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INTERGOVERNMANTAL AUTHORITY ON DEVELOPMENT

FORMULATING A STRATEGY FOR PRODUCTION, VALUE ADDITION AND MARKETING OF PRODUCTS FROM ARID AND SEMI ARID (ASAL)

IN THE IGAD REGION

CASE OF KENYA

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A review of Production, Value addition and Marketing of Non Wood Forest Products (NWFPS) from Arid and Semi Arid Lands (ASALS) in Kenya




By
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A report presented to IGAD Secretariat

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ADS	Agricultural Development Strategy
AOP	Acacia Operation Project
ASALs	Arid and Semi Arid Lands
AWF	African Wildlife Foundation
BABE	Baringo Aloe Bio enterprise
CBOs	Community Development Organizations
CDF	Community Development Fund
CETRAD	Centre for Training and Integrated Research for ASAL areas
CIG	Common Interest Group
CITES	Convention on International Trade in Endangered Species
DRSRS	Department of Resource Surveys and Remote Sensing
ECRSWCE	Economic Recovery Strategy for Wealth Creation and Employment
ENNDA	Ewaso Nyiro North Development Authority
FAO	Food and Agriculture Organization of the United Nations
GAF	Green Africa Foundation
GARA	Gum Arabic and Resin Association of Kenya
GDP	Gross Domestic Product
GIS	Geographic Information System
GoK	Government of Kenya
GTZ	German Technical Cooperation
IFT	Indigenous Fruit Trees
IUCN	International Union for Conservation of Nature
JKUAT	Jomo Kenyatta University of Agriculture and Technology
KARI	Kenya Agricultural Research Institute
KEFRI	Kenya Forestry Research Institute
KENRIK	Kenya Resource Centre on Indigenous Knowledge
KEPHIS	Kenya Plants Health Inspectorate Services
KFS	Kenya Forestry Service
KGARL	Kenya Gums and Resins Limited
KIRDI	Kenya Industrial Research Development Institute
KVDA	Kerio Valley Development Authority
KWS	Kenya Wildlife Service
MDGs	Millennium Development Goals
NGARA	Network for Natural Gums and Resins in Africa
NOCREM	Nomadic Community Resource Management
NCAPD	National Coordinating Agency for Population and Development
NWFPs	Non Wood Forest Products
TORS	Terms of Reference

EXECUTIVE SUMMARY

Kenya's arid and semi-arid areas (ASAL's) cover about 80% of the total land surface; hold 25% of the human population and 65% of the wildlife. The future for sustainable development of the drylands lies in the rational use of natural resources. In recent times it has been noted that the ASALs have enormous economic potential and are the home of vital non wood forest products such as dyes, medicines, resins, gums, perfume, honey, fruits and other important emerging natural products that are made from indigenous plants. At international level, the natural products market from such pure and unpolluted sources has risen quite high with bio-enterprises capable of offering new sources of livelihood to the population of the ASALs areas. In Kenya, the level of NWFPs utilization varies from one region or community to another, and in line with the ecological zones differentiation. Utilization is more in the drylands than high potential areas where modern agricultural crop production dominates land use decisions.

IGAD has recognised that promoting sustainable land use in the dry lands requires a regional perspective on the challenges that pastoralists face with greater attention on transboundary ecosystem management, markets and service provision. The 2nd IGAD/IUCN conference of Directors of Finance and Planning and Directors of Conservation Ministries held on 9 -13 March 2010 in Entebbe, Uganda recommended a proposal that IGAD formulates a strategy to look into the potentials and products from arid and semi-arid areas, and especially at the marketing chains and value addition.

In identifying useful plant crops for ASALs, it is necessary to take cognisance of other plants of economic importance that are threatened by climate change, predatory exploitation and desertification. There is also need to undertake feasibility studies and develop business plans in order to understand the the challenges involved, opportunities, cost benefit and definition of business case scenarios appropriate for each ASALs product in the IGAD member states.

The proposed overall objective of the IGAD programme is to contribute to food security, income generation and alternative livelihoods in the ASALs by exploiting and promoting eco-(bio) enterprises from non wood forest products existing in the ASALs. The specific objectives of the programme are expected to contribute to the diversification of the livelihood systems in the ASALs by creating new opportunities for trade and availability of foods and products from ASALs. It is expected that the artificial and misplaced prejudice to these products as inferior should end due to their publicity, marketing, popularization and availability in the form that is acceptable to the local and international markets.

Development of national strategies for the production, value addition and marketing of products from arid and semi-arid lands is to be implemented in four phases. The current study was the first phase and involved review of literature and documentation in this subject and production of a national report.

The key non wood forest products in Kenyan ASALS include: gums, resins, indigeneous fruits, aloes, dyes, tannins, medicaments, essential oils, honey and bee products, which are mainly associated with a number of plant species. This paper reviews the ecology of the plant species, NWFP resource mapping, production, processing, marketing, commercialization and their economic contribution. Associations along the value chains, policy and legal frameworks, research and development and constraints to optimal utilization are also dealt with. Recommendations and the way forward are also highlighted. Some of the key constraints on the commercialization of NWFPS identified in the study include: inadequate quality control of the products, un-streamlined supply chain, poor pricing and linkages with markets, unclear policy on the development of NWFPs, inadequate product standards, poor access to capital including credit, poor production practices, inadequate data on some of the products and the markets among others. It is concluded that the following interventions should be undertaken in order to enhance the sustainable commercialization of NWFPS in Kenya:-

- Re-emphasize development of the NWFPs in the national forestry plans, enshrined in the cultural heritage, health, food, wildlife and gender empowerment policy plans, the national economic recovery action plan, the strategic rural poverty alleviation schemes, and other established human and development initiatives.

- Collaborative resource surveys (particularly in NWFPs endowed regions) to ascertain and identify indigenous (as well as exotic) NWFPs' ecological niches and their potential for promotion.

- Build information, seed databases and technological transfer networks among different NWFPs producers and users and to enhance NWFPs development at both the local and national levels.

- Extension education programmes to safeguard, integrate, raise awareness on and transfer existing indigenous NWFPs use-wisdom amongst the different consumers, particularly the youth.

- Capacity building on micro-credit, entrepreneurial and NWFPs processing skills, hygiene, and bookkeeping.

- Legal mechanisms for the standardization and certification of processed NWFPs, with well defined patent rights
- Commercialization of NWFPS Germplasm production and exchange

1 INTRODUCTION

Kenya's arid and semi-arid areas (ASAL's) cover about 80% of the total land surface; hold 25% of the human population and 65% of the wildlife. On the basis of moisture availability for plant growth, the country is classified as 88% arid to semi-arid (ASAL). The ASALs represent a very important socio-economic region with a potential value of about Ksh 180 billion annually. The dry lands are unique in nature and require special attention to strengthen not only the economic base of the inhabitants, but also the national economy. Kenya drylands are rich in biodiversity and experience recurrent drought and occasional floods. Livestock keeping is the main economic activity in these areas. Due to the increase in livestock and human population, there is land use pressure resulting in decline in grazing lands and depletion of forest resources.

The future for sustainable development of the drylands lies in the rational use of natural resources. This entails recognizing and developing the potential that exists in the vegetation resources for production of economically valuable products. A commitment by the government to address ASAL challenges has been made in the National Policy for the Sustainable Development of the Arid and Semi Arid Lands (Draft), Strategy for Revitalisation of Agriculture (SRA), Vision 2030 and Forest Policy (Draft), among others.

In recent times it has been noted that the ASALs have enormous economic potential and are the home of vital non wood forest products such as dyes, medicines, resins, gums, perfume, honey, fruits and other important emerging natural products that are made from indigenous plants. At international level, the natural products market from such pure and unpolluted sources has risen quite high with bio-enterprises capable of offering new sources of livelihood to the population of the ASALs areas.

It has become evidently clear that natural resources in the region will be protected by the community only if the community derives benefits and improves their livelihoods. The value of traditional knowledge, particularly in relation to medicinal plants is also gaining acceptance and is getting more widely recognised. With support from environmental groups, local communities and indigenous peoples are becoming aware of the value of wild and cultivated plants. Communities know that the economic stakes run high if market chains and value addition is effected in the products that grow wildly around them.

2 OBJECTIVES

Overall objective of the programme

To contribute to food security, income generation and alternative livelihoods in the ASALs by exploiting and promoting eco-(bio) enterprises from non wood products existing in the ASALs.

Specific objectives of the programme

The following specific objectives are expected to contribute to the diversification of the livelihood systems in the ASALs by creating new opportunities for trade and availability of foods and products from ASALs. It is expected that the artificial and misplaced prejudice to these products as inferior should end due to their publicity, marketing, popularization and availability in a form that is acceptable to the local and international markets. These objectives include:

a. To undertake a baseline survey of the status of dryland products to identify under or over-exploited species that exist in wild or have limited cultivation in the IGAD region with a view to promoting and increasing cultivation, multiplication and production.

b. To develop appropriate training modules to build capacity of producer groups, private sector and user communities to enhance the production and marketing of dryland products

c. To undertake training for producer groups and private sector to increase the effectiveness and efficiency of involvement of these groups in production and marketing of dryland products as well as promoting rural cottage industries and community groups for processing and packaging these products

d. To market and carry out product development for various dryland products through research, value addition and market chains (processing and packaging of new foods and products as well as exhibiting, publishing and dissemination of results of new products and crops in the region

e. To facilitate micro-credit linkages for producer groups to promote production and marketing of dryland products through investments in multiplication and release to research institutions of small quantities of seeds of most promising species cultivars and ecotypes

f. To facilitate community / private sector partnership to ensure the sustainability of the dryland products

3 BACKGROUND TO THE STUDY

About 80 % of the 5.2 million km^2 of the IGAD region[1] is ASALs and prone to periodic droughts and chronic desertification. Any normal drought episode quickly escalates into famine, making the sub region one of the most food insecure and vulnerable sub regions in the world. Consequently, the population in the ASALs are subjected to both seasonal food insecurity and perpetual famines while options and potentials to develop and utilize other available food crops and products exist. Although livestock remains the principle source of livelihood in the ASALs, the future lies with a combination of livestock and exploitation of products from ASALs. It is time to shift livelihoods beyond livestock. Being one of the Vavilov centres[2], the sub-region is rich in both wild and domestic plant species that have been used as food for millennia. The local livelihoods therefore depend heavily on natural resources making conservation of these resources closely linked to sustainable development.

In October 2008, the International Union for Conservation of Nature (IUCN) and IGAD facilitated a tour of IGAD Parliamentarians and journalists to the dry lands of Kenya, to learn firsthand from local communities about the challenges and successes in conservation and sustainable livelihood development in dry lands. The group visited community conservancies in the districts of Laikipia North, Samburu East and Garbatula. They saw firsthand processed and manufactured products from ASALs indigenous plants and the effect they had on the local communities. The consensus of the participants on this tour was that goods and services from the arid and semi-arid lands are not understood, which restricts their effective utilization. The Members of Parliament were unanimous that all IGAD countries have potential to develop their arid and semi-arid areas just as the communities in Northern Kenya have.

Attitudes towards the ASALs are changing, with new understanding about the value of dry lands environment, the way these environments function, and the way the inhabitants of the dry lands have adapted their livelihoods to the constraints and opportunities that the environment presents. In Kenya for example, 80% of the country is arid or semi-arid and contributes 25% of National GDP. Yet the dry lands are home to the country's highest poverty levels, conflict and insecurity. As a result of the new understanding, there is a growing level of innovation for sustainable dry lands development, particularly in consolidation of successful innovations that are scattered through these sparsely populated and poorly connected regions. At the sub regional level it is possible to draw lessons

[1] The region comprising Djibouti, Eritrea, Ethiopia, Kenya, Somalia, Sudan and Uganda.
[2] A Vavilov Center or a Center of Diversity is a region of the world first indicated by Dr. Nikolai Ivanovich Vavilov to be an original center for the domestication of plants

from such successful innovations and use them to direct new investments and to help create supportive policy and planning that supports ASALs development.

Promoting sustainable land use in the dry lands therefore requires a regional perspective on the challenges that pastoralists face with greater attention on transboundary ecosystem management, markets and service provision. After visiting the three community conservancies, the IGAD parliamentarians concluded that the potential of the ASALs in the IGAD region is much greater and underutilised than it is realised. It was recommended that for long-term sustainability, IGAD should identify and support a pastoralist development institute/dry land training institution to promote eco- and bio-enterprises in the arid and semi-arid lands. In addition, the 2nd IGAD/IUCN conference of Directors of Finance and Planning and Directors of Conservation Ministries held on 9 -13 March 2010 in Entebbe, Uganda recommended a proposal that IGAD formulates a strategy to look into the potentials and products of arid and semi-arid areas, looking at marketing chains and value addition.

Consumers worldwide are looking for quality, authenticity and a sense of originality. These market characteristics provide opportunities for the region to harness the growing need for natural products with lower production costs and availability of ready-made products. Bio and Eco-enterprises[3] developed by communities would provide alternative livelihoods and be the drivers for environmental protection, desertification control and meeting of the MDGs.

At present only the ***Aloe* species** have been extensively exploited for various products including soap, shampoo, body lotion etc. Others are essential oils from aromatic plants such as the wild basil (*Ocinum americanum sp*., wild mint (*Saturea abyssinica*), gums and resins from *Comiphora africana and Boswelia neglecta*, wild fruit jams from prickly pear cactus (*Opuntia vulgalis sp.)* and jellies from wild kei apple *(Dovyalis caffra*). Historically the Horn of Africa was known as the land of Punt, the home of genus *Boswellia sacra* (frankincense) and (myrhh) *Commiphora myrrha*, dyes/ henna(*Lawsonia inermis)* and other medicinal herbs that are locally and internationally known for their efficacy. It is now time for these products to move from localised/domestic to international recognition and be marketed alongside other products. There should be sustainable harvesting and domestication, value addition and appropriate technologies for processing and packaging. The ultimate objective is to identify the products, marketing chains and value addition that would provide jobs and income for the communities in these areas.

[3] Bio- enterprises are based on biological part of plant e.g. resins, gums, flowers etc. while Eco- enterprises refers to the ones based on whole ecosystems use e.g eco-tourism, conservancies, eco – lodges etc.

In identifying useful plant crops for ASALs, it is necessary to take cognisance of other plants of economic importance that are threatened by climate change, predatory exploitation and desertification. There is also need to undertake feasibility studies and develop business plans in order to understand the opportunities, the challenges involved, cost benefit and definition of business case scenarios appropriate for each ASALs product in the Member states.

3.1 Methodology and approach

Development of the national strategy for production, value addition and marketing of products from arid and semi-arid lands is to be implemented in four phases. The current study was the first phase and involved review of literature and documentation in this subject and production of a national report. The Terms of Reference (TORS) were as follows:

a) Undertake literature review and identify over and underexploited and new crop species that exist in the wild and/or in limited cultivation in the country with a view to promoting and increasing cultivation, multiplication, production, value addition including branding and packaging where applicable. It is also important to indicate whether the resources, NWTP, are adequately mapped and where the information is currently held.
b) Identify the key players in the sub-sector including any producer and/or marketing groups /associations, and CBOs known to be active in the sub-sector. At each level in the production and marketing chains identify the actors and indicate how community participation / benefits can be enhanced / increased and what support is required to do so, if any.
c) Identify research and training institutions involved in forestry research and training and indicate the level of effort put into NWFPs. Is there private sector participation?
d) Determine the potential of multiplication and release to research institutions of small quantities of seeds of most promising species, cultivars and ecotypes. Identify the actors and indicate how public and private sector institutions participation / benefits can be enhanced / increased.
e) Explore the present and future research on value addition and market chains (processing and packaging of the new foods, medicaments (ethno-medical, ethno-veterinary or ethno-botanical) and/or products). At each level in the production and marketing chains identify the actors and indicate how community participation / benefits can be enhanced / increased.
f) Based on available information and experience on marketing systems for these products, medicaments (ethno-medical, ethno-veterinary or ethno-botanical) and establish what needs to be done to ensure sustainability of production (quality and quantity)?
g) Identify rural cottage industries and community groups for the processing and packaging of the respective foods and clearly indicate potential

areas of intervention/investment. Indicate the status of any public and/or private sector initiatives to improve and/or enhance community access to NWFPs and participation in harvesting, processing, value addition and marketing of the products.

h) Determine the possibility, including cost implications, exhibiting these products in the national, regional and international arena – e.g. in food, NWFP, traditional medicine and agricultural expos, pastoral week in the region among others. A good place to start is to determine the cost of a private or public sector representative to exhibit a selection of the country's NTWPs in the forth coming one week Pastoral Week Festival to be held in Nairobi on the 7th December 2010. If there are similar events in the other IGAD Member States - indicate when they are held, the venue and the cost of participation.

i) Under a, b, c, d, e, f, g and h above identify potential areas of intervention, potential investors and issues that need to be addressed to encourage public and private sector investment.

j) Based on (i) above prepare a logframe of future activities to address the identified prioritized constraints.

k) Send a soft and bound copy of the full report and the presentation format to the Regional Resource person by the end of October 2010 (at least two (2) weeks) before a regional conference scheduled to be held in Djibouti in the last week of November 2010.

l) The national resource person shall present the country paper at the consultative meeting to be held in Djibouti.

m) Undertake other related activities as directed by the ES IGAD or his representative

3.2 Expected out put

a. The national resource person, in collaboration with others in the member state, was to collect and analyze the available data and information and produce a report using the format suggested in Appendix 1.
b. In as far as is possible the national resource person was to quote verifiable production, processing, value addition and/or marketing data

4 AN OVERVIEW OF NON WOOD FOREST PRODUCTS IN KENYA

NWFPs use, conservation and development in Kenya

Non-wood forest products are goods of biological origin other than wood, derived from forests, other wooded land and trees outside forests. In the last decades, the role of NWFPs in the Kenyan economy has been minor compared to the supply of timber and wood products (Muniu and Kahuki 1998). Recent studies however, show refreshed interests in NWFPs identification research and development (Chikamai *et al*. 2004; Jama *et al*. 2008). The importance of NWFPs for rural households, particularly in times of adversity, is well documented (Arnold

2001; Falconer 1992, 1997; Falconer and Arnold 1992; ICRAF 2004; Shackleton and Shackleton 2004). In Kenya, the level of NWFPs utilization varies from one region or community to another, and in line with the ecological zones differentiation. Utilization is more in the drylands than in high potential areas where modern agricultural crop production dominates land use decisions.

NWFPs are exploited for multipurpose usage. Communities living adjacent to the south west Mau forest for example use the bark of *Podocarpus* species and *Juniperus procera* trees for thatching, weaving, basketry, medicine, wall panelling and beehive construction (Muniu and Kahuki 1998). In the coast of Kenya, bamboo, coconut, palm ''wild banana'' leaves, reeds, ferns and grass, are commonly used for house and granary construction (Muniu and Kahuki 1998). *Kigelia abyssinica* fruits have been used in traditional beer brewing as well as other non-alcoholic drinks, including stews and herbal soups (Muniu and Kahuki 1998, Russo and Etherington 2000). In the drylands, trees, shrubs and herbal products provide the only year-round food security nets for livestock (Muniu and Kahuki 1998). In Kathama area of Machakos district, wild fruits such as *Sclerocarya birrea* are valued as buffer food resources in periods of famine and food shortage (Russo and Etherington 2000). Fruit species sold in the local and major urban centres like Mombasa include, *Tamarindus indica, Adansonia digitata, Ximenia americana, Vitex doniana, Azanza garckeana, Berchemia discolor, Sclerocarya birrea, Ziziphus mauritiana* and *Syzygium guineense* (Mbabu and Wekesa 2004). They provide employment opportunities for the youth and women. Conservation of these species is primarily based on specific geographical local knowledge. In Kenya, three quarters of the poor live in rural areas, where food poverty incidences in 1997 were estimated at 51 and 53% for general poverty (GOK 2000; Ndeng'e *et al.* 2003). Like in other developing nations, many of the poorest people in Kenya live in situations where a nearby forest is the only available source of livelihood; yet, they are often denied access rights. NWFPs collection rights (permits) can be purchased from the Kenya Forest Service. In cases where such a fee is unaffordable, illegal collection may not be ruled out. These uncertainties (fuelled by scarcity) call for more participatory approaches in the sustainable management of the forest and its products.

Most non-wood products may be identified and classified by either, their basic generic or functional characteristic. Of the organic subset, of non-wood forest products, generically there are;

- floral-based products such as resins, gums, grass, bamboo and fern, tubers and fruits used for food, roots, bark and leaves used for medicines.
- faunal based products such as honey, bees wax, game meat and trophies, silk, live butterflies and insect larvae and pupae that have use in one form or the other depending on a particular community.

The range of non-wood products that are extracted and used in one form or another in Kenya, and the importance of the product varies widely depending on the user community and its proximity to the resource. The intensity, extent and mode of use are also dependent on availability of substitutes.

Increasing NWFPs identification and development research in Kenya has been concentrated mainly within the arid and semi-arid (dryland) regions of the country (Muok *et al*. 2000; Muok 2005).

The key non wood forest products in Kenyan ASALS include: gums, resins, indigeneous fruits, aloes, dyes, tannins, medicaments, essential oils, honey and bee products. These are mainly associated with a number of plant species growing in the ASAL areas. This paper reviews the ecology of the plant species, NWFP resource mapping, production, processing, marketing, commercialization and their economic contribution. Associations along the value chains, policy and legal frameworks, research and development and constraints to optimal utilization are also dealt with. Recommendations and the way forward are highlighted.

4.1 Ecology

The information on the ecology of the key non wood forest products producing species are summarised below, a short description of the plants and the main products from them are reported in Annex 1.

Osyris lanceolata (Sandal wood)

This species is normally found in rocky sites and along margins of dry forests, evergreen bushland, grassland, and thickets at altitude of 900 – 2550m above sea level. Temperature: 14-22°C, Rainfall: 600-1600 mm. It prefers well drained soils preferring humic friable clays or deep loams.

Prosopis juliflora

P. juliflora is xerophytic and is adapted to many soil types under a wide range of moisture conditions. The value of the tree lies in its exceptional tolerance of drought and marginal soils. It tolerates strongly saline soils and seasonal water logging.

Altitude: 0-1500 m, mean annual temperature: 14-34°C, mean annual rainfall: 50-1 200 mm. Grows on a variety of soils including rocky hills, saline flats, on shifting sand dunes and coastal sand, although it attains its best size in localities protected from wind and with high water table. It can grow in waterlogged conditions and is tolerant to high salinity.

GUMS AND RESINS RESOURCES

Acacia senegal

Acacia Senegal is found mainly in rocky limestone hills, sandy plains, 400-1130m above sea level with 300-550 mm rainfall *(ICRAF, 1992)*

Boswelia neglecta

It is common and occurs in most drylands in *Acacia-Commiphora* bushland particularly on red sandy soil over basement complex and on lava flows, between 200-1350m above sea level with 250-600 mm rainfall *(Chikamai, B.N. and J. Kagombe, 2002).*

Boswellia rivae

This species is found in dryland ecosystems in the open *Acacia/Commiphora* bushland and on limestone hills with 220mm rainfall *(Chikamai, B.N. and J. Kagombe 2002).*

Commiphora myrrha

Usually grows on shallow soils over limestone or granite, rocky lava hills, in open *Acacia-Commiphora* bushland, between 220-800 m above sea level with 230-300 mm rainfall *(ICRAF, 1992)*

Commiphora holtiziana (Haggar-),

It is found in *Acacia-Commiphora* bushland on well-drained red sandy soils, between 20-1100 m above sea level with rainfall 220-630 mm.

