

Public Private Partnerships Opportunities for Forestry Sector Development in Kenya: Synthesis of Primary and Secondary Production Actors, and Trade

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Abstract

Kenya Forestry research Institute (KEFRI) with support from African Forest Forum undertook a study 2016 to evaluate the potential roles of the private sector in development of primary and secondary forest production in 10 countries in Eastern Africa. The main objective of the study was to provide information to support the emergence of organized private sector for sustainable forest management and enhanced livelihoods. The study involved literature reviews and some rapid reconnaissance surveys in key areas to facilitate updating of information and data especially in areas where gaps existed. Results showed that primary forest production takes place in 5 forest categories public plantations, farm forests, community forests and private forests. The primary management objective for public natural forests is mainly for watershed protection and biodiversity conservation with controlled extractions for non-commercial uses, mostly by forest adjacent communities. The community forests mostly located in the ASALs are the largest in terms of area standing at 24,510,000 hectares. Second and third positions are farm and private forests located in agricultural landscapes estimated at 10,385,000 and public forests estimated at 3,467,000 hectares with forest plantations accounting for 107,000 hectares. In the last decades except for farm and private forests other types of forests are declining in in both coverage and quality. In the high potential zones the popular plantation species include *Eucalyptus grandis* and *E. saligna*, *Pinus patula*, *Cupressus lusitanica* whereas in the lowmands the preferred species are *E. camuldulensi*, *E. terreticorni*, *Casuarina equisetifolia*, *Tectonia grandis* and *Gmelina arborea*. In the primary forest production Kenya forest Services key public agency in management and protection of public forests and support to private and individual forest owners. The private sector players such as the tea estates, social entrepreneurs, investment syndicates and individual investors have entered into primary production driven by high demand and returns to investment hence leveraging on operational efficiency to maximize profits. The secondary production actors are largely private players that have heavily invested in sawmilling, reconstituted wood manufacturing, utility pole manufacturing, charcoal production, wood carving, paper and paper product manufacturing, biomass energy and non-timber production. Non-timber products collected in indigenous forests and woodlands are sorted graded and processed into various products for home use and surplus for sale. Some of the technical and management organization in primary production include partnerships/contracts between tree growers and companies or social investors, tree growers associations and manufacturers associations. Most of them are still at infancy stages and still need support from the public sector and other agencies to enhance levels of professionalism and service delivery. The country has in place policies and legislations to support PPPs implementation in the forest sector. The supporting instruments include the multi-sectoral PPP policy 2013 and PPP Act of 2013. The forest sector instruments include the National Forest Policy 2016 and Forest Conservation and Management Act 2016 whose provisions include granting of forestland concessions to private sector investors on a competitive basis under specified conditions. No concession has been undertake because of lack of supporting subsidiary legislation. Some PPP variants already in operation include Community Forest Associations (CFAs) in the management public forests and Corporate Social Responsibility initiatives in rehabilitation of key water towers.

Keywords: Primary forest production, secondary forest production, public private partnerships, forest policies and legislations, technical and management organizations, trade in forest products.

1.0 Introduction

In Kenya private sector participation in primary forest production as an organized entity is at infancy stages and needs to be nurtured in order to enhance their contribution to the forest sector contribute development. Therefore private sector players have to be organized from the many diverse actors who largely operate informally better coordinate their roles in forestry sector development. Some other private sector players of interests are the diversified groups of individuals including young men and women and marginalized/disadvantaged/vulnerable groups that are dependent on forest sector resources for their livelihoods. To Facilitate such development demands the identification and understanding of the interactions between the different groups of people and the forest resources as well as their differing needs, privileges, contributions, challenges and priorities. However, information on the various categories of players with interest in forest sector and their contributions to the local economy are

limited. The private sector development will play greater role in poverty alleviation, and significant impact on women and other marginalised groups. Hence disaggregated data and analysis is crucial in helping to fill the information gap. African Forest Forum with support from donor partners commissioned a national in Kenya to identify key actors in both primary and secondary forestry production. The purpose of this study was to facilitate the development of an organized private sector in forestry, and including the identification and promotion of promising public private partnership (PPP) models/approaches for an all-inclusive forest compatible sustainable livelihoods development, including gender considerations.

1.1 Objectives of the Study

The main objective of the study was to 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.

