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Private forestry sector in Kenya: status and potential

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Private forestry sector in Kenya: status and potential

Dr Joshua Kiplongei Cheboiwo

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Acronyms and Abbreviations

AFF	African Forest Forum
KFS	Kenya Forest Service
MEWNR	Ministry of Environment, Water and Natural Resources
KEFRI	Kenya Forestry Research Institute
ENSDA	Energy for Sustainable Development in Africa
NGO	Non-Governmental Organization
CPA	Charcoal Producers Association
PELIS	Plantation Establishment Livelihood Improvement Scheme
MF&W	Ministry of Forestry and Wildlife
UNESCO	United Nations Scientific and Cultural Organization
USD	United States Dollar
DRC	Democratic Republic of Congo
ASALs	Arid and Semi-Arid Lands
ILO	International Labour Organization
EMCA	Environmental Management and Coordination Act
KWS	Kenya Wildlife Service
FOMAWA	Friends of Mau Watershed
TMA	Timber Manufacturers Association
MF&W&MFA	Ministry of Forestry and Wildlife and Finland Ministry of Foreign Affairs
CAP	Charcoal Producers Association
KWPA	Kenya Wood Preservers Association
KEFGA	Kenya Forest Growers Association (KEFGA)
SAPs	Structural Adjustments Programmes
Sida	Swedish International Development Cooperation Agency
UNDP	United Nation Development Programme
UNEP	United Nation Environmental Programme
UN-REDDP	United Nation Programme on Reducing Emissions from Deforestation and Forest Degradation

Executive Summary

The primary production in Kenya takes place in public plantations, farm forests, community forests and private forests. Public natural forests are mostly managed for protection and biodiversity purposes with some minimum controlled extractions for non-commercial uses, mostly by forest adjacent communities. The largely community forests/woodlands, mostly located in the ASALs, are the largest in terms of area standing at 24,510,000 hectares; second is farm and private forests estimated at 10,385,000 hectares, located in agricultural landscapes; and third are the public forests, estimated at 3,467,000 hectares with forest plantations accounting for 107,000 hectares. Except for farm and private forests other types of forests are declining in either coverage and quality or both. The preferred plantation species, though differing according to ecological conditions, revolve around fast growing exotic species and few retained or planted indigenous species. The key species planted in the country include *Eucalyptus grandis* and *E. saligna*, *Pinus patula*, *Cupressus lusitanica* for highlands and *E. camaldulensis* and *E. terreticorni*, *Casuarina equisetifolia*, *Tectonia grandis* and *Gmelina arborea* for lowlands.

Public forest resources are managed through well-defined management plans that align resources around technical and commercial aspects of the business. KFS has been the dominant player in primary production with well-organized administrative structure and resources to cover the core business of management and protection of public forests and support to private and individual forest owners. Recent entry of private sector players such as the tea estates, social entrepreneurs, investment syndicates and individual investors has changed the primary production landscape into more efficient profit driven business models.

The key primary and secondary processing actors in the country include sawmillers, reconstituted wood manufacturers, utility pole manufacturers charcoal producers, wood carvers, paper and paper product manufacturers, biomass energy producers, and non-timber producers. The key primary products that are produced for use in domestic and industrial purposes include sawlogs, peelerlogs, woodfuel, pulpwood and poles that are inputs to secondary forest processing. The forest roundwood are harvested and processed into various products for different purposes by key industries that include sawmills, veneer plants, plywood plants, chipping facilities, pulp and board facilities, utility poles, fence posts and rail manufacturers, firewood processers, woody biomass energy producers, fuel pellet producers, handcraft makers and furniture manufacturers among others. The non-timber products are also collected in forests and woodlands before sorting grading and processing into various products for home use or sale.

The technical and management organization differ among key players in the primary production, and ranges from partnerships that involve signing of contracts between the individual farmers and respective companies or social investors to tree growers associations that in most cases are still at infancy stages and with varying levels of professional inputs from public officers, NGO staff and other technically qualified personnel. Estimates indicate that there are already 10,000 tree growing farmers that have organized into planting groups across the country after many years of pilot trials and support from NGOs and public

agencies. These include the Charcoal Producers Association (CPA) and the Kenya Forest Growers Association (KEFGA). Technical and commercial organizations in secondary forest production include Timber Manufacturers Association (TMA) whose objective is to promote the interests of sawmillers countrywide. Another group, the Wood Preservers Association (KWPA), is a membership organization that draws the bulk of its members from wood treatment plant owners, suppliers of treatment chemicals and others persons and entities with interest in wood preservation activities.

There are various policies and laws already in operation or undergoing revisions including Forests Act 2005, Farm Forestry Rules 2009 and Environmental Management and Coordination Act (EMCA) 2009 that are key instruments that support promotion of tree growing in the country. Some of those that are undergoing revisions to align them with Constitution of Kenya 2010 include the proposed Forest Policy 2015 and Forest Bill 2015. These instruments have good provisions to support vibrant tree growing and environmental management in the country. However, like most such instruments they may continue to remain in paper with minimal coherent implementation strategy and resources to translate such provisions into reality.

Forest products processing and trade are key activities that generate wealth and create employment to hundreds of actors in the country. Kenya is the leading importer of hardwood and softwood timber from East and Central Africa and manufactured products such as furniture, paper and paper products and wood panels from Asia and Europe. Some of the imported products are re-exported to the regional markets. Therefore the country provides opportunities for investors that can produce some of the imported products for local and export markets.

The PPP Act of 2013 provides supporting legal tools for engagement of private sector in delivery of public sector services in various sectors of the economy including forestry. In the forestry sector some variants of PPP do exist mostly focused on corporate responsibility of funding awareness creation, protection and rehabilitation key forests in the country. Such projects include electric fencing to protect forests from interference while keeping wild animals away from farms. Some corporate supported marathon races are undertaken in some key water towers whose objectives are to create awareness on the importance of conserving water towers for provision of water to greater public. Some potential PPPs in the forest sector that are yet to be fully realized include out-grower schemes and forest land concessions through lease agreements. There are also some forms that may resemble PPP that include structured engagement of KFS with Community Forest Associations (CFAs) in the management public forests mostly in raising of seedlings, undertaking plantation operations and protection of natural forests. The National Forest Management and Conservation Bill 2015 proposes a subsidiary legislation on Forest Concession Framework to be developed to confer rights to management of public forests to third party players up to a period of 30 years. Under these conditions, the risk and uncertainty borne by investors in the forest sectors will be mitigated by the terms provided in concession agreement.

The projection on supply and demand of products in the country indicates that the demand for various forest products is fast growing as compared to supply potential from the various

sector actors. MENR (2013) study found that Kenya has a wood supply potential of 31.4 million m³ against a national demand of 41.7 million m³ hence a current deficit of 10.3 million m³. Timber, poles, fire wood and charcoal supply stands at 7,363,414m³, 3,028,907m³, 13,654,022m³ and 7,358,717m³ while demand stands at 5,262,624m³, 1,409,482m³, 18,702,748m³ and 16,325,810m³ respectively. MENR (2013) forecast for a 20 year period 2010-2032 indicates that the total forest product supplies will increase by 20% and overall demand by 21.6% which signifies a gradually increasing deficit. Therefore entry of private sector with desired financial capital and operational efficiency expertise will compliment public and smallholder actors in expansion of the sector forest product supply capacity and contribution to overall national economic development.



Clonal nursery in Tea Estates, Kericho, Kenya: photo credit: Dr. Joshua Kiplongi Cheboiwo

1.0 INTRODUCTION AND OBJECTIVE OF THE STUDY

1.1 OBJECTIVES OF THE STUDY

The main objective of the study is provide information to support catalysing the emergence of organized private sector in forestry through promotion of promising public private partnership (PPP) approaches for sustainable forest management and enhanced livelihoods including gender considerations.

1.1.1 Specific objectives

- To identify the key actors and gender groups' representation in primary forest production and secondary forest production including SMEs based on all forest types in the country;
- To collect information on actors in primary forest production including tree species, their productivity and use, distribution by area, age classes, and volume and plans for sustainable supply;
- To provide information on actors in secondary forest production, collect information on industry type, installed capacity, products lines/types, capacity utilization, production volumes in the last five years and raw material types and sources;
- To evaluate actors in primary and secondary forest production in terms of employment opportunities, policies, regulations and other factors facilitating and/or constraining the development of forest products industry including undertaking a SWOT analysis;
- To identify assess and identify gender specific inequalities;
- To assess and identify the factors inhibiting and or promoting the full and equal participation of marginalised groups;
- To assess and analyse gender based control and access to required assets/resources including the specific opportunities, challenges and privileges of involvement and participation in the sector;
- To evaluate marketing and trade (domestic and international) in their products including volumes, production costs, revenues and prices of products traded in the last five years.
- To evaluate the relationship/linkages among actors in primary forest production on one hand and the relationship/linkages among actors in secondary forest production on the other hand and how this can be organized to contribute to the growth of a well-organized formal private sector in forestry

- To evaluate the scope, within the country, for public private partnership in forestry including existing promising models/approaches that can enhance social inclusion, gender equitable practices and forest compatible sustainable livelihoods development in the different forest types and propose recommendations on way the forward;
- To provide past trends on production, trade and consumption on timber and non-timber products in the countries in the last five years. Also provide forecasts of future production, trade and consumption of the same; and
- To assess the contribution of these private forestry sector activities to local livelihoods and national economy.

1.2 BACKGROUND AND JUSTIFICATION OF THE STUDY

1.2.1 Methodology

1.2.1.1 Study methods

The study on the forestry sector in Kenya involved use of literature reviews of past works from various sources. The countrywide reconnaissance assisted in updating some information and data especially in areas where gaps existed.

1.2.1.2 Literature review

The study relied mostly on information and data that were already available in literature that covered various aspect of forestry in the country. The information accessed were on forest types, primary and secondary production, technology adoption, key actors, forest types, tree species preferences, types of timber and non-timber forest products, recovery efficiency, potentials opportunities for public private partnerships in the forest sector in Kenya. The projections of supply and demand of key forest products in the country for the next 5 years among others were also covered. The literature consulted include a long list publications by public agencies, donor projects reports, technical papers, local and international academic papers and NGOs reports among others.

1.2.1.3 Stakeholders consultations

The study consulted experts in various fields of forestry and practitioners mostly through one to one discussions. The consultation process was guided by simple questionnaire and checklist of issues. Those contacted include KFS officers, saw millers or their agents, tree growers, wooden pole manufacturers, woodworks sector operators and researchers. The stakeholders were consulted through visits, emails and phone discussions.

1.2.1.4 Visits

The study involved visits to many offices, sites, libraries, farms, factories, timber yards and furniture making sheds. The visits yielded some critical information that supported various aspects of the study. The study team visited coastal region that included KOMAZA, Kilindini Port, KFS offices (Mombasa, Kwale and Kilifi), Bamburi-Haler Park and South Coast Tree Growers Cooperative Society.

In Rift Valley the team visited several transmission wooden pole treatment plants, KFS offices (Kericho, Uasin Gishu and Keiyo-Marakwet), saw mills (3), Power saw operators, FOMAWA and Homalime Ltd. The urban centres visited in western Kenya were Kisumu, Eldoret, Busia and Kisii; and in Central and Eastern Kenya they were Nairobi, Nyeri, Muranga, Kitui, Embu, Meru, Machakos and Kibwezi.

1.3 DATA ANALYSIS

The data and information collected from various sources were organized and those relevant to the study were picked and used in various sections of the report. These include recent work on forecast modelling and estimation of supply and demand for various forest products in the country.

1.4 LIMITATIONS OF THE STUDY

The major limitation of the study was unavailability of recent data in some areas. The information on gender and vulnerable groups were also inadequate. The large industrial complexes were unwilling to provide information on their activities despite several visits and hence reliance on published information. Therefore under such circumstances the study results are taken as indicative of the true situations. In some cases the data sources were not current. In some cases expert estimates were used in absence of accurate information.



Eucalyptus plantation in Tea estate, Nandi County, Kenya. Photo credit: Dr. Joshua Kiplongi Cheboiwo

2.0 RESULTS OF THE STUDY

2.1 TYPOLOGY OF THE SECTORS

The typology of forest sector actors, their mandates and objectives, current management levels and potential for public private partnership are presented in Table 1. The table indicates that public private partnerships in primary production, except for public plantations, are rated low to medium due to scale and complexities involved on property ownerships that may not be attractive to private investors. The rating for manufacturing sector is low due to the dominance of private sector investors with minimal public sector participation except in policy and regulatory roles.

Table 1: Typology of the forest sector actors

Sectors	Key players	Management objectives	Management levels and technologies	PPP rating
Primary production				
Public natural forests	KFS, KWS, communities, private sector	Conservation purposes for biodiversity and water provision	Medium to low	Medium
Public plantations	KFS, counties, licensed companies, CFAs	Commercial timber production	Medium to low	High
Farm Forests	Farmers, schools	Subsistence and commercial	Medium to low	Medium
Community forests	Community groups, counties individuals	Subsistence and commercial	Low	Medium
Private forests	Tea estates, investment syndicates, social investors, large scale farmers	Commercial timber production	High	Low
Secondary production				
Saw milling	Individuals, companies	Commercial business	High, medium, low	Low
Wooden utility pole manufacturing	Individuals, companies	Commercial business	High medium	Low

Woodworks sector	Individuals, companies	Commercial business	High, medium, low	Low
Reconstituted wood manufacturing	Wood based complexes,	Commercial business	High	Low
Non timber products	Individuals, Social investors,	Subsistence and commercial	Low	Medium
Woodwork sector	Formal manufacturers and traders	Commercial business	High/medium, low	High/medium
	Informal sector player <i>Jua Kali</i>		Medium/low	Low
Forest products trade	Merchants	Commercial	High medium	Medium/Low
Research and development	KEFRI, ICRAF, EAWLS, IUCN, NMK and universities	Development and dissemination of technologies and information	High	Low

Source: Own experiences in the sector

2.2 ORGANIZATION OF FOREST PRODUCTION SECTORS AND GENDER GROUPS' REPRESENTATION

2.2.1 Primary forest production

The primary production in the country takes place in public plantations, farm forests, community forests and private forests. The outputs of primary production include sawlogs, pulpwood, peeler logs, firewood and poles. The community forests and woodlands are natural forests dominated by indigenous species that are not specifically managed for commercial production but are key sources of firewood, charcoal, timber and poles for local use and surplus for sale to urban areas. Community forests are largely located in the Arid and Semi-Arid Lands (ASALs) of the country except for some few forest blocks in Narok, Baringo, Keiyo-Marakwet, Lamu and Homa Bay and some other counties. The public natural forests are scattered in medium and high rainfall of Western, Rift Valley, Central and coastal regions. Natural forests host indigenous trees species and animals, and public policy and laws are meant for their protection, and not for production purposes, though illegal harvesting of forest products often takes place in them.

The most vibrant primary production for sustainable supplies for subsistence and commercial production purposes are public plantations, farm forests and private forests. Key species planted across the country include *Grevillea robusta*, *Eucalyptus grandis*, *E. saligna*, *E. camaldulensis*, *E. tereticornis*, various *Eucalyptus* hybrids, *Casuarina equisetifolia*, *Pinus patula*, *Cupressus lusitanica*, *Acacia mearnsii*, among hundreds of minor species of both indigenous and exotic species. The species distribution in the country is dictated by climatic and utility preferences, among others values, by both public and

private investors. The public plantations located in high potential areas are dominated by industrial species of *Eucalyptus grandis*, *E. saligna*, *Pinus patula* and *Cupressus lusitanica*. On farms woodlots and trees are based on history and climatic conditions, though similar to public plantations, but in most cases take some regional dominance; with Coastal region being dominated by *Casuarina equisetifolia*, *Gmelina arborea*, *Tectonia grandis*, and *E.camaldulensis*, *E. tereticornis* and *E. europhylla*. In Central Kenya the dominant species are *Grevillea robusta*, *Cupressus lusitanica*, *Acacia mearnsii* and *E.grandis*, with the latter gaining popularity due to the high demand for transmission poles and its various products. The Rift Valley is dominated by *Pinus patula*, *Cupressus lusitanica*, *Grevillea robusta* and fast emerging *Eucalyptus grandis* for commercial production of transmission poles. The Western Kenya, that includes Kisii, Kakamega, Vihiga, Bungoma counties and some parts of Nyanza, is dominated by *Eucalyptus grandis* in the high rainfall areas and *E.camaldulensis* and *E. tereticornis* in low rainfall lowlands. The private sector players, that include tea estates and wood based industries and individual investors, prefer *Eucalyptus grandis* for commercial pole production and firewood for textile and food manufacturing processes but some of the investors have lately diversified into growing *Cupressus lusitanica* and *Pinus patula*, among other species, for timber production for own use and surplus for sale.

The planting patterns, management operations and rotation periods differ per species and products purpose in both farms and plantations. On farms trees are planted on boundaries, homesteads, single and in small woodlots as compared to public and private forest plantations that have trees planted in blocks. The rotation periods for planted trees range from 3 to 30 years depending on species, climatic conditions, end uses and market niche specifications. The shortest rotations observed are those for firewood and construction poles and the longest are for saw and peeler logs. The key industrial species such as *Cupressus lusitanica* and *Pinus patula* mature for sawlogs at 25-30 years but the rotation length stretches from 5-17 years for *Eucalyptus* grown for transmission poles, sawlogs, construction poles and firewood. Kenya's wood consumption is estimated 41 million m³ annually of which 32 million m³ are used as fuelwood that comprises firewood and charcoal. The balance of 6 million cubic metres is used in production of sawnwood for construction and woodworks, pulp and paper, plywood and wood carvings. The country's per capita consumption is estimated at one cubic metre of wood (MENR, 2013).

Table 2 shows that from 1990 to 2010 forest categories experienced mixed performance in terms of forest cover change with the overall change being positive. The key categories that experienced decline were bushlands, indigenous closed forests and public plantation forests in that order. Except for public plantations the future projection for the other categories indicates a trendal decline because the production areas are the frontier for population outmigration hence expansion of settlements and marginal agricultural activities. Those that had a positive increase are trees on farms, and private plantations that currently are exhibiting resurgent growth fueled by high demand for its various products that include transmission poles, sawnwood, wood fuel and constructions poles. The smallholder and large scale farming actors have diversified their portfolio to tree growing as a commercial enterprise but the latter rapid expansion will come under strain from competition from settlements and agricultural activities hence the pace is likely to slow down.

Table 2: Forest and tree cover (ha) trends in Kenya: 1990-2010

Forest type	1990	2000	2005	2010	Change (%)
Indigenous closed forests	1,240,000	1,190,000	1,165,000	1,140,000	-5
Indigenous mangroves	80,000	80,000	80,000	80,000	0
Open woodlands	2,150,000	2,100,000	2,075,000	2,050,000	-5
Public plantation forests	170,000	134,000	119,000	107,000	-3.15
Private plantations	68,000	78,000	83,000	90,000	+1.1
Subtotal	3,708,000	3,582,000	2,357,000	3,467,000	-12.05
Bushland	24,800,000	24,635,000	24,570,000	24,510,000	-14.5
Farms with Trees	9,420,000	10,020,000	10,320,000	10,385,000	+48.25
Total	41,636,000	41,819,000	40,769,000	41,829,000	+5.93

Source: FAO 2010: Forest Resources Assessment Report

2.2.2 Public forests

2.2.2.1 Natural forests

The main forest types in Kenya (Figure 1) include the *montane forests* of Aberdares and Mt Kenya in Central Kenya and Mt Elgon, Cherangany and Mau Forest of Rift Valley that are located at 1,800-3,500m and receive rainfall of between 940 to 3,220 mm per annum. Due to high altitudes the forests are always covered with cloud and mist that provide additional moisture.

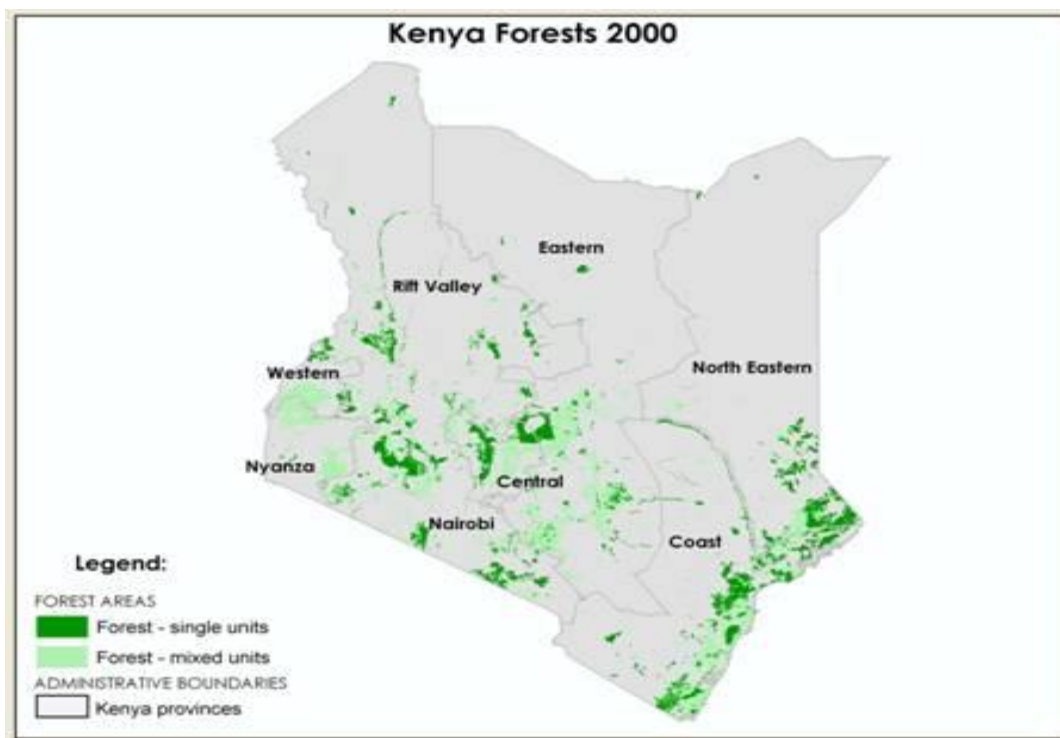


Figure 1: Map of forests in Kenya

The montane forests are key water towers in the country and form the largest forested mountain blocks of recent volcanic origin and have relatively few species. The most widespread montane species associations are the moist *Ocotea-Polyscias* and drier *Podocarpus-Cassipourea* forests. *Juniperus-Olea* associations dominate the upper slopes characterized by volcanic mountains and high ranges that consists of evergreen and deciduous species such as *Calodendrum capense* and *Ekebergia capensis* and the association of the *Cassipourea-malosana* and evergreen seasonal forests such as the *Cassipourea malosana*, *Popocarpus latifolius* and the *Cassipourea mallosana-Olea capensis*. Mt Elgon forests contain *Rapanea dodendroides* and *Hagenia abyssinica* and in Mt. Kenya forests are *Hypericum keniense* and *Hypericum revolutum* (Virtanen 1991). The Mau complex is the largest continuous forest ecosystem in East Africa. The montane forests are not only rich in flora and fauna but also form the 5 key water towers in the country that most of the major rivers like Tana and Uaso Nyiro in Eastern Kenya and Mara, Nzoia, Yala, and Nyando rivers that drain to key lakes in western Kenya such Nakuru, Turkana, Victoria, Naivasha and Baringo; all being of great tourism attraction. The rivers also provide water for both domestic and industrial purposes to many urban and rural homes, wild game and livestock as well.