KEY INDIGENOUS FRUITS

Annona senegalensis

Wild fruit trees of this species are found in semi-arid to subhumid regions of Africa. The species occurs along riverbanks, fallow land, swamp forests and at the coast. Commonly grows as a single plant in the understorey of savannah woodlands.

Altitude: 0-2400 m, Mean annual temperature: 17-30 deg. C, Mean annual rainfall: 700-2500 mm. Soil type: Although A. senegalensis grows on various soil types; it does well on coral rocks dominated by sandy loam soils.

Antidesma venosum Tul

Grows in riverine vegetation, woodland and wooded grassland, on rocky outcrops and along forest margins.
Altitude range: Up to 1830 m above sealevel.

***Azanza garckeana* (F. Hoffm.) Excell and Hillcoat**

The adaptability of *Azanza garckeana* to various climatic conditions and soil types makes it suitable for planting as a shade tree in most areas. *A. garckeana* grows naturally in miombo wooded grasslands, open woodlands and thickets. The tree is evergreen in the warmer areas but semi-deciduous in colder regions. It is drought resistant but thrives with abundant water during the rainy season. It can withstand mild frost. ***(****World Agroforestry Centre and PROSEA network****, 2009****)***

Altitude: 0-1900 m, Mean annual rainfall: 250-500 mm Soil type: Prefers mostly light yellow-brown to reddish-yellow gritty, sandy clay loams, and often grows on black to dark grey and brown clays. ***(****World Agroforestry Centre and PROSEA network, 2009****)***

Balanites aegyptiaca (L.) Del. (Desert date)

It is found in bushland, wooded grassland and open grassland with cotton soils mainly in arid and semi-arid regions to sub-humid savannah with altitude between 0-1500m above sea level. Rainfall 200-800 mm. Found in agro-ecological zones IV-VI, Lambwe valley and Kaputei plains at 250-2000 m. *(Chikamai et al, 2004)*

Baobab (Adansonia digitata)

It grows from 0 to 1250 m above sea level in most well drained soils. It is deep rooted, drought hardy and prefers areas with a high water table. *(ICRAF, 1992)*.

***Berchemia discolor* (Klotzsch) Hemsley**

It is widespread in semi-arid bushland, wooded grassland, rocky hillsides, often riverine or along luggas between 1-1600 m above sea level. Found in agro-ecological zones V-VII. *(Chikamai et al, 2004)*

***Borassus aethiopum* Mart. (African fan palm)**

B. aethiopum is abundant in all types of savannah of the region, occurring at low altitudes along rivers and in coastal woodlands. It can tolerate high temperatures and will grow in areas with rainfall less than 500 mm/year if the groundwater table is high. It is often in dense stands. The palm can serve as an excellent firebreak, especially in the arid regions of West Africa, which are prone to wildfires.

Altitude: 0-1200 m above sea level, Mean annual rainfall: 500-1000 mm, Soil type: It usually found in sandy, well-drained soils, but prefers alluvial soils near watercourses.

***Bridelia taitensis* Vatke and Pax**
It grows in dry bushland, woodland or riverin bushland, often on rocky or gravelly ground and on sandy soil, 440-1,200 m above sea level. It is commonly found in Zones IV-V.

***Canthium lactescens* (Hiern)**
Grows in deciduous woodland, often among rocks.
Altitude range: (metres) 1000 - 1800 m above sea level.

***Canthuim glaucum* Hiern**
Found in coastal bushland, usually in open places with deep sandy soils, 0-150 m above sea level, e.g. in Marafa and in Arabuko forest (Kilifi). It is commonly found in Zones III-IV.

***Cordia monoioca* Roxb**
It is found in hot and dry woodland, often on rocky hill sides or termite mounds.
Altitude range: Up to 1200 m above sea level.

Cordia sinensis Lam.

This species is common in dry riverine vegetation, usually with *Salvadora persica*, or in open bushland in low altitude arid and semi-arid areas on termite mounds and in littoral scrub.
Altitude: 0-1500 m above sea level
Mean Annual Rainfall: 600-1000 mm
Soil type: Prefers alluvial, sandy, red loam and rocky soils in moist river beds

***Dialium holtzii* Harms**
A moist forest species which can occur in wetter or riverine areas of dry forests.

***Dialium orientale* Bak. f.**
It grows at 1-100m altitude in evergreen dry forest. It is found in agro-ecological zones II-IV with sandy alluvial soils. *(Chikamai et al, 2004)*

***Dispyros mespiliformis* A. DC**
This species occurs in woodlands, savannahs and along riverbanks. It prefers areas with permanent water that helps in natural regeneration, and it grows faster in frost-free areas. It favours heavy soils on riverbanks but also occurs in open woodland and is commonly found on termite mounds.

Altitude: 350-1250 m above sea level., Mean annual temperature: 16-27 deg. C., Mean annual rainfall: 500-1 270 mm. Soil type: D. mespiliformis prefers rocky soils along seasonal water courses and swamps. It grows well in moist, red loams, volcanic and loamy sands.

***Ficus sycomorus* L.**

It is a common savannah tree that grows in high water table areas. Often found along watercourses such as streams and rivers, swamps and waterholes. The sycamore fig is sensitive to frost but can withstand some cold. It is found in afro-montane rain forests and undifferentiated afro-montane forests, especially along edges and in clearings, riverine forests, riparian woodland, secondary evergreen bushland; left as single trees in farmland and occasionally seen as single trees on rocky outcrops.

Altitude: 0-2000 m above sea level, Mean annual temperature: 0-40 deg. C, Mean annual rainfall: 500-1800 (max. 2200) mm Soil type: prefers deep, well-drained loam to clay soil rich in nutrients. Sandy soils with a shallow groundwater level may also be suitable.

***Flacourtia indica* (Burm. F) Merr**

Flacourtia indica is a common in tropical dry deciduous and thorn forests, though more abundant in the former. It also occurs in seasonally dry forest, woodland, bushland, thickets, wooded grassland, and often in riparian vegetation. The species is drought resistant though somewhat frost tender.

Altitude: 0-2 400 m above sea level, Mean annual temperature: 4-10 -41-48 deg. C, Mean annual rainfall: 500-2 000 mm Soil type: Grows on variety of soils including limestone, clayey and sandy soils.

***Flueggea virosa* (Willd.) J. Voigt**
Flueggea virosa is common in deciduous woodland and on forest margins, along rivers and in rocky areas.
Altitude range: Up to 1530 m above sea level.

***Grewia bicolor Juss*.**
It occurs most frequently in dry deciduous woodland at low altitudes, on sandy flats and rocky mountain slopes; also at medium altitudes in high-rainfall areas, often associated with termite mounds and frequently found in riverine fringes.

Tropical summer rainfall and subtropical arid climates are suitable. *G. bicolor* is very drought resistant.

Altitude: 800-2 000 m above sea level, Mean annual rainfall: (200) 400-900 mm, Soil type: prefers rich, shallow sands, occasionally on clay in the more northerly part of its natural distribution.

***Garcinia livingstonei* T. Anderson**
It is found in scrub, open woodland and forest, along rivers in the low veld and frequently in riparian and munga, mopane woodland and termite mounds. It also found on rocky soil away from water and in open coastal forest.

Altitude: 0-1 900 m above sea level, It is hardy and successful on acid sandy and alkaline rocky soils.

Sclerocarya birrea (A. Rich)
Widely distributed species in the dry zones occurring at medium to low altitudes scattered in mixed deciduous woodland, wooded grassland. Found in agro-ecological zones IV and V with altitude 800-1800 m above sea level.

Tamarindus indica
Avery adaptable species, drought hardy, preferring semi-arid areas and wooded grasslands, tolerating salty, coastal winds, and monsoon climates, grows in 0-1500 m above sea level, and in most soils, prefers well-drained deep alluvial soil. *(ICRAF, 1992)*.

Vitex payos (Lour) Merr
V. payos is a species of hot, low and semi-arid places with high water table. In more arid zones it is found near rock outcrops.
Altitude: 0-1 600 m above sea level, Mean annual rainfall: 650-850 mm; Soil type: V. payos often grows in sandy soils and less often clay

DYES AND TANNIN RESOURCES
***Acacia bussei* sjQsted**
Mostly on sandy soils with an Altitude 1-1000 m above sea level, Rainfall of 130-500 mm/year, Temperature: 12-38 °C and 300-1800 (Higher altitudes of dry East Africa)

Acacia horrida
It is either a a tree or shrub. It grows in riverine communities and even in arid environments, where it can do well provided there is an assured supply of groundwater. It competes for space, water and nutrients with pasture grasses, thus replacing them. It is wweet thorn which is frost- and drought-tolerant. ***(****World Agroforestry Centre and PROSEA network, 2009****)***

Altitude: 0-1 000 m above sea level, Mean annual temperature: 12-40 deg. C, Mean annual rainfall: 200-1 500 mm, Soil type: prefers heavy black, hydromorphic cracking vertisols with high pH, deep alluvial clay-loam soils in river valleys and sometimes on shale and even on acid soils. . ***(***World Agroforestry Centre and PROSEA network***,*** *2009)*

Acacia mearnsii

Altitude: 300-2 440 m above sea level, Mean annual temperature: 9-20 deg. C, Mean annual rainfall: 500-2 050 mm Soil type: *A. mearnsii* flourishes in deep, well drained, light textured and moist soils. It thrives in well-aerated, neutral to acid soils, loamy soils, soils derived from shale or slate and is highly intolerant of alkaline and calcareous soils. Soils with lateritic pan close to the surface are most unsuitable. ***(****World Agroforestry Centre and PROSEA network.2009)*

Acacia melifera

It is a commonly occurring shrub on rangelands throughout the savannah in western, eastern and southern Africa. The terrain preference is rocky hillsides with rainfall along seasonal watercourses, mixed with other trees. If left unattended, especially if grazing is not heavy and no fires to check its spread, it may form dense, impenetrable thickets, 2-3 m high and sometimes hundreds of metres across, slowly taking over good grazing land. This species is drought-tolerant.

Altitude: 0-1500 m above sea level, Mean annual rainfall: 250-700 mm Soil type: *A. mellifera* is normally found on hard-surfaced, sandy soils and rocky hillsides. It grows well in black cotton soils but prefers loamy soils. ***(****World Agroforestry Centre and PROSEA network****.2009****)***

Acacia nilotica

Altitude: 0-1 340 m above sea level, Mean annual temperature: 4-47 deg. C Mean annual rainfall: 200- 1270 mm. Soil type: grows on a wide variety of soils, seemingly thriving on alluvial soils, black cotton soils, heavy clay soils, and can tolerate poor soils. . ***(****World Agroforestry Centre and PROSEA network****,*** *2009)*

It is drought resistant and occurs in plain, flat or gently undulating ground and ravines. Trees grow best on alluvial soils in ravine areas subject to periodic inundation.

Acacia tortilis

A. tortilis is drought resistant, can tolerate strong salinity and seasonal water logging and generally forms open, dry forests in pure stands or mixed with other species. The long taproot and numerous lateral roots enables it to utilize the limited soil moisture available in the arid areas. It tolerates a maximum

temperature of 50 deg. C and a minimum temperature close to 0 deg. C. ***(****World Agroforestry Centre and PROSEA network, 2009)*

Altitude: 0-1 000 m above sea level, Mean annual temperature: 23.4-31.3 deg. C, Mean annual rainfall: 100-1 000 mm. Soil type: The tree favours alkaline soils and grows in sand dunes, sandy loam, rocky soils and other soils that drain well. It also does well on light brown, sandy soil with little or no calcium carbonate, and pH ranges of between 7.95-8.30. . ***(****World Agroforestry Centre and PROSEA network, 2009****)***

- Repeated

Bixa orellana (Annatto)
B. orellana requires a frost-free, warm, humid climate and a sunny location. It can grow in tropical to subtropical climates where rainfall is distributed throughout the year. (*World Agroforestry Centre and PROSEA network, 2009)*

Altitude: Up to 2000 m above sea level, Mean annual temperature: 20-26 deg C, Mean annual rainfall: 1250-2000 mm Soil type: *B. orellana* grows on almost all soil types, with a preference for well-drained, neutral and slightly alkaline soils. It grows into a larger tree when planted in deeper and more fertile soil, rich in organic matter. *(World Agroforestry Centre and PROSEA network 2009)*

Cassia abbreviate
C. abbreviata commonly occurs in *Acacia-Commiphora* bushland, becoming rare in woodland or wooded grassland. Usually found on anthills and clayey soils. The long pod cassia is moderately fast growing; drought tolerant and can withstand moderate frost. The mature trees are fire resistant, however young seedlings are vulnerable. (World Agroforestry Centre and PROSEA network, 2009)

Altitude: 350-1 000 m above sea level, Mean annual temperature: 27 deg C Mean annual rainfall: 1 400 mm Soil type: prefers deep light/sandy and well drained soils (gleysols). ***(****World Agroforestry Centre and PROSEA network, 2009)*

Commiphora boiviniana
It is a variable plant commonly occurring in *Acacia-Commiphora* bushland (deciduous bushland). Altitude: 450-1 500 m above sea level, Mean annual rainfall: 350-900 mm Soil type: normally found on rocky soil. *(ICRAF, 1992*

Ekebergia capensis (Kyuasi),

E. capensis can tolerate slight drought conditions and very light frost but is tender to severe frost. It occurs in a variety of habitats including high-altitude evergreen forests, riverine forests and coastal sandveld; *(World Agroforestry Centre and PROSEA network, 2009)*

Altitude: 0-3 000 m above sea level, Mean annual rainfall: 750-2 000 mm, Soil type: The species does particularly well in deep sandy soil. *(World Agroforestry Centre and PROSEA network, 2009)*

Euclea divinorum

E. divinorum is common in bush, dry forest margins, thornscrub and open woodlands. It is usually associated with *Acacia spp*. and also grows on anthills and river banks in hot dry areas below 900 m. *(World Agroforestry Centre and PROSEA network, 2009)*

Altitude: 1-2 400 m above sea level, Mean annual temperature: 17 deg C, Mean annual rainfall: 700 mm Soil type: prefers mesic calcareous valley clays and sometimes rocky ground. *(World Agroforestry Centre and PROSEA network, 2009)*

Lawsonia enermis L (Elan-), Henna

A shrub widely distributed from North to West and Central Africa. It is common at the Kenyan coast, along river courses and in semi-arid parts of the north. It can withstand low air humidity and drought. It requires high temperatures for germination, growth and development. (*World Agroforestry Centre and PROSEA network, 2009)*

Mean annual temperature: 19-27 deg. C, Mean annual rainfall: 200-4200 mm Soil type: prefers sandy soils but can tolerate clays and poor, stony, sand soils; optimum soil pH is 4.3-8. *(World Agroforestry Centre and PROSEA network.2009)*

Terminalia brownii

It is probably the commonest and most widespread *Terminalia* in Kenya. The drought resistant species occurs in the high rainfall woodlands, bushlands, and wooded savannah of the arid and semi-arid regions but can also be found in the sub-humid areas. It is often found near rivers in very dry areas. ***(****World Agroforestry Centre and PROSEA network,2009)*

Altitude: 600-2 000 m above sea level, Mean annual rainfall: 500-1300 mm Soil type: *T. brownii* prefers deep, sandy soils, and is widespread on loam soils. . It is

planted in Kisumu and Nairobi, (*World Agroforestry Centre and PROSEA network, 2009).*

ALOES AND OTHER DRY LAND MEDICINAL PLANTS

Aloe turkanensis

Aloe turkanensis grows on stony, sandy soil or lava, usually in the shade of shrubs in arid areas at 600–1250 m altitude, and at Kenyan coast between 170 m – 200 m above sea level *(Lubia et al 2008)*

***Aloe* vera**

Aloe vera grows in a wide range of climatic conditions. It prefers sandy or loamy, well-drained soils and can grow in nutritionally poor soil, but thrives on rich soils. It is tolerant of salinity. Established plants will survive drought quite well even though the root system is relatively shallow. *Aloe vera* is not very frost-hardy, but will survive a temperature of –3°C with only slight injury. It should be planted in full sun or light shade. During the winter months in the subtropics, the plant becomes dormant and utilizes very little moisture. *(www.prota4u.org)*

Aloe ferox

It grows in a wide range of climatic conditions. It is especially abundant on arid rocky hillsides up to 1000 m altitude, where mean temperatures range from 27–31°C. Annual rainfall ranges from 50–300 mm. Though the root system is shallow, the plant can grow under dry conditions. Water logging should be avoided and *Aloe ferox* thrives on well-drained, rich soils. It withstands light frost, although the flowers may be damaged by the frost. (www.prota4u.org)

Acacia seyal Del

It is one of the most common trees in the savannah and often occurs as a pure forest over quite large areas of land. Frequently, it grows in groups or patches, sometimes of considerable size, in areas inhabited by *A. senegal*. This species is characteristic of the Nile region. It is tolerant to high pH (6-8), salts and periodic flooding. *Acacia seyal var. fistula* is more tolerant to waterlogging than *A. seyal var. seyal* (*World Agroforestry Centre and PROSEA network, 2009).*

Altitude: 1700-2000 m above sea level, Mean annual temperature: 18-28 deg. C, Mean annual rainfall: 250-1000 mm Soil type: It normally prefers heavy, clayey soils, stony gravely alluvial soils or humic soils. (*World Agroforestry Centre and PROSEA network, 2009).*

Acalypha fruticosa Forssk

Acalypha fruticosa occurs in coastal and deciduous bushland and thickets, wooded grassland, riverine grassland, on rocky shores or outcrops, and in humid localities, from sea-level up to 1400 m altitude. It is common in overgrazed areas.

Agave sisalana Perrine

Sisal is a hardy tropical plant needing full sunlight and moderate relative humidity. It grows best in regions with an average annual rainfall of 1000—1250(—1800) mm, but is often grown in areas with less rainfall. The maximum temperature should be 27—32°C, with minimum temperatures of 16°C or higher and daily fluctuations not exceeding 7—10°C. Sisal is damaged by frost and hail. Under dry conditions or at low average temperatures it forms fewer leaves per year and has a longer life cycle. Sisal prefers sandy-loam soils but can be grown on a range of soils, provided they are rich in bases, especially calcium , and well drained, as sisal does not tolerate waterlogging. The pH should be between 5.5 and 7.5. (www.prota4u.org)

Albizia amara (Roxb.) Boiv

A. amara is a strong light-demander, is intolerant of shade, very hardy and shows marked resistance to drought. It grows mainly in sandy woodlands. The scrub forests in which it is usually found often have thorny species, particularly acacias. Its most common associates are xerophytic species such as *Annogeissus latifolia, Boswellia serrata, Chloroxylon swietenia, Dalbergia paniculata* and *Ziziphus mauritiana*.

Altitude: 400-1 500 m above sea level, Mean annual temperature: 10-47 deg. C, Mean annual rainfall: 400-1 000 mm. Soil type: tolerates clays and is often found near streams, where it can reach more water. (*World Agroforestry Centre and PROSEA network, 2009).*

Albizia anthelmintica Brongn

A. anthelmintica commonly occurs in deciduous or evergreen bushland and scrubland especially along seasonal rivers and on termite-mound clump thickets.

Altitude: 400-1 500 m above sea level, Mean annual temperature: up to 40 deg C, Mean annual rainfall: 400-1 000 mm Soil type: prefers clayey soils but is also known to perform well in deep, loose red sand soils. (*World Agroforestry Centre and PROSEA network, 2009).*

Aloe secundiflora Engl

Aloe secundiflora is well adapted to dry semi-arid conditions. It occurs in grassland and open woodland on sandy soil at 600–2000 m altitude.

Antidesma venosum Tul
Found on rhyolitic and sandy granite soils. Sands fertile from flooding .Salty subsoil. Mainly found on rocky hill slopes with light clay soil or sandy loam. Altitude : 7 - 1220 m above sea level. (www.prota4u.org)

Azadirachta indica A. Juss
A. indica is said to grow 'almost anywhere' in the lowland tropics. Under natural conditions, it does not grow gregariously. It is found in evergreen forest and in dry deciduous forest. Adult *A. indica* tolerates some frost, but seedlings are more sensitive. It quickly dies in waterlogged soils. It requires large amounts of light, but it tolerates fairly heavy shade during the first few years. (*World Agroforestry Centre and PROSEA network, 2009).*

Altitude: 0-1500 m above sea level, Mean annual temperature: Up to 40 deg. C, Mean annual rainfall: 400-1200 mm, Soil type: It grows on a wide variety of neutral to alkaline soils but performs better than most species on shallow, stony, sandy soils, or in places where there is a hard calcareous or clay pan not far below the surface. It grows best on soils with a pH of 6.2-7. (*World Agroforestry Centre and PROSEA network, 2009).*

Boscia coriacea Pax
It usually grows in very arid sites such as hills, laterite outcrops and cliffs, and sometimes dry riverbeds.
Altitude: up to 2 100 m above sea level, Mean annual rainfall: 200-800 mm Soil type: it tolerates a wide variety of soils and grows on free draining red soils, laterites, or on rocky screes. (*World Agroforestry Centre and PROSEA network, 2009).*

Carissa edulis (Forssk.) Vahl
It is usually found on termite mounds in wooded grassland, especially in low-lying areas associated with *Grewia similis* and also in thickets in woodlands, forest edges and secondary scrub. It prefers dryish conditions. It is a tree of deciduous forest and coastal thickets. Altitude: 1000 - 2000 m above sea level, Soil type: tolerates most soils including black cotton. (*World Agroforestry Centre and PROSEA network, 2009).*

Croton megalocarpus Hutch
C. megalocarpus is a pioneer species and it is found growing in cleared parts of natural forests, forest margins or as a canopy tree. Altitude: 1 200-2 450 m above sea level, Mean annual temperature: 11-26 deg. C, Mean annual rainfall: 800-1 900 mm (*World Agroforestry Centre and PROSEA network, 2009).*

Ricinus communis L

Castorbean tolerates annual precipitation of 2.0 to 42.9 mm, annual temperature of 7.0 to 27.8°C and pH of 4.5 to 8.3. It grows best where temperatures are rather high throughout the season, but the seed may fail to set if it is above 38°C for an extended period. It does best on fertile, well-drained soils which are neither alkaline nor saline; sandy and clayey loam being best.

