

# Forest Outlook studies in Africa (FOSA)



## Kenya



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*Please note that the views expressed in this paper reflect those of the authors and should not be attributed to any of the institutions.*

*This paper has been minimally edited for clarity and style.*

## **SUMMARY**

Given the current state of the forestry sector in Kenya, unless changes in regulatory mechanisms such as legislation and policy are put in place in good time, a lot of the remaining forests will disappear due to unsustainable wood extraction and land-use change in favor of agriculture. In view of the critical importance of the role of indigenous forests in soil and water conservation, biodiversity conservation and contribution to the country's socio-economic development, it is imperative that the current destructive trend should be reversed. Plantation forestry and farm forestry must contribute largely in the future supply of wood. Valorization and commercialization of non-wood forest products will stimulate the people to manage the forest resources appropriately.

### **Key-words:**

Kenya, non-wood forest products, paper, charcoal, fuel wood, land tenure rights, forest, plantations, farm forestry

## **1. INTRODUCTION**

The preparation of the Kenya Forestry Outlook Paper is an initiative between FAO, Forest Department and other land-use related sectors i.e. Agriculture, Kenya Wildlife Services (KWS), Kenya Forestry Research Institute (KEFRI), Energy, Service sectors e.g. Treasury and the Private Sector in forestry.

The process of developing this paper involved largely literature review, meetings, workshops, case studies and individual consultations with the country expertise. The compilation of this document covered a period of 3 months starting July 2000.

Currently, Kenya has elaborate management strategies for farm forestry and industrial forestry. However, within the natural/indigenous closed forests and dry-land forests, there is no elaborate management strategy other than some aspects of forest protection. Currently these forests are threatened with degradation and excisions as a result of land-use conflict resulting from a lack of a comprehensive land-use policy.

It is envisaged that if policy and institution reforms, management strategies, research programmes and new appropriate technologies are implemented within the short term, then the contribution of forestry sector to the economy will improve greatly.

## **2 INTERNAL AND EXTERNAL FACTORS INFLUENCING FORESTRY**

### **2.1 POPULATION FEATURES AND RELATED TRENDS**

### 2.1.1 Size and Growth

According to the provisional results of the 1999 population and housing census, Kenya has a population of 28.7 million compared to 21.4 million, 15.3 million, 10.9 million and 8.6 million in 1989, 1979, 1969 and 1962 respectively. These figures translate into growth rates of 2.9, 3.4, 3.8, and 3.0% per annum over the inter-censal periods 1999-1989, 1989-1979, 1979-1969 and 1969-1962 respectively. The trend confirms the rapid decline in fertility rates, rapid increase in urbanization rates and changes in migration patterns and mortality rates.

### 2.1.2 Fertility

According to the 1998 Kenya Demographic and Health Survey (KDHS), fertility rate has shown a steady decline from 8.1 in 1978, to 6.7 in 1989 and further to 4.7 in 1998.

The trend in the next 20 years is expected to follow a similar pattern. At the same time, the composition of the population has shifted and there is now a significantly higher population, about 61%, that is under age 20 and 51% under 15. Fertility differentials are profound with respect to geographical areas and education. The survey confirmed that 5.2 children are born to a woman in the rural areas compared to 3.1 children in the urban areas; and 5.8 children are born to women with no education compared to 3.5 children for women with secondary education.

### 2.1.3 Mortality

Evidence from the KDHSs shows a worsening mortality situation in Kenya over the 1990s as compared with the situation over 1980s. The figures for infant and under-five mortality rates are 62 and 91 per 1,000 live births respectively in mid 1980s as compared to 74 and 112 in 1998. There are pronounced differentials in infant and child mortality across geographical areas and according to the level of education of mother, reflecting to a great extent the imbalances that exist in levels of development in socio-economic factors across the country.

### 2.1.3 Migration and Urbanization

Projections based on Kenya's 1989 population and housing census indicate profound changes in rural to urban migration reducing the concentration of rural population from a level of 82% in 1990 to 77% in 2000. It is projected that the level will be 64% by the year 2020.

The rate of urbanization was projected to grow at an approximate annual rate of 3.5% resulting in the proportion of urban to rural population of 21% in 1990, 27% in 2000 and 42% in 2020. Evidence shows that rural-urban migration is a key source of economic growth in Kenya having accounted for 4.6 percentage points of per capita income growth over a period of 10 years between 1970/72 and 1980/82 compared to 4% experienced in the case of technical change over the same period.

In light of the current slow growth of the economy, urbanisation is resulting into a concentration of a population that is increasing beginning to depend on fuel wood for their energy demand. This trend will result into increased demand of wood fuel products.

#### 2.1.4 The HIV/AIDS Scourge

Kenya faces a high rate of HIV infection as shown by the urban and rural prevalence rates of 18.1 and 13.0% respectively in 1998. The rate of growth of HIV infection in rural areas is higher than that of the urban areas growing from 8.7% in 1994 to 13.0% in 1998. Compared to 14.5% and 18.1% in urban areas over the same period. The strategy of the government is to enhance the use of information, communication and education as measures for controlling and preventing HIV infection.

The scourge will reduce ability of majority of Kenyans to afford alternative energy sources such as gas, electricity or paraffin for domestic use. These will lead to more dependency on fuel wood.

#### 2.1.5 Land-Use

Kenya has a total land area of about 582,645 km<sup>2</sup> or about 5.8 million ha including 2.6 million ha of forest on both government land (56%) and trust land (44%). Population densities have grown over time, rising from 15 persons per km<sup>2</sup> of land in the 1960s to 27 and 37 in the 1980s and 1990s respectively. The country's population density is estimated at 50 persons per km<sup>2</sup> for the 2000s. This increase in population density has taken place against a shortage of good agricultural land that is only about 1.9 million ha which represents only a third of the total land area. This scenario translates to corresponding figures for arable land per capital of 2.2 ha in the 1960s, 1.24 ha in the 1980s, 0.89 ha in the 1990s and 0.66 ha estimate for the 2000s. By the year 2020, arable land per inhabitant is projected to be 0.48 ha.

#### 2.1.6 Income Changes and Distribution

The trend of real income per capital over time shows a sharp decline as reflected by annual growth rates of 1.5% over the 1972-1979 period, 0.5% over the 1982-1989 period and -0.5% over the 1992-1999 period. Income distribution is largely skewed with 20% of the rural population sharing only 3.5% of the national income compared to the top 20% of the population sharing more that 60% of the national income.

#### 2.1.7 Poverty Incidence

The poverty situation in Kenya is a national crisis and its reduction is a national challenge. Kenya's Economic Survey 2000 stipulates that 56% of Kenyans are living below the poverty line. This comprises the rural and urban proportions of 13.8 million people or 85% and 2.4

million people or 15% respectively. Although poverty has always been assumed to be a rural phenomenon, it is now evident that it is prevalent in urban areas as well. This scenario leads to increased dependency on wood fuel resources.

## 2.2 OVERALL ECONOMIC PERFORMANCE

### 2.2.1 Gross Domestic Product (GDP) Growth Rate

Since the mid-1970s, the performance of the economy has been poor, declining to 5.2% annual average growth rate of GDP over the second half of 1970s, 4.1% in the 1980s and 2.3% during the first half of the 1990s. Structural reforms in the next half of the 1990s have focused on maintaining macro-economic stability by removal of bottlenecks to growth, improving public financial management, enhancing external and domestic competitiveness of the economy as well as addressing social aspects of development.

### 2.2.2 Structural Changes

Over the last three and half decades, notable structural transformation has occurred in the economy of Kenya, as reflected by changes in sectoral share contributions to total GDP. The share of agriculture sector has declined sharply from an average of 37% per annum over the 1964-1973 period to 27% over the 1990-1999 period, compared to a marginal decline of 1% in the share of the manufacturing sector from an annual average of 12% over the 1964-1973 period to 11% over the 1990-1999 period.

Kenya adopted an industrial transformation strategy in 1996 designed to expand considerably the share of contribution of the manufacturing sector to GDP and transform the country into a Newly Industrialized Country (NIC) by the year 2020. The service sector has grown rapidly with its share contribution to GDP rising from 53% over the 1964-1973 period to 62% over the 1990-1999 period.

### 2.2.3 External Trade

Kenya's exports are dominated by a few agricultural commodities including tea, coffee and horticultural crops. Exports of manufactured goods accounted for 17% in 1990. Major import items include crude petroleum, industrial machinery and industrial inputs such as iron and steel. The sharp decline of the share of the total value of imports of the three mentioned products during the last years, was due to increased shares of other import items such as motor vehicles, chassis, refined petroleum products and pharmaceuticals following trade liberalization.

Value of exports as a percentage of GDP recorded an annual average of 21% between 1990 and 1999 as compared to 33% in the case of the value of imports over the same period. Terms of trade have remained favourable since 1993.

#### 2.2.4 Investment and Savings

The general decline in economic performance since the mid-1970s reduced the growth of capital stock. The sources of gross investment financing have shifted significantly since 1991 toward the domestic saving financing. Inflows of Official Development Assistance (ODA) declined sharply since 1991 following suspension of donor aid to Kenya. To achieve sustainable levels of development, it is crucial to have the investment level increased to the level attained in the 1970s of about 30% of the GDP.

Since development in the forestry sector requires long-term investment, the current reduced investment capacity implies that the government will have inadequate capital to invest into forestry development. Therefore the improvement of forestry sector will depend heavily on external funding and individual investors in farm forestry.

### 2.3 DEVELOPMENT IN INFRASTRUCTURE AND COMMUNICATIONS

Kenya recognizes the overriding importance of sound development of the infrastructure and communications sector because of its great potential in stimulating economic activities and improvement in the welfare of the people. Improved infrastructure will lead to improved livelihood resulting to less dependence on forest resources.

#### 2.3.1 Development in the Infrastructure (Transport System) Sub-Sector

Most of the basic infrastructural facilities regarding the transport system that are necessary for an “economic-take off”, by the integration of various production and population centres as well as facilitating mobility in both rural and urban areas, are already in place. Nevertheless, the deterioration in quality of the facilities in the last 15 years has posed a major challenge to economic growth. In order to ensure sustainable development in the sub-sector, the Government has placed emphasis on improving efficiency and quality of the existing infrastructural facilities.

Similarly within the forestry sector, there has been no proper maintenance of the transport infrastructure. The sector experiences inadequate supply of vehicles, collapsed unclassified road network and inadequate operational funds. Conservation efforts have therefore been subdued.

- Road Transport:

The road transport accounts for 80% of the country’s total passenger and freight traffic. It comprises a total of 151,000 km of both classified and unclassified network as well as the urban

transport system. The classified network, or 42% of the total road transport network is under the Ministry of Roads and Public Works whereas the unclassified network (53%) is under the Forest Department in the Ministry of Environment and Natural Resources as well as Kenya Wildlife Service (KWS) and the Ministry of Tourism. The urban transport network, consisting of only 5% of road transport, is crucial for Kenya's industrial development and is under municipal authorities including the City Council of Nairobi.

- Railway Transport:

Railway transport, the second most important transport mode after the roads, is particularly important for the carriage of bulky goods over long distances. Freight haulage accounts for more than 80% of the total earnings from the railway transport whereas passenger transport accounts for 10% only and the rest of the earnings come from catering and other services.

It is envisaged that if Kenya improves her capability of increasing export of her forest produce, the use of railway transport is likely to be the best option available.

- Marine Transport, Air Transport & Pipeline Transport:

The implementation of Kenya's industrial policy required increasing the efficiency and capacity at the port of Mombassa to handle the expected increase in the magnitude of economic output that would emanate from increased export-oriented manufacturing as well as increased productive activities.

- Air transport is Kenya's key sub-sector for promoting the development of tourism industry and regional integration as well as for the transportation of high value exports and perishable goods especially horticultural crops, major sources of foreign exchange earnings.

Pipeline transport is the main mode of transporting petroleum oil under the management of Kenya Pipeline Corporation. Development of pipeline and liberalisation of the petroleum sector is expected to lead to reduced consumer prices for the petroleum products. Such reduced prices will lower consumer demand for wood fuel products.

### 2.3.2 The Communications Sub-Sector

The communications sub-sector consists of the postal and telecommunications services delivery as well as a regulatory mechanism. Kenya has joined the "information superhighway" following the convergence of technologies in the areas of computing, telecommunications and audio-visual, in order to improve the quality of services delivery.

If not for the current development in wireless telecommunications, the demand for poles for telegraphic purposes was expected to double in the year 2001, as predicted in the KFMP,1994.

### 2.3.3 Meteorology Sub-sector

Meteorology is recognized as an important aspect of economic development through provision of accurate and reliable information on climatological and weather conditions. The policy of the Government is to strengthen the capacity of meteorological facilities and avail information from the centres to resources planners.

## 2.4. INVESTMENT TRENDS IN THE FORESTRY SECTOR

### 2.4.1 Overview

The Kenyan population has continued to increase and this will continue putting more pressure on land resources. Farm holding sizes are likely to be subdivided further as people continue to depend more and more on primary land productivity. If the past trends are anything to go by, tree cover will increase in the farmlands because more and more people will continue to invest on tree planting as a fall back mechanism during times of difficulties. It has been reported that with smaller land holdings and increased settled population density, tree cover tends to increase (KFMP, 1994).

At the beginning of the last century, it was realized that wood production from the country's indigenous forest would not sustain demand for industrial demand for long. It was therefore decided to establish fast growing exotic species for production of industrial wood. This programme has been supported by 4 development credits from the World Bank totalling to US \$65 million. Several other donor grants have also been channelled into indigenous forest conservation, extension services and research programmes.

After the expiry of the last World Bank Forestry Development Project, funding of the major development programme reverted to the Government. Due to financial constraints budgetary allocation dropped to a tenth of the previous funding levels, with a corresponding drop in annual work programme. Currently the annual planting programme stands at about 400 hectares compared to 4800 during the World Bank Project days. In contrast, demand for timber has continued to increase leading to the opening of more areas during harvesting. The reduced annual work programme has therefore led to accumulation of backlogs in plantation establishment and maintenance, now standing at about 40,000 ha.

With foreign direct investment levels in Kenya still stagnant and falling, the investment in forestry sector has declined drastically at the moment resulting in reduced development programmes. If this scenario persists, the future sustainability of government dominated forestry development will be at stake. This trend can only be reversed if the envisaged policy and institutional reforms are put in place in good time to incorporate other interested stakeholders in the sector.

From the current observations, we are likely to have a shift from a government dominated timber supply to a private sector (farm forestry) dominated market. There are new tree products with favourable markets that are likely to influence tree growing at the farm level. In some areas and especially in the semi-arid areas, forestry investment is more sustainable and profitable in the long term than agriculture. Trees are more adapted in these environments and tree-based crops are likely to be the answer in coping with the harsh environment. Ngugi (1997), found that farmers with heavy reliance on tree crops were more secure in food security than those depending heavily on food crops alone. With introduction of land tax, people are likely to invest in forestry (which has low investment costs) as a way of assigning the land to its most productive use. This will however, need to be supported by incentive measures like technologies, suitable species, micro credits, and market support systems. This observation is drawn from the realization that the Ministry of Agriculture and Rural Development (MoA&RD) is in the process of formulating a comprehensive land-use policy.

We are likely to see more local investments on tree production, marketing and processing especially for non-wood forest and tree products. A lot of potential exists in both the high potential and marginal areas in the production and processing of these products. Information and awareness has started reaching the target areas, and this is likely to change the tree investment scenario with the realization that public land under forestry production is likely to go down during the period under review.

Following the identification of fast growing and high quality commercial tree species, a substantial amount of land in the semi-arid areas and high potential areas is likely to be allocated for growing trees on commercial basis, with private entrepreneurship taking a dominant role in this sector. The current estimate is that approximately 70,000 ha of fast growing plantations are under private ownership. Apart from tea and tobacco firms with good management, some of these resources are poorly managed. There is however, some scope for improved management given the supply scenario from gazetted forest areas, as the price starts to increase due to shortfall in supply.

Trees such as *Melia volkensii*, *Albizia tanganyikensis*, *Terminalia prunioides*, *T. brownii* and *Acacia xanthophloea* have been found to grow fast in semi-arid areas with high water table (at the age between 10-12 years) and produce commercial timber for construction, furniture and carving. Similarly, trees such as *Acacia senegal*, *Commiphora africana*, *Sclerocarya birrea*, *Tamaridus indica* and *Hyphaene compressa* have also been observed to grow fast in semi-arid areas and have important commercial non-wood tree products. The large-scale establishment of plantations will only be possible with appropriate land use policy, defined land tenure and an appropriate regulatory and monitoring system. The need to involve pastoralists communities in tree crop development and conservation is recognised as a national priority. The process must however be packaged and introduced suitably to allow the communities to realize the benefits and own the process.

If the past trends are anything to go by, we are likely to continue to have an estimated KSh 0.5 billion investment from the donor community per year. This external capital is needed to augment the current low-level government funding towards the development of the forestry

sector. Similarly, the private sector will be expected to continue investing in excess of KSh 1 billion per year (50 million seedlings at KSh 20 per seedling production, including cost of seedling, planting, tending and protection).

Although it has been quoted in all economic surveys that the share contribution by the forestry sector to total capital formation over the first half of 1990s averaged about 0.5%, this figure is only official government revenue from gazetted forests. It is noted that contributions to the rural economy based on fuel wood alone, with a demand of 24 million m<sup>3</sup> of wood, is valued at about KSh 7.2 billion annually. Similarly, non-wood forest and tree products generate about KSh 2.8 billion a year according to estimates by Kenya Association of Forest Users (KAFU, 2000) while the carving industry alone contributes about KSh 1.5 billion (WWF, 1998). It is important to note here that both the carving industry and non-wood forest products earn the country a substantial amount of the much-needed foreign exchange.