1.2.0 Study methods

1.2.1 Methodology

1.2.1.1 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.

1.2.1.2 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.

1.2.1.3 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-Heler 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. Many private forest based enterprises were unwilling to provide information on their activities and the study relied on secondary information in such cases where available. Therefore the study results are indicative of the true situations. In some cases expert estimates were used in absence of accurate information.

2.0 Results of the study

2.1 The actors in forest sector

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
Primary production		
Public natural forests	KFS, KWS, communities, private sector	Biodiversity conservation
Public plantations	KFS, counties, licensed companies, CFAs	Commercial timber production
Farm Forests	Farmers, schools, social investors	Subsistence and commercial
Community forests	Community groups, counties, individuals	Conservation, subsistence and commercial
Private forests	Tea estates, investment syndicates, large scale farmers	Commercial timber production for own use and surplus for same
Secondary processing		
Saw milling	Individuals, companies	Commercial business
Wooden utility pole manufacturing	Individuals, companies	Commercial business
Reconstituted wood manufacturing	Wood based complexes,	Commercial business
Non timber products	Individuals, Social investors,	Subsistence and commercial
Woodwork sector	Manufacturers and traders ,	Commercial business
Forest products trade	Merchants	Commercial
Research and education	KEFRI, ICRAF, EAWLS, IUCN, NMK and universities	Capacity building, technology development and information dissemination

Source: Own surveys and experiences in the sector

2.2 Primary forest production organization

2.2.1 Primary forest production

Primary forest production in the country takes place in public plantations, farm forests, community forests and private forests. 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. 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. Public, private and farm forests plantations provide sustainable supplies roundwood for subsistence and commercial purposes. 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. europphylla*. 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 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 rotation periods for planted trees range from 5 to 30 years depending on species, climatic conditions, end uses and market niche specifications. The country'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 the selected 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. 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 construction 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

Sources: FAO 2010: Forest Resources Assessment Report

2.2.2 Public forests

2.2.2.1 Natural forests

The natural closed forests measure approximately 1.4 million hectares that consist of various forest types, mostly montane, humid lowland, coastal, mist montane and riverine forests. The montane forests include Aberdares, Mt Kenya, Mt Elgon, Cherangany and Mau forests Forest that are located between 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. The montane forests are key water towers in the country. These forests form the largest forested 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*. The montane forests 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 such Nakuru, Turkana, Victoria, Naivasha and Baringo that are also 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 that is 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 smonkey (*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. 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 golandi*). 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 forests were retained as sacred forests and are often on hill tops and act as critical water catchments that support diverse flora including medicinal plants.

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 (Karakka, 1996). Lower Tana River forests have two endemic species namely the Tana River red colobus *Procolobus rufomitatus* and Tana River mangabey (*Cercobus galeritus*) (Sayer et al. 1992).

In general most natural/indigenous forests in Kenyan 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 located in high population areas and 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 are inhibited from crossing pollination hence 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.

There is only indigenous bamboo species found in Kenya is *Yushania alpina* that thrives well between 2,400 and 3350 metres above sea level mostly in slopes of 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 hectare 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.

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 Eucalyptus, Pines and Cypress that heavily borrowed experiences from South Africa and Australia (Gibson, 1965). The objectives for establishment of industrial plantations were to provide wood raw material for specialized industries such as sawmills in 1986 at 172,000 hectares and annual planting at 8,600 hectares (Cheboiwo, 2007). Massive excisions of plantation forests in 2000s led to loss of 35,000 hectares to settlements and by 2010 the public forest plantations covered between 125,000-135,000 hectares depending on source of information accounting for 6% of total forest area managed by KFS. The key species are Cypress at 52%, Pines (35%), Eucalyptus (12%) and mixed 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 that excludes 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 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. 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 has changed the age composition drastically. KFS has set annual planting target of 3,000 hectares per year and plans to engage private sector stakeholders through concessions, contracting and joint management to boost plantation development in public forests. Recent studies show that the average aggregated yields for key commercial species are as follows *Cupressus lusitanica*, *Pinus patula* and *E. grandis* 385 m³, 401 m³ and 503m³ per hectare respectively (MENR, 2013). The yields are relatively low as compared to private sector production within similar ecological zones that range from 630-750 m³/ha hence potential room for yield improvements through enhanced silvicultural management and integrated harvesting techniques.