Salvadora persica L

S. persica is widespread, notably in thorn shrubs, desert floodplains, river and stream bank vegetation, and grassy savannahs. Prefers areas where groundwater is readily available, by riverbanks, on perimeters of waterholes, in seasonally wet sites, and along drainage lines in arid zones. Also found in valleys, on dunes and on termite mounds. The tree is able to tolerate a very dry environment with mean annual rainfall of less than 200 mm. Highly salt tolerant, it can grow on coastal regions and inland saline soils. (*World Agroforestry Centre and PROSEA network, 2009).*

Altitude: 0-1 800 m Soil type: Prefers clays but is found on loam, black soils and sand. It is adapted to alkaline or very saline soils, usually clay-rich, and soils without salt. (*World Agroforestry Centre and PROSEA network, 2009).*

Vernonia amygdalina Del

It is found in afro-montane rainforest, undifferentiated afro-montane forest (broadleaved forest, mixed Podocarpus forest) and dry single-dominant afro-montane forest (Juniperus and Juniperus-Olea); also in secondary montane evergreen bushland and sometimes forming clumps in upland wooded grassland. It is also found in lowland humid rangeland, savannah and riverine fringes, often associated with termite mounds (*World Agroforestry Centre and PROSEA network, 2009).*

Altitude: (min. 600) 1250-2800 m above sea level, Mean annual rainfall: 750-2000 mm Soil type: light shallow soils. (*World Agroforestry Centre and PROSEA network, 2009).*

Warburgia ugandensis sprague

W. ugandensis occurs in lowland rainforest, upland dry evergreen forest and its relicts in secondary bushland and grassland; also on termitaria in swamp forest. Altitude: 100-2 200 m above sea level, Mean annual rainfall: 1 000-1 500 mm Soils: can withstand swamp forest soils. (*World Agroforestry Centre and PROSEA network, 2009).*

BIOFUEL CROPS

Jatropha curcas

Jatropha grows in well-drained soils with good aeration and is well adapted to marginal soils with low nutrient content. It can thrive on poor and stony sites, or rock crevices. Root development is reduced in heavy clay soils. It requires little water and can withstand periods of drought by shedding of its leaves to reduce transpiration. *(Nyamai and Omuodo 2007)*

Rainfall: 300mm to >1500mm
Altitude: 0 to 1500 above sea level
Temperature: 20 C to 32 C

4.2 NWFP Resource mapping

Table 1: NWFP resource mapping

NWFP	Inventory and resource mapping	Where the information is held
Osyris lanceolata(East African Sandal wood)	• Only the general distribution of Sandal wood is known in Kenya but no resource mapping has ever been undertaken. • Therefore Sandal wood resource mapping should be undertaken to establish their specific locations, quantity available and their quality.	KEFRI and NMK
Gums and Resins	• Resource assessment and mapping of gums and resins in Kenya was conducted in 2005 by the Regional Centre for Mapping of Resources for Development through the support of the Technical Cooperation Programme of FAO. This was a regional project in the framework of the Network for Natural Gums and Resins in Africa (NGARA) involving 15 countries. • A GIS database comprising the AFRICOVER land use / land cover, elevation, soils, agro-ecological zones, administrative boundaries, Landsat satellite imagery, etc for the Eastern African countries was developed and backed up on a compact disc (CD). Metadata for all project datasets was developed. • A probability map showing the locations of gums and resins producing species in Kenya and member countries in the region was produced.	FAO, NGARA, KEFRI, RCMRD
Dyes and	• Resource mapping done in the past for *Terminalia brownil*, *Commiphora holtziana* and *Bixa orellana* in some parts of	NMK

Tannins	Kenya. • Updating the data base necessary in selected sites	
Indigenous fruits	A survey on distribution and socioeconomic aspects of important indigenous fruit species as well as establishing the levels of utilization of the resources has been done. The National Museums of Kenya has conducted studies on indigenous fruits through its various departments; the herbarium carries out identification and storage of plant materials while KENRIK has carried out ethnobotanical surveys and recorded indigenous knowledge of traditional food plants of Kenya and holds a database on these resources *(Chikamai et al, 2004)* There are 800 indigenous food plants (belonging to 105 families) out of which 400 species are fruit plants (57 families)	NMK, KEFRI
Jatropha curcas	The East African Herbarium of the National Museums of Kenya has mapped the distribution of *Jatropha curcas* in Kenya in terms of floral regions. The herbarium collection has identified 6 floral regions which include Turkana and parts of North-Eastern province; West Pokot, stretching into north-eastern Uganda; the south eastern semi arid lands covering Kibwezi, Voi, Taveta, Machakos and part of lower Nairobi; Nyanza and the Lake Victorai Basin; Kajiado and the Greater Narok and Maasai Mara Game Reserve; and the Coastal belt. *(Nyamai and Omuodo 2007)*. A map showing pattern of *Jatropha curcas* in East Africa was produced *(Otieno and Muasya 2005)*.	NMK
Medicinal plant resources	A comprehensive data base for medicinal plants in Kenya exits at the National Museums of Kenya. However, detailed resource inventory and mapping for the individual plants is yet to be carried out.	NMK

Aloes	A survey of aloe resource status, distribution and exploitation conducted in 2005-2006 as a collaborative effort of Kenya Wildlife Service (KWS), Kenya Forestry research Institute (KEFRI), National Museums of Kenya)NMK) and Department of resource Survey and Remote Sensing (DRSRS) produced valuable and important information. The information has been used in development and National Guidelines for utilization of aloes and gazetted as Aloe Regulations and in the Development of a Strategy for Conservation and Management of Commercial Aloe Species in Kenya. *(Mukonyi et al, 2008)* Rapid aloe resource base estimates were established through; ground reconnaissance, GPS mapping and conventional plant sampling techniques. The study established that about five aloe species as the main source of aloe bitter gum in Kenya. These were *Aloe secundiflora, Aloe scadrifolia, Aloe turkansensis, Aloe rivae and Aloe calidophila.* All the five species grow in areas with relatively low annual precipitation. *A.secundiflora* was more widely distributes compared to other species and it contributed about 80% of aloe bitter gum produced in the country. *(Mukonyi et al. 2008)* The study estimated over 131 million plants with a potential to produce about 2,000 tones of aloe bitter gum a year. The study showed that the following areas; Baringo, Isiolo, laikipia, samburu, Kilifi and West Pokot had high density of commercial aloes. Reports revealed that West Pokot is the main source of aloe bitter gum sourced from *A. secundiflora. (Mukonyi et a., 2008)* The study shows the country has potential for commercial production of bitter aloe gum from different aloe species. There is need to put in place standardized aloe conservation, management and utilization protocols to guide the industry. *(Mukonyi et al. 2008)*	KWS, KEFRI, DRSRS

4.3 Production, processing and marketing of key NWFPs including factors affecting supply and NWFPs market information system

Gums and resins

Production: Harvesting of natural gums and resin, including frankincense, is believed to have a long history. Harvesting is done manually by labor-intensive traditional methods of tapping. Tapping and collection of gum is carried out following a specific pattern around mid-September up to the end of the dry season, usually June. Tapping involves the shaving of a very thin, i.e. 2mm deep and 4-8mm wide, external layer of the bark starting at 0.5m from the base of the stem using a hand tool, ''Mingaf" for resins and Sonke for Gum arabic. Once the first tapping is done, the second tapping will take place after 30-40 days and involves a moderate widening of the wound, which was started during the first tapping. This tapping process will continue for three to four months until the wound has reached 4cm width. After each wounding/incision, the exudates start to ooze and becomes dry in 2-3 weeks when it will be ready for collection. *(Chikamai. and Kagombe, 2002).* Collection of gums and resins from the wild is mainly done by women and herders during the dry months of the year.

Processing: All gums and resins produced in Kenya are exported in raw form except for a small quantity of the total volume produced that is processed for essential oils. There is only one processor of gum resins in Kenya, Vetochem Limited. Vetochem limited extracts essential oils from myrrh, Olibanum (Frankincense) and Opoponax (Hagar) through steam distillation process with an efficiency level of 70%. The yield of essential oils at 70% efficiency level is 5% for myrrh and 6% for Olibanum and Hagar. Thus, the product derived from gum resins is mainly the essential oils. In Kenya, there is no company that processes gum arabic. However, Arid Land Resources Limited (ALRL) carries out value addition to gum arabic by grinding the product and grading it before exporting. To enhance the quality of gum, gum arabic should not be stored in plastic bags but in clean sisal or polyethylene gunny bags as plastic bags forms moisture which results in the contamination of the gums. The gum should also be stored in a dry, clean and cool place, right from the village level.
Storage: The gum should be stored in a raised ground. Resins need to be stored separately in a different store to avoid mixing with gum Arabic.
Packaging is done according to the importers requirements. Powdered gum arabic is packed in 50 kgs net weight bags while first grade lumps are packed in 25kgs net weight bags.

Marketing: Profit margins for local traders and producers are quite low making them to rely on selling groceries, and hides and skins to break-even. This explains

why investment by such local dealers in marketing infrastructure is low. Both cultural and conventional markets exist for products.

Factors affecting supply and market information system

(i) Ongoing land degradation in ASALs
(ii) Seasonality of the commodities
(iii) Lack of adequate data on the resources and commodities
(iv) Lack of sound production practices
(v) Inadequate Market Information
(vi) Poorly developed markets and marketing systems
(vii) Poor government involvement in the Sub-sector
(viii) Weak community institutions
(ix) repeated
(x) Lack of a policy of the sub-sector

Indigenous fruits

Processing and storage of indigenous fruits

Indigenous fruits are processed by local communities using knowledge acquired over generations to provide a more palatable product, preserve the product, and obtain products that can easily be converted into other products (Saka, 1994). Studies by Maundu *et al.* (1999) show that local communities process *Adansonia digitata* and *Tamarindus indica* to produce an extract that is utilized in many ways. Within the Pokot and Turkana communities, *Ziziphus mauritiana* is sun-dried, pounded in a mortar (*kono*, Pokot) and winnowed to remove particles of crushed seeds. The resulting fine flour may be mixed with figs in honey and stored in large containers *(kosim*) to be used in times of food scarcity *(Maundu et al. 1999).* However, commercial processing of indigenous fruits for development of processed products (e.g. jams, juices, oils) and preservation of by-products is still low in Kenya. Studies conducted show that only a few indigenous fruits like *Tamarindus indica, Sclerocarya birrea and Adansonia digitata* are being processed on limited scale to produce commercial products like ice drink, jams and sweets *(Muok, 2001).*

Marketing potential of indigenous fruits

Market studies that have been carried out indicate that a number of indigenous fruits are sold in the local markets and major urban centres like Mombasa *(Maundu et al. 1999; Muok, 2001; Muok and Kariuki, 2001).* Such fruits include *Tamarindus indica, Adansonia digitata, Ximenia americana, Vitex doniana, Azanza garckeana, Berchemia discolor, Sclerocarya birrea, Ziziphus mauritiana* and *Syzygium guineense*.

Fruits such as *Tamarindus indica, Adansonia digitata* and *Ziziphus mauritiana* are marketed widely in the country both within the production points and major urban centres like Mombasa (Muok, 2001; Muchiri *et al.* 1999). *Sclerocarya birrea* though not very popular in local markets has high potential for commercialization based on the experience from Southern Africa where commercial products such as wine (*Amarula*) are sold on the international market.

Studies also revealed that coloured *Adansonia digitata* fruits were being sold in supermarkets such as Nakumatt in Nairobi (Muok, 2001) and in local shops in many parts of the country including in North Horr and Turkana District (Karmann and Lorbach, 1996).

In Wajir District, some fruit species such as *Givotia gosai* are sources of income for the community. It was also observed that *Acacia nilotica* fruits are sold for use in production of dyes or as fodder for goats (Ishmael *et al.* 2000).

Aloes

Propagation

Source of seedlings, period of harvesting and storage are quite important in the propagation of Aloes. Mature ripen seeds are selected and the pods dried under shade. The dehisced seeds are dried to low moisture content and stored in proper storage material not polythene papers but sisal sacks as poor storage affects viability. Seed collection is done in pure stand of particular species from healthy not diseased individual and this also applies to the seedlings. Seeds are sowed in well prepared seed beds and when seedlings are ready, they are transplanted into standard well prepared nurseries.

Harvesting

Traditionally Aloes are harvested by cutting leaves and heaping them in a container for the sap to naturally ooze out. The sap is sieved to ensure there is no contamination of foreign particles.

Gel on the hand is obtained by peeling the Aloe leaf and slicing the inner part.

Processing and product development

Processing is done depending on the end product. Gel is whipped into a liquid and the sap is used directly.

Marketing

There is no established aloe gum marketing mechanism in Kenya. It appears the dealers who buy from middlemen know the market, which is concealed from the rest of the chain. However, information gathered shows that the main martket for aloe bitter gum is Saudi Arabia, United Kingdom, Pakistan and China. If the Kenyan market is regularized, there may be potential for reaching

more markets and fetching better premiums. Unregulated markets have serious implications for the conservation of the species and sustainability of the trade. The dealers export the crude sap at US $ 2.5 per kilogram (Mukonyi *et al.* 2008).

Factors affecting supply and market information system

- There are inadequate number of established commercial plantations
- Lack of proper system for marketing aloe products
- Trade is done illegally where the aloe products are smuggled out and therefore the prices are poorly negotiated

Other Medicines

The knowledge of plant-based household remedies is considerable; for common ailments people often rely on their own traditional knowledge and for more complicated health problems traditional healers are consulted. Only for the most serious problems do patients refer to hospitals and academically trained medical doctors. Production of medicinal plants by end-users is related to home garden cultivation, commercial production and sustainable harvesting.

Production

Medicinal plants mainly grow in the wild. Production of medicinal plants is mainly done in home gardens. In many cases cultivation of medicinal plants in home gardens is useful, as they provide a solution for health problems close at hand. This is especially useful in urgent or recurrent cases. Managing a home-grown plant aims at keeping the plant alive for a long time whereas harvesting in the wild is certainly not sustainable. Commercial production becomes more important if the locally produced plants can be used in the national pharmaceutical industry to replace imported drugs.

Sustainable harvesting

In many cases bark and/or roots are harvested. Debarking and uprooting are unsustainable especially with perennial species. Domestication in these cases is an alternative for the unsustainable harvesting.

Dyes and tannins

Production and processing

Though Kenya has been cited to export dyes and tannins from *Acacia mearnsii* and *Bixa orellana* L. (annatto), the community based dye and tannin industry is not well developed as it is in West Africa. Some communities have perfected an art of dyeing such as the Bogolan techniques in Mali whose products are in high demand locally and internationally. The use of these products promotes African cultural values, support cottage industries which indirectly promote related ventures like cotton and leather systems.

Plantation grown *Acacia mearnsii* has been the main source of vegetable tannins. Kenyan tannin extract company (EATEC) closed down their operations. However, Kenya vegext Ltd is extracting tannins from *A.mearnsii* and require 50 tones of bark per day which means about 1000 trees per day translating to about 700 acres of trees per year (Standard Newspapers April 26, 2006 Supplementary G).

With collapse of major leather industries in Kenya, the dry land communities which produce high amounts of leather have been supported on a limited scale to undertake the primary leather processing instead of selling raw products. Some communities are using tannins from *Acacia nilotica* for hides and skins. The Somali communities in Kenya use a lot of tannins for their beautification. Vitasi Women group in Taita (Mukonyi et al. 2004) use various natural dyes for their weaving.

Optimal extraction methods for both dye and tannin producing species are worth researching on. This is because only traditional methods are currently used for most of the species. Most of the traditional extraction techniques are probably not the most efficient and they do not extract the chemicals exhaustively. The traditional extraction techniques are also faced with the challenge of formation of by-products which require purification that is costly.

Marketing

Kenya (25,000 tonnes /year) ranks second after South Africa (30,000 tonnes /year) in exporting of vegetable tannins from *Acacia mearnsii*. Small scale farmers in coastal region in Kenya have also been exporting about 1500 tonness of Annato seeds and extracts of *Bixa orellana*. Exportation of this *Lawsonia inermis* dye to Middle East has also been reported (Musyoki *et al.* 2008). For most of the dye and other tannin producing species, it is unclear what the national market demand is, what prices are paid and what quantities and what quantities are traded. Local or national studies could provide insight in existing or potential opportunities for farmers. Changes over time in intensity of use of a species could indicate a need for conservation measures. Most dye species have multiple uses hence the need to conserve them, increase their coverage and protect them from getting extinct.

Biofuels (*Jatropha curcas*)

Production: Currently three different modes of jatropha production are taking place in Kenya: monoculture mixed intercropping, hedges and intercropping with vanilla. In Makueni District where jatropha production has been introduced by non-governmental organizations, some farmers are converting their farms into jatropha plantations, although they intercrop jatropha with other food crops for the first year when jatropha is relatively small. Some farmers with limited landholdings have decided to experiment with growing jatropha as a hedge.

However, the majority of farmers in the area are observing their neighbours' production of this new crop to see how profitable it will be. The intercropping of jatropha with vanilla was started in the coastal zone of Kenya since 2005. (Muga et al. 2009)

It has been observed that the yield and growth of jatropha varies with agro-ecological conditions. In Malindi town, the average height of 30 jatropha plants of 13 years of age is reported to be only around 2 meters, while jatropha can reach a height of up to 5 meters (Tomomatsu and Swallow, 2007).

Processing: There are companies that have interest in commercial biodiesel operation in Kenya such as Hydronet Energy Company Ltd., and Biwako Bio-Laboratory Inc., both from Japan. (Muga et al. 2009)

Jatropha oils of Kenya has been recently registered as private oil milling and processing company whose objective is the extraction of pure oil from *J. curcas* seeds and the processing of the oil to produce bio-diesel. Currently Jatropha can be processed only in small mills using available methods applicable for other oils. There has been no attempt of commercial production of Jatropha oil in Kenya. However, the technology for milling jatropha is available.(Muga et al. 2009)

Marketing: The current market conditions do not make jatropha production an attractive investment for smallholder farmers in Kenya, despite heavy promotion by several private firms and some non-governmental organizations. However, other value chains exist for jatropha biodiesel production in which smallholder farmers might be able to obtain more attractive outcomes that could contribute to the improvement of rural livelihoods (Tomomatsu and Swallow, 2007). For this to be realized there are policy changes that might be required. The value chain consists of four stages: production of feedstock (farming), oil extraction (first processing), trans esterification (second processing), marketing to end-users, and distribution of products that connect each stage. The actors in the value chain include local farmers, domestic and international private enterprises, government agencies and national and international end-users, depending on the local context.

Although jatropha seedcake could be used as organic fertilizer, it has a relatively low market value.

Honey and bee products

Production

The production of hive/bee products is below the national potential. Although improved technologies are being introduced in most parts of the country

practicing bee keeping, adoption levels are still low and many beekeepers are using indigenous knowledge, skills and equipment. Activities in production still don't aim at increasing productivity and quality of honey, beeswax and other hive products. However, the decline in productivity is likely to adversely affect household incomes and employment.

Beekeeping Equipment

The beekeeping production equipment are hives, bee protective clothing, bee smokers, hive tools, containers for honey and beeswax. There is in adequate supply of these equipment to these farmers due to limited or lack of appropriate production skills, poor infrastructure, lack of capital, information and high cost of raw materials. The quality assurance in production and processing equipment is still inadequate. Due to lack of inspection, some of the equipments being used are of poor quality and eventually result in lowering production and quality of the hive products. The country has standards for Kenya top bar hive (KTBH) but not for other production and processing equipment. Currently beekeeping equipment have not been developed to suit these different ecological zones.

Sources of honey

Honey color and flavor are determined by the various plant species visited by the bees. In these regions (ASALs) bees get their nectar from the common sources which include agricultural crops, fruit trees, small fruits, ornamentals, and wild flowers. One hive will require several acres of flowering plants to provide it with sufficient nectar, this makes bees to travel long distances in search for nectar.

Processing

Hive products are currently being processed both on-farm and in community – owned processing centers. The technologies used in honey processing include extraction, pressing, and straining while the technologies used in bees wax processing include pressing, solar and steam extraction. Majority of producers depend on low technologies of processing such as cloth strainer for honey and squeeze methods for bees wax, but with increased production, there is need for appropriate equipment. Moreover, hive product processing and packaging is currently constrained by inadequate knowledge and skills, unavailability and high cost of equipment and packaging materials. However, extractors can be borrowed from other beekeepers or some local beekeeping associations make them available to the communities.

Marketing

The honey market is currently very strong, especially for locally produced honey. The local marketing structure involves individual farmers, cooperatives, CBOs,

NGOs, traders, processors, packers and other actors in the value chain. The main challenges facing marketing of hive (bee) products include: poor marketing infrastructure, inadequate marketing information, poor market organization, unethical marketing practices and high consumer prices due to low supply. These challenges affect the performance of the industry. The government should promote the development of effective local marketing organization and information system, and strengthen regulatory mechanisms to regulate the quality of products available in the local market. In addition the government should improve the infrastructure in beekeeping areas.

Factors affecting supply and market information system

- Local honey and beeswax prices are higher than those in the international market making it difficult to sell it in the international markets.
- Honey quality is low, especially for export market.
- Decreased land sizes in high potential agricultural areas prevent the increase in Beekeeping
- Poor infrastructure
- Low level training in Beekeeping technologies for farmers and staff
- Lack of research in Bee forage

4.4 Associations along the production and marketing chains of key NWFPs

Gums and Resins

Producer associations have been formed in most of the gum and resin producing districts and many members have received training on harvest and post harvest handling of gums and resins. There is still need for further capacity building and formation of associations in production areas where these do not exist.

Indigenous fruits

- Not well priced and valued so less development of associations and common interest groups.
- Only some major products have marketing strategies e.g. *Tamarindus indica*.
- Market structures not well developed. There are producers on one end, and middle men in the other.

Aloes

There are many associations along the market chain right from the production level. There are groups that have been formed, registered and are harvesting, making products and selling.

Dyes and Tannins

Dye community based groups exist in some areas but need to be strengthened.

Medicines

There exists Traditional Health Practitioners (TMP) who are currently registered by the Department of Culture in the Ministry Gender, Sports, Culture and Social services, although others are not registered and operate illegally *(Kamau, NMK)*. They also have an umbrella national organization and local district based associations in some parts of the country.

Jatropha curcas

There a number of farmer groups involved in Jatropha value chain. These groups mainly operate under the many NGOs which are already involved in the promotion of Jatropha. These NGOs include: Sun Mango LTD- Jatropha Maragwa, Spectre Internationa l- Western sorghum, Vanilla Jatropha Foundation, Green Africa Foundation, Malt Limited - Coast sugar, Horizon Ventures in Nyeri district - Rapeseed, croton and cape chestnut, Bio-Energy Utilities, Rural Bio-Diesel Project Self Help Centre, Action Aid, World Vision at the coast, Nature Kenya, Africa Harvest*(Muga et al. 2009)*.

Honey and bee products

Currently there is a strong linkage between the honey producers and the local markets resulting from the increased consumption of honey. Although beekeeping is considered to be an individual activity, in many communities it has brought individuals together, sharing equipment and learning from each other's experiences. In some drylands villages, beekeepers have come together to form their own groups and associations. Honey production is rural based; with forward and backward linkages to other sectors of the economy.

Public/Private sector initiatives to enhance community access and participation

Public Private Partnership (PPP) concept is quickly being embraced in the country in a number of development initiatives. There are limited PPP initiatives in NWFPs sub-sector. KEFRI has piloted a PPP with the Kenya Gums and Resins

Limited (KGARL) with very good results. The two institutions jointly carried out a study aimed at generating information for commercialization of the gum arabic sub-sector.

4.5 Economic contribution of NWFPs

Gums and Resins

Exports of gum arabic from Kenya are still very small relative to the resource potential. Annual exports have been only a few 100 tonnes which reached a peak of 460 MT in 1995. (IChikamai *et al.* 2010)

Kenya is a major exporter of resins (myrrh, hagar and frankincense) being number three after Ethiopia and Somalia. Export volumes reached a peak of 1130 MT worth about US$ 2.6 million in 2000 (Chikamai and Casadei, 2005).