Although the contribution of forest resources to the economy is highly undervalued, realistically, the sector's contribution to the national economy stands at 2 billion Ksh, which is approximately 10% of the agricultural sector GDP (KEFRI Strategic Plan 1999-2001). There is therefore an urgent need to carry out national forest valuation exercises to collect data to be fed into the national economic planning and accounting system.

Investment in the forestry sector also includes human resource development at undergraduate level in the departments of Forestry and Wood Science Technology at Moi University, which amounts to an annual average of 5.6% of the total undergraduate enrolment between 1988 and 1995.

- *Investment in Research:*

Forestry Research in Kenya started about the same time as the practice. Due to the experiences encountered in regeneration of indigenous forests the department embarked fully on exotic programs that required investments in research in order to ascertain optimum working rules for industrial plantation development. These rules were to be the basis for policy prescription for optional management.

KEFRI has received development assistance from JICA since 1988. This contribution has been mainly in the construction of buildings and research facilities, staff training and in procurements of vehicles and equipments. There are also a host of other donors financing various research programs highlighted above. KEFRI's strategic plan is to devise research and development programmes that will be supported by a service program whose activities include information documentation and dissemination.

Appended in Table 1 are direct financial inputs to further forestry research between the periods 1995/96 to 2000/01 in Kenya.

Table 1 Kenya Forestry Research Institute Recurrent and Development Expenditure 1995/96-2000/01

Financial Year	Recurrent Expenditure			Development Expenditure			
	Salaries	O&M	Total	Gok	Donor	Total	Grand Total
1995/96	165,558,820	14,236,400	176,795,220	24,051,000	39,900,000	63,951,000	240,746,220
1996/97	173,009,920	9,055,520	182,065,440	8,671,320	-	8,671,320	190,736,760
1997/98	177,994,680	17,339,000	195,333,680	1,930,000	-	1,930,000	197,263,680
1998/99	232,843,840	22,467,400	255,311,240	200,000	52,760,000	52,960,000	308,271,240
1999/00	230,760,700	22,266,380	253,027,080	5,000,000	58,000,000	63,000,000	316,027,080
2000/01	242,592,000	23,408,000	266,000,000	11,000,000	18,800,000	29,800,000	295,800,000
<b>Total</b>	<b>1,219,759,960</b>	<b>108,772,700</b>	<b>1,328,532,660</b>	<b>50,852,320</b>	<b>169,460,000</b>	<b>220,312,320</b>	<b>1,548,844,980</b>

#### 2.4.2 Constraints in Forestry Investment

Constraints in forestry or tree-based programmes originate primarily from inappropriate legislations, in-adequate institutional capacities, lack of credit support, poor planning, weak project preparations and implementation capable of competing successfully for scarce investment funds with non-forestry projects.

Credibility of forestry business among financial institution is usually poor because of lack of understanding and difficulties involved in valuing and pricing of forest/tree products. In summary, the following constraints affect the development of forestry sector in Kenya:

- Inappropriate policies in encouraging private sector participation
- Institutional inadequacies (including skills)
- Lack of incentives
- Weak economic conditions and inadequate infrastructure
- Environmental policies (e.g. those discouraging forest utilization, especially bamboo, cactus and aloe)
- Political interests and interference
- Forest resources are often assigned a very low market value

Although financial resources alone are not sufficient to ensure sustainable forestry, without appropriate financing, the goal of economically efficient, socially balanced and environmentally sound forest management will be difficult to be achieved.

#### 2.4.3 What Needs to be Done

There is need to improve investment in the forestry sector so that the sector can contribute effectively to the socio-economic development of the country and play its other roles as highlighted under the policy objectives. To achieve this, the following issues needs to be resolved:

- Policy reforms that include securing the market value of the national resource capital stock and land-use planning
- Create and promote a favourable environment for investment in sustainable forest management, and develop and maintain strong institutional and human capacities
- Provide incentives and promote the use of appropriate technologies to support sustainable forest management
- Donors should focus on resource management based on appropriate land-use practices, value-adding and tree-based income-generating activities
- A comprehensive forest establishment, management and utilization monitoring and evaluation programmes should be established

## 2.5 POLICY AND INSTITUTIONAL CHANGES IN THE FORESTRY SECTOR

### 2.5.1 Latest Developments of Kenya Forest Policy

Significant changes have taken place in the country and the world since the present forest policy was adopted. Since the 1992 United Nations Conference on Environment and Development (UNCED) the country has embarked on updating the policies and legislation relating to the management of natural resources including forests. Sustainable forest management requires the involvement of all citizens and the adjacent forest communities. Nationally forestry development is now seen as a component in an integrated effort to raise the living standards of the people, create employment and increase industrial output for both local and export market.

The current policy undergoing revision has been found to be inadequate in a number of areas. It is through this recognition of the inadequacy of the existing policy as a basis for long term sectoral planning that the government, since 1991, has been undertaking to review both the forest policy and legislation. A new forest policy has therefore been proposed and adopted by the government and is ready for submission to parliament for enactment. The new policy will in particular address the following issues:

- The need to sustainably manage all types of forests including those in state, trust and private lands
- Farm forestry and dry land forestry, which provide an opportunity for the expansion of the forest resource services and products
- Increased role of the private sector and other stakeholders including forest industry in sustainable forest management and utilization
- Participation of local communities and gender issues in planning, programming and implementation of forest programmes as well as providing them with guidelines on access and benefit sharing
- Recognition and institutionalise global conventions and other protocols related to sustainable forest management
- Incorporation of environmental impact assessment as a major criterion in forest development

This new policy takes into consideration the existing land-use, environmental, energy, industrial and other related policies. It has been prepared through wide participation of all the stakeholders including NGOs, education and research institutions, international donors and local level communities. This policy is therefore expected to guide forestry sector development into the new millennium. This has been done in order to make the policy & legislation stakeholder driven and hence acceptable within the overall social and economic development context of the country. In order to enforce the new forest policy, a new forest bill has been drafted and is awaiting enactment. This new bill will re-define forest management in line with emerging challenges.

## 2.5.2 Institutional Framework for Forestry

The broad responsibilities of the Forest Department as stated in Government Circular No. 1 of 1995 on organization of the Government of Kenya, is conservation and development of all forest resource in the country. It is the responsibility of the department to ensure that forests are managed sustainably so as to provide the country's need for wood products and ensure environmental and biodiversity conservation. In addition the department also provides extension services to farmers and other landowners in order to increase tree cover and wood production outside the gazetted forests.

In pursuing these objectives, it must be borne in mind that as the country's population grows to an estimated 30 million in 2020, the adequate supply for fuel wood, poles and posts, industrial wood and many other forest products will be maintained. If these needs are not sustainably met, then the forest and tree resources of the country will decline at an accelerated pace that will intensify environmental imbalance and cause irreversible loss of biodiversity.

The forestry sector is currently faced with several critical challenges, including:

- Difficulties in undertaking regulatory, statutory and extension services due to lack of commercial flexibility and existing cumbersome procedures
- Lack of autonomy and external influences
- Multiple licensing authorities (for forest produce extraction) including local authorities, provincial administration and other departments
- Under-valuation of forestry resources leading to inadequate linkages between budgetary allocations on operations and maintenance (O&M) and revenue collection leading to absence of incentives to improve revenue collection
- Depletion of forest cover through over-exploitation and excision
- Lack of an effective management information system and technology
- Land-use conflicts between forests, agriculture and urban development

In view of the above constraints, the Forest Department cannot be able to adequately carry out its functions and mandate. Development partners have therefore to be identified and given appropriate roles, according to their existing or potential interests and capabilities.

For the seek of public sector amenities, the government must continue to be the highest authority in the forestry sector, and particularly in areas of policy, law enforcement, licensing forest

utilization, collection of revenue, research, education and training, extension and other public services. The government is also expected to co-ordinate and provide support to the forestry activities of the other development partners. All these activities are geared towards the development of an appropriate multi-agency regulatory and monitoring framework.

### 2.5.3 Focus on Forest Department

The Forest Department was established through an Act of Parliament (Cap. 385) of the laws of Kenya in 1942. It is headed by a Chief Conservator of Forests who is assisted by other forestry professional and technical officers at national, provincial, districts, divisional and forest station levels.

Logistical support within the department is provided by a variety of support staff. The development of the forestry has been mainly in the hands of the state although farmers have been planting trees for decades especially where they have had secure tenure of their land.

The Forest Department has had a dual role as forest authority and as manager of forest resources. Under this arrangement the department has established a good supply of industrial wood predominantly from fast-growing exotic tree species. However, due to the various constraints enumerated earlier, the management of the forest resources is a serious cause for concern.

In view of the challenges facing the department, an organizational change has been proposed. One of the most conspicuous options is a move in the long-term direction to commercialise the management of state-owned forest plantations. This will mean splitting the functions of the Forest Department into two. The management and development of forest plantations will be taken over as a business venture, and carried out on commercial basis. The remaining Forest Department will become the National Forest Authority dealing with indigenous forest conservation and responsible for policy, legislation, law enforcement, extension and monitoring. Under this arrangement, there will be a clear separation of the regulatory and development functions in forest resource management. The new organizational structure is aimed at making the department more focused, productive and efficient, with appropriate staff rationalization. It is anticipated that under this re-organization, adequate revenues will be generated for sustainable plantation management, with surplus being utilized for indigenous forest conservation and extension services.

### 2.5.4 Structure and Functions of Kenya Wildlife Service (KWS)

The Kenya Wildlife Service is an institution established under the Wildlife Conservation and Management Act (1989). One of the statutory functions of the service is formulation of policies regarding the conservation, management and utilization of all wild animals. It has the sole jurisdiction over national parks and an oversight role in management of national reserves and private sanctuaries. It also has the legal mandate to enforce wildlife laws and regulation.

In carrying out the above mandate, KWS has recognized the need to form partnership with stakeholders (including private researchers, group researchers, Forest Department through Memoranda of Understanding, etc) and local people living adjacent to protected areas for effective and sustainable management of the natural wildlife heritage. The future vision of KWS is to focus on mobilizing the competent authorities and stakeholders, educating them on the importance of biodiversity, on user-rights policy and in providing the skills needed to participate in conservation programmes.

#### 2.5.5 The Private Sector

The role of private sector participation in the forestry sector has been mainly in forest enterprise use area especially within forest industry. These are however, plantation forests under private companies, tea & tobacco that are well managed and are based on short-term fuel wood cycles to cure their raw materials. Within such estates, *Eucalyptus spp* is the dominant and preferred species. The information on the exact area under the above forests is however not available.

A number of such companies have shown interests in leasing government forestland to grow trees for their use. Therefore if an enabling environment is created, a number of these private firms could secure deforested government land for reforestation programmes and in the process ease the government's role in forest development.

Individual farmers have however been planting trees outside the gazetted forest estate for a long time, especially when they had secure tenure of their land. They constitute a very large and important sector in forestry related private sector. With the intended shift in the reorganization of forestry sector, the role of private sector/local communities in future forestry management will continue to play an increasingly important role in tree planting and forest management.

#### 2.5.6 Research and Education

There are a number of institutions involved in forestry-related research and education on the research aspect. Kenya Forestry Research Institute (KEFRI) has the overall mandate to conduct research in forestry issues in Kenya. KEFRI co-operates with other research bodies within and outside Kenya carrying out similar research, liaises with other organizations and institutions of higher learning in training and on matters of forestry research and in disseminating research findings. KEFRI strategic plan is to undertake more discipline-oriented and prioritised research programmes, and develop a flexible problem oriented research structure based on core research programmes in farm forestry, natural forests, plantation forests and dry land forestry.

Kenya Forestry College is an institution that trains at sub-professional level and is the main trainer of technical cadres for the Forest Department. Professional forestry training is done at both Moi and Egerton universities.

## 2.6 DEVELOPMENTS IN THE AGRICULTURAL SECTOR AND THEIR IMPLICATION ON FORESTRY

### 2.6.1 Overview

Since independence, Kenya has continued to rely heavily on agricultural sector as a base for economic growth, employment creation and foreign exchange generator. Agriculture has been the mainstay of the Kenyan economy. The share of agriculture in Gross Domestic Product (GDP) declined from 36.6% during 1964-73 to 26.2% during 1990-95. The agriculture sector's share in GDP is projected to decline from 27.9% in 1996 to 26.0% in 2001. Unless urgent interventions are carried out, this share is projected to decline further by 2020.

The small-scale agricultural sector is the single largest source of employment in Kenya absorbing over 51% of the labour force. On the National Level, the plan is to create 2.6 million jobs annually by year 2001. Of these jobs, small-scale agriculture is projected to create 1.08 million or 41.6% of the new jobs.

While there is no doubt that agriculture is the mainstay of the country's economy, agriculture as a land-use option cannot be seen in isolation from other related land-use sectors. It is by emphasizing too much on one sector and de-emphasizing on other sectors that has made sustainable agriculture development rather difficult in Kenya. The fact that Kenya has no comprehensive land-use policy has meant that agriculture development (expansion) has infringed to some extent on forestry conservation, biodiversity conservation, water conservation, etc. Urban development has also occurred at the expense of forestry and agriculture.

The forestry sector has also been weak in using its development potential to compete with agriculture in resource allocation. While a lot of research has gone into agriculture development and agro-based industries, the same cannot be said of the forestry sector and its associated industries. While agriculture has been vibrant, the forestry sector has remained largely traditional despite the overwhelming productive and industrial potentials. Lack of information on the forestry potential, importance and the difficulties involved in valuing forest resources have also contributed to the poor performance of the forestry sector.

### 2.6.2 Subsistence Nature of Agriculture

The fact that a majority of Kenyans live in the rural areas means that majority of Kenyans depend on primary products. Most farmers in the rural areas produce or attempt to procure their own food for subsistence.

Since people have been accustomed to growing their own food, over time, there is usually presumed food insecurity if one is not able to grow their own food for consumption. This means that more land is brought under cultivation to grow own food and in most cases, the land in question is usually forest land. Food security is however more to do with income security

(regular incomes) rather than growing own food. If the trend changes from subsistence agriculture (growing own food) to income security (regular incomes), then the land can be allocated to what is best suited to produce (rational allocation of resources).

This way, forests can be expanded and protected where they have comparative advantage over any other land-use. Factors that have made forestry not competitive enough (like credit incentives) must be addressed. This way, farmers will be able to allocate their natural resources to the most sustainable and productive use, and which might not necessarily be agriculture. Policy on food security has to be addressed to reflect the real issues (food and income security).

### 2.6.3 Public Versus Private Goods

Forests are largely seen as public goods while agriculture is treated as a private good. Property rights are an incentive in resource management and conservation. Since agriculture falls largely within private property domain, it enjoys legal and economic incentives, which makes it grow and develop.

Forestry, on the other hand, is largely a public good therefore greatly affected by its common use. As a common property resource, forestry enjoys less personal initiative for its protection, at the same time exposed to less investment incentives to develop it. By assigning user rights to stakeholders, forest may receive better protection and development resources and the urge to convert them to other uses may be greatly reduced.

Similarly, fishing, bee keeping and eco-tourism practised by forest-adjacent communities would be sufficient incentives to protect the forest if the property/user rights are put in place.

### 2.6.4 Policy Environment

Kenya has no comprehensive land-use policy and this has meant that we have allocated our resources on very narrow land-use considerations, which are greatly influenced by the politics of the day.

Alternative uses of land must be sought and supported with incentives for the take-off while the necessary infrastructures must be put in place to support food security (communication, transport and marketing). There must also be an emphasis on income security as opposed to growing own food.

To some extent, agriculture expansion has meant sacrificing forests, both gazetted and ungazetted. There has been tremendous increase of area under tea. The expansion of tea growing has meant conversion of 6,000 ha of forests, although in partial compensation, the tea plantations are supposed to be a buffer zone to protect the forest from future encroachment.

Although agriculture was commonly considered more important than forestry, now it is clear that forestry supports agriculture and other sectors that are related to agriculture like livestock, fisheries, energy and rural employment. Of interest here is the need to clearly articulate the role of forestry in providing clean water for irrigated agriculture, livestock keeping, industrial and domestic use and electric power generation. Consequently, the sustained development of these other sectors must be understood to directly depend on the good health of our forestry sector.

#### 2.6.5 Legislative Schemes

Settlement Act among the agricultural-related pieces of legislation is the most important in expansion of agriculture. Forestland is usually seen as idle land (mainly by politicians) and for this misconception, many of the settlement schemes have been created by excision of forest land. Again because of the ease of valuing resources under agriculture, it is possible to visualize the importance of agriculture enterprises as compared to forestry enterprises, which are difficult to discuss and measure. Forestry problems are usually long term in nature and will tend to remain obscure in the short term, just to appear in compounded nature in the long run.

#### 2.6.6 Institutional Linkages

There are no elaborate linkages between agriculture and forestry. This means that agriculture development may at times affect forestry indirectly. The issue of agricultural subsidies and other incentives like credit (not available in forestry sector) has encouraged people to invest more in agriculture and, at times, at the expense of forestry.

