	*Sclerocarya*	*birrea*	**Olmang'uai/ olmangwai**	**Ilmangwa**		T	fruits	roots/barks		
Flacourtiaceae	*Scolopia*	*theifolia*	**Oladarridar /oladardar**	**iladarrrdarri**		S		stem/roots		wood fuel, fencing
Rhamnaceae	*Scutia*	*myrtina*	**Osanankurrurri/ Osanangurruri**	**Ilsanangururr**	**Ilsanangururr**	S	fruits	root bark, stem		woodfuel , carving, fencing
Compositae	*Senecio*	*hadiensis*	**Olairamirami**	**ilairamiram**		H	stem	roots leaves stem	forage	fencing
Leguminosae	*Senna*	*didymobotrya*	**Osenetoi/esenetei**	**isenet**	**isenet**	S	leaves	barks, roots, stem		cleaning
Malvaceae	*Sida*	*schimperiana*	**Enkonini**	**loninin**		S		root		groom, ceremonial, spiritual purposes
Compositie	*Solanecio*	*hadiensis*	**Olairamirami**	**Ilairamiram**		S	stem	roots	leaves fodder	
Solanaceae	*Solanum*	*aculeastrum*	**Osikawoi**		**sikaoni**	S		roots		fencing

Family	Genus	Species	Local name (singular)	Local name (Plural)	Name of plant part	Life form	Part used as food	Part used as human medicine	Live stock use	Other uses
Solanaceae	*Solanum*	*incanum*	**Oltulelei**	**iltalele**		H	Root	fruits roots	fruits	make toothbrush, spriritual use
Solanaceae	*Solanum*	*indicum*	**Entemelwa**	**entemelwa**		H	fruit	root		fencing*
Solanaceae	*Solanum*	*nigrum*	**Olmomoi**	**ilmomo**	**ilmomo**	H	fruits	leaves	leaves	sell in market
Compositae	*Sphaeranthus*	*confertifolius*	**Oleturot**	**oleturot**		H	whole plant	stem, root, leaves		
Asclepiadaceae	*Stathmostelma*	*propinquum*	**Ole kule**	**Ilekulen**		H	tuber			
Loganiaceae	*Strychnos*	*henningsii*	**Oltipilikua**	**Ntipilikwani**		T	barks/stem/roots	roots , stem		
Euphorbiaceae	*Synadenium*	*grantii*	**Olkobobit**	**Ilkorbob**		T		stem, leaves	latex	grave marker
Myrtaceae	*Syzygium*	*cordatum*	**Olairragai**	**Ilairraga**		T	fruits	bark, stem		sale in markets
Myrtaceae	*Syzygium*	*guineense*	**Olairragai**	**ilairraga**		T	fruits	fruits, bark		herbal tea
Compositae	*Tagetes*	*minuta*	**Olbangi**			H		leaves	leaves	acaricide
Leguminosae	*Tamarindus*	*indica*	**oloisiijoi**	**ilaisiijo**		T	fruits			woodfuel
Compositae	*Tarchonanthus*	*camphoratus*	**Oleleshua/ osentu**	**Ileleshuani / isentui**		S		roots, bark	bark leaves	construction, fencing, matresses
Rubiaceae	*Tarenna*	*graveolens*	**Olmasei**	ilmase		S	fruits	roots, stem		make arrows , fencing , carving