The resource potential of gums and resins far exceeds current levels of production. For example, potential for gum arabic production is 3,000 MT against an average production of 400-500 MT while for resins (myrrh, hagar, frankincense) the potential is 3500 MT against an average production of around 1000 MT. An enabling environment is required.

Indigenous fruits

Have great contribution to the rural economies. For example, the average volumes of *T. indica* and *A. digitata* fruits traded are 5 kg and 10 kg per trader per day respectively. Producers of *T. indica* and *A. digitata* are selling at average price of Ksh. 2.50 and Ksh. 3.50 per kilo respectively. The selling price of a kilogram of *T. indica* and *A. digitata* by the local traders is Ksh. 5 and Ksh. 9 respectively. These products are life savers during drought as they are consumed by the local communities.

Indigenous fruits also earn foreign income but the level is very low. The average trade flows per transaction per trader in the regional market are 6,500 kg and 250 kg of *T. indica* and *A. digitata* fruits respectively (Wekesa, 2010 cited in Muga *et al.*(eds.) 2010) Regional traders buy a kilogram of *T. indica* and *A. digitata* fruits from local traders at average prices of Ksh. 9 and Ksh. 10 respectively. The average prices for a kilogram of *T. indica* and *A. digitata* sold to retailers at regional markets are Ksh. 15 and Ksh. 20 respectively. The average retailing price for a kilogram of *T. indica* and *A. digitata* fruits to consumers in the regional markets are Ksh. 18.50 and Ksh. 25 respectively. The export destinations for *T. indica* fruits include Tanzania, Zanzibar and the Middle East (mostly Yemen). The trade of the *T. indica* fruits has thrived between Kenya and Tanzania which is her East Africa neighbour as a result of differences in the fruiting seasons in the two countries. *T. indica* fruits are indicated to be in very high demand among the coastal communities and Muslims in general.

Aloes

There are many socio-economic gains from *Aloes,* these include treatment of various ailments and for cosmetics. Price of Aloes is quite attractive, at US$4-6/kg of the aloe gum. The global trade of Aloe vera gel and its derivatives is currently USD 110 billion annually (Mukonyi *et al.* 2008). The annual global consumption of aloe bitter gum is about 1000 tonnes. Kenya exports about 200-300 tonnes, though this is smuggled out (Mukonyi, 2004).

Other medicines

Economic analyses have shown that medicinal plants have considerably contributed to economic welfare of the involved local communities by providing and generating reasonable income. They also contribute to household self-sufficience in food security through accumulation of savings and minimization of risks *(Conserve Africa)*

Dyes and Tannins

Harvesting and sale of NWFPs provide alternative sources of livelihood to local communities and contribute to poverty alleviation.
The economic contribution of dyes and tannins to livelihoods of dry land communities in Kenya has not been well documented.

Sale of naturally dyed products is the third most important source of livelihood with an average income of KSh26,503.70 per year in Garissa (Musyoki *et al.* 2008).

Biofuels (*Jatropha curcas*)
Economic opportunities exist during production, transport, processing and marketing although large scale production may not benefit small scale farmers (socio-economic inequity). One hectare of *Jatropha curcas* is estimated to give a net profit value of Kshs. 616,607.4 in ten years (Nyamai and Omwodo, 2007).

Honey and bee products
Honey and bee products have some contribution to the economy, some of the contributions include:

- Beeswax is used by beekeepers for baiting their hives, or sold locally as a floor polish and for making candles
- Direct Income from beekeeping and tree nurseries for each individual in the practicing community. At least four bee hives per person and a considerable number of tree seedlings. From this an individual will harvest 14 kg of honey in

one season. But one can harvest at least twice a year making the total to be 28kg. This with the current market conditions of $4 per Kg the farmer will have $112 for two seasons. Total benefits of the project to an individual could be equivalent of $112 plus economic value of improved agriculture as stated above.

- Improved nutrition for the nation; honey is very nutritious and is known to have medicinal value.
- Increased attention, knowledge and motivation of the community to conserve and rehabilitate our natural forests and establish farm forest. This is the prescribed remedy to global warming; a local action with global impacts.
- Restored and sustained biodiversity and general environmental health and improved resilience of indigenous communities to withstand the effects of climate change.

4.6 Commercialization including laboratory production of NWFPs planting material

For the commercial off-take of NWFPs, robust market demand, adequate product availability, and advantageous pricing generally provide the strongest incentives for harvesters, buyers and processors. Identifying the key incentives and disincentives driving product off-take becomes more complex. Price and profit margins differ from collection site to market, to manufacturer and end-user. Most of NWFPs in Kenya are yet to be fully commercialised. A short review of the situation for each NWFPs is done below:

Gums and Resins

There is commercial production of gums and resins from Kenya. However, all these are from trees growing in the wild. There is minimal plantation development for these resources. Production of planting material is limited to seedlings production in nurseries. Studies on the genetic diversity of the Kenyan populations of *Acacia senegal* have been carried out and morphological characterization of the Kenyan populations of *Acacia senegal* has also been initiated. Once these are completed, laboratory production of planting materials will be initiated.

Indigenous fruits

However, commercial processing of indigenous fruits for development of processed products (e.g. jams, juices, oils) and preservation of by-products is still low in Kenya. Studies conducted show that only a few indigenous fruits like *Tamarindus indica, Sclerocarya birrea and Adansonia digitata* are being

processed on limited scale to produce commercial products like ice drink, jams and sweets *(Muok, 2001)*.

Aloes

There are a few established commercial plantations of Aloes in Kenya at the moment especially in Laikapia and Baringo Districts. KEFRI and Baringo Aloe project (EU-funded) are engaged in nursery production of Aloe suckers and seedlings. There is potential in this field, and a lot is already going on what needs to be done is documentation of the volumes that are sold in the market and the cost implication. Among the products in the market are shampoos, hair conditioners, soaps, hair activation gels, skin creams, body lotions and health drinks.

Medicines

Many medicinal plants are traded for the extraction of their active ingredients. On one hand this trade will become less important as these active ingredients can be synthesized. On the other hand the trade will become more important as the locally produced plants can be used in the national pharmaceutical industry to replace imported drugs.

Critical issues in commercialization

I. There is need to define different types of ownership of traditional knowledge when it comes to equitable sharing of benefits. For example, standard measures should be set to determine ownership of territories versus ownership of genetic resources versus ownership of traditional knowledge, innovation or practices.
II. There is a lack of data demonstrating the socio-economic importance of medicinal plants and traditional medicine practice to the rural livelihoods of majority of Kenyans.
III. Traditional medicine Practitioners (TMPs,) and those knowledgeable about medicinal plants typically have poor access to credit and micro-finance essential to facilitate commercial production.
IV. There are presently poor or non-existent marketing channels for medicinal plants or traditional medical knowledge. This has lead to exploitation of farmers and gatherers by middlemen and those already established in the business.
V. Inadequate mechanisms to enhance partnership in product development involving the community, TMPs, commercial partners, research institutions and government.
VI. There has been an inadequate inventory and prioritisation to date on the resource base, users, current technologies and socio-economic value of medicinal plants.

VII. Products of traditional medicine have a low appeal, hence low demand due to poor processing, presentation and packaging.

Dyes and Tannins

Acacia mearnsii has been grown in plantations as the main source of commercial vegetable tannins.

Biofuels

Jatropha is currently being grown in at least ten districts in Kenya (Kitui, Thika, Namanga, Kajiado, Malindi, Nyanza, Nakuru, Marakwet, Naivasha, in the coastal regions and in Meru) and there is opportunity for expansion to other areas. Milling points can now be established in areas where jatropha is being grown and collection systems created leading to bio oil bulking and storage and future bio-diesel refining. The current market conditions do not make jatropha production an attractive investment for smallholder farmers in Kenya, despite heavy promotion by several private firms and some non-governmental organizations. Tissue culture is a potential future direction for laboratory production of planting materials.

Honey and bee products

Commercialization of bee products still lacks in Kenya. Laboratory production of the products is not being practiced in Kenya currently due to the low investment in the sub-sector.

4.7 Policy and legal frameworks

The government of Kenya has made a commitment to address ASAL challenges where these commodities occur in the following policy and legal frameworks;

- National Policy for the Sustainable Development of the Arid and Semi Arid Lands (Draft)
- Strategy for Revitalisation of Agriculture (SRA)
- Vision 2030
- Forest Act and draft forest policy

The new Forest Act No.7 was enacted in 2005 and a draft forest policy is awaiting parliamentary approval. This act builds on the national development plan, the millennium development goals (MDG's) and international conventions and treaties; CBD (Convention on Biological Diversity) and Convention to Combat Desertification) CCD. Both the forest policy and stature recognize the rights of communities to collaborate in forest management through participatory forest management practices that culminate in the formation of empowered forest Associations. The new Act defines forests to include woodland areas that do not have a closed canopy. The new forestry policy for Kenya [Sessional Paper No. 9 of 2005] on Forest Policy supported by Forests Act

No. 7 of 2005 also recognizes the importance of the drylands especially on the richness of biodiversity. The policy and legislation recognizes the potential of the drylands to supply marketable commodities on a sustainable basis such as gums, resins, aloe, charcoal, essential oils, silk, edible oils, bio-diesel, commercial juices, frankincense, indigenous fruits, honey and timber. These products can go a long way in improving the livelihoods of Kenyans living in the drylands. The policy recommends ways of achieving this and these includes:

- Forests and other types of woody vegetation in the drylands will be sustainably managed and conserved for the production of wood and non-woody forest products.

- The establishment of forest based micro-enterprises and community forest associations will be supported.

- Degraded and over-exploited areas will be rehabilitated by community forest associations with government support.

- Research, technology development, education and training in drylands forestry will be intensified.

- Tree planting in the drylands will be promoted.

- Community forest associations will be supported to develop management plans and manage community forests.

- Sustainable commercial production of charcoal will be promoted.

In addition, the Kenya government, under the Office of the President is finalizing a new ASAL policy – the *National Policy for the Sustainable Development of the Arid and Semi-arid Lands of Kenya*. One of the policy's strong points is that it aims at reversing some of the past ASAL development biases and is more inclusive.

Through these policies, incentives are being created for producers to take advantage of identified opportunities. Government and private sector are also increasingly getting involved in improvement of production of agricultural products from the dry lands. However, the growth in this sub-sector is yet to be fully stimulated and markets for various agricultural commodities and NWFPs are yet to be improved.

There are additional regulations that govern the utilization of Aloes, others medicinals, biofuels, honey and bee products. These are briefly reviewed below:

Aloes

National regulations

Prior to the Wildlife (Conservation and Management) (Aloe Species) Regulations, 2007 published in Legal Notice No 403, Kenya lacked adequate regulations and mechanisms to oversee or regulate the protection, conservation and management of aloes, outside protected areas. The unclear provisions for regulation of use of the species within the wildlife legislation framework saw the unchecked utilization of the aloe species in the 1980s resulting into over exploitation and wanton destruction of aloes in the wild. This prompted a Presidential Decree in 1986 prohibiting harvesting of the species from the wild for commercial purposes and instead encouraged establishment of aloe plantations for commercial exploitation of the species. The Wildlife (Conservation and Management) Amendment Act, 1989 mandates Kenya Wildlife Service to formulate policies to govern conservation of all fauna and flora (not domesticated). (Lubia *et al.* 2008). Increased demand for alternative investment opportunities, technological innovations and expanding socio-economic developments, has resulted in increased demand for utilization of plants and their products (including aloes) as alternative source of income. In response, Kenya Wildlife Service has undertaken several consultative processes to develop a conservation and management strategy for commercial aloe species with the objective of regulating trade in the species to sustainable levels. The steps include undertaking national aloe resource mapping and quantification to advise the Minister in charge of wildlife in accordance with the Act, interventions regarding harvesting from the wild populations for commercial trade and development of national guidelines for certification of artificially propagated sources for export /import. (Lubia *et a.*, 2008)

The Government has considered allowing controlled trade in specimens of Aloe species under the following guiding principles:

- Utilization of aloes should be sustainable and should not be detrimental to their conservation or supporting ecosystems
- Sustainable use of aloes is a legitimate means of satisfying the subsistence, spiritual, cultural, recreational and commercial needs of the people of Kenya
- Conservation of aloe and their natural habitats and microhabitats on private and communal lands will be enhanced through landowners and regulatory agencies
- Economic benefits derived from using Aloe species shall be used sustainably to create economic incentives for the landowners to conserve the species and their natural habitats and to cooperate with the regulatory authorities pursuing conservation goals.
- Aloe management programmes shall be adaptive based on the best available scientific and indigenous knowledge about the species and its habitats and provide for regulation, monitoring, reporting and review and adjustment.

• Enhancement of aloe conservation will be the control point for consideration when evaluating sustainable use management options.
These principles are embedded in The Wildlife (Conservation and Management) (Aloe species) Regulations, 2007 (Lubia et al. 2008)

International regulations
Trade in Aloe species and their derivatives is regulated under the provisions of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). All Aloe species except *Aloe vera* are listed in Appendices I and II of CITES. CITES Appendix I listed species include all species threatened with extinction, which are or may be affected by trade and international trade in these species is generally prohibited. CITES Appendix II listed species include all species which although not necessarily now threatened with extinction may become so unless trade in specimen of such species is subject to strict regulation in order to avoid utilization incompatible with their survival and other species which must be subject to regulation in order that trade in specimens of certain species may be brought under effective control. Indigenous Kenya aloes are listed in Appendix II of CITES and therefore any international trade in these species and their derivatives require CITES permit/certificate. Export and import of wildlife species under CITES Appendices are regulated through use of Permits and Certificates issued by designated CITES Management authorities in consultation with the scientific authorities. (Lubia et al. 2008)

An export permit can only be issued by the Management Authority provided that the Scientific Authority has advised that the proposed export will not be detrimental to the survival of the species and that the Management Authority is satisfied that the specimens were legally obtained. CITES is therefore a powerful tool for achieving consistent international regulation of trade in wildlife for conservation and sustainable use (Lubia et al. 2008)

Other medicines

In order to facilitate effective use of traditional medicine (TM) within the context of official allopathic health care and ensure the sustainable utilization, conservation, domestication and regulated trade of medicinal plants, it is apparent that functional legislation needs to be enacted. Such a legislation/policy would ensure that the necessary regulatory and legal mechanisms are created to promote and maintain good practices in the TM and Medicinall plants (MP) sub-sector.

It is against this background that a national process to develop Medicinal and Aromatic plant species was started in November 2001 when a draft strategy and action plan was formulated by the Kenya Working Group on Medicinal

and Aromatic Plant Species (KWG-MAPS) at the conclusion of a National Stakeholders Workshop in Naivasha.

An inter-ministerial committee was set up under the Ministry of Planning and National Development and four – committees constituted : (1) Conservation, (2) Domestication and Production, (3) Commercialization and Marketing and (4) Quality, safety and efficacy of TM and Medicinal plants. The sub-committees developed specific work programmes which were consolidated into a draft policy. The contents of this draft policy reflect the contributions of the four sub-committees on the background of TM and MP in Kenya, justification of a national policy, the critical issues, the policy goals, objectives and policy targets, priority policy actions and policy interventions in the four thematic areas and a proposed institutional framework (NCAPD, 2005) .

Biofuels

The development of biofuel in Kenya is currently hampered by lack of policy frameworks. The Government of Kenya (GoK) has made several initiatives to address this gap. For example, the GoK Sessional Paper No. 4 of 2004 on Energy seeks to encourage wider adoption of renewable energy technologies. The Energy Act of 2006 mandates the government to pursue and facilitate the production of biofuels. Though the government is yet to adopt a biofuels policy in response to its mandate under the Energy Act, an initiative has been taken to develop a comprehensive biodiesel strategy. The Ministry has constituted a National Biofuels Committee which is currently addressing biodiesel issues. The membership of the National Biofuels Committee includes public sector, private sector and non-governmental organization participants in the energy value chain. The committee has produced a draft biodiesel strategy which is now awaiting cabinet approval. No similar efforts have begun regarding the bioethanol industry. Though there are some initiatives being undertaken by the government to develop a policy framework for biofuel development, much remains to be done to develop regulations and standards that will promote and regulate the biofuel industry in Kenya. The biofuel industry cuts across several sectors that are governed by different policies, all of which need to be harmo-nized to speed up the industry. (Muok et al. 2008)

Honey and bee products

Currently there is no strong policy and legal framework to focus on the development and Beekeeping Regulations as well as Guidelines for Quality Assurance, despite its production being in existence for quite along time.

4.8 Research and development

A lot of research and development have been initiated on NWFPs in Kenya. A quick over view is given on each of the NWFPs and a list of key institutions involved in training and research also highlighted (Table2).

Gums and Resins

The following Research and Development activities have been accomplished:

- Taxonomic and ecological characterization of the producing species,
- Chemical characterization of the gum and resins
- Production and management of *Acacia senegal* has been piloted
- Training and capacity building
    - Development of training curriculum for TOTs and communities in production, processing and marketing of gums and resins
    - Generated knowledge and built capacity of extension workers and local communities in harvesting, handling and marketing of gums and resins (Over 500 TOTs and 300 Community members trained)
    - Develop and maintain a Database of TOTs and Community Resource Persons with expertise in Gums and Resins
- Documented and disseminated information products on gums and resins including books, brochures, and flyers nationally and in the region.
- The traditional ecological knowledge and its application in the management of *Acacia senegal* trees in Isiolo and Samburu Districts has been documented.
- The market chains of gum arabic, the stakeholders participating in the management and marketing of *Acacia senegal* products and the constraints to gum arabic production and collection within the Kenyan drylands have also been documented.
- Studies on the genetic diversity of the Kenyan populations of *Acacia senegal* using nuclear and mitochondrial micro satellite markers have also been carried out and higher genetic diversity and little population structuring detected. Morphological characterization of the Kenyan populations of *Acacia senegal* has also been completed and data analysis underway.
- Characterization of the populations using randomly amplified polymorphic DNA (RAPD) is on going.
- The effect of chemical properties of soils on gum elementary compositions from *Acacia senegal* variety *kerensis* in Samburu and Marsabit districts has also been studied.
- Soil characterization has been completed in selected pilot sites and mycorrhizza trapping initiated and ongoing.

Indigenous fruits

A number of research and development initiatives have been undertaken on indigenous fruits in the country. The key research studies undertaken have covered areas such as

- taxonomy,
- eco-geographical distribution of the species,
- phenology,
- management,
- nutritional status and
- Socio-economic aspects of indigenous fruits:- Utilization and Nutritional Value of Indigenous Fruits, Processing and storage of indigenous fruits, Marketing potential of indigenous fruits, Threats to conservation of indigenous fruit species

Aloes

Vast research has been done on *Aloes* and proved to be very effective and significant in the treatment of various ailments, skin disorders, cancer, reducing blood pressure and many others. The following formulations have so far been optimized in KEFRI: Aloe facial cream, Aloe shampoo, Aloe soap, Aloe body wash, Aloe hair activator, Aloe lotion, Vitex payos jam and Baobab juice. Production protocols and standard operating procedures for the production of these products have been also been developed. Linkage of products to industry is ongoing. At least two Aloe products have been linked to small and medium enterprises. Some community groups have also trained on production and marketing of Aloe shampoo and soap. Training on production and quality control has also been conducted at Koriema Aloe factory. Branding for these products is currently on going.

Dyes and Tannins

Key dyes species for Kitui and other Ukambani areas have been identified and propagation techniques are being developed.

Medicines

The key areas of Reseach and Development have been:

- Development of strategies to conserve threatened plant species and traditional knowledge of traditional medicines
- Ethno botanical studies that have reported medicinal plants usage has been carried out in some part of the country especially Eastern Province with focus on Embu, Mbeere, Makueni and Machakos districts
- Studies on prioritized traditional medicinal plants
- Phytochemical evaluation of some Kenyan Medicinal Plants
- Development of medicinal products from plants

Biofuels (*Jatropha curcas)*

The main current research themes are:

- Domestication and agronomy
- Local value addition
- Oil research
- Genetic improvement
- Integrated Pest Management
- Diversified uses
- Conservation and ecology
- Utilization technology
- Marketing research
- Policy measures
- Economic cost benefit analysis
- Development of prototype equipment for use with Jatropha oil

Jatropha facial cream has also been developed and sent to Kenya Bureau of Standards for analysis.

Honey and bee products

There is no formal research in beekeeping by Kenyan Universities and Research Organisations, apart from the few technical institutes which try to offer mainly extension services to the farmers.

Table 2: Research and training institutions involved in forestry research and training and the level of effort put on NWFPs.

Institution	Type	Mandate/ Mission	Role in NWFPs
KEFRI	Public	• Conduct research in forestry; • Disseminate research findings; • Co-operate with other research bodies within and outside Kenya carrying out similar research; and • Establish partnership with other organizations and institutions of higher learning in training and on matters of forestry.	Research Training and capacity building Product development Hosting of networks relevant to NWFP
KIRDI	Public	Carry out research and development in industrial and allied technologies.	Product development Fabrication of relevant processing equipment and machines
NMK	Public	Promote the conservation and sustainable utilization of national heritage through generation, documentation and dissemination of research and collection management knowledge, information and innovations	Research Conservation
KEMRI	Public	• Conduct research in human health. • Co-operate with other organizations and institutions of higher learning in training programmes and on matters of relevant research. • Liaise with other relevant bodies within and outside Kenya carrying out Research and related activities. • Disseminate and translate research findings for evidence-based policy formulation and implementation. • Co-operate with the Ministry of health, the Ministry for the time being responsible for	Research on herbal medicine

		medical research, the National Council for Science and Technology and the Medical Science Advisory Research Committee on matters pertaining to research policies and priorities. • Do all things as appear to be necessary, desirable or expedient to carry out its functions.	
ENNDA	Public- Regional Development Authority	Promote economic development in its area of jurisdiction through:- • To Coordination and planning of development in the Ewaso Ng'iro North River basin; • Implementation of projects and programmes for conservation and management of natural resources including water, forestry, minerals, agriculture, wildlife and tourism; • Management, Planning and Development of Water Resources; • Formulating long range plans for social economic development in the Region.	Capacity building/Training
Moi University – School of Environmental studies	Public	To stimulate the development of expertise in the field of environmental conservation and management through cutting edge facilitation of interdisciplinary learning research, outreach and consultancy.	Capacity building/ Training Research
JKUAT	Public	Offer accessible quality training, research, and innovation in order to produce leaders in the fields of Agriculture, Engineering, Technology, Enterprise Development, Built Environment, Health and other Applied Sciences to suit the needs of a dynamic	Capacity building/ Training Product development Research

		world.	
Kenyatta University- School of Environmental Studies and School of Agriculture and Enterprise Development	Public	Provide quality education and training, promote scholarship, service, innovation and creativity and inculcate moral values for sustainable individual and societal development."	Capacity building/ Training Research
Nairobi University	Public		Capacity building/ Training Product development Research
Egerton University- Faculty of Environment and Resources Development	Public	Generate and disseminate significant knowledge and offer exemplary education to contribute to and innovatively influence national and global development.	Capacity building/ Training Research
KGARL	Private		Public Private Partnership (PPP) ; Capacity building
Wild Living Resources	Private	Wild Living Resources Business Park is a practical and commercially viable working model of integrated land use that has realistic potential to create tangible livelihoods whilst conserving the natural resource base. The Business Park provides demonstration, the first of its kind in Eastern Africa, and a practical in-situ training facility for the capacity building of rural communities, and public and private sector support agencies. The business park acts as a model for the fully working integrated demonstration of six (rising to eleven) natural resource use and livelihood options. These are Eco charcoal processing, East African Wild Leafy Vegetables, East African Wild Mushrooms, East African Aloe, East African Herbals	Sustainable harvesting model for livelihoods, healthcare and biodiversity conservation in East Africa.

		and Good Woods	
Centre for Training in Integrated Research in ASAL Development (CETRAD)	Bilateral Institution between the Government of Kenya (through the Ministry of Water and Irrigation) and the Government of Swiss Confederation.	Focuses on the assessment and evaluation of the potential and the utilisation of the resources in the said areas. This mandate as well includes the assessment and evaluation of the interaction and relations between the ASAL and the high potential areas (in particular mountains and highlands) on the one hand, and the interaction and relations with the economic core regions (in particular urban centres). This mandate is, therefore, twofold: to undertake and to carry out area or situation-specific, regionally oriented and applied research for the purpose of developing and maintaining an integrated and comprehensive data and information base for the entire Arid and Semi Arid Lands (ASAL) of Kenya	Capacity building/ Training Research
African Wild Life Foundation	International NGO	To ensure the wildlife and wild lands of Africa will endure forever. They target communities which live in wildlife migratory corridors in order to reduce human wildlife conflicts and enhance habitat conservation.	Capacity building/ Training, Marketing

4.9 Constraints to optimal utilization of NWFPs in the IGAD region

Gums and Resins

- Quality control of the products,
- Streamlining the supply chain
- Poor pricing and linkages with markets
- Lack of clear policy on the development of gums and resins
- Lack of product standards
- Lack of access to capital
- Poor production practices
- Lack of adequate data on some of the resources

Indigenous fruits,

- Low prices
- Expansion of agriculture and clearing of natural vegetation.
- Competition for land with other uses.
- Poorly structured markets
- Low investments.