Any agricultural intervention that affects forestry development will, in the final analysis, affect agriculture and thereby, leave people worse off than before. A good example is the conversion of forests into agricultural land and the subsequent loss of the catchment's function. This leads to reduced water flow and less water being available for irrigation. There is thus need to have linkages between agriculture and forestry in terms of ecological functions and conservation of resources like soil, water and biodiversity. Impact assessments should be strictly followed for any change in land-use while forests need to be valued for their physical resources, functional roles and for their use and non-use values.

### 2.7 INDUSTRIAL DEVELOPMENT AND ITS DIRECT AND INDIRECT IMPLICATION ON FORESTRY

#### 2.7.1 Historical Background

Kenya's post-independence industrialization process was based on an import substitution strategy. Through this strategy, rapid growth was attained in the manufacturing sector during the first two decades of independence in 1963. However, this strategy developed some weakness and

problems as some industries turned out to be inefficient with high production costs. The protection of local industries reduced domestic competition and created monopolies that lead to continuous raised consumer prices. The industries also found it more profitable to produce for a highly protected domestic market than for the export market and hence resulting in anti-export bias (Development Plan, 1994-96). Since 1990, industrial growth declined sharply because of continued global recession, poor weather conditions, shortage of foreign exchange, inflation and political uncertainty and inefficient resource allocation.

### 2.7.2 Current Industrialization Status

Kenya targets to become one of the newly industrialized countries (NIC) by the year 2020 and the government's efforts are focused on encouraging new investors. Manufacturing by the primary industries within the country are mainly agro-based and include fruit and vegetable processing, vegetable oils and fats, bakery, alcoholic beverages, dairy, fish, leather tanneries, cotton textiles, pulp and paper, timber and wood products. The other category of industries are in chemical and mineral industrial sector and engineering industrial sector which include pharmaceutical, fertilizer industry, pesticides, plastics industry, cement and lime products, glass industry, petroleum and oil product industry, iron and steel industry, transport industry, motor industry, electrical and electronic industry.

With market liberalization, some agro-based industries have been facing acute competition from imported products. This has led to the collapse of some industries especially the public-owned ones. The public-owned industries have been performing poorly resulting to the government embarking on privatising its interests.

Industrial and commercial sectors being the engines of faster development, they are expected to provide significant employment opportunities for the rapidly growing labour force. However, there is very little growth in employment in these sectors and therefore there is always a labour surplus. The current economic situation within the country is forcing some industries to retrench work force and therefore making the employment situation worse. The government is now encouraging the small scale and *jua kali* enterprises to develop and play an important role in job creation.

### 2.7.3 Industrialization and its Implication on Forestry

The Eighth National Development Plan (1997-2001) reiterates the broad national goals of poverty alleviation, eradication of illiteracy and disease, and the creation of employment mainly through industrialization. There is however a very strong forward and backward linkage between agricultural and industrial sectors. These sectors will therefore continue to be the vehicles for economic growth. Resulting from the unreliability of agricultural sector due to weather vagaries, poor infrastructure, low domestic savings and unfavourable investment climate, it is unlikely that NIC status will be achieved in the planned period.

As Kenya transforms into a NIC, one of the major challenges to be faced will be promotion of industrialization without compromising environmental quality. One of the acute problems that arise as a result of industrial development is pollution in form of solid wastes, gaseous pollutants (sulphur dioxide and other toxicants from industrial effluent which may have local and regional effects). Forestry plays a beneficial role in terms of reducing the carbon in the atmosphere and fixing it into woody material (sequestration).

During the initial stages of industrial development, packaging was mainly of paper products made from plant fibres where forestry had a big contribution. However, the trend is changing to plastics packaging, which is not easily biodegradable leading to several tonnes of plastic wastes, which are not environmentally friendly. Development in the petroleum industry has also affected the use of plant fibres, as synthetic ones are preferred.

Currently, there is a shortage of wood products as the consumption of forest products by the forest industries has been higher than the forest establishment. This inefficient management of the resource base has resulted in environmental degradation. To achieve efficient resource management, there is need to develop environmental management tools which include laws relating to the management of regional and international shared resources, environmental pollution, environmental impact assessments, environmental auditing, monitoring and evaluation.

The horticultural industry is growing very fast in Kenya and is supported by forestry in the supply of support sticks for horticultural crops. This industry is contributing significantly in the export market.

#### 2.7.4 Forest Industries and Raw Materials Availability:

Since 1982, logging of hardwoods from indigenous forest has been banned, and the wood-based industries have therefore been relying on plantations and farmlands. The main plantation species used in the building industry are cypress and pines. These plantation species account for 76% of the total area planted (KFMP, 1994). Until recently, the rate of harvesting industrial wood exceeded the average rate of replanting which threatens the long-term supply of industrial wood in the country.

Forest industries can be classified as wood based and non-wood-based, these being further subdivided into mechanical wood industry and the pulp and paper industry. Kenya's mechanical wood industry includes saw milling, wood-based panels manufacture (plywood, particleboard and fibreboard), wood processing and pole production.

There are about 450 sawmills in Kenya, which produce about 200,000m<sup>3</sup> of sawn wood. These industries face the problems of depletion of hardwood stocks from natural forests and softwoods plantations, low recovery rates of 25-40% due to poor machinery and pollution caused by residue disposal problems.

The production of poles and post for construction and transmission markets forms a significant industry. About 50% of the total industrial wood production goes to pole market (KFMP, 1994). A lot of these poles will be expected to be supplied from the farm forestry in the future.

The wood-based panel industry comprises three plywood mills, one particleboard mill and one fibreboard mill (KFMP, 1994). The furniture and joinery industry consists of a large number of small diversified artisan workshops absorbing 15-20% of the sawn wood and panel output.

Tea and Tobacco industries use fuel wood from forest resources in drying and curing. With the increasing cost of industrial oil, most tea factories are converting their boilers to fuel wood fire.

Industrial development is likely to lead to improved income level and this is expected to lead to a shift in demand resulting from change in preferences and technology. It is therefore envisaged that the above changes will translate into efficient production systems and less dependency on extractive forest uses.

## 2.8 DEVELOPMENT IN THE SERVICES AND OTHER SECTORS

### 2.8.1 Construction

With industrial development it is expected that incomes will improve and people will invest in the development of better housing. This will increase the demand for scaffolding and use of timber in housing. As a result, there will be increased pressure on forest and tree resources.

### 2.8.2 Water supply

There will be increased demand for water resource. To cope with this demand for water resource by the year 2020, forest resources require to be conserved and protected sustainably.

### 2.8.3 Health

There is likely to be an increase in use of herbal medicine as evidenced by a variety of products got from e.g. *Prunus africana* bark in the treatment of prostate cancer and Neem (*Azadirachta indica*) in the treatment of malaria and other diseases. In order to have sustainable supply of the herbs from some of these very useful trees, it is important that their production be commercialised and regulated through the envisaged forest policy. Many other indigenous trees are used in herbal medicines for human beings and/or livestock. Their importance, especially in the ASALs, cannot be overemphasized given the sparse distribution of human health and veterinary services centres.

#### 2.8.4 Eco-Tourism Development

Kenya has a network of protected areas spread over representative ecological zones and ecosystem ranging from the coastal mangrove estuaries through arid and semi arid plains to high land forests and alpine tundra. This diverse and spectacular heritage forms the backbone of the country's tourism industry. The tourism industry in Kenya is a precursor for the development of the eco-tourism sector. The management of this new emerging sector falls within the mandates of Kenya Wildlife Service (KWS) and the Forestry Department (FD) by virtue of the two institutions being charged with the responsibility to manage the protected area systems. The two institutions FD and KWS therefore entered into a memorandum of understanding for the joint management of some key forest blocks with potential for eco-tourism development. Again both the two institutions have recognized the need to form partnership with local communities living adjacent to those protected areas including the NGOs and private firms to encourage joint participatory management by all stakeholders. In some of the conservation programs, communities benefit through economic incentives by sharing gate fees or having a percentage of the collected royalties ploughed back to the respective county councils.

In contrast to the wide spread mass tourism sector in Kenya, the development of eco-tourism sector infrastructure has been restricted to zones with diverse or unique biodiversity. These zones have tended to cover mostly the forest reserves with an exception of eco-tourism infrastructure developed for the mount Kenya National Park. At the moment, eco-tourism activities are concentrated within Araboko-Sokoke Forest Reserve, Kakamega Nature / Forest Reserve and Mount Kenya Park/Forest Reserve. Within these sites, the supportive infrastructures such as accommodation have been developed by the private sector and county councils. It should however be noted here that over the years, FD had developed good accommodation infrastructure in all key stations country wide in the form of guest houses for eco-tourism sector. These facilities were not maintained and therefore collapsed.

The challenges that need to be overcome in-order to enhance eco-tourism development should therefore include the following:

- Provision of clear legislative mechanism to guide the development of eco-tourism
- Improvement of capacity to monitor impact of development of other sectors on eco-tourism
- Improvement of capability to plan for and to develop eco-tourism infrastructure
- Development of a comprehensive land-use plan to reduce conflicts
- Improvement of security within the eco-tourism zones
- Decimation of information to improve public awareness on the potentials of the sector
- Institutionalisation and strengthening of capability of regulatory authority for the sector

If developed properly, eco-tourism as a non-extractive form of forestry activity especially within the indigenous forest zones has enormous potential in generating foreign exchange at the same time providing employment opportunity for the locals and a forum for education and scientific development. To achieve the benefits from eco-tourism, it is imperative that the government should provide an enabling environment where all the stakeholders have appropriate roles to play.

As more people start to appreciate the roles of eco-tourism potential and the need for a more balanced resource utilization, it is anticipated that more people will take the challenges thereby increasing the variety of attraction and thereby becoming competitive in this important sector.

## 2.9 CHANGES IN ENERGY USE AND THEIR IMPLICATION ON FORESTRY

### 2.9.1 Energy Use in Kenya

- Wood fuel:

Over 80% of Kenya’s population is dependent on wood fuel for their domestic energy needs. Wood fuel caters for between 70 and 80% of the country’s final energy demand and provides for more than 93% of rural household energy needs. In urban areas, use of wood fuel is predominantly in the form of charcoal rather than firewood. It is estimated that about 80% of the urban households’ wood fuel demand is met by charcoal.

Cooking and space heating represents the largest single demand for fuel wood. There are many rural and urban small-scale industries using fuel wood or charcoal as a source of energy in processing their products. Examples include tobacco and tea curing, brick-making, fish drying, bakeries and small-scale workshops.

The major government agencies concerned with energy issues are Forest Department and Ministry of Energy. The Ministry of Agriculture and Rural Development mainly complements the two agencies (FD and Ministry of Energy) in terms of on-farm wood production and domestic energy conservation. Other agencies, government and non-government, also collaborate with the three agencies in promoting energy utilization and conservation in various ways.

Most of the country’s wood fuel comes from forests, woodlands, shrublands and farmlands. Government gazetted forests cover about 2.5% of the country and are mainly found in the high and medium potential areas of the country, which are only 20% of the total land area. The government plantation forests provide most wood fuel for industries.

#### **Sources of wood fuel in Kenya**

An assessment of vegetative cover of Kenya was done for the Water Master Plan (1992) and its interpretation modified by KIFCON (1994a), with re-mapping to correspond to the broad vegetation units defined by White (1987). The Kenya Forestry Master Plan (1994) has estimated that closed indigenous forests, woodlands and bushlands, farmlands and settlements and protected area industrial plantations have between them a total of 48.6 million ha of wood. These are distributed as shown in Table 2 below.

Table 2: Sources of Wood fuel in Kenya (millions of ha)

Source/Year	2000	2005	2010	2015	2020
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Closed indigenous forests	1.27	1.245	1.22	1.195	1.17
Woodlands and Shrublands	37.15	36.875	36.6	36.325	36.05
Farmlands and Settlements	10.02	10.32	10.62	10.92	11.22
Protected Area Industrial Plantations	0.134	0.118	0.107	0.093	0.078
<b>Total</b>	<b>48.574</b>	<b>48.558</b>	<b>48.547</b>	<b>48.533</b>	<b>48.518</b>

Source: KFMP, 1994

#### ✓ Closed Indigenous Forests

One of the main sources of wood fuel is the gazetted closed indigenous forest. This contains stocks of non-commercial species, which are used primarily for rural wood fuel as well as construction poles and timber. It is estimated that about 5,000 ha of the closed forest are being lost each year to both authorized excisions and illegal encroachments. A 1994 estimate (KFMP, 1994) indicated that the average closed indigenous forest growing stock is 176 m<sup>3</sup>/ha, which includes stem and branch biomass. From these forests, the sustainable annual wood fuel is 0.9 m<sup>3</sup>/ha. The decline in closed indigenous forest size is expected to be steady at an estimated 5,000 ha every year to reach 1.17 million ha in 2020. Wood production from closed indigenous forests consists of 60% wood fuel, 27% timber and 13% poles. Hence, in the year 2000, these forests are estimated to carry wood fuel stocks amounting to 105.6 m<sup>3</sup>/ha or a total of 154.4 million m<sup>3</sup>. The wood fuel stock will decline to 99 m<sup>3</sup>/ha or a total of 115.8 million m<sup>3</sup> by 2020.

#### ✓ Woodlands and Shrublands

Over 80% of the country is arid and semi-arid (ASAL) and contains over 80% of the country's forest resources. The population is sparse and shortages of wood are not severe. People do not cut down trees for wood fuel but gather fallen wood. However, this situation has been changing over recent times as much of the charcoal used in urban centres such as Nairobi, Mombasa, Kisumu, etc. comes from these areas. This has caused serious deforestation in most ASALs and the continued increase in urban population is expected to accelerate this situation. Decline in area under wood has been estimated at 5,000 ha annually (KFMP, 1994), especially in unmanaged areas. These areas will decline to 36 million ha by 2020.

Woodlands, shrublands and wooded grasslands currently cover about 37.2 million ha and are mainly found in the rangelands but also occur in the medium and high potential areas. This woody vegetation is under threat, mainly from opening up of new farming land, followed by charcoal production (Leach and Mearns, 1988). In settled ASALs and where tenure has been established, trees are being protected and planted. The forestry master plan (KFMP, 1994) estimated that the average growing stock of the woodlands, shrublands and wooded grasslands is about 16 m<sup>3</sup>/ha of woody biomass with an annual increment of about 0.115 m<sup>3</sup>/ha. The stock will attain a high of 19 m<sup>3</sup>/ha by 2020. Elsewhere, savannah woodlands and reasonably productive bush have been estimated to have standing tree stocks of about 20-30 m<sup>3</sup>/ha (ETC, 1987). Degraded savannah and dry bush, on the other hand, have 7-10 m<sup>3</sup>/ha of wood (Leach and Mearns, 1988).

Woodfuel production from woodlands and bushlands is 89% (14.24 m<sup>3</sup>/ha or a total of about 530 million m<sup>3</sup> in 2000) and the sustainable annual woodfuel production is 2% of the inventory. The

total amount of woodfuel in these forests will drop by about 20 million m<sup>3</sup> to an average of 510 million m<sup>3</sup> by the year 2020 (KFMP, 1994).

Charcoal production in the rangelands is an important income generation option and is done by most households on small-scale basis. Sometimes people get together in organized groups and produce charcoal on a substantially larger scale. During the dry season and extended periods of drought, charcoal production for cash income becomes more important when other types of activities fail to produce sufficient household income. It is estimated that around 20% of marketed charcoal originates from these sources.

The productivity of these areas is quite low (1 m<sup>3</sup>/ha/yr) and intensive clearing of vegetation for agricultural land and subsequent charcoal production has caused long-term resource management problems. Since these areas are ecologically fragile, full recovery of degraded land takes 40-50 years, and this has forced the migration of large numbers of people and animals. With continued and increased influx of human population from the high-potential agricultural areas to the rangelands, it is likely that charcoal production will become the primary rather than the secondary objective of land clearing operations in these marginal areas. It is difficult to ensure that these operations are carried out on a sustained-yield basis or in an environmentally sound way. These harvesting procedures will be devastating and will have irreversible negative impacts on soil and water resources and on agricultural productivity.

#### ✓ Farmlands and Settlements

Most farmlands are found in the high potential agricultural lands, which cover less than 20% of Kenya's land area. More than 25% of the country's wood supplies are located in these areas and most of the resources are in protected forests. These areas also accommodate about 80% of the population of Kenya and have a high potential for annual biomass production. Most charcoal production is from land being cleared for agricultural development. These operations are small-scale and have the primary objective of facilitating land clearing and not specifically to produce charcoal (Agatsiva, 1997; Leach and Mearns, 1988). This source is unsustainable for charcoal production since it is a once-only operation and is further limited by the size of the resource as most arable land is settled.

Wood production from farmlands and settlements, according to KFMP (1994), consists of 73% wood fuel, 20% timber and 7% pole. The amount of wood in farmlands and settlements available for wood fuel in the year 2000 then is estimated at 9 m<sup>3</sup>/ha (or a total of about 82 million m<sup>3</sup>). The farmlands and settlements are expected to provide more wood for fuel attaining a maximum of 15 m<sup>3</sup>/ha or a total of 155 million m<sup>3</sup> by 2020.