2.2.3 Farm 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 155-200 different tree species (Betser et al, 2000; Oginosako et al, 2006). The species density vary according the land potential, high potential zones recorded 155 timber trees as compared to 77 in lower cotton zones. The studies showed that 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. 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). In general farm forestry in large land holdings is on the increase due to high demand for transmission poles and sawnwood that has motivated medium and large scale farmers to diversify into commercial forest enterprises. However, the smallholder farm forest sector is faced with many challenges that include small farm sizes, conflicts with neighbours over crop losses, felling restriction during crop growing seasons and permits requirement for harvesting and movement of tree products (Oeba et al, 2014). Furthermore, land available for tree growing within agricultural landscapes in high and medium potential zones is likely to decrease given the already decreasing landholding sizes and competition from agriculture, infrastructural development and settlements. Despite the 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 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 motivated 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. 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.

Though the private plantations expanded marginally by 1.1% from 68,000 to 90,000 hectares between 1990-2010 (Figure1) and lately large companies purchase of huge tracts of land for tree growing the sector has limited room for expansion due to shortage of land and competition from agricultural enterprises and settlements. 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. Some of the private sector players include James Finlay Tea Estate with 3,000 hectares under forests mostly with *E. grandis* and hybrids of Eucalyptus. Others include Timsales Company Limited 1,500 hectares and Homa Lime Company (280 hectares). Some of the private sector firms are involved in forest conservation and out grower schemes with land owners who sell wood to them such as Homa Lime Ltd.

2.2.5 Bamboo growing

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. 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. 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.

3.0 Secondary forestry processing

The secondary forestry production involves any alteration of wood harvested from the forest into forms for direct use or transfer to market outlets. Primary processing facilities include sawmills, veneer plants, plywood plants, chipping facilities, pulp and board facilities, utility pole treatment plants, firewood processors, woody biomass energy producers, fuel pellet producers, handcraft makers, furniture manufacturing, shake and shingle operations, among others.

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 2016 there were 663 registered sawmills operating in the country all owned by private sector entities. 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 is estimated at 450 m³ and combined production by 2010 was estimated at 400,000m³ per year (EPZ, 2010). The saw milling sector is estimated to employ 50,000 workers directly and 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 mismanagement in 1990s led to the sawlog harvesting ban that lasted a decade between 2002 and 2012 resulting in the collapse of saw milling sector and loss of associated skills. During the ban, most saw milling machinery and equipment were left idle and economies of forest dependent urban centres and families collapsed. 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. Among the 633 registered mills consisted of 30 large mills, 65 medium, and 538 small saw mills (Cheboiwo, 2012). The lifting of the ban in 2012 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 that translates to roundwood output of between 2.4-2.8 million m³ per year.

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. Muthike et al (2013) report observed that most of the saw milling managers and staff had inadequate skills in saw milling operations and machine maintenance hence the low conversion rates that averaged 30% as compared to KFS recommended 40% the wastes 70% of the harvested wood.

In summary, the country has sufficient installed capacity of saw milling facilities to 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.

3.2 Reconstituted wood products

The reconstituted wood sector is dominated by three privately owned industrial complexes, the Rai Ply, Comply, and Timsales that are involved in integrated wood processing that range from saw milling to plywood and particle boards manufacturing. The board manufacturing units consume about 200,000–250,000m³ of round wood annually (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 Furniture and joinery.

The sector cover such activities as furniture and wooden interior fittings, mouldings, doors, staircases or windows and are spread across the major urban centres in the country. The sector supports about 160,000 people in the forestry and manufacturing sectors of the economy. It is a 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 products are mostly for local markets and 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 woodworks sector is dominated by small entrepreneurs 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. 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.

World Banks (2014) indicate that the furniture sales in 2013 was approximately US\$496 million with an annual growth rate of 10% for 2007-2013 that is likely to maintain in the coming years. The report indicate that imports into the country in 2013 was KES 6.6 billion (US\$66 million) approximately 13% of the total market but imports grew by 24% during 2009-2013 period 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. Further, the report notes that the country's furniture industry is better placed to expand its sales domestically and regionally to capitalize on the growing demand in local and regional markets in East Africa, African and global markets due its advantageous geographic position, supply of raw materials from neighbouring and 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.

