Food and Agriculture Organization of the United Nations

KENYA FORESTRY RESEARCH INSTITUTE KEFRI

gef

RESOURCE ASSESSMENT AND MAPPING OF PRIORITIZED NON-TIMBER FOREST PRODUCTS WITH COMMERCIAL POTENTIAL IN MT. KULAL AND MUKOGODO ECOSYSTEMS

June 2021

Authors:

Rose Chiteva,

Violet Oriwo,

Magrate Kaigongi (PhD)

James Ndufa (PhD)

Contact address:

Director

Kenya Forestry Research Institute

P.O. BOX 20412-00100

NAIROBI

Email: director@kefri.org

Website: www.kefri.org

Telephone number: + 254-724259782 /722157414/724259781

Food and Agricultural Organization (FAO) -Kenya

Food and Agriculture Organization of the United Nations (FAO)

United Nations Complex, Block P, Level 3,

United Nations Avenue, Gigiri, Nairobi, Kenya.

Telephone: +254 20 762 5919

URL: http://www.fao.org/kenya/en/

National Forest Products Research Programme (NFPRP) - Karura

P.O. Box 64636-00620

Mobil Plaza, Nairobi, Kenya

Tel: +254 (20) 2020623/2011629

E-mail:CDkarura@kefri.org

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Acknowledgements

The Authors wish to thank Food and Agriculture Organization (FAO) and Kenya Forestry Research Institute (KEFRI) management through Forest Biodiversity and Environment Management Thematic Area and National Forest Products Research Programme, for financial and logistical support during the study. The co-operation and contributions of the Kenya Forest Service (KFS) staff; Josephine Karugah, Alice Mutemi and Margaret Wamanyengo; and Kennedy Matheka from National Museums of Kenya (NMK) who assisted in resource mapping and data collection are very much appreciated. Special mention goes to Mr. Charles Situma and Robert Kimutai from the Directorate of Resource Surveys and Remote sensing (DRSRS) in the Ministry of Environment and Forestry for their assistance in mapping. The vital information on the study sites could not be obtained without the cooperation and support from the various contact persons from the County Governments, Northern Rangeland Trust (NRT), KFS and local administration. The contribution made by the community resource persons from Mt. Kulal and Mukogodo ecosystems during the assessment and mapping is also appreciated.

ABBREVIATIONS AND ACCRONYMS

NTFPs	Non-Timber Forest Products
NTFPS	Non-Timber Forest Products and Services
FAO	Food and Agriculture Organization
MENR	Ministry of Environment & Natural Resources
KNBS	Kenya National Burau of Statistics
TRI	The Restoration Initiative
ROAM	Restoration Opportunity Assessment Methodology
IUCN	International Union for Conservation of Nature
WRI	World Resources Institute
FLR	Forest Landscape Restoration
KFS	Kenya Forest Service
NMK	National Museums of Kenya
NRT	Northern Rangeland Trust
MKBR	Mt. Kulal Biosphere Reserve
KWTA	Kenya Water Towers Agency
GPS	Global Positioning System
GCP	Ground Control Points
CF	Coefficient Factor
SPSS	Statistical Package for the Social Sciences

EXECUTIVE SUMMARY

This study is important for the commercialization of potential Non – Timber Forest Products (NTFPs) in Mt Kulal and Mukogodo ecosystems. This is informed by the generated knowledge based on Non-Timber Forest Products and Services (NTFPS) in the two targeted landscapes and their commercial potential.

A total of eight key NTFPs were identified in the two ecosystems. In Mt. Kulal Biosphere Reserve (MKBR), four NTFPS were identified; gums (*Senegalia senegal*), resins (*Commiphora holtiziana, Boswellia negelcta*), medicinal plants e.g., *Myrsine africana*, aloes (*A. secundiflora, A. lateratia*) and fodder (*Vachellia tortilis* (Syn. *Acacia tortilis*) and grass species of *Chloris, Eragrostis, Cenchrus, Cynodon* and *Pennisetum*) In Isiolo County (Mukogodo ecosystem), apiculture, gums and resins were identified. In addition, *Boscia coriacea* was recorded as an indigenous vegetable. Laikipia County recorded *Opuntia* species (*O. stricta* and *O. ficus indica*) fruits, apiculture, gum producing species (*S. senegal*) and aloe species (*A. scabrifolia, A. secundiflora*)

In MKBR low densities of gums (*S. senegal)* and low to medium densities of resins (*Commiphora holtziana & Boswellia negelcta*) were recorded. These low densities are caused by the ecosystem's high altitude. Aloes*; A. secundiflora* and *A. lateratia* the prevalent species were also low in densities. In Mukogodo ecosystem, gums (*S. senegal*) was in medium densities. Apiculture has commercial potential with over 6,000 and 4260 beehives available in Kurikuri and Makurian group ranches respectively. In Ilngwesi and Lekurruki, a total of 30 and 3470 unmanaged beehives respectively were encountered. *Opuntia* species (*O. stricta* and *O. ficus indica)* of fruits bearing age in Mukogodo ecosystem were recorded in high densities in Makurian and Kurikuri group ranches all in Laikipia County.

Yield was directly proportional to densities, hence either NTFPS recorded in medium to high densities were recommended for commercialization. Thus, *Opuntia* spp in Laikipia, *B. neglecta* in Mt. Kulal and *S. senegal* in Mukogodo (Isiolo County) are recommended for commercialization. NTFPs found in low densities e.g., aloes were recommended for commercialization with conservation efforts put in place to ensure sustainability. There was also potential for apiculture in the two ecosystems, with capacity building required. The other recorded key species such as aloes, medicinal plants (*Myrsine africana*) as well as gums and resins, *Commiphora holtiziana*, were recommended for commercialization with conservation measures as well as enriched planting of degraded areas to ensure sustainability. The commercialization of *Opuntia* spp in Laikipia County (Mukogodo ecosystem) will not only be a revenue generation venture to the local communities but also will act as a management strategy of these invasive plant species.

1. INTRODUCTION

The Non-Timber Forest Products (NTFPs) refer to all the resources/products (other than industrial round wood and derived sawn timber, wood chips, wood-based panels and pulp), that may be extracted from forest ecosystem and are utilized within the household or are marketed or have social, cultural or religious significance (FAO, 1990). FAO (1992) defined NTFPs as "non-wood forest products which include all goods of biological origin, as well as services derived from forests or any land under similar use and exclude wood in all its forms. Non-Timber Forest Products (NTFPs) play a significant and critical role in the livelihoods to a large part of the world's population (MENR, 2000). Most of these NTFPs are harvested for domestic use and are obtained from forests and woodlands because their extraction is easy.

Globally, forests are important to forest adjacent communities not only to provide a living but also for environmental benefits. Utilization of NTFPs varies from one region or community to another, and in line with the ecological zones' differentiation. Utilization is more in the dry lands than high potential areas where modern agricultural crop production dominates land use decisions. Despite their importance, not much effort has been made to quantify and advance their development unlike timber. There is need therefore, for information on quantities.

Forests and woodlands in African drylands provide a wealth of products essential for the livelihoods and well-being of local people. Many NTFPs have significant economic potential in African countries: each year, for example, African countries export 100 000 tonnes of gum arabic, a product in high demand in the food industry. The oil of *Balanites aegyptiaca* is used for cooking, as well as in cosmetics and soap, and sales of honey provide many communities with valuable revenue. People eat the leaves of the baobab tree (Adansonia spp.), and the fruits and leaves of the gao tree (*Faidherbia albida*) are used as fodder for animals (Sacande and Parfondry, 2018).

Kenya, with a population of around 48 million people (KNBS, 2019) is the fourth largest economy in Africa. Kenya's forest covers currently stands at 7.2% (FAO, 2015) against target to restore 5.1 million hectares by 2030, of which 1 million hectares is planned to be from restoration through bio-enterprise development and other forest related initiatives (Muratha, 2016). The Non-timber Forest Products (NTFPs) play an important role in the livelihoods and development of the economy in Kenya where they are increasingly becoming commodities of commerce. Despite the importance of NTFPS in the Kenyan economy, there is existing knowledge gaps and other challenges that impede the realization of NTFPs full potential in local, national, and global markets bio economies (FAO, 2020a). This includes a general lack of information on the volumes and values of NTFPs to the bio economy, land use changes, land tenure systems, decline in forest cover, use of traditional production and harvesting technologies and poor market systems. Apart from the above challenges, approaches to track and monitor the

harvesting, processing and marketing of NTFPS are not well developed and integrated into marketing institutions as the case for timber products.

FAO through the The Restoration Initiative (TRI) project on restoration of Arid and Semi-Arid lands of Kenya through bio-enterprises development and other incentives adopted an integrated approach to address the above-mentioned challenges. The Project is being implemented in: Mount Kulal Biosphere Reserve (MKBR), Marsabit County and Mukogodo Forest and landscape (Laikipia and Isiolo Counties). The project's overall objective is to restore deforested and degraded lands through the FLR approach and enhance the socio-economic development of local communities through the development of bio enterprises of NTFPs and Services in ASALs. Its goal is to reduce the overall proportion of degraded land by 20% in the areas covered by the project. Based on the ranking criterion (FAO, 2020a), 14 priority NTFPs in each ecosystem were identified namely; gums and resins, seed oil / essential oils, indigenous fruits, African indigenous vegetables, medicinal plants, aloes, forage (foliage & grass), barks and natural fiber, poles, withies & fitos, forest products insects and ecosystem services; fungi and associated microorganisms, dyes and tannins, wood fuel, and ecotourism. Further, a value chain analysis was conducted which prioritized the NTFPs with potential for commercialization.

Previous work conducted according to the mapping module of the Restoration Opportunity Assessment Methodology (ROAM) by IUCN and WRI (2014), indicated that NTFPs were threatened by deforestation and overgrazing. In a study conducted in 2015 (Cuni Sanchez, 2016), among the ecosystem services that face challenges in Mt. Kulal and Mukogodo ecosystems are; water, poles (for construction of local houses), fuel wood, herbs and medicine, fruits and honey. This therefore calls for the mapping and quantification of the resources to ascertain their commercial potential and possible Forest Landscape Restoration (FLR) initiatives. In collaboration with KFS, NMK, NRT, County governments and private sector, species identification, resource assessment, mapping and quantification of the NTFPS was carried out and estimation of the potential annual production levels of the priority NTFPs done.

Overall objective

To generate knowledge base on Non-Timber Forest Products and Services (NTFPS) in the two targeted landscapes and their commercial potential

Specific objectives

- To carry out identification of commercially viable NTFPs and their associated species
- To map the identified NTFPs and their densities
- To assess the commercialization potential of identified NTFPs

2. METHODOLOGY

2.1. Resource assessment and mapping

2.1.1 Study Area

Mount Kulal Biosphere Reserve (MKBR) in Marsabit county (Figure 1), with Arapal covering an area of 42,810 ha, Gatab 71,490 ha and Olturot, all located between 36^{o} 92’ and 37^{o} 02 E latitude and 02^{o} 56’ and 02^{o} 82’ N longitude. MKBR is at altitude of between 350 and 2335 m above sea level. The high evaporation potential is over 2600 mm. In contrast, the top of Mt. Kulal is cool and moist (bimodal precipitation +900-1200 mm in March/April and October/November) (Borghesio and Laiolo, 2004; Mati, 2015).