#### ✓ Forest Industrial Plantations

Forest industrial plantations under the management of the Forest Department cover less than 170,000 ha with a growing stock of 332 m<sup>3</sup>/ha of wood biomass (KFMP,1994). A steady decline is estimated to put the amount at 320 m<sup>3</sup>/ha in 2020 while the area under forest will decline to 78,000 ha or less by 2020 if the trend of non-planting and excisions observed in the 1990's continues at the then estimated rate (KFMP, 1994). Wood fuel plantations from these areas serve many industrial

requirements such as the tea and tobacco industries. Fuel wood salvaged as waste wood from plantations and sawmill sites supplies about 20% of the country's fuel wood requirements as detailed below:

Table 3: Wood Biomass Inventory (m<sup>3</sup>/ha, 1994 Trends)

Source/Year	2000	2005	2010	2015	2020
Closed indigenous forests	176	176	176	176	176
Woodlands and Bushlands	17	18	18	19	19
Farmlands and Settlements	13	16	20	23	27
Forest Industrial Plantations	332	320	320	320	320
<b>Total</b>	<b>538</b>	<b>530</b>	<b>534</b>	<b>538</b>	<b>542</b>

Source: KFMP, 1994

### Wood fuel Species

Species preferred for woodfuel (charcoal and fuelwood) vary from place to place. In the drylands, *Zizyphus mauritiana*, *Acacia senegal*, *A. seyal*, *A. tortilis* and *Eucalyptus grandis*, among others, are the most preferred species. In the high potential agricultural areas, the most preferred woodfuel species include *Croton megalocarpus*, *Eucalyptus* spp., *Acacia mearnsii*, *Azelia quanzensis*, *Olea europaea* var. *africana*, etc. When suitable wood fuel species are cleared, any available species can be selected to meet wood fuel demands.

### Standing Stock Wood Biomass

Farmlands and settlements will produce an increased amount of wood fuel from 7.7 million m<sup>3</sup> in 2000 to a high of 15 million m<sup>3</sup> in 2020, an overall increase of 67%. This will only be possible if sustainable resource management strategies are adopted. On the other hand, wood fuel production will decrease in other land-use categories with the exception of FD forest industrial plantations, which will produce a modest overall increase of 6% from 0.42 million m<sup>3</sup> in 2000 to 0.44 million m<sup>3</sup> in 2020 based on assumptions made by KFMP (1994). The situation has changed slightly as some forestland has been alienated for agricultural and other developments in recent years.

Overall, available wood varies between 0.1 tonnes/ha in poor woody biomass cover categories to 317 tonnes/ha in woodlands with taller and bigger trees. This represents the standing or wet weight. Poor roads, rugged terrain, poor security and land-tenure problems sometimes hamper accessibility of some of this wood.

Table 4: Accessible Sustainable Wood fuel Production by Land-use Category ('000 m<sup>3</sup>)

Land-Use/Year	2000	2005	2010	2015	2020
Closed indigenous forests	1,143	1,120	1,098	1,076	1,053
Woodlands and Bushlands	10,508	10,430	10,352	10,274	10,196
Farmlands and Settlements	7,746	9,418	11,079	12,947	14,731
FD Forest Industrial Plantations	416	352	361	380	443
<b>Total</b>	<b>19,813</b>	<b>21,320</b>	<b>22,890</b>	<b>24,677</b>	<b>26,423</b>

Source: KFMP, 1994

Most of the wood is found in the southern rangelands such as Narok and Kajiado, while Kiboko, Kibwezi, Masongaleni, Taru, Bachuma and Samburu are major charcoal-producing areas along the Nairobi-Mombasa road and are the major charcoal-supply sites for the two towns. Numerous points along this road sell charcoal in varying quantities every day. The majority of the trees along the road have a diameter of less than 12 cm and at this rate of exploitation, these areas could become deficient areas in the near future.

The northern rangelands have less wood fuel since most woody species have stem diameters of less than 5 cm and therefore are unsuitable and often uneconomical for charcoal production. Also, demand zones are far away from markets and, therefore, it is uneconomical to transport charcoal. Woody production from other lands consists of 95% wood fuel.

### **Scenarios of Woodfuel Supply and Demand Dynamics**

Under sustainable forest management strategies and on 5-year intervals, total wood fuel demand will increase by between 16% (between 2000 and 2005) and 12% (between 2015 and 2020). Over the 20 years under consideration, the demand for wood energy will increase from 23.9 million m<sup>3</sup> to 40.1 million m<sup>3</sup>. On the other hand, and based on similar 5-year periods, the total accessible sustainable supply (all wood) will increase at between 6% (between year 2000 and 2005) and 8% (between year 2010 and 2015 and also between 2015 and 2020). Over the 20-year span under analysis, accessible sustainable supply of all wood will increase from 25 million m<sup>3</sup> to 33.1 million m<sup>3</sup>. If non-sustainable wood supply and wood fuel substitutes are included, the total supply will increase from 27.7 million m<sup>3</sup> in 2000 to 38 million m<sup>3</sup> by 2020. However, after 2000, there will be a deficit that will rise gradually, reaching about 1 million m<sup>3</sup> in 2005 to a high of about 6.8 million m<sup>3</sup> by 2020, manifested mainly as deficits of wood fuel. The annual rate of increase in charcoal demand is projected at 11.4%, which will result in a shortfall of about 23.3 million tonnes by 2010. (KFMP, 1994; Agatsiva, 1997)

The need to increase stock to meet current and rising demand goes without saying. Farm forestry has been playing an increasingly leading role in wood production not only for wood fuel but for a wide range of needs and is expected to continue doing so in the next 20 years. Suitability of available wood resources to meet local wood fuel demand depends on many factors, including distance to population centres, incomes and budgets of households, availability of tools for cutting and climate.

There exists a relationship between wealth and fuel use. Households with more income tend to use kerosene, gas or electricity, while poorer ones go for agricultural residue and animal dung. This would result from decreased availability of wood fuel. As income increases, energy use also increases.

At least 80% of urban wood fuel demands by households are met by charcoal. Charcoal use amounts to about 1.4 million tonnes annually (10-14 million tonnes of wood fuel, at 10-14% recovery). Traditional forest and farm-based wood supplies are being used faster than they are being replaced. At 10-14% conversion rate, charcoal production is not efficient.

- Petroleum:

Petroleum is the major source of energy used by commercial and industrial establishments. Overall, imports of crude oil and refined products rose from 2.8 million tonnes in 1997 to 5.9 million tonnes in 1998, with the refinery processing some 1.7 million tonnes of crude oil in the same period (Annex 3).

Total domestic demand for petroleum products in 1998 was 2.3 million tonnes. The trend in consumption of petroleum is highly dependent on economic performance of the country. With improved economic performance it is expected that petroleum as a source of energy will continue to rise.

- Electricity:

Electricity is the third largest source of energy in Kenya after wood fuel and petroleum fuels. However, it is second to petroleum fuel as a source of commercial energy.

Demand for electricity by domestic and small commercial establishments went up by 8.2%, mainly as a result of the expanding micro and small-scale enterprises sector as well as the increase in human settlement particularly in urban areas. This has resulted in overloading of the national electricity grid leading to frequent power outages, failures. Reforms in this sector could lead to better management and efficiency resulting to affordable tariffs and direct shift from wood fuel dependency especially in urban centres.

- Alternative Energy Sources

### **Solar Energy**

Solar energy is proving to be very popular and appears to be an attractive option, especially where accessibility of energy from the national electricity grid becomes less guaranteed. However, this source of energy has not been fully utilized due to the relative cost of the systems, lack of standards and poor consumer education. Kenya is estimated to have over 120,000 solar home systems rated at approximately 1.3 MW of power currently operational. Most of the systems are the 2- to 4-lamp installations costing approximately KSh 950 to 1,400 per watt  $\pm$  20%.

### **Wind**

Wind energy has been used in Kenya for water pumping purposes since the beginning of the last century. A major advantage of wind energy is its cost-effectiveness of incremental at particular sites. Lack of appropriate technology and effective promotion strategies have, however, hampered the exploitation of this source of energy, which could be harvested as an alternative to wood-fuel.

### **Biogas**

Biogas, which is appropriate for rural areas, has been adopted in Kenya. It can help lower household demand for wood fuel and commercial fuels. Constraints hampering exploitation of this source of energy include lack of extension programmes, technology and high capital cost.

### 2.9.1 Major Issues

The major challenge facing Kenya today is poor economic performance, the ensuing problems of rising unemployment and increasing levels of poverty. Under this situation, the future of the economy is not bright and therefore it has necessitated the county to put in place policies and strategies to stimulate economic growth to generate necessary job opportunities for the country's expanding labour force. This calls for enhanced efficiency in utilizing available energy and other resources so as to maximize productivity and ensure rapid and sustained economic development without straining the environment and especially the forest estates, which act as primary biomass reservations.

The broad issues in energy that require addressing in future include the following:

- Whether future energy use can be restrained so that it grows substantially less rapidly than does economic output (economic efficiency)
- Whether domestic sources of energy can be available in the long run to support the production of goods and services desired by the country
- Whether the cost of that energy, including environmental and health costs, can be sufficiently low to sustain expected standard of living
- The high dependency on wood fuel contributes to forest and tree cover depletion thereby destroying the fragile ecosystems and rainfall catchment areas while lowering productivity
- If the economy does not improve over the period under review, it is expected that more people in both the urban and rural areas will continue to rely on wood fuel as source of energy due to high costs of other alternatives
- Low exploitation of domestic non-biomass energy resources due to three major constraints, i.e
  - Existing resources with the exception of solar energy are located far from main consumption centres
  - Their valorisation requires high capital investments
  - There is lack of financial resources to develop these resources
  - Poor distribution and outlets for petroleum products and electricity in the rural areas where the bulk of population lies
  - Weak planning, co-ordination and monitoring and evaluation capabilities in the field of household energy. This includes insufficient allocation of financial resources to the household energy issues and lack of comprehensive and integrated strategies

### 2.9.3 Priority Action Programmes

The Kenya government recognizes some critical areas of focus for development of the energy sector. The priority action points are:

- Improvement and rationalization of supply of the rural energy through concerted action on:

- Improvement of woody resources management and replenishment.
- Expanded development and utilization of substitute fuels for cooking such as kerosene, electricity and charcoal briquettes.
- Improvement in efficiency of cooking through use of more efficient cooking devices and techniques of food preparation
- A more rigorous campaign on alternative energy especially solar, wind and biogas
- Diversification of conventional energy sources with major emphasis on development of local geothermal and hydro sources of energy
- The creation of Rural Electrification Fund at 5% levy on energy used in part responses to this need
- Expanded participation by the private sector
- Vigorous application and utilization of new and renewable sources of energy with a view to substituting wood fuel, agricultural waste and cow dung in some areas
- Educating the public about energy conservation and promoting efficient utilization and management of energy use

In this programme of action, some specific action areas include:

- Specific conservation efforts targeting specific types of technology
- Government fuel efficiency standards
- Policy and institutional initiatives to realize the full measure of feasible energy savings
- Easily understood information on comparative economics, which help people towards choices that save money and energy
- Development of a Code of Practice, specifications and standards especially for the renewable forms of energy, which operate without specific standards and quality control mechanisms

## 2.10 ECONOMIC LIBERALISATION

The single most important determinant for meeting Kenya's economic aspirations is the extent of the country's success in export to world markets. The industrial and trade sectors have a crucial role to play in this strategy. With respect to trade liberalization, the most important elements of Structural Adjustment Programmes (1980/1981) have been liberalization of prices and marketing systems, financial sector policy reforms, international trade, budget rationalization, divestiture and privatisation. With the implementation of trade liberalization, imports and exports of forest-based products are likely to improve and reduce pressure on forests. Other investors are likely to exploit the potential existing in Kenya.

It is also expected that local demand for high quality forest products will increase trade and expand the contribution of the sector to the national economy. At the same time, local dependency on wood fuel for domestic energy will drop resulting into the long-term conservation of the nation's forest resources.

## 2.11 TECHNOLOGICAL CHANGES IN THE FORESTRY AND ALLIED SECTORS

### 2.11.1 Overview

The technology in forest-related industries has been improving very slowly in terms of operational efficiency due to the high cost of investment that is involved and the uncertainty on availability of raw materials. This slow progress in technological change has resulted in the current use of obsolete technologies.

It has also been noted that some current developments in allied sectors such as plastics industries and alternative energy sectors already have significant impact on the forestry sector.

### 2.11.2 Pulp and Paper Making

Currently, pulp and paper making in Kenya utilizes two methods, mechanical and chemical pulping methods. However, both processes are inefficient and not environmentally friendly hence room exists for improvement. There is scope for use of wood substitute materials such as sugar baggase, banana stems, papyrus and bamboo for pulp and paper production.

Wood and bagasse are the dominant biomass fuels used in Kenya. Bagasse is being used by the industry only. An excess amount of 270,000 tons of bagasse is available from the sugar industry. The total amount of bagasse used amounts to slightly over 1 million tons annually. Surplus of bagasse could mainly be used for industrial power and steam generation. For wood fuel replacement bagasse would have to be dried and briquetted, which might make it uneconomic to use especially in the households.

### 2.11.3 Tree Improvement and Propagation

Since the introduction of exotic fast growing commercial tree spp. at the beginning of the last century, there have been efforts to improve productivity through use of proven superior provenances. Seeds from these provenances have been utilized to develop the planting stock. With proper management the productivity of our plantation has been in the average range of approximately 300-400 m<sup>3</sup> per hectare. Due to management problems this production has been declining steadily. It is however envisaged that with the involvement of competent and commercially oriented players the productivity through improved management can be improved as a first step measure.

In order to further improve on productivity, some new improvement techniques will need to be explored through the use of:

- Clones obtained from selected superior individual trees. This will ensure propagation of desired genotypes for specific management objective. These include high calorific values for firewood or fibre characteristics for pulp production.
- Hybridisation: will have similar results as in agriculture. In forestry use of hybrids will increase the planting range while maximizing on the superior characteristics of the

species. Included in these is the hybridisation between drought tolerant species and fast growing species.

- Pest management and particularly the Integrated Pest Management Systems, has been applying biotechnology by use of gene probes in diagnostic services.
- Tissue culture technology is gaining momentum in forestry as a tool of bulking up of selected individuals. With this technique species with poor natural regeneration and poor seed reproduction can be multiplied rapidly and selectively. There are many such instances where tissue culture will in future be a superior tool of trade, thereby impacting positively on forestry development.

In general, forestry development in Kenya should harness biotechnology techniques in order to claim its place in the modern management particularly as we move towards private sector and enhancement of conservation of the fast declining natural resources. These techniques and many others will optimise on productivity and mitigate losses in order to optimise on utilization of the forestry resources.

#### 2.11.4 Conversion

The documented wood conversion efficiency currently in Kenya stands at 25 to 30%. (KFMP, 1994). This level of efficiency is wasteful. With improved technology there is capability of increasing efficiency to over 50%. The implication of this scenario means improvement of supply of raw materials, culminating in improved forest conservation.

#### 2.11.5 Processing and Utilisation of Non-Wood Tree and Forest Products

Currently Kenya lacks appropriate technologies in processing and utilization techniques for non-wood tree and forest products. There is therefore a need to invest in appropriate technologies to fully maximize the potential of the non-wood tree and forest products especially in ASALs. The non-extractive use of forest resource such as eco-tourism will in future contribute significantly to forest resource conservation and management.

#### 2.11.6 Alternative Energy Sources

As previously mentioned, there is a potential in the use of wind power, biogas and micro-hydro schemes to meet the country's energy requirements. The shift from wood-based energy to alternative energy sources would mean reduced pressure on forests.

#### 2.11.7 Plastics Industry

The emergence of plastics industry especially in the packaging industry has greatly reduced pressure on wood-based packaging materials. This has however, brought negative environmental impact. With the anticipated public environmental awareness, there is likely to be a shift in future

from plastics-based packaging to biodegradable materials. This will likely have a negative impact on the forest resources conservation .

## 2.12 OTHER FACTORS THAT MAY CONTRIBUTE TO CHANGE

In addition to the major change drivers discussed above, the following are other, mainly external, factors that may affect the sector in various ways:

- Major changes in weather and natural catastrophes
- Political climate and governance
- Adherence to national, regional and global conventions and protocols
- Regional stability
- Major outbreak of diseases and pests

## 3. CURRENT STATUS OF FORESTRY SECTOR AND THE VISION FOR THE YEAR 2020

### 3.1 STATE OF NATURAL FORESTS IN KENYA

#### 3.1.1 Extent and Distribution of Indigenous Natural Forests

The latest inventory done in 1994 by Kenya Indigenous Forest Conservation Programme (KIFCON) came up with a differentiation between two types of forest cover. The total indigenous forest cover in gazetted forest areas was estimated by KIFCON (Wass, 1994), to be 1.06 million ha (excluding the mangrove forests along the coastline), while the area of indigenous closed canopy forest outside the gazetted forests was estimated to be 180,000 ha (0.18 million ha). Besides the gazetted forests, the country has a total of about 37.6 million ha of natural woody vegetation consisting of 2.1 million ha of woodlands, 24.8 million ha of bush-lands and 10.7 million ha of wooded grasslands.

Most of the closed canopy forests are concentrated in the high and medium potential zones of Kenya where, incidentally, the human population and agricultural production are also concentrated; hence there is potential conflict between closed canopy forest and agriculture. Within the arid and semi-arid zones, closed forests are fewer and are found concentrated mainly on isolated mountain ranges and along river courses, both permanent and seasonal, with the rest of this zone being composed of woodlands, bush-lands and wooded grasslands.

An extensive cover of mangrove forests are found along the coastline, which is estimated to total 54,355 ha (0.54 million ha.), a figure which was not included in the national forest cover estimated by KIFCON (Wass, 1994).