The *lowland forests* include the Kakamega Forest of western Kenya, the only tropical rainforest remnant in Kenya that host a range of indigenous tree species such as Elgon teak, Red stinkwood (*Prunus africana*) and African satinwood (*Zanthoxylum gillettii*), *Aningeria altissima*, *Cordia millensii* and *Entandrophragma angolense*. The forests are reported to host as many as 400 species of flora and fauna that include unique animals such as Hoest's monkey (*Cercopithecus lhoesti*) and two globally threatened bird species:

Turner's eremomela (*Eremomela turneri*) and Chapins flycatcher (*Muscica palendu*) (Marttila, 1998).

The *coastal lowland mosaic forests* occur mainly in strips bordering rivers and coastlines that include extensive mangroves particularly in Lamu and the mouth of the Tana River. The estuaries that fresh and sea water mix form excellent habitats for mangrove forests. The coastal forests are considered to be the last refuges of an ancient forest mass that covered most of Central Africa between the Atlantic and the Indian Ocean. The area's climate is governed by trade winds, and with annual mean rainfall of about 1200 mm. In addition to rainfall, a considerable amount of precipitation occurs in the form of fog and dewfall. The tree species composition includes the highly diverse Sterculia-Clorophora-Memecylon, Clorophoro-Strychnatalia and Clorophora-lovoa lowland forests. The coastal forests host diverse wildlife such as the endemic Arabuko-Sokoke Sokoke scops owl (*Otusireneae*) and Clarke's weaver (*Ploceus gollandi*). The forests also have endangered and rare animal species such as Golden rumped elephant shrew (*Rhynchocyon chrysopygus*), the Sokoke bushy tailed mongoose (*Bdeogale crassicauda*) and Aders duiker (*Cephalophus adersi*). The coral rag coastal forests are dry and typical species include *Antiaris toxicaria*, *Milicia excelsa* and *Cussonia zimmermannii*. Also along the coastal belt are the Kaya forests that are relict patches of the once extensive and diverse Zanzibar-Inhambane lowland forests that the Mijikenda people built defensive structures to avoid the attacks of raiding Galla warriors. The Kaya means a homestead in several Bantu languages. The Kaya forests were retained as sacred forests for they contained the skulls and skeletal remains of ancestors. The Kayas were often on hill tops and have remained critical water catchments that support diverse flora including medicinal plants. The Kaya forests have traditionally been protected by tribal elders who use old Kaya clearings for ceremonies. However, the breakdown in traditional beliefs and growing influence of Christianity and Islam along the coast and increasing demand for forest products is breaking the system down (Goldammer 1992). The highest species diversities are found in the coastal forests, western plateau forests represented by Kakamega, and Eastern Arc Block Mountains of Taita Hills and Kasigau.

Mist mountain forests are found in the isolated hills and mountain ranges that are dated across the ASALs of northern and eastern Kenya. The mist forests include Mt Kulal, Loima Hills, Mt Marsabet, Kyulu Hills, Mathews Range and Loita Hills, among others. Due to high altitude the ranges are always covered by mists that provide water to support unique and diverse ecosystems of flora and fauna. The mist forests provide shelter, food, medicine, cultural sites and critical dry season grazing refuge. The water springs support livestock and settlement in an otherwise dryland, hence are part of the 16 micro water towers in the country.

The last group of forests are the *riverine forests* that form narrow belts on the floodplains on the major river systems in the country. For example, the largest river, the Tana River, that originates in Mt Kenya and flows into the Indian Ocean, have belts of evergreen forest that depend on its water, and subsides rapidly, away from the river, with the width ranging approximately 1-3 km on either side of the river (Kaarakka, 1996). Lower Tana River forests have two endemic species namely the Tana River red colobus *Procolobus rufomitratu*s and Tana River mangabey(*Cercobus galeritu*s)(Sayer et al. 1992).

In general most natural/indigenous forests in Kenya are under pressure from deforestation, forest fragmentation, forest degradation, and over-exploitation of tree species and the introduction of exotic species (Langat et al 2012). The greatest threats are from clearing for agricultural activities because forestlands are good for agricultural production. Apart from the key forest blocks most of the remaining forests in Kenya are highly fragmented and many tree species that are inhibited from crossing forest gaps face additional risks of extinction. Deforestation and forest degradation can adversely affect many ecological processes and therefore impacting on the soil-water relationship. The Kakamega Forest for example has suffered from continued overuse for timber, charcoal, firewood, cash crops and clearing for forest plantation establishment. The process is attested by Table 2 that shows that of the three categories of natural forests namely the closed and open canopy indigenous forests and woodlands, stagnated or recorded significant decline from 1990 to 2010.

The natural forests are biologically diverse; some are isolated and highly fragmented. These forests host some endemic and endangered species of flora and fauna. The forests, apart from production of high value species for sawnwood, poles and wood fuel, are also critical for water provisioning, biodiversity conservation and ecotourism. The natural forests in public, private and community lands are facing anthropogenic pressures from human needs and genetic erosions due to fragmentation and overexploitation. The government policy of categorising all public natural forests as protection forests has not stopped illegal timber and allied product extraction that is more prominent in community owned forests as compared to public owned forests. Therefore natural forests, and especially those located in community and private land, are likely to continue to decrease in both land area and species diversity into the future. To counter such a process there is need to take into account, in forest management policies and plans, the characteristics of the biophysical environment, patterns of resource use and consumption, socio-cultural conditions and the socio-economic roots of dependence on forest resources by various actors. The fragmented forests and non gazzeted forests will require community involvement in forest resources development for enhanced livelihoods support and long term sustainable management (Pahkasalo 2004).

Since central government lacks sufficient resources to adequately manage natural forests the Draft Forest Policy 2014, the Forest Act 2005 and National Forest Management and Conservation Bill 2014 recognize the need to bring on board communities and other stakeholders through Participatory Forest Management (PFM) that involves communities in forest management through Community Forest Associations (CFAs). There are opportunities for some forms of public private partnerships in the sector through corporate trusts and other forms of multipurpose vehicles that bring together public and corporate sector to pool resources and management of specific forests in order to promote conservation and enhance the country's natural assets and as well provisioning of social goods and services.

2.2.2.2 The public plantation forests

Kenya has long history of public forest plantations development that emerged after trials of indigenous species realized low growth rates in early 1900s and by 1902 the trials of exotic species were initiated with Eucalyptus, Pines and Cypress being the key species; heavily

borrowing experiences from South Africa and Australia (Gibson, 1965). The key objectives for establishment of industrial plantations were to provide wood raw material for specialized industries, and on a sustainable basis, such as roundwood for sawnwood, plywood, firewood, transmission poles and pulp and paper production. The long term objective was to convert 9% of suitable areas of the gazetted forests; and by 1995 plantation forests stood at 165,000 hectares and annual planting peaked at 8,600 hectares in 1986 before falling to 300 hectares in 1990s (Cheboiwo, 2007). Massive excisions of plantation forests in 2000s lost 35,000 hectares to settlements; however, some fragile sites were reverted to natural forests through restoration. By 2010 the public forest plantations covered between 125,000-135,000 hectares depending on source of information, hence accounting for approximately 6% of total forest area managed by KFS. The breakdown by species indicates that Cypress accounted for 52%, Pines (35%), Eucalyptus (12%) and mixed species including various indigenous species (11%). At its peak in 1980s the plantation forest sector supported over 400 saw mills that created 50,000 direct employment and another 300,000 indirectly, excluding downstream woodworks sectors that created further employment in value additions.

The forest sector reforms that began in 1990s culminated in the formulation of Forest Act 2005 and draft Forest Policy 2007 that resulted in the formation of KFS as a semi-autonomous organization with mandate to professionally manage public forests and guide the forest sector in the country. Guided by Vision 2030 and Forest Act 2005 a five year strategic plan was developed to guide sustainable management of public forest plantations through prequalification of saw millers, regulation of production, a transparent tendering process, and transportation and trade in forest products, among others.

The successful establishment of public plantations in the country had relied heavily on the involvement of the local people through *shamba* systems, currently renamed Plantation Establishment Livelihood Improvement Scheme (PELIS). The systems involve partnerships with local people through allocation of plots for food production and some compensation schemes for their efforts. KFS has established a plantation planting and monitoring programme unit to oversee the harvesting and planting programme. The annual planting target is 3,000 hectares per year. Other planned strategies to boost plantation development in public forests include engaging stakeholders through concessions, contracting and joint management.

An inventory done in 2009 shows that there were 38,000 hectares of over-mature forest industrial plantation valued at over KES 38 billion (USD 450 million) and another 18,000 ha of between ages 10 and 22 years due for commercial thinnings (Wasike, 2010). However, since the lifting of the ban on harvesting in public plantations in 2012 accelerated harvesting of mature stands may have changed the age composition drastically.

Table 2 shows that between 1990 and 2010 public plantations decreased by 3.3% in land area leaving its only opening to contribute to the widening gap between supply and demand of timber in the country being through increase in productivity per unit land area.

The main plantation tree species produce various products that include firewood, charcoal, poles, sawlog, peelerlogs and pulpwood depending on the rotation age and as by products. Table 3 shows the average yields (in m³/ha) at harvesting for *Cupressus lusitanica*, *Pinus patula* and *E. grandis* as well as the aggregated yields: 385 m³, 401 m³ and 503m³ respectively. The aggregated yields are relatively low as compared to private sector production within similar ecological zones that range from 630-750 m³/ha; there is therefore room for improvement through enhanced silvicultural management and integrated harvesting techniques that utilize the whole tree, thinnings and by products.

Table 3: Average yields (m³/ha) for main plantation tree species

Operation	<i>C. lusitanica</i>	<i>Pinuspatula</i>	<i>E. grandis</i>
Thinnings	50	66	30
Clear-fell	254	243	-
Poles	27	31	132
Woodfuel	54	61	341
Total	385	401	503

Source: MENR, 2013.

Table 4 shows productions from public plantation forests in 2011/2012 that indicate that saw milling sector consumed 44.1% and the 3 large wood-based manufacturing complexes 43.8% and Pan Paper Ltd (10.5%) of the timber harvested. The extraction/harvest varied from 66 to 850 m³/ha, indicating potential tenfold yield improvement in the public plantation sector if the integrated harvesting and utilization approach is adopted by most key players including the saw mills. Alternatively, the differences may be traced to the roundwood measurement methods in use, hence some need for examination of the systems and procedures with the aim of improving the accuracy levels. This is because the amount available for future plantations is limited as most are concentrated in the medium and high rainfall potential areas alongside natural forests of Rift Valley, and Central, Eastern and Western Kenya where competition for land between agriculture and settlements is stiff.

Table 4: Logging and yields (m³/ha) in public forest plantation: 2011/2012

Company	Logged area(ha)	Volume harvested in m ³	Extraction (m ³ /ha)	Proportion of total harvest (%)
Rai Ply Ltd	187	74,385.50	850.12	18.7
Timsales Ltd	87.4	47,051.50	538.34	11.8
Comply Ltd	241	53,164.70	220.6	13.3
Pa Paper Ltd	179	42,776.50	239.0	10.7
Homalime Ltd	42.60	5,579.91	131.0	1.4
Other saw mills	2,630.62	175,372.66	66.66	44.1
Total	3367,62	398,330.77	341	100

Source: Kenya Forest Service Annual Report 2011/2012

2.2.3 Farm and private forests

Table 2 shows that since 1990 trees on farms expanded considerably, by 48.12% to 10,385,000 hectares in 2010 as compared to marginal increase of 1.1% for private forests and a decline of 3.5% for public plantations forests. The trend attests to the growing importance of farm forests in forest sector timber production in the country. Some past reports show that in Central Kenya densities of trees on farms averaged 76 stems per ha (Tyndall 1996), and can host up to 155 different tree species (Betser et al, 2000). In the same region in some cases 200 different species were identified on farm (Oginosako et al, 2006). The species density also differs according the land potential, for example, high potential zones had 155 timber trees as compared to 77 in lower cotton zones; and twice as many trees are sold per household as felled for domestic use (Holding et al, 2006). Indigenous trees found on farms were *Cordia abyssinica*, *Vitex keniensis* and *Prunus africana*. MKEPP (2008) found that in Central Kenya households around Mt Kenya utilized trees on farms for various purposes such as for firewood (93%), fruits (79%), timber (78%), poles (64%) charcoal (43%), fodder (28%), herbs (20%), amenity (8%) and honey (5%). The report also noted that most of the harvested materials were from “standing wood stock” with minimal evidence of replacement indicating that the practices may be unsustainable.

Studies indicate that for high potential agricultural landscapes the number of trees per hectare of land should not exceed 100 trees to avoid excessive competition for light, water and nutrients (Beer et al 1998). In the study cases, recommended tree stock density in most cases was exceeded indicating potential competition with crops that is likely to lower yields and food security. Similar practices are repeated in other high potential zones of Rift Valley and Western Kenya.

Some of the factors that motivate smallholder farmers to grow trees on farms include high population that creates demand for own use supplies of tree materials and surplus for sale, land size, forest incomes, market access and alternative incomes (Cheboiwo, 2014). Therefore the key determinants for adoption of intensive farm forestry include climatic conditions, population density and commercial orientation that vary across the farming landscapes and ecological zones. In general farm forestry in large land holdings is on the increase due to high demand for transmission poles and sawnwood that has attracted medium and large scale farms to diversify into commercial forest enterprises. However, the smallholder farm forest sector is faced with many challenges that include low tree prices (trees are sold standing), lack of tree valuation techniques, small farm sizes, conflicts with neighbours over crop losses, felling restriction during crop growing seasons and permits requirement from chiefs and foresters before harvesting trees for commercial purposes. Others include poor tree management practices to meet the requirement of end use specifications such as siting, spacing, thinning, pruning, lopping and pollarding. Another issue is that farmers’ tendency to sell trees when they are “desperate”, for money and not when prices are good. Further, farmers have inadequate information on wood utilization options that could maximize incomes. This is because most sell standing trees at negotiated

prices that in most cases are not based on accurate volumes as the case in public plantation sector. Family conflicts with regard to tree ownership and planting location affects value/prices since most trees are planted in steep slopes and on low quality land sites that eventually attract high transport costs and difficulty in harvesting, and in some cases due to proximity to buildings and other structures.

A recent study by Oeba et al (2014) highlighted some of the challenges smallholder tree growers face that ranged from poor road networks, high harvesting and log assembly costs from hundreds of farmers with few trees to sell, poor stem forms (sometimes with metal objects in them), and inability to guarantee continuous supply to ensure that processing plants are in operation throughout the year. The challenges have discouraged saw millers and others major tree processors to rank highly trees from farms as sources for their roundwood materials. Furthermore, land available for tree growing within agricultural landscapes in aggregate amounts in high and medium potential zones is likely to decrease given the already decreasing land/farm sizes and competition from agriculture, infrastructural development and settlements.

The solutions proposed to mitigate smallholder tree growers' challenges include improved road infrastructure to enable delivery of trees to processing plants, provision of extension services, development of appropriate techniques for logging on farms and guidelines for tree volume estimation to enable farmers calculate prices more effectively. Other strategies include encouragement of farmers to form associations or societies to facilitate marketing their products, circulation of KFS industrial round wood prices for use by farmers to guide their valuations, availability of low cost equipment for handling and value addition at the farms, among others.

Despite the cited challenges farm forests have performed well in all aspects especially during the period of the sawlog harvesting ban in public forests that lasted from 2002 to 2012 when it became the major source of both subsistence and commercial forest products in the country. The farm forestry sector will remain an important component of the forestry sector in the country in the future.

2.2.4 Private forests

The sector in the past was dominated by tea estates owned by multinationals and local companies that planted mostly Eucalyptus for tea curing to substitute expensive furnace oil. However, the inability of the public forest plantations to meet local timber needs has attracted several investors into the forest sector that include leading wood based companies, syndicated private investors and large scale farmers that are attracted by lucrative business in tree-based enterprises.

The recent expanded electricity power generation and distribution in the country has created high demand for transmission poles, mostly sourced from *Eucalyptus grandis* trees, making it one of the leading short rotation crops grown by private investors and mostly for commercial purposes. Due to high prices and inadequate supplies private sector investment in short rotation species mixes for various purposes has grown faster than public sector plantations in recent times across the country. The private sector investors deploy broader wood utilization models that include integrated utilization processing and value addition to minimize wastage and improve their operating profit margins. This is because private sector investors are driven largely by profit making hence centred on deployment of efficient management and modern processing technologies. The business model is largely a diversification strategy from a predominantly core agricultural based business into a profitable forest business that takes both vertical and horizontal integration dimensions depending on the core business of the investor.

Table 2 shows that private sector plantations expanded marginally by 1.1% from 68,000 to 90,000 hectares or 220 hectares per year. However, lately large companies have been purchasing land for tree growing but the sector has limited room for expansion due to shortage of land and competition from agricultural enterprises and settlements. The competition for land in the country that has made land prices sky rocket is likely to limit the land available for future forest expansion. However, all indicators show that private sector forests are here to stay and will leverage on efficiency in land use, efficient technologies and high demand for forest products to compete in local and regional timber markets. The private sector players are also gearing for the potential opening up of public plantations for forestland concessions under PPP provisions outlined in the proposed National Forest Policy 2015 and National Forest Conservation and Management Bill 2015.

2.2.4.1 James Finlay Tea Estate

The James Finlay tea estate started in 1925 and is located in the Rift Valley highlands at an altitude of 2,200m above sea level with annual rainfall average of 2,000mm. The estate owns 10,000 hectares with about 3,000 hectares under forests mostly with *E. grandis* and others being hybrids of Eucalyptus namely GS (*grandis-saligna*), GR (*grandis-robusta*) and GT (*grandis-torelliana*). There estate owns some natural forest blocks scattered in its property mostly along water catchments. Other commercial plantations are mostly of Cypress. Finlay has continued to improve its flagship *E. grandis* since 1980s through rigorous breeding that has resulted in development of 14 selections that are now being multiplied clonally in its central nursery for its own use and surplus for sale to other tree growers. The main use of the Eucalyptus plantations is for production of firewood for processing its tea and surplus for sale to transmission pole manufacturing companies. Finlay forests operations are mechanized from planting to harvesting and therefore deploy specialized planting, logging and processing machines and tools. The planting spacing is 3x2m (1,600 stems) and 3x3m (1,100 stems). The mean annual increment for *E. grandis* is 50m³ and total production yields can reach 760m³ per hectare, one of the highest in the country. Its saw mill is fitted with flexible circular and band saws that can achieve recovery rates of up to 75% and with daily turnover of 18-20m³ of sawn timber. The saw mill operates an integrated production processing line that ensures that all by products are utilized in Finlay's various processes.

At the edge of the saw mill facility is a kiln for seasoning the timber. Timber produced is used in its tea packaging and infrastructure activities and the surplus is released to local timber markets. Finlay produces high quality the timber that is highly demanded by woodwork sectors in the country. Finlay supports Mau Forest Complex conservation efforts through dedicated funding through Friends of Mau Water Catchment (FOMAWA), in addition to running an education programme that targets students in creation of awareness on the importance of environmental conservation.

2.2.4.2 Timsales Company Limited.

Timsales is one of the largest wood-based industrial complexes in the country that manufactures plywood, fibreboards, block boards, flush doors, transmission poles and sawn timber for local use and export to regional markets. Timsales operates an integrated production model that ensures that by-products of other units are taken up as raw material in other units, hence minimal material waste. Today, nearly 70 years since its inception, Timsales is one of the largest timber companies in Kenya. It has its Head Office in Elburgon and branches in Nairobi, Mombasa, Kisumu and Nakuru. By 2015 Timsales was estimated to have a workforce of 1,500 and supports approximately 6,000 family members. It has been reliant on public forest plantations for its roundwood requirements but since 2004 it has purchased land to establish its own plantation forests and currently has over 1,500 hectares under various species, mostly *Eucalyptus grandis*. As part of its promotion of forest development in the country it assists KFS to plant and maintain trees in some areas it harvests logs in order to secure a continuous availability of industrial roundwood for the industry in the future.

2.2.4.3 Homa Lime Company

This is a diversified family business started in 1920s at Kanjirain Karochuonyo, Nyanza. Its key flagship business is limestone processing but has diversified overtime into jiggery production, agricultural production (sugar cane and maize), livestock rearing, forestry and tourism. The company has planted 280 hectares of forest plantations, mostly Eucalyptus species, for firewood production for use in its lime processing facility; and has also gazetted 100 hectares as national monument for preservation of indigenous woodlands. The company has initiated an out grower scheme with flexible contractual agreements with many farmers in parts of neighbouring Rift Valley and Nyando Valley to develop woodlots of Eucalyptus. Homalime undertakes planting and maintenance operations on behalf of land owners on condition that the costs are deducted on harvesting of the woodlots or the company is reimbursed its costs if the landowners decide to sell the wood to other buyers. The model has worked well due to good supervision and its flexibility. The company also buys firewood from hundreds of tree growers in the region.

2.2.5 Bamboo production

The indigenous bamboo species found in Kenya is *Yushania alpina* that thrives very well between 2,400 and 3350 metres above sea level. The limited high altitude range restricts it to a few key mountain ranges namely, Mt Kenya, Aberdares, Mt Elgon Cherangany and Mau Complex where it occupies an estimated 155,821 hectares.

On average it is estimated that *Y. alpina* life cycle is 40 years before mass flowering and death (Wimbush, 1945) and can produce 3,700-4,000 culms per hectares every three years. Further, an undisturbed crop can carry about 10,000-17,000 stems per hectare with capacity to produce 100 tonnes of air dry weight of culms (Kigomo, 1988). Bamboo is very useful in stabilizing top soils and conservation of water quality and is good for protection of fragile areas such as steep slopes and riverine areas. The challenges facing *Y. alpina* in Kenya is human induced degradation mostly wanton harvesting, overgrazing and wild life destruction. The species, in addition to limited ecological range, is also difficult to propagate and this hinders extensive planting on farms.

The country has embarked on rigorous bamboo production on farms through introduction of 8 lowland Asiatic bamboo species as part the country's mix options to diversify the supply base of natural forest resources. In this regard, the country has undertaken some robust measures to promote expansion of bamboo growing that include awareness creation on its importance, building capacity on propagation and nursery management, training on product harvesting and processing. These developments have culminated into recent drafting of bamboo policy paper that is aimed at facilitating the promotion of bamboo as one of the key development intervention measures for supply of materials to support cottage industries in various parts of the country.