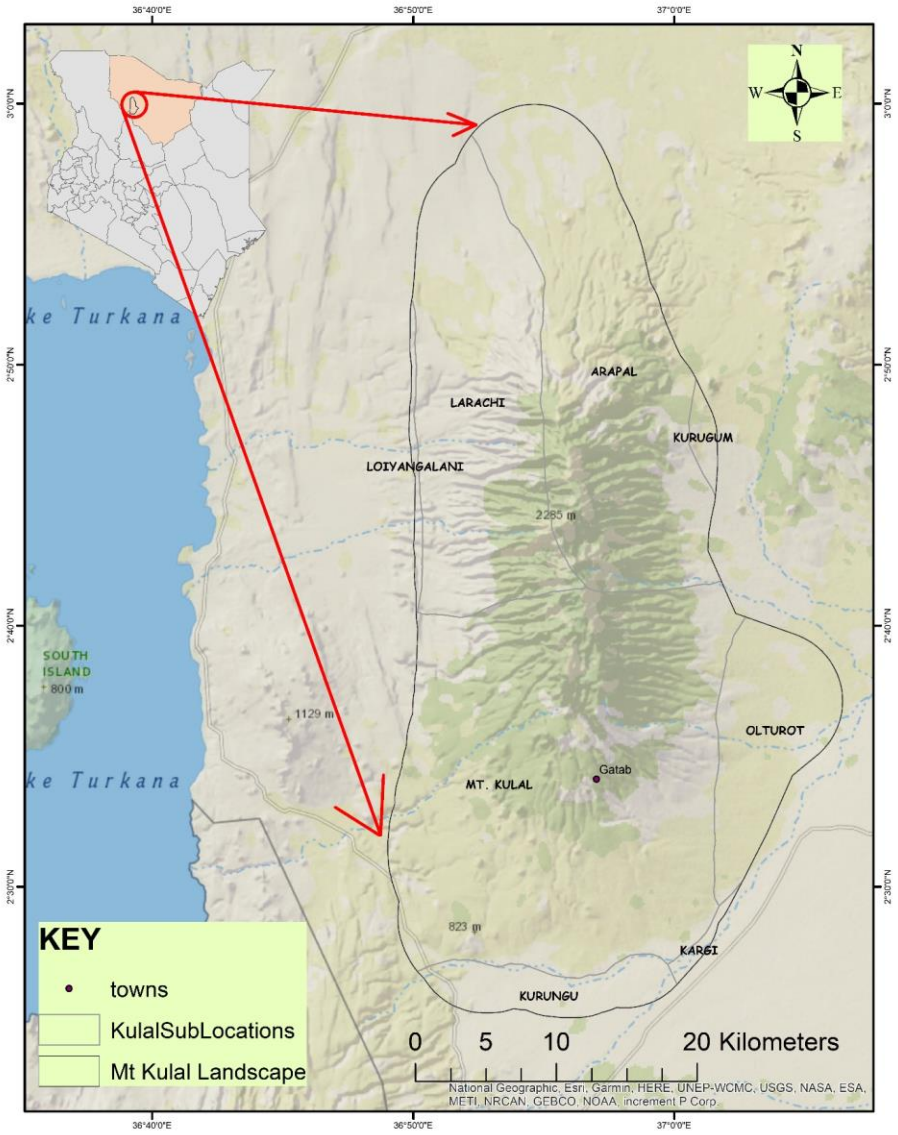

Figure 1: Mt. Kulal Biosphere

The four traditional sub-locations in the MKBR have about 1,500-2,000 households altogether, with an average of 8-10 people per household. The main indigenous community around Mt. Kulal is the Samburu (90%) and the Rendille (10%) which is considered a sub-tribe. The Samburu predominate on the mountain, while the Rendille are more on the eastern lowlands. The indigenous communities have been responsible for the preservation and maintenance of traditional knowledge and practices that are highly relevant for sustainable use of biodiversity of Mt. Kulal.

The Mt. Kulal area is remote and living standards are low with majority of people living below the poverty line. The inhabitants of the landscape surrounding Mt. Kulal rely on the ecosystems for herding and farming livelihoods while in turn having an undeniable impact on it. Gatab, the main settlement on the top of Mt. Kulal is heavily dependent on forest products. The forest products used most often are poles for construction of local houses. However, the people are allowed to collect dead wood for fuel wood, and cutting of living trees for fuel wood in the forests on the mountain is limited and controlled (Watkins and Imbumi, 2007). Livelihoods in Arapal on the other hand are based on pastoralism complemented with some subsistence farming on the top of Mt. Kulal.

The Mukogodo forest is a large dryland cedar and olive forest to the north-west of Mount Kenya. Surrounding it are rangelands that have been transformed into conservancies which in turn comprise a number of group ranches. The forest and landscape (Figure 2) consist of: Laikipia with Illngwesi (9,470 ha), Lekurruki (15,872 ha), Kurikuri (3,340 ha) and Makuriani (5,390 ha) at between 37^{o} 14'and 37^{o} 35' E latitude and 00^{o} 35' to 00^{o} 40' longitude. Isiolo County includes; Leparua conservancy (34,200 ha) between 37^{o} 36' and 37^{o} 51' E latitude and, Oldonyiro (52,500 ha), 36^{o} 29' to 36^{o} 85' E latitude and 10^{o} 00' longitude.

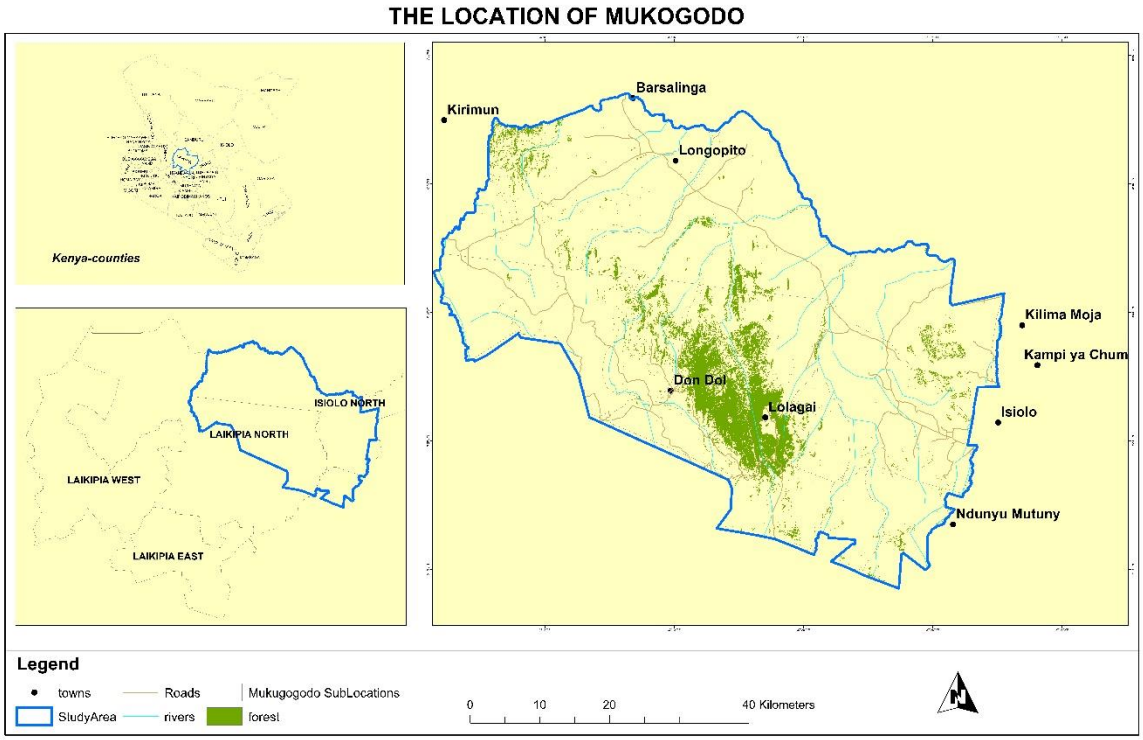

Figure 2: Mukogodo Forest Landscape

The forest landscape receives an annual mean rainfall of 400-600 mm; the rainfall distribution is bimodal with peaks of long rains in March-April and short rains in October- December. The soils in the landscape were formed from basement rocks. The annual forest cover loss is estimated to be 383 ha (KWTA, 2015). Mukogodo forest is a source and habitat for wildlife and livestock during the dry season to both the local and neighbouring communities.

The main ethnic group in the project area in Laikipia County is the Maasai, more specifically the Laikipia Maasai. The two Isiolo conservancies are mainly composed of Samburu and Turkana in Oldonyiro while the Leparua conservancy is composed of Ndorobo, Turkana, Somali, Borana and Samburu. The area is also home to the indigenous hunter-gatherer community Yiaku (Yaaku) also known as Mukogodo Maasai. The landscape is an important watershed, which maintains water quality, quantity, and regulates flow. It is an important water catchment to the surrounding communities and the neighbouring counties (Okello, 2005) and is identified as one of Kenya's important water towers (KWTA, 2015)

2.1.2 Equipment and tools

The materials and equipement used for the study were: Global Positioning System (GPS – Garmin Fenix 6) used to collect ground control points (GCP), satellite images, Global Information Systems (GIS) software, topographic maps, pencils, data sheets and clipboards. String, colored flagging ribbons, diameter and linear tapes (30 m) were used to measure the

plots, whereas Suunto hypsometer was used to measure tree height and a camera used to take photographs for ground verifiction.

2.1.3 Sampling design

The location of the first plot and subsequent plots were purposively selected based on the availability of the NTFPs and information by the local community resource persons.

Plot design and sample units

The methodology included setting up a plot measuring 100 x 25m with the orientation of ^{o}N. A marker was placed at the beginning of the plot and after every 20 metres with the centre being 12.5 to make 10 sub plots in total. As shown in **figure 3** below

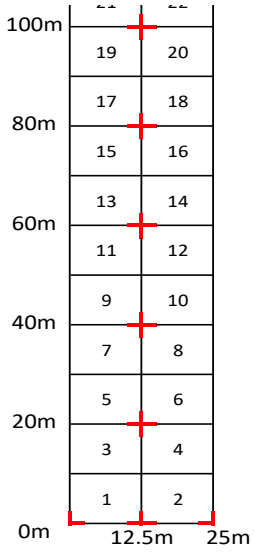

Figure 3: Plot layout

2.1.4 Field assessment and mapping

(i) Identification of NTFPs and their associated species

Information on all NTFPs within each plot was identified to species level with the help of a plant taxonomist. The NTFPs were further identified in local names and their uses with the help of community resource persons. Based on the value chain analysis of NTFPs in the two ecosystems (FAO, 2020b), the identified NTFPs were grouped into two categories; key NTFPs and others. All the associated species within each plot were also identified to species level.