### 3.1.2 Current Status of Natural Forest Management

The management of the natural forests and that of the forest resource in general is governed by the national forest policy which is implemented mainly by the Forest Department, since most forest land falls under its jurisdiction as gazetted forest reserve. The Kenya Wildlife Service (KWS) has management responsibility for all indigenous forests falling within national parks, national reserves and game sanctuaries. These two organisations recently signed a Memorandum of Understanding (MoU) for joint management of selected indigenous forests of particular importance. In addition to the above gazetted categories of forests, other natural forests are found falling under trust lands, lands held in trust for the local people under the jurisdiction of the local authorities commonly known as County Councils. These forests are managed by the local county councils and in some cases with assistance of the Forest Department and KWS. Forests falling within gazetted national monuments are managed by the National Museums of Kenya (NMK).

Following a presidential decree in 1985 that banned commercial exploitation of natural forests, there is no formal indigenous forest management in Kenya to date. In the recent past however, other forms of non-traditional forest management are emerging based on non-extractive uses. The current policy initiative has also proposed participatory forest management strategies based on benefit sharing, with the forest adjacent communities.

In general terms, the national parks and reserves enjoy stronger political support in conservation than gazetted forest reserves where management is low keyed. The Forest Department at the moment lacks adequate funding and other resources for effective management of the forest resources. Hence, most of the natural forests are currently facing a lot of threat from human activity that include illegal encroachment, excisions, charcoal burning, poaching of timber and other forest products and forest fires originating from adjacent farmlands. If this trend persists it is expected that the total area under national forest will decline substantially to give way to agricultural activities. This portends a catastrophe in view of this limited resource and its direct/indirect linkage with agricultural activities.

Over-exploitation and lack of proper management is also rampant in most of the forests falling under the local authorities in trust lands, some of which are faced with threat of extinction. A few of the small parcels of natural forests especially at the coast (*Kaya* forests) have been preserved by the local communities for religious and other ceremonial purposes who exert a lot of traditional control over their use. Their future lies to a large extent in the hands of these communities. Other problems facing the conservation and management of indigenous forests involve the following:

- Forest excisions for human settlement and agriculture as a result of high population pressure;
- Lack of proper management plans for most of the forest reserves
- Forest research has been focusing on plantation forestry and indigenous forests have largely been overlooked;
- Lack of involvement of adjacent communities and other stakeholders in conservation and management

- Lack of information on the location, size and structure of privately owned natural forests

Under the above circumstance, it is envisaged that the area under natural forest will remain under pressure for conversion to other uses thereby, reducing significantly the total area during the period under review. In the last 10 years, it is noted that the country has experienced the worst forest excisions ever, rating at 5000 ha yearly.

### 3.1.3 Goods and Services

#### ○ Commercial Exploitation:

It is estimated that more than 50,000 m<sup>3</sup> valued at KSh 350 million are poached from the natural forests annually despite the ban from 1985 (Wass, 1994). Illegal felling by timber poachers has led to over-exploitation to such an extent that most of the species of commercial value have become almost depleted and very few high quality mature trees can still be found. Some limited removal of wood products from the natural forests by licensed individuals is currently allowed but these are limited to fuel wood, deadwood for carvings, withies, poles and posts.

Since the ban has not yielded the deserved results and in view of the fact that sustainable management may offer some limited returns, it is probably the right time to review the ban and allow limited exploitation based on the concept of sustainable forest management. The communities neighbouring these resources should be given the first opportunities under this arrangements in order to develop a sense of ownership for future sustainability.

#### ○ Non-wood Products:

The natural forests provide a wide range of non-wood products ranging from medicinal herbs, honey, food (meat) from trapped animals, fish (trout), fruits, vegetables, fibres, nuts and tubers which form an important source of food to forest-adjacent households especially during periods of drought and famine.

#### ○ Soil and Water Conservation:

Natural forests play a very significant role in environmental conservation and water catchment protection as most of the water sources in the country originate from these areas. It should however be noted that most of Kenya's electric energy needs are met from hydro-electric sources which are intricately linked to forest management.

#### ○ Conservation of Biodiversity:

A wide range of both flora and fauna species are found within Kenya's natural forests, some of which are endemic to specific forests in the country. Out of these, the rare and endangered forest-dependent species are found in these forests hence the conservation of these forest areas are of vital importance.

- Recreation, Education and Research:

Forest recreation (e.g. eco-tourism) is today becoming very popular whereby natural forests and other natural formations are attracting a large number of eco-tourists into the country. In addition, many scientific and other social studies are carried out in natural indigenous forests yielding valuable local, regional and global benefits.

- Provision of Habitat for Traditional Forest Dwellers:

Traditional forest dwellers, composed of scattered communities estimated at 10,000 households, have lived deep inside the forests since time immemorial and depend on forests for their subsistence needs. Their presence was not considered a threat to the forest resource. In addition to these traditional forest dwellers, a new breed of forest dwellers have recently encroached and in some cases invaded the forest reserves illegally and are the ones currently causing destruction in these forests. This group of people legally known as forest squatters reside, cultivate and carry out other illegal activities within the forest reserves without permission of the department and are estimated to be over 4,000 households in various forest reserves. The increasing population pressure on land, bearing in mind that these forest reserves are found within the highly productive areas where human population and agricultural activities are also concentrated, has largely brought about this encroachment into forest reserves. This squatter issue poses the biggest threat to the management and conservation of forest reserves in Kenya today though the government has been trying to solve the problem with varying degrees of success.

- Grazing Havens During Drought Periods:

Forest reserves especially those situated within the dry zone forest regions provide refuge for the surrounding pastoralists communities who move into those areas to graze their animals during the dry seasons and periods of severe drought.

- Cultural and Religious Roles:

Many natural forests or specific areas within the forests play a significant cultural and religious role for the surrounding communities where certain rituals and ceremonies are performed.

- Carbon Sequestration:

Natural forests in addition to other vegetation cover act as carbon sinks hence playing a global role of reducing the amount of carbon dioxide in the atmosphere and decrease in the green house effect.

### 3.1.4 Estimate of Current Standing Wood Product Volumes

The latest forest inventory by KIFCON in the indigenous natural forests in Kenya estimated the total standing volume in Kenya's forests (i.e. sum of timber, pole wood and fuel wood) at 200

million m<sup>3</sup>. The timber volume alone was estimated at 47 million m<sup>3</sup>. Besides the species composition, also the timber volume per forest region shows some difference:

- The coastal forest region contains the lowest mean standing volume per ha. The mean timber volume in the closed canopy forest is estimated at under 4 m<sup>3</sup>/ha
- Within the dry forest, the timber volume per ha is estimated to average 47 m<sup>3</sup>/ha
- In terms of area and stocking of commercial species, the montane forest zone forms the most important zone. It contains the highest mean total volume per ha with standing volume estimated at 253 m<sup>3</sup>/ha and an average timber volume of 61 m<sup>3</sup>/ha. Majority of the vegetation is of secondary growth following past logging. In the more accessible areas the vegetation is sometimes converted into plantation forests. The remaining undisturbed primary forests are mainly confined to the deep inaccessible areas, mainly in the Mt. Kenya area.
- Within the western rainforest region, the standing volume is estimated at 230 m<sup>3</sup>/ha and the mean timber volume at 78 m<sup>3</sup>/ha

### 3.1.5 Estimate of Sustainable Yields of Timber, Poles and Fuel Wood from Kenya's Natural Forests

The total sustainable yield from the natural forests is estimated at 1.5 million m<sup>3</sup>. These figures do not take into consideration the areas falling within nature reserves, national parks and other forest areas currently or which may in future be zoned as protected areas where no harvesting is allowed. Equally important to note is the fact that no permanent sample plots (PSPs) have been maintained in the indigenous natural forests in Kenya to monitor growth and yields from those forests, hence no data is available on the growth rates or annual increment to accurately determine the sustainable yields from these forests.

With proper controls and sound exploitation based on sustained yield management with strict annual allowable cuts from each forest area, there are great prospects for modest utilization of the timber, fuel wood and pole wood resources from these natural forests on a sustainable basis as inventory studies have shown that the sustainable volume of hardwood that could be extracted from Kenya's natural indigenous forests is considerably higher than the present amount used by the wood industry in Kenya today.

## 3.2 STATE OF PLANTATION FORESTRY

### 3.2.1 Overview

Just before independence, the Forest Department prepared a guide to long-term industrial plantations investment and forest-based industries, particularly pulp and paper. The target was for 136,000 ha of sawn timber plantations and 24,000 ha of pulpwood plantations to be established by 1980. These plantations are made up of about 86% exotic softwoods (mainly pines and cypress), 10% Eucalyptus and the other 5% indigenous hardwoods and softwoods. The exotic softwood

plantations form the bulk of Kenya's industrial wood raw material, while the eucalyptus are primarily for transmission poles, fuel wood and to some extent, pulpwood and fibre-boards in the west of Rift Valley.

### 3.2.2 Area by Species

An analysis of plantation stocking in the county carried out by Forest Department in 1999 indicates that the country had a stocked area of approximately 78,000 ha by November 1999. Of this area, 48.8% was cypress, 34.7% was pines and 8.3% was *Eucalyptus* spp. This area is in contrast to a stocked area of about 163,820 ha by 1992 (KFMP, 1994) and a projected 134,000 ha by year 2000.

### 3.2.3 Area Distribution by Age

From the analysis, the areas covered by cypress plantations dominate age classes 0-28 years while pine plantations dominate age classes above 29 years. This is due to the higher preference for cypress for harvesting by saw millers. On the other hand, plantations aged over 35 years comprise of over 7,000 ha of pines and only 600 ha of cypress. This can again be attributed to inaccessibility in some areas, thus hampering the harvesting process.

On average, every year there are between 100 and 800 ha of cypress plantations between ages 0-10, while on the other hand there are between 100 and 300 ha of pines of the same age class. This material forms the basis for supply for the period 2015-2025.

Plantation aged 11-28 years average about 2,300 ha/year. Species distribution scenario is 1,000 ha for cypress and 800 ha for pines per year. This will form the timber supply base for the years 2002-2015 if harvesting is at age 28-30 years.

For the short term, plantations aged 24-30 years average about 1,000 ha per year for cypress and 900 ha per year for pines, giving a total average of less than 2,000 ha per year of clear-fell which is far below the current allocation which averages 6,500 ha per year.

The emerging scenario is one with large areas of over-mature pines, which need to be harvested immediately. Plywood factories at Elburgon, Nakuru and Eldoret can access the material. Other remnants of over-mature pines are found in inaccessible areas in Mt. Kenya and the Arberdares.

### 3.2.4 Resource Distribution by District

The overall national volume distribution of industrial plantation as at end of 1999 shows that large volumes of *P. radiata* are manifested in plantations aged over 34 years which amounts to approximately 1.5 million m<sup>3</sup>. Preference for cypress by the market is responsible for these large volumes of over-mature pines which are found mainly in Koibatek, Kericho, Kakamega and Mt.

Elgon districts. The volume of cypress drastically declines beyond age 28 years. Old cypress plantations are only found in inaccessible areas.

The total volume of pine and cypress plantations above age 30 is approximately 5.2 million m<sup>3</sup>. For plantations aged 26-30 years, the volume of pines averages about 280,000 m<sup>3</sup>/year while cypress is about 300,000 m<sup>3</sup>/year.

### 3.2.5 Rationalization Strategies

#### ○ Plantations Establishment and Treatment:

While the normal planting programme averages 3,000 ha per annum, areas allocated for clear fell are in excess of 6,000 ha per annum. The resultant allocations have had a very serious effect on plantation management (silvicultural treatment and establishment) and have contributed to an accumulation of approximately 40,000 ha of planting backlog.

The method used to establish plantations is the *shamba system*, which is locally known as non-resident cultivation (NRC). Currently this system is being used in all major plantation districts. NRC remains the best system of plantation establishment with potential benefits to both the Forest Department and the cultivator. It offers an opportunity for reduced cost of establishment and improved survival rate on one hand and increased food production and employment on the other. This approach has the potential to reduce land use conflict, particularly if the allocation process is fair and provides for continuity of farming benefits. However the following needs to be done in order to improve management of NRC:

- Both the forest officers and the cultivators should be compelled to strictly adhere to the set guidelines. The District Forest Officers and the Provincial Forest officers must closely supervise implementation of NRC to ensure that the guidelines are followed
- We should ensure that future opening is commensurate with the planting programme. A long-term plan to ensure that harvesting matches planting should also be put in place.
- There is need to establish dialogue with local communities with a view to getting their support in seedling production and tree planting. NRC Management Communities, representing the interests of farmers should be formed in every station with the Forest Officers taking the leading role in organizing the committees.
- The National NRC Management Committee should monitor implementation and management of NRC and also the dynamics of the system.
- In order to recognize NRC as a method of plantation establishment, there is need to give the system legal basis by gazetting the guidelines as subsidiary legislation to the Forest Act.

#### ○ Integrated Harvesting:

If the plantations were to be managed for multipurpose use, the integrated harvesting system of the final crop would ensure optimal prices and revenues for the various categories of wood as well as their allocation to the most appropriate user.

#### ○ Policy and Institutional Changes:

In order for the forestry sector to play its role effectively in terms of providing goods and services and contribute to national economic development, policy and institutional reforms, well focused investments and adoption of sustainable forest management needs to be done.

Policy and institutional reforms are already in progress. A new forest policy and forest bill are at an advanced stage. There should however be a close follow-up to effect speedy completion. It is expected that the completion of the new forest policy and bill, will lead to the strengthening of the capacity especially expertise and logistical capability in the institution which will be charged with the management of the forest resource. To achieve this, the following interventions are envisaged:

- A detailed study, followed by its implementation, should establish an efficient management organization for forest plantations.
  - Field implementation to rationalize the management of forest plantations.
  - Medium term (5-15 years) to involve full transfer of management of forest plantations to a new efficient management organization
  - Long term (15-25 years) to ensure that the long term objectives of the programmes is being met sustainably
- Investment in Plantations:

In order to achieve sustained plantation forest management, there will be a need to carry out a well focused investment in the following areas:

- Capacity building in resource planning and management, impact assessment, geographical information systems (GIS), monitoring and evaluation.
  - Research in non-wood tree products to enhance their economic potential
  - Development of credit support to private forest investments
  - Improving data and information for management planning through regular surveys and forest inventories
  - Developing and improving marketing of forest products
  - Streamlining the administration and management of the forest plantation enterprise
- Forest Plantation Management

Management of forest plantations on public lands should primarily aim at increasing supply of forest-based products and services. Their management should be efficient, self-supporting, and profit-oriented so that they may contribute in supporting essential non-profit forest activities such as forest conservation. Efficient utilization of raw material shall take into consideration the knowledge of the market situation. In order to improve the management on public forest plantations, there is need to adopt the Kenya Forestry Master Plan scenario of a well-managed forest plantation sector, which proposes the following:

- Separation of the functions of the Forest Department by transferring the management of forest plantations to an efficient forestry enterprise. Under this scenario, the land remains under the ownership of the state. In the long run, it is envisaged that forest plantations will be managed by the private sector while the Forest Department will be expected to retain and

strengthen its responsibilities as forest authority, principally in the fields of forest policy, legislation, regulation and law enforcement

- Reduction in cost and improvement in success of plantations established through NRC. This approach has the potential to reduce land uses conflict, particularly if the allocation process is fair and provides for continuity of farming benefits. Under NRC, survival rate is improved through weed control and improved protection against fire and animal damage. On the other hand, the farmers benefit through increased food production and family income
- Carrying out silvicultural operations as prescribed in the management plans. This will improve growth rates and product quality
- Efficient collection of revenue and fair pricing of forest products

If the management strategy is implemented within a short term, the following projections are likely to be achieved:

Table 5: Projected Area of Forest Plantations ('000 ha)

Scenario/Year	1995	2000	2005	2010	2015	2020
Current scenario	148	134	118	107	93	78
Future scenario	148	145	154	164	166	174

Table 6: Projections of Sustainable Wood Yields from Forest Plantations ('000 m<sup>3</sup>)

Current Trend/Year	1995	2000	2005	2010	2015	2020
Timber	1,768	2,078	1,760	1,804	1,901	2,214
Woodfuel	354	416	352	361	380	443
<b>Master-Plan Scenario</b>						
Timber	1,791	2,167	2,002	2,362	2,704	3,174
Woodfuel	358	433	400	473	541	636

### 3.3 STATE OF TREES OUTSIDE FORESTS

#### 3.3.1 Extent of Tree Cover

According to the proposed Forest Policy, the future of the Forestry Sector lies outside the gazetted forests. This is imperative given the fact that the gazetted forests are less than 2.5% of the total land area of Kenya. The country has a total of about 37.6 million ha of natural woody vegetation outside the forests. A further 9.5 million ha of woody vegetation is found in farmlands and settlements (Wass, 1994).

Woodlands and bush-lands do not have formal management strategies and they are mainly used for grazing. There are huge potentials for non-wood tree products, which can be incorporated to strengthen the management strategies. These forests are in the semi-arid and arid lands (ASALs) and are in most cases faced with the problems of drought. They act as important fodder reserves for wildlife and livestock, especially during the dry periods. The most important factor, which influences management, is land tenure. Land in ASAL is mainly owned by communities. In Eastern and Coast provinces, however, there is permanent cultivation, and progress has been made in assigning property rights. It is largely in these areas with secure land tenure that tree improvement through management can be initiated. In order to address the intensification of resource use conflict a new land use policy will need to be developed including land tenure arrangements.