The furniture is projected to grow at an 8% compound annual growth rate (CAGR) between 2013 and 2018, driven by the growing population, urbanization, and increasing purchasing power. Therefore the sector mat needs reforms to address quantity and quality material supplies, appropriate technologies, skilled manpower and incentives to attract investments. The woodwork sector is estimated to consume 77,672 m³ of timber per year (Githiomi, 2010).

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 of construction due shortage of high grade timber and 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 Wooden transmission pole sector

3.6.1 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 transmission pole sector has attracted many private sector players due to high demand returns due to good prices on offer.

3.6.2 Manufacturing of wooden transmission poles

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 but wooden poles have since then displaced hollow tubular and steel lattice.

The sector has recorded the fastest growth within the last two decades for in 2004 there were only 2 treatment plants in the country capable of processing 160,000 power transmission poles per year that rose to over 55 by 2016 with to treat over 2 million poles per year (Cheboiwo, 2016). According to electricity power sector projections the local supply of treated wooden poles stood at 63% in 2008 and was expected to meet the country's demand by 2012. Though country is currently self-sufficient in treated wooden poles but it still imports 20-25% of the requirements from Tanzania and Uganda. The combined demand for poles in 2015 was 480,000 poles that was 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 concrete 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. Despite such massive expansion of processing capacity, local plants face several handicaps that include unpredictability of tendering process by the power utility firms that constrain their precise predictions on the actual quantities demanded on annual basis. Such information facilitates them to accurately predict the desired production volumes to aide their synchronization of the purchase of semi-processed poles and import of treatment chemicals from overseas suppliers.

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. Thus the demand for transmission poles will be highly correlated to the power generation and transmission that will depend on the availability of funds to finance power generation plants and distribution infrastructure in the country. The wooden transmission poles sector is valued at USD 64 million (KES 6.4 billion) spread across tree growers, logging operations, treatment plants and transportation.

3.8 Wood carving

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 as soldier in Tanzania in the Second World War (Choge, 2010). By 1956 the wood carving business was worth USD 1.3 million by 2010 exchange rates. 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 in Machakos County. Others include Ukamba Wood Carving Cooperative Society (UWCCS) in Mombasa town and smaller production units in Malindi in Coast region, Nanyuki, Gikomba in Nairobi, Kitui, Kisii, Nakuru, Nyeri, Ukanda, Kibwezi, Kalawa, Meru and Mililuni. The sector employs approximately 60,000 people that are 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 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.

In the past Kenya was a globally significant producer of woodcarvings 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. Due to the diverse problems the country's export markets shrunk 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 wood carvers prefer specific tree species for carving, with *Dalbergia melanoxylon* being the highest ranked. Other popular species include *Terminalia brownii* (muuku in Kamba); *Azelia 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. 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 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.

The recent development in the sector has made most wood carvers to diversify their livelihoods strategies

away from wood carving. Recent study showed wood carvers in Wamunyu that relied on wood carving were 62% as 38% had diversified into agricultural and retail businesses to increase their incomes and also cushion them from adverse fluctuation in sales of carvings.

3.9 Paper and paper products

The largest pulp and paper mill in the country Pan African Paper Mill at Webuye in western Kenya a subsidiary Birla Company of India used to consume annually about 500,000 m³ of pulpwood and 250,000m³ of firewood, mostly from farms. The firm collapsed in 2009 and was recently acquired by Rai Group that has started the revival of the giant mill. There are other 13 companies operating in the country that use recovered paper to manufacture various paper products that 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 Industrial firewood

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 *Acacia 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 5 show some other industries that are dependent on firewood in the country.

Table 5: 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. Some wood based industries use firewood to drive steam turbines to produce electricity for their internal use. A private company the Cummings Cogeneration plant at Marigat Baringo County was commissioned to utilize *Prosopis juliflora*, a weedy tree species found in ASALs, to produce 30 MW of power 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 producers associations 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 two 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 (MENR, 2013). These would require 538,000 hectares, of which 298,000 hectares will be for firewood and 240,000 hectares for charcoal production. Most of the charcoal traded in the country 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. Sustainable charcoal production model based on *Acacia mearnsii* is an established enterprise in Rift Valley that dates back to 1880s whose other product is wattle bark for tannin production. Currently small-scale farmers are the main suppliers of bark in the country and poles are converted into charcoal by the traditional earth kilns. 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. 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.