Aloes

a) **Unsustainable utilization of wild Aloe populations**
   -Over reliance on wild populations
   - Lack of standardization protocols
b) **Research and development**
- Quality planting materials lacking
- Pests and diseases
c) **Value addition**
- Limited technological innovation
- Limited access to credit facilities
- Quality assurance procedures
d) **Awareness on Conservation management and utilization of *Aloes***
- Land tenure and changing land use patterns
- Undervaluation of Aloes as a commercial plant
- Lack of information on agronomic practices
e) **Regulatory framework**
- Controlling illegal trade
- Enforcement and compliance monitoring
- Cross border trade
f) **Markets and market access**
- Lack of fair trade (equity and benefit sharing)
- Unclear, unfavourable market channels
g) **Operational institutional governance structure**
   Lack of viable community *Aloe* bio-enterprise

Other Medicines

- The main problem facing the use of traditional medicines is the proof requirement that the active components contained in the medicinal plants are useful, safe and effective. This is required to assure the medical field and the public regarding the use of medicinal plants as drug alternatives.
- Overexploitation resulting from excessive commercialization, habitat destruction and other natural and man-made destructive influences
- Lack of breeding and selection for increased yields
- No product development, production and marketing
- Lack of toxicity profile and dosage of herbal medicine
- Lack of candidate species for domestication and husbandry or silvicultural techniques
- Standardization and formulation studies: There is still lack of suitable technical specifications and quality control standards for these resources. The lack of such standards is also a major barrier to regional and international trade and an important reason why traditional medicine has not been integrated into African primary health care as it should be.
- Effects of changing environment on medicinal plants pharmacology and chemistry
- The possible influence of climate change on the life cycles and distribution patterns of medicinal plants, as well as on the production of secondary metabolites.
- Lack of policy on plant toxicity and human health, conservation measures and regulation of medicinal products

Bio-fuels

- Lack of systematic silvicultural / agronomic trials
- Lack of market opportunities for small scale producers
- Lack of coordination of activities of the various actors
- Lack of capital to support emerging entrepreneurs
- Environmental management challenges in case of large scale investments

Honey and bee products

- Poor statistics on the size and structure of the sector.
- Lack of policies and a regulatory framework to guide stakeholders on management of bees and handling of bee products.
- The lack of national honey standards reduces the general quality of honey sold within the country and also reduces the price of Kenyan honey on the international market.

- Due to the lack of an accredited certifying institute in Kenya, the opportunity to export at a premium price is unattainable for most producers and trading companies.
- No or very little competition amongst input providers and traders increases prices of inputs and reduces farm gate prices for honey and beeswax.
- Infrastructure and transport facilities in most beekeeping areas are extremely poor, which increases transaction costs.
- General lack of collaboration between stakeholders in the sector, notably the service providers. Beekeeping support is fragmented, sometimes even duplicated, and predominantly focused on training new farmers in basic beekeeping skills.
- Producers lack market information and entrepreneurial skills. They are therefore not able to locate input and credit providers, find buyers and negotiate fair prices.

4.10 Recommendations and the way forward

Gums and Resins

- Empower the communities through establishment and/or strengthening of Producer Associations
- Develop the market by mapping the trade chain from producer to exporter including market intelligence
- Streamline the supply chain by improving access to markets
- Further research on improvement of resource productivity
- Comprehensive characterization of the quality of gum arabic and gum resins in support of plantation establishment
- Promote conservation and domestication of gum and resin producing species
- Enhancing information dissemination and technology transfer
- Re - training on harvest, post harvest handling and primary value addition including packaging and development of a regional standard for gums and resins products classification
- Need for more technical and business support
- Improve access to capital
- Establishment of storage facilities
- Explore sub-sector development through Public Private Partnership

Indigenous fruits

Origins and local naming and synonyms of the species

Although useful taxonomic information exist on indigenous fruit species in the country, pertinent information about the origin of some species is not clear. The centre of origin of some indigenous fruit species such as *Tamarindus indica* is still unknown leading to a number of theories. It is, therefore, necessary that studies be carried out to unearth centres of origin of the species to establish genetic diversity. In addition, all possible local names and synonyms of the species in areas where they are distributed have not been documented.

Genetic diversity

Detailed information on genetic diversity of most indigenous fruit species in the country is lacking. Very little is known about genetic variation of most indigenous fruit species and how genetic improvement could be effected. It is, therefore, necessary that genetic mapping studies be undertaken to establish genetic variation, effective size of breeding populations and provenances of the indigenous fruits, both in the natural and naturalized conditions. There is need too to conduct progeny trials in many parts of the country to select superior germplasm for adoption and further improvement.

Flowering and fruiting phenology and reproductive biology

There is insufficient information on the flowering and fruiting phenology, pollination mode, fertilization, seed dispersal mechanisms and regeneration potential of indigenous fruit species in the country. For effective development and utilization of the fruits to be realized, an understanding of such basic biology of the species is required. Therefore, research on these biological aspects should be initiated to meet this need.

Silvicultural management of indigenous fruit species

The amount of information documented on the silvicultural management practices of indigenous fruit species is limited. There is paucity of information on the cultivation and cultural requirements of indigenous fruit species including germplasm development, propagation, establishment and management in the field.

Fruit yields and economics of production

In most cases indigenous fruits are harvested either in the bush from naturally established or conserved stands. However, no efforts have been made to quantify their costs of production and yields under different conditions. There is, therefore, need to collect statistical data to establish the most remunerative fruit species.

Harvesting and Post harvest information

Most of the indigenous fruit species e.g. *Adansonia digitata* are big tall trees making harvesting of the fruits laborious and time-consuming. There is need, therefore, to develop efficient harvesting techniques to encourage commercial harvesting of the fruits.

Most indigenous fruits are utilized in their raw state or processed mainly based on indigenous knowledge. The processing methods available are limited hence many fruits are wasted. Other fruits such as the *Balanites* require long time to be processed and prepared as food. There is need to develop simple and cost effective methods for processing, storage and value addition for indigenous fruits.

Marketing of the fruits

Marketing of most indigenous fruits is restricted to the local supply systems whereby trade flows and prices are extremely low to generate enthusiasm among the producers. It is essential, therefore, that marketing systems for the indigenous fruits be organized and developed to create more rewarding opportunities for producers and collectors of the fruits. An organized marketing system could be affected by coming up with local level cooperatives, collection stores and contractual supply arrangements. It is imperative, therefore, for market studies to be conducted on the structure, conduct and performance of the marketing systems for the fruits at both domestic and international market levels.

Nutritional studies and preservation

Although various studies have been undertaken to establish nutritional composition of indigenous fruits, information gaps exist in terms of levels of anti-nutritive substances such as tannin and tryptic inhibitors. It is argued that Baobab has high anti-nutritional substances that affect bioavailability of essential nutrients. There is need to conduct research on the safety measures for fruit utilization and identify of processing arrangements that can remove anti-nutritive factors and possible toxic constituents.

Industrialization/commercialization of the indigenous fruits

The way forward in terms of developing indigenous fruits as reliable sources of food and income is dependent on the production of industrial/commercial products from the fruits. Efforts have been made elsewhere in the world to produce industrial products from indigenous fruits as in the case of *Amarula* wine from *Sclerocarya birrea* in South Africa. However, no such efforts have been explored in Kenya although marketable products are being produced from fruits at domestic/subsistence levels. It is important, therefore that efforts be made in development of products and their standards for industrial/commercial production. The existing indigenous knowledge could be harnessed and

incorporated in the development of processing technologies that could be disseminated among entrepreneurs.

Coordination and communication on research and development (RandD) initiatives

The key players implementing initiatives on indigenous fruits are scattered and exchange of materials and information among them is low. From the institutional analysis and field appraisal it was evident that no opportunities existed to allow interactions and exchange of information among different organizations and players. Information from research was not flowing to the producers and entrepreneurs interested in production and commercialization of indigenous fruits. There is need, therefore, to explore possibilities for coordinated RandD initiatives and effective communication among different stakeholders.

Aloes

- Capacity building on production, sustainable harvesting, processing, product development and value addition for the communities in the project areas; and this to include making known the policies and framework in the *Aloe* industry.
- Help form associations along production and market chains
- A resource map essential to determine the densities of *Aloes* in the project sites.
- The socio – economic survey to come up with figures of production and marketing
- Standard Operating Procedures (SOPs)) to be developed for every step in the processing and in turn effect of processing on the final products to be determined
- Commercial opportunities of Aloes for private enterprise

Other Medicines

Development

(i) Development of safe medicines by using published information

An enormous amount of data exists on medicinal plants of tropical Africa. There is a lot of information on which plant species are used to treat what diseases, the chemical and pharmacological properties of these medicinal plants and even the active ingredients responsible for the therapeutic effects.

(ii) Breeding and selection

There are several ways to improve the production of medicinal plants through breeding and selection. Increasing the dry matter yield is a valid target that will give meaningful results in most species. Selection and breeding for increased content of specific compounds is another way to arrive at increased yields.

(iii) Commercial production and extraction
Markets exist for the commercialization of raw medicinal plant material or extracted compounds at local and international level. Raw plant material can also be dried and exported to countries where the active ingredients are extracted.

(iv) Product development, production and marketing
There are a number of plant species that have been well investigated to be the basis for the development of commercial products. Products for external use can be developed and marketed faster than products for internal medicinal use.

Research
(i) Toxicity profile and dosage
Toxicity and dosage are major concerns in phytomedicine. Dosage of herbal medicine has always been an issue, especially when dealing with plants that are recognized as toxic. At inadequate doses some compounds of medicinal plants can be dangerous.

(ii) Candidate species for domestication and husbandry
To expand the production of medicinal species and to keep pressure off wild populations it is necessary to develop husbandry or silvicultural techniques urgently.

(iii) Breeding
To overcome some production constraints or meet preferences of users breeding appears as an important research area to invest in for many medicinal plants.

(iv) Standardization and formulation studies
Despite the fact that medicinal plants are commonly used in Africa, there is still lack of suitable technical specifications and quality control standards for these resources. The lack of such standards is also a major barrier to regional and international trade and an important reason why traditional medicine has not been integrated into African primary health care as it should be.

(v) Effects of changing environment on medicinal plants pharmacology and chemistry
Experts raised concerns about the possible influence of climate change on the life cycles and distribution patterns of medicinal plants, as well as on the production of secondary metabolites. As secondary metabolites are usually produced in larger quantities under stressed conditions, the changing environment could have a positive or negative influence on the production.

Articles on some plant species may not accurately reflect the reality due to environmental changes: some active molecules responsible for the therapeutic effects might be lacking for the same species growing in different climatic environments.

Policy

(i) Toxicity and human health

Policy makers should discourage use or make potential users aware of the risks involved in the use of toxic plants as medicine.

(ii) Conservation measures

Governments bear the responsibility to assure measures that natural resources are not lost for the future and that the harvesting of the plant resources from the wild is done in a sustainable way. An active role for policy makers is needed in: Conservation measures, control wild harvesting, enforce legislation / regulation, facilitate conservation efforts, international trade to be regulated, legislation to protect habitat, promote conservation and promote sustainable exploitation.

(iii) Regulation of medicinal products

There is no standard policy for traditional medicine in tropical Africa as a whole. Many countries are in the process of establishing regulatory mechanisms or frameworks, including the establishment of Boards and Councils. It is important to get critical stakeholders into these Boards and Councils to facilitate better regulation of the practice and also to prevent clashes that are likely to arise due to possible overlap of roles of players.

Marketing and value added products

There is a need to initiate, support and promote formulation and development of projects that are aiming at value-added traditional medicinal plant products. Investment in supply and market development should be undertaken given an assured market for indigenous medicinal products. New opportunities should be investigated as demand grows, and export opportunities investigated and developed. Research should be carried out into the development of efficient packaging and storage of plant medicines. Many plants originating from Africa have become sources of important drugs. However, hardly any effort has been made towards adding value to local natural products. By value-added processing, communities in these countries would have earned more income and thereby become more aware of the value.

<u>Dyes and Tannins</u>

- Resource mapping should be done for key dye species to know their coverage

- There should be focus on conservation of the key dye species with multiple uses. Establishment of conservation plots and demonstration plots are important.
- Awareness created among the community groups on the need to conserve the dye plants.
- Taxonomical studies to identify dye pecies appropriately. Local studies on variation in characteristics such as productivity need attention as well.
- The national market demand for dyes and tannins to be determined
- Enhance conservation and improve on dye extraction process.
- Need to undertake chemical analysis to enhance characterization of the compounds responsible for the colorants
- Toxicity studies to identify other potential uses of these dye species.
- In Kwale where *Bixa orellana* was introduced, the status of commercial cultivation, market demand and supply needs to be confirmed, challenges being faced identified and strategies developed to address the challenges.

Biofuels

- Identification of the best bio-energy species with proper propagation and management guidelines
- Identify fast growing tree species for energy production
- The "Jatropha hype phase" is now over and farmers and other actors in the Key issues for investigation include appropriate soils/nutritional requirement, best germplasm (either seed or seedlings) for establishment, and pests and diseases and their control/management practices. Although the seedlings may appear to have advantages as in theory, current observations that require careful seedlings transplantation erode those advantages.
- Further analysis on the economic viability of Jatropha necessary using data collected from scientific trial plots.
- Farmers to be encouraged to produce Jatropha for kerosene substitution. The cottage processing arrangements for bio-fuels modeled along the posho milling model whereby farmers take their seeds for crashing at a fee into bio-fuel for either own use or sale be applied.
- Facilitating framework with government support especially tax reprieves be put in place for producers and processors to encourage production and processing.
- Jatropha production be done as an intercrop with high value crops especially legumes for immediate returns and help cushion producer from high initial investment.
- Value chain are in dire need of technical information backed by research
- Investment opportunities based on best practices for Jatropha and other biofuel crops

- There is need to fast tracking mechanisms for the implementation of the draft biodiesel strategy.

Honey and bee products

- The various universities and other research institutions should be encouraged to carry out research on bee keeping to improve the quality of honey and its products.
- African Beekeeping Resource Centre (ABRC) being established in Kenya as an NGO to work on African beekeeping development.
- There should be a network to enable dialogue among the stakeholders promote African bee products in the markets, promote sufficient supply of bee products, addressing barriers to markets access, ensure good practice and conduct among members and lobbying and advocating building a competitive sector in Africa.
- There should be some policy and legal framework on bee keeping to encourage investors and organizations who would want to invest in this sector.
- Formal trade in honey and other bee products should be promoted by strengthening business relationships between producers and buyers, and strengthening the capacity of the supply chain to comply with market quality requirements.
- The general market information on bee products should reach the farmers as early as possible to enable them improve on the quality of their honey and its products.
- There is need for an effective network for marketing African honey in definite and all stakeholders must agree to the establishment of ApiTrade Africa.
- Those interested in beekeeping should be trained in management, record keeping and farm economics. Such training should be undertaken in groups or honey associations at the community level.
- Provide farmers with technical advice whenever possible in issues related to honey quality, beekeeping techniques and harvesting of honey.
- Give resource support to bee keeping groups in form of bee hives so that they can improve their honey production methods. Modern hives includes the Langstroth beehive and Kenya Top Bar hive. Link beekeeping communities to regional NGOs and marketing groups e.g. Honey Care Africa which markets honey on behalf of member community groups.

5. LIST OF PERSONS INTERVIEWED AND PLACES VISITED

Table 3: Persons interviewed

NO	NAME	INSTITUTION	CONTACTS
1.	Dr. Ben Chikamai	KEFRI-HQS	Email: director@kefri.org Cell phone: 0722756483
2.	Dr. Daniel Nyamai	KEFRI Karura	Email: d.nyamai@kefri.org, d.nyamai@jatropha-foundation.org Cell Phone: 0722726438
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7.	Gitehi Giathi	KEFRI Kitui	Email: ggitehi@yahoo.com Cell Phone: 0727634779
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12.	Albert Luvanda	KEFRI-Marigat	Email: luvandaa@gmail.com Cell phone: 0720 829870
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14.	Peris Kariuki	NMK	Email: Cell phone: 0722 615259
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17.	Chemuku Wekesa	KEFRI Gede	Email: chemuku@yahoo.com Cell phone:0722985279
18.	Nellie Oduor	KEFRI-Karura	Email: nelliecoduor@yahoo.com Cell phone:0722241036
19.	Norman Gachathi	KEFRI-Muguga	Email: fgachathi@yahoo.com Cell phone: 0720400263

6. A prioritized list of areas of intervention and an indication of which areas are the most appropriate for investment by the state, IGAD and other development partners.

Table 4: Prioritized list of interventions and areas most appropriate for investment

Areas of intervention	Most appropriate areas for investment		
	GOK	IGAD	Development partners
Re-emphasize development of the NWFPs in the national forestry plans, enshrined in the cultural heritage, health, food, wildlife and gender empowerment policy plans, the national economic recovery action plan, the strategic rural poverty alleviation schemes, and other established human and development initiatives.	√		
Collaborative resource surveys (particularly in NWFPs endowed regions) to ascertain and identify indigenous (as well as exotic) NWFPs' ecological niches and their potential for promotion.	√	√	√
Build information, seed databases and technological transfer networks among different NWFPs producers and users and to enhance NWFPs development at both the local and national levels.		√	√
Extension education programmes to safeguard, integrate, raise awareness on and transfer existing indigenous NWFPs use-wisdom amongst the different consumers, particularly the youth, Capacity building on micro-credit, entrepreneurial and NWFPs processing skills, hygiene, and bookkeeping.	√	√	√
Legal mechanisms for the standardization and certification of processed NWFPs, with well defined patent rights	√	√	√
Commercialization of NWFPS Germplasm production and exchange			√

7. CONCLUSION

Considering the increasing demand for NWFPs in the face of diminishing forest lands, and pressing calls for human development improvement, adequate investment in innovative research and development is needed for the promotion of local NWFPs forestry, industry, and gene-banks, particularly for the identified species. Implementation of identified domestication options will help to provide rural households environmental, socioeconomic and spiritual benefits and conserve their cultural heritage, climate change management and the fight against biodiversity loss in Kenya, SSA, the developing countries and worldwide.

Efforts to develop the NWFPs industry in Kenya should be re-emphasised in the national forestry plans, enshrined in the cultural heritage, health, food, wildlife and gender empowerment policy plans, the national economic recovery action plan, the strategic rural poverty alleviation schemes, and other established human and development initiatives. At the same time, collaborative resource surveys (particularly in NWFPs endowed regions) are needed in Kenya (where such studies have not yet been done) to ascertain and identify indigenous (as well as exotic) NWFPs' ecological niches and their potential for promotion. This would not only be important for the policy-makers but will also help to build information, seed databases and technological transfer networks among different NWFPs producers and users and to enhance NWFPs development at both the local and national levels.

To safeguard, integrate, raise awareness on and transfer existing indigenous NWFPs use-wisdom amongst the different consumers, particularly the youth, extension education programmes facilitated by the government and interested NWFPs stakeholders are important. As regards efforts being made to strengthen NWFPs development efforts, all future projects on NWFPs development should largely invest (also through affordable micro crediting) in women group's training on entrepreneurial and NWFPs processing skills, hygiene, and bookkeeping.

Finally, there is a need for Kenya and other IGAD countries to consider putting in place legal mechanisms for the standardization and certification of processed NWFPs, with well defined patent rights. Adequate legal protection would safeguard the rights of local people and protect them (and their local knowledge) from exploitation by commercial interests.

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ANNEXES

Annex 1: Plant species, description and key non-wood forest products

Species	Short description	Key Non Wood Forest Products
Osyris lanceolata (Sandal wood)	*Osyris lanceolata* is dioecious (different male and female plants). It is documented that *O. lanceolata* growing in the field is parasitic through root attachments on other trees like *Dodonea viscosa*, *Rhus natalensis*, and *Carissa edulis*. The species has a relatively wide ecological distribution occurring in Eastern and Southern Africa. In Kenya, it grows in Coast, Eastern, Rift valley, Nyanza, Central and Western provinces.	**Essential oils:** Roots and wood are scented and used to make cosmetics and perfume **Others** **Food:** Roots and bark (for tea and as a tonic in soup), Fruits are edible. **Medicine:** Root (to treat diarrhea); plant extracts (cure diseases, including the killer Hepatitis B) **Tannin** (Root**) or dyestuff:** root gives a strong red dye. **Fibre** (root fibres are used in basketry)
Prosopis juliflora	Evergreen tree, a large crown and an open canopy, growing to a height of 5-10 m. Fruit a non-dehiscent pod, straight It is mainly found in Garisa, Tana River, Marigat, Turkana and recently new growths have been observed in Taita Taveta Districts	**Nutritious Pods (Food and fodder)** **Food:** A rich delicious flour from pulverized pods, a flour rich in protein and sugar appropriate for diabetic people from the cotyledons and embryos, preparing bread, sweets, syrup. Sugars and sweeteners can be produced from the pods. **Fodder :**(Flour makes up 40-60% of concentrate rations for dairy cows; Ripe pods contain 12-14% crude protein; short-fibred parts are suitable for pigs and poultry). **Bee forage** (due to the species very copious nectar flow).