There is also a need to address the problem of inefficient charcoal production technologies. Since the traditional charcoal kilns have an efficiency of about 15%, by introducing modern kilns, ploughing back a proportion of less money collected by the local authorities in afforestation programmes, promotion of food security to reduce forest/environmental degradation and promotion of other income generation activities than charcoal production alone. This way farmers can increase their benefits substantially (even double) besides improving on conservation by judicious utilization and processing of resources. About 70% of the charcoal produced in the country at present comes from the ASALs. However, wood deficits forecast to occur after year 2000 will increase to such an extent that they can no longer be met by charcoal imports from ASALs.

### 3.3.2 Management Issues

Plantation forests under companies (tea and tobacco) are usually well managed and are based on short fuel wood cycles with *Eucalyptus* spp as the main species. For non-wood forest products, only *Acacia mearnsii* plantations (under farms and companies) have a history of good management. Most of these plantations however, have been converted into agriculture.

For the production of fuel wood, agroforestry programmes, mainly in the high potential areas, have successfully been the main source of wood energy. In the same agroforestry programmes and farm woodlots, farmers have also managed to produce commercial timber and poles (*Grevillea robusta*, *Cupressus lusitanica*, *Pinus patula*, *Eucalyptus* spp, *Markhamia lutea*, *Vitex keniensis* and *Melia volkensii*).

### 3.3.3 Farm Forestry

Farm forestry has taken over a substantial part of the wood production function of the indigenous forests and large-scale forest plantations. The country's farms are located mainly in the high and medium potential areas.

The results of farmers' efforts can be seen from the Kenya Forestry Master Plan (KFMP, 1994) survey of woody biomass, which indicated that about 40% of the woody biomass outside closed-canopy indigenous forest are from planted trees, and that the total volumes of trees planted by

farmers equals that of the closed-canopy indigenous forest and government forest plantations combined. From the results of this study, it is estimated that farmlands and settlements contain, on average, about 9.3 m<sup>3</sup>/ha of woody biomass, and that this is increasing annually at a rate of about 0.5 m<sup>3</sup>/ha.

By 2020, KFMP, (1994) it is estimated that the farm forests (farms and settlements) will produce about 17,825,000 m<sup>3</sup> of wood which approximates to 80% of the total wood production in the country then. Agroforestry studies suggest that the present average wood biomass growing stock of 9.3 m<sup>3</sup>/ha (1995) could be raised to 27 m<sup>3</sup>/ha, an increase of 190%, without adversely affecting agricultural production. On current trends, assuming that the present rate of increase in tree planting on the farms continues, the farms will produce 9.4 million m<sup>3</sup> of wood in 2000 and about 17.8 million m<sup>3</sup> in 2020 (KFMP 1994).

It is projected that on current trends, the demand for wood in the high potential and medium potential districts will increase from 15.1 million m<sup>3</sup> in 1995 to 30.7 million m<sup>3</sup> in 2020. Wood fuel (firewood and wood for making charcoal) will account for about 86% of the total wood demand in 1995, and 89% in 2020.

#### 3.3.4 Issues to be addressed

In order to maximize forest resource production outside the gazetted forest area, the following areas need to be focused on:

- In the Arid and Semi Arid Lands (ASALs), security of tenure is the major issue. To effect sound resource management, user pay principle has to be employed so that those using the resources have a responsibility to undertake efficient measures in the use of resources. By assigning property rights, the incentive to conserve the resource will have been created
- Resources management plans are largely lacking in the areas and efforts should be undertaken to draw participatory resource management plans
- Use of resources has to be diversified to include not only fodder and fuel wood production but also production of non-wood forest/tree products
- Resource owners of forests and trees should also be trained on the appropriate use and integrated utilization of tree resources. This will entail training in processing, value adding and marketing of non-wood tree products
- In high potential areas, the main shortcoming is lack of credit and this has made forestry a low priority investment option. The inefficiency of wood utilization in this area needs to change so that wood industries are able to absorb the farm produce in an efficient way.

### 3.4. STATUS OF NON-WOOD FOREST PRODUCTS IN KENYA

#### 3.4.1 Non Wood Forest Products: The Kenyan Scene

According to a survey on production and marketing of NWFPs in Kenya carried out by Vomigel Ltd. (KAFU, 2000), NWFPs play an important role in Kenya's economy, generating about US\$40 million annually. The survey also found out that NWFPs are used for different purposes widely in Kenya, both at the household level and in industry, directly and indirectly.

The survey found that there are many players active in the NWFPs sector; both government and non-government are involved in different aspects of the conservation, management and exploitation of NWFPs and their trade. Most of the production, processing and marketing is done in uneconomical ways and practical strategies to address these issues have not been developed. Exploitation and marketing of NWFPs is affected by the following aspects:

- a)** The raw materials for NWFPs are often gathered from government owned or communal (as opposed to private) lands. Tenure systems on these lands may be more complex and rules of access are not as clear as on private lands. When users fear they may lose access to forest, they may be less likely to invest in the resource and monitor and control harvesting. This may cause conflicts between users while making plans for sustainable management becomes difficult.
- b)** Many NWFPs, such as mushrooms and fruits, are seasonal and depend on natural growth and regeneration, which makes their productivity unpredictable. Prices may vary depending on availability. The seasonality may be an advantage in that many of NWFPs are available during non-agricultural seasons. In this way, exploitation of these products can complement farming activities and fill gaps in household income flow.
- c)** Producers are frequently rural people and often poor or landless. Production is frequently small scale. NWFPs often provide income to people with limited alternative employment opportunities and low income.
- d)** The percentage of the final sale price for a NWFP received by the local-level collector, producer or processor is frequently extremely small. The often low profitability of NWFPs-based enterprises can be attributed to some factors such as the fact that trading is done individually, producers are unorganised and dispersed, individuals lack the necessary marketing skills and information to gain leverage in the market and individuals lack related business assets such as storage and transport.
- e)** Information on the exploitation of NWFPs is often lacking. There is little information available on exploitation of NWFPs attributed to many factors. Some of these include lack of training and experience with NWFPs on the part of foresters, who are trained in timber management and gaps in indigenous knowledge (concerning production and management of NWFPs) found within communities in considerable amounts. Research has generally focused on only a few products that are important on the international market (e.g. rubber, gum arabic).
- f)** Many NWFPs have only weak links to official marketing systems. There is little information available on exploitation of NWFPs attributed to many factors. Because NWFPs are often sold in informal markets, information about prices, product flow and marketing options is less well known than for major crops or for timber. However, absence of formal marketing channels can be advantageous since it is easier for small producers to gain access to these markets, and regulations are often less onerous than in government-regulated markets.

NWFPs currently in the market in Kenya are herbal medicines, plant resins, plant gums, oleoresins, aloe vera gel and tannins. Those that are currently either used at subsistence level but could have market potential are wild fruits, edible mushrooms, indigenous vegetables, nuts, gum arabic, silk, aloe vera plus drink and traditional oils, resins and medicines.

A major marketing constraint for NWFPs is the exclusive control of forests vested in Forestry Department. The current forestry policy does not provide for involvement of communities in management and decision making for forests. A proposed policy and bill allows for community involvement in forest management and the role of non-timber forest products. This, and deliberate effort at promoting production of NWFPs on the farm will augur well for NWFPs development in Kenya.

Another bottleneck in growth of the NWFP industry is lack of structure in NWFPs information and knowledge dissemination. Thus only a negligible proportion of Kenyans are able to relate their livelihoods to NWFPs. Towards solving some of these problems, the Kenya Association of Forest Users (KAFU) has been formed with the aim to oversee and liaise with stakeholders for increased sustainable productivity, value-adding and product quality control for NWFPs, in order to enhance trade in the products.

There are quantified values for the use of the forests by forest-adjacent communities and forest dwellers (Larsen, 1992), which is estimated at Ksh.850 million. Grazing and hunting of game meat accounts for nearly 60% of this amount. Other non-wood uses of the forest include fibres (Ksh 149 million), honey (Ksh 139 million) and others (Ksh 70 million). The proposed policy recognises the need to develop non-wood forest products, especially those that are found outside gazetted forests.

The present forestry extension strategies incorporate NWFPs in providing extension services to farmers and pastoralists. The Forestry Department endeavours to assist communities exploit resources on their farm holdings for the greatest benefits while recognising sustainability of the resources. Communities are therefore encouraged to manage trees under them for not only timber products but NWFPs as well. Two short-term project proposals have been written by Forestry Extension Services Branch (FESB) for donor support. These are:

- Gum arabic production development project in Marsabit, Kajiado and Samburu districts (duration: 3-5 years; budget: USD 3.6 million)
- Forestry Products development project in both high and low agricultural potential areas, addressing both wood and non-wood products (duration: 3-5 years; budget: US\$2 million).

Kenya Forestry Research Institute (KEFRI) is charged with the responsibility of carrying out research and development on forestry matters on behalf of the Kenya government. KEFRI's R&D activities are implemented through the following four core research programmes, listed in order of priority.

- Farm Forestry
- Natural Forests
- Dryland Forestry

- Forest Plantations

Research in the area of non-wood forest products is carried out in the four programmes listed above. It looks at:

- Improved utilisation of known and lesser known indigenous species for NWFPs
- Improving the harvesting and utilisation of NWFPs
- Development of marketing systems for products
- Policy issues on guidelines of harvesting-protecting the intellectual knowledge, benefit sharing and commercialisation

### 3.4.2 Common NWFPs in Kenya

- Medicinal Plants:

In Kenya, about 80% of the local population meet their Primary Health Care (PHC) needs through herbal medicines (Situma, 1999). In rural areas where about 20% of the medical services are realised, people are treated largely by use of traditional medicines. This is mainly due to inadequate supply of modern medicines, shortage of qualified medical staff, increased population and high poverty levels.

A good example of a medicinal plant with great potential is *Prunus africana* whose bark has a large cash value as a remedy against prostate disorders, a condition that afflicts many men over the age of 50. While western science ‘discovered’ prunus in mid-1960, its medicinal properties were known in African communities long before then.

Global trade in prunus remedies is estimated to be worth US\$220 million per year. The demand is expected to double or triple in the second millennium as the population in the North ages. The threat of extinction of the prunus tree is expected to increase as well. The tree matures in 15-20 years when its bark can produce the active ingredient for the medicine. Harvesting has not been done sustainably as most harvesters have been stripping the whole tree. When a tree is stripped bare in this way, the yield of bark is about 1 tonne (worth about US\$200, about a year’s income for many of Africa’s rural poor) but this leads to the death of the tree. Sustainable harvesting, on the other hand, would entail removing the lower part of 2 opposite quarters or panels of the trunk and allowing 8 years for regeneration before harvesting the other 2 quarters. The yield obtainable this way averages about 55 kg/tree/harvest and fetches around US\$10-20 when delivered to a processing factory.

In 1995, because of the threat of extinction of this tree species, the government of Kenya requested the Convention on International Trade in Endangered Species (CITES) to place the tree in Appendix II. This means that although trade is not banned, it must be strictly regulated under a licensing regime. Deliberate cultivation on farmers’ fields is the only option that will ensure sustainability of bark supply.

- Gum Arabic:

Gum arabic is produced from *Acacia senegal* trees. Kenya is rated as one of the emerging important sources of gum arabic though the amount is little and the gum is of poorer quality when compared to the Sudanese gum, which is used as the international standard setter (Koppel, 1995; Kareko, 1999). Low production is attributed to land ecological degradation, rainfall shortages, disorganisation in trade networks, bureaucracy and focus on other products such as fuel wood and poles. Efforts are being made to revive interest through education of private entrepreneurs, effective involvement of relevant government agencies and creating more awareness on the importance of gum arabic and other NWFPs, as alternative sources of income generation, environmental conservation and other products (Kareko, 1997). Organisations playing a leading role in this area are Gum Arabic and Resins Association (GARA), the Arid Lands Resources Project (ALRP) of the Semi-Arid Lands Training and Livestock Improvement Centres of Kenya (SALTICK) and Kenya Association of Forest Users (KAFU).

○ Mushrooms:

Mushrooms are an important source of food for a substantial proportion of people all over the world. In Kenya, use of mushrooms for food is rare except in the Pokot, Turkana, Luo, Luhya and coastal (especially Giriama) communities. In some communities within East Africa, the anthill mushrooms (*Termitomyces*) are a social food and one does not harvest and eat these alone but has to share with the rest of the community. Mushrooms also find use in dyeing, medicine, and ornamentation and as a lactating agent for breast-feeding mothers.

○ Honey:

Beekeeping as a forestry-related activity is not very well developed in forestry but new projects at forestry department, especially those addressing extension, are taking it up. Otherwise, the Apiculture and Emerging Livestock Division of the Ministry of Agriculture and Rural Development (MoA&RD) has officers up to the divisional level who are charged with the duty of promoting bee-keeping activities all over the republic.

Honey is a major source of income for some people in settled ASALs like in Ukambani (Mwingi, Kitui, Machakos and Makueni districts), parts of Rift Valley, Central province and indeed almost all parts of the country.

According to the 1998 annual report of the Apiculture and Emerging Livestock Division of MoA&RD, the country has 1,191,731 beehives. The amount of honey produced from these hives totals about 4,538,498 kg with a monetary value of Ksh.46,555,012. The corresponding values for beeswax are 273,899 kg and Ksh.1,766,600 respectively. These figures should, however, be taken with caution, as not all district reports are included in the national report due to non-submission.

An area of concern in beekeeping is failure to maximise honey production per beehive. This has been attributed to various problems chief among them poor harvesting techniques, failure to time properly when to harvest, depletion of honey by pests and climatic conditions as well as quality of pollen in season.

In marketing of honey, there has been no reliable national assessment done to find out quantities, markets and prices. However, the agriculture ministry indicates that as much as 75% of the honey produced in the districts is utilised within the district and the rest sold to markets not very far off.

ICIPE is also acting as an intermediary between farmers and traders to assist the beekeepers in the marketing of commercial insect products. Through IFAD's support, the farmers benefit economically through the use of procedures designed at ICIPE to conserve and protect a fragile and eroding environment.

- Fodder:

Research has been going on to investigate the long-term effects of *Calliandra calothyrsus* fodder species at the Regional Centre of the collaborative KARI-KEFRI-ICRAF agroforestry research programme. This is being done with a view to finding the possibility of promoting *calliandra* as a viable source of fodder for small-scale farmers who are practising zero grazing for their livestock. Even before any conclusions are arrived at, many farmers have been growing this fodder shrub and using it.

- Wild and Domestic Silk:

ICIPE, under the commercial insects programme, is promoting silk production from both wild and domestic silk moths. An extensive survey to identify indigenous species of wild silk moths has been conducted throughout Kenya and Uganda and two species (*Argema mimosae* and *Gonometa spp*) found that produce silk-fibres of high quality. Also, a new domestic silkmoth hybrid that produces high quality silk has been developed. Silk production has a great potential in this country especially if it is linked to forest conservation.

- Neem-based Products:

The neem tree (*Azadirachta indica*) is increasingly in demand because of its myriad potential uses: in afforestation, as timber-firewood-fuel, as a shade tree, in plant and livestock protection, in animal care and hygiene and in human health. Although not indigenous to Africa, it has been planted as an exotic shade tree in many areas.

The Neem Project at ICIPE promotes the tree for its remarkable properties in controlling literally hundreds of insect pests of crops and public health importance. So far, the project has achieved some success in testing neem-based management technologies against plant pests. Large-scale neem planting has been accomplished by the Neem Awareness Project in 75 schools in Suba and neighbouring districts in Kenya, Adjumani in northern Uganda, Kwimba Reforestation Project in Mwanza, Tanzania, and in numerous homesteads in western Kenya.

The project has future plans that include a follow-up project (Neem-Health and Wealth Project), which will focus on developing neem extracts for medicinal, veterinary, and plant health uses. Research and training in production, mode of action and application will be emphasised as the foundation to efficient production and utilisation of the natural resource. The mechanism of action of novel neem compounds will be demonstrated and the modes of action of major

bioactive neem constituents studied in selected lepidopteran and hemipteran pests. Information materials such as publications, booklets, flyers, audio-visual tutorial modules and documentary films will be prepared, distributed and disseminated through national extension channels in the target countries. Other related activities will also be carried out.

- Bio-insecticides:

Plant products have been traditionally used by rural communities for protection against disease vectors such as mosquitoes and have also served as sources of mosquito repellents and insecticidal compounds for modern industry. Only a fraction of the world's plants have been analysed, in spite of the fact that more than a quarter of modern medicines are based on natural constituents derived from plants. As environmental destruction proceeds at an alarming rate, useful plants are being obliterated faster than they can be examined for their useful components.

The “Research and Development Partnership in Bioprospecting for Mosquito Repellent and Insecticidal Plants for East Africa: Capacity Strengthening Through Networking Programme” is a project being undertaken by ICIPE's Environmental Health Division in collaboration with a network of seven institutions in four East African countries. The network approach allows for pooling of facilities, expertise, experience and resources. The project's objective is to screen for mosquito-repellent and insecticidal plants and to develop technologies for use of these selected plants and plant products, particularly for mosquito control.

In future, the project envisages further strengthening the collaborative bioprospecting research and information network and improving research capability through seminars and training of students from the region. The mosquito repellent and insecticidal plants discovered will be analysed to determine the identity of the active components and to evaluate their toxicity. In addition, rural communities will develop new products and technologies for use of the selected plants in mosquito control, with special reference to their application. Local communities will also be encouraged to cultivate the useful plants as an income-generating activity, as part of an environmental education programme.