3.12 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 6 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 woodfuel 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 6: National supply and demand potentials for key forest products (m³).

Product	Timber	Poles	Firewood	Charcoal	Total woodfuel	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 Gums and Resins

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 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). 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 band Okoro, 2005). Kenya has the 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. 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 woodland 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). 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 all 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 and since then no legal exports have taken place in the country. However, herbal practitioners continue to use the bark for production of various medicinal products for local use. 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. The legal trade in Prunus products will motivate land owners to plant them 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 Marsabet in Eastern Kenya. The wood contains highly valued essential oils by Muslims, Hindus, Buddhists and Chinese for its sweet fragrance. 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. The sandalwood tree received protection through 2007 Presidential Decree and is one of the species cited for protection by 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 (Ochanda, 2014).

Sandalwood propagation has faced challenges due poor seed germination and saprophytic behaviours that need a host plant to survive its early stages of growth. Many private investors have shown interest in planting commercial plantations but have faced challenges of seedling availability and field survival due to lack of appropriate host plants. Kenya Forestry Research Institute has invested heavily in research activities on propagation methods and production protocols to enhance production of seedlings and commercialization of sandalwood. However, there is no breakthrough for mass production of seedlings and field survival hence more efforts still needed.

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. The production of baobab pulp and leaves is almost entirely sourced from trees growing naturally in woodlands. 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. Among local investors in baobab processing is Elekea a Nairobi based SME that has established an integrated baobab processing unit 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 benefits hence cases of increased felling of the magnificent tree to make way for conventional agriculture. Elekea by products include charcoal briquettes and oil seed cake for animal feed. Elekea in collaboration with local research institute 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. The plant has potential for commercial utilization in medicinal and pharmacologic activities. Tamarind business revolves around

fruit collection in ASAL and transportation to key markets in Mombasa because local market opportunities are limited. In 1999 the price per kilo 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 a practice that can be commercialized by local firms.

4.6 Tannins

Tannins from black wattle (*Aciacia mearnsii*), originally from Australia is the main source of high quality tannin used internationally in the leather sector. 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 into smallholder agricultural farms. 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 local bark supplies and imports from Tanzania. The country's leather factories rose from 9 in 2005 to 13 in 2009 with capital investment of KES 3.8 billion (USD 38 million). The leather 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 and increased domestic demand with expanding leather tanning sector that needed up to 10,000 tonnes of tannin per year in 2009. The demand for the tannin in the country is expected to increase with the growth of domestic leather sector and the country may realize shortfall in supply 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 that have emerged as an important source for production of various medicinal and industrial products. The high value species include *Aloe turkanensis* and *Aloe secundiflora* that contain aloin the highly sought for as a 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 by KEFRI has 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. 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 of forest primary 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.

5.1.1 Training, Research and Technical support

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. Its work force is estimated at over 5,000 with 60% involved in enforcement activities. 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. 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. Graduate level foresters are trained in University of Eldoret and Kenyatta University, and Egerton University offer graduates in natural resources and environmental science courses whereas University of Kabianga and Eldoret University offer Agroforestry courses as well. The Kenya Forestry Research Institute (KEFRI) mandate revolves around research to generate and promote improved technologies for sustainable management, conservation and development of forests and allied natural resources. 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.

5.1.2 Investment syndicates forest joint ventures

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 and ASANTE 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.

5.1.3 Tree Growers Associations

There are two categories of tree grower umbrella groups in the country namely Farm Forestry Smallholder Producers Association of Kenya (FF-SPAK) for smallholders and Kenya Forest Growers Association (KEFGA) for large scale growers.

FF-SPAK smallholder woodlots range from less than 0.025 to 10 hectares for subsistence and commercial purposes. The smallholder tree growers generally are poorly organized because in most cases the individual farmer manages the production systems with minimal professional inputs. The smallholder sector has been target for transformation into better organized producer associations to enhance yields and pricing for their products. Estimates indicate that there about 10,000 tree growing farmers that are members of tree growing associations affiliated to FF-SPAK. The FF-SPAK core business is to mobilize tree growers into networks that can do business including management and administrative capacity building and extension services

The Kenya Forest Growers Association (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 membership is estimated at 5,000 members and has been in many forestry related forum such as National Forest Management and Conservation 2016 that ensured that the interests of private tree growers was taken care. According to KEFGA its members has added 17,000 hectares of forest cover across the country and created 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 in public forests between 2002-2012 period.