Family	Genus	Species	Local name (singular)	Local name (Plural)	Name of plant part	Life form	Part used as food	Part used as human medicine	Live stock use	Other uses
Rutaceae	*Teclea*	*nobilis*	**Olgilai**	**ilgila**		T		roots, leaves		ceremonial,carving, fencing, cleaner-brewers
Rutaceae	*Teclea*	*simplicifolia*	**Olgilai**	**Ilgila**		T		roots		fencing , walking sticks
Labiatae	*Tetradenia*	*raparia*	**olokoromua**	**ilokoromwa**		S		leaves, stem		
Rutaceae	*Toddalia*	*asiatica*	**Oleparmunyo**	**Oleparmunyo**		C	fruits	roots		
Flacourtiaceae	*Trimeria*	*grandifolia*	**Oledat**	**oledat**		T		roots		
Meliaceae	*Turraea*	*abyssinica*	**Enchani enkashe**	**Enchani enkashe**		S		bark		make arrows , fencing , carving, tool handles
Meliaceae	*Turraea*	*mombassana*	**Emasei**	**Ilmase**	**Ilmase**	S		Steam bath		make rungus
Urticaceae	*Urtica*	*massaica*	**Entamejoi**	**Ntamejo entim**	**Ntamejo entim**	H	leaves	roots leaves	roots, leaves	
Rubiaceae	*Vangueria*	*apiculata*	**Olngumi etare**	**Naibungi akiti**	**Ingum etare**	S	fruits			fencing
Rubiaceae	*Vangueria*	*madagascariensis*	**Olgumi/Engumi**	**ingum**	**Naibungi akiti**	S	fruits	roots, leaves	roots leaves	fencing, fuel
Compositae	*Vernonia*	*auriculifera*	**Olmusaakwa**	**ilmusaakwani**		T				

Family	Genus	Species	Local name (singular)	Local name (Plural)	Name of plant part	Life form	Part used as food	Part used as human medicine	Live stock use	Other uses
Compositae	*Vernonia*	*brachycalyx*	**Enkogumati**	**Ilogumat**		S		leaves, roots	leaves	make arrows
	Vernonia	*grandifolia*	**Enkogumati**	**Inkogumat**		S		root		
Compositae	*Vernonia*	*lasiopus*	**Enkogumati**	**Inkogumat**		S		root		
Leguminosae	*Vigna*	*friesiorum*	**Olgisoyiai**	**Ilgisoyiai**		H	Tuber			
Leguminosae	*Vigna*	*membranacea*	**Olgisoyiai**	**Ilgisoyiai**		H		roots		
Canellaceae	*Warburgia*	*ugandensis*	**Osokonoi/ entoroniki**	**Isokon**	**Isoko**	T	fruits	stem bark		make tooth brush,carving, timber
Solanaceae	*Withania*	*somnifera*	**Olesayiet**	**Olesayiet**		S	fruits	root	leaves	
Olacaceae	*Ximenia*	*americana*	**Enkamai**	**olamai/ ilama**	**Inkama**	T	fruits	bark , stem, roots		make a life fence
Olacaceae	*Ximenia*	*caffra*	**Enkamai**	**Inkama**	**Olamai**	T	fruit, stem	stem bark		fencing
Rutaceae	*Zanthoxylum*	*usambarense*	**Oloisuki /Enkoisuki**	**Iloisuk**	**Loisuk/ilosuk**	T	fruits , leaves	bark		fencing, woodfuel
Rhamnaceae	*Ziziphus*	*mucronata*	**Oloilalei**	**iloilale**		S	gum/latex	roots, leaves		fencing
Leguminosae	*Zornia*	*pratensis*	**Olkiloilo**	**ilkiloila**		H		root		

APPENDIX III: WILD MEDICINAL FOOD PLANTS FOUND ON SALE IN NAROK MARKETS

Local name(s)	Family	Genus	Species	Life Form	Plant part(s) WMFPs
Esonkoyo	Acanthaceae	*Ruelia*	*patula*	C	leaves, stems
Osuguroiloombokush	Aloaceae	*Aloe*	*kulalensis*	S	root, leaves
Osuguroi	Aloaceae	*Aloe*	*secundiflora*	S	roots, leaves
Osuguroi	Aloaceae	*Aloe*	*volkensii*	S	Roots, leaves
Olokunonoi	Anacardiaceae	*Ozoroa*	*insignis*	T	Bark
Oltankotua	Anacardiaceae	*Pistacia*	*aethiopica*	T	Bark
Olmisigiyioi	Anacardiaceae	*Rhus*	*vulgaris*	S	bark
Olmang'uai /olmangwai	Anacardiaceae	*Sclerocarya*	*birrea*	T	Roots, stem barks
Olmorijoi	Apocynaceae	*Acokanthera*	*schimperi*	T	Fruit
Olamuriaki	Apocynaceae	*Carissa*	*spinarum*	S	Root
Engoswa /olngosua	Balanitaceae	*Balanites*	*aegyptiaca*	T	fruit, bark
Olekikuuni	Berberidaceae	*Berberis*	*holstii*	S	root, stembark
Oldarpoi	Bignoniaceae	*Kigelia*	*africana*	T	fruit, roots
	Bombacaceae	*Adansonia*	*digitata*	T	Fruit
Oseki	Boraginaceae	*Cordia*	*monoica*	S	roots, stem
Olmaroroi	Burseraceae	*Commiphora*	*africana*	S	stem b*ark*
Osokonoi /entoroniki	Canellaceae	*Warburgia*	*ugandensis*	T	stem, barks, roots
Olokordodai	Capparaceae	*Capparis*	*fascicularis*	S	Bark
Osoket	Celastraceae	*Elaeodendron*	*buchananii*	S	Fruit
Olodonganayioi	Celastraceae	*Mystroxylon*	*aethiopicum*	T	Barks
Olaimurunyai	Celastraceae	*Maytenus*	*senegalensis*	S	Roots
Olmaroroi	Combretaceae	*Combretum*	*molle*	T	Barks