The country held an international bamboo workshop in April 2014 to share experiences with key players in the bamboo sector that involved local investors, experts, farmers, and international agencies engaged in bamboo promotion. Some nascent investors on nursery production, commercial growing and processing have started in earnest in various parts of the country. However, there are some outstanding issues that are yet to be addressed that include rigorous evaluation of economic potential contribution to household livelihoods through some cost benefits analysis of bamboo enterprises, guidelines on commercialization of bamboo, and development of efficient market value chains to support a vibrant bamboo sector in the country.

2.2.6 Gender and minorities' participation in primary production

Gender participation in public plantation sector varies according to the operation segment activities. Nursery, planting and maintenance operations provide equal opportunities for youth, men and women but women tend to dominate due to the light duty and gentleness requirements in handling seedlings. Thinning, pruning and logging operations are heavy duty activities that are dominated by men due to physical nature of the work and type of machinery and equipment deployed. In general the minority groups have equal opportunities in primary production activities for there are no significant constraints to their engagement as owners or employees. However, in forestry like many other sectors of the economy, factors like weak political connections and lack financial capacity weakens the ability and capacity of minorities and women groups to participate in key forest sector operations and investment such as obtaining logging licences and undertaking saw milling activities.

3.0 SECONDARY FORESTRY PROCESSING

The secondary forestry production involves any alteration of wood or other plant material harvested from the forest to prepare it for further processing, direct use or transfer to market outlets. The forest materials that are routinely processed for use include roundwood logs, firewood, wood fibre, medicinal plant parts and edible materials among others. Therefore primary processing refers to the initial processing of a product whether it is a primary or secondary wood product but the processing should begin and end at the same manufacturing operation. Primary processing facilities include sawmills, veneer plants, plywood plants, chipping facilities, pulp and board facilities, log sorting and debarking facilities, debarking, utility pole treatment, firewood processers, woody biomass energy producers, fuel pellet producers, handcraft makers, log furniture manufacturing, shake and shingle operations, among others. The primary processing include debarking, peeling, drying, chipping, sawing, shaping, notching, cleaning, washing, sorting, or other similar methods of initial processing needed for the type of forest product being produced. Therefore in Kenya there are various primary processing facilities that transform wood into various products for different purposes.

3.1 SAWMILLING INDUSTRY

The sawmilling industry in Kenya is one of the most developed in the region having evolved for 80 years, and by 1999 there were 444 registered sawmills operating in the country. The saw milling sector is the largest primary wood processing undertaking in the country that deploys a wide range of equipment from simple machines that include power saws and bench saws to saw mills equipped with gang or band saws and woodmizers. The saw milling operations annual output per saw mill has been estimated at 450 m³, and that was similar to same sized mills in Africa; and the combined production by 2010 was estimated at 400,000m³ per year (EPZ, 2010). The saw milling sector used to employ 50,000 workers directly and was indirectly providing employment to about 300, 000 people in forest and wood processing operations, as well as in transportation and other supporting services. The public plantations development peaked at 174,000 hectares of well managed forest estates in 1980s before the decade of mismanagement in 1990s that led to the sawlog harvesting ban that lasted a decade between 2002 and 2012. The sawlog harvesting ban in public forests resulted in the near collapse of saw milling sector and loss of associated skills. Under these circumstances the biggest problem in the sawmilling industry has been one of efficient roundwood utilization that is characterized by low recovery rates mostly linked to use of thick saw blades, poor cutting practices and use of unskilled labour (KFMP, 1994). According to KFS recommended roundwood recovery rates for sawmills is 40%. The sector is estimated to consume annually about 507,000 m³ of round wood.

The moratorium and subsequent ban on sawlog harvesting in public forests in 2002 had a devastating impact on the once vibrant saw milling sector in the country that was highly dependent on public plantations. During the ban, most saw milling machinery and equipment were left idle and economies of forest dependent urban centres and families collapsed. During the decade long logging ban in public forests the saw milling sector lost competent and professionally skilled labour that were forced into early retirement and engagement in non-forest activities. The lifting of the ban in 2012 has not reignited the vibrancy in the sector for most of the machines left idle are obsolete and need fresh investments in new and efficient machinery. In 2008 KFS initiated a prequalification process for sawmills in the country for the purpose of screening those that qualify to be given licences to bid for logs from public plantations and only 356 out of the listed 450 saw mills applied out of which 276 that had some basic machinery and equipment were recommended to participate in bidding for timber licenses. The recommended saw mills with capacity of less than 20 m³ of logs per day or 4,800m³ per year dominated the bidding process, representing 70% of the saw mills (MF&W & MFA 2008).

Since the lifting of the ban in 2012 KFS has registered and prequalified 633 saw mills that consisted of 30 large mills, 65 medium, and 538 small saw millers (Cheboiwo, 2012). However, most of the old sawmills have not serviced their old machines or installed new ones but have resorted to tractor drawn bench saw and power saw milling. Random discussions with some saw mill owners revealed that they were hesitant to pay the required annual license fees of KES 30,000 (USD 300) or upgrade their machines without assurance of being allocated sufficient roundwood to enable them recoup their investment in machine upgrade or procurement of new ones to avoid unnecessary losses. However, most were willing to pay the license fees and upgrade their machines once they were assured on the procedures of roundwood allocation and availability of the sawlogs.

According to KFS there are three categories of saw mills for registration; small mills that can process less than 30,000m³, medium size mills between 30,000m³ to 60,000m³ and large mills greater than 60,000m³ of roundwood per year (Wasike, 2010). During the harvesting ban many unlicensed roundwood processors emerged that included small scale mobile saw bench operators, power saw operators and pit sawyers that continue to process sawnwood mostly in farms. According to KFS the lifting of the ban has released 38,000 hectares of over-mature plantations worth KES 36 billion and another 18,000 ha ready for commercial thinning (Wasike, 2010). The softwood logging plan prepared by KFS indicates that up to 6,000 hectares per year will be available for logging, and that translates to roundwood output of between 2.4-2.8 million m³ per year. The closure of the only paper mill that was a high consumer of roundwood from plantations, the Pan African Paper Mill at Webuye, in 2009 whose annual intake was 500,000m³ will translate to more logging allocation to the remaining industries and including registered saw mills.

In a competitive forestry sector, raw material recovery is critical for it determines the profitability that will have some knock on effects on tree owner's incomes, labour wages, recouping of investment in technologies, and retail timber prices for consumers. Muthike et al (2009) reported that due to different saw blades and sawing methods employed, the recovery rates for the 5 alternative sawing techniques were: power saw (27%), tractor

mounted circular saw (29.8%), two man pit sawing (39.9%), saw mill equipped with circular saw (40.1%) and saw mill equipped with band saw (46.1%). The pit sawing was the best sawing model for manual sawing operations and bandsaw sawing were the best for mechanical timber conversion.

However, the most important aspects in achieving higher recovery and improved sawing skills competence of sawyers as well as the application of appropriate technologies and equipment for the prevailing conditions; these have not been addressed after lifting of the ban (Muthike et al, 2013) Therefore most saw millers have not been able to upgrade their logging and processing technologies as most still use outdated saw milling technologies and wasteful benchesaws and power saws to process logs. The report observed that most of the saw milling managers and staff had inadequate skills in saw milling operations and machine maintenance hence the current conversion average of below 30% as compared to KFS recommended 40% recovery rates, and this results in a 70% wood wastage.

The country's multisector policy Vision 2030 emphasizes promotion of industrialization as a pathway to tapping the country's resources for sustainable economic growth into middle level income country. The industrialization strategy is critical to the country's generation of value added capital, creation of employment and contribution to social development. However, the wood processing industry in the forest sector has been shrinking due to various reasons, key being dwindling wood resources, mismanagement and governance challenges in the sector, contestable rights on public forest resources by competing interests (communities, counties and central government) and inadequate political will and inadequate policy and legal frameworks to support a vibrant wood processing industry. Studies by Nganga et al (2011) of 284 wood based SMEs in Kericho, Nakuru and Uasin Gishu counties showed that the infrastructure accessed by wood industries was poor, the technology employed low, the wood enterprise growth poor and collective efficiency also poor. The study recommended more focus on small manufacturing enterprise's infrastructure and technological development planning based on the collective efficiency to anchor sustainable industrial development.

With regard to processing of trees from farms studies show that Kenya, India and China are listed as the pioneers in widening timber sources into farmlands and drylands (HDRA, 2006). Trees on farms are by characterized low tree densities and volumes for conventional forestry practices to apply, hence the need for development of appropriate forest technologies and practices for the sector. However, power saws in milling roundwood are considered handy because of their portability and efficiency in cutting small diameter and sometimes crooked logs when fitted with thin saw blades. The technology requires low capital, and is therefore economical in milling a few cubic metres per week. Power sawmilling is popular in a wide range of farm forestry, agroforestry and dryland forests, especially where log extraction and transport is difficult or too costly. Power saws can process logs that are 30 cm long or 15 cm diameter that may include branch wood, are bent, damaged or oversized logs, offcuts, and reclaimed building timber, or street and fence trees that are likely to contain nails or other metal. Power saws when fixed with variety of frames can produce quality boards with a bandsaw-like finish and improved recovery, and

reduce risks of accidents as compared to common freehand power saw sawing (Muthike 2013).

In summary Kenya has sufficient installed capacity of saw milling enterprises that can produce enough timber to meet the country's needs and surplus for export only when provided with sufficient roundwood. The problem is on the status of the saw milling machinery that have been out of use since 1999 that may need to be addressed to ensure that the sector deploys state of the art machinery for integrated efficient conversion and high recovery rates. This is attested by the fact that softwood timber imports fell from 75,354m³ in 2010 to 9,425m³ by 2013 after the entry of local processed sawnwood into the markets.

3.2 RECONSTITUTED WOOD PRODUCTS

The reconstituted wood sector is dominated by three industrial complexes, the Rai Ply, Comply, and Timsales that are involved in integrated wood processing that ranges from saw milling to plywood and particleboards manufacturing. The board manufacturing units consume about 200,000–250,000m³ annually of round wood (MF&W & MFA 2008). Timsales at Elburgon for example produces soft and hard fibreboards with an estimated capacity of 7,000 tonnes per year. Rai Ply at Eldoret primarily produces plywood, particle and chip boards but has diversified into manufacturing of foam and polythene bags for local and export markets. Comply at Nakuru and Njoro produces medium density fibreboards (MDF) and various particle and chipboards. The complexes have also diversified to manufacturing of plywood, doors, block boards, veneer blockboard, hardboards, chipboard, melamine, machined timber, veneer plywood, creosote transmission poles, flooring tiles and blocks, HDF laminated flooring, MDF, formica, kitchen, wardrobes and office furniture. Furniture includes objects such as tables, chairs, beds, desks, dressers, or cupboards, sofa sets that are usually kept in a house or other building to make it suitable or comfortable for living or working. The complexes have also expanded their operations beyond Kenya into neighbouring countries to widen their operations and access more material base.

3.3 WOODWORKS SECTOR: FURNITURE AND JOINERY

Woodwork is defined as objects or parts made of wood, mostly furniture and wooden interior fittings, mouldings, doors, staircases, or windows that are spread across the major urban centres in the country, with some pockets of concentrated units in major towns. The sector supports about 160,000 people in the forestry and manufacturing sectors of the economy. The woodworks sector is highly diversified with different types of machines, ranging from imported to locally fabricated wood lathes, bench/handsaws and clamps, among other tools and equipment. The sector is dynamic and its production units can be found in markets, backyards, vacant plots, and road reserves; and supply the needs of the local people and has limited exports. The sector is more of cottage industry than a manufacturing sector for lack standardized products and most is self-employed or with 5-10 employees.

Most survive on hard work and ingenious use of resources and form a critical sector in country's economic growth. The woodwork sector is estimated to consume 77,672 m³ of timber per year (Githiomi, 2010). The sector includes production of coffins estimated to take up considerable sawnwood annually; this is because 80 per cent of the dead in the country are buried in wooden coffins.

The woodworks sector is dominated by small entrepreneurs, mostly in the informal sector commonly known as *Jua Kali*. The medium and large firms are experiencing declining production capacity due to lack of quality grade timber, high timber prices, high power costs and high cost of imported chemicals. They also face severe competition from *Jua Kali* sector and imports from Asia and Europe. Most of the medium scale firms have reduced their operations to barely minimum and some are shifting to other business including real estate and warehousing. However, there are some very specialized small scale furniture manufacturing firms that target prime upper class markets that have managed to thrive in the market due to their ability to produce high quality products that have won them confidence of reliable clientele. The wood works sector has not received sufficient government attention despite current policy and legal reforms being undertaken in various sectors of the economy. Such reforms should address quantity and quality material supplies, appropriate technologies, skilled manpower and incentives to attract investments into the sector.

There are few barriers to entry into the woodwork business as most are very small businesses therefore unlikely to take advantage of significant economies of scale and standardized products. However, it requires low initial financial outlays mostly generated through savings as access to loans from financial institutions is minimal. Most of the funds are used for purchase machinery and rent for premises. Most woodwork skills are easily obtained from various training institutions and apprentices in the country. The furniture sector is also characterized by widespread duplication of products resulting in monotony hence marginal price differentiation and stiff competition among producers.

The actors in the sector undertake advertisements in the print or electronic media to promote sales, they largely use traditional displays of finished products, photo albums, word of mouth, personal selling, posters, network of friends and neighbourhood sales, (Kerubo, 1998). However, the recent government policy that requires public agencies to procure furniture from local sources may enhance market access by domestic manufacturers of furniture into the future.

A recent study indicate that the furniture market in Kenya stood approximately at US\$496 million in sales in 2013, with an annual growth rate of 10% for 2007-2013 that is likely to remain the same in the coming years (World Bank 2014). The furniture imports into the country in 2013 stood at KES 6.6 billion (US\$66 million) approximately 13% of the total market. Imports grew by 24% during 2009-2013 indicating it will take up a large portion of the Kenyan market in the coming years. The annual furniture sector exports stood at KES 2.2 billion (US\$22 million) (World Bank, 2014). The demand for furniture in the country is driven by rapid urbanization and increasing purchasing power.

The study also estimates that the East African furniture market is valued at US\$1.2 billion whereas the regional trade is worth paltry US\$298 million per year. Therefore the country's furniture industry is better placed to expand its furniture sales domestically and regionally to capitalize on the growing demand in local and regional markets in East Africa, African and global markets. It has a logistically advantageous geographic position that confers it comparatively easy access to local, regional and international markets, a supply of raw materials from neighbouring countries that is relatively accessible, and a large workforce with a strong tradition of working in both the informal and formal segments of the furniture value chain. Recent furniture reports show that Kenya is both the largest market for furniture and the largest producer of furniture in East Africa. Its market is expected to grow at an 8% compound annual growth rate (CAGR) between 2013 and 2018, driven by the growing population, urbanization, and increasing purchasing power.

3.4 RUSS RAFTERS' PRODUCTION

There are only two firms that make prefabricated trusses in the country, both located in Nairobi. The Trussed Rafters Development Unit of the Ministry responsible for housing located on Ngong Road. It is equipped with simple industrialized set of truss fabrication jigs, fabricated hand nailed metal plates and conventional woodworking machines. The second firm that makes prefabricated trusses is Harry Timber Engineering Services Limited (H-TES), located along the Mombasa Road. The prefabricated roof trusses are light in weight and are made from well-seasoned grade timber. Truss rafters according to contractors are gaining popularity in the construction industry due to savings in timber and will be a sector to watch with the changing construction styles and technologies in the country. The sector is likely to attract more investments since sawlog harvesting has resumed in public plantations hence availability of high grade softwood timber that had beset the sector for the last decade due to the logging ban.

3.5 PREFABRICATED HOUSING

There are two major manufacturers of fabricated housing units in the country, the Economic Housing Group (EHG) of Naivasha and Timsales of Elburgon. The demand for prefabricated houses in the country has not grown for many years for various reasons that are unique to housing preference in the country that is skewed towards brick and stone houses. Cited also is the high cost construction due shortage of high grade timber and to increasing timber costs and use. The two manufacturers make units on orders and thus experience limited capacity utilization and fluctuations. The units are made from well-seasoned good gauge softwood timber, mostly of pines and cypress.

3.6 THE WOODWORKS SECTOR ANALYSIS

3.6.1 Status and dynamics

The woodworks sector is the most diversified and comprises various value addition activities including wood seasoning, resizing, re-sawing planning, machining, moulding and fabrication of various products. The sector manufactures a wide range of products that include doors, windows, cupboards, sofa sets, chairs, tables, dining sets, stools, sideboards, desks, beds, frames, T&G, cones, floor tiles, flush boards, etc. The few seasoning facilities that are crucial in stabilizing wood materials are old, and are also very expensive to operate due to high energy prices that have left most of them out of operation. The sector dominantly use old machinery imported or improvised locally. This is because sector almost collapsed in 1980s and 1990s due SAPs that also led to the decline of various primary manufacturing sectors in the country. The old type machinery have some advantages such as strength hence less breakages, durability, low maintenance and less skill required to operate and maintain. The disadvantages include poor quality control and are labour intensive. The sector, like other manufacturing sectors, is facing high costs of inputs including power, chemicals and labour that have significantly increased cost of production making the products expensive. The sector is also facing stiff competition from medium density fibreboards (MDF), and fabricated products from China, Indonesia, and Malaysia. The MDF products are made from low quality fibre and that can be mass molded to desired shapes by computerized machines and with good finish make them attractive in appearance. The transaction costs for imported hardwood from DRC are very high despite the government lowering the duty on imported timber. Therefore the high retail prices when local inputs are added make the locally produced hardwood furniture very expensive. For example in Mombasa locally assembled hardwood door costed KES 11,000(USD 129) in 2010 as compared to multi-coloured-coated units imported from China that retail at KES 2,000(USD 24).

3.6.2 Skills and training

The country is also reported to have few training institutions that offer education and training on the latest woodwork technologies and skills. Thus the country doesn't have skilled manpower for computerized woodwork design and manufacturing that is dominant in Asia and Europe. Many players in the woodworks sector partially trace their problems to the general lack of public policy to address the many problems in the sector hence lack of support. It is the general feeling that the sector has been forgotten and left on its own. Many key players in the sector have since moved from placing emphasis on local manufacturing to relying on importation of knockdown products from Asia and Europe for local wholesale and retailing because the margins are good as compared local manufacturing business. A good example of one of a firm that has shifted from local manufacturing to importation and retailing of furniture from Asia and Europe is Victoria Furniture Ltd. Many other players have followed suit because it is no more profitable to operate large scale woodworks business in the country.

Those that partially operate have diversified into real estate, warehousing and manufacturing of non-wood products to survive. The medium and large woodworks manufacturing sectors in Kenya are being squeezed from above by imports and from below by highly diversified and versatile *Jua Kali* producers, in addition to high prices of inputs.

The country should put in place favourable policy and legal environment in order to jumpstart the declining woodworks sector. Some observers point out that in the short term the country, given its decades of poor performance, should focus more on meeting the local market demands as it plans to enter global markets in the future. The risk of rejection of exported products is very high due lack of standardized designs for mass production for uniformity and benefits from scale cost cutting. The actors in the sector pointed out some issues that need to be addressed as follows:

1. Training local manpower in computerization of design and manufacture of wood products especially on MDF hence institutions such as Forest Industrial Training Centre (FITC) in Nakuru, Kenya Forestry College (Londiani) and other public and private training institutions should be equipped with latest instruction equipment and instructors with computerized furniture making skills.
2. Availability of high quality and competitively priced timber and reconstituted wood materials supplies from local sources and imports to ensure sufficient materials for woodworks manufacturing in the country.
3. The country should develop policy and legal frameworks that will promote manufacturing and trade in wood based products in order to position itself as a potential regional woodworks hub.
4. The sector should embrace a woodworking environment that rewards productivity and creativity in order to attract hardworking and skilled manpower especially those that service high quality products niche markets

3.6.3 Opportunities

The country has some comparative advantages and opportunities to turn around the woodworks sector into a phase of vibrant growth. These include the following:

1. It is strategically located to serve East and Central Africa with relatively good infrastructure that links the country with trading partners.
2. The country has a relatively broad base of cheap and skilled labour force that can be easily absorbed and apprenticed for mass production.
3. The country is endowed with vibrant entrepreneurship, hardworking culture that can easily take up profitable opportunities to produce desired products.
4. High competition in the sector to ensure competitive production practices in terms of quality and price that can be competitive at local and regional markets
5. The country has commenced manufacturing of MDF that will offer opportunities for local entrepreneurs to diversify into computerized design and mass manufacturing ventures that can compete with products imported from Asia.

The operators in the woodwork sector do not receive sufficient good quality softwood and hardwood timber. The quality of timber and reconstitute wood available in the country need also to be addressed to ensure that they meet international standards for specialized woodworks. However, there are a small numbers of woodworks units that are engaged in production of specialized products on order or produce few products on demand by customers. Most are not prepared for export manufacturing because the local market is more than adequate for their low outputs as most have reduced their capacity by up to 90% of the 1970s level. They no more hire labour on permanent basis but on task rates that are based on product orders.

The future of the woodwork sector will depend largely on what future barriers to entry will be, improvement of the industry position relative to substitutes and imports, ultimate competition intensity. Growth in the sector will be largely driven by technology and therefore need for technological innovations by importation or acquisition through adaptation and adoption.

3.6.4 Wood based SMEs

Wood based SMES are spread across the country and deal with a wide range of products and services that account for 99% of private sector businesses (Ngugi and Bwisa, 2013). The report showed that wood based SMEs face several problems that include outdated technologies, low product standards and inadequate marketing techniques. Among the policy and legal environment that affect SMEs are high taxation, cumbersome licensing procedures, corruption and many taxes. Ngugi and Bwisa, (2013) found out that the sector faces several financial related obstacles such as high cost of credit, collateral requirements, high transaction costs for small loans and inadequate financial institutions in rural areas. SMEs also face poor physical infrastructure, lack appropriate equipment and technologies, unreliable power supply, lack of water, unreliable ICT support and inadequate storage space. Therefore despite good government policies to buy goods from the sector it is still handicapped by unreliability in capacity to supply goods and services due various factors such as inadequate funds to support adequate/sufficient production, lack of technical capability and capacity to produce a wide range of goods and services in bulk to satisfy major customers. Also production processes require expensive technologies and equipment that most SMEs cannot afford. Since access to markets is critical in SMEs success, the high transport costs due to poor road networks constrain most SMEs from taking advantage of market opportunities that require large volumes of a broad range of products and on regular supply. Most SMEs managers lack information and marketing skills and have minimal access to expertise and financial support to meet high specifications and strict standards for products at competitive market outlets. Some policies that target development of SMEs in the country include Kenya Sessional Paper No. 2 of 1992 and Sessional Paper No. 2 of 2005 on Development of Micro and Small Enterprises for Wealth Creation and Employment Creation.