The success of such initiatives will provide ready remedial measures for the improvement of forest health especially industrial plantations through the control of diseases and pests using bio-insecticides.

- Eco-tourism:

Though this is not strictly a NWFP, eco-tourism has potential to generate income and ensure sustainable management of forest. ICIPE has a project under the Biodiversity and Conservation Programme, Environmental Health Division of ICIPE. It is scheduled to be implemented between 2000 and 2005. The Kakamega forest, the only surviving rain forest in Kenya, harbours many endemic plants and animals found nowhere else in the region. The highest human population density and growth in Kenya also occurs in the surrounding areas. Pressure on the forest, in form of conversion of forestland for agriculture and as a source of forest products, is high. A recent valuation of the off-take of these multiple products from the forest was conservatively estimated at US\$1.7 million per year.

ICIPE has entered into a collaborative venture with several agencies and NGOs to contribute to the conservation of the Kakamega forest through community-driven education, reduction of the communities' dependence on the forest, inventorying and monitoring of target taxa and improvement of forest management. Activities undertaken so far include field operations, holding of 2 large meetings (with collaborating agencies, community leaders and stakeholders) for co-ordination of activities and working out of detailed plans for the various project components.

In coming times, ICIPE will provide the overall co-ordination to a group of conservation organisations in a multi-faceted approach to conserving the remainder of this important rain forest.

By introducing alternative, sustainable income-generating activities, the local people will be more eager to preserve the forest. These activities include apiculture, sericulture, silk moth-culture, butterfly farming, harvesting of medicinal plants etc.

### 3.4.3 Emerging Issues

In addressing issues of NWFP, a take-off strategy would be to focus on production and processing of tree and shrub species with commercial potentials. In the high potential agricultural areas, what could be lacking is management techniques for optimal production and processing technologies. The following tree species have great potential:

- *Eucalyptus spp* for eucalyptus oil
- *Prunus africana* for its bark
- *Pinus radiata* and *P. elliottii* for rosin
- *Acacia mearnsii* and other tree species that can produce tannin

In the arid and semi-arid lands (ASALs), specifically the settled areas, there is huge potential in NWFP, not only in terms of honey, wild and domesticated silk and fruit production, but also in terms of tree species with potential for other products:

- *Acacia tortilis* for its protein rich fodder
- *Acacia xanthophloea* for its fast growth (high volume yielder) in dry areas.
- *Tamarindus indica* for nuts, juice, jams, wine, etc
- *Sclerocarya birrea* for wine, juice, fruits, etc
- *Trichilia emetica* for nuts and soap production
- *Commiphora africana* for resins
- *Acacia senegal* for gum arabic
- *Moringa oleifera*. The leaves are a good source of protein, vitamins A, B and C, and calcium and iron. Young plants are eaten as a vegetable, and young pods and “peas” are cooked in various ways. The bark provides a fibre for ropes and mats. Seeds are effective against skin infections, provide an excellent salad oil and their powder is an excellent coagulant for clarification of muddy water. The tree also helps to control soil erosion.

- *Azadirachta indica* for fruits ,young twigs and flowers for consumption. Leaves are used as dry-season fodder. The wood is excellent both as firewood and charcoal. Resin tapped from the trunk is widely used in Southeast Asia as “neem glue”. Oil from the seeds is used in Asia for soaps, cosmetics and pharmaceuticals. Seeds also produce an extract as a liquid pesticide for crops. An excellent shade tree, it is also a multi-purpose medicinal resource. Saroc Ltd, Nairobi and ICIPE are currently exploiting the tree for oil.
- *Hyphaene compressa* for baskets and mats, which can be exported outside the country for better prices
- *Adansonia digitata* produces a powdery fruit pulp rich in vitamin C and B2, used in Ukambani, Kenya for flavouring porridge. Young leaves are in demand in West Africa as a vegetable soup. Leaves, fruit, pods and seeds provide fodder for animals. Wild bees perforate the soft wood and produce honey there. The bark from young trees produces a valuable fibre for a multiplicity of uses, its most famous being the world-famous kiondo baskets of Kenya (Ukambani region). Its most “valuable” product is the strong, tough, tear-resistant paper that makes India’s rupee banknotes
- *Aloe spp.* This species should be explored for commercial uses and tied with forest conservation

#### 3.4.4 The Way Forward in the Next Decade

The increasing demand for forest products, as a result of the increasing population, has led to a major shift to farm forestry. Currently research and development activities are geared towards this area of forestry. This is seen as the direction in the next decade as the land area of plantation and indigenous forests diminishes. It is therefore, envisioned that there will be increased on-farm domestication and commercialisation of trees for NWFPs, thus benefiting the smallholder farmers, traders and processors. This will cause a realisation of social benefits in the form of food security, poverty alleviation and employment as well as environmental benefits.

As the development of the NWFP industry in Kenya grows there is need to focus on the following areas to improve it:

- There is need to deliberately operationalise support for NWFPs development enshrined in the proposed forestry policy and legal frameworks through practical action
- Awareness on the role of NWFPs in provision of added benefits from forests needs to be created
- Promotion of production of NWFPs on the farms (domestication)
- Identification, assessment and use of efficient and cost-effective NWFPs information and knowledge dissemination structures and instruments in order to reach a wider segment of the country’s population. This will enable people to see the relationship between their livelihoods and NWFPs and therefore, take concerted action at conservation and sustainable management of the same
- There is need for training of NWFPs producers on sustainable harvesting methods. The role of private sector, the major buyers of NWFPs, cannot be overemphasised

- There is need to regulate harvesting of, and trade in NWFPs, through community involvement in forest management (CIFM) and/or licensing regimes, especially for those species facing threat of extinction
- There is need to put in place effective policy and legal measures to halt further excisions of forest land into agricultural or development land
- There is need to carry out resource surveys to determine exactly how much of NWFPs resources we have, and status of management, extractability and potential in terms of income generation
- Facilitation of networking between farmers in different parts of the country for information, technology and seed exchange, and marketing of NWFPs is required
- There is need to organise forums for sharing of knowledge and experiences for government agencies, researchers and universities, to develop new technologies, product processing techniques and marketing mechanisms
- 11. There is need to consider putting in place mechanisms for standardisation and certification of processed NWFPs

### 3.5 STATE OF FOREST INDUSTRIES IN KENYA

#### 3.5.1 Overview

The forest industries operating in Kenya can be classified as wood based and non-wood based. Wood based types include mechanical wood industries and pulp and paper. The mechanical wood industries include saw milling, wood based panels manufacture (plywood, particle board and fibre board), furniture and joinery and pole production.

Among the non-wood products includes tannin and resins and other non-wood products.

#### 3.5.2 Mechanical Wood Industries

##### ○ *Saw milling:*

There are about 450 sawmills in Kenya, which serve mostly the domestic market. The potential annual capacity of the mills ranges from less than 500m<sup>3</sup> of log input to more than 30,000m<sup>3</sup>. The sawmills, as well as the other mechanical wood industries, are privately owned, but the ownership of the small establishments changes frequently because the entry barrier is low and inputs are easily affordable

The small mills depend mainly on circular saws, while the larger mills use also band saws. The recovery rate ranges from 18% to about 30%. The main reasons for the low post-recovery rate are the use of thick saw blades, poor cutting practices and employment of unskilled labour. The sawmilling industry employs 14,000 people, corresponding to an annual output of only 15m<sup>3</sup>/person. The challenges facing the industry are therefore:

- Restructuring by reducing the number of sawmills and increasing the size of the remaining ones
  - Modernization of the sector in conjunction with the restructuring process so that by the year 2020 the whole process is modernized
  - Introduction of kiln drying so that by 2020, 60-70% of the output is artificially dried
  - Skill development at all organizational levels to improve competitiveness, productivity, and product quality
  - To encourage the mill owners to invest in new machinery in the Master Plan Scenario, a secure and competitive raw material base for forest based industries must be developed
- Plywood Mills:

There are three plywood mills with a total annual achievable capacity estimated at about 40,000 m<sup>3</sup>, while the actual output in 1990 was 35,000 m<sup>3</sup>. All the plywood mills are integrated with a sawmill. The industry produces interior grades of plywood with thickness running from 3 to 25 mm, the emphasis being on thin panels. Pine accounts for more than 80% of the input, followed by cypress.

The basic machinery is of reasonable quality, but the operations are very labour intensive. The technology currently used can only take logs up to a certain minimum size. However in future, smaller logs may form the main bulk of the input material. Technology development should move towards developing technology that can take a wide range of log sizes. Annual labour productivity is estimated at 20 m<sup>3</sup>/person, which is low, by average international standard; this urgently requires improvement. The challenges faced by plywood industry includes:

- Improvement of productivity
- Change of the raw material mix
- Coping with lower quality raw material; this can be overcome partly by restoring pruning and thinning operations to the prescribed levels

Investment in new machinery will also be enhanced by:

- Dissemination of information to the industry on government policies and regulations, raw material availability and characteristics, efficient conversion technology, product quality improvement, market development and other relevant matters
- Facilitating financial arrangements for industry modernisation and expansion (including setting up of effective pollution control systems) in cooperation with national and international financing institutions
- Re-tooling and modernising industrial processes, the government should facilitate this process by reducing import duties on machinery

In order to ensure the development of a favourable business environment, the following measures are proposed:

- Monitoring and analysis of the performance of the forest based industry and dissemination of the results

- Development of dialogue between government and the industry to discuss issues and problems and workout solutions

- Reconstituted Wood-Based Panel Industry:

There is one fibreboard mill and two particleboard mills. The fibreboard mill has an annual capacity of 700 tonnes. It uses plywood and sawmill residues, as well as *Eucalyptus* roundwood. The technology employed is outdated. Unlike most mills in the world, this one does not use resin or wax in the production process, which makes the board unsuitable for exterior use. The mill recirculates some of its process water, but the effluent water is not treated at all. When it is completely worn out, the mill will most probably be closed, because the future of fibreboard manufacture is in the dry process and practically no new wet process mills are being built in the world at present. The particleboard industry was started in the early 1980s, but output has remained low, about 6000m<sup>3</sup> in 1990, which represents a very low capacity utilization rate. In the entire wood-based panel industry, annual labour productivity is low (even when considering the scale of operation); it stands at about 25 m<sup>3</sup>/person.

- Furniture and Joinery Industry:

The furniture and joinery industry consists of thousands of small-scale entrepreneurs both in the rural and urban areas, mainly in the informal sector. About 60% of the furniture market is controlled by the so-called *jua kali* (“informal sector) artisans.

The traditional raw materials of the furniture and joinery industry were indigenous hardwoods. The ban on their exploitation has forced a shift to plantation-grown softwoods; the market however, appear to accept softwoods very slowly. The softwood-sawn wood is generally of poor quality, because of poor drying and consequent staining. A few large units are capable of exporting furniture, but the volume exported so far has been modest. All the others suffer from lack of tools and equipment as well as from shortage of working capital. Development of the joinery industry also includes two prefabricated house plants. Investment in new machinery will also be enhanced by:

- Dissemination of information to the industry on government policies and regulations, raw-material availability and characteristics, efficient conversion technology, product quality improvement, market developments and other relevant matters
- Facilitating financial arrangements for industry modernization and expansion in co-operation with national and international financing institutions
- Re-tooling and modernizing industrial processes, the government should facilitate this process by reducing the import duties on machinery
- In order to ensure the development of a favourable business environment, the following measures are proposed:
  - Monitoring and analysis of the performance of the forest-based industry, and dissemination of the results
  - Development of dialogue between the government and the industry to discuss issues and problems and work out solutions

- Wood Carving:

### **Economic Potentials**

Among the many handicraft activities, wood carving forms the most important component in Kenya. Study by Obunga (1998) revealed that the wood carving industry consist of a complete chain of players including resource/ harvesters, raw materials agents, the carvers, apprentices, intermediates, curio vendors/hawkers, stockists/wholesalers, retailers and exporters. The industry has about 80,000 wood carvers spread all over the country but mainly in Central, Eastern and Coast Provinces. Overall the industry provides a means of livelihood to over 30,000 people in Kenya and was valued at over KSh 100 million in 1995. Currently the industry has a turn over of about KSh 1.5 billions. The industry embraces all age groups between 16 and 92 years old with the youth (27 years) making over 50% of the current population of the industry. Comparison between monthly income among those considered “poor” in the industry with less than KSh 10,000 was found to be above most salaried employees in the civil service (Obunga, 1998).

### **Management Issues**

The carving industry is tourism and market focused. The largest markets for the products are the United States of America, Canada and Europe. The small-scale industries (informal sector) like handicrafts are going to absorb a significant number of jobless people (Obunga, 1998). The industry (wood carving) has relied on a narrow range of slow growing indigenous hardwoods throughout its 70 years’ history, with consequent severe degradation of the resource and its base.

Some areas close to the production centre have witnessed local extinction of some of the most preferred species of timber used in the industry. The current trends indicate that all remaining populations of the preferred spp are coming under greater pressure to support the ever increasing demands of the industry; as well as the socio-economic needs of the rapidly rising local human population seeking the same species for fuel wood, building materials as well as land for cultivation and settlement. The study showed that all the four major species (*Brachylaena huillensis*, *Dalbergia melanoxylon*, *Olea europaea* var. *africana* and *Combretum Schumannii* (ebony) currently forming the backbone of the industry cannot sustain it.

Concern over the depletion of hardwoods natural forests and woodlands has brought about an alliance of carvers, community development organisations, concerned citizens, conservation groups, the forestry sector and traders in carving. Jointly, they aim to ensure that the woods used for carving increasingly comes from sustainable supplies

### **Important Facts about the Carving Industry**

- The Kenyan woodcarving industry uses over 50,000 trees equivalent to almost 8,000 m<sup>3</sup> of wood annually. This is equivalent to ten trees being felled per hectare of natural closed-canopy forest in Kenya every year.
- The collapse of Kenyan populations of muhugu, mpingo and other carving species has caused the problems to be exported into Tanzania, with hundreds of logs being smuggled across the border to meet the Kenyan demand for woodcarvings.
- Because of the shortage of traditional carvings woods, carvers have explored the possibility to use alternative species, most of which are fast-growing multi-purpose species grown on farms.

These include neem (mwarubaini, *Azadirachta indica*), *Jacaranda mimosifolia* *Grevillea robusta* (mukima), mango (mwembe, *Mangifera indica*) and others. These species are also called “good woods” and can be obtained sustainably as they originate from managed farms

-The Annual Allowable Cut (AAC) of neem trees with diameters greater than 50 cm in the Kenyan Coastal strip is over 200,000m<sup>3</sup>. This species alone could therefore supply a woodcarving industry 25 times the size of the current without negative ecological consequences.

○ *Pulp and Paper Industry:*

It is estimated that the total consumption of paper and paperboard in Kenya will grow by 4.4% annually up to the year 2020. Among the different grades, the demand for newsprint, printing and writing papers, boards, and tissue will grow faster than average. During the same period the production of paper and paperboard will grow by 4.9% annually. The local paper industry can satisfy the main part of the growing demand by increasing its production capacity.

The pulp and paper industry is small by international standards. On the other hand, it must be noted that Kenya’s paper and paperboard industry is one of the biggest in Africa and the most important among the Common Market for East and Southern Africa States (COMESA). This situation is related to the protective industrial and trade policies, which provide a protective umbrella of high import duties and a bureaucratic import licensing system. The self-sufficiency objective and the lack of export-market orientation have led to industrial operations that are very inefficient by modern standards.

The paper and paperboard industry comprises 6 mills with 11 paper and board machines with a total capacity of about 110,000 tonnes. The biggest company, Pan African Paper Mills, dominates the local market with its total annual capacity of 87,000 tonnes. The company produces about 30 different paper and paperboard grades on three machines. It has a chemical pulping annual capacity of 54,000 tonnes and mechanical pulping of 23,000 tonnes. The company has plans to increase its de-inking capacity so that it can use more recycled paper. The national self-sufficiency objective has driven Pan Paper to produce large amounts of different paper and paperboard grades, involving frequent production cuts for grade changes and consequently, low productivity. The company could make considerable financial and economic gains by specializing in the grades where it is most competitive. Trade barriers would need to be abolished to facilitate the balancing of exports and imports.

Pan Paper has a monopolistic position of many paper grades in the domestic market. Development of the domestic market alone will not allow the construction of large new paper and paperboard mills in the short-term. The deregulation of international trade will provide the only means to create a competitive paper market and to open up reasonably priced paper sources to printers and converters. Deregulation would therefore force Kenya’s paper industry to develop and improve the quality of its products.

Pan African Paper Mills should keep its future expansion in line with market prospects and low material availability. Because of the low volume of the domestic markets, the export market should also be considered when assessing development options. The planned increases of mill capacities deserve critical re-evaluation, at least in terms of employing larger machines to cater

partly for exports. Also more research work should be done to analyse the market development for paper in the surrounding countries.

The five small companies produce mainly recycled fibre-based packaging grades and tissue. The total annual production capacity is estimated to be 21,000 tonnes.

- Tannin:

There are 15 tanneries of different sizes. The tanning materials used can be classified as vegetable, mineral, and synthetic. Mineral tanning materials are popular, mainly because of the scarcity and cost of vegetable tannins. Although most woody plant species contain tannin, and at least thirty Kenya species contain useful amounts, there is only one species, *Acacia mearnsii* (wattle), which is actually being used commercially in Kenya.