(ii) Mapping and inventory of the resources

Elevations at each GPS location, bearings of central line, local landmarks to assist with relocation (directions to plot) were used. GPS coordinates were collected every 20m along the

central line, so there was an accurate record of the central line used in the plot. Additionally, GPS coordinates were collected in all 4 corners of the plot as per **figure 3.** Tree data was captured as shown in **figure 4**. Sketch of important features in plot. e.g., streams, tracks/paths, slopes, rocky areas, changes in land use (i.e., remnant forest vis avis secondary vegetation) were also documented. Stock taking of the recorded key NTFPs was carried out by counting their frequencies within each plot.

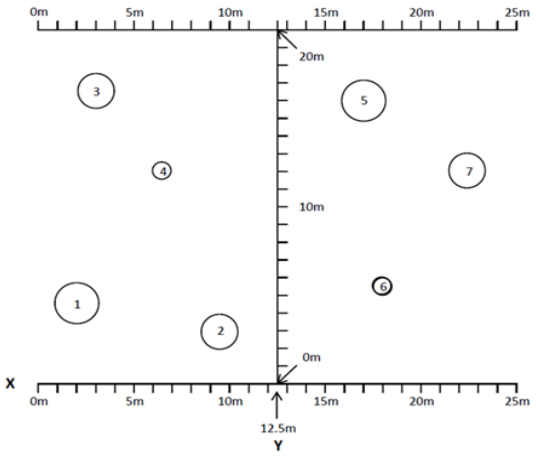

Figure 4: Sampling technique

2.1.5 Estimation of production potential of NTFPs

(i) Estimation and quantification of gums and resins

Within each population frame, the sampling plots measured 100m in length and 25m in width

- Based on these measurements, the respective area sizes were calculated using the following formula:

  Area= length × height…….in hectare.

- Stocking density (stems per hectare) (separately for each sampling plot) was calculated for each resource as follows:

  Stocking Density (stems/ ha) = No. of stems within the sampling plot / area of respective sampling plot

  Average density (of the stock for the target resource) was calculated as the mean value of the sampling plots average.

Stocking Density classes were then assigned based on the following criteria: The stocking density for *Senegalia senegal* is based on the optimal stocking density for a plantation of 400 stems per hectare and a spacing of 5 x 5-m while that for *Commiphora holtziana & Boswellia neglecta* is based on an optimal stocking density for a plantation of 278 and a spacing of 6 x 6 m.

Based on this criterion, the stocking density for each resource is then classified into low, medium and high (Tables 1).

Table 1: Density Classification for gums and resins (stems/ha)

Species	Density	Density classification
Senegalia senegal	< 300	Low
	300-500	Medium
	> 500	High
Commiphora holtziana & Boswellia neglecta	< 156	Low
	156-300-	Medium
	>300	High

- Based on the densities, the yield was calculated using the following formula:
  Yield (kg/ha) = density (stems/ha) × estimated yield per stem (kgs).

(ii) Aloe productivity estimation

The aloe densities per hectare were calculated and classified as follows:

Density Classification for Aloe (stems/ha)

< 1000 - Low

1000 – 3600 - Medium

> 3600 - High

The densities were classified into low, medium and high density classes and the mean, standard deviation and coefficient of variation calculated.

(iii) Estimation of fruit yield from Opuntia sp.

Fruit yield for both *Opuntia ficus indica* and *Opuntia stricta* fruits were estimated counting and averaging to get a correlation factor. Plots measuring 25 by 100 m were laid and all *Opuntia* clumps within the plots were counted and their clumps of *Opuntia* per ha were determined. Further, number of branches per stem, number of cladodes per branch and number of fruits per cladode was determined.

Quantification of *Opuntia* stems

Total number of *Opuntia* stems^{-ha} = N × CF

N- Average number of clumps per ha

CF- Coefficient factor for average number of stems in an *Opuntia* clump ≈ 25

Quantification of Opuntia fruits

CF – Coefficient factor for average number of fruits per stem was calculated using the following formula:
CF = Average number of branches per stem*Average number of cladodes per branch* Number of fruits per cladode ≈ 384

2.2. Data entry & cleaning

Analysis of the data was carried out using SPSS and MS Excel. Quantitative data was analyzed for proportions, frequencies and means. Qualitative data synthesis and analysis techniques largely involved systematic synthesis or putting the data collected into a narrative account related to commercialization potential.

3. FINDINGS AND DISCUSSIONS

The study generated important information which included location of the NTFPs and their associated plant species. The densities and yield of prioritized NTFPs was also determined. The NTFPs of focus were, gum arabic from *Senegalia senegal*, resins from *Commiphora holtziana* and *Boswelia neglecta*, *Aloe* spp, *Opuntia* spp, apiculture (honey), medicinal plants (*Myrsine africana* and *Boscia coriacea*), ecosystem services (ecotourism) and pasture.

3.1. Location of NTFPs in the ecosystems

The maps in figures 5, 6 and 7 show the location of the various NTFPs in Mukogodo and Mt. Kulal ecosystems.