3.7 WOODEN TRANSMISSION POLE SECTOR

3.7.1 Primary production of poles

The traditional producers of the wooden transmission poles in Kenya have for a long time been the Kenya Forest Service but the high demand for wooden transmission poles since 1999 has shifted supply to new players, mostly farmers, private companies and importers. The new producers have benefited from access to improved germplasm and plantation management practices for *E. grandis* for high potential growing areas and hybrid clones for medium potential growing areas. The rotation of transmission poles has shortened to 6-10 years and relatively higher for less favourable growing sites. The recommended spacing ranges from 2.5x2.5m to 3x3m and with an initial stock of 1,650 and 1,100 trees respectively. Smallholder farmers in most cases intercrop the trees with maize for the first year and singling individual trees for harvesting on the basis of specification; as compared to clear-felling that is done by conventional large scale commercial growers.

The specifications for transmission poles include uniform taper and straightness, minimum size of 10 meters length and 150mm top diameter and 220mm ground line diameter. The ground line diameter is measured 1.8 meters from the butt end. The poles harvesting operations involve felling and skidding to stacking in an area where seasoning takes place to about 28% moisture content before loading and transportation to treatment plants. The air seasoning in stacks takes between 4 to 6 months. For smallholder growers manual loading onto truck or tractor trailers is common and is time consuming and dangerous because one pole can weigh over 300kgs. The poles are further stacked to bring the pre-treatment moisture content to 25%. Few plants have accelerated kiln drying to shorten the process which is also energy consuming and an expensive undertaking. Due to its profitability, the transmission pole business has attracted hundreds of smallholders and private companies that differ only in scale, ranging from small woodlots of few trees to large estates of up to 400 hectares (Cheboiwo 2013). The by-products, when sizing of transmission poles at the farm and factory are, mostly used as firewood for domestic, institutional and industrial processes. Some are used in farm structures and fencing.

3.7.2 Manufacturing of wooden transmission poles

Generation and distribution of power in Kenya has a long history. The use of wooden poles to transmit power lines dates back to incorporation of Kenya Power and Lighting Company in 1922. Two other materials, concrete and steel poles, were used in 1960s in transmission of 66 and 11 KV lines in Nairobi and Mombasa. The steel commonly used is hollow tubular or steel lattice. In 2004 there were only 2 treatment plants in the country capable of processing 160,000 power transmission poles per year. These were Timber Treatment International (TTI) formerly East African Tannin Extract Company (EATEC) at Eldoret and Gilgil Telecommunications Industries (GTI) at Gilgil. By 2005 there were 5 treatment facilities capable of producing 250,000 treated poles per year (Cheboiwo and Langat, 2006).

The treatment plants have risen from 4 in 2005 to over 55 by 2015 and treatment capacity rose from less than 100,000 to over 2 million poles per year (Table 5). However, logistical problems such as synchronizing chemical, semi-processed pole sourcing and uncertainty on tendering process for treated poles with KPLC makes it difficult for the plants to attain 60% of installed capacity. According to KPLC projections in 2008 the local supply of treated wooden poles stood at 63% and was expected to reach 70% by end of 2012. The country is currently self-sufficient in treated wooden poles but KPLC still has 20-25% imports mostly from Tanzania and Uganda. The combined demand for both KPLC and REA in 2015 was 480,000 poles and is projected to increase to about one million by 2030. The fast growth in treatment plants has come with a cost of inadequate attention to standard treatment procedures hence pole durability and maintenance in use is reported to have worsened.

The sector is also facing competition from resurgent cement pole sector that has increased from two in 2013 to 7 in 2015 and output from 20,000 to 150,000 poles during the same period. Wooden pole imports from outside EAC, mostly from South Africa, Brazil and Finland, have reduced from 200,000 poles in 2007 to zero by 2015.

Despite such massive expansion of processing capacity, local plants face several handicaps that include unpredictability of tendering process of KPLC and REA that constrain treatment plants from making predictions of actual quantities needed, so as to enable them synchronize acquisition of semi-processed poles and import of treatment chemicals from overseas suppliers.

Electricity generation and distribution in Kenya is vested in three institutions Kenya Power (KPLC), Kenya Electricity Transmission Company (KETRACO) and Kenya Energy Generation Company (KENGEN). The power generation in Kenya stand at 1,412MW (Cheboiwo, 2014). The demand for electricity is expected to grow by 10% annually according to Vision 2030 projections and Ministry of Energy has embarked on massive investment in mixes of geothermal, diesel, coal gas, wind and hydropower and imports from Ethiopia and regional utility firms. This is expected to add up to 5,000MW by 2025. However, the sector projection may remain long shot given that 2,000MW that was projected to be in operation by 2014 was not met.

Table 5: Treatment plants for transmission poles

Company	Location	Installed capacity (poles/yr)
TTI-EATEC	Eldoret	50,000
TTI-EATEC	Londiani	40,000
TELKOM-GTI-Equip Agencies	Gilgil	72,000
Timsales Ltd	Elburgon	84,000
ComplyLtd	Nakuru	36,000
EA Cabro	Elmenteita	90,000
Typsy Timber Treatment Ltd	Eldoret	72,000
Muringa Holdings Ltd	Limuru	50,000

KUZA Ltd	Kitale	40,000
Central Imenti Cooperative Society	Meru	40,000
Murendat Timber Treatment Ltd	Nakuru	40,000
Kakuzi Ltd	Thika	40,000
Makuyu Timber Treatment Ltd	Maragua	40,000
Rosogo Enterprises Ltd	Molo	75,000
Keystone Treatment Services	Lessos	25,000
Capital Oasis	Eldoret	40,000
Marula	-	-
Miti Industries	-	-
Outpan Timber treatment	Eldoret	30,000
Jua Kali	Turbo	25,000
Royal Transmission	Nakuru	30,000

Source: Guda (2014) and Cheboiwo (2014)

Thus the demand for transmission poles will be highly correlated to the power transmission expansion that will depend on the availability of funds to finance power generation and the distribution infrastructure in the country. The recent government efforts to heavily invest in mixes of power generation sources and transmission infrastructure is likely to resurrect the transmission pole sector into vibrancy. The current power consumption rate is way below the projected demand of 25% per year and hence the new developments may see the demand for transmission poles grow by between 7% and 10% per year inclusive of replacements within the next 10 years. The above projection takes into account the expected investments into geothermal generation facilities that may increase the available electricity power to be distributed within the next 6-15 years.

3.8 WOOD CARVING

Wood carving has been an integral form of artistic expression and use among the communities in Kenya. The common items made for use for various purposes were mostly utensils, furniture and ceremonial artifacts. The history of commercial wood carving in Kenya is traced to a renowned Kamba wood carver Mutisya Munge who acquired the knowledge from the Zaramo carvers while serving a soldier in Tanzania (Choge, 2010). By 1956 the wood carving business was worth USD 1.3 million (using 2010 exchange rates), and had spread from the Wamunyu base in Machakos County to several strategic locations in the country. Therefore Wamunyu is the cradle of art and industry of wood carving in Kenya as most carvers in the county trace origin of skill to Wamunyu. The oldest organized group is the Wamunyu Woodcarving Cooperative Society (WWCS) that was registered in 1965, and currently has 1,200 members and a large showroom and marketing warehouse in Katangi Centre of Machakos County, making it the highest concentration of wood carvers in the country. The major wood carving enterprises are WWCS and Ukamba Wood Carving Cooperative Society (UWCCS) in Mombasa town. Other minor regional hubs are in Malindi in Coast region, Nanyuki in Central region, Gikomba in Nairobi region and are located in towns of Kitui, Kisii, Nakuru, Nyeri, Ukanda, Kibwezi, Kalawa, Meru and Mililuni.

In general, the carvers market their products through their marketing societies or brokers or directly to individuals. The middlemen dominate marketing of carving destined for international markets. In the smaller wood carving sites, most woodcarvers are not members of a registered cooperatives society but operate independently.

Most of the Wamunyu carvers rely on wood carving (62%) and 38% have diversified to agricultural and retail businesses to increase their incomes and also cushion them from adverse fluctuation in sales of carvings. The carvers are organized into various categories of artisans that process the wood from rough wood to finished products; and are mostly men and a small number of women.

The wood carvers prefer specific tree species for carving, with *Dalbergia melanoxylon* (mpingo in Swahili; ebony in English) being the highest ranked. Other popular species include *Terminalia brownii* (muuku in Kamba); *Azalia quanzenis* (mahogany in English); *Jacaranda mimosifolia* (Jacaranda); and *Combretum schumannii*. The wood carving species are sourced from a variety of sources mostly from farms, woodlands and public forests and minimal imports from Tanzania. The preferred characteristics for wood carving species include high wood density (0.6 to 1.23g/cm³), hardness (4 to 20KN), coloured heartwood, non-irritating odour and fine texture, among other features. Recent technical tests of 52 species were categorized as major (4), minor (7), and alternative (41) but customers preferences will be the ultimate tests to translate it from potential into workshops destined materials (Muga et al, 2014). In 1990s the demand for wood for carvings ranged from 800-1,200 tonnes per month, sourced from distances as long as 100kms. The sector involved approximately 60,000 people that were directly involved in wood carving, and that translated to one million persons indirectly dependent on the trade (Choge, 2002). The distribution of costs according to Choge (2002) were cost of wood (30%), splitting and crosscutting (5%), filing of carvings (8%), sanding (30%), painting (12%) and polishing (15%).

In the past Kenya was a globally significant producer of woodcarvings, with 50,000-60,000 carvers generating around US\$20 million in exports per year (Cunningham et al, 2007). The major market destinations for Kenyan wood carvings are U.S.A., United Kingdom, Sweden and Norway. Currently, the wood carving sector is facing several challenges that include shortage of quality wood, ban on harvesting in natural forests, green consumerisms in western countries, and competition from other countries; and this has made production and its export markets shrink by 75% (Hamilton, 1996), that may likely to have worsened by now. The competition is made more severe by lack of creativity amongst the carvers, where most of them produced similar products thus negatively affecting the pricing of their goods. The sector needs a complete transformation from traditional into well-structured and financed enterprises that can engage in innovative interventions including bulk importation of high quality logs and establishment of commercial plantations of preferred species to sustain the sector into the future. Given the employment creation and forex earning potential the public sector plantations need to factor the need of the wood carving sector in plantation development in the medium and ASAL regions to produce sustainable supplies of the desired species to support the wood carving enterprises.

3.9 PAPER AND PAPER PRODUCTS

There are 13 companies operating in the paper and pulp industry after the collapse of Pan African Paper Mill at Webuye in 2009 that used roundwood in pulp and paper manufacturing. Pan African Paper Mill used to consume annually about 500,000 m³ of pulpwood and 250,000m³ of firewood, mostly from farms. Most of the paper products manufacturing mills use recovered paper to various paper products. These plants include Chandaria Industries located in Nairobi, and Highland Paper Mill located in Eldoret, and among others.

3.10 OTHER PRODUCTS

3.10.1 Construction poles

Construction poles are mostly produced from farms from various species such as Eucalyptus, Pines, Cypress and many indigenous species. The poles in the coastal region are mostly harvested from *Casuarina equisetifolia* woodlots and are in high demand for construction and renovation of *makuti* buildings (grass thatched buildings) that are popular with tourists. In Central and Western Kenya construction poles are mostly from Eucalyptus woodlots and in some cases Cypress and Pine thinnings that are mostly used for low value construction works such as scaffolding in high-rise buildings and construction of mud houses and kiosks. Construction poles are bulky and low value end products that tend to be supplied from adjacent areas to consumption centres. The major centres of consumption in the country are Nairobi, Mombasa, Kisumu, Nakuru and Eldoret, among other urban areas. The demand for poles has been on the increase due to vibrant construction activities taking place in many towns that require poles for scaffolding and props. Construction poles also form the bulk of the materials used in expanding slum areas in major towns. According to MEWNR (2013) the annual supply for poles in the country, including construction poles, is estimated at 3,028,907. However, the demand stands at 1,409,482 meaning that there is a surplus of 1,619,482, and that is mostly from farms. In summary the construction pole business in the country is assured of sufficient supply of poles from local sources for some time into the future. It has the advantage of short rotation and in small growing spaces, hence can be accommodated within agricultural landscapes across the country.

3.10.2 Construction poles

The key users of industrial firewood in the country are textile, food and chemical processing industries, and recently in generation of electricity. The major supplies of industrial firewood are the smallholder tree growers who are spread across the country. One of the major consumers of industrial firewood is the tea sector which is one of the major agricultural activities that contribute to both GDP and foreign exchange.

The tea sector in Kenya consists of the smallholder farmers affiliated to Kenya Tea Growers Agency (KTDA) that has 65 factories that account for 80% of the tea output in the country, and the large scale tea growers who are affiliated to Kenya Tea Growers Association (KTGA) that has 29 factories and accounting for 20% of the tea produced in the country. The KTGA affiliated factories were the first group to realize the cost saving measures of switching from furnace oil to firewood use in tea processing. Firewood use in tea processing has triple benefits because it increases profitability of the sector by cutting costs, saving on foreign exchange and increasing overall incomes to tea growers who also supply firewood to affiliate factories. In 2010 the tea sector demand for firewood stood at 1,592,000 m³ with an estimated value of Kshs.2.2 billion, with KTDA accounting for 60% equivalent to its share of tea output.

The large tea estates are generally self-sufficient in firewood, and only sources small quantities from smallholder trees growers and transmission poles treatment plants. The common source of industrial firewood is the fast growing *E. grandis*, *E. saligna* and *Aciacia mearnsii*. To sustain the demand for firewood by KTDA affiliated factories requires that a total of 22,800 hectares of forest plantations be developed in the country with an equivalent annual output value of KES 1.3 billion (Cheboiwo, 2012). To ensure sustainable supply of firewood to its factories KTDA encourages its affiliate factories to establish tree nurseries to provide tree seedlings to farmers at reduced prices in order to enable them grow trees for sale to the factories. On average each KTDA managed factories use between 1,000-2,500m³ of firewood per month. The tea factories uses about 2.7 m³ of firewood per ton of tea produced. Thus, the value of firewood used per ton of tea is approximately US\$87 (about US\$814,320 per year). Table 6 show some other industries that are dependent on firewood in the country.

Table 6: Consumption of firewood by some key industries in Kenya

Enterprises	Intake in tonnes	Unit price(\$)	Total value (US\$)
Rupa Mills	2,000	15	30,000
KenKnit	1,700	16	27,200
Corn Products	18,200	18	327,600
Lessos creameries	4,700	18	84,600
Arkay Industries	600	18	1,080,000
Homalime	14,500	23	333,500
D.EA Ltd	2,700	22	59,400
Menengai Industries	2,700	18	48,600
Njoro canning	7,488	16	119,808
Elites Bread	3456	17	58,752
Bidco Industries	5,000	16	80,000
Pan Paper Mills	250,000	18	4,500,000
Highland Paper Mills	4,000	17	68,000
KTDA tea factories	955,200	18	17,193,600
Pwani Oil	8,200	35	287,000

Source: Cheboiwo and Langat 2014

*Closed in 2009

3.10.3 Wood for steam and gasification in electricity production

Recent developments have diversified electricity generation from traditional water hydros and geothermal infrastructure to use of woody biomass, for steam technology and gasification processes. BIDCO, a vegetable oil manufacturer in Thika, uses firewood to drive steam turbines to produce 2 KW of electricity for its use. Cummings cogeneration in Marigat Baringo County, currently nearing completion, is another firm that utilizes *Prosopis juliflora*, a weedy tree species found in ASALs, to produce 10-30 MW through gasification technology. The biomass energy sector is expanding and woody wastes are likely to have good markets as the country expands its electricity generation through mixes of energy sources with green based technologies being preferred. The Cummings has organized the local communities into CBOs that will be contracted to supply *Prosopis* wood to the factory from their own farms and community lands. To produce 30 MW electricity Cummings estimates that it will require 240,000 tonnes of *Prosopis* wood per year. Cummings own estimate of a potential yield of 12,000 tonnes per hectare might require 12,000 hectares of well stocked *Prosopis* in the target supply areas.

3.10.4 Charcoal production

Firewood and charcoal production are important forest activities that account for 94% of roundwood extraction from forests and woodlands in the country. The wood fuel per capita consumption is estimated at 742kgs/yr, translating into 34.3 million metric tonnes; with firewood share being 15.1 million metric tonnes and charcoal 16.5 million metric tonnes. These would require 538,000 hectares, of which 298,000 hectares will be for firewood and 240,000 hectares for charcoal production. KFS developed Charcoal Rules in 2009 in an attempt to organize and regulate production, processing and marketing of charcoal in the country. However, preliminary findings indicate that since the sector is dominated by small scale and irregular producers deep in the rural areas the rules have disadvantaged the poor and smallholder producers that have limited capacity to undertake compliance procedures. Despite the numerous challenges facing it charcoal has remained an important source of energy for cooking by most urban and rural households and a highly traded commodity in the country.

Except for some sustainable production from black wattle in North Rift region most of the charcoal is sourced from unsustainable harvesting in ASALs and farm clearing in high agricultural potential areas. In most cases charcoal is produced and consumed within the local areas with surplus being moved to major urban areas such as Nairobi, Kisumu and Mombasa. In the coastal strip the key production areas are Samburu in Kwale County, Marafa and Baricho in Malindi, Galicha Tana River and many parts of TaitaTaveta County. In Eastern Kenya the expansive Ukambani counties of Machakos, Kitui and Makueni located in the Nyika Plateau drylands are the major charcoal exporters to Nairobi and Mombasa. In Central Kenya the major charcoal producing areas include Laikipia County, mostly from expansive ranches, and dry parts of Embu and Meru counties. In western

Kenya the major charcoal producers are in Rift Valley mostly Baringo, West Pokot, Turkana, Narok, Kajiado, Nandi, Uasin Gishu, and Keiyo-Marakwet counties that supply Kisumu, Nakuru, Eldoret and Nairobi. The charcoal production projection indicates progressive fall in supplies in major production areas of the country, mostly attributed to decline in tree populations available from woodlands and farmlands in the future, implying that a large section of the charcoal market demand will remain unmet.

Sustainable charcoal production model based on *Acacia mearnsii* commonly, known as black wattle, is an established enterprise that dates back to 1880s. It is widely adopted across many sites from the temperate and tropical lowlands to tropical highlands. The East African Tanning and Extract Company (EATEC) was one of the largest commercial growers of *A. mearnsii* in Kenya that produced charcoal and bark for tannin extraction but closed shop in 2000. It was producing bark for tannin extraction and pole for charcoal production in brick made kilns till 2000 when it sold its farms. Since then farmers with small woodlots have become the main production centres mostly in Keiyo-Marakwet, Uasin Gishu, Nandi, Kakamega (Lugari) and Trans Nzoia counties. Pockets of black wattle trees are also found in Kiambu, Nyeri and Machakos counties of Central and Eastern Kenya. Currently small-scale farmers are the main suppliers of bark in the country and the stripped poles are converted into charcoal by the traditional method of earth kilns. Black wattle charcoal from North Rift region is traded in most towns in western Kenya that include Kisumu, Eldoret and Bungoma among others, some is transported to Nairobi. A well-managed *A. mearnsii* stand growing in a good site has a potential of producing 80 tonnes of firewood per hectare at the age of 9-10 years; however, on poor sites the yield can fall to 50 tonnes.

According to Cheboiwo and Mugo (2012) charcoal production and marketing is a big business in the rural and urban areas, with an estimated 67 million bags, an equivalent to 2.4 million metric tonnes of charcoal, being traded annually. The estimated annual trade arising from charcoal at current average price of KES 800 per 40kg bag or USD 200,000 per tonne translates to USD 530 million (Wamugunda, 2014). ESDA (2005) reported that the sector involves 200, 000 producers and another 700,000 persons employed in the market value chains that support over 2 million dependents. The charcoal market value chain indicates that producers earn 19.3%, transporters/merchants (48.5%) and vendors (32.2%) of the consumer price (Mugo, 2012).

Charcoal production in the country is fast changing with more efforts being put in biomass technologies such as charcoal and saw dust briquetting technologies to compliment tree-based production. The technologies are also changing with entry of private sector players that are investing in high recovery charcoal production technologies. Despite the changes the rural based earth kiln producers still dominate the charcoal production business in the country.

3.11 EFFICIENCY IN PRIMARY PROCESSING

Round wood is converted into various products for use in many sectors of the economy ranging from households, furniture making, construction industry and to biomass energy production, for both domestic and industrial uses. The conversion processes have varied recovery rates depending on the sectors and product forms. In the saw milling sector processing is done through various technologies such as sawmills, mobile saw benches, pit sawing and power saws. The roundwood from public plantations that are processed by sawmills is estimated at 65% of the total and mobile saw technologies and others process 35% of total wood, mainly from community, private and farm forests. The estimated recovery rates for sawmills is between 26% and 35% that translates to an average of 32% while that of mobile saws is estimated at 25%. Other forms of processing take an average of 5% of total round wood, mostly for plywood, pulp, paper and particle boards, and with recovery rates of 95% (Githiomi 2012). Processing trees into poles and firewood is mostly done at stump site with a processing efficiency estimated at 95% for both products. Round wood processing into charcoal has the most inefficient conversion rate with 16% recovery (ENSDA, 2005). Table 7 shows volumes of wood products available after processing that indicate that 11,979,146 m³ of the total wood supply potential of 31,372,531m³ is lost during processing, making only 19,428,576 m³ available for intended purposes (MEWNR, 2013). The highest losses are recorded in charcoal and saw milling. Therefore about 38% of the harvested wood (about 12 million m³) in the country is lost in processing.

The losses are attributed to the use of old, inappropriate and inefficient machinery by many players. The use of inefficient technologies is also a problem in wood based SMEs and other small scale operators that still use old inefficient machinery in their processes. Most operators attribute the low recovery rates to lack of supportive policies on technology access at affordable costs given that commercial lenders charge high interests rates of between 18 and 30% that discourage individuals and SMEs from taking loans to invest in efficient technologies. There is therefore need to provide a favourable environment for access to efficient technologies and loans at reasonable interests rates to the wood industry.

Table 7: Processing losses for some forest products

Lost volumes through processing inefficiencies of raw forest wood (m3)						
	Timber	Poles	Fire wood	Charcoal	Total	TOTAL
Wood supply	7,363,414	3,028,907	13,654,022	7,358,717	20,980,209	31,405,060
Recovered	2,402,399	2,877,461	12,971,321	1,177,395	14,148,716	19,428,576
Wood lost	4,961,016	151,445	682,701	6,181,322	6,831,494	11,976,484
Percentage loss	0.67	0.05	0.05	0.84	0.33	0.38

Source: MEWNR, 2013

3.12 NATIONAL WOOD SUPPLY AND DEMAND NET BALANCES

The natural public forests, public plantations, farm forests, private forests and community forests are the key suppliers of round wood for both domestic and industrial uses in the country. Table 8 shows the estimates on the potential supply from various forest types to sustainable supply specific type of wood products based on the yield capacity and area occupied.