		Others **Tannin or dyestuff**: (Yield is only about 10%) **Medicine:** Syrup prepared from pods has various medicinal values (given to children with weight deficiency or retardation in motor development and also believed to increase lactation and syrup used for preparing expectorants.
Gums and Resins resources		
Acacia senegal	Armed, deciduous shrub or small to medium-sized tree up to 15 m tall; bark yellowish-brown to purplish-black. Leaves alternate, bipinnate; stipules minute or absent Main gum producing species is *Acacia senegal* var *kerensis* found mainly in Northern Kenya *in Isiolo,* Turkana, Wajir, Marsabit, Samburu, Garissa, Moyale and Mandera Districts *(ICRAF, 1992)*	**Gum Arabic** in the form of whole, round tears, orange-brown in colour and with a matt surface texture.
Boswelia neglecta	Shrub or, less often, a tree. Leaves: Borne in tufts on small side shoots. Flowers: Greenish white. Fruits: Red, triangular, Is the most widespread among *Boswella spp*, being found in the north west, north, north-east, east and south-east of the country (North Eastern Province, Isiolo, Samburu, Marsabit, Meru National Park, Mwingi/Kitui and Northern Baringo)*(Chikamai, and Kagombe, 2002)*.	Incense from *B. neglecta* is of two types (black and white), in the form of small droplets that harden on exposure to air to form nodules or large lumps **Local uses** – chewed as gum, ground into powder and burnt as incense, local perfumes, medicine for a wide range of ailments. Gift for baby Jesus (Matt 2:11) **Commercial uses** – essential oil used in perfumery, cosmetic industries as well as flavour industries.

Boswellia microphylla	Are confined in Wajir, Moyale and Mandera Districts	**Frankincense(Olibanum**) production
Boswellia rivae	It is found in Mandera District near the Ethiopian border.	**Frankincense(Olibanum**) production
Commiphora myrrha	It is found in Mandera and Wajir Districts. *(ICRAF, 1992)*	**Myrrh** -an aromatic bitter tasting orange colored resin. The gum resin exudate drips and harden to form lumps of varying shapes and sizes. Color variable from red, brown to dark brown; red and brown – best grades
Commiphora holtiziana (Haggar-),	A widely distributed species of the drylands particularly in northern Kenya in *Acacia*	**Oily gum resin exudate** – various sizes and shapes; more oily than myrrh for fresh lumps Color – yellow to dark brown; black lumps common
Key Indigenous Fruits	**Ecology and distribution**	**Key Non Wood Forest Products**
Acokanthera schimperi (A.D. C) Schweinf	A dense round evergreen shrub, spreading sparsely to 7 m high. Found in Muumandu (Machakos), Ongata-Rongai (Kajiado), Rumuruti (Laikipia), Loita, Chepelion in Northern Baringo *(Chikamai et al. 2004)*	**Ripe fruits** edible, sweet with a slightly bitter taste. **Others** Arrow poison, medicine, ornamental
Annona senegalensis	Spreading shrub or small tree to 6 m. In West Africa to Sudan and South Africa. Found in coastal zones, Kitui, Kisii, and Homa bay districts in bushed grassland and forests *(Chikamai et al. 2004)*	**Ripe fruit** edible. **Others** Roots used as medicine, dye from the bark.

Antidesma venosum Tul.	Shrub or less often a small tree to 6 m tall with scattered branches. Boni Forest, Thui Hill (Makueni), Kitui Hills, Nzaui Hills (Makueni) Mavuria (Embu), Central Coast and Nyanza province. *(Chikamai et al, 2004)*	**Edible fruits** **Others** **Dyes (**fruits used as dye or ink). Medicinal
Azanza garckeana (F. Hoffm.) Excell and Hillcoat	Shrub/tree up to 8 m high, crown light spreading, occasionally narrow and high. Found In Ukambani in open bushland and woodland. Common in *Combretum, Terminalia* bushland *(Chikamai et al. 2004)*	**Edible fruits**. **Others** Medicine, bee forage and fodder
Balanites aegyptiaca (L.) Del. (Desert date)	Found in bushland, wooded grassland and open grassland with cotton soils mainly in arid and semi-arid regions to sub-humid savannah Found in agro-ecological zones Lambwe valley and Kaputei plains. *(Chikamai et al. 2004)*	**Ripe fruits** edible, seeds beanlike cotyledons eaten. **Others** Medicine.
Balanites rotundifolia (Van Tiegh.) Blatter	A spiny shrub or small tree to 5 m, crown is usually open. Grows in Turkwel River, Kerio delta, Muthaa Hill and in other parts of the country in dry Acacia-*Commiphora* bushland. *(Chikamai et al. 2004)*	Pulp of ripe orange fruit eaten fresh. Boiled cotyledons eaten, pounded fruit pulp made into local brew. **Others** Medicine(boiled root)
Baobab (*Adansonia digitata)*	Grotesque-looking deciduous tree 15 m, large trunk, twisted branching. It is found in coastal region, Taita, Kibwezi, South East Makueni, dry parts of Kitui, Meru National Park, Torosei in Kajiado	**Indigeneous fruits :** Food (fruit pulp), **Others** Medicine (roots, bark), fodder (leaves, shoots and fruits), bee forage, gum, resins, dyes.
Berchemia discolor (Klotzsch) Hemsley	A more or less evergreen tree up to 10 m high with narrow or rounded crown. *(Chikamai et al. 2004)*	Ripe and unripe fruit eaten whole. **Others** Gum edible, medicine, bee forage, dye.
Borassus aethiopum Mart. (African fan palm)	A strikingly tall unbranched palm to 25 m high. In Kenyan coast at Mandunguru (Kilifi), Gede	**Fruits** edible, seed edible. Excellent palm wine from sap tapped from inflorescence

	ruins, Shimba forest. *(Chikamai et al. 2004)*	stalks. **Others** Medicine, fodder and oil
Boscia coriacea pax	Evergreen, much branched, usually multi-stemmed shrub or small tree up to 6 m high. In in Turkana, Tsavo, Northern province, Maasai, Kilifi, Taita district. *(Chikamai et al. 2004)*	Boiled cotyledons eaten. Ripe **fruit** sucked for sweet taste. **Others** Medicine, fodder.
Bridelia taitensis Vatke and Pax	Much branched, multi-stemmed shrub 2-3 m high. Found in Marsabit, Motomo, Tsavo East national Park. *(Chikamai et al. 2004)*	Fruits are edible. **Others** Medicine
Canthium lactescens (Hiern)	A shrub or small tree to 9 m. Stems thick with short internodes. In Samburu, Siyabei River in Narok, Baringo and West Pokot. *(Chikamai et al. 2004)*	**Fruits** fleshy when ripe and very sweet.
Canthuim glaucum Hiern	A spiny shrub usually 2-4 m high. A spiny shrub usually 2-4 m high. Found in coastal bushland, usually in open places. Marafa and Arabuko Forest (Kilifi). *(Chikamai et al. 2004)*	Ripe **fruits** fleshy sweet and much liked by Miji Kenda.
Cordia monoioca Roxb.	Spreading, much branched bush, shrub or tree to 6 m high. Widely distributed all over Kenya in bushland at 0-2,200 m. *(Chikamai et al. 2004)*	Edible fruits-mucilagous pulp is sweet and gummy. **Others** Medicine, sand paper and bee forage,
Cordia sinensis Lam.	A low leafy shrub or bush, rarely a small tree up to 6 m high, multi-stemmed. Widespread in dry parks of Kenya but absent in Western and Nyanza. *(Chikamai et al. 2004)*	Edible fruits eaten raw. Fruit pulp mixed with tamarind juice fermented to make fresh juice. **Others** Fodder, edible gum, bee forage and fibres.
Dialium holtzii Harms	Tree up to 20 m. Crown with medium spread. At the East African Coast, from Kenya - Tanzania -Mozambique. In Kenya only at the coastal region especially towards Tanzanian border. *(Chikamai et al. 2004)*	Fruits edible, pulp has a sweet to acid taste, used in porridge. Ripe fruits occasionally sold in coastal towns. Fruits may be kept for over 2 years.
Dialium orientale Bak. f.	Spreading, often-multi-stemmed shrub/small	Fruits eaten raw and have a sweet acid

	tree 5 m, rarely to 15 m. Branches drooping, occasionally touching the ground. Grows along the east African coast from southern Somalia to north-eastern Tanzania. In Kenya found in the coastal area at Kwale, Kilifi, Tana River and Lamu *(Chikamai et al. 2004)*	taste. Wood -dhow ribs and building poles Fruits may be kept for over 2 years. Fruits sold in Malindi town.
Dispyros mespiliformis A. DC.	An evergreen tree that grows to 30 m or more. Crown usually narrows dense with drooping smaller branches. In Kitui, Taveta, Meru districts near watercourses. *(Chikamai et al. 2004)*	Ripe fruits sweet. Seeds may be eaten or discarded.
Dovyalis abyssinica (A. Rich) Warb.	A shrub or small tree, often 2.5-5 m but occasionally reaching 9 m. Native to forests of East Africa, particularly in Kenya and Uganda. Found in Mt. Nyiru, South Turkana.	Ripe fruit eaten raw, but very acidic, excellent for making jam. **Others** Medicine-roots, fodder, bee forage
Dovyalis macrocalyx (Oliver) Warb.	A spiny shrub 2-4 m high, less often a tree 6 m high, spines narrow. In Kenya is found along the Mara River, in Uasin Ngishu, West Pokot and Kisumu *(Chikamai et al. 2004)*	Ripe bright red fruit edible. Sour with a slight sweet taste.
Ficus sycomorus L.	A large tree to 20 m with a upright branching habit and a dense or open rounded or occasionally spreading crown.	Figs fleshy, sweet and eaten raw or cooked.
Flacourtia indica (Burm. F) Merr.	A much-branched shrub or a tree to 15 m high with narrow or spreading crown. Widespread in Kenya e.g. at Kacheliba, Chepareria (West Pokot), Thika, Iveti, Karura, Baringo, Nandi and Gede. *(Chikamai et al. 2004)*	Soft, sweet, reddish purple ripe fruit is eaten. Fruits sold in West Pokot **Others** Medicine, fodder, construction, fencing, live fence.
Flueggea virosa (Willd.) J. Voigt	Shrub (rarely a tree) 1-6 m. Fruits 2-3 by 4-5 mm. In Kenya is found in open bushland, bushed grassland. *(Chikamai et al. 2004)*	Ripe wild fruits eaten whole, soft and sweet with bitter taste. **Others** Medicine,
Garcinia livingstonei T. Anderson	Semi-multi-stemmed shrub or tree with narrow crowned branches 3-6 m high, may be up to 15 m. Found along the Athi River, (Mbiuni,	Fruit edible, juicy with sweet acid taste. **Others** Medicinal, fodder

	Machakos) and Kitui Central. *(Chikamai et al. 2004)*	
Grewia bicolor Juss.	Much-branched shrub or tree with light crown and up to 7 m high. Widespread in dry country, common species all over Kenya especially in lowlands in dry bushland, bushed grassland at 300-1,800 m. *(Chikamai et al. 2004)*	Fruits eaten raw, pulp sweet but scanty. **Others** Medicine, fibre.
Grewia tanax (Forssk.) Fiori	Small much branched multi -stemmed straggling deciduous shrub up to 3 m or more. Widely distributed in Kenya except Western part. Found in dry acacia bushland at 0-1250 m above sea level *(Chikamai et al. 2004)*	Ripe and unripe fruits eaten raw. **Others** Medicine, toothbrushes (Maasai), fodder This species is most preferred in dry lands.
Grewia tembensis Fres.	Small-multi-stemmed straggling shrub up to 4 m or more. Widespread in Kenya except western parts. Found in bushland often-riverine at 250-2000 m above sea level *(Chikamai et al. 2004)*	Fruits sweet, juice extracted.
Grewia villosa Willd.	Small deciduous shrub to 3.5 m high often 1.3-2.5 m.	Fruits edible seeds discarded. **Others** Medicine and fodder,
Hoslundia opposita Vahl	Much branched herbaceous shrub often short lived perennial 1-1.5 m. Widely spread in bushland at edges of bush, road sides at 0-2000 m. *(Chikamai et al. 2004)*	Fruit eaten whole, sweet and soft. **Others** Leaves and stems occasionally used for tea, medicine, fodder, brooms.
Hyphaene compressa H. Wendl.	Tree 7- 12 m, trucks solitary or forking below ground. At the coast and inland along seasonal water courses, along Turkwel/Kerio River, Lodwar, Kwale, Kilifi, Malindi. *(Chikamai et al. 2004)*	Brown fibrous pulp of mature fruit eaten raw. Juice from immature plant used for beer making. **Others** Medicine (fruit), basketry (leaves).
Hyphaene coriacea Gaertner	A palm to 8 m high, rarely more than 5 m. In Somalia, Kenya and Tanzania. In Kenya in coastal areas at Diani, Gazi creek, Malindi, sand dunes at Shela, Lamu flood plain.	Dark brown fruit pulp (mesocarp). **Others** Medicine, materials for braiding around skin of containers and thatching. Products

	(Chikamai et al. 2004)	from leaves sold in coastal markets.
Landolphia buchananii Stapf.	An extensive strong-stemmed liana. In Central and Western Kenya. In Karura forest, Thui hills (Makueni), Marsabit, Kisii, Nandi, Uasin Gishu, Baringo and Meru *(Chikamai et al. 2004)*	Ripe fruit eaten sour sweet taste white juicy pulp. Used for making jam. **Others** Medicine, weaving materials, fodder.
Landolphia kirkii Dyer	Shrub or climber 1.5-6 m. In coastal area – Arabuko-Sokoke forest at forest margin in *Brachystegia* woodland and coastal bushland. *(Chikamai et al. 2004)*	Ripe fruit edible. Popular fruit eaten as a snack. Sold in most coastal towns including Mombasa, Malindi, and Kilifi. **Others** Rubber for trapping birds.
Lannea alata (Engl.) Engl.	Much branched spreading deciduous shrub usually 1.5 - 4 m high with drooping branches and spiky appearance. Somalia, coastal, eastern and northeastern parts of Kenya and northern Tanzania. In Kenya found in Nyika. Elwak, Wajir, Mtito Andei, Karura Mutwang'ombe (Kitui). *(Chikamai et al, 2004)*	Fruits edible and much liked. Fruits sold in Mwingi District. **Others** Fdder.
Lannea edulis (Sond.) Engl	Short shrub with underground branches which produce leaves and fruits hardly 30 cm above the ground. East and Central Africa to Mozambique, Angola, and South Africa. In Kenya-Kitale, Soy (Uasin Gishu). *(Chikamai et al, 2004)*	Fruits eaten mainly by children.
Lannea rivae (Chiov.) Sacleux	Shrub /tree 1.5-6 m high with flat spreading, crown. Southern Ethiopia, Kenya and Tanzania. In Kenya at Moyale, Maasai, Machakos, Kajiado in wooded grassland, semi-evergreen deciduous bushes. *(Chikamai et al, 2004)*	Fruit edible but unimportant. **Others** Bark –fibre.
Lannea schimperi (A. Rich) Eng l	Tree to 7 m high. Trunk more than 45 cm in diameter. In Ethiopia-south to Zimbabwe and Mozambique In Kenya, found in Kanzulu Range (Machakos), Wikililye (Kitui), Loima Hills (Turkana). *(Chikamai et al, 2004)*	Fruit edible. **Others** Bark used for tea, medicine, and shade.

Lannea triphylla (A Rich.) Engl.	Deciduous spreading shrub which grows up to 5 m high. Branches flexible. Found at Nginyang (Baringo), Kwale, Ukambani, and Taita. *(Chikamai et al. 2004)*	Ripe fruit edible. Roots from young plants peeled and chewed during dry season. **Others** Weaving materials, fodder.
Lantana trifolia L.	Small much branched shrub usually 1 to 1.5 m high up to 3 m. Common in Kenya highlands at 900-2500 m above sea level. *(Chikamai et al. 2004)*	Fruits edible. Eaten by children. Fruit also used for dyeing paper and fingers by youths.
Maerua decumbens (Brongn) De wolf Family	A small multi-stemmed shrub up to 3m high. Found in Kenya, Uganda, Tanzania, and Somalia, In Kenya at Nginyang (Baringo), Kaputir (Turkana), Muthaa (Kitui) and Marafu (Kilifi). *(Chikamai et al. 2004)*	Ripe fruit edible sucked. **Others** Medicine (roots), fodder, water purifiers and sweeteners (Roots)
Manilkana mochisia (Baker)	Tree 3-6 m high or bushy stunted shrub with open crown often browsed back. In Kwale, Kilifi, Tana River, Kibwezi forest, Mwala, Taita and Lamu in dry deciduous bushland and grassland *(Chikamai et al. 2004)*	Fruit edible when ripe. **Others** Flavours
Meyna tetraphylla (hiem) Robyns	Spiny shrub 2-4 m high with ascending branches and a narrow crown. Found in Endau (Kitui), Kapitir (Turkana), Nginyang (Baringo) and Samburu. *(Chikamai et al. 2004)*	Fruit edible and liked by pastoralists. **Others** Medicine (root concoction given to pregnant women to ease pain).
Momordica rostrata A. zimm	A climbing or trailing plant arising from tuberous rootstock often seed exposed above ground. Found in Elang'ata Wuas (Kajiado), Embu, Machakos and Kwale (Chikamai *et al.* 2004*)*	Ripe fruits edible. **Others** Leaves used as, tuber used as soap.
Moringa oliefera Lam.	Growing at coast, Makindu and drier parts of the country.	Young capsules are delicacy at coast. **Others** Medicine, Seeds (used for water purification, seasoning, edible oil and cosmetics) Fibre.

Moringa stenopetala (Bak.f.) Cuf	Tree up to 9 m high with smooth bark and soft branches found in Baringo, Marsabit, Turkana especially in sandy areas with high water table. *(Chikamai et al. 2004)*	Pod like fruits used as vegetables. **Others** Medicine (Roots) Seeds (for muddy water purification)
Pachystigma schumannianum (Robyns) Bndson and Verdc.	Much-branched narrow shrub up to 3-4 m high with main branches ascending with numerous lateral branches. Found in coastal and south eastern Kenya at Ngong Hills, Masii, Makueni, Kitui, Embu, Tharaka and Taita bushland. *(Chikamai et al. 2004)*	Ripe fruits edible and sweet. Occasionally eaten unripe and seeds discarded. **Others** Smoking stems inserted in milk gourds to impart a good flavour to the milk (Kamba).
Pappea capensis Eckl and Zeyh	Shrub or tree 2-9 m high with dense crown and low drooping branches. Found in Kisamis (Magadi Rd), Likerin (Loita), Juja, Thika, Churo (Baringo), Chepararia (W/ Pokot), Makueni, Machakos and Kitui. *(Chikamai et al. 2004)*	Both ripe and unripe fruits edible. **Others** Medicine, fodder, bee forage and tannin.
Parinari curatellifolia Planch.ex.Benth	Evergreen tree up to 15 m high. Found in Siakago, Wanjare (Kisii), Suna, Lolgorei, Maasai mara, HomaBay, Kuna, and Kwale.	Ripe fruit pulp edible. **Others** Tannin, dye, and fodder
Rhus natalensis Krauss	A shrub or small tree usually 3-5 m high. In Kenya is found in the Chyulu, Mt. Elgon, Ngong Hills, Thui hills (Makueni) Kitui hills, Chepareria (West Pokot). *(Chikamai et al. 2004)*	Fruits edible with a sweet acid taste. **Others** Medicine, dye, bee forage
Rhus tenuinervis Engl	Shrub or tree to 6m branches twiggy, some thornlike. In Kenya is found in Kitui, Embu, Machakos and Kajiado in Combretum bushland. *(Chikamai et al. 2004)*	Fruits eaten mainly by children. **Others** Medicine,
Rhus vulgaris Meilke	Tree usually 3-5 m high. In Kenya is found in Chyulu hills, Mt. Elgon, Ngong hills, Thui hills, Kitui hills. *(Chikamai et al. 2004)*	Fruits edible with a sweet-acid taste. **Others** Medicine (Stems boiled applied to wounds)
Rubus pinnatus Wild	Prickly scrambling shrub. Branches occasionally white armed with hooked prickles. Found in	Fruits are edible and sweet.