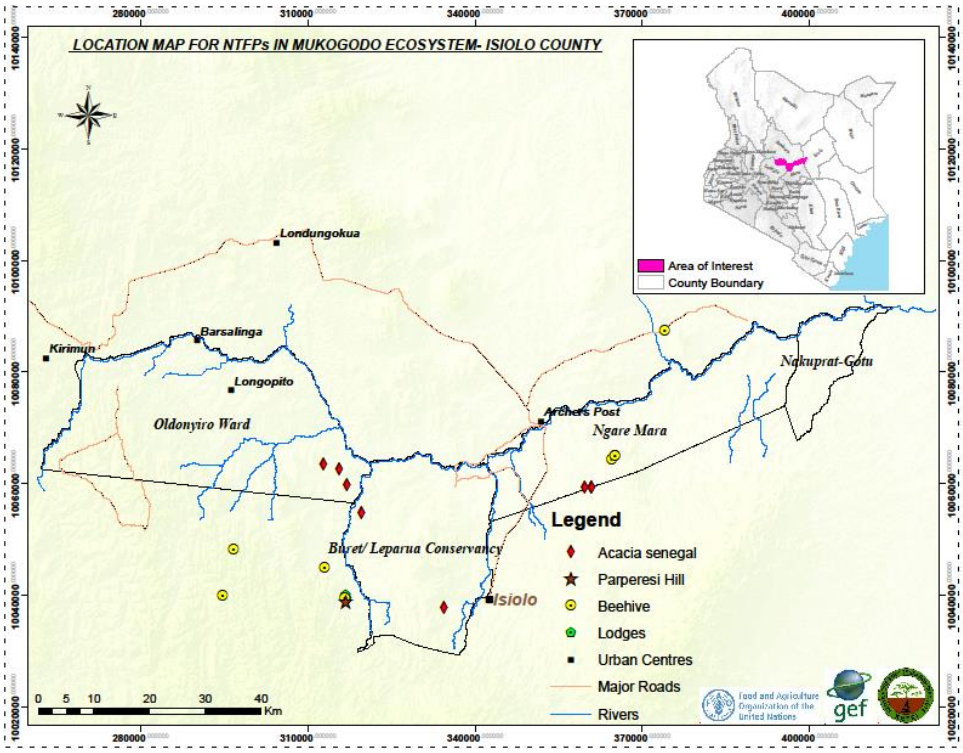

Figure 5: Location map for NTFPs in Mukogodo Ecosystem – Isiolo County

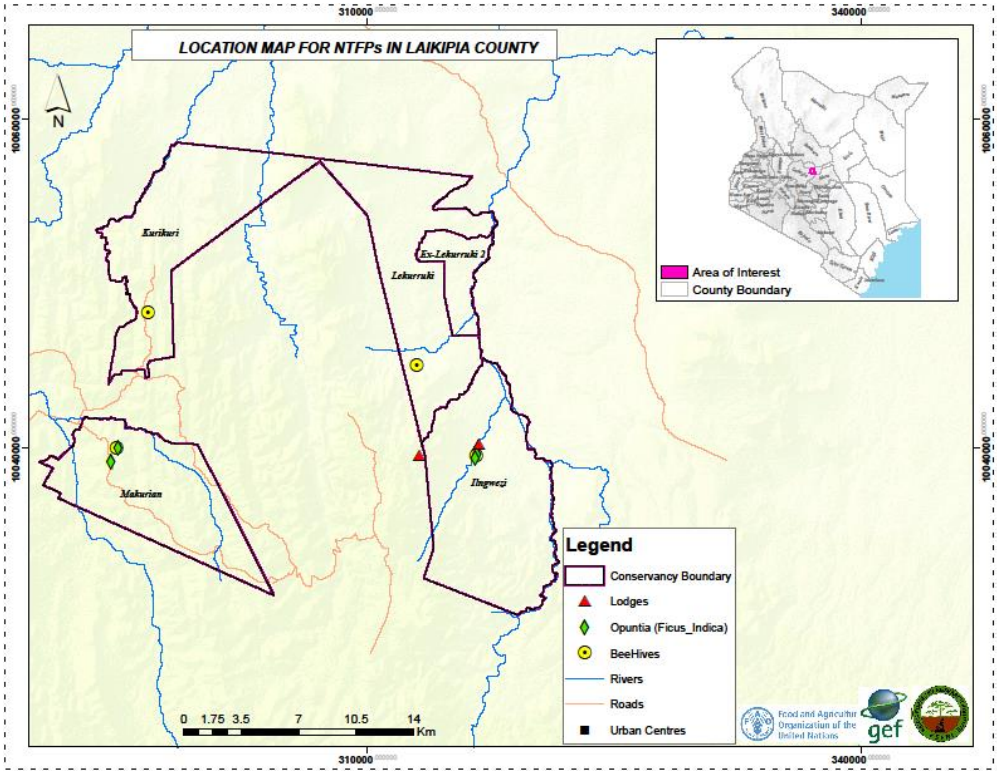

Figure 6: Location map for NTFPs in Mukogodo Ecosystem – Laikipia County

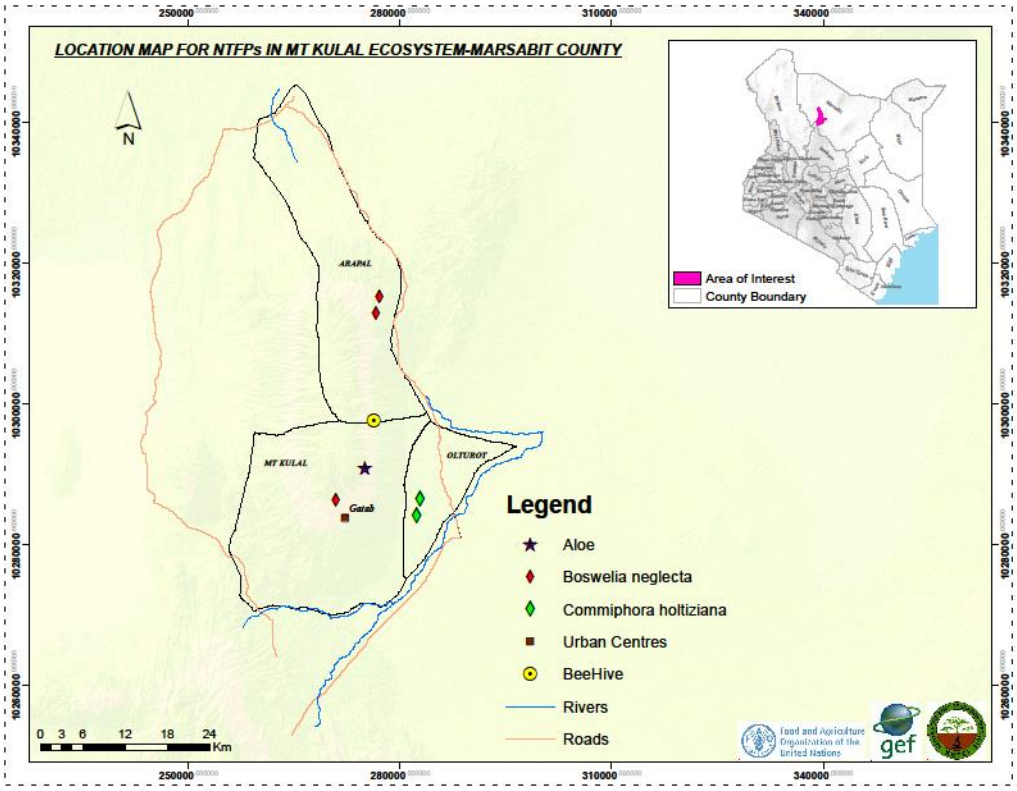

Figure 7: Location map for NTFPs in Mt. Kulal Ecosystem – Marsabit County

3.2. Identified key NTFPs and the associated plant species

A total of eight key NTFPs were identified in the two ecosystems. In Mt. Kulal Biosphere Reserve (MKBR), four NTFPS were identified; gums and resins (*C. holtziana, B. negelcta* & *S. senegal*), medicinal plants e.g. *M. africana*, aloes (*A. secundiflora, A. lateratia*) and pasture. In Isiolo County (Mukogodo ecosystem), apiculture, gums and resins were identified. In addition, *Boscia coriacea* was recorded as an indigenous vegetable. Laikipia County, recorded *O. stricta* and *O. ficus indica* fruits, apiculture, gum producing species (*S. senegal*) and aloes (*A. scabrifolia, A.secundiflora*) **Table 2**.

The total number of beehives was estimated to be 6000 across the Kurikuri Group Ranch. In Makurian group ranch, fifteen beehives were located at each household hence 4260 beehives. In Ilngwesi, 30 bee hives were earlier installed but are no longer working. There are however plans to install bee hives along the river. There are 3470 beehives across the entire group Lekurruki group ranch. Different plant species were found to be associated with different NTFPs across the study areas **(Table 2**). The different species in apiculture areas are known to play a key role in honey production as they act as sources of pollen.

Table 2: Key NTFPS identified for commercial value and their associated species

County	Locality	Botanical Name	Local Name	NTFP	Associated species
Marsabit	Gatab (Limotinyekie)	*Boswelia neglecta*	Ubani Silalei	Resins	*Vernonia cinerea, Plectranthussp, Hibiscus micranthus, Kleiniaodora, Barleria acanthoides, Sansevieria robusta, Cissus quadrangularis, Justicia odora, Cynanchum viminale, Euphorbia sp., Acacia mellifera, Heliotropium strigosum, Senegalia senegal, Commiphora sp., Commiphora rostrata, Kedrostissp, Helichrysum glumaceum*
	Gatab (Loyokor)	*Aloe secundiflora*	Sukuroi	Medicinal	*Turraea mombassana, Aloe scabrifolia, Pavetta sp., Psychotria kirkii, Psiadia punctulata, Hypoestes forsskaolii, Osyris lanceolata, Solanum phyllanthum, Euclea divinorum, Maytenus arbutifolia, Aloe secundiflora, Rhus natalensis, Carissa spinarum, Jasminum grandiflorum, Coptosperma graveolens, Aerangis confusa, Rangaeris amanuensis, Pappea capensis, Tinnea aethiopica, Aristada sp., Plectranthus sp.*
	Gatab (Ndoropsen)	*Myrsine africana*	Seketet	Medicinal	*Asparagus falcatus, Zehneria scabra, Eragrostis sp., Chloris pycnothrix, Phaulopsis imbricate, Scutia myrtina,* Cyphostemma sp., *Juniperus procera, Lepidium bonariense , Olea europaea* subsp. *africana, Heteromorpha arborescens, Cineraria deltoidea, Maytenus arbutifolia, Rhus natalensis, Pavonia burchellii, Vepris simplicifolia, Harpachne schimperi, Aloe lateratia, Justicia debilis, Vangueria madagascariensis, Cyphostemma sp., Eragrostis aspera, Jasminum grandiflorum, Themedatriandra, Rhamnus staddo*
	Olturot (Nongolin)	*Senegalia senegal* *Commiphora holtziana* *Boswelia neglecta*	Ilderkesi Loilipai Ubani/	Gum &resins	*Justicia odora, Cadaba ruspolii, Hibiscus micranthus, Hildebrandtia obcordata, Acacia mellifera, Indigofera spinosa, Sesamothamnus sp., Boscia coriacea, Graells sp., Euphorbia correllii, Commiphora rostrata, Grewia sp., Boswellia neglecta, Grewia tenax, Commiphora africana, Commiphora Sp., Cadaba glandulosa, Justicia sp., Premna sp., Asepalum eriantherum, Euphorbia natalensis, Heliotropium strigosum, Abutilons sp., Indigofera spinosa, Senegalia senegal, Commiphora sp., Acacia mellifera, Acacia reficiens, Sesamothamnus sp., Euphorbia heterochroma, Boscia coriacea, Grewia sp., Hildebrandtia obcordata,*

			Silalei		*Barleria acanthoides, Sericocomopsis pallida, Blepharispermum pubescens, Chascanum* sp.
	Arapal (Lositani)	*Boswelia neglecta*	Ubani/ Silalei	Resins	*Plicosepalus meridianus, Commiphora sp., Commiphora holtziana, Sericocomopsis pallida, Hildebrandtia obcordata, Asepalum eriantherum,Solanum coagulans, Senegalia senegal, Acacia tortilis, Abutilon sp., Justicia sp., Indigofera spinosa, Grewia tenax, Barleria acanthoides, Commiphora africana, Ipomoea cicatricose, Aristida sp., Cadaba farinosa, Asparagus racemosus, Cordia sinensis, Boscia coriacea, Grewia villosa, Hibiscus micranthus, Kedrostis sp., Maerua endlichii, Solanum coagulans*
Isiolo	Leparua Conservancy (Thenge)	*Boscia coriaceae*	Eendung/ Serishoi	vegetable	*Ocimum americanum, Ipomoea obscura, Ruellia patula, Tennantia sennii, Grewia tenax, Grewia villosa, Acacia tortilis, Balanites pedicellaris, Pavonia burchellii, Barleria eranthemoides, Boscia coriacea, Opilia campestris, Senna longiracemosa, Achyranthes aspera, Hibiscus micranthus, Senegalia senegal, Abutilon mauritianum, Capparis tomentosa, Sericocomoposis pallida, Maerua endlichii, Solanum campylacanthum*
Laikipia	Makurian-Kiwanja ya ndege	*Opuntia ficus indica*	Matundai / Ilkurasi	fruits	*Euphorbia laikipiensis, Pennisetum mezianum, Acacia tortilis, Opuntia vulgaris, Kalanchoe lanceolata, Aristida sp., Barleria acanthoides, Lycium europaeum, Pollichia campestris, Ipomoea sinensis, Solanum campylacanthum, Edithcolea grandis,Crassula schimperi, Kleiniapetraea, Chloris pycnothrix, Cynodon sp., Alternanthera pungens, Asparagus racemosus, Sida alba, Commicarpus grandiflorus*
		Opuntia stricta	Matundai / Ilkurasi		
	Makurian	Beehives		Apiculture	*Opuntia ficus indica, Aloe scabrifolia, Alternanthera pungens, Opuntia vulgaris, Opuntia stricta, Senna didymobotrya*
	Makurian, Loisukut (Aloe Demo Plot)	Aloe	Suguroi	Medicinal	*Euphorbia laikipiensis, Opuntia vulgaris, Aristida sp., Acacia seyal, Eragrostis tenuifolia, Cucumis prophetarum, Acacia nilotica, Solanum campylacanthum, Gomphocarpus stenophyllus, Grewia similis, Lycium europaeum, Ipomoea sinensis, Cynodon* sp.
	Kurikuri	*Beehives*		Apiculture	*Croton dichogamous*

	Ilngwesi	*Senegalia senegal*	Ilderkesi	Gums	*Hibiscus micranthus, Actiniopteris radiate, Grewia tephrodermis, Achyranthes aspera, Hygrophila auriculata, Kleinia odora, Acacia brevispica, Boscia angustifolia, Indigofera spinosa, Coptosperma graveolens, Ipomoea kituiensis, Ocimum kenyense, Acacia mellifera, Vigna membranacea, Commiphora africana, Tephrosia sp. Marsdenia sp., Hermanniaex appendiculata, Melhania velutina, Ormocarpum sp., Ochna ovate, Portulaca quadrifida, Ipomoea kituiensis, Pupalia lappacea, Canthium pseudosetiflorum, Dracaena angustifolia, Dolichos sp., Euphorbia heterochroma, Enteropogon macrostachyus, Boscia coriacea, Pavonia sp., Acacia tortilis, Plicosepalus meridianus, Hermannia exappendiculata*
	Lekurruki	Bee hives		Apiculture	*Phyllanthus maderaspatensis, Euphorbia heterochroma, Hygrophila auriculata, Boscia angustifolia, Coptosperma graveolens, Acacia brevispica, Haplocoelum coeruleum, Acalypha fruticosa, Sericocomopsis hildebrandtii, Cissus quadrangularis, Hibiscus micranthus, Canthium pseudosetiflorum, Leptothrium senegalense, Sansevieria sp., Cyperus sp., Grewia villosa*

3.3. Identified Ecosystem Services

The study sites provide a wide range of ecotourism activities including cultural (indigenous people) environmental (hiking and adventure tourism and wildlife safaris**)**. Mukogodo (Ilngwesi and Lekurruki group ranches) is home to a wide range of wildlife including lions, elephants, zebras etc. The group ranches support wildlife conservation. The group ranches have Eco lodges which offers accommodation as well as opportunities for viewing wildlife. The Lodges contributes to developing communities by supporting education, health and livelihood projects by providing jobs.

Mt Kulal biosphere reserve on the other hand provides opportunities for tourism. Key tourist attractions include Elmolo Village located 12km north of Loiyangalani, the sacred Island of Lorian near the village, Lake Turkana, South Island, Mt. Kulal, Lava flows and the desert (UNESCO, 2007). The forest in Mt. Kulal is an attraction in itself and it is a paradise for the botanists. The mountain top has beautiful scenery (UNESCO, 2007). These opportunities contribute to alternative livelihoods for the local community.

3.4. Other NTFPs identified

Several NTFPs were identified in addition to the ones mentioned in **Table 2**. This was done based on the reports given by the local resource persons. The NTFPs under this category as well as the details of their uses are as shown in **Table 3**. Pasture species were identified across the two ecosystems.