Table 8: National wood supply potential in major forests

Forests Type	Product aggregate	Timber	Poles	Wood fuel		
		Timber	Poles	Firewood	Charcoal	Total
Public natural forest (ha)	905,357					
Yield (m ³ /ha)	0.9	-	-	0.585	0.315	0.9
Allowable cut (m ³ /year)	814,821	0	0	529,634	285,187	814,821
Public plantations (ha)	4,934					
Yield (m ³ /ha)	407.5	262.2	44.5	65.52	35.28	100.8
Allowable cut/year	2,010,605 m ³	1,293,695	219,563	323,276	174,071	497,347
Total Public Forests (ha)	2,825,426	1,293,695	219,563	852,909	459,259	1,312,168
Community Natural Forests (ha)	3,252,922					
Yield (m ³ /ha)	1.5	0.4	0.2	0.59	0.32	0.9
Allowable cut/year	4,879,383	1,301,169	650,584	1,919,224	1,040,935	2,927,630
Private Plantations (ha)	4,483.14					
Yield (m ³ /ha)	407.35	88.17	140.66	116.04	62.48	178.52
Allowable cut (m ³ /year)	1,826,208	395,279	630,599	520,215	280,116	800,331
Trees on Farms (ha)	1,242,406					
Yield (m ³ /ha)	17.58	3.52	1.23	8.34	4.49	12.83
Allowable cut (m ³ /year)	21,841,513m ³	4,373,272	1,528,160	10,361,673	5,578,407	15,940,080
Total allowable cut (m³/yr)	31,372,531	7,363,414	3,028,907	13,654,022	7,358,717	20,980,209
% Share per product type		23	10	44	23	67

Source: MEWNR, 2013

Table 9 shows that country has the capacity to sustainably supply of 31,372,531 m³ of roundwood that is broken into timber (23.5%), poles (9.7%), firewood (43.5%) and charcoal (23.5%). However, the demand is estimated at 41,700,664m³ broken into timber (12.6%), poles (3.8%), firewood (44.9%) and charcoal (39.2%). Timber and pole production were the only products that marginally exceeded demand, however, wood fuel deficits exceed by 50% of the national supply. That indicates that domestic wood fuel users have to resort to unsustainable sources or deplete growing stocks, which will subsequently lead to considerable deforestation or some in cases use agricultural residues. The deficits indicate that wood product consumers, especially in the construction industry, have to rely on imports, especially of hardwood for furniture making and softwood for construction activities or use of substitutes such as metal and plastics in various construction activities.

Table 9: National supply and demand potentials for key forest products (m³).

Product	Timber	Poles	Firewood	Charcoal	Total wood fuel	Grand Total
Potential supply	7,363,414	3,028,907	13,654,022	7,358,717	20,980,2009	31,372,531
Potential demand	5,262,624	1,409,482	18,702,748	16,325,810	35,028558	41,700,664
Net balances	2,100,791	1,619,424	(5,048,726)	(8,967,093)	14,048,349)	(10,328,134)

Source: (MEWNR) 2013.

4.0 NON TIMBER FOREST PRODUCTS

Non timber forest products (NTPs) consist of a range of products extracted from forests and woodlands that include fruits, leaves, bark, gums and resins, among others, for use in subsistence and trade. NTPs have emerged as critical products that support livelihoods of marginalized communities for income and social benefits. Therefore they are important ingredients in local economies and should be considered in sustainable management of natural resources for the benefit of the current and future generations. The following sections discuss the some NTPs of social and economic importance to household and national economies.

4.1 GUM RESINS, OPOPANAX AND MYRRH

Gums and resins are among the most valuable dryland woodland resources to ASAL communities. Gum arabic is obtained from *A. senegal* and *A. seyal* while gum resins such as myrrh are produced from *Commiphora* species and frankincense from *Boswellia neglecta*. Harvesting of gums and resins is based on labour intensive traditional methods of tapping. Nearly, all gums and resins produced in Kenya are exported in raw form; only small quantities are processed locally into essential oils. The post harvesting processing involves cleaning, sorting, packaging and labelling. The country, on average, exports about 460MT per year that peaked in 2000 to 1,130MT that was valued at USD 2.6 million (Chikamai and Casadei, 2005). The business involves hundreds of collectors, assembling traders, wholesalers and exporters that are wholly or partially dependent on gums and resins for their livelihoods. Ethiopia, Eritrea, Sudan and Kenya are the leading producers and exporters of frankincense, opopanax and myrrh (Cunningham et al, 2007). The global demand for Gum arabic is about 100,000 MT projected to grow to 150,000 MT by 2020 (Muller and Okoro, 2005). By 2002, Sudan was providing 62.8% of global supplies of gum arabic that is used in various products ranging from Coca-Cola to perfumes, with France the major importer and re-exporter of the processed products (Cunningham et al, 2007).

Kenya is estimated to have potential to annually produce 3,000 MT of gums and 3,500 MT of resins as compared to the current production levels of 400-500 MT for gum arabic and 1,000MT of gum resins (Luvanda, 2015). At an average export price KES 120 per kilogram the country earns KES 36 million (\$3.6 million) per year. The sector is undergoing some transformation with the entry of many agencies to promote sustainable management and utilization of gums and resins in the drylands. Kenya Forestry Research Institute(KEFRI) in collaboration with Ewaso Nyiro North Development Authority(ENNDA), Centre for Training and Integrated Research in ASAL Development (CETRAD) and many CBOs such as Mandate For Future(MTF) have trained over 300 people on production and post harvesting handling procedures (Wekesa, et al, 2013).

New developments include opening of one processor in the country, Vetochem, that extract opoponax essential oils through distillation process. Arid Land Resources Limited (ALRL) value adds gum arabic by grinding and grading before export. Despite the efforts trade in gums and resins in the country has remained largely an informal business due to various factors that range from non-conducive environment for business, resource supply reliability (availability, quantity and quality) and scattered production units (high assembling costs and small scale operational economies) (Wekesa et al, 2013). The country has great potential to produce and trade in gums and resins if some of the constraints are addressed, and these include access to vibrant markets, creation of favourable conditions for producers and traders, and sustainable management of resources.

4.2 PRUNUS BARK

In Kenya, *Prunus africana* grows on the major forest blocks of Aberdares, Mt Kenya, Mt Elgon, Cherangani Hills, Timboroa, Nandi Forests, Taita Hills, Chyulu Hills, Tugen and Marsabit Hills, Kakamega Forests and the Mau ranges. The Prunus bark products are used in treatment of prostate cancer that is common with ageing population mostly in developed countries, this cancer is also receiving local attention. The Prunus bark is traded in various forms such as dried bark, bark extracts, herbal concoctions, capsules and tonics (Schippmann, 2001). The species has been listed under Appendix III of CITES thus providing it protection through regulating international trade. Kenya is listed among the leading countries in planting of *P. Africana*; accounting for 628 hectares out of 878 hectares of plantations found in Africa, with the other 250 hectares located in major bark producing countries mostly in Cameroon (Dawson et al 2000). A recent study in western Kenya (Gachie et al, 2014) shows that *Prunus africana* is one of the widely retained or planted indigenous tree species in smallholder farms, and with mean density of 0.8 trees per household. The species is mostly planted for ornamental purposes and medicinal use. In the local markets the bark is sold in various forms such as air-dried bark, ground bark powder and herbal liquid concoctions.

The country has been one of the major exporters of Prunus bark since 1960s mostly in purely unprocessed form, with the only value addition being air-drying. The major buyer was the French company, Prosynthese, a subsidiary of the Fournier Group, manufacturers of the 'Tadenan' tablets; with Kenya supplying 60% of its bark demand (Cheboiwo, et al 2014). The country on average exported between 200 and 250 tonnes of dried bark annually to France between 1995 and 2003 and some of the bark was re-exported to China and USA (Cheboiwo et al, 2014). The unit price of dried bark during the period was \$60 per kg that translates to between KES 1.2-1.4 billion (\$14-17 million) annually over the 20-year period of trade in the bark. However, the license of the only exporter was cancelled by the government in 2003 on grounds of monopolistic exploitation of the country's natural resources at the expense of the society. Since then no legal exports have taken place in the country, herbal practitioners continue to use the bark for production of various medicinal products for local use. However, recently some local beverage companies have developed

interest in the bark for blending with several products to enhance their curative values and gain local and international consumer preference.

The Prunus bark trade and associated activities are some of the potential green based economic activities that have the potential to generate annual incomes in excess of KES 3 billion(\$35 million) to the country's economy. However, the country needs to put in place policies and legal structures to promote planting, sustainable harvesting procedures and appropriate extraction technologies to attract investors into the sector to engage in legal Prunus bark trade. Therefore promotion of a Prunus based enterprise is likely to enhance the management and conservation of the trees by various land owners for commercial purposes, and also to enable them diversify their revenue base and spread farming risks while earning the country much needed foreign exchange.

4.3 SANDALWOOD ESSENTIAL OILS

Sandalwood (*Osyris lanceolata*) is a widely distributed species in the rocky areas of drylands in Kenya ranging from Kwale in the Coast, to Pokot in Rift Valley and Marsabit in Eastern Kenya. The plants' parts of the species contain essential oils that are highly valued as sweet fragrance for various purposes by Muslims, Hindus, Buddhists and Chinese. In Kenya the sandalwood products are used to treat various ailments but such traditional uses in the past have not adversely impacted on its wild populations. However, recent entry of merchants into the sandalwood business mostly for export to Tanzania and India has led to accelerated exploitation across the country. The harvesting methods involve whole tree uprooting for the roots have higher concentration of the essential oils. The local prices range from KES 10-30 per kilogram (USD 0.1-0.3) as compared to KES 700/kg (USD 0.7) in international markets. Illegal trade in sandalwood thrives in various parts of the country as evidenced by regular reports from arrest and confiscation across the country at the Tanzanian border and Mombasa Port. No statistics are available on the quantity and value of the illegal trade on sandalwood in the country but reports on confiscated products indicate that it is multi-million dollar illegal business. The sandalwood tree received protection through 2007 Presidential Decree and is one of the species cited for protection in the country's Forest Act 2005. To widen control in sandalwood trade in the region and globally Kenya proposed its inclusion under CITES in 2013 COP 16 meeting in Bali, Indonesia. However, recent studies indicate that the two protection instruments have not been sufficient to deter illegal harvesting and trade across the country and hence need for more strategic interventions that take into consideration the interests of the land owners, among others (Ochanda, 2014).

4.4 BAOBAB FRUIT

Baobab (*Adonsonia digitata*) is an iconic multipurpose tree of the semi-arid and sub-humid zones of sub-Saharan Africa whose leaves, fruit, seeds and trunk provides a variety of uses that include water storage, medicine, oils, and clothes. Its fruit is a nutritious source of food and incomes from fruit sale to hundreds households. Its fruit pulp has five times vitamin C concentration of an orange, and is high in minerals such as calcium, magnesium and iron. The fruit can be eaten fresh or processed into porridge, juice, jam, ice cream and sweets. The seeds are rich in protein and fat and can be roasted and eaten as a tasty snack or pressed into oil for consumption and industrial use, particularly for cosmetic products. The leaves have high protein, beta-carotene and iron content and are used fresh as leafy vegetables or dried and powdered as a soup ingredient. The production of baobab pulp and leaves is almost entirely based on trees growing naturally in forests and woodlands or in farmers' fields. Therefore its fruit has the potential to play an important role in family nutrition and food security in marginalized rural communities. In addition, baobab products have growing markets in the country, Europe and the US. Therefore baobab products offer income opportunities to landowners that have baobab trees on their farms. However, despite a long history of traditional use, most baobab products in Kenya are not marketed to generate income to producers.

Elekea Nairobi based SME has established an integrated baobab processing plant to produce O'Bao Baobab Fruit Powder brand that consist of a range of products for the purpose of building an economic business around the baobab resource in Kenya. This is because the presence of baobab trees is increasingly becoming a burden to land owners who do not see any economic potential hence cases of increased felling of the magnificent tree to make way for conventional agriculture. The Elekea strategy is to use integrated processing procedures to utilize all baobab fruit by-products such as use of shells to produce various products like charcoal briquettes and oil seed cake for animal feed. This SME, in collaboration with KEFRI, has been creating awareness on the economic potential of baobab trees by providing markets for baobab fruits in ASALs of Eastern and Coastal regions of Kenya. Elekea with support from KEFRI has built a network of women groups to harvest, assemble and sell baobab fruits through fair-trade pricing structures to incentivise the farmers to protect the trees.

4.5 TAMARIND PRODUCTS

Tamarindus indica commonly known as *Tamarind* tree is one of the most important multipurpose tropical fruit tree species that grows in ASALs and coastal areas of Kenya. Its fruit has been used as a traditional medicine in Asia and Africa for centuries. In Kenya many communities use tamarind fruit to treat many ailments such as abdominal pain, diarrhoea and dysentery, among others, since the fruit is rich in phytochemicals, and hence possess antidiabetic, microbial, venomic oxidant and malarial activity. Thus the plant has potential for commercial utilization in medicinal and pharmacologic activities.

In Kenya the tamarind business revolves around linking fruit collectors in ASAL counties of eastern and northern Kenya, most in Tharaka-Nithi, Kitui, Lamu, Baringo and West Pokot, to key markets in Mombasa for because other local market opportunities are limited. The production from the key counties experience some seasonal fluctuations hence influence offer price across the entire market chain. In 1999 the price per kilo in Tharaka-Nithi County was KES 3(\$ 0.04) but in Mombasa it traded at KES 20-60(\$0.26-0.79). The country is estimated to have capacity to produce 600-800 tonnes per year (Bester, 1999). Although the export market potential exists in Japan, North America, Europe and Middle East, the country only exports about 1,000 tonnes per year to Somalia and Yemen. The ripe fruit is usually eaten fresh and also made into juice, jam, syrup and candy in India; a practice that can be adopted by local firms in Kenya.

4.6 TANNINS

Tannins are a light brown chemical substance found in plants that is used to tan leather. Its use in leather processing is legendary for it can be traced to the Egyptian and Babylonian civilizations. It is produced from a wide variety of plants but during the 20th century black wattle (*Aciacia mearnsii*), originally from Australia, had become the main source of high quality tannin used internationally in the leather sector. Solid wattle extract for export contains a legal minimum 60% tannin since most exports are in the form of solid extract for ease in freight. Roughly half a kilogram of pure tannin is required to process a kilogram of air dried leather for shoe soles and lesser amounts are used for lighter leathers. In 1999, South Africa produced 66% of world supply of black wattle tannin extract from its 202,345 hectares under South Africa Wattle Producers Association and Kenya was second with 25,000 tonnes. The winding of East African Wattle and Extract Company (EATEC) in 2000 saw the subdivision of its 10,000 hectares of black wattle estates near Eldoret. The exit of EATEC saw the closure of the tannin extract factory in Eldoret, leaving the country with only three factories in Nairobi and Thika that are still being sustained by bark supplies from North Rift region, Central and Eastern Kenya and imports from Tanzania.

The tannins are critical for the country's leather factories that rose from 9 in 2005 to 13 in 2009 with capital investment of KES 3.8 billion (USD 38 million); and whose production rose from 5,000 tonnes in 2003 to 20,000 tonnes in 2007. The turnaround has been largely due to increase on tax levied on raw hide exports from 20% in 2006 to 40% in 2007. The leather factories employed 4,000 people. However, the country's black wattle extract exports fell from 5,340 tonnes in 2002 to 46 tonnes by 2008 due to combination of falling production of bark due to closure of EATEC and increased domestic demand with expanding leather tanning sector that needed up to 10,000 tonnes of tannin per year in 2009. The main importers of tannin from Kenya were UK and India.

The demand for the tannin in the country is expected to increase with the growth of domestic leather sector and the country may realize some shortfall in the next few years if the sector maintains the current declining annual growth.

4.7 ALOE PRODUCTS

Aloes are a group of succulent plant varieties adapted to dryland conditions. They have emerged as an important source for production of various medicinal and industrial products. The key Aloe species of high value include *Aloe turkanensis* and *Aloe secundiflora* that contain highly valued aloin content that is most sought after for its high natural ingredient for body lotion and medicinal products. There are two Aloe products processors in the country, namely the Pwani Aloe Processors based in the Coastal region and Baringo Bioenterprise based in Baringo County of Rift Valley. The two processors purchase and process indigenous aloe products for local and export markets. Some research and development work by KEFRI, KFS, and KWS, among other players, resulted in the publication of technical guidelines on planting, management and harvesting of various aloe species in the drylands. Many individuals, groups and institutions have trial plantations of Aloe of various sizes across the ASALs areas of the country. In 2008 KWS published Aloe Regulation to guide Aloe leaf harvesting and processing in the country. The sector is still in its infancy and is likely to expand its presence in the future due high interest from various investment groups, both at primary and secondary production, targeting growing local and global markets for herbal ingredients and remedies. However, global trade in indigenous Aloe products are regulated under CITES and therefore local producers eyeing international markets have to undertake rigorous management and production procedures that meet the stringent export licensing requirements by KWS.

5.0 TECHNICAL AND COMMERCIAL ORGANIZATION OF FOREST PRODUCTION

5.1 TECHNICAL AND COMMERCIAL ORGANIZATION IN PRIMARY FOREST PRODUCTION

Technical and commercial organization in primary production looks at the organization, the structure of the sectors, skills and strategies to enhance primary forest production in key enterprises such as sawlog, polewood, firewood and charcoal production. Primary forest resources are normally managed through well-defined management plans that align resources around technical and commercial aspects of the business. In primary production KFS has been the dominant player with well-organized administrative structure and resources to cover the core business of management and protection of public forests and support to private and individual forest owners. The KFS management organization is multifaceted, and includes social, commercial and service provisions. The recent entry of commercial oriented entities such as the tea estates, social entrepreneurs, investment syndicates and individual investors has changed the primary production landscape into more efficient profit driven business models.

5.1.2 Kenya Forest Service

Kenya Forestry Service is parastatal with delegated management structures by the Kenya Forest Service Board managing the entity on behalf of the central government. It is the technical arm of the government that manages all types of forests on public lands and provides support to private and individual forests. KFS has its headquarters in Karura where the Directorate is located and has 9 regional level conservancies. KFS has employed about 5,000 workers in directorate, while technical support and enforcement account for about 3,000 to undertake its various functions. It collaborates with many non-state agencies with interest in forests including individuals, producer associations, private sector estates and county governments. The public forests are classified into 3 categories depending on the management objectives, and these are commercial plantations for production of wood, natural forests for biodiversity and water provisioning, and nature reserves for biodiversity conservation. The extension division of KFS is mandated to provide technical services to private, communities, county and individual forests owners. KFS is well-organized in terms of technical capacity and organization structures for both commercial and non-commercial aspects of forest management.

5.1.3 Forestry education and research

In forestry education the Kenya Forestry College, started in 1957, enrolls students for certificate and diploma in forestry courses that is geared towards skills on practical competence in forest management operations in nursery, plantation silvicultural operations, basic survey, fire and pest and disease control. At graduate forestry foresters in the country received their trainings in Makerere University in Uganda, Sokoine University of Agriculture in Tanzania and Nairobi University in Kenya until 1986 when Moi University was established as a premier forestry institution. The split of Moi University constituent colleges into fully fledged universities in 2013 saw the forestry courses retained in the University of Eldoret. However, many universities in the country have started various courses related to forestry that include natural resources management (Egerton and Kabianga), Agroforestry (Eldoret and Kabianga), environmental management (Kenyatta and Eldoret) and recently dryland forestry (South Eastern). Many other universities offer hybrid courses on forestry, environment and natural resources.

The Kenya Forestry Research Institute (KEFRI), established in 1986, has mandate on research to generate and promote improved technologies for sustainable management, conservation and development of forests and allied natural resources. The Institute's research activities cover all aspects of forestry and natural resources that are aimed at addressing various issues and challenges in the forestry sector. Its key research themes focus on (a) development and promotion of efficient technologies for processing and utilization of scarce forest resources; (b) development of technologies for rehabilitation and sustainable management of natural forests and woodlands; (c) improved productivity of forest plantations and trees planted on farms through species diversification and breeding for high quality tree germplasm; (d) forest policies and legislation, society interests on forests and environment, forest governance, and markets and trade in forest products; and (e) development of strategies for dissemination of forestry technologies and research findings to stakeholders. The Institute has played a key role in the identification, selection and promotion of species for various agro-ecological zones in the country for both subsistence and commercial purposes. It also supports training and capacity building in forest management, product processing and pest and disease control, among others. KEFRI has about 1,000 staff, ranging from technical to support services, to carry out its various functions.

5.1.4 Investment syndicates

This is a new set of limited companies that have acquired investment funds from corporate and individual investors locally and overseas, and with interest in green economy and profits from forestry enterprises. Examples include Better Globe Forestry Ltd in eastern drylands and Coast region, Million Tree Project, in western Kenya, and KOMAZA in Kilifi County in the Coast region. The companies have partnered with tree growers under various partnerships that involve signing of contracts between the individual farmers and the respective companies.

Under the contract agreements the companies provide seedling and technical services whereas the land owners provide some minimum land for planting trees and woodlot maintenance. The proceeds from sale of the harvested produce are shared between the two entities in agreed ratios after costs are deducted. Some contracts are leasehold type where the investors pay land owners for the use of the land for an agreed period that ranges from between 10 to 30 years, depending on rotation period of the tree crop. The payments also vary from wholesome for contracted period to annual payments. Some contracts are flexible and provide room for contracted tree growers to withdraw from a contract within the contract period by paying stipulated compensation sum to the company for costs incurred. The technical and organizational structures are well structured for the companies for they normally operate as business entities, and with staff with technical and financial expertise to advise the companies and individual tree growers. The trees grown are managed to the highest standards that meet the expectation of the investing company and individual contracted farmers.

5.1.5 Smallholder tree growers

This category includes many smallholder tree growers with some orientation on commercial tree growing, mostly in the high potential humid zones and drylands. The sizes of planted areas vary according to the land owners objectives but range from less than 0.025 hectares for subsistence smallholders to over 10 hectares for commercial tree growers, mostly for production of transmission poles. The smallholder tree growers generally are poorly organized because in most cases the individual farmer manages the production systems with minimal professional inputs from public officers, NGO staff or other technically qualified personnel. The management operations involve land preparation, tree husbandry and harvesting.

The smallholder sector has been target for transformation into better organized producer associations to enhance yields and pricing for key products. Estimates indicate that after many years of pilot trials and support from NGOs and public agencies there are 10,000 tree growing farmers that are members of planting groups across the country. The groups include the Western Kenya Tree Planters Association (WETPA), started in 2007 with support from Forest Action Network (FAN) that targeted supplying of firewood and pulpwood to Pan African Paper Mill (PPM), among others markets. Since then five other tree planting groups have been started across the country, and they include the South Coast Forest Owners' Association, Kisii Tree Planters' Association, Meru Farm Forestry Association and Community Food and Environment Group. The five were recently transformed into Farm Forestry Smallholder Producers Association of Kenya (FF-SPAK) with the support of Swedish International Development Cooperation Agency (Sida) and the International Family Forest Alliance (IFFA). In 2014 the Forest Farm Facility (FFF), a multi-donor funding programme co-managed by the FAO, the International Union for the Conservation of Nature (IUCN) and the International Institute for Environment and Development (IIED), was launched to strengthen forest and farm producer organizations globally including Kenya.