Local name(s)	Family	Genus	Species	Life Form	Plant part(s) WMFPs
Naing'ong'undeyo	Compositae	*Gutenbergia*	*cordifolia*	H	stem, leaves
Olabaaiepartolu	Compositae	*Psiadia*	*punctulata*	S	roots, stems, leaves/ sap
Oleturot	Compositae	*Sphaeranthus*	*confertifolius*	H	stem, root, leaves
Olbangi	Compositae	*Tagetes*	*minuta*	H	leaves
Oleleshua /osentu	Compositae	*Tarchonanthus*	*camphoratus*	S	roots, bark
Enchaniembae	Compositae	*Vernonia*	*brachycalyx*	S	Roots
Olng'arlayioi	Cucurbitaceae	*Coccinia*	*grandis*	C	Roots
Esumeita	Cucurbitaceae	*Momordica*	*friesiorum*	C	Tuber
Olekidong'o	Dracaenaceae	*Dracaena*	*ellenbeckiana*	S	Tuber
Oloiborbenek	Euphorbiaceae	*Croton*	*dichogamus*	S	Roots
Olmergueit	Euphorbiaceae	*Croton*	*megalocarpus*	T	barks, stems
Enchaniolpurkel	Euphorbiaceae	*Croton*	*menyharthii*	S	Root
Ooltangararian	Euphorbiaceae	*Euphorbia*	*ugandensis*	S	root, stembark
Olkobobit	Euphorbiaceae	*Synadenium*	*grantii*	T	stem, leaves
Olmorogi/ Olmorog	Flacourtiaceae	*Dovyalis*	*abyssinica*	S	roots/ stem
Oladarridar/ oladardar	Flacourtiaceae	*Scolopia*	*theifolia*	S	stem/ roots
Oledat	Flacourtiaceae	*Trimeria*	*grandifolia*	S	Roots
Oltiasimpol	Icacinaceae	*Apodytes*	*dimidiata*	T	Stem bark
Oltarara /oltaraarani	Leguminosae	*Acacia*	*abyssinica*	T	stems bark
Oluaai/oluai/ Eluaai	Leguminosae	*Acacia*	*drepanolobium*	S	Roots