Table 3: Summary table of other identified NTFPs in Mukogodo and Mt. Kulal ecosystems

County	Location	Botanical name	Local Name	Uses	Parts used	Preparation method
Marsabit	Limotinyekie	*Boswelia neglecta*	Silalei	Gum/resin	Stem bark	
	Limotinyekie	*Cissus quadrangularis*	Sukurtuti	Thatching/mats	stem	weaving
	Limotinyekie	*Sansevieria robusta*	Ildupai	Ropes, mats	stem	weaving
	Limotinyekie	*Grewia tenax*	Riposan	food	fruits	chewing
	Limotinyekie	*Grewia villosa*	Ilpupoi	food	fruits	chewing
	Loyokor	*Aloe secundiflora*	Suguroi	Diarrhea, Malaria	leaves	soaking
	Loyokor	*Carissa spinarum*	Lamurei	flu, malaria, cold	roots	boiling
	Ndoropsesen	*Clinopodium sp*	Uhligi/ Peremende	flu, spices	leaves	boiling
	Ndoropsesen	*Myrsine africana*	Seketeti	aphrodisiac, arthritis	Fruits/seeds	boiling
	Olturot-Kisima	*Hyphaene sp.*	Iparwai	Basketry, food	Leaves, fruits	Weaving, chewing
	Nongolin	*Senegalia senegal*	Ilderkesi	Gum arabic	Stem bark	
	Nongolin	*Commiphora holtziana*	Loilipai	Gum arabic	Stem bark	
	Nongolin	*Boswelia neglecta*	Ubani	Gum/ resins	Stem bark	
	Lositani	*Euphorbia heterochroma*		Medicinal(Malaria, detoxification, flu)	Leaves/ roots	boiling
	Lositani	*Boswelia neglecta*	Ubani	Gum and resins	Stem bark	
Isiolo	Nakuprat	*Solanum arundo*	Entulelo	detergent	Fruits	soaking
	Nakuprat	*Cordia sinensis*	Edome	food	fruits	chewing
	Nakuprat	*Balanites aegyptiaca*		food	fruits	chewing

	Oldonyiro	*Acacia tortilis*	Ltepesi	fodder	Fruits, leaves	
	Thenge	*Boscia coriacea*	Eendung/ Serishoi	vegetable	Leaves	Dried and boiled
	Burat	*Ocimum americanum*		Spices, mosquito repellent	leaves	burning
Laikipia	Kiwanja ya ndege	*Opuntia stricta*	matundai	food	fruits	chewing
	Kiwanja ya ndege	*Opuntia stricta*	matundai Ilkurasi	food	fruits	chewing
	Kiwanja ya ndege	*Croton dichogamous*	Nlopon	Apiculture, Medicinal (flu, fever)	Flowers, roots	boiling

3.5. Estimation and quantification of the population of NTFPs

3.5.1 Densities of *Senegalia senegal*

The mean stocking densities for *S. senegal* ranged between 116 – 420 stems/ha in the Mukogodo ecosystem indicating low to medium densities while it ranged between 88-96 stems/ha in Mt. Kulal Ecosystem indicating low densities **(Table 4).**

Table 4: Densities of *Senegalia senegal* in Mt Kulal and Mukogodo ecosystems

Ecosystem	**County**	**Area**	**Mean stocking density(stems/ha)**	**Density classification**
Mukogodo	Isiolo	Oldonyiro Conservancy	325	Medium
		Leparua Conservancy	180	Low
		Nakuprat-Gotu conservancy	420	Medium
	Laikipia	Ilngwesi Group Ranch	116	low
Mt. Kulal	Marsabit	Arapal	88	Low
		Olturot	96	low

Figures 8 and 9 below shows the densities of *Senegalia senegal* in the two ecosystems

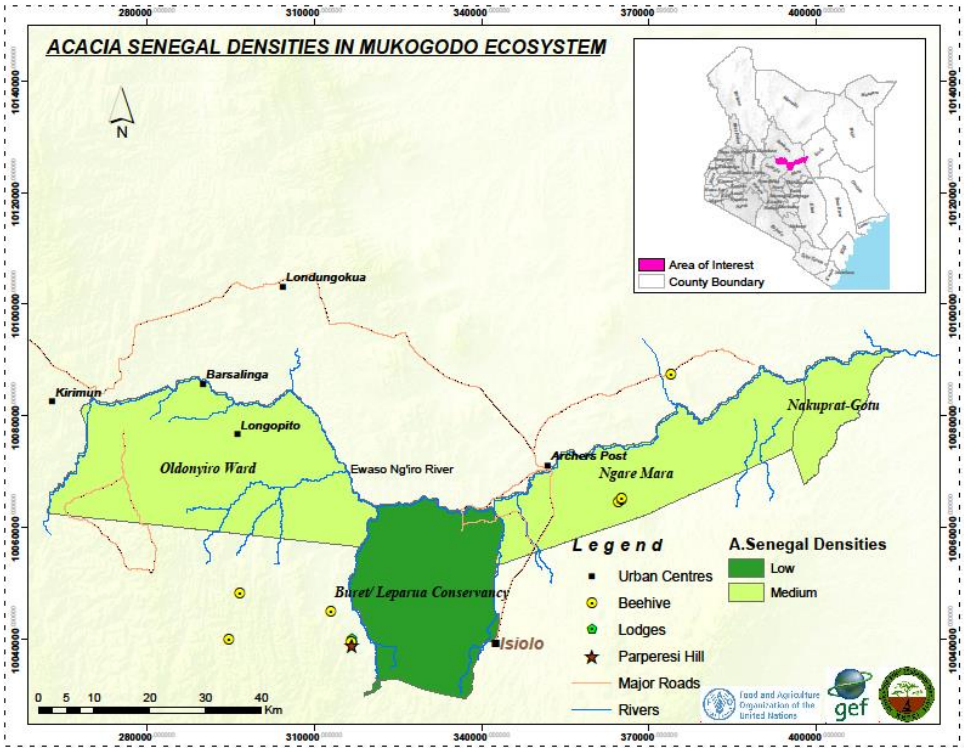

Figure 8: *Senegalia senegal* densities in Mukogodo ecosystem -Isiolo County

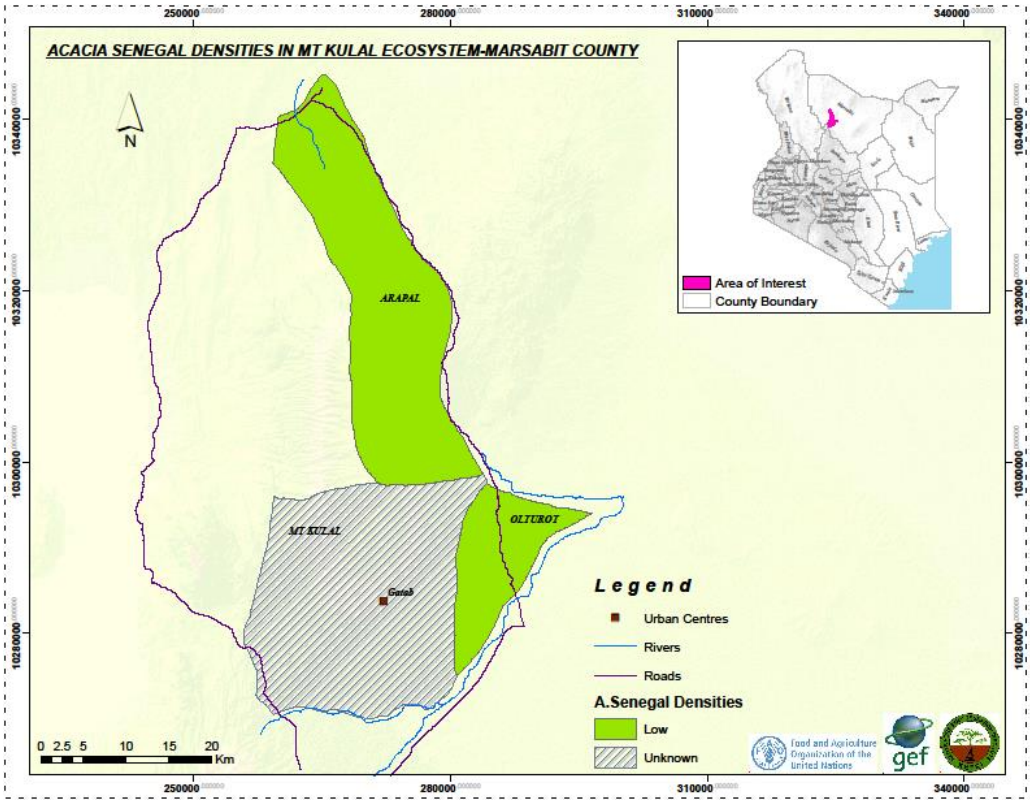

Figure 9: *Senegalia senegal* densities in Mt. Kulal ecosystem

3.5.2 Densities of *Commiphora holtiziana* and *Boswelia neglecta*

The resins producing plant species (*B. neglecta* and *C. holtziana*) were only recorded in Mt. Kulal ecosystem in low density except in Arapal where *B. neglecta* was recorded in medium densities **(Table 5 and figures 10 & 11).**

Table 5: Densities of resin producing tree species in Mt. Kulal ecosystem

County	Sub-location	Tree species	Mean Density (Stems/ha)	Density classification
Marsabit	Gatab	*Boswelia neglecta*	64	Low
	Arapal	*Commiphora holtziana*	14	low
		Boswelia neglecta	164	medium
	Olturot	*Boswelia neglecta*	76	low
		Commiphora holtziana	84	low