During the launching of FF-SPAK the participants drew up a six point plan to operationalize it that included the following:

1. Broaden the membership base of forest and farm networks
2. Register cooperatives and shape governance structures so that the networks can do business
3. Assess market demand against what farmers together might supply
4. Build management and administrative capacity
5. Explore options for self-generating, or getting access to, start-up finance, and
6. Strengthen government extension work and services at the appropriate level.

5.1.6 Large scale tree growers

The Kenya Forest Growers Association (KEFGA) is an umbrella tree growers group with more bias towards large scale players in the country. KEFGA has a well-structured national office and its members pay registration and annual subscription fees based on size of their forest woodlots, and are categorised into two groups: those with woodlots below 12 hectares and those owning above 12 hectares. KEFGA is yet to open branches in the regions and counties. Its membership is estimated at 5,000 members. KEFGA was very instrumental during the drafting of the National Forest Policy 2014 and National Forest Management and Conservation Bill 2015 and in this way ensured that the interests of private tree growers were included in both documents. According to KEFGA brochure there are an estimated 16,000 private tree growers in Kenya who have added 17,000 hectares of forest cover across the country and 30,000 new jobs in rural areas. KEFGA members were critical in supplying about 200 saw millers that operated during the ban on harvesting sawlogs 2002-2012; especially those that diversified to use less preferable timber species such as Grevillea and Eucalyptus.

5.1.7 Charcoal producers associations

Another producer association operating in the country is the Charcoal Producers Associations (CPAs) which is the outcome of the subsidiary legislation the Charcoal Rules 2009. The Charcoal Rules 2009 requires that all charcoal producers in the country to become members of a CPA in order to be registered, licensed and qualify for technical support by KFS and county governments. The CPA is an umbrella body to bring together individual charcoal producer groups who control and produce charcoal in a sustainable way in the various parts of the country. Some of the requirement includes registration under the Societies Act, CAP 108, and among the provisions are procedures for election of officials to manage the CPAs and terms of office for elected officials. The CPAs are required to develop management plans for not less 100 hectares, use high recovery technologies, and have a tree nursery with capacity of at least 25,000 seedlings. Several CPAs have been registered with the KFS directorate and their operational status is yet to be evaluated.

5.2 TECHNICAL AND COMMERCIAL ORGANIZATION IN SECONDARY FOREST PRODUCTION

5.2.1 Timber Manufacturer Association (TMA)

Timber Manufacturers Association (TMA) was formed in 1981 to promote the interests of saw millers countrywide. It is a loosely operated entity without clear leadership structure and business operation. TMA objective is to lobby for timber rights for its members mostly from KFS plantations. At its inception it had 200 active members and now has 300 members on paper as 80% closed their saw mills and are yet to open due to unclear tendering processes. Its members are required by KFS to be tax compliant, and have adequate workers compensation schemes and payment of a non-refundable KES 30,000(USD 300) license fee before being considered for pre-qualification. TMA members are of late facing many problems even after lifting of 10-year ban on harvesting trees in public forests. Some of the problems cited by TMA include, its members being stopped from harvesting paid-for-logs by communities and some county governments through physical barricades or court cases, unfair licensing procedures and unfair competition from well-connected buyers in bidding for lots in public forests. The problems are more pronounced in Rift Valley and Central Kenya the regions hosting most public forest plantations in which county governments and communities are contesting management of licensing and sharing of revenues. Saw mills, unlike before when they were the dominant players in the public plantation forest sector, are facing serious competition from large scale integrated wood based industries and hundreds of mobile saw millers spread across the country. During the 10-year ban on harvesting in public plantations some TMA members relied on farms for sawlogs to keep the mills in operation. On the bright side few large saw millers have started establishing own plantations and are also eyeing the highly anticipated public forest land concessions to grow trees for future supplies once the subsidiary legislation on forestland concession is put in place. At present TMA is weak and does not have adequate finances for its activities and its memberships has fallen from 300 members before the logging ban in 2002 (MENR 2008) to sole active chairman by 2015. Other TMA handicaps include its inability to offer business development services to its members (Wamukoya and Ludeki, 2007).

5.2.2 Kenya Wood Preservers Association (KWPA)

KWPA is a membership organization that draws the bulk of its members from wood treatment plant owners, suppliers of treatment chemicals and other persons and entities with interest in wood preservation activities. The main objective of KWPA is to promote the preservation of wood in the country to international standards for longevity in use, convenient to use and attractive to customers. KWPA aspires to achieve its objectives through implementation of its code of practice by members. It also advocates for proper disposal of chemical waste, increased production capacity of plants and reduction of production costs. Members are required to pay registration fees of KES 100,000 (USD

1,000) and an annual subscription of KES 50,000 (USD 500). It has an office in Nairobi staffed with wood scientist who handle inspections of plants and offer full-time quality surveillance. In collaboration with Moi University, KWPA affiliated plants provide internship for fresh graduates to mentor them in wood preservation practices as a means to enhance the country's expertise in this area. By 2015 it had a membership of 40 fully paid up members. KWPA collaborates with Kenya Bureau of Standards (KEBS) in the development of a code of practice for treatment plants in the country in order to ensure that they meet international standards. It also aims at mobilization its members to negotiate for fair prices for raw materials, chemicals and treated wooden pole materials. It also lobbies the government to provide conducive legal and business friendly environment to enable the sector grow. KWPA also offers technical assistance to farmers to form groups of polewood growers that use the best management practices to meet the desired specifications and that attract better prices.

5.3 RELATIONSHIPS BETWEEN ACTORS IN PRIMARY AND SECONDARY FOREST PRODUCTION

In the country there are minimal linkages between primary forest producers and secondary forest production actors. Though the primary sector is the major supplier of materials to the secondary production sectors in most cases each sector operates independent of the other. In some cases, such as KWPA and TMA, the formal structures have some interest in primary production through technical support and price negotiations or participation in tenders for KFS which is the dominant primary sector player. The secondary production sectors in some cases use brokers to source raw materials from farmers through some formal or informal supply contracts. This is largely because farmers don't provide continuous supply of wood but in most cases sell trees in times of need or once after a long period.

Past attempts to link tree growers to secondary producers has failed because trees take long time to mature and family dynamics make it difficult to draw and observe contracts that bind tree growers to secondary producers as buyers. Some of the issues that arose on use of contracts to link farmers to industry were high cases of failure due to their non-observance of the agreed terms. The problems cut across others sectors like tea, tobacco, sugarcane and coffee sectors where farmers on realization that they could fetch higher prices from non-contracted buyers ended selling to them despite some payments advances or contracts in place. Some contracts drawn by few industrial firewood consumers were not feasible because the farmers could not supply on regular basis but often after more than 2 years.

5.3.1 Kenya Forest Service

The KFS, during the difficult economic period of 1990s under the Structural Adjustments Programme (SAPs) fronted by IMF, faced severe financial strains and had to enter into informal arrangement with some of the largest roundwood consumers to support plantations forest establishment in logged areas. The major actors were Rai Ply, and Timsales that initiated large tree nurseries in Elburgon and Timboroa that supplied KFS with millions of free seedlings for plantation establishment. In some cases the firms undertook establishment of plantations on sites they harvested for free or no condition attached as part of their corporate responsibility. The rationale for the undertaking could be based on anticipation that the established plantation forests will be allocated to them on maturity given that the firms are major buyers of roundwood from KFS plantations. KFS has also been collaborating with forest adjacent communities through participatory forest management framework (PFM) to undertake various forest related operations that include seedling production for sale to KFS, farming in logged areas, planting of seedlings, thinning and pruning operations and forest protection. The PFM activities are implemented through KFS registered community forest associations (CFAs). By 2014 there were 97 CFAs in the country that had signed management agreement with Director of KFS under PFM covering 1,000,000 hectares. The collaboration and sharing of costs and benefits between KFS and CFAs have remained an unresolved issue and therefore major source complaints by communities.

5.3.2 Western Kenya Tree Growers Association (WTGA)

WTGA is a large a tree growers association that was affiliated to Pan African Paper Mills (PPM) before it collapse in 2009, in an out-grower scheme to supply firewood and pulpwood. The out grower schemes had over 25,000 registered tree growers spread over 10 counties within a radius of 100km of PPM. PPM had technical officers in 8 counties to provide professional services alongside staff from KFS, NGOs and other agencies. The arrangement was the most elaborate linking framework to be developed in the sector but the relationship collapsed when the factory wound up in 2009.

5.3.3 Homalime Limited

In Nyanza, Homalime Ltd, an industrial lime manufacturer that consumes large volumes of firewood in its lime processing, and has developed a woodlot development programme with various land owners. Homalime signs contracts with land owners with interest in establishing woodlots within the Nyando Valley where it is located. Once contracts are signed Homalime goes ahead to develop woodlots, mostly of Eucalyptus, on behalf of the land owners under a flexible model where it deducts its costs on harvesting of the woodlots or receives reimbursement of the planting and maintenance costs in cases where the landowners decide to sell the wood to other buyers.

The flexibility of the contracts has attracted many tree growers with most smallholders preferring to operate within the contract of being paid net of the incurred costs after harvesting by woodlot by Homalime. However, most large scale growers opt to repay the expenses after 2-3 years of the contracted period and regain ownership of the woodlots for disposal to any buyers or own use. The Homalime model has worked well due to good supervision and flexible terms that need deployment of resources into the venture that many companies may not be willing to commit, hence the reason for them opting for simpler supply agreements that outline the quality requirements and price offer for materials ready for harvesting or delivery.

5.3.4 Syndicated and social investors

Currently there are three such partnership arrangements in the country KOMAZA Ltd in Coast region, Better Globe Forestry in Eastern and Coastal region and Friends of Mau Forest (FOMAWA). The first two are discussed below

5.3.4.1 KOMAZA Tree Based Social Enterprise

KOMAZA is a non-profit social enterprise that was founded by Tevis Howard, a social entrepreneur, through various award grants that have been invested in promoting small scale tree growing enterprises. KOMAZA through its micro-forestry model that combines microfinance, sustainable forestry development and forest conservation operates in the semi-arid areas of the coastal strip in Kenya. KOMAZA works through village based social businesses that provide registered farmers with agricultural inputs and tools on credit such as improved seeds and fertilizer and on-farm support training. The business model is a vertically integrated value chain of services to facilitate smallholder's access markets and transform their unproductive land into valuable trees farms. KOMAZA recovers its costs and earnings from each farmer and reinvests in its expansion and community development activities. KOMAZA's vision is to mould a self-sustaining and self-scaling partner for rural development. By 2015 KOMAZA had registered 4,200 farmers in its tree growing activities and intends to recruit up to 10,000 smallholder farmers growing a total of 2 million trees. It has employed more than 100 people in its technical and extension activities. KOMAZA plans to commission processing plants for charcoal production, fencing poles and transmission poles to add value to trees from farmers and enable them access high end markets in the coastal region. KOMAZA has demonstrated the potential of tree based businesses and some resourceful farmers are already replicating the model independently on their own farms at a fast rate that may surpass the project activities in the future. However, the success of the model in the long run will be gauged after the first forestry cycle is complete, operation of processing facilities and returns from the markets for various products.

5.3.4.2 Better Globe Forestry Ltd (BGF)

BGF is a profit driven forest sector investor that collaborates with various land owners in profitable forest enterprises mostly based on specific commodity. The *Melea volkensii* planting is a timber commodity venture that revolves around a well-known hardwood timber species that grows well in the drylands of Eastern Kenya. It currently has 450 hectares under contract plantation with farmers and other partners. It intends to open a wood

processing unit for harvested roundwood from contracted farmers when the trees mature. BGF is also in the process of contracting farmers with one hectare and above to grow *Acacia senegal* for gum Arabic production in Kitui and Makueni counties. BGF is supplying seedlings and technical support for its establishment and the farmers takes up its protection from animal browsing. It projects to recruit 600 farmers for 2015-2016 seasons. The projects aims at producing Gum arabic for local use and exports when the plantations mature after 6-8 years. BGF concepts are based on a mixture of models that range from long term leasing of land to grow trees and to various contract arrangements with land owners depending on the preferences and interests of the partners and for mutual benefits.

5.3.5 Actors in non-timber products

This is the least organized sector that includes a wide range of small scale operators such as honey gatherers, herbal medicine collectors, and pastoralists involved in gum and resin collection. The sector is characterized by small scale actors that collect specific non timber products in small quantities from the wild for subsistence or sell to merchants. The non-timber products collected from forests and woodlands in the country include the following: Aloe sap, honey, fruits, grass, gums and resins. For example, in Northern Kenya some attempts have been made to organize gum and resin collectors into loosely networked groups that are trained on improved tapping procedures and linking them to better markets. In public forests under PFM, CFAs in collaboration with KFS regulate collection of non-timber products for own uses.

6.0 TRADE IN TIMBER AND OTHER FOREST PRODUCTS

6.1 LOCAL PRICES FOR SELECTED PRODUCTS

A recent price dynamics survey indicates that the prices of sawnwood varied per species and wood density (Cheboiwo, 2014). In the Coast region most of the softwood sawnwood imported from Tanzania and Malawi, were mostly of Cypress and Pines. All the hardwood sawn timber was imported into the country. This is because of the restriction on harvesting from local natural forests and those from farms are almost exhausted. The hardwood sawn timber such as that of camphor and Mvule were imported from Tanzania but Mahogany was imported mostly from Democratic Republic of Congo (DRC). The softwood sawnwood timber traded in most towns including Nairobi was from local supplies after lifting of the ban on harvesting in public plantation forests in 2012.

The Cypress sawnwood prices ranged from USD242/m³ in Eldoret to USD 297/m³ in Malindi. Similarly Pine sawnwood was the cheapest in Eldoret and most expensive in Nairobi (Table 10). Mahogany timber ranged from USD 508/m³ in Eldoret to USD 742/m³ in Mombasa, probably due to the cost of transport from DRC. Cedar from Narok and some imports from Tanzania were more expensive in Mombasa and cheapest in Eldoret due to proximity to production sites in Uasin Gishu and Keiyo-Marakwet Counties.

Table 10: Retail prices of sawnwood in selected towns in 2014

Town	Prices (US\$/m ³)								
	Cypress	Pine	Mahogany	Mvule	Cedar	Campho	Grevillea	Eucalyptus	Indigenous
Malindi	297	224	636	742	415	657	-	-	-
Mombasa	288	246	742	826	475	-	246	-	-
Kisumu	267	225	-	-	-	-	204	203	203
Bungoma	254	246	-	-	322	-	156	153	-
Nairobi	288	254	614	742	466	-	148	225	195
Nakuru	254	242	602	-	360	-	180	-	-
Kericho	275	-	-	-	-	-	191	191	220
Nyeri	254	212	-	-	-	-	127	191	-
Busia	220	-	-	847	-	-	161	161	203
Eldoret	241	216	508	572	317	-	127	136	-

Source: Own annual price and products flow dynamic surveys: 2014-2015

6.2 LOCAL PRICES FOR KEY FOREST PRODUCTS: 2009-2013

The price trends for key tradable forest products such as sawnwood, charcoal, construction poles and transmission poles shows that normalized prices have been on an upward trend as shown in Figures 2a, 2b, 2c and 2d. The prices for the selected products that were traded within the country, except for charcoal in Mombasa, exhibited a smooth upward trend. However, sawnwood recorded a price spike in local markets in 2002 immediately after the ban on logging in public plantation forests in 2002 but the upward price trend was checked by entry of imported sawnwood from Tanzania in 2003. The products price trends reflected the supply and demand dynamics of the specific products in the country.

In summary prices for the selected forest products are likely to take an upward increase in the medium and longer term due expected increase in demand in the vibrant construction sector and projected constrained supplies from both public and farm forests.

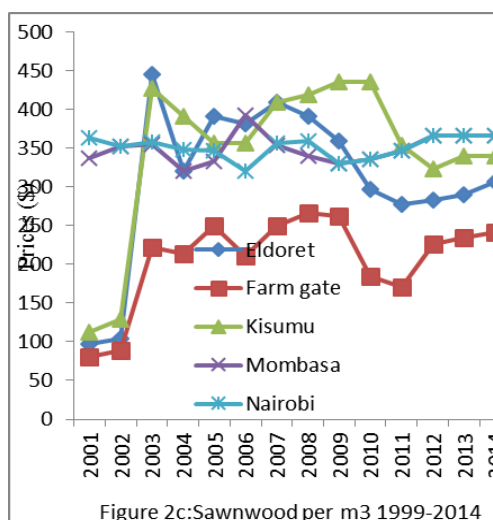
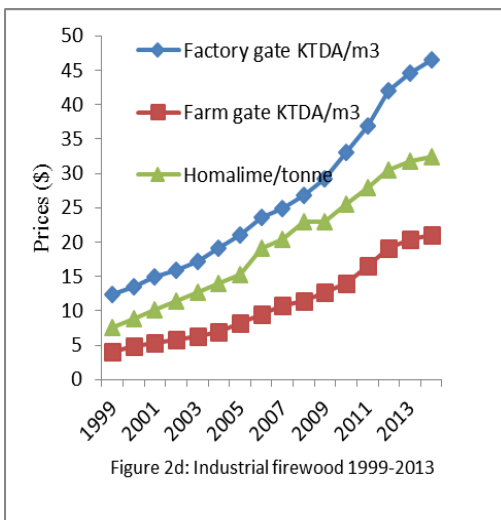
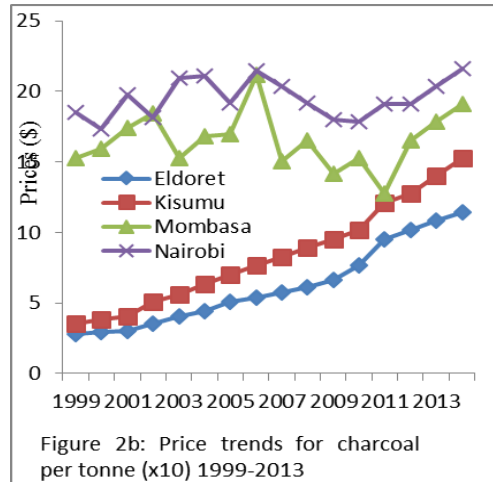
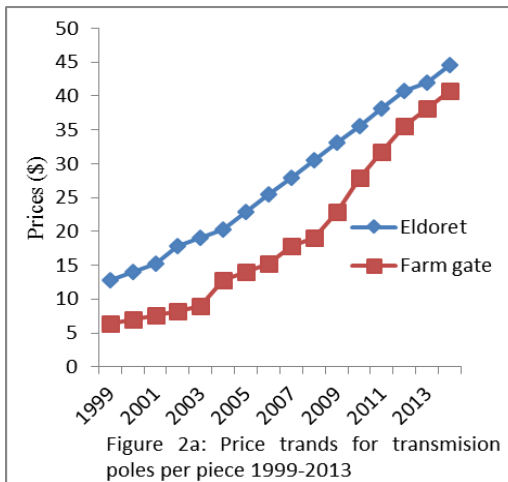


Figure 2: Price trends for key tradable forest products
Source: Own Annual price and products flow dynamic surveys for 2014-2015

6.3 TREE PRODUCTS IMPORTS FROM EAST AND CENTRAL AFRICA

Kenya stopped harvesting hardwood from its public indigenous forests in the 1980s and since then the entire secondary forestry sector relies on softwood from public forest plantations, farms and community forests. However, the country's construction and woodwork sectors are undergoing rapid growth hence need large quantities of both softwood and hardwood timber to meet the demand occasioned by rapid urbanization. The woodwork sector that includes furniture, joinery and house fittings needs large quantities of hardwood and softwood timber to meet the increasing demand for local uses and export. The country has progressively increased its hardwood timber imports from DRC and softwood timber from Tanzania to close the widening gap between local timber production and demands. The country has developed a vibrant timber import infrastructure over the years that includes favourable policies and laws, regulatory and enforcement agencies and a wide range of players including timber importers, transporters, wholesalers and retailers to support cross border timber trade. Hardwood imports from DRC rose steadily from 9,267 m³ in 2009 to 38,506 m³ in 2013. The records exclude quantities that may have entered into the country through unofficial routes.

Softwood sawn timber from Tanzania peaked at 57,300 m³ in 2010 but have since fallen to 9,425 m³ by 2013 (Figure 1). However, for softwood the lifting of sawlog harvesting ban in 2012 has seen local softwood timber outcompete those imported from Tanzania in major markets outlets in the country. The spike in transmission pole imports in 2012 may have been due to export tender awards to Tanzanian firms to fill local shortfalls.

Despite the reforms being undertaken in the region the trade in forest products still remains in the hands of informal sector players due to policy and legal barriers that have hindered development of competitive markets and marketing systems.

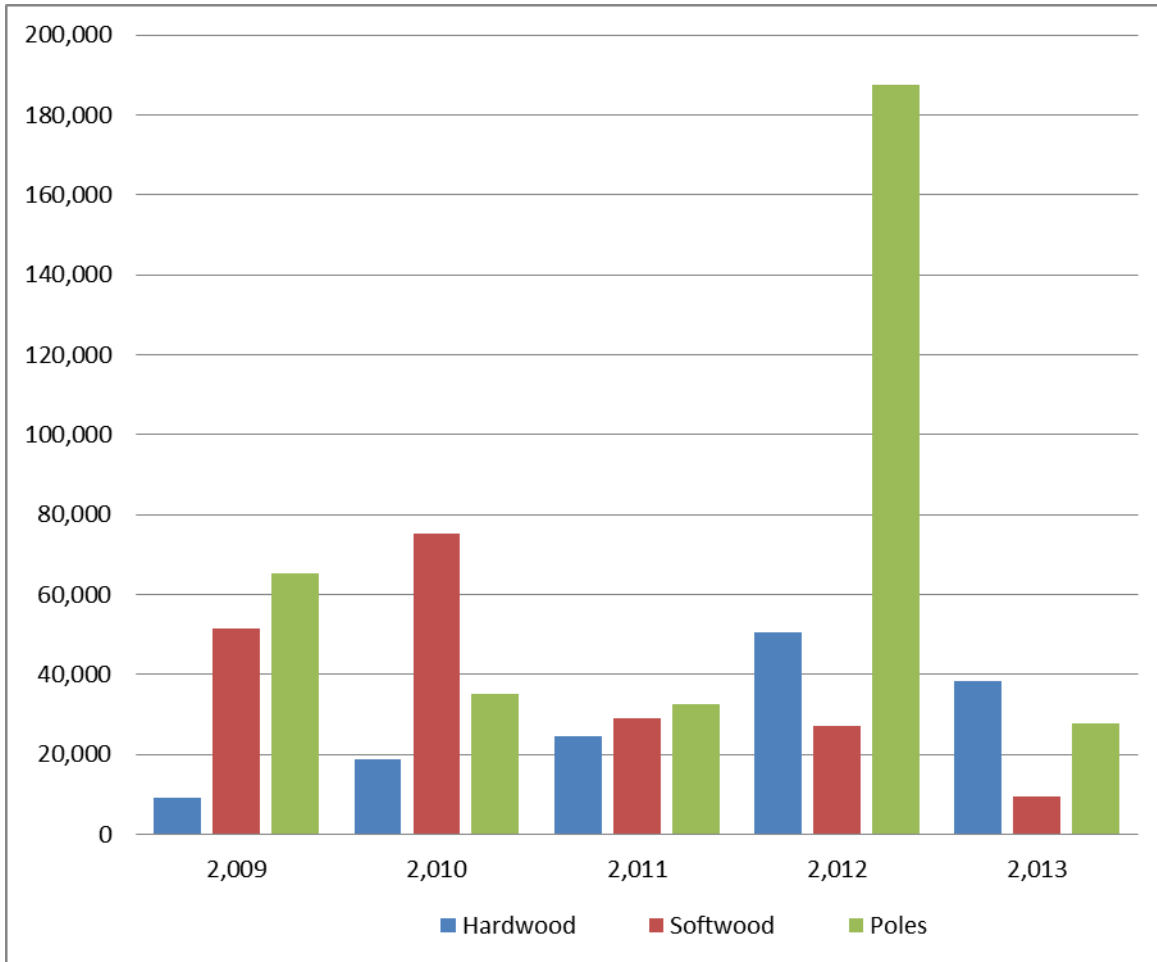


Figure 3: Import of sawnwood and treated transmission poles from East and Central Africa
 Note: Hardwood and softwood sawnwood are in m³ and poles are in number of pieces.