	Kenyan riverine vegetation near hillside springs, forest edges	
Saba comorensis (bojer) Pichon	An extensive liana climbing up to the top of trees and capable of creeping over low bushes for over 50 m. In Kenya is found in Thui hills, Nzeeu river (Kitui), Cherengani, Muhoroni, Kahajija, Pengi hill (Kwale), Thiba River. *(Chikamai et al., 2004)*	Fruits edible ripe fruits burst open when pressed. **Others** Weaving materials
Salacia magadigascarensis (Lam) Dc.	Evergreen bush/shrub/liana. Found in coastal area e.g. Diani, Kwale town, Boni reserve, Lamu in bushland dry evergreen coastal forest. *(Chikamai et al. 2004)*	Fruits edible.
Salvadora persica L.	An evergreen bush to climbing shrub, insubstantial tree to 8 m.	Ripe fruits eaten whole, fruits dried and stored for future. **Others** Medicine and fodder,
Sclerocarya birrea (A. Rich)	A deciduous medium-sized tree about 15 m, usually with rather dense rounded crown. Bark is gray cracked. In Kenya e.g. in Lambwe valley, Ruma National Park, Moyale, Ortum (W. pokot) and Baringo. *(Chikamai et al., 2004)*	Ripe fruit eaten raw. Seeds are edible. **Others** Medicine, dye, drink, oil, fodder, bee forage in Tanzania and Eritrea.
Strychnos henningsii Gilg.	Shrub/tree 2.5-12 m. Bark pale grey and rough. Widely distributed in Kenya in dry *Podo carpus* and *Olea* forests, hillsides, riverine vegetation, thickets and Combretum bushland at 0-2300 m.	Fruits used for flavouring beer. **Others** Medicine in Tanzania.
Strychnos madagascarensis Poir	Much branched shrub or small tree to 6 m high. In Kenya and Tanzania. In Kenya at the coast and inland to Makueni district, in coastal bushland. *(Chikamai et al., 2004)*	Ripe orange **f**ruit eaten. Pulp soaked in water to make juice with a sweet to acid taste.
Syzygium guineense (Willd). DC	Tree 4-18 m, evergreen, bark grey or brown flaking in patched. Found in eastern and southern Africa. In Kenya at Nguruman, Kibwezi, Tambach, Churo, Kitale, Nyeri, Kwale	Fruits edible, pulp sweet, could be made to drink. **Others** Fodder in Tanzania.

	in high altitude forest. *(Chikamai et al. 2004)*	
Tamarinus indica	Evergreen tree with thick bole and spreading crown, bark rough, grey-brown. Very common in the drier parts of coast province and along rivers and streams in dry northern and southern parts of the country.	Fruits edible and a pleasant drink, flavouring stews. Fruits sold in Siaya, Lodwar, West Pokot, Baringo, Kitui and coastal towns and in large supermarkets in Nairobi and Mombasa. **Others** Fried seeds eaten. Could be used to prepare jams, sweets, juice. Medicine, dye, tannin.
Uvaria acuminata Oliv.	A shrub or liana 1-6 m high. In Kenya found mainly in the coastal region e.g. at Kiunga (Lamu) in coastal bushland at 0-1400 m. *(Chikamai et al. 2004)*	Ripe fruit eaten raw but the edible portion is scanty. Medicinal
Uvaria scheffleri Deils	Tree or often more a liana 1-4 m. Found in Karura forest, Kibwezi, Namanga, Sigor, Ongata Rongai, Thui Hills, Kitui hills, Kerio valley. *(Chikamai et al. 2004)*	Ripe fruits edible, sweet with an appealing acid taste. **Others** Medicine and weaving materials.
Vangueria infausta Burch. Ssp. *rotundata* (Robyns) Verdc.	A deciduous usually multi-stemmed bushy shrub/tree rarely exceeding 5 m. Widespread in Kenya and Tanzania. In Kenya on the south-eastern slopes of Mt. Elgon, Kibwezi, Machakos, Nairobi. *(Chikamai et al. 2004)*	Ripe fruits relished. Pulp added to milk to feed children (Maasai). Dry fruits stored for over one year without loss of acid taste. Shade, fuelwood, tools, poles, ornamental, browsed by animals
Vitex payos (Lour) Merr	Tree 2-9 m with low rounded crown. *V. payos* is a species of hot, low and semi-arid places with high water table. In more arid zones it is found near rock outcrops. The most commonly associated tree species are *Acacia polyacantha, Dalbergia melanoxylon, Brachystegia spiciformis* etc. It is found in Kitui, Embu, Machakos, Kilifi, Kwale in hot low semi-	**Indigenous fruit** **Food:** The ripe fruit contains a black, mealy and sweet pulp. **Others** **Fodder**: Leaves are used as fodder. **Medicine:** *V. payos* is used as medicine for stomach-ache.

	arid lands *(World Agroforestry Centre and PROSEA network , 2009)*	
Ximenia americana L. (X. caffra Sonder)	Tree/shrub to 6m, branches normally arching down often armed with straight spines. Widely distributed in Kenya e.g. at Madunguni (Kilifi), Kisamis (Kajiado), Nginyang (Baringo) and Kapitir (Southern Turkana). *(Chikamai et al. 2004)*	Fruits edible. **Others** Seed has up to 60% oil for multiple uses. Medicine, fodder, oil for cosmetics
Zanthoxylum chalybeum Engl. Var *Chalybeum snyn. Fugara chlalybea (Engl)*	Shrub/tree 1.5-10 m, evergreen trunk, furrowed with corky knobs or ridged crowned spines. Madunguni (Kilifi), Waita (Mwingi), Mile 46 (Kajiado), Nginyang (Baringo) and Chepereria, *(Chikamai et al. 2004)*	Strongly aromatic leaves and fruits used for flavouring tea. **Others** Medicinal, soap (Mbeere), stoppers for guards, toothbrushes-branches,
Ziziphus mauritiana Lam.	Shrub/tree 2.5-12 m tall, crown spreading, bark grey, branchlets, with pairs of thorns at the nodes.At the coast and northern arid and semi arid areas of Kenya, *(Chikamai et al. 2004)*	Refreshing beverage. **Others** Medicine, dye, bee forage, in Ethiopia and Tanzania.
Dyes and Tannin Resources		
Acacia bussei sjQsted	Shrub or tree 3-10(-16) m, usually flat-crowned and with a well-defined trunk, sometimes branching from the base.(www.prota4u.org) Conservation Status: Not Threatened (www.prota4u.org)	Tannins **Others** ➢ Fodder ➢ Honey ➢ Medicine ➢ Gums (Edible)
Acacia horrida	*Acacia karroo* is an evergreen tree 3-15 m tall, rarely shrubby; bark on trunk dark red-brown to blackish **(**World Agroforestry Centre and	**Tannin or dyestuff:** The bark contains up to 19% tannins, which gives the leather a red colour.

	PROSEA network*, 2009)* Conservation Status: Not Threatened (www.prota4u.org)	**<u>Others</u>** **Food:** gum (eaten); seeds (are substitute for coffee), sweet thorns (chewed by children) **Fodder:** (Foliage, flowers and green pods) **Bee forage** **Fibre:** Root bark (for twine and rope) **Gum or resin:** A. karroo gum is used as a substitute for gum arabic in southern Africa). **Medicine:** A root infusion is taken for pain in the alimentary canal, rheumatism, convulsions, gonorrhea and as an aphrodisiac
Acacia mearnsii	Small to medium-sized evergreen tree up to 30 m tall; trunk straight, up to 50 cm in diameter; bark brownish-black.(www.prota4u.org) A small tree native to Australia where grown in plantations in Kenya. ***(****World Agroforestry Centre and PROSEA network.2009)*	**Tannin or dyestuff:** Wattle bark is the most widely used tannin material in the world. It contains 30-45% (dry basis) high-quality tannins that are used in tanning many classes of skins and hides for many different classes of leather. **Fodder:** The leaves have high protein content (about 15%). **Bee forage:** The extra floral nectaries of A. mearnsii (containing about 20% pollen protein and 40% sugar) and its late flowering makes the tree a suitable bee forage. ***(****World Agroforestry Centre and PROSEA network.2009)*
Acacia melifera	*A. mellifera* is a low, branched tree with a more or less spherical crown. Small, short, sharply hooked spines in pairs. Flowers sweetly scented, especially at night. ***(****World Agroforestry Centre and PROSEA network.2009****)***	**Tannin or dyestuff:** The inner bark contains 18–23% tannin, which is used for tanning and dyeing leather black. Young pods produce a very pale tint in leather, notably goat hides. Extracts from the bark, leaves and pods are used for dyeing

		cotton, silk and leather **Others** **Food:** Gum collected from injured stems is edible and relished by children, animals and birds. **Fodder:** Camels and goats browse the leaves, which are rich in protein, taking them from the shrubs or from the ground. **Bee forage:** The cream/white flowers produce excellent quality honey ('mellifera' = producing honey). **Medicine:** The bark decoction is used for stomach-ache, sterility, pneumonia, malaria and syphilis.
Acacia nilotica	*Acacia nilotica ssp. nilotica* is an evergreen, usually moderate-sized (2.5-25 m) tree with a short, thick and cylindrical trunk. (*World Agroforestry Centre and PROSEA network, 2009)*	**Tannin or dyestuff:** The inner bark contains 18–23% tannin, which is used for tanning and dyeing leather black. Young pods produce a very pale tint in leather, notably goat hides. Extracts from the bark, leaves and pods are used for dyeing cotton, silk and leather. **Others** **Food:** Tender pods and shoots are used as a vegetable, and roasted seed kernels are sometimes used in Sudan for food flavouring. **Fodder:** The crude protein content of the leaves is 14-20%, and 11-16 % for the highly palatable pods. Pods and shoots are used as forage for camels, sheep and goats, **Bee forage:** The fragrant flowers are popular bee forage. **Gum or resin:** *A. nilotica* ssp. *nilotica* is probably the earliest source of gum

		arabic, although this now comes mainly from *A. senegal*. The gum tapped from the bark is used in manufacturing matches, inks, paints and confectionery.
Acacia tortilis	*Acacia tortilis* is a small to medium-sized evergreen tree or shrub that grows up to 21 m tall. (*World Agroforestry Centre and PROSEA network, 2009*)	**Tannin or dyestuff:** The bark is reported to be a rich source of tannin. **Others** **Food:** The Turkana make porridge from the pods after extracting the seed; the Maasai eat the immature seeds. **Fodder:** It is an important source of fodder. Foliage and fruits form important browse. The leaves are fed green as well as dry. **Medicine:** The dried, powdered bark is used as a disinfectant in healing wounds.
Azanza gackeana	*Azanza garckeana* is a deciduous shrub or small, spreading tree, 3-13 m high, with a diameter at breast height of up to 25 cm. The adaptability of *A. garckeana* to various climatic conditions and soil types makes it suitable for planting as a shade tree in most areas. (*World Agroforestry Centre and PROSEA network, 2009*)	**Dyes and tannins** **Food:** Ripe fruit carpels are edible and have an energy content of 8.10 kJ/g. A sweet mucilage comes out when chewed. The fruit may be eaten raw if gathered green and juicy and the rind is peeled off. Boiled, it is widely used as a relish or made into porridge. The leaves make a relish or can be burned to produce salts. **Fodder:** Browsed by game and in the dry season by cattle. **Fibre:** Good quality rope can be made from the fibres of the inner bark. **Medicine:** A decoction is made from the roots and taken orally for painful menstruation and to treat coughs and chest pains. An

		infusion made from the roots and leaves is dropped into the ear to treat earache or taken orally as an antiemetic.
Bixa orellana (Annatto)	*Bixa orellana* is an evergreen shrub or small tree, 2-8 m high; trunk up to 10 cm in diameter. *(World Agroforestry Centre and PROSEA network 2009)*	**Tannin or dyestuff:** The extract from the pigment coating the seeds yields a harmless, non-carcinogenic dye, used as colouring for food, especially dairy products. The dye obtained from the seed is used in manufacturing cosmetics. **Others** **Food:** the thin pigmented pulp covering the seeds is used as a condiment. **Fodder:** Bixa meal, which remains after extraction of the pigment from the seed, is a useful additive to poultry feed and can replace 30% of the maize in the food. However, the seed embryo contains a poisonous alkaloid, so it is not wise to use the residues from the extraction process directly. **Bee forage:** The flowers are a source of nectar for honey. **Gum or resin:** Bark from the branches of the trees yields a water-soluble gum that is similar to gum arabic. **Essential oil:** Seeds contain characteristic pleasant-smelling oil. **Medicine:** Leaves are applied to the head and to sprains to relieve aches; a decoction is gargled as a cure for mouth

		and throat infections.
Cassia abbreviate	Cassia abbreviata is a single-stemmed shrub or small tree 2-15 m with a medium round canopy. C. abbreviata commonly occurs in Acacia-Commiphora bushland, becoming rare in woodland or wooded grassland. ***(****World Agroforestry Centre and PROSEA network, 2009)*	**Tannin or dyestuff:** Stem bark is used in dyeing. **Others** **Fodder:** Young branches are browsed by wildlife, the fruit pulp and seeds are popular with birds. **Medicine:** Root decoction used in treating gastrointestinal disorders, malaria, gonorrhoea, pneumonia, uterus complaints and as a purgative. Stem bark used to treat dysentery, diarrhoea, gonorrhoea, toothache, blackwater fever, abdominal pains and as an abortifacient. Smoke of burnt branches inhaled to relieve headaches.
Commiphora boiviniana	*Commiphora boiviniana* is a small tree 2-10 m tall; bark smooth, pale grey; A variable plant commonly occurring in Acacia-Commiphora bushland (deciduous bushland). *(ICRAF, 1992)*	**Food:** Fruits of subsp. holosericea are edible. **Others** **Fodder:** Foliage browsed by goats. **Gum or resin:** Exudate from stem cuts is fairly scented, sparse or sometimes copious and milky. Sap used as glue for attaching feathers on to arrows. **Medicine:** Bark infusion used to treat malaria. The roots, leaves and stem are used as remedy for stomach ache, menstrual problems and illnesses caused by spirits.
Commiphora campestris var campestris Engl	A tree of *Acacia-Commiphora* bushland or open woodland. It occurs in abundance in the Kibwezi -Taita area, where the two varieties coexist and interbreed.	**Dyes and tannins**

Commiphora holtiziana (Haggar-),	A widely distributed species of the drylands particularly in northern Kenya in *Acacia-Commiphora* bushland. Common around Garba Tula	**Dyes and tannins**
Ekebergia capensis (Kyuasi),	*Ekebergia capensis* is an evergreen or semi-deciduous, medium-sized to large tree, 7-20 (max. 35) m tall. *(World Agroforestry Centre and PROSEA network, 2009)*	**Tannin or dyestuff**: The bark contains 7.23% tannin and is used for tanning leather **Others** **Food:** Although the flesh of the fruit is edible, it is not very palatable. Fodder: Domestic stock and game. **Apiculture:** Trees provide forage for bees **Medicine:** A decoction of the root is said to relieve headaches and chronic coughs; leaves provide a remedy for intestinal worms.
Euclea divinorum	*Euclea divinorum* is a shrub or small tree up to about 6 m tall, often branching from the base or sometimes with a single stem. *(World Agroforestry Centre and PROSEA network, 2009)*	**Tannin or dyestuff:** The bark is rich in phenolics (123 mg/g) and tannins (94 mg/g). The bark extract is used in dyeing baskets. **Others** **Food:** The fruits are edible. In Kenya the bark is used in the preparation of fatty-meat and milk soups. The roots are chewed to impart a red colour to the mouth. **Fodder:** The leaves are browsed by wild animals such as the rhino, giraffe and grey duiker. **Alcohol:** The fruit is used in making beer. **Medicine:** E. divinorum branches are used as chewing sticks for oral care. The fruits are said to be strongly purgative. In Kenya

		the root decoction is used as a purgative and the bark infusion as an appetizer.
Lawsonia enermis L (Elan-), Henna	*Lawsonia inermis* is a much-branched glabrous shrub or small tree 2-6 m in height, which may be spiny A shrub widely distributed from North to West and Central Africa. *(World Agroforestry Centre and PROSEA network.2009)*	**Tannin or dyestuff:** An orange-red dye is made by crushing the leaves and younger shoots to a grey-green powder. The powder is soaked in a mixture of strong tea and lemon juice and is used for decorating hands, nails and feet with patterns. Henna is also used as a hair dye and conditioner as well as a colouring agent for leather and cloth. It may also be used to stain wood **Others** **Fodder:** Leaves of *L. inermis* are browsed by livestock. **Fibre:** In Turkana, Kenya, the stems are used for making fishing baskets. **Medicine:** Roots are regarded as a potent medicine for gonorrhoea and to enhance fertility in women; a decoction of them is considered to be diuretic or for treating blenorrhoea and pectoral for bronchitis.
Terminalia brownii	*Terminalia brownii* is a leafy deciduous tree usually 4-15(25) m high with a rounded, flat topped, spreading crown, and a straight bole. Probably the commonest and most widespread *Terminalia* in kenya. It is planted in Kisumu and Nairobi, (*World Agroforestry Centre and PROSEA network, 2009)*.	**Tannin or dyestuff:** Bark and fruits contain 19% tannin and warrant further investigation for both local and commercial exploitation. A yellow dye comes from its roots. **Others** **Medicine:** The phloem fibres are chewed and the solution swallowed in the treatment of yellow fever, particularly in children. An extract from the leaves is used to treat pink-eye in livestock and a medicine from the bark is used in the local

		treatment of hepatitis. **Fodder:** Leaves are browsed by livestock. Fuel: T. brownii is a good source of timber and charcoal.
Aloes and other dry land medicinal plants		
Aloe turkanensis	A shrub with stems of up to 70cm long. It grows in loose clumps up to 2m diameter. *(Lubia I.K et al 2008)* It *is* mainly found in Baringo, Isiolo, Laikipia, Turkana and West Pokot districts.	**Gum:** Are exploited for their gum. Aloe gum is used for: Purgative, Antibacterial, antiviral products, Hair enrichment, lotions, pharmeceutical industries, drink additives, and tick repellents. The Turkana people of Kenya apply the leaf sap of *Aloe turkanensis* to wounds and as a cure for eye diseases. The juice from boiled roots is added to a drink to induce vomiting, which is said to relieve persistent headaches. The roots are used to flavour beer.
Aloe scabrifolia	A sprawling species, with stems of up to 120cm. It branches from the base to form clumps of up to 3m in diameter. The leaves are borne in a loose rosette, are erect to spreading and often recurved. The inflorescence is up to half a meter tall, with dull red flowers. *((Lubia I.K et al 2008)* *A. scabrifolia* is restricted and occurs mainly in Samburu, Laikipia, Isiolo and Marsabit districts. *(Lubia et a.l 2008)*	Are exploited for their bitter gum. Aloe gum is used for: Purgative, Antibacterial, antiviral products, Hair enrichment, lotions, pharmeceutical industries, drink additives, and tick repellents.
Aloe rivae	A stemless species growing solitary or in small clumps. Older plants have a stem up to 60cm high. Leaves are borne in a dense rosette,	Are exploited for their bitter gum. Aloe gum is used for: Purgative, Antibacterial,

	erect or spreading and slightly recurved at the tips. The inflorescence is much branched up to 75cm high with bright red or yellow flowers. *(Lubia et al. 2008)* The species has restricted distribution in Kenya and occurs in Marsabit district especially in Badha Hurr area. *(Lubia et al. 2008)*	antiviral products, Hair enrichment, lotions, pharmeceutical industries, drink additives, and tick repellents.
Aloe calidophila	A shrub with stems up to 1m high, branching from the base to form clumps. The inflorescence is up to 1.3cm high with bright red flowers. *(Lubia et al. 2008)* *A. calidophila* has restricted distribution and is mainly found in Marsabit, Wajir and Moyale districts. *(Lubia et al. 2008)*	Are exploited for their bitter gum. Aloe gum is used for: Purgative, Antibacterial, antiviral products, Hair enrichment, lotions, pharmeceutical industries, drink additives, and tick repellents.
Aloe vera	Succulent perennial herb up to 160 cm tall, without stem or with a short stem up to 30 cm long, freely suckering and forming dense groups. *(www.prota4u.org)*	**Medicine:** *Aloe vera* is a well-known medicinal plant widely used in modern herbal practice It is furthermore used as a hair wash to promote hair growth and against dandruff, and as a general cosmetic to improve the complexion and to smooth the skin. **Food supplement:** *Aloe vera* gel is said to facilitate digestion, and to improve blood and lymphatic circulation, as well as kidney, liver and gall bladder functions The gel is used in the manufacture of commercial jellies, drinks and ice-cream. A novel application of gel powder is as a 1% addition to concrete, which gives the reinforcing steel better resistance against corrosion. *Aloe vera* is often grown as an ornamental in gardens or pots.

Aloe ferox	Succulent shrub up to 3(–5 m) tall; stem solitary, up to 30 cm in diameter, rarely branching from above the base, with persistent dead leaves.(www.prota4u.org)	**Medicine:** Gel from the core of the leaves has a similar use as the gel from the leaves of *Aloe vera* (L.) Burm.f. and is used to treat skin afflictions (burns, wounds, abrasions, irritations), and is applied as a poultice on contusions or as a general refrigerant. It is furthermore used as a hair wash to promote hair growth and against dandruff and as a cosmetic to improve the complexion and to smooth the skin. Aloe gel is also widely used as a hydrating and skin-protecting agent in creams and liquids such as sun lotion, shaving cream, lip balm and healing ointments.
Acacia seyal Del.	A small to medium-sized tree, growing to 17 m tall, crown is umbrella shaped. (*World Agroforestry Centre and PROSEA network, 2009).* It is one of the most common trees in the savannah and often occurs as a pure forest over quite large areas of country. Frequently, it grows in groups or patches, sometimes of considerable size, in areas inhabited by A. senegal. (*World Agroforestry Centre and PROSEA network, 2009).*	**Medicine:** The bark, leaves and gums are used for colds, diarrhoea, hemorrhage, jaundice, headache and burns. **Food:** Gum talha from A. seyal is eaten when fresh, although it has slightly acid taste **Fodder:** The bark is extensively used for feeding cattle, sheep and goats during the dry season. When fresh, it is smooth and relatively soft. In February to March (the dry season in Kenya) thick branches are lopped and animals browse the bark and eat the leaves, which are relatively few at that time. The pods and leaves are nutritious and palatable to livestock. **Bee forage:** Its yellow fragrant flowers yield a white-coloured honey with mild aroma. **Tannin or dyestuff:** Pods and bark contain 20% tannin.

Acalypha fruticosa Forssk.	An aromatic shrub up to 4 m tall. Stems pubescent and greenish at first, later glabrescent and reddish-brown.	• It is eaten as a vegetable. • It is also an important browse plant for sheep. • In East Africa and southern Africa it is used as a medicinal plant. The Suiei hunter-gatherers of northern Kenya boil the root in goat bone soup and drink the soup to treat liver problems, and stomach-ache caused by eating too much honey. • In northern Kenya arrow shafts and beehive lids are made from the stem.
Agave sisalana Perrine	Succulent shrub with thick, sword-shaped leaves in a basal rosette. Suckers from the base. Flowering pole 5-6 m tall. Inflorescences: Flowering pole 5-6 m tall. (www.prota4u.org). Grown in gardens, in plantations and also in landscaping cultivation.	**Antibiotics, haemolyses**: Extract of the plant have given negative antibiotic tests **Materials fibres:** Sisal fibre is mainly used to make twines, ropes, strings, fishing nets and hammocks. Sisal fibre is also woven into material for carpet-backing, sacks, industrial fabrics and matting and is used as padding in cars and upholstery **Nectar source:** Sisal is a valuable bee plant because of its irregular and long lasting flowering periods and is of great attraction especially during times of pollen shortage. It provides sufficient nectar for stimulating brood rearing. The honey is however dark and of strong and unpleasant flavour
Ajuga remota Benth	Cultivated as a traditional medicinal plant in the Eastern Ethiopian Highlands.	The herb is used for diabetes, hypertonia and anthrax.
Albizia amara (Roxb.) Boiv	A small to moderate-sized, much-branched deciduous tree with smooth, dark green, scaly bark. (*World Agroforestry Centre and PROSEA network, 2009).*	**Food:** Leaves are used as an adulterant for tea. **Fodder:** The leaves make excellent fodder. Fuel: The branches are suited to

		both firewood and charcoal. **Tannin or dyestuff:** Tannins may be obtained from the bark. **Medicine:** The tree yields a gum used against ulcers; fruits are said to cure malaria and coughs.
Albizia anthelmintica Brongn.	A thorny/spiny, deciduous, multi-stemmed, medium canopied tree growing to about 8m. Bark smooth, gray to brown. (*World Agroforestry Centre and PROSEA network, 2009).*	**Food:** *R*oots are commonly used as additive in meat and milk based soups. **Fodder:** Pods, leaves and shoots are browsed by animals. **Medicine:** The stem bark is widely used as a purgative and anthelmintic.
Aloe secundiflora Engl.	Stemmless species growing solitary or sometimes suckering. Older plants may have stems up to 30cm long. *It is* highly hybridized and some of the hybrids are source of the commercial aloe gum especially in Kwale, Kilifi and Taita-Taveta districts.	**Medicine:** The leaves of *Aloe secundiflora* are applied to wounds to assist healing. The leaf sap is drunk as an appetizer and anti-emetic. Diluted leaf sap is drunk as a cure for malaria, typhoid fever, diarrhoea, oedema, swollen diaphragm, nosebleed, headache, pneumonia, chest pain and as a disinfectant. The basal parts of the leaves are used in the fermentation of local beer by several tribes in East Africa. The plant is sometimes added as an ingredient to Acokanthera schimperi (A.DC.) Schweinf. or Adenium obesum (Forssk.) Roem. and Schult. for arrow poison in Kenya. Two products from *Aloe secundiflora* can be used commercially in the manufacture of medicinal and cosmetic preparations. One is the gel from the centre of the leaf, and the other is the exudate from longitudinal vessels situated at the outer