Local name(s)	Family	Genus	Species	Life Form	Plant part(s) WMFPs
Olng'ong'uenyi	Leguminosae	*Acacia*	*gerrardii*	S	roots, bark stem
Olerainanyokie	Leguminosae	*Acacia*	*kirkii*	T	Bark
Oitiorok	Leguminosae	*Acacia*	*mellifera*	T	Barks
Olkiloriti	Leguminosae	*Acacia*	*nilotica*	T	Barks
Oitioibor	Leguminosae	*Acacia*	*senegal*	T	Barks
Olerai	Leguminosae	*Acacia*	*seyal*	T	Bark
Oltepesi	Leguminosae	*Acacia*	*tortilis*	T	roots bark resine
Elerai	Leguminosae	*Acacia*	*xanthophloea*	T	Barks
Oldepe	Leguminosae	*Acacia*	*nubica*	T	Bark and Roots
Olmugutan	Leguminosae	*Albizia*	*anthelmintica*	T	Roots, Bark
Olasiti /olmoso	Leguminosae	*Albizia*	*gummifera*	T	bark
Olbukoi	Leguminosae	*Piliostigma*	*thonningii*	T	Roots
Osenetoi	Leguminosae	*Senna*	*didymobotrya*	S	barks, roots, stem
Olchaki	Leguminosae	*Vigna*	*membranacea*	H	Roots
Olkiloilo	Leguminosae	*Zornia*	*pratensis*	H	Root
Oltipilikua/oltipilikwa	Loganiaceae	*Strychnos*	*henningsii*	T	roots, stem
Muarobaine	Meliaceae	*Azadirachta*	*indica*	T	roots, leaves
Olmokorionko	Meliaceae	*Ekebergia*	*capensis*	T	roots, bark
Osukunua	Moraceae	*Ficus*	*cordata*	T	Barks
Olngaboli	Moraceae	*Ficus*	*sycomorus*	T	barks, stems
Oseketeki	Myrsinaceae	*Myrsine*	*africana*	S	roots, seeds
Seketeki/olenkaburra	Myrsinaceae	*Rapanea*	*melanophloeos*	S	Roots
Enkamai	Olacaceae	*Ximenia*	*americana*	T	bark stem/ roots

Local name(s)	Family	Genus	Species	Life Form	Plant part(s) WMFPs
Oloirien	Oleaceae	*Olea*	*europaeasppafricana*	T	stems, barks
oliala	Oleaceae	*Schrebera*	*alata*	S	roots/ leaves
Olkirenyi	Oliniaceae	*Olinia*	*rochetiana*	S	roots, leaves, stem
Enkaisiijoi	Oxalidaceae	*Oxalis*	*latifolia*	H	leaves, roots
	Palmae	*Phoenix*	*reclinata*	T	Root
Olkarlei/olkalei	Papilionaceae	*Dolichos*	*oliveri*		Root
Olngeriantus	Plumbaginaceae	*Plumbago*	*zeylanica*	H	leaves, roots
Olorte	Proteaceae	*Faurea*	*saligna*	T	Bark
Olkonyil	Rhamnaceae	*Rhamnus*	*prinoides*	S	stem, bark roots
Olkokola	Rhamnaceae	*Rhamnus*	*staddo*	S	barks, stems, roots
Olkujuk	Rosaceae	*Prunus*	*africana*	T	roots, stem
Entakurukuriet	Rubiaceae	*Gardenia*	*volkensii*	T	Fruits
Olonini	Rubiaceae	*Rubia*	*cordifolia*	C	Roots
Enchanienkashe	Rubiaceae	*Tarenna*	*graveolens*	S	roots, stem
	Rubiaceae	*Vangueria*	*apiculata*	S	Roots
Oleparmunyo	Rutaceae	*Toddalia*	*asiatica*	C	roots
	Rutaceae	*Vepris*	*nobilis*	S	Stem
Osojo/Enkinyei/olchaniorok	Rutaceae	*Vepris*	*simplicifolia*	T	Root
Oloisuki /Enkoisuki	Rutaceae	*Zanthoxylum*	*usambarense*	T	bark
Oremit	Salvadoraceae	*Salvadora*	*persica*	S	roots, stem
Olosesiai	Santalaceae	*Osyris*	*lanceolata*	S	barks, roots