6.4 VALUE OF CROSS BORDER TIMBER TRADE

The cross border timber trade between Kenya and its partners in East and Central Africa is of great socio-economic importance to various players in the market value chain that includes government agencies and private sector traders (Cheboiwo et al 2014). Between 2009 and 2013 the total value of timber imported into the country from both DRC and Tanzania was KES 15.6 billion (\$184 million) out of which the government sector earned KES 3 billion (\$36 million) in form of taxes and fees. The private sector players, with transporters leading the pack, accounted for the balance of KES 12.6 billion (\$148 million) (Figure 4). The timber imports are facilitated by an array of players that include loggers, processors, exporters/importers, clearing agents, brokers, wholesalers, retailers and furniture and fittings businesses that generate employment and incomes from cross border timber trade.

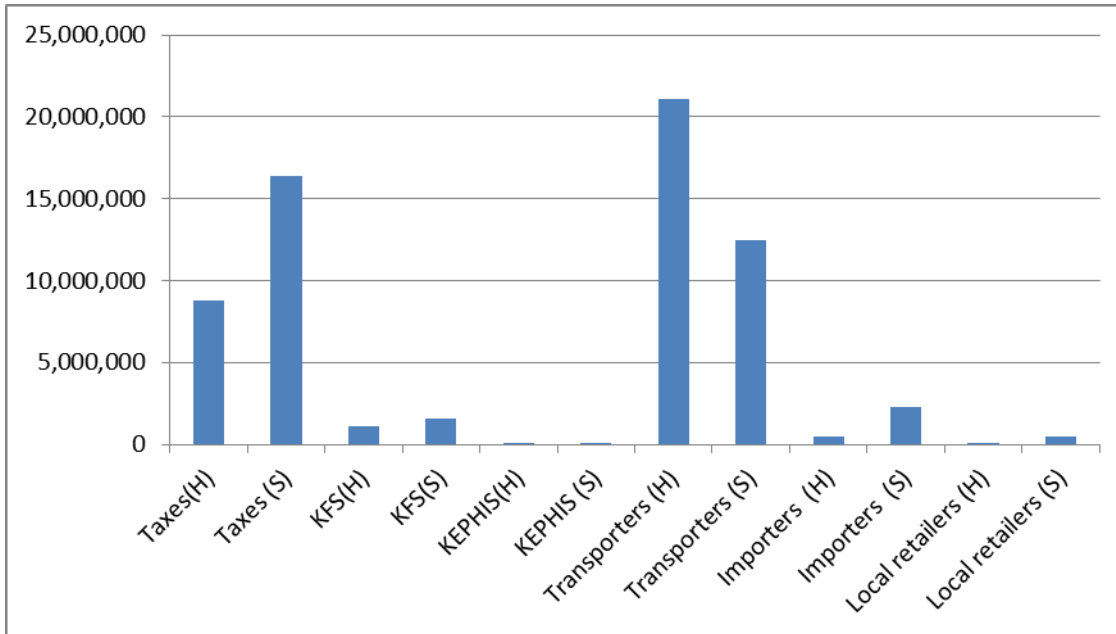


Figure 4: Taxes and levies collected by various agencies from harwood (H) and softwood (S) products imports (US\$)

6.5 INTERNATIONAL TRADE IN FOREST PRODUCTS

Kenya, despite being the most industrialized in terms of the number of wood based industries in the region, remains a net importer of various products that include timber, paper and paper products, wood based panels (Table12). The exports include paper and paper products, wood based panels, pulp and recovered paper. For example in 2014 Kenya imported 47 million metric tonnes (MT) of wood based panels and exported 3.5 million metric tonnes of the same. In the period 2010-2015 the value of imports was US\$ 1.8 billion as compared to US\$ 350 million worth of exports. The trend in imports, on average, is on an upward trend, whereas exports are on a downward trend; indicating the country's balance of trade in forest products is negative. The collapse of PPM in 2009 translated into massive jump in imports and increased the country's dependence on imported paper and allied products.

The exporters of forest products to Kenya include China, South Africa, Malaysia, Tanzania, Turkey, Germany, Thailand, India, USA and Sweden among many others countries.

Kenya exports various wood products which include cork, wood carving, paper, and wattle bark extract to different countries mostly in Africa. These include Sudan, Democratic Republic of Congo, Rwanda, South Africa, Uganda, Tanzania, Ethiopia, Cameroon, Zimbabwe and Western Sahara. Kenya also exports to other parts of the world namely Israel, Italy, England, Belgium, Norway and China

Table 11: Export and imports of forest products in Kenya: 2010-2015

Commodity	2010	2011	2012	2013	2014	2015*	Value in US\$
Roundwood (m ³):Exports	26,592	80,815	14,921	67,699	5,494,320	235,828	4,281,318,736
Imports (m ³)	498,250	213,771	109,3527	117,202	316,5591	1,897,922	6,200,184
Wood Fuel (MT): Exports	84.9	34.2	24.1	136.5	129.6	56.1	184,455
Imports (MT)	23	75	48	73	9	163	138,493
Sawn wood (MT): Exports	147,050	137,105	101,874	38,755	55,116	34,550	7,347,849
Imports(MT)	112,617	173,782	121,034	103,786	128,700	196,952	1,300,756
Wood based panels (MT): Exports(MT)	12,621,196	14,636,908	10,666,984	10,750,900	10,370,338	5,300,483	134,641,197
Imports	31,901,758	37,254,300	46,315,076	45,896,200	56,298,649	47,040,139	52,031,670
Pulp/recovered paper (MT): Exports	18,626	2,388	6,530	893	11,586	12,094	6,920,106
Imports	2,433	1,629	1,288	1,114	1,480	1,031	101,253
Paper/paperboard (MT): Exports	45,220,274	52,310,413	56,178,002	53,527,093	45,204,168	35,287,459	1,625,574,900
Imports (MT)	301,486	320,126	304,073	306,831	351,998	239,466	290,695,325
Total export value in USD	49,217,776	64,476,491	61,058,594	79,254,997	55,618,725	40,841,099	350,467,683
Total import value in USD	255,215,865	344,315,717	323,905,628	304,345,011	335,802,539	241,336,181	1,817,481,696

Source: National Bureau of Statistics 2015. *Data up to August 2015

6.6 BARRIERS TO PARTICIPATION OF TREE GROWERS IN LOCAL MARKETS

There are various barriers that constrain tree growers in accessing and benefiting from various tree products markets in Kenya.

6.6.1 Timber quality

The timbers from public forests and private forest plantations that are harvested and processed by the state of art machines and well-seasoned before use form the bulk of high quality traded timber in the country. However, trees grown on farms in many cases are not managed to meet market specifications for various market niches, and therefore have many quality challenges such as deformities from animal damages, nail wounds, heavy branching and smaller diameters due high planting density. The situation is made worse by use of powers saws in processing into timber. The many defects therefore lead to high rejection rates and discounted and lower price offers on selling and this in turn leads to lower incomes to growers as compared to competing large commercial growers. Therefore quality challenges can become a barrier to entry into competitive local and regional markets. Some of the challenges can be solved through capacity building of smallholder tree growers on tending trees, use of superior germplasm, good spacing and management of the stands and use of superior processing technologies.

6.6.2 High transportation costs

The cost of transporting various low value forest products is relatively high and eats into revenues tree growers earn at the market place. The high transport costs is due to poor road networks connecting production to consuming areas, especially off trunk roads that contribute significantly to delivery prices. For example, transport costs for industrial firewood delivered at Eldoret constitute 53% of the factory gate prices in Eldoret. Thus good road networks will cut down the share of transport costs that can significantly reduce delivery price and improve tree growers take home incomes.

6.6.3 Policy and legal barriers

Tree growers also face various legal and policy challenges starting from felling at farm to delivery of the product to consumers in various markets that include requirement to obtain felling and movement permits that make them incur time and transport costs. Another issue is the forest products movement restriction to between 6PM to 6AM daily and off during weekends that increases transaction costs; such costs are loaded on both the producers and consumers as merchants attempt to maintain their profits margins. A classical example are the provisions in the Charcoal Rules 2009 that many charcoal producers and merchants

report that restriction on movement time adds enormous cost to doing business. The provisions also open up rooms for various levies that are charged on operators dealing in forest products at various stages of the market value chain; and they include movement permit fees, local government levies, in addition to bribes often paid to enforcement agencies along the roads.

6.6.4 Many players in forest product market value chain

Marketing of forest products involves many players that offer services between production to consumption points and each taking a share of the final price. These include loggers, loaders, transporters, brokers and financiers that are active within the tree product value chain. Therefore the fewer the players the more efficient the marketing system becomes in terms of costs. This is because they unnecessarily add costs and final sales price of the product. Thus policy and legal reforms should always be geared to reducing the cost of doing business by excluding the need for extra players to facilitate trade in forest products.

6.6.5 High taxation on forest industry and products

Most players in the market value chain are some of the most affected by both legal and illegal fees imposed by various entities. This is because tree products are not well articulated in both policy and laws leaving room for various interpretations and room for many regulatory agencies that tend to interfere with their movement hence high inefficiency. Apart from the VAT and license fees the enactment of the Constitution of Kenya 2010 brought in two levels of government (central and county) with each imposing its own taxes on natural resource based businesses. This has made the cost of doing business in the forest sector very high, uncompetitive and very discouraging to investors.

6.7 POLICY AND LEGAL ENVIRONMENT

6.7.1 Rationale for policy and legislations

Land use in Kenya is influenced by many factors that include soils, climate, labor, technology and markets. Since land has increasingly become a scarce resource land owners' decision making process on land use choices is, in most cases, influenced by prevailing policy and legal environment through commodity prices and incomes. Therefore governments always influence land use change towards national desired direction through policies, legislations, and regulations that are crafted to provide incentives to land owners to realize socio-economic and social values. In 1990 private land comprised 6% of the total land area; public land that includes national parks, forest land, alienated and un-alienated land made up 20%, and the rest were community lands held by communities or on transition to private land. Therefore favourable forest policies and regulations put in place are likely to

influence individuals, private sector players, among others, to invest in forest enterprises and vice versa.

6.7.2 Policies and laws on forest sector

Some of the policy and legal frameworks with a positive influence on wood supply are those that promote the use of renewable energy, encourage the planting of trees and woodlots by individual land owners, institutions and community groups; and that provide economic incentives, promote sustainable land use planning, facilitate long term tree investments, and promote and facilitate certification and authentication of forest products.

6.7.3 Public private partnerships

A public private partnership (PPP) is a government service or private business venture which is funded and operated through a partnership of government and one or more private sector entities, and could also involve local communities. The recent government decisions to embrace PPPs are aimed to reduce public funding to such ventures, provide new source investment capital, utilize the efficiencies of private sector in running public services and expand the economy for job creation, among other societal benefits. The Public Private Partnerships Act, 2013 of the Kenyan Law Gazetted on 25 January 2013 was developed to tap into the potential of private sector participation in major service and development projects to compliment government investment to deliver “Vision 2030”, which is the multi-sectoral policy blue print. The Act establishes the Public Private Partnership Unit (PPPU) as a special purpose unit within the National Treasury to serve as the secretariat and technical arm of the PPP Committee that is mandated with assessing and approving PPP projects in the country. The key public entities like KFS are required to include PPP approaches into their sectoral policies and legislations in order to effectively guide investment opportunities in the specific sector. Also in this context the National Forest Policy 2014 under objective 6 and National Forest Management and Conservation Bill 2015 section 45 outline some provisions and conditions for implementing forest concessions, and other PPP related management agreements. Further, the Constitution of Kenya 2010 section 69 places some conditions on acquisition of large land and natural resources concessions that include consultative processes and parliamentary approvals.

6.7.4 Policies promoting renewable sources of energy

Policies and legislation promoting adoption of renewable sources of energy by individuals, institutions and community groups include the Environmental Management and Coordination Act (EMCA) 1999, various agriculture policies and laws, Forests Act (2005), the draft National Forestry Conservation and Management Bill 2015, the Forests (Charcoal) Rules, 2009, the Energy Act 2006 and Vision 2030. The Vision 2030 recognises that energy is critical in achieving socio-economic transformation and industrial development.

It recognises that the supply of steady, predictable, quality and affordable energy, among others, is a major ingredient to catalyse industrialization. The EMCA 1999 outlines some incentives to land owners who invest in renewal biomass energy through tax exemptions and subsidies. The Charcoal Rules 2009 provides enabling environment for investors to invest in commercial charcoal production activities under the umbrella of Charcoal Producer Associations (CPAs) which are licensed by KFS to enable them have collective bargaining for better prices and higher returns. However, despite the good government intentions in crafting favourable policies and legislation the outcomes have not been good due to various factors. For example, charcoal has remained a high risk business with minimal long term investment horizon and high turnover of actors because of the many taxes and bribes that actors have to pay to keep their business operating.

6.7.5 Incentives for forestry investments

The Draft National Forests Management and Conservation Bill 2015 provides economic incentives through the establishment of a forest conservation and management fund for commercial forestry. The Bill proposes tax and other fiscal incentives to increase investments in forest land use and forest resource utilization. The Bill also provides incentives for increasing forest and tree cover through the establishment of a National Community Forestry Programme; a National Reforestation Programme; and a National Programme for Craft Apprenticeships and Vocation Training. The Land Act, 2012 provides incentives for communities and individuals to invest in income generating natural resource management programmes. It provides measures to facilitate access, use and co-management of forests, water and other resources by communities who have customary rights to these resources.

6.7.6 Other relevant policies and laws

There are several regulations that would enhance sustainable management of forests in the country, and they include Timber (Harvesting) Regulations, 2009; Participation in Sustainable Forest Management Regulations, 2009; and Agriculture Farm Forestry Rules 2009; and Charcoal Rules, 2009. Participation in Sustainable Forest Management Regulations, 2009, allows KFS to develop joint agreements or long term concession agreements for specified forest related activities. Agriculture Farm Forestry Rules 2009 and proposed Private Forests Rules 2015 allow maintenance of 10% tree cover on farms, encourage sustainable production of wood, charcoal and non-wood products.

6.7.6.1 Policies and laws on sustainable land use planning

The multi-sectoral law, the EMCA, provides safeguards for sustainable land use practices through stringent environmental impact assessments that ensure mitigation measures are put in place in any development activities that involve deforestation or removal of trees. It also requires that regular environmental audits are done to ensure compliance with the mitigation measures that enhance the quality of the environment.

The Land and Land Use Policy 2009 promotes sustainable land use planning through the development of land use plans at national, regional and local levels. The County Government Act No 17 of 2012 requires the undertaking of land use planning in order to facilitate the development of a well-balanced system of settlements that would ensure productive use of scarce land, water and other resources for economic, social, ecological and other functions across counties. Further, it requires new urban centres and developers to include green and open spaces in their development plans without which they will not be approved. It also requires counties to work towards the achievement and maintenance of a tree cover of 10% as outlined in the Constitution of Kenya 2010.

6.7.6.2 Public forest concessions

In line with PPP Act of 2013 the National Forest Management and Conservation Bill 2016 under section 45 provides conducive environment for private sector engagement in long term sustainable forest management practices through various instruments including concessions. The draft National Forestry Conservation and Management Bill 2015 requires that a subsidiary legislation on Forest Concession Framework to be developed to confer right to management of public forests to third party players up to a period of 30 years. Under these conditions, the risk and uncertainty borne by investors with interest in entering partnerships with KFS will be mitigated by the terms outlined in concession framework.

6.7.6.3 Facilitating trade in carbon

The Draft National Policy on Carbon Finance and Emissions Trading supports activities that attract carbon finance to mitigation areas/activities such as sustainable management and conservation of forest areas, afforestation and reforestation. It promotes sustainable energy consumption, use of renewable energy, and energy efficient measures, as well as large-scale tree-planting programmes, plantation forestry with suitable species, and commercial farm forestry to reduce pressure on natural forests. Trading in carbon will bring additional benefits and therefore likely to attract investors to venture into large scale tree growing in the country. Other policies such as those promoting foreign investments are also critical in long term tree investments in Kenya.

6.7.6.4 Promotion of certification and authentication of forest products

The Forest Bill 2015 has provision for the establishment and management of a Chain-of-Custody system for managing tree product flows. It also provides for verification of products sources to minimize illegal exploitation of forests and promote sustainable tree growing in public and private land as a business. It also allows for rules and regulations to establish standards for scaling, grading and marking of timber and other forest products. However, despite global growth of markets for certified forest products there are only a few producers and exporters of certified forest products such as Ukamba Wood Carving Cooperative Society (UWCS) in Mombasa. However, UWCS could not renew its license due to various reasons, the key ones being inadequate finances to pay for license and also inability to maintain the desired procurement and production procedures and standards.

6.7.6.5 Policies promoting gender equity

Since forestry activities are tied to land tenure several policy and legal provisions are in place to reduce gender discrimination in economic activities and all kinds of employments. The land Act 2010 values and principles include equitable access and elimination of gender

discrimination in law, customs and practices related to land and properties on land. Gender equity is also well articulated in Constitution of Kenya 2010, National Land Policy, Land Registration Act and National Land Commission Act. Reconciling customary land governance practices, formal policies, legislation and constitutional requirements to provide for gender equity in all activities and at all levels and situations may remain a challenge in the short term.

6.7.6.6 Policies that promote SMEs development and gender considerations

Vision 2030 envisages realizing an industrial competitive nation through promotion of Small and Medium Enterprises (SMEs) by increasing their productivity and competitiveness. Most forest based SMEs are family owned and hence the family members play various roles irrespective of gender. A recent study put the gender balance in SMEs at 50:50 rating it relatively high as compared to others business sectors (Ngugi and Bwisa, 2013). The government policy requiring at least 30% threshold in women employment in the public sector is likely to have knock-on effect on private sector as well.

6.7.6.7 Policies and laws on management of community land.

Among the three categories of land as per the Constitution of Kenya 2010 community land covers 67% of Kenya's land, making it one of the potential destinations for investments in forestry projects and away from the crowded high and medium agricultural potential areas. However, community land has limited security of tenure to attract private investors or motivate local individuals to invest in land development activities such as growing trees. The Draft Community Land Bill 2015 that seeks to provide a strong legal framework for management of community land and land based resources, including forests and trees, has generated a lot of conflicting issues that may push its enactment further into the future than anticipated. In the meantime forests and trees in community land will be prone to the tragedy of the commons, with more degradation experienced mainly through livestock overgrazing; and overexploitation for firewood and charcoal. This is because most of the charcoal consumed in the country is sourced from ASALs. The drylands have high potential to attract investments in sustainable dryland forests for firewood, sawnwood, poles and charcoal production through planting of fast growing and drought tolerant tree species or conservation strategies that will allow vibrant regeneration through use of existing technologies.

6.7.6.8 Viability of forest versus agricultural activities

The fast growth in population in the country has necessitated enactment of policies and legislation to facilitate expansion of land for agricultural production, and this has been mostly at the expense of land under forests and trees. Pricing of agricultural crops and provision of subsidized inputs have favoured agricultural enterprises making their profit margins higher than those of forestry enterprises. This will continue to encourage agricultural land expansion at the expense of trees on farms (Langat and Cheboiwo, 2007). Unless the factors that have hindered the competitiveness of forest enterprises are addressed farmers will continue to allocate their land and inputs away from forestry to mostly to agricultural activities for it makes economic sense to do so.

6.7.6.9 High taxation on forest industry and trade

Most players in the market value chain are some of the most affected by both legal and illegal fees imposed by various entities along the market value chain. This is because forest products are not well articulated in both policy and laws. The gaps therefore leave room for various interpretations and many regulatory agencies to interfere with forest products' movement that in most cases results in higher transaction costs that eventually push up retail prices in selling centres. Apart from the VAT and licence fees the enactment of the Constitution of Kenya 2010 brought about in two levels of government (central and county) with each imposing its own taxes on natural resources based businesses. This has made the cost of doing business in the forest sector very high, uncompetitive and very discouraging to investors.

6.7.6.9 Limited operationalization of policies and legislations

Despite the country having a reasonable array of policies and legislations for promotion of investments in commercial tree growing and processing ventures such provisions largely remain on paper, and with minimal coherent implementation strategies and resources to translate the provisions into reality.

6.8 EMPLOYMENT OPPORTUNITIES AND WEALTH CREATION IN PROCESSING AND MARKETING FOREST PRODUCTS

Kenya's forestry sector contributes 3.6% to the GDP, and is one of the sectors identified by the vision 2030 as critical to sustainable development in the country (UNEP, 2012). The forest employment and income generation opportunities within the forest products market value chains are vast. Enormous opportunities exist in products processing to distribution of key products such as sawlogs, transmission poles, reconstituted wood products, furniture, charcoal, construction and fencing poles, and non-timber forest products. Therefore forest sector creates employment and income from direct and indirect business opportunities it creates. However, despite the obvious observation on the potential contribution of forest sector in employment creation and income generation the data gaps and absence of reliable information are major problems in estimating the economic contributions of forests. Forest related businesses provide both direct cash and non-cash economic contributions and substantial levels of employment, both in formal and informal sectors, mostly in SMEs. However, lack of systematic data makes it near impossible to estimate closely how many people are employed in the forest sector. The non-timber forest products sector also lacks aggregated data on its economic contributions, hence compounding the problem of understanding the overall forest sector contributions. Data on employment opportunities, where available, has been presented in sector analysis sections elsewhere in the report.

Table 12 shows estimates of annual consumption of some forest products by some key economic sectors in the country. The value of such consumption is estimated at US\$ 785,440,000 (KES 78.5 billion), mostly traced to domestic household energy needs, and therefore indicating the economic importance of the forest sector to the country's economy.