5.1.4 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

There are two technical organizations in the secondary production namely Timber Manufacturers Association (TMA) and Kenya Wood Preservers Association (KWPA). 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. Saw mills, unlike before when they were the dominant players in the public plantation 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 (2002-2012) 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. 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. 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 managed plantations 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.

Non timber forest products (NTFP) 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 Tree products imports from East and Central Africa

Kenya stopped harvesting hardwood from its public indigenous forests in the 1980s and 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 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. Hardwood imports from DRC rose steadily from 9,267 m³ in 2009 to 38,506 m³ in 2013 (Cheboiwo 2015 and softwood sawn timber from Tanzania peaked at 57,300 m³ in 2010 but have since fallen to 9,425 m³ by 2013 (Cheboiwo et al, 2015). The value of hardwood import between 2009 and 2013 from both DRC and Tanzania was KES 15.6 billion (\$184 million).

6.2 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 (Table 7). The exports include paper and paper products, wood based panels and 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 7: 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	34.9	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)	12,617	173,782	121,034	103,786	128,700	196,952	1,300,756
Wood based panels: 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

7.0 Other Forest sector related issues

7.1 Forest sector related policies 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. The government has enacted various policies and legislations in order to positively influence investments in primary and secondary forest production by individual land owners, public institutions, private investors and community groups. Some of them include Public Private Partnerships Act, 2013, National Forest Policy 2016 and Forest Management and Conservation Act 2016. The Forest Act 2016 provides conditions for implementing forest concessions, and related management agreements. It obliges the government to fast tract formulation of subsidiary legislation on Forest Concession Framework that confers 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. 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. Therefore PPP Act of 2013 and Forest Act 2016 provides conducive environment for private sector engagement in long term sustainable forest management practices through various instruments.

7.2 Gender and marginalised groups participation

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. In most cases 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 (Minority Right, 2012). 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, which is exacerbated by their low numerical numbers, low education levels, high poverty levels and ignorance of their rights (Songoei, 2012). The structure put place to address the problems facing minorities and other vulnerable groups that include the Constitutional Implementation Commission (CIC), Truth, Justice Reconciliation Commission, (TJRC) and Ombudsman that can join hands with civil society groups and other agents to ensure that the progressive provisions in the Constitution advance the protection of minorities and vulnerable groups for national stability.

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. 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. Observations showed women dominate in 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. 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.

7.3 Trends on production, trade and consumption of timber and non-timber products

7.3.1 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 8).

Table 8: 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)

7.3.2 Forecast of future forest products 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 9). 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 9: 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)

7.4 Contribution of private forestry sector to employment and livelihoods

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(Cheboiwo 2014). At its peak the wood carving sectors employed between 50,000-60,000 carvers, and generating around US\$20 million in exports per year(Choge, 2002).Therefore the diverse private activities create employment opportunities to hundreds of people; generate taxes to governments, interest to financial institutions and profits to investors.

7.5 Forest sector contribution to national economy

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. 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. 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.

7.6 Existing and Promising public private partnership models in forestry

There are some existing and potential PPP models for forestry sector investment in the country that include public forestland concessions, out-grower contract schemes, land lease agreements and combinations of market assurances, technical and financial support. PPP in the forest sector may take longer to implement due to some structural development that may need to be put in place such as the guiding principles that will encourage and sustain out- partnerships. These include building of mutual trust, fair negotiation processes, longer learning curve, and equitable share of benefits and risks. The country has in place some key ingredients that make out-grower schemes attractive and viable such as the inbuilt culture of tree growing 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 local and overseas 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.

8.0 Conclusions and Recommendations

8.1 Conclusions

In general the primary forest production sector concentrated in public, private and community forests are experiencing decline in size and cover through several degradation processes mostly overgrazing, tree cutting, poaching, charcoal production, encroachment by illegal settlers and conversion into other land uses. The public plantation forest sector declined from 174,000 ha in 1980s to 125,000 hectares but the farm forests and private sector experienced slight increase over the same period. In contrast the demand for various product categories is fast increasing hence need for concerted effort in forest sector development in order to expand production of various forest products in the future.