		sides of the vascular bundles of the leaves. In Kenya only the exudate is harvested, as it can be processed easily into a solid material suitable for trading, known as 'bitters'. Most of the material harvested in Kenya is exported. One small factory in Kenya uses *Aloe* in the manufacture of bathing soap and a crude medicine for abdominal pain. Large-scale Kenyan producers of cosmetic products import gel of *Aloe vera* (L.) Burm.f. **Ornamental:** *Aloe secundiflora* is planted as a garden ornamental in tropics and subtropics. In East Africa farmers sometimes plant *Aloe secundiflora* as a live fence.
Antidesma venosum Tul	Leaves: Large, elliptic, densely hairy and light green to reddish brown beneath. Height: 4-5 m, sometimes 7 m. (www.prota4u.org)	**Medicines:** Tea made from leaves for stomach troubles. Bark, leaves, fruit, roots: Used for stomach complaints. Leaves, leafy stems, roots, : Used to to treat abdominal pains **Tannins dyestuffs:** Fruits used by children as dye or ink (Makueni). The writing fades slightly from blue-purple to light reddish purple after some time.
Azadirachta indica A. Juss.	A small to medium-sized tree, evergreen, up to 15 m tall,; bark moderately thick, with small, scattered tubercles (*World Agroforestry Centre and PROSEA network, 2009)*.	**Food:** Fruits are eaten fresh or cooked, or prepared as a dessert or lemonade-type drink. The young twigs and flowers are occasionally consumed as vegetables. **Fodder:** The leaves, though very bitter, are used as a dry season fodder. *A. indica* fruit is an important source of food for some wildlife, especially birds and bats,

		although they digest only the pulp, not the seed. **Gum or resin:** An exudate can be tapped from the trunk by wounding the bark. **Tannin or dyestuff:** Tree bark contains 12-14% tannins. This compares favourably with conventional tannin chemicals. **Lipids:** *A. indica* oil has long been produced on an industrial scale for soaps, cosmetics, pharmaceuticals and other non-edible products. The seed oil yield is sometimes as high as 50% of the weight of the kernel. **Medicine:** Neem has proved effective against certain fungi that infect humans. In a laboratory study, neem preparations showed toxicity to cultures of 14 common fungi. The tree has suppressed several species of pathogenic bacteria, including *Salmonella typhosa* and *Staphylococus aureus.*
Boscia coriacea Pax	It usually grows in very arid sites such as hills, laterite outcrops and cliffs, and sometimes dry riverbeds. (*World Agroforestry Centre and PROSEA network, 2009)*.	**Medicine:** Bark is applied on swollen feet, for kidney pains and stiff neck, roots for chest pains, fruit as a laxative. Pounded leaves are used as tonic for horses and camels. **Food:** Fruit and seeds are edible after cooking. **Fodder:** The foliage is consumed by camels and small livestock, especially at the time of flowering and towards the end of the dry season.
Carissa edulis (Forssk.) Vahl	It is a spiny, much branched, small tree, shrub or scrambler, up to 5 m in height, with a milky	**Medicine:** Roots contain an active ingredient, carissin, that may prove useful

	sap.	in the treatment of cancer. The twigs contain quebrachytol and cardioglycosides that are useful as an anthelmintic against tapeworm. An infusion of roots along with other medicinal plants is used for treating chest pains, and a root decoction is also used for treating malaria. **Food:** Fruits are sweet and pleasant to eat. Vinegar can be made from them by fermentation; in Sudan and Kenya, they are made into a jam. The roots are put into water gourds to impart an agreeable taste and are added to soups and stews for the same reason. **Fodder:** Goats and camels in the dry parts of Sudan browse on C. edulis. **Poison:** In Kenya, a piece of the root is fixed into a hut roof as a snake repellent.
Commiphora erythraea Engl.		**Essential oils:** Sesquiiterpenoid components of ***C. erythraea***, include -bisabolene, ar-curcumene, -santalene and humulene. Moyler and Clery (1997) report 228 components in the oil of ***C. erythraea*** var. ***glabrescens*** of which they identify 13, with tr--ocimene (26.2%), -santalene (14.2%) *cis*- and *tr*-bisabolene (14.2%) being stated as the major components.
Croton megalocarpus Hutch.	A large tree up to 30 m tall with a spreading crown, monoecious or dioecious. Bark and twigs pale grey or brown (*World Agroforestry Centre and PROSEA network, 2009).*	**Medicine:** Seed contains up to 32% oils, which have been used favourably as medicine. Bark decoction is used as a remedy for worms and whooping cough. **Fodder:** The seed is incorporated in poultry

		feeds, as its protein content is high (50%). **Bee forage:** This species produces a dark-ambered honey with strong flavour.
Ficus sycomorus L.	*Ficus sycomorus* is a large, semi-deciduous spreading savannah tree, up to 21 (max. 46) m, occasionally buttressed.	**Medicine:** The bark is used for the treatment of scrofula, coughs, and throat and chest diseases. The milky latex is used for treatment of dysentery and chest diseases, or is applied to inflamed areas, while ringworm is treated with the bark and milky latex. Leaves are said to be effective against jaundice and as an antidote for snakebite, while the roots have laxative and anthelmintic properties. **Food:** Mature fruits are eaten fresh, stewed, or dried and stored for later use. Fruit can also be used for the preparation of an alcoholic beverage. Leaves are used in soups and groundnut dishes. **Fodder:** Leaves are a much-sought fodder with fairly high nutritive value (9% crude protein and 7 mJ/kg net energy dry matter); they are valuable fodder in overstocked semi-arid areas where the trees occur naturally. Fruits are eaten by livestock, wild animals and birds **Fibre:** Inner part of the root used as weaving fibre, and a strong rope can be made from the inner bark.
Ricinus communis L.	Evergreen, glabrous, soft-woody shrub or small tree, often grown as an annual, up to 7 m tall.	**Castor oil:** Castorbean is cultivated for the seeds which yield a fast-drying, non-yellowing oil, used mainly in industry and medicines. Oil used in coating fabrics and other protective coverings, in the manufacture of high-grade lubricants,

		transparent typewriter and printing inks, in textile dyeing **Medicine:** The oil and seed have been used as folk remedies for: warts, cold tumors, indurations of the abdominal organs, whitlows, lacteal tumors, indurations of the mammary gland, corns, and moles,
Salvadora persica L.	It is an evergreen shrub or small tree to 6-7 m; main trunk erect or trailing with profusely branched, wide crown of crooked, straggling and drooping branches. *(World Agroforestry Centre and PROSEA network, 2009)*. Found in arid lands of Kenya : Mwingi District	**Food:** Fruits have a sweet, agreeable, aromatic, slightly pungent and peppery taste. They can be eaten raw, cooked, or dried and stored. Fermented drinks are also made from the fruit. **Fodder:** Leaves and young shoots are browsed by all stock, but normally cattle do not occur in the driest part of the S. persica distribution range and hence it tends to be valued more as a camel, sheep and goat forage. **Bee forage:** *Salvado persica* is reported as a good source of nectar. **Gum or resin:** Resin that drips from the tree is supposedly useful for making varnish. Lipids: Seeds of *S. persica* contain 30-40% of greenish-yellow, non-edible oil that has over 50% lauric and myristic acids. It has a high melting point and a disagreeable odour that disappears on purification. The most important aspect of the oil is the presence of a low percentage of C8 and C10 fatty acids that are of great economic significance. The oil is an alternative source of oil for soap and detergent industries.

		Medicine: Toothbrushes made from roots and small branches of about 3-5 mm diameter have been used for over 1000 years, especially by Islamic populations in India, Arabia and Africa. Several agents occurring in the bark and wood have been suggested as aids in prevention of dental caries, such as antimicrobial agents that suppress bacterial growth and the formation of plaque. The tooth stick is also said to relieve toothache and gum disease. Roots also are used for cleaning teeth and for relieving toothache. Decoctions of leaves are used as a mouthwash, and masticated leaves for tooth and gum problems. A decoction of the root is used to treat gonorrhoea, spleen trouble and general stomach-ache. Roots are also used for chest diseases or pounded and used as a poultice to heal boils. The bark is scratched and the latex used for treating sores. Seeds are used as a tonic, and seed oil is used on the skin for rheumatism.
Sclerocarya birrea (A. Rich.) Hochst.	It is a medium to large tree, usually 9 m tall, it is single stemmed with a dense, spreading crown and deciduous foliage. (*World Agroforestry Centre and PROSEA network, 2009)*.	**Medicine:** Bark of *S. birrea* is used to treat a variety of ailments, notably fever, boils and diarrhoea. **Food:** All parts of the fruit of S. birrea are edible. The vitamin C content of the fruit is 54 mg/100 g, which is 2-3 times that of the orange. The seeds are high in fat (56-61%), protein (28-31%), citric acid (2.02 %), malic acids and sugar, phosphorus, magnesium, copper, zinc, thiamine and nicotinic acid.

		The pulp can be consumed raw or boiled into a thick, black consistency and used for sweetening porridge. The fruit is an excellent conserve and makes a delicious amber-coloured jelly. **Fodder:** The fruits are eaten by cattle and goats and a wide variety of game animals, **Fibre:** A relatively good quality rope can be made from the inner bark. **Gum/resin:** The gum that exudes from the tree is rich in tannin and is sometimes used in making ink by dissolving it in water and mixing in soot. **Tannin or dyestuff:** Bark contains 20.5% tannin and some alkaloids.
Strychnos henningsii Gilg	It is a small erect, much-branched tree, 2-12 m tall with a clean green-reddish stem. *(World Agroforestry Centre and PROSEA network, 2009).*	**Medicine:** It is used as traditional medicine to treat various ailments including rheumatism, syphilis, gastrointestinal disorders (purgative) and snake bites. The ground bark is a mouth antiseptic and applied onto wounds in cattle and horses to hasten healing. **Food:** In East Africa S. henningsii is used in the preparation of fatty-meat and milk soups.
Vernonia amygdalina Del.	*It* is a bushy shrub or well-formed tree up to 7 m in height. *(World Agroforestry Centre and PROSEA network, 2009).*	**Medicine:** An infusion from the roots is given to children suffering from infection by a trematode (Enterobius vermicularis). A cold infusion of the root bark, together with other plants, is given in daily doses to treat bilharzia. The bark and root are taken as a tonic by people suffering from fevers; leaves are also pounded, the juice

		extracted and drunk for fever. The leaves are pounded and mixed with warm water for bathing to treat spots on the skin and nausea. **Food:** Leaves, although rather bitter to taste, are eaten as raw vegetables. 'Chewsticks' from the roots and twigs are regarded as an appetizer. **Fodder:** Produces a large mass of forage from the leaves and shoots and therefore is a good fodder species. **Bee forage:** Produces very light, fine flavoured honey.
Warburgia ugandensis sprague	*It* is a spreading evergreen tree 4.5-30 m tall, 70 cm in diameter (*World Agroforestry Centre and PROSEA network, 2009)*.	**Medicine:** Dried bark is commonly chewed and the juice swallowed as a remedy for stomach-ache, constipation, toothache, cough, fever, muscle pains, weak joints and general body pains. It is also effective in powdered form for treating the same diseases. Fresh roots are boiled and mixed with soup for the prevention of diarrhoea. Leaf decoction baths are used as a cure for several skin diseases. The inner bark is reddish, bitter and peppery and has a variety of applications. It provides treatment for the common cold; dried and ground to a snuff it is used to clear sinuses; and it is chewed, or smoke from the burning bark inhaled, as a remedy for chest complaints. The bark, roots or leaves can be boiled in water and the decoction drunk to treat malaria, but this causes violent vomiting.

		Food: Fruit edible; all parts have a hot peppery taste. The leaves and seeds are sometimes used to add flavour to curries. **Fodder:** Leaves, pods and seeds are fed to livestock. Fuel: The wood has a high oil content and burns well with an incense-like smell. **Gum or resin:** The resin is used locally as glue to fix tool handles.
Zanthoxylum chalybeum Engl	It is a deciduous spiny shrub or tree up to 12 m, crown rounded but open. (www.prota4u.org)	**Medicine:** Bark extracts are said to cure malaria. **Food:** When dried, the leaves can be brewed to make a kind of tea. **Fodder:** The leaves and fruit are eaten by goats throughout the year. The branches are sometimes lopped for feed.
Biofuel crops		
Jatropha curcas	It is a perennial, monoecious shrub or small tree up to 6 m high(www.prota4u.org)	**Biofuel:** Oil – Raw material for industrial use ➢ Ornamental plant ➢ Potential as medicinal plant ➢ Raw material for dye ➢ Enrichment of Soil ➢ Potential as insecticide/pesticide

Annex 2: Key actors, Associations and Community groups involved in the NWFP value chains

COMMODITY	KEY ACTORS/ASSOCIATIONS/COMMUNITY GROUPS	CONTACTS/Contact person
GUMS AND RESINS	Kenya Forestry Research Institute	Meshack Muga- Tel: +254 722 237193 Email: meshackmuga@hotmail.com, meshackmuga@ngara.org
	Kenya Forest Service	P.O Box 30513-00100 Nairobi Kenya Tel: +254 (0) 20 2396440 +254 715 735555, +254 715 736262 Email: info@kenyaforestservice.org
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	Ewaso Ngiro North Development Authority (ENNDA)	Eng. Mulwa-0712885447
	Gum Arabic and Resin Association of Kenya (GARA)	Mr. Quresh: quresh@africaonline.co.ke, +254 722-718290 Mr. Robinson Ng'ethe-0717262301
	German Technical Cooperation (GTZ)	Kenya-Africa Head Office P.O. Box 41607 Kilimani 00100 Nairobi Email: gtz-kenia@gtz.de Tel: +254 20 4228000
	Centre for Training and Integrated Research for ASAL areas (CETRAD)	
	African Wild Life Foundation (AWF)	African Wildlife Foundation

		Ngong Road, Karen P.O. Box 310, 00502 NAIROBI, KENYA Tel: +254 20 2765000 Fax: +254 20 2765030 africanwildlife@awfke.org
	Gum Arabic and Resin Association of Kenya (GARA Members)	
	Vetochem Ltd.	sadqa@africaonline.co.ke, +254 723-972442
	Elegant Trading Co. Ltd.	quresh@africaonline.co.ke, +254 722-718290
	Kenya ASALs Resources Agency Ltd.	abeysomo@yahoo.com, +254 720-684056
	Vetochem Ltd.	ad_arif@hotmail.com, +254 733-720066
	Arid Lands Resources Limited	leete@wananchi.com
	Isiolo traders	
	Nantudo gums and resins	c/o Abdi somo, 0720 684056
	Chumvi yare gums and resins	c/o Abdi somo, 0720 684056
	Daaba gums and resins	c/o Abdi somo, 0720 684056
	Samburu traders	
	Sereolipi group	c/o Pauline Lemalasia 0727790716
	Marsabit traders	
	Merrile gums and resins	c/o Lekilio, 0728 556450
	Umoja gums and resins	c/o Fatuma Letaraya, 0720 891298
	Dukana gums and resins	c/o Abdi somo, 0720 684056
	Moyale	

	Dabell gums and resins	c/o Mohsmed Dika, 0728 307426
	Turkana	
	Kaakong gums and resins	c/o Abdi somo, 0720 684056
	Namoruputh gums and resins	c/o Abdi somo, 0720 684056
	Kaaleng gums and resins	c/o Abdi somo, 0720 684056
	Mandera	
	Rhamu gums and resins	c/o KFS Zonal Manager, Mandera Mohamed Adan 0720 805684
	Sake gums and resins	c/o KFS Zonal Manager, Mandera Mohamed Adan 0720 805684
	20 gums and resins traders in Wajir	c/o Ambia Osman, KFS Zonal manager, Wajir, 0720 969074
ALOES	The Baringo Aloe Bio-enterprise (Baringo)	Mr. Kimuge, 0721 359751 P.O Box 66-20105, Mogotio, Kenya Email: baringoaloe@gmail.com, info@baringoaloe.org Website: www.baringoaloe.org
	Wilson Chebungei farm at Loruk	c/o Martin Welimo-0720 531655 KEFRI Marigat
	Kieni Aloe Plantation (Laikipia/Nyeri)	Mr. Maina-0722 536376 Mrs Hilda-0722 239025
	Gede Aloe Growers (Malindi)	c/o Florence-0723 655506 KEFRI Gede
	Kwale Aloe Growers (Kwale	c/o Gilbert Imbwanga-0720 226267

		KFS, Zonal manager Kwale
	Pwani Aloe Processors	Hamisi-0727941032
	Equator Conservation Group (Baringo/Koibatek)	c/o Martin Welimo-0720 531655 KEFRI Marigat
	Taita Aloe Growers(Taita Taveta)	Mrs Madoka- 0725 711738
	The Kenya Aloe Working Group (KAWG)	P.O Box 10400, Nanyuki Tel: 062-32165 Email: herbal_allied@yahoo.com
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	Aloe Processors Association-Coast	c/o Florence-0723 655506 KEFRI Gede
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	Tesia Isanga Organization(T.I.O)-Taita	0735 759260, 0725 5711738, 0733 717270
	Turkana Women Group-Loima in Lodwar	0724 466982
	Kenya Wildlife Service (KWS)	Mr. Kavaka Watai 0722 389819
	National Museums of Kenya (NMK)	Lusweti A.M.
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	Kenya Forest Service (KFS)	Mr. Clement Ngoriareng Email: Ngoriareng@yahoo.com Cell phone: 0720 223201
	Kenya Plants Health Inspectorate Services	Dr. Joseph Ahenda

	(KEPHIS)	
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	Action Aid	Jean Njeri Kamau Country director AACC Building, Waiyaki Way P.O Box 42814-00100, Nairobi Tel: 254 (20) 4440444/4/9 Fax 254 (200 4445843
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	World Agroforestry Centre (ICRAF)	World Agroforestry Centre (ICRAF) World Agroforestry Centre (ICRAF) PO Box 30677, 00100 GPO Nairobi, Kenya Nairobi, Kenya
HONEY AND BEE PRODUCTS	Kapkuikui self help group at Loboi	C/O NALEP officers-Mr. Mureithi-0712951518; Mr. Ruto-0721311323 and Mr.

		Matetei-0721559217
	Mogoswok honey self help group at Kibingor	C/O NALEP officers-Mr. Mureithi-0712951518; Mr. Ruto-0721311323 and Mr. Matetei-0721559217
	Kamache honey self help group at Sabor	C/O NALEP officers-Mr. Mureithi-0712951518; Mr. Ruto-0721311323 and Mr. Matetei-0721559217
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	Chairman of Herbal Practitioners in Nairobi.	Dr. Maina/ 0722 827199, foratramintl@yahoo.com
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	Ufanisi representative	Beatrice Siza
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	St. Mary's Clinic-Matore	Mary Muga-0721847660

Annex 3: LOGICAL FRAMEWORK MATRIX OF PROPOSED PRIORITY ACTIVITIES

Objectives and outputs	Intervention Logic	Objectively verifiable indicators of success /achievement	Source and means of verification	Assumptions
Overall Objective (Impact)	The participating local communities are successfully assisted in improving local livelihoods, food security, alleviating poverty and promoting environmental good governance through the sustainable production and commercialization of non timber forest products in the ASALs."	Rise in living standards and increased income of rural households from NWFPs Lessons learnt disseminated and adopted by other communities and countries	Project reports Review and other reports Relevant networks utilizing Project experience and providing visibility	Kenya economic growth trends are maintained Rural households continue to engage in forestry activities Political situation remains relatively stable and does not affect project implementation substantially Natural disasters (famine, flooding, drought) do not occur
Project purpose (Outcome)	The capacity of key stakeholders in the country for sustainable production and commercialization of non wood forest products in arid and semi-arid areas with a view to improve livelihoods, fight poverty, improve food security, and promote environmental good governance is increased	• Improved production and commercialization of NWPS in pilot districts by 10 % as compared to baseline • NWFPs business opportunities identified in all pilot areas • At least two new NWFPs developed and marketed • Information on production, processing, value addition, marketing and value chains of Key NWFPS generated and packaged • A national resource centre established and	Project Technical Reports Annual reports Final evaluation report	• Government maintains commitment to Vision 2030, • Government continues to support development in the forest sector in general and

		information dissemination on NWFPS enhanced • Relevant policy frameworks harmonised, approved and implemented • Capacity of at least 2 Key institutions dealing with NWFPs strengthened		have increased interest in supporting NWFPs • Private sector sees viable business opportunities in NWFPs • The incentive framework is sufficient to motivate communities and individuals in sustainable production and commercialization of NWFPs
	Intervention Logic	**Objectively verifiable indicators of success /achievement**	**Source and means of verification**	**Assumptions**
Out put 1	Conservation, production and domestication of NWFPs resources using appropriate technologies improved	➢ At least 4 pilot Districts Selected from promising agro-ecological pilot sites in ASALs ➢ Socio-economic characterization and market analysis of all the selected pilot sites carried out ➢ An appraisal of appropriate methodologies and technologies carried out ➢ Suitable germplasm for the selected commodities secured from within and without the country	Reports Germplasm	Communities willing to provide land and participate Germ plasm available

		➢ Production and domestication of selected NWFPs using suitable germ-plasm and appropriate technologies piloted in at least 50 % of the pilot Districts		
Output 2	Value addition, Product development and improved market access and trade of selected dryland NWFPs promoted	➢ Vale chain analysis of selected NWFPs established ➢ Existing processing technologies and practices reviewed and appraised ➢ At least 2 sound technologies sourced, pre-tested validated and incubated for adoption ➢ Quality control, certification, packaging and branding of new products promoted ➢ At least 30 associations/ entrepreneurs adopt new or improved technologies and are linked to appropriate markets ➢ At least 90 subject matter specialists trained as TOTS and provide training to at least 30 groups on improved or new technologies	Reports	New technologies available and accessible Infrastructure available to facilitate trade Intermediary trading institutions emerge in response to perceived market demands Entrepreneurs willing to adopt new or improved technologies
Output 3	Information dissemination and technology transfer within the country as well as linkages with regional and international networks enhanced	➢ The capacity of the national focal point in information dissemination Strengthened by establishing a resource centre at KEFRI Karura to serve as a regional hub and national depository of information. ➢ Information dissemination plan for the country developed based on the regional plan ➢ Resource inventory and mapping of at least 3 key NWFPs carried gum	Resource centre Reports Information dissemination plan Maps Database	Effective communication skills available Sufficient funds are available for resource inventory and mapping

		➢ A national NWFPS databases developed based on regional guidelines ➢ Relevant Kenyan web page updated and linked to relevant websites ➢ Information dissemination products (e.g. flyers, newsletters, outreach materials, books, documentaries and related audio visual products) products ➢ Capacity building on information dissemination carried out for key stakeholders	Websites Information dissemination products Training reports	
Output 4	Relevant policy frameworks harmonised and institutional capacity of key partners strengthened	➢ Existing policies and strategies on dryland NWFP resources appraised, and reviewed ➢ Stakeholders workshops held to elaborate effective mechanisms of community engagement and ownership to facilitate implementation of policies ➢ Feed back obtained from stakeholders and policies and strategies updated, harmonized and approved.	Reports	Sufficient political will exists to harmonise policies and strategies relevant to NWFPs
Output 5		➢ Formation and capacity building of at least 20 NWFPs producer associations supported ➢ Human resource capacity enhanced through local and international training for policy makers, technical staff, extension staff, and local communities. ➢ Exchange visits and study tours promoted at national and regional levels (policy makers, technical staff, extension staff, producers and traders) ➢ Key equipment and facilities provided for selected local and national institutions	Registration certificates Training reports Equipment	Service providers can be identified that can cover the broad range of the training requirements