Table 12: Annual consumption of forest product by some key economic sectors

Sector	Quantity (m ³)	Value (US\$)
Domestic firewood	30,000,000	540,000,000
Industrial logs	500,000	15,000,000
Firewood for tea processing (KTDA)	700,000	10,500,000
Firewood for tobacco curing	78,000	1,170,000
Firewood for bricks curing	56,000	840,000
Firewood for fish smoking	18,000	270,000
Firewood for bakeries	94,000	1,410,000
Firewood for restaurants /kiosks	5,500,000	82,500,000
Firewood for institutions	250,000	3,750,000
Transmission and construction poles	-	130,000,000
Total estimate	37,196,000	785,440,000

Source: GOK 2011

6.9 FACTORS INHIBITING AND/OR PROMOTING FULL AND EQUAL PARTICIPATION OF MARGINALISED GROUPS

The population of Kenya in 2009 was estimated at 40 million people, and consisting of 43 ethnic groups of which five communities accounted for over 50 per cent of the population. The breakdown of country's population shows that 9 ethnic groups had a population that exceeded one million people and 32 were below one million people. Those ethnic groups that had populations of less than 100,000 people were 18 and therefore fall into the category of minorities. Some of these minority groups are hunter-gatherer communities that are dependent on forests resources, and include the Ogiek, Yaaku, the Sengwer, El Molo and Awer, among others.

They are facing sustained pressure from neighbouring populous agricultural communities that are hungry for land and are also vulnerable to government eviction from public forests reserves. The minority communities rely on insecure customary rights in relation to forests and lands in their regions. However, the country's resources are managed through statutory legal systems that are taken into consideration in judicial processes, and hence are likely to deprive minority communities of the decision power on their natural resources.

Although the Kenya Constitution 2010 contains numerous positive provisions for minorities and other vulnerable groups, recent assessments indicate that in general their vulnerability has increased because the capacity and institutional structures on legislative and administrative matters are weak (Songoei, 2012). Minorities are vulnerable to assimilation, displacement, exploitation and even discrimination by powerful communities and land grabbers because of their weak bargaining position in political, policy and legal decision making that is exacerbated by their low numerical numbers, low education levels, high poverty levels and ignorance of their rights (Songoei, 2012). Some reports indicate that minority communities in Kenya have lost land to logging and clearing for agriculture by outsiders, and in some cases face eviction from forests; and worse still they have almost no political representation (Client Earth, 2013). A case in point is the plight of the Boni community that resides deep in expansive Boni Forest that face frequent famines and others natural calamities but are now at the centre of more threatening forces that include terrorists hiding in their forests, government law enforcement agencies, pastoralists and a wave of agricultural settlers (Minority Right , 2012).

Due to the multidimensional nature of the challenges facing the minority communities in the country their vulnerability situation may not undergo positive qualitative transformation any time soon unless the government, civil society groups and other agents work together to put in place operational programmes to address the problems facing minorities and other vulnerable groups. This is not to say that the country does not have instruments and institutions to address their issues, far from that for it has put in place some transitional instruments that include the Constitutional Implementation Commission (CIC), Truth, Justice Reconciliation Commission, (TJRC) and Ombudsman that are well placed to ensure that the progressive provisions in the new Constitution advance the protection of minorities and vulnerable groups for national stability.

6.10 GENDER BASED CONTROL AND ACCESS TO RESOURCES IN THE FOREST SECTOR

The basic factor of primary forestry production is land, hence it determines the quantum of control, investment and access to forest resources for socio-economic development. However, traditional customs and conventional policies and legislations guide gender related land control and access to forest resources on day today basis. The 1995 Nairobi Forward-Looking Strategies (NFLS), for example, emphasized women's participation in national and international ecosystem management and control of environmental degradation. International Labour Organization (ILO) and UNESCO agreements have also

been adopted to end gender-based discrimination and ensure women access to land and other resources. Therefore participation of women in forestry cannot be complete without reference to prevailing land tenure systems, and women's rights to access, use and ownership of land. The Sessional Paper No. 3 of 2009 on National Land and Land Use Policy provided avenues for women to own land and other properties.

Although existing policies and legislations are not primarily discriminatory with regard to women owning land, they have however not provided adequate security of tenure for women, especially where land is administered through customary norms and procedures. World Bank Report (2007) shows women owned only 1.5% of all titled land in the country, and this attests to the property relationship between men and women that is shaped mostly through traditional customs and marital arrangements. This is the case despite the fact that that 30.9% per of households in the country are female-headed (CBS, 2006). In most cases land asset ownership in rural areas is transferred through males in the family tree. Therefore women currently face natural resource and asset vulnerabilities because their access rights are still dominantly related to kinship and marital relationships.

Therefore participation of women and youth in primary forest production on family land may be realized more through family dynamics and negotiations but may remain limited unless they acquire their own land. However, their participation in employment opportunities in primary production and secondary production are only limited by a few factors such as time available outside family commitment and strenuous menial challenging jobs such as logging and heavy machine operations. However, women dominate in some key primary production activities such tree nurseries and forest products market value chains such wholesaling and retailing in both urban and rural areas of such products as firewood, charcoal and NTFPs related SMEs.

6.11 SCOPE OF PUBLIC PRIVATE PARTNERSHIP (PPP)

The current PPPs policy and legislative frameworks in Kenya are more biased towards high cost infrastructure development such as petroleum pipelines, ports, roads, tourism, housing, railways and water and sanitation. However, other sectors including forestry have put in place some policies and laws that relate to some variants of the PPP. There are few variants of PPPs that focus more on corporate responsibility through financial support to awareness creation and rehabilitation of water towers in collaboration with KFS and KWS. Some of projects include electric fencing whose objective is to keep wild animals away from farms and to minimize conflicts between local communities and public agencies involved in management of forests and wildlife. Such projects involve building of strong relationships between government, local communities, private individuals and corporations to raise funds for fencing off Kenya's vital ecosystems and water towers. The key projects undertaken through the initiatives are construction and maintenance of electric fences to protect Mount Kenya, Arabuko Sokoke forests in Kilifi County and Eburu of East Mau Forest block.

Public-private partnerships through trusts have played crucial roles in putting up governance structures for implementation and monitoring of the fencing projects.

Given that Kenya is an athletic giant some PPPs have actively supported water for life campaigns to create awareness on the importance of forests in water provisioning in the key water towers of Aberdares Forest through Ndakaini Dam Marathon, Mau Forest Complex (Mau Forest Marathon) and Cherangany Hills (Cherangany Forest Marathon), and the number is growing. The private sector players include telecom, insurance, financial tourism, and banks, among others. The awareness campaigns have enhanced the visibility of key water towers to greater public and to activities that have enhanced forest conservation.

6.12 CAPABILITIES OF PUBLIC PRIVATE PARTNERSHIP IN FORESTRY

Some of the potential PPP models in the forest sector that are attractive to private sector players include land concession and lease agreements to operate public plantations, county forests, and large scale land estates. The country has a huge market for various wood based products that is attested by the big bill incurred on annual basis in importing such products, most of which could be produced locally. Therefore there is good opportunities for private sector players to invest in local manufacturing with public sector support that manufacture furniture, pulp and paper products, among others, from locally available materials such as plantation forest roundwood, waste paper, bagasse and sisal waste straw and later integrating backwards by planting trees. Other PPPs models may involve investments in industries that can work closely with hundreds of tree growers through some form of out-growers schemes or variants such models such as those currently being experimented by social investment syndicates in the country. The supporting instruments include the multi-sectoral PPP policy 2013 and PPP Act of 2013. In the forest sector the National Forest Policy 2014 and National Forest Conservation and Management Bill 2015 are the instruments that will guide PPPs. The two instruments propose concessions of forest plantations to private entities to enable KFS concentrate in regulatory functions and protection of natural forests. National Forest Conservation and Management Bill 2015 sets out conditions for forest concessions and management agreements for private sector players and KFS, and proposes development of subsidiary legislation to operationalize the concessions after the Bill is passed and signed into law. The 6th principle of the Draft Forest Policy 2014 outlines the importance of PPP in forest development by stating that the government will encourage private sector participation in the establishment and management of forest plantations on public and community land through granting of concessions on a competitive basis.

6.13 TRENDS ON PRODUCTION, TRADE AND CONSUMPTION OF TIMBER AND NON-TIMBER PRODUCTS

6.13.1 Forecast on future forest product supply: 2012-2026

MEWNR (2013) used models based on population and sectoral economic growth, including wood based consumption centres and yield potentials for the various types of forests, to forecast the supply of wood products in Kenya for 2012-2032. The forecasts for key forest products showed that the supply of timber is to grow by 28.8%, poles by 29.2%, firewood by 15.3%, and charcoal by 16.1% in this period. The overall wood supply was forecasted to increase by 20% from 31,372,530m³ to 37,647,850m³ for the period (Table 13).

Table 13: National wood products supply projection for 2016-2026 (1000' m³)

Product	2012	2014	2016	2018	2020	2022	2024	2026
Timber	7358.45	7550.89	7723.49	7942.39	8117.71	8352.66	8547.92	8777.35
Poles	3029.65	3102.52	3177.29	3265.30	3357.87	3445.37	3535.49	3618.75
Firewood	13639.88	13845.77	14054.78	14254.17	14451.38	14678.82	14875.43	5064.60
Charcoal	7344.55	7454.29	7566.21	7680.33	7792.73	7909.19	8028.06	152.51
Total	31372.53	31953.47	32521.77	33142.19	33719.69	34386.04	34986.90	5613.21

Source: MEWNR (2013)

6.13.2 Forecast on future forest products demand: 2012-2026

6.13.2 Forecast of future forest product demand: 2012-2026

The demand for forest product is highly correlated with the economic development, demographic changes, and competition from competing substitutes in use. According to MEWNR (2013) the demand of timber is projected to increase by 43.2%, poles (58.2%), firewood by (16.1%) and charcoal (17.8%) by the end of this period. The total wood demand is expected to grow by 21.6% from 41,700,660 m³ in to 50,712,100m³ an increase of 9,011,440m³(Table 14).

The supply and demand projections clearly indicate that the country will face acute shortages of forest products in the near future, and therefore the needs to intensify productivity in public forest plantations and as well bring on board the private and farm forestry sectors into the national supply of forest products. The nascent private sector and farm forestry are the only potential sectors that may realize some significant growth in both land areas and production given the land and management constraints currently facing the public sector plantation forests.

Table 14: National wood products demand projection for 2016-2026 (1000' m³)

Product	2012	2014	2016	2018	2020	2022	2024	2026
Timber	5262.62	5465.05	5674.72	5908.44	6120.67	6356.66	6628.14	6802.66
Poles	1409.48	1473.85	1542.10	1613.93	1692.38	1768.05	1854.65	1932.33
Firewood	18702.75	18936.08	19220.67	19559.70	19860.51	20135.65	20441.91	20749.93
Charcoal	16325.81	16615.39	16851.66	17127.07	17415.41	17737.85	18046.41	18398.90
Total	41700.66	42490.37	43289.15	44209.14	45088.97	45998.21	46971.11	47883.82

Source: MEWNR (2013)

6.14 CONTRIBUTION OF PRIVATE FORESTRY SECTOR TO LIVELIHOODS AND NATIONAL ECONOMY

The private forestry sector activities are spread across both primary and secondary productions that include plantation establishment, plantation maintenance, logging, processing, manufacturing and transportation. The manufacturing sectors are crucial in forex saving and earning in cases of exports. The key private forestry activities include sawmilling, wood based manufacturing complexes, furniture making and collection, processing and value addition of non-timber products. For example the transmission pole sector is worth KES 6.4 billion shared among many actors in the market value chain with wooden pole tree growers taking 29%, manufacturers-31%, treatment costs-29%, and logging transport-11%. The value of the furniture market in Kenya is estimated at approximately at US\$496 million. At its peak the wood carving sectors employed between 50,000-60,000 carvers, and generating around US\$20 million in exports per year. Therefore the diverse private activities create employment opportunities to hundreds of people; generate taxes to governments, interest to financial institutions and profits to investors.

6.15 PROMISING AND STRONG PUBLIC PRIVATE PARTNERSHIP MODELS/APPROACHES IN FORESTRY

There are many potential PPP models for forestry sector investment in the country that include concessions of public forest concessions and out-grower contract schemes that can use varieties of incentives such as lease agreements and combinations of market assurances, technical and financial support. There are various forest based enterprises that can be managed under out-grower scheme models that include transmission poles, construction poles and industrial firewood. Studies by Cheboiwo (2006) provide some key principles that encourage and hold potential to sustain out-grower partnerships that included mutual trust, fair negotiation processes, longer learning curve, and equitable share of benefits and risks. In Kenya the conditions that make out-grower schemes attractive and viable are inbuilt culture of tree planting among farmers, favourable policies and legislations, many wood based enterprises that can buy various products, efficient marketing and price information systems and a big pool of investors in the forest sector businesses.

Despite conceptual appeal and the perceived benefits, the out-grower schemes based on forestry commodities are still new ventures in the country, and with some fundamental issues and experiences having not been tested fully. Some of the key factors that are yet to be fully appreciated include commodity types, technical requirements, cultural aspects, and observation and enforcement of contractual agreements, among others. These are crucial in designing replicable and scalable PPP models in the forestry sector.

7.0 CONCLUSION AND RECOMMENDATIONS

7.1 CONCLUSIONS

The various actors in primary and secondary forest production include public agencies, companies, farmers, community groups, investment syndicates/social entrepreneurs and traders, among others. The primary and secondary production sectors have diversified interest, management levels, and potential capacities to enter into PPPs with private investors. The key primary producers include KFS that own plantation forests and public natural forests. The public natural forests are, by policy and legislation, protected for biodiversity and water provisioning services but still face considerable degradation through overgrazing, tree poaching, charcoal production and encroachment by illegal settlers.

The country, due to its diversified ecological and climatic conditions, can support a wide range of exotic species adapted to highland and lowland conditions. The key plantation species grown include *Grevillea robusta*, *Eucalyptus grandis*, *E. saligna*, *E. camaldulensis*, *E. teretecornis*, *E. europlylla*, various *Eucalyptus* hybrids, *Casuarina equisetifolia*, *Pinus patula*, *Cupressus lusitanica*, *Acacia mearnsii*, *Gmelina arborea*, *Tectonia grandis*. The species provide a wide variety of commercial products such as saw logs, poles, peeler logs and firewood for both subsistence and industrial purposes. The wood carvers preferred species include *Dalbergia melanoxylon*, *Terminalia brownie*, *Azelia quanzenis*, *Jacaranda mimosifolia*, and *Combretum schumannii*.

The productive forests in the country are located in high and medium potential agricultural zones that fall under private and public ownerships but the largest category of forests, the woodlands, are located in ASALs and are mostly owned by local communities. These forests produce a wide range of forest products that includes firewood, commercial logs, charcoal, poles, and many other products that supply key sectors of the economy. The high forests and woodlands produce a wide range of non-timber forest products that include Gum resins, opopanax and myrrh, Prunus bark, sandalwood essential oils, baobab fruit, Tamarindus products, tannins and Aloe products.

Secondary forest production is dominated by private actors that include saw millers, manufacturers of reconstituted wood, charcoal producers, in addition to producers of furniture, non-timber products, wooden transmission poles, paper and paper products. The country has robust markets for diverse forest products, however, in some cases huge deficits are contained by imports. Secondary forest production faces many challenges that range from inadequate Roundwood supplies, suitable technologies for better conversion, high transaction costs, lack of specialized skills, high cost of credit facilities, inadequate transport infrastructure and unfavourable policy and legal environments.

The technical and commercial organization in the primary production sector is dominated by KFS that, apart from being involved in production of commercial roundwood, is also mandated to regulate production processing and trade in all types of forests in the country. However, many other actors have also entered into primary forest production that range from well-established private run forest based enterprises, individuals that are in few cases have grouped themselves into tree grower associations. These tree growers associations include smallholder Farm Forestry Smallholder Producers Association of Kenya (FF-SPAK), large holder Kenya Tree Growers Association (KEFGA) and Charcoal Production Association (CPA) that brings together charcoal producers in the country. Some variants of PPP include tree out-grower schemes such as Better Globe Forestry Ltd, One Million Tree Project and KOMZA.

The secondary production is dominated by Timber Manufacturers Association (TMA) that draws its membership from saw millers and the Kenya Wood Preservers Association (KWPA) that represents the interests of wood treatment plant owners and suppliers of treatment chemicals.

The furniture sector is dominated by artisanal operators that are not able to sustain high production of desired products to meet the tastes for various consumer niches for diverse wood-based products.

The link between primary tree growers and secondary producers in the country is weak. This is because trees are perceived to take long time to mature and family dynamics make it difficult to draw and observe contracts that bind tree growers to secondary producers as buyers. Many players also don't take contractual provision seriously because enforcement is difficult and costly, therefore few seek redress.

The country has made strides in policy and legislation to empower women and vulnerable groups in ownership, access and management of land and natural resources. However, the good policies and laws may not translate to reality at grassroots level without strong political and financial capacity given strong cultural and traditional norms that many communities still have in relation to such resources.

Kenya's economic sectors that are dependent on wood based products such as saw milling, construction, transmission utilities, pulp and paper industries and furniture makers, among other, need considerable materials inputs from primary production sectors. Therefore public plantation forests, private forests and farm forests are under pressure to produce more roundwood to the increasing diverse forest products demands from various sectors of the economy as a result of rapid expansion of population and urban areas. To meet the deficits in local production the country imports a wide variety of wood based products that include both hardwoods and softwoods timber, knock down furniture, paper and paper products and wood panels from Asia and Europe.

Kenya has embraced the PPPs concept in its policies and laws with the aim injecting private sector management efficiency and financial resources into public sector service delivery.

The most attractive PPP project to private investors in the forest sector is the public forestland concessions for establishment of forest plantations. However, no project has been initiated because the supporting legislation framework is under development. However, there are some forms of PPPs in operation such as linkages between tree growers association and wood based companies or social entrepreneurs such as KOMAZA and Better Globe Forests Ltd that are already operating in the country.

The private sector generates income to various players in the country that include employees, input suppliers, financial service providers, taxes to government and its agencies and forex exchange. Therefore the sector needs to be expanded through attractive incentives to key investors that also include PPP arrangements.

Production and consumption trends in the country indicate that forest product supplies for major forest products fall short of the growing demand, hence the need for increased investments to enhance primary and secondary forest productivity, increased value addition and efficient infrastructure to serve both local and export markets. Therefore favourable policies and legislations should be put in place to attract more actors and investments into the forest sector, at both primary and secondary production levels.

7.2 RECOMMENDATIONS

- The forest sector in Kenya has many players that currently operate in isolation of each other or with minimal engagements at both primary and secondary levels. Therefore there is need for establishment of umbrella body that would support the development of the entire forestry sector in Kenya. The forest sector associations representing the various actors will foster linkages and encourage dialogue between stakeholders, with a view to putting forward a unified representative voice to government and other stakeholders.
- There is need for elaborate data collection on primary and secondary production including data on potential land suitable for forestry, forestry productivity, logging operations and transport efficiency. Others include data and information on markets cost competitiveness, supply and demand scenarios. The lead agencies KFS and KNBS in collaboration with others stakeholders need to urgently take up the task.
- There is need for opening up of public forest plantation sector to many players through concession agreements to inject more professionalism into primary forest production management and to enhance competition for greater productivity.
- The government and its agencies need to put more efforts in branding the forest sector as a viable investment destination in order to attract more investments into saw milling and wood panel sectors. Such developments will create competition and specialization that can increase productivity and cost efficiency.
- Policy and fiscal intervention are also needed to include reducing or removing import duties/taxes on machinery and intermediate materials to enhance industrialization of the forest sector.
- The saw millers need to be given incentives to consolidate their businesses, upgrade their technologies and operational management in order to achieve competitive

operational scale for increased quality and quantities of sawnwood and related products. The support could include subsidized loans to speed up the consolidation and machinery upgrading processes.

- In the woodworks sector, mostly furniture making, more emphasis should be placed on attracting mass production firms to compete or complement local medium specialized industries and artisanal *Jua Kali* enterprises. The government could make available soft loans for investments in training on modern mass production, upgrading equipment and machinery for large-scale manufacturing that will increase overall output, productivity, sales, exports, and value addition. The country is the most advanced in furniture production in East and Central Africa therefore placing it at a competitive advantage to capture market share relative to overseas furniture producers.
- The market for manufactured wood products in Kenya is very big and therefore investments in industrial wood processing offers viable business opportunities. However, competition from exporting countries, in terms of quality and price, need to be taken into consideration in feasibility evaluation for such investments.
- The proposed forest sector policies and legislations should be speedily concluded and subsidiary legislation to guide domestication of PPPs operationalized to attract private sector into various levels of forest production in the country.
- The current nascent out-grower schemes by social investors and private sector syndicates should be given more public support through appropriate policy, legal, political and some form of incentives to ensure that they achieve their objectives of entrenching viable forestry enterprises to millions of farmers in the country.
- The woodworks sector has not received sufficient attention despite current policy and legal reforms being undertaken in the sectors. The outcome of these reforms have not been felt at the woodworks sector and hence the need for comprehensive framework that will address the problems facing the sector. The outlined action includes addressing material supplies, technological transfer, skilled manpower and sufficient investments into the sector.
- The forestry sector, as part of its contribution to Vision 2030, should factor in industrialization strategy including reviving the woodworks sector to position itself to tap widening supply potential areas that now include Tanzania, Malawi, Zambia, Angola and DRC.
- Kenya should strategize to position itself to exploit the vast regional high quality forest resources in order to become the regional hub for secondary processing and export in the region. Alternatively, Kenya should encourage its firms and individual investors to venture into forest based industries within the EAC and COMESA countries to tap the vast forest resources for re-export of surpluses to Kenya and member countries. However, the country industrialization and transport infrastructure strategy should take into consideration the forestry sector, including the woodworks sector, to exploit local and export market opportunities.

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10. APPENDIXES

Appendix 1: List of people contacted

Name	Place	Affiliation	Location
David Langat	Maseno	KEFRI	
James Were	Busia County	Ecosystem Conservator, KFS Busia	Busia, Town
Joshua Belle Okelo	Teso District, Busia County	District Forest Officer, KFS Malaba	Teso District Hqts
Moses Serem	Nakuru County	Rosaga Manager	Total Junction, Mau Summit
Jan Van	Nairobi County	Better Globe Forestry	Nairobi Office, Nairobi
Ezekiel Korir	KFS Hqts	KFS Marketing	KFS Hqts, Karura
Mathias Mutisya	Kilifi County	KOMAZA	Kilifi Offices
Albert Nyabuti	Mombasa County	District Forest Officer, KFS, Mombasa	HOC offices, Mombasa Town
Francis Maina	UasinGishu	Tree grower,	Soy Division
	Kilifi	Kilifi Plantations	Kilifi Plantation offices
Florence Towett	Mombasa	Bamburi Cement Baobab Farm	Baobab Farm
Joseph Kibugi	Kwale	South Coast Family Forest Marketing Cooperative Society	Diani, Offices
Geodrey Ali	Nairobi	Chariman, KWPA	Nairobi
James Koigo	Londiani	Eureka Saw mills	Londiani Town
Joseph Kanyongo	Molo	Biashara Master Saw mills	Molo Township



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