Local name(s)	Family	Genus	Species	Life Form	Plant part(s) WMFPs
Oltimigomi/Entimigomi	Sapindaceae	*Pappea*	*capensis*	T	bark
Olenyawaitie	Scrophulariaceae	*Craterostigma*	*pumilum*	H	stem, barks
	Solanaceae	*Physalis*	*peruviana*		
Osikawoi/ osikawai	Solanaceae	*Solanum*	*aculeastrum*	S	fruits, roots, stems, barks
Entulelei	Solanaceae	*Solanum*	*indicum*	S	Roots
Olesayiet	Solanaceae	*Withania*	*somnifera*	S	Root
OsupukiaiOrok	Sterculiaceae	*Dombeya*	*burgessiae*	T	roots-human
Olmotoo	Sterculiaceae	*Dombeya*	*rotundifolia*	T	roots barks
Ositeti	Tiliaceae	*Grewia*	*bicolor*	S	roots
olkuyiaine/Enkuyiaine	Umbelliferae	*Heteromorpha*	*trifoliata*	H	Stems
Olmakutukut	Verbenaceae	*Clerodendrum*	*myricoides*	S	stem roots
Olmakirikiriaine	Verbenaceae	*Lantana*	*trifolia*	S	Roots
Osinoni	Verbenaceae	*Lippia*	*javanica*	S	Leaves
Osinoniorok	Verbenaceae	*Lippia*	*kituiensis*	H	Leaves
Osukurtuti	Vitaceae	*Cissus*	*quadrangularis*	C	Stem
Olorrondo	Vitaceae	*Cyphostemma*	*cyphopetalum*	C	leaves/ barks
Olkilenyai	Vitaceae	*Rhoicissus*	*revoilii*	C	Roots
Olkilenyai	Vitaceae	*Rhoicissus*	*tridentata*	C	tuber, stem,sap

APPENDIX IV

Appendix IVA: Families of documented WMFPs in Loita

No.	Family	Number of Species	Percentage (Approx.)
1.	*Acantheceae*	4	1.98
2.	*Aloaceae*	3	1.48
3.	*Amarantheceae*	2	0.99
4.	*Anarcadiaceae*	6	2.97
5.	*Apocynaceae*	2	0.99
6.	*Araceae*	2	0.99
7.	*Asclepiadaceae*	6	2.97
8.	*Asparagaceae*	3	1.48
9.	*Balanitaceae*	1	0.49
10.	*Basellaceae*	1	0.49
11.	*Berberidaceae*	1	0.49
12.	*Bignoniaceae*	1	0.49
13.	*Berberidaceae*	1	0.49
14.	*Bombacaceae*	1	0.49
15.	*Boraginaceae*	1	0.49
16.	*Burseraceae*	3	1.48
17.	*Cannellaceae*	1	0.49
18.	*Capparaceae*	4	1.98
19.	*Celastraceae*	5	2.47
20.	*Combretaceae*	2	0.99
21.	*Compositae*	14	6.93
22.	*Convolvulaceae*	4	1.98
23.	*Crassulaceae*	1	0.49
24.	*Curcubitaceae*	4	1.98
25.	*Cupressaceae*	1	0.49
26.	*Cyperaceae*	1	0.49
27.	*Draccenaceae*	3	1.48
28.	*Ebenaceae*	1	0.49
29.	*Eurphobiaceae*	10	4.95
30.	*Flacourtiaceae*	5	2.47
31.	*Gramineae*	2	0.99
32.	*Hydnoraceae*	1	0.49
33.	*Lamiacae*	7	3.46
35.	*Leguminoseae*	26	12.87
36.	*Loganiaceae*	1	0.49
37.	*Loranthaceae*	2	0.99

No.	Family	Number of Species	Percentage (Approx.)
38.	*Malvaceae*	2	0.99
39.	*Meliaceae*	3	1.48
40.	*Moraceae*	3	1.48
41.	*Myrsinaceae*	3	1.48
42.	*Myrtaceae*	1	0.49
43.	*Olacaceae*	2	0.99
44.	*Oleaceae*	2	0.99
45.	*Oliniaceae*	1	0.49
46.	*Oxalidaceae*	1	0.49
47.	*Palmae*	1	0.49
48.	*Pytolaccaceae*	1	0.49
49.	*Plumbaginaceae*	2	0.99
50.	*Proteaceae*	1	0.49
51.	*Rhamnaceae*	4	1.98
52.	*Rhizophoraceae*	1	0.49
53.	*Rocaceae*	4	1.98
54.	*Rubiaceae*	5	2.47
55.	*Rutaceae*	5	2.47
56.	*Salicaceae*	1	0.49
57.	*Salvadoraceae*	1	0.49
58.	*Santalaceae*	1	0.49
59.	*Sapindaceae*	1	0.49
60.	*Solanacea*	7	3.46
61.	*Sterculiaceae*	3	1.48
62.	*Tiliaceae*	2	0.99
63.	*Umbelliferae*	1	0.49
64.	*Urticaceae*	1	0.49
65.	*Verbarnacea*	4	1.98
66.	*Vitaceae*	5	2.47
Total		**202**	**99.99%**