The key primary producers include KFS that is mandated to manage public plantation and public natural forests. Other actors in primary forest production include companies, farmers, community groups, investment syndicates/social entrepreneurs and traders, among others.

The 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.

Forests also produce a wide range of non-timber forest products that include Gums, resins, opopanax and myrrh, Prunus bark, sandalwood essential oils, Baobab fruit, Tamarind products, tannins, medicinal plant parts and Aloe products, among others.

The level of investment in processing technologies varies depending on the sectors, actors, and technology requirements. The sector is dominated by saw milling that varies from the high recovery advanced large scale mills to artisanal power saw and hand saw operators with low recovery rates. Others include reconstituted wood industries and wooden pole treatments plants. The secondary production and manufacturing sectors face numerous challenges ranging from inadequate roundwood supplies, inefficient technologies for better conversion, high transaction costs, lack of specialized skills, high cost of credit facilities, inadequate transport infrastructure and unfavourable policy and legal environment.

In the country technical and organizational in the primary production are dominated by small-scale tree growers that in some cases are organized into grassroots and apex associations.

The secondary production is dominated by saw milling association that draws its membership from saw millers. Smaller groups include furniture makers wood carvers and wooden pole preservers association that represents the interests of respective members.

The links between primary tree growers and secondary producers in the region is still weak because tree growing is 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.

The country has made strides in enactment of favourable policies and legislations to empower women and vulnerable groups in ownership, access and management of land and natural resources. However, the good policies and laws are hindered by strong cultural and traditional norms held by many communities in relation to land and associated resources such forests.

Kenya has enacted policies and laws that are supportive to PPPs in the forest sector in order to inject private sector management efficiency and financial resources in both primary and secondary production. The most attractive PPP models to private sector investors include public forestland concessions for establishment of forest plantations. However, there is no concession project in place because the subsidiary legislation framework to support its implementation is not yet in place.

Some forms of PPPs in operation include linkages between public sector agencies and various actors such as individual tree growers, community forest associations and wood based companies or social entrepreneurs.

The private sector investors in the forest sector through their diverse production activities create employment and generate income to various players that include employees, input suppliers, financial service providers, taxes to government and its agencies and forex exchange.

The 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 sectors needs high 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 some the country imports wide variety of wood based products that include sawnwood, knock down furniture, paper and paper products and wood panels from Asia and Europe.

8.2 Recommendations

There is need for concerted efforts to reduce forest degradation and enhance productivity in all types of forests to enhance of forest products goods and services for rapid socioeconomic development.

The forest sector has many players that are still poorly organized at both primary and secondary production

levels and hence the need for support establishment of grassroots and apex associations to foster linkages and encourage dialogue between stakeholders and be in a position to engage the government and facilitating agencies in a unified voice.

Production and consumption trends indicate growing demand and falling supplies hence the need for increased investment to enhance primary and secondary forest productivity, increased value addition and efficient infrastructure to serve both local and export markets. The stakeholders need to put more efforts in operationalization of the favourable policies and legislations to attract more actors and investment into the forest sector both at primary and secondary production levels.

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 to create competition and specialization that will lead to enhancing productivity and cost efficiency.

The saw milling, charcoal processing, reconstituted wood industries and furniture making need support to consolidate their businesses, upgrade their technologies and improve their operational management to achieve competitive operational scale for increased quality and quantities of products. The support needed include subsidized loans to speed the consolidation and technology upgrading process.

The policies and legislations in place provide opportunities for women, youth and minority group to fully participate in forestry activities, however, various factor still hinder their access and control of forest resources. These factors include political power, traditional norm related to land and associated resources and inadequate capital and skills. Therefore there is urgent need to empower women, youths and minority group in forestry activities.

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 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.

Given that the vast market opportunities in the country and the wider Eastern Africa region Kenya can position itself to capture greater share relative to overseas furniture producers.

The forest sector has potential to significantly contribute to the national economy and social development through job creation and income generation. While the government has expressed political will to provide an enabling environment to facilitate the growth of the private sector, more is required to remove the remaining hurdles that constrain the pace of establishment and development of the private forestry sector in the country.

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