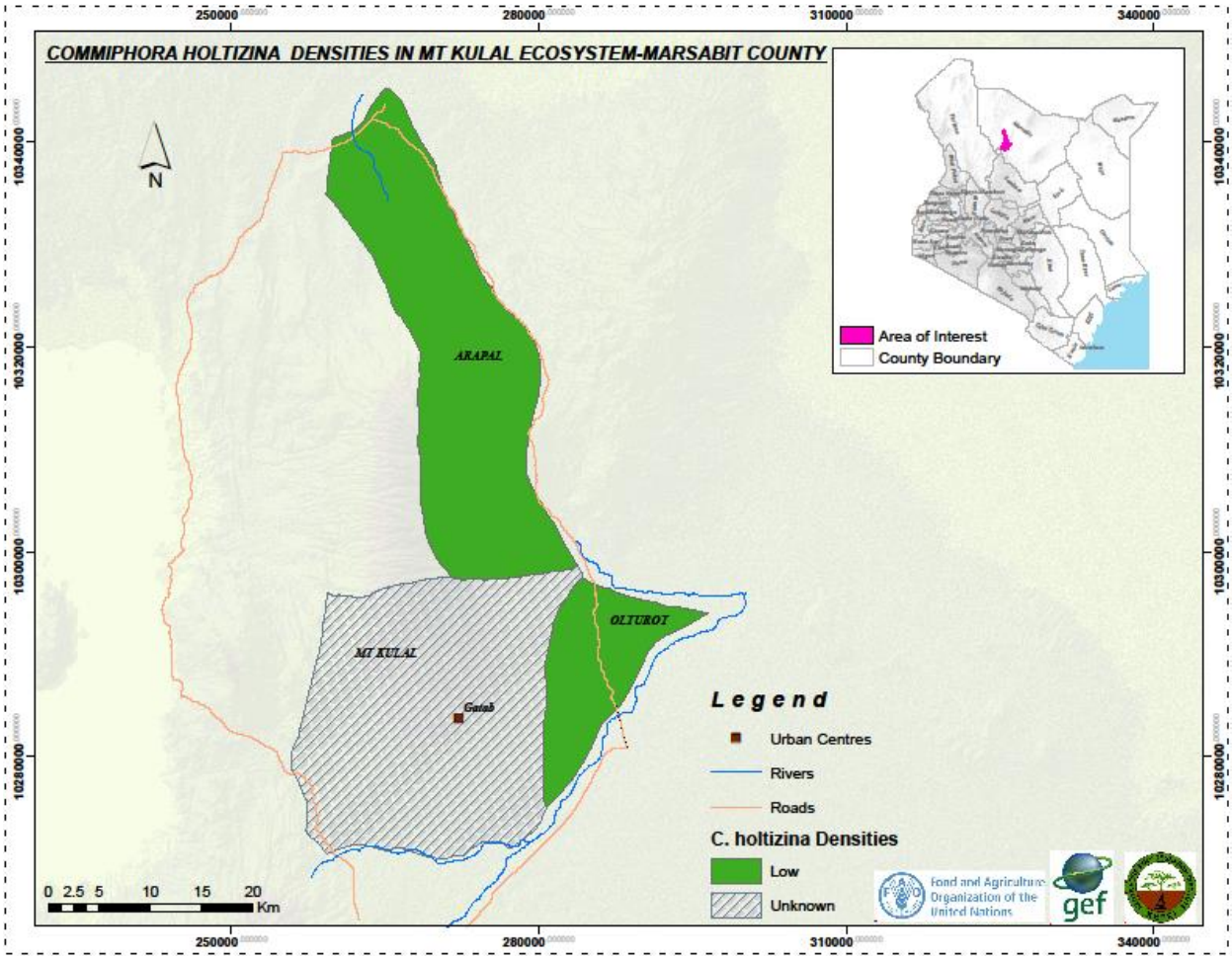

Figure 10: *Commiphora holtiziana* densities in Mt. Kulal Ecosystem

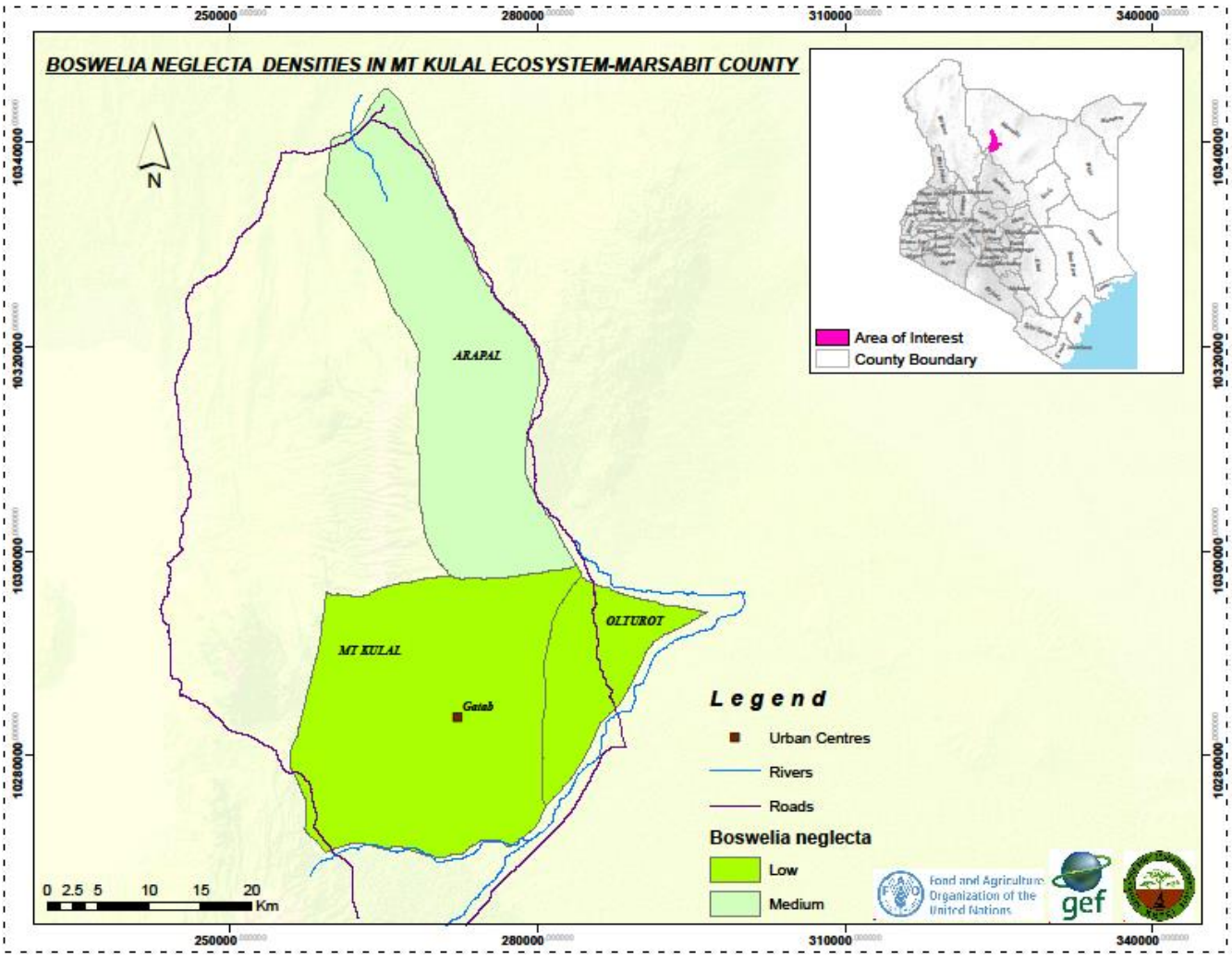

Figure 11: *Boswelia neglecta* densities in Mt. Kulal ecosystem

3.5.3 Aloe and Opuntia densities

Aloes were recorded in both Mukogodo and Mt. Kulal ecosystems while Opuntia species were recorded in Mukogodo ecosystem only as shown in Table 6.

Table 6: Density of Aloe and Opuntia in the study sites

County	Site	Resource	Mean density stems/Ha	Density classification
Marsabit/ Mt. Kulal	Gatab (Loyokor)	*Aloe secundiflora*	540	Low
	Gatab (Lngoon)	*Aloe lateratia*	388	low
Laikipia/ Mukogodo	Makurian	*Opuntia* spp	11, 835	High
		Aloe spp.	478	Low
	Kurikuri	*Opuntia* spp.	11,000	High

Figure 12 below shows the densities of aloes in Mt. Kulal ecosystem. The aloes are mainly found in Gatab but in low densities.

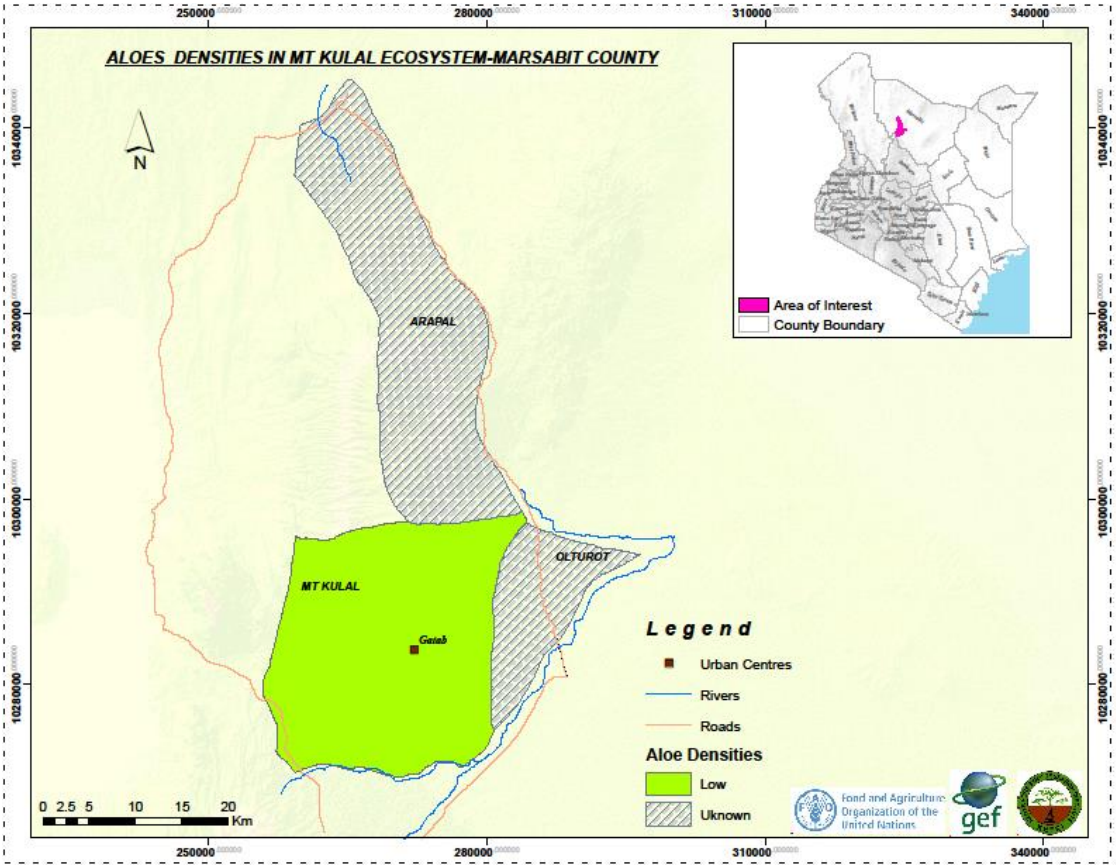

Figure 12: Aloe densities in Mt. Kulala Ecosystem

3.6. Estimation of production potential of NTFPs

3.6.1 Gums and resins production potential

Gums and gum resins emerge naturally from slits in tree barks; or by creating additional man-made slits, which yields larger quantities. The amount of gum produced varies, depending on the tree species, age, site and season (ambient temperature).