Appendix IVB: Descriptive Analysis Household Questionnaire (n=152)

Variable	Response	Frequency	Percentage
Gender	Male		
	Female		
Age	1	13	8.7
	2	28	18.7
	3	44	29.3
	4	38	25.3
	5	18	18
Education	No education	109	72.7
	8years and below	18	12
	9years and above	23	15.3
Locality	Forest edge	103	68.7
	Plains	47	31.3
Occupation	Farming	113	75.3
	Formal employment	20	13.3
	THP/Herder	17	
MFPs use	YES	150	100
	No	0	0
IK TRANSMISSION	Warrior hood &meat camps	24	16
	Apprenticeship	39	26
	Peers	11	7.3
	Elders	76	50.7
MFPs preparation	Men	12	8
	Women	27	18
	Children	2	1.3
	All people	109	72.7
Habitat MFPs collection	Bushland	24	16
	Forest	12	8
	All	112	76
Mfps sale in markets	Yes	87	58
	No	63	42

Appendix IVC: Descriptive Analysis of Market Survey Data in Narok (N=40)

Variable	Category/group	Frequency	Percent
Future trade	Yes	28	70
	No	12	30
Other Options	None	9	22.5
	Cultivation/Cropping	11	27.5
	Livestock keeping	6	15
	Other trade	14	35
No. Species	10 species & below	3	7.5
	11-20sp	16	40
	21-30sp	10	25
	31-40sp	7	17.5
	41sp &above	4	10
Preference MPS	Cost (other options expensive)	11	27.5
	Failed to be healed using e of conventional medicine)	14	35
	Cultural practice	15	37.5
Customer knowledge MPs	Some	6	15
	No	8	20
	Yes	26	65
Customer advice	Sometimes yes/no	12	30
	No	1	2.5
	Yes	27	67.5
Customers know species	Some	6	15
	No	8	20
	Yes	26	65
Wild sp stocks decline	No	11	27.5
	Yes	29	72.5
Nursery growing	No	33	82.5
	Yes	7	17.5

APPENDIX V: PUBLICATIONS AND DISSEMINATION

i. Peris M. Kariuki-, Catherine W. Lukhoba, Cecilia M. Onyango, Jesse T. Njoka. **The Trade in Wild Medicinal Plants, Narok County, Kenya** *Applied Ecology and Environmental Sciences*. **2018**, 6(4), 118-127. DOI: 10.12691/aees-6-4-3

ii. Peris M. Kariuki-, Cecilia M. Onyango, Catherine W. Lukhoba Jesse T. Njoka. **The Role of Indigenous Knowledge on Use and Conservation of Wild Medicinal Food Plants in Loita Sub-county, Narok County** Asian Journal of Agricultural Extension, Economics & Sociology, ISSN: 2320-7027,Vol.: 28, Issue.: 2

iii. **Book Chapter:** Kariuki P.M., Njoka J.T., Saitabau C.L. & Saitabau H.S. (2016). Forest Governance, Livelihoods and Resilience: The Case of Loita Forest Entime e. Naimina Enkiyio) Narok County Kenya. In Purabi Bose & Han Van Dijk Dryland *Forests: Management and Social Diversity in Africa and Asia.* Springer International Publishing Switzerland 2016. PP.117-138.

iv. **Policy Brief titled**: *Communal Land and Forest Management for Sustainable Livelihoodsin the Dry Lands: The Case of Loita Division Narok South Sub county.*

v. **Presentation**: **Peris M. Kariuki**, J.T. Njoka, C.W.Lukhoba & C.M.Onyango, 2016. Wild Food Plant Use among the Loita Maasai of Kenya. 15TH Congress of the International Society Conference of Ethnoboilogy to be held 1-7th August 2016 in Kampala Uganda: Overall theme is: Ethnobioloical Knowledge for improved human well being.