(i) Gum arabic production potential

The average annual gum yields/tree range from 0.5-1 Kg in Sudan and 0.1-0.5 Kg in Nigeria (SSGCL, 2006). In Kenya the average annual yields per tree is about 1.5 g (non-tapped) and 6.2 g (tapped) (Wekesa et al., 2009). Based on the mean stocking density of stems $ha^{-1}$of *Senegalia senegal* and estimated average gum arabic yield per tree (0.5 kg), the potential annual gum arabic yield was estimated to in Kg ha^{-1} in the different areas as in Table 7

Table 7: Gum Arabic production potential

Ecosystem	County	Area	Mean stocking density (stems/ha)	Estimated average Gum arabic (kg/ha)
Mt. Kulal	Isiolo	Oldonyiro Conservancy	325	162.5
		Leparua Conservancy	180	90
		Nakuprat-Gotu conservancy	420	210
	Marsabit	Arapal	88	44
		Olturot	96	48
Mukogodo	Laikipia	Ilngwesi Group Ranch	116	58

(iii) Resins production potential

Yields of 1-3 kg per tree per year have been cited for olibanum in Somalia (http://www.fao.org/docrep/v5350e/V5350e11.htm). It is also reported that the average yield per tree is 1.5 kg for *Boswellia papyrifera* in Ogbaghi (Chikamai and Enrico, 2005). Yields and quality are known to decline during each tapping season as well as over the longer term, particularly in prolonged periods of drought. Based on the mean stocking density and estimated hagar (*C. holtiziana*) yield per tree (1.5kg) and frankincense (*B. neglecta*) yield per tree (2kg), the potential annual mean yield in Mt. Kulal was 73.5kg/ha and 202 kg/ha for hagar and frankincense respectively in Mt. Kulal **(Table 8).**

Table 8: Production potential of resins in the study sites

Ecosytem	Sub-location	Tree species	Mean Density (Stems/ha)	Estimated resins yield (kg/ha)
Mt. Kulal	Gatab	*Boswelia neglecta*	64	128
	Arapal	*Commiphora holtziana*	14	21
		Boswelia neglecta	164	328
	Olturot	*Boswelia neglecta*	76	152
		Commiphora holtziana	84	126

3.6.2 Opuntia fruit yield

There was high Opuntia fruit yield per hectare in the two group ranches (Makurian and Kurikuri) as shown in Table 9.

Table 9: Opuntia fruit yield in the two group ranches (Makurian and Kurikuri) in Mukogodo ecosystem

County	Site	Resource	Mean density stems/Ha	Fruit yield/ha
Laikipia/ Mukogodo	Makurian	*Opuntia* spp.	11, 835	4,509,135
	Kurikuri	*Opuntia* spp.	11,000	4,224,000

NB: ***Opuntia*** **spp** represents *O. ficus indica* and *O. stricta* recorded in the two sites

4. CONCLUSION & RECOMMENDATIONS

A total of eight key NTFPs were identified in the two ecosystems. In Mt. Kulal Biosphere Reserve (MKBR), four NTFPS were identified; gums and resins (*Commiphora holtziana, Boswellia negelcta* & *Senegalia senegal*), medicinal plants e.g., *Myrsine africana*, Aloes (*Aloe secundiflora, Aloe lateratia*) and pasture. In Isiolo County (Mukogodo ecosystem), apiculture, gums and resins were identified. In addition, *Boscia coriacea* was recorded as an indigenous vegetable. Laikipia County, recorded *O. stricta* and *O. ficus indica* fruits, apiculture, gum producing species (*S. senegal*) and Aloes (*A. scabrifolia, A. secundiflora*)

Resin producing species (*C. holtziana & B.negelecta*) were only found in Mt. Kulal in low to medium densities. In Mukogodo ecosystem (Isiolo County), *S. senegal* was found in low to medium densities, while in Mt. Kulal its densities were low. On the other hand, *Opuntia* spp. were only found in Mukogodo (Makurian and Kurikuri group ranches) in high densities. Aloes were found in low densities in Mukogodo (Makurian group ranch) and Mt. Kulal ecosystems.

NTFPs classified as medium to high were recommended for large scale commercialization. Based on this criterion, *S. senegal* (Gum arabic) in Isiolo County, Opuntia species (both fruits and stems) were found with a potential for large scale exploitation. This will not only help to improve the livelihood of the local communities but also will help in the control of the invasive nature in the case of *Opuntia* species in Laikipia through utilization. Yield was directly proportional to densities, hence *Opuntia* in Laikipia, *B. neglecta* in Mt. Kulal and *S. senegal* in Mukogodo (Isiolo County) are recommended for commercialization. NTFPs found in low densities e.g., aloes and *C. holtziana* are recommended for commercialization with conservation conservation measures as well as enriched planting of degraded areas with these species to ensure sustainability. There is also potential for apiculture and medicinal plants such as *M. africana*) in the two ecosystems.

REFERENCES

Borghesio, L., & Ndang'ang'a, P. K. (2001). An avifaunal survey of Mt Kulal, Kenya. *Scopus*, 12.

C. Wekesa, P. Makenzi, B. N. Chikamai , J. K. Lelon, A. M. Luvanda and M. Muga. 2009. Gum arabic yield in different varieties of *Senegalia senegal* (L.) Willd in Kenya

Cuni-Sanchez, A., Pfeifer, M., Marchant, R., & Burgess, N. D. (2016). Ethnic and locational differences in ecosystem service values: Insights from the communities in forest islands in the desert. *Ecosystem Services*, *19*, 42-50.

FAO (1990a). Utilization of tropical foods: fruits and leaves.FAO Food and Nutrition Paper No. 47/7. Rome.

FAO (1992). Risk analysis in dryland farming systems, by J. Anderson & J. Dillon, Farm Systems Management Series No. 2, Rome.

FAO (2015). Global Forest Resources Assessment, 2015. Kenya Country Report. Rome 2014.

FAO (2020a). Report: Status of the interventions on Non-Timber Forest products in Kenya

FAO (2020b). Report on Gender Based Value Chain Analysis of Non-Timber Forest Products and Services in Mt. Kulal, Mukogodo Forest and Kirisa Forest Ecosystems

IUCN, W. (2014). A guide to the restoration opportunities assessment methodology (ROAM): assessing forest landscape restoration opportunities at the national or sub-national level. *IUCN, Gland, Switzerland*.

KNBS (2019). Distribution of Population by County and Sub County in: Kenya Population and Housing. Government Printers, Nairobi, Kenya.

KWTA (2015). Kenya Water Towers Status Report.

Mati, B. M. (2015). Assessment of ecosystem services in Kenya's ASAL water towers (Marsabit and Samburu). FAO.

MENR (2000). The Kenya National Biodiversity Strategy and action Plan. Ministry of Environment and Natural Resources. Government of Kenya, COP 2.

Murathe, F. M. (2016). Factors affecting growth of micro and small family business enterprises: a case of Nairobi Central Business District (Doctoral dissertation, Strathmore University).

Okello, J. B. (2005). The Role of Community Participation in Forest and Natural Resources Management: A Case Study of Mukogodo Forest Reserve in Kenya. KFS.

Sacande, M. & Parfondry, M., 2018. Non-timber forest products: from restoration to income generation. Rome, FAO. 40 pp. License: CC BY-NC-SA 3.0 IGO.

UNESCO (2007). A photo -story of Mt. Kulal Biosphere Reserve.

Watkins, T. Y., & Imbumi, M. (2007). Forests of Mount Kulal, Kenya: source of water and support to local livelihoods. *Unasylva*, 33-37.

ANNEXES

Annex 1: Inventory tool for assessment

Tree Data Sheet

Plot ID		**Date:**			**Team:**			
Tree Noumber	**Sub plot No.**	**X**	**Y**	**Species**	**DBH (mm)**	**POM (cm)**	**H (m)**	**Notes**

Annex 2: Species Check lists

(i) Mt. Kulal species check list

Asparagus falcatus	*Commiphora sp. 2*	*Myrsine africana*
Commiphora africana	*Conyza pyrrhopappa*	*Mystroxylon aethiopicum*
Coptosperma graveolens	*Conyza schimperi*	*Ocimum gratissimum*
Euclea divinorum	*Coptosperma graveolens*	*Olea europaea susp. africana*
Heliotropium strigosum	*Cordia sinensis*	*Osyridicarpos schimperianus*
Maytenus arbutifolia	*Crassula schimperi*	*Osyris lanceolata*
Olea europaea subsp. africana	*Crotalaria sp.*	*Pappea capensis*
Phaulopsis imbricata	*Cynanchum viminale*	*Pavetta sp*
Acacia reficiens	*Cyphostemma sp.*	*Pavonia burchellii*
Opilia sp.	*Dovyalis abyssinica*	*Pistacia aethiopica*
Abutilon mauritianum	*Dyschoriste radicans*	*Pittosporum viridiflorum*
Abutilon sp	*Eragrostis aspera*	*Plectranthus sp*
Acacia mellifera	*Eragrostis patula*	*Plicosepalus meridianus*
Senegalia senegal	*Eragrostis sp.*	*Premna sp.*
Acacia tortilis	*Euclea divinorum*	*Psiadia punctulata*
Acalypha fruticosa	*Euphorbia correllii*	*Psychotria kirkii*
Aerangis confusa	*Euphorbia cuneata*	*Pterolobium stellatum*
Albizia grandibracteata	*Euphorbia heterochroma*	*Pupalia lappacea*
Aloe kulalensis	*Euphorbia natalensis*	*Rangaeris amaniensis*
Aloe lateritia	*Euphorbia sp.*	*Rhamnus staddo*
Aloe scabrifolia	*Euphorbia tirucalli*	*Rhus natalensis*
Aloe secundiflora	*Grewia similis*	*Rhus pyroides*
Aloe sp.	*Grewia Sp.*	*Rhus vulgaris*
Apodytes dimidiata	*Grewia tenax*	*Salvadora persica*
Aristada sp.	*Grewia villosa*	*Sansevieria robusta*
Asepalum eriantherum	*Harpachne schimperi*	*Scutia myrtina*
Asparagus falcatus	*Helichrysum glumaceum*	*Secamone sp.*
Asparagus racemosus	*Heliotropium strigosum*	*Sericocomopsis pallida*
Barleria acanthoides	*Heteromorpha arborescens*	*Sesamothamnus sp.*
Bidens pilosa	*Hibiscus micranthus*	*Solanecio mannii*
Blepharispermum pubescens	*Hildebrandtia obcordata*	*Solanum coagulans*
Boscia coriacea	*Hildebrandtia sepalosa*	*Solanum phyllanthum*

Boswelia neglecta	*Hyphaene sp*	*Solanum sp.*
Bothriochloa insculpta	*Hypoestes forsskaolii*	*Themeda triandra*
Brachiaria sp.	*Indigofera spinosa*	*Tinnea aethiopica*
Cadaba farinosa	*Ipomoea cicatricosa*	*Turraea mombassana*
Cadaba glandulosa	*Jasminum fluminense*	*Tylophoras sp*
Cadaba ruspolii	*Jasminum grandiflorum subsp. floribundum*	*Vangueria madagascariensis*
Carissa spinarum	*Juniperus procera*	*Vepris simplicifolia*
Cenchrus cenchroides	*Justicia debilis*	*Vernonia brachycalyx*
Chascanum sp.	*Justicia odora*	*Vernonia cinerea*
Chloris pycnothrix	*Justicia sp.*	*Vernonia galamensis*
Cineraria deltoidea	*Kalanchoe densiflora*	*Zehneria scabra*
Cissus quadrangularis	*Kedrostis sp*	
Citrullus lanatus	*Kleinia odora*	
Clinopodium uhligii	*Lepidium bonariense*	
Commiphora abyssinica	*Leptothrium senegalense*	
Commiphora africana	*Maerua decumbens*	
Commiphora holtziana	*Maerua endlichii*	
Commiphora rostrata	*Maytenus arbutifolia*	
Commiphora sp. 1	*Micromeria imbricata*	

(ii) Mukogodo ecosystem species checklist

Abutilon martinianum	*Dolichos sp*	*Opuntia ficus indica*
Abutilon sp	*Dovyalis abyssinica*	*Opuntia stricta*
Acacia brevispica	*Dracaena angustifolia*	*Opuntia vulgaris*
Acacia mellifera	*Edithcolea grandis*	*Ormocarpum sp*
Acacia nilotica	*Entada leptostachya*	*Pavonia burchelii*
Acacia reficiens	*Enteropogon macrostachyus*	*Pavonia sp*
Senegalia senegal	*Eragrostis superba*	*Pennisetum mezianum*
Acacia seyal	*Eragrostis tenuifolia*	*Phyllanthus maderaspatensis*
Acacia tortilis	*Erythrococca sp*	*Plectranthus barbatus*
Acacia xanthophloea	*Euphorbia heterochroma*	*Plectranthus caninus*
Acalypha fruticosa	*Euphorbia laikipiensis*	*Plicosepalus meridianus*
Achyranthes aspera	*Evolvulus alsinoides*	*Pollichia campestris*
Acokanthera oppositifolia	*Fuerstia africana*	*Portulaca quadrifida*
Actiniopteris radiata	*Gomphocarpus stenophyllus*	*Premna sp*

Actiniopteris sp.	*Gomphrena celasioides*	*Psiadia punctulata*
Aerva javanica	*Grewia similis*	*Pupalia lappacea*
Aloe scabrifolia	*Grewia sp*	*Pyrostria phyllanthoidea*
Aloe secundiflora	*Grewia tenax*	*Ruellia patula*
Alternanthera pungens	*Grewia tephrodermis*	*Salvadora persica*
Aristida sp.	*Grewia villosa*	*Sansevieria robusta*
Asparagus racemosus	*Haplocoelum coeruleum*	*Sansevieria sp*
Balanites aegyptiaca	*Harpachne schimperi*	*Senna didymobotrya*
Balanites pedicellaris	*Helichrysum glumaceum*	*Senna longiracemosa*
Balleria delamerei	*Helinus integrifolius*	*Sericocomoposis pallida*
Barleria acanthoides	*Heliotropium steudneri*	*Sericocomopsis hildebrandtii*
Barleria delamerei	*Hermannia exappendiculata*	*Sericocomopsis pallida*
Barleria eranthemoides	*Hibiscus calyphyllus*	*Sida alba*
Blepharis edulis	*Hibiscus micranthus*	*Sida massaica*
Blepharis maderaspatensis	*Hygrophila auriculata*	*Solanum arundo*
Boerhavia grandiflora	*Hypoestes forskaolii*	*Solanum campylacanthum*
Boscia angustifolia	*Indigofera erecta*	*Solanum coagulans*
Boscia coriacea	*Indigofera spinosa*	*Solanum phlomidifolium*
Cadaba farinosa	*Ipomoea hildebrandtii*	*Solanum sp.*
Canthium pseudosetiflorum	*Ipomoea kituiensis*	*Steganotaenia araliacea*
Capparis sp	*Ipomoea obscura*	*Talinum portulacifolium*
Capparis tomentosa	*Ipomoea sinensis*	*Tennantia sennii*
Cenchrus cenchroides	*Justicia calcarata*	*Tephrosia sp.*
Chenopodium sp	*Justicia diclipteroides*	*Vangueria madagascariensis*
Chloris pycnothrix	*Justicia odora*	*Vepris simplicifolia*
Chloris roxburghiana	*Kalanchoe lanceolata*	*Vigna membranacea*
Cissus quadrangularis	*Kleinia odora*	*Withania somnifera*
Cissus rotundifolia	*Kleinia petraea*	
Cleome sp.	*Lannea edulis*	
Commelina benghalensis	*Leptothrium senegalense*	
Commelina latifolia	*Leucas sp*	
Commicarpus grandiflorus	*Leucas tomentosa*	
Commiphora africana	*Lonchocarpus eriocalyx*	
Commiphora edulis	*Lycium europaeum*	

Commiphora schimperi	*Maerua endlichii*	
Coptosperma graveolens	*Marsdenia sp.*	
Cordia monoica	*Maytenus putterlickioides*	
Cordia sinensis	*Melhania velutina*	
Crassula schimperi	*Ochna ovata*	
Croton dichogamus	*Ocimum americanum*	
Cucumis prophetarum	*Ocimum gratissimum*	
Cynodonsp.	*Ocimum kenyense*	
Cyperus rohlfsii	*Ocimum sp.*	
Cyperus sp.	*Olea europaea subsp. africana*	
Cyphostemma sp.	*Opilia campestris*	

Appendix 3: List of participants

Food and Agriculture Organization of the United Nations

gef

Activity: RESOURCE ASSESMENT & QUANTIFICATION OF NTFPs IN ISIOLO

LIST OF PARTICIPANTS Date 1/2/2021

NO.	NAME	GENDER	ORGANIZATION	CONTACT		SIGN
				Phone	Email	
1.	COMM. Lesokoyo	M.	Nanuapa	0726757365	lesokoyo gmail.com	
2.	DAWIEL EKOMWA	M	Nanangpa	0708052795		
3.	JACKSON LEKUMONA	M	Nanapa	0729661241	nannapa@nrt-kenya.org	
4.	CLEOPHUS LEPARMORIJO	M	Naunapa	0728256300		
5.	Abdi SOMO	M	Leparua	0720684056	abdi-abdullahisomo@gmail.com	
6.	Mohamud Ibrahim	M	Leparua	0719738159	leparua@nrt-kenya.org	
7.	SAMUEL AULE	M	LEPARUA	0700288345		
8.	Sabinah Namoe	F	Nakuprat	0742925678	—	
9.	Margaret Nasere	F	Nakuprat	0705551601	—	M.N

1

NO.	NAME	GENDER	ORGANIZATION	CONTACT		SIGN
				Phone	Email	
10.	JOSEPH LOWOI EKENO	M	NAKUPURAT	0797688774	lowojoseph@gmail	
11.	Magrate Kaigongi	F	KEFRI	0729457080	kaigongim@gmail.com	
12.	Kennedy Matteva	M	NMK	0724-763838	kennedoz06@yahoo.com	
13.	Rose Chiteva	F	KEFRI	0721497867	vchiteva@gmail.com	
14.	GEORGE N LOKO	M	KEFRI	0723-353784		
15.	David N. Munene	M	Kefri	0720928935	Munene.david@gmail.com	
16.	VIOLET A. ORIKO	F	KEFRI	0721490303	voriko@yahoo.com	
17.	JOSEPHINE W. NJUI	F	KFS	0711896540	josenjuigate@gmail.com	
18.	GEORGE IGOKO	M	KEFRI	0723353784		
19.						
20.						

get

Activity: RESOURCE ASSESSMENT OF NTFPS IN MUKOGODO FOREST ECOSYSTEM (LAIKIPIA COUNTY)

LIST OF PARTICIPANTS

Date 10/2/2021 TO

NO.	NAME	GENDER	ORGANIZATION	CONTACT		SIGN
				Phone	Email	
1.	SAMUEL TEMA	M	IL-GWESI	0727645422	N/A	
2.	LEITEN KIPERUS	M	IL-GWESI	0702654288	"	
3.	MAPPE PARKUSAA	M	IL-GWESI	0717442796	"	
4.	FRANCIS LEKILIMMO	M	LEKURRUKI	0703328086	"	
5.	LEKINENJI LEMORLE	M	LEKURRUKI	3036482	"	
6.	TURANTO LOLKINYANGI	M	LEKURRUKI	6587582	"	
7.	SIMON NJELIS	M	LEKUNUKI	11295796	njalisb@gmail.com	
8.	JOHNSON MERAMUS	M	KURI KURI	0706412449	"	
9.	JOHNSON SADIMU	M	KURI KURI	0702732574	Johnson saidimu @gmail.com	

1

NO.	NAME	GENDER	ORGANIZATION	CONTACT		SIGN
				Phone	Email	
10.	SAMSON MANTIAN NGOPERIAN	M	KURI-KURI	0758791323	Mantianngoperian@gmail.com	[illegible]
11.	Magrate Kaigongi	F	KEFRI	0729459050	kaigongim@gmail.com	[illegible]
12.	Kennedy Matheka	M	NMK	0724963838	kennedoz06@yahoo.com	[illegible]
13.	Rosa Chiteva	F	KEFRI	0721457807	rchiteva@yahoo.com	Chiteva-
14.	David N. Murone	M	Kefri	0720928935		[illegible]
15.	Joel Legei	M	Makurian	0794785749		[illegible]
16.	Saruni Samuel Longishu	M	Makurian	0726814022		[illegible]
17.	Benson Mepukori	M	Makurian	0705346765		[illegible]
18.	JOSEPHINE W. NJUI	F	KFS	0711896540	joskaruganeq@mail.com	[illegible]
19.	MARGARET KIAMANTHIGO	F	KFS	0707[illegible]	[illegible]@gmail.com	[illegible]
20.						
21.						
22.						
23.						

Activity: RESOURCE ASSESSMENT OF NTFPS IN MT. KULAL ECOSYSTEM (GATAB, OLTUROT & ARAPAL SUB-LOCATIONS)

LIST OF PARTICIPANTS

Date 5/1/2021 - 8/2/2021

NO.	NAME	GENDER	ORGANIZATION	CONTACT		SIGN
				Phone	Email	
1.	SHUKRI LASAPICHO	M	MT. KULAL - GATAB	0729924453	lasapicho@yahoo.com	
2.	ELIAKIM LEMONI	M	GATAB	0722725784	lesuixer@gmail.com	
3.	Boni Lengoftap	M	GATAB	0758868153	lenkusia@hotmail	
4.	Immanuel Naikoi	M	Olturot	0724023454	emmanuelnaikoisel@gmail	
5.	Baatin Liyamyan	F	Olturot	0768640751		
6.	KOITEGALGOLOLE	M	OLTUROT	0791527062		
7.	Solomon Lenguro	M	ARAPAL	0701089868		
8.	Isaiah Olontipa	M	ARAPAL	0768814477		
9.	Lipale Leparsanti	M	ARAPAL	0740617172		

1

NO.	NAME	GENDER	ORGANIZATION	CONTACT		SIGN
				Phone	Email	
10.	VIOLET A. OREVO	F	KEFRI	0721490303	vaviov@yahoo.com	
11.	Rose Chiteva	F	KEFRI	0721497807	rchitevo@gmail.com	
12.	MARPE PARKUSAA	m	IL-GWES1	0717442796		
13.	SAMUEL TEMA	m	IL-GWES1	0727764523	TemaSammy41@gmail	
14.	LEITEN K. PERYS	m	IL-GWES1	0702654288		
15.	Magrate Kayongi	F	KEFRI	0729457080	kayongam@gmail.com	
16.	Kennedy Mattaka	M	NMK	0724-963838	Kennedoz06@yahoo.com	
17.	GEORGE IGOGO	m	KEFRI	0723353784		
18.	D.N. Munene	m	Kefri	0720928935		
19.						
20.						
21.						
22.						
23.						

2