There are two factories in Kenya which extract wattle tannin. Kenya Tannin Extractors Co. Ltd. (KTE) at Thika, and the East African Tannin Extraction Co. Ltd., (EATEC) at Eldoret. The installed capacity of the KTE factory is 75 tonnes of dry bark per day but they are actually processing only 50 tonnes. The annual production of the factory is 3900 tonnes, 50% of which is solid and 50% is in the form of tannin extract. About 2.75 tonnes of solid dry bark yields 1 ton of extract. KTE does not own any plantations; they rely from farmers. Their aim of establishing plantations is hampered by the lack of land or the difficult of obtaining secure tenure.

EATEC is a broad-based industry dealing not only with tanning material, but also with other products. It has about 18,000 ha. of land, of which 8,300 ha. are *Acacia mearnsii* plantations. In 1991 it produced 12,800 tonnes of bark and bought an additional 3,000 tonnes from farmers. This company is in the process of being wound-up and being converted to agriculture.

Marketing of wattle bark is quite well organized. The tannin extraction companies buy the bark from the farmers in their fields, paying KSh 850 per tonne of green bark or KSh 1100 to 1300 per tonne of dry bark. Some farmers sell dry bark at the factory. There is great scope for the export of wattle extract to Asian countries especially India.

The main problem faced by the tannin industry is obtaining raw material. Land for plantations is not readily available, and it is difficult to persuade the farmers to plant more wattle trees. There are also information gaps. In particular, information about the use of species other than wattle is not readily available.

- Resins:

Of the two classes of resin, oleo-resin and oleo-gum-resin, oleo-resin has the greater industrial potential. In Kenya, oleo-resin is tapped from exotic tropical or subtropical pines, the common ones being *Pinus patula*, *P. caribaea*, *P. elliottii* and *P. radiata*. Sizeable plantations of pines have been raised in Kenya for almost 35 years, but tapping for oleo-resin started only after 1985.

The only consumer of oleo-resin in the country is Rosin Kenya Ltd. at Nakuru. The annual intake of its factory is 360 tonnes. Turpentine is not recovered and it goes to waste, because recovery is more expensive than the price it would fetch. Only rosin is recovered, at a rather low rate of 55%

of the raw material. No resin tapping rules have been framed by the Forest Department. Tapping is done by the factory through locally available casual labour. Tapping of pines is allowed only in the year immediately preceding clear-felling. The royalty paid to the Forest Department is KSh 650 per tonne. The main problems faced by the industry are lack of knowledge, experience, and rules on resin tapping, and the lack of a market for turpentine.

### 3.5.3 Export Markets For Wood Based Products

A marked growth in exports took place between 1975 and 1980 when the net volume increased from a few thousands to more than 50,000 m<sup>3</sup> annually. If Kenya intends to fully utilize its wood production capability, it should revitalise sawn softwood exports by rebuilding the present mills and expanding new capacity in order to achieve a new position in the export markets. The sawmilling industry should, among other things:

- Improve the overall quality of sawn wood
- Introduce kiln-drying, grading, and packaging
- Establish marketing channels suitable for the volumes in question
- Work out the logistics needed to reach the target markets
- Be competitive with such low-cost producers as Chile

The COMESA countries with limited wood resources would be a logical target for sawn wood export from Kenya. These include Burundi, Comoros, Djibouti, Ethiopia, Mauritius, Rwanda, and Sudan. However, the annual export potential to these countries ranges from only a few hundred to a few thousand cubic metres per country. Therefore these countries are suitable targets for individual companies, but not for a concentrated effort involving the entire sub-sector. Madagascar and Reunion each import 20,000-30,000m<sup>3</sup> per year but these markets are already well covered by South Africa.

If Kenya intends to export sizeable volumes of sawn wood, it should try to penetrate the markets in Egypt and Saudi Arabia, which are forecast to import 1.5-2.0 million m<sup>3</sup> and 0.4-0.6 million m<sup>3</sup> per year, respectively. In these two countries, as well as in the other North African and Near East markets, price is the major means of competition although good appearance is also an important.

The present average delivered price of sawn softwood is estimated at US\$150-250/m<sup>3</sup> depending on the market.

### 3.5.4 Environmental Impacts of Forest Industries

In the mechanical wood industry, pollution arises from two main sources:

- Wood residues from saw milling in rural areas
- Effluent water from the particleboard and fibreboard mills

Pan Paper has invested heavily in effluent treatment facilities, including primary clarifiers and biological treatment in aerated lagoons. According to the mill management, its discharges are in compliance with official regulations. Optimisation of mill production and modernization of some processes could presumably still improve the situation to some extent. On the atmospheric side, controlled combustion of bark in a modern bark boiler would decrease smoke generation, make the smoke cleaner, and at the same time save much of the fuel oil which is used at present in the power-plant boilers.

The waste paper-based mills reject 20-30% of the input as process waste, which needs to be disposed of. Especially in the case of de-inking sludge, disposal (or incineration) has to be done properly to avoid harmful environmental effects. The present practices of the small mills are in need of special attention and development effort in this respect.

### 3.6 WOOD DEMAND AND SUPPLY SITUATION

#### 3.6.1 Determinants of Demand

Population growth and the economy are the major basic determinants of demand for most of the forest products. The demand supply scenario is focused on the major forest products: Fuelwood, Poles and posts, Mechanical wood products, Paper and paperboard.

#### 3.6.2 Estimates of Future Demand for Forest Products

##### o Woodfuel:

About 71% of the energy consumed in Kenya comes from wood fuel mainly as firewood for cooking and heating in rural areas and as charcoal in most households in urban centres. The Kenya Forestry Master Plan (1994) estimates the demand for wood fuel (charcoal and firewood) to increase systematically to 30.1 million tonnes by the year 2020. The scenario on the demand for wood fuel forecast based on the 1994 KFMP trends is shown below.

Table 7: Projected Demand for woodfuel (Million Tonnes)

Year	Charcoal	Firewood	Total woodfuel Demand
2000	0.97	11.18	17.96
2005	1.17	12.90	20.77
2010	1.40	14.75	23.79
2015	1.65	16.67	26.91
2020	1.92	18.65	30.10

##### o Poles and Posts:

The annual demand for poles and posts is projected to grow at 2.4% from 1.4 to 2.7 million m<sup>3</sup> between 2000 and 2020 as shown in Table 8. These will be consumed by the construction

industry and as transmission poles by Kenya Power & Lighting Company and Kenya Posts and Telecommunications Corporation (Telkom).

Table 8: Projected Demand for Poles/Posts ('000m<sup>3</sup>)

Year	Construction Poles	Transmission Poles	Total Demand
2000	1254.2	180.4	1434.6
2005	1446.8	242.6	1689.4
2010	1663.2	326.1	1989.3
2015	1896.4	438.5	2334.9
2020	2146.5	589.6	2736.1

o Mechanical Wood Products:

The mechanical wood products focused under this category include sawn timber (both hard and soft wood), plywood, particle and fibreboard. Demand for these products is projected by the Kenya Forestry Master Plan (1994) to grow at an annual rate of 3.3% whereby the demand for sawn timber is expected to increase from the current rate of 0.32 m<sup>3</sup> to 5.39 million m<sup>3</sup> by the year 2020. The demand for the wood based panels is projected to reach 0.13 million m<sup>3</sup> by the same year. The demand for the various products is shown in the table below:

Table 9: Projected Demand for Mechanical Wood Products ('000m<sup>3</sup>)

Year	Sawn Softwood	Sawn Hardwood	Plywood	Fibre Board	Particle Board	Total Demand
2000	239.7	23.1	44.1	9.1	8.9	324.9
2005	297.5	28.7	55.1	11.8	11.6	404.7
2010	352.3	34.0	65.2	14.5	14.3	480.3
2015	407.7	39.3	75.4	17.3	17.0	556.7
2020	491.4	47.4	91.2	21.4	21.1	672.5

o Paper and Paper Board:

The demand for paper and paperboard in Kenya is projected to grow at an annual average rate of 7.3% within the next 20 years (2000 to 2020). The forecasted demand is projected to increase to 0.27 million tonnes by the year 2020. Table 12 below shows the projected demand for the various paper products.

Table 10: Projected Demand for Paper and Paper board ('000 tonnes)

Product/Year	2000	2005	2010	2015	2020
Newsprint	22.2	26.1	33.2	41.9	49.8
Printing and Writing	46.2	57.4	72.3	91.4	116.2
Tissue	12.4	16.5	20.4	25.2	30.7
Boards	30.2	40.0	49.3	61.2	77.2
<b>Total Demand</b>	<b>111</b>	<b>140</b>	<b>175.2</b>	<b>219.7</b>	<b>273.9</b>

### 3.7 SOCIAL AND ECONOMIC IMPLICATIONS

Forestry as a sub-sector of the Kenyan economy is important in contributing to direct and indirect benefits. For the purpose of past and current national economic accounting, only direct benefits have been considered. As well as playing structural role, Kenya's forest sub-sector is the backbone to other functional roles, which include protection of watershed and Biodiversity conservation. It is estimated that the forest provides habitation to about 40% of large mammals, 30% of birds and 35% of butterflies found in Kenya. More than half of Kenya's threatened and endemic mammals are also forest-dependent (Wass, 1995).

#### 3.7.1 Economic Implications

Forests and trees yield a wide range of products, including fuel, shelter, timber, foods and medicines. Understanding the diversity of these trees and their value in local livelihood is an important step in identifying the potential for broadening use and income generation. Tree products generate vital support to livelihoods by producing goods and services that include fuel, shelter and food which are unavailable or unaffordable elsewhere for many households.

Some of the economic activities that provide cash incomes, revenues and employment include timber industry, pulp and paper, charcoal, fuel wood, wood carving, non-wood products, tourism etc.

It is strongly felt that if statistics that show contribution of forestry/trees products to livelihoods is made available, forestry as a sector may assume an important status as an economic base in the eyes of planners and politicians. We need to devise new monitoring and reporting systems that are able to capture data on social and economic contributions arising from forestry/tree activities. The data that are currently available are only partial because most of the forests/tree products do not pass through the markets and where prices are known, they are usually distorted prices.

It is estimated that the forestry sector contributes about US\$88 million to Kenya's Gross Domestic Product (GDP) and stimulates capital formation worth US\$3 million (Republic of Kenya, 1996). Although the sector's contribution to GDP has been reflected to be small and constant over the years (approximately 1.3% and 13% of monetary and non-monetary economy respectively), its support to informal and subsistence activities is substantial. It is estimated that the forestry sector and other associated enterprises and industries support approximately 10,000 households through formal employment and generate direct financial revenue to the Forest Department of about US\$3 million annually (Republic of Kenya, 1997c). As already mentioned, it is estimated that about 3 million forest-adjacent people who live directly adjacent to forest boundaries derive cash income and meet their subsistence needs through the use of this resource, but however, the value of forests is not reflected in the national statistical abstracts.

Table 11: Estimated Value of Projected Wood Demand (Ksh '000)

Wood Use/Year	2000	2005	2010	2015	2020
Fuelwood	1,676,290	2,132,361	2,696,200	3,372,720	4,414,630

Poles	21,525	28,713	37,791	49,035	62,928
Industrial Wood	2,591,600	3,563,700	4,570,100	5,872,200	7,578,400
<b>TOTAL</b>	<b>4,289,415</b>	<b>5,724,774</b>	<b>7,304,091</b>	<b>9,293,955</b>	<b>12,055,958</b>

-The prices are the average for the commercial species (highest and lowest), Cypress, Pines, *Grevillea* and *Eucalyptus*. Industrial wood (Ksh.1900), Fuelwood (Ksh.70) and poles (Ksh.15).

-A 10% increase is used in prices for the projected demand for each period.

Table 12: Estimated National Unaccounted For Economic Value of Forest: Resources to Local Communities (Million)

Forest Type	No. of Households	Estimated National Value	
		KSh	US\$
Dry Forests	77,000	555.0	7.8
Coastal Forests	11,000	77.8	1.1
Montane	275,000	4,774.1	68.2
Western Rainforest	220,000	3,819.3	54.6
<b>Total</b>	<b>583,000</b>	<b>9,226.2</b>	<b>131.7</b>

Source: Mogaka, 1999

The results reveal that the value of forest resources unaccounted for is about KSh 9,226.2 million (US\$131.7 million) per annum.

It is noted here that the contribution of the forestry sector to the national economy has remained constant for the last decade. The sector's contribution to the non-monetary and monetary economy is estimated at 13% and 1.3% respectively (CBS, 1996) for the years 1989 to 1995. Using 1995 prices, the total contribution of the forestry sector to the GDP was estimated at KSh 5,727.4 million (US\$ 81.82 million), (CBS, 1996). Therefore, the estimated value of forest products locally consumed and traded informally reveals that approximately 62% of the total contribution of the sector to GDP is not accounted for. This confirms the argument that there is under-estimation of the value of forest resources.

### 3.7.2 Social Implications

Forests are used in Kenya by different communities for different social values. Some communities use the forests for cultural ceremonies, religious practices, while others use them for subsistence needs.

#### o Cultural Heritage:

*Kaya* forests are located in Coast Province and are strictly used for religious values (traditional prayers). They are usually small natural forests scattered in Coast Province and their value as sacred sites make them important to the local people.

Christians have also in the recent past discovered caves in forest areas where such caves are used as a retreat for prayers. Some communities like Kalenjin and Maasai use their local natural forests to observe certain cultural rites like circumcision. To these communities, forests have a

cultural value, which cannot be quantified in terms of money. The use value relevant to such forest (non-extractive) makes them unique to those communities and this is one strategy that makes their conservation a community agenda.

Elsewhere people (forest dwellers) live in forests and derive their subsistence livelihoods from forest resources. Other communities in Kenya have through generations isolated certain tree species as sacred trees while certain forest types are observed as sacred. For example, *Ficus* spp are revered by most communities in Kenya.

These values will however, vary with different communities. In some urban centres, county councils have set aside forest areas that are used as parks. These are used mainly for amenity values.

Table 13: Estimated Forest-Adjacent Population in Kenya

Forest type	1995	No. of households	1999 (projected)	No. of households
	Population		Population	
Dry forests	400,000	70,000	440,000	77,000
Coastal forests	60,000	10,000	66,000	11,000
Montane forests	1,340,000	250,000	1,474,000	275,000
Western rainforests	1,100,000	200,000	1,210,000	220,000

Source: Adopted from Wass, 1995; KFMP, 1994

Mogaka (1999), has argued that forest resource values vary significantly from one zone to another. However, for the purposes of estimating the national value of unaccounted for forest value, it implies that benefit transfer has to be effected. This calls for a number of assumptions to be made. The national forest value estimates are indicative of the broader picture regarding under-valuation of the forestry sector and not necessarily definitive. This assumption is made on two grounds. A more definitive picture on a national value will require more case studies and less benefit transfer. Similarly, to enhance the accuracy of the estimate calls for case studies that cover the country's non-amalgamated agro-ecological zones.

Based on absolute figures as an indication of the importance of various products within local household production and consumption activities, a hierarchy of products value is displayed. The products, in order of importance, are aimed at meeting the following community needs, which are energy-related, building, dietary and on-farm natural capital formation. For the survival of any relatively cash-poor society, these are the most fundamental requirements and it is suggested that forest resources are well placed to satisfy the local needs.

o Shamba System and Food Security:

*Shamba* system has been used in plantation establishment in Kenya since 1910. The FD benefit is low cost of plantation establishment while the farmer benefit from the returns from the *shamba*. The method has proved to be a cost-effective method of plantation establishment so long as it is managed properly to avoid abuse. The farmer tills the land and cultivates crops for about one

year after the trees are harvested and a further three years after the trees are planted. A study done in Kiambu District gave an average direct contribution of *shamba* is KSh 124,141 per ha per year. The total area opened up for cultivation in Kiambu was 2294 ha thus giving a total contribution of KSh. 284,779,454. (Kagombe, 1998). The total contribution is much higher if the added benefits by the middlemen, transporters, other people employed by this sector and family labour is considered.

*The shamba* system is suitable to improving the socio-economic well being of the communities' surrounding the forest stations and ensuring food security. These benefits are in addition to the contribution the *shamba* has in ensuring that trees are successfully established. These benefits need to be improved through proper marketing of the products, efficient management of the *shamba* and joint efforts in solving constraints faced by the FD and farmer in management and administration of *shamba* system. There is a need to look into the sustainability of the *shamba* system to ensure that the benefits can be provided on a sustainable base for a long time.

These benefits can be enhanced and improved if farmers have access to agricultural extension staff, provision of credit facilities to buy input and proper marketing channels for the produce. The period a farmer cultivate crops before trees are planted has reduced from the earlier 18 months to less than a year and even several cases where trees are planted immediately after allocation is done. This is not economically suitable to the farmer because it reduces the benefits from the *shamba*. In addition, the farmer faces serious problem of game damage and impassable roads during wet season, both of which reduce the benefits.

The future of plantation establishment depends on the way *shamba* system is optimised for the continued benefits of FD and the farmer. The current area opened for *shamba* system is bigger than that expected under sustainable plantation development. This does not assure continued benefits for the farmer in the future. These areas need to be gradually reduced to a level that can be managed sustainably. The future outlook for *shamba* system is to involve farmers in decisions regarding administration and management of the system. *Shamba* system should be considered as one form of community participation in forest management and one that can be a solution of the persistent problem of pressure on forest land. As noted in the KFDP Midterm Review (1996), *shamba* system can be a compromise solution to the pressures by the surrounding communities to excise forest land. One way forward would be to adopt a Joint Forest Management approach in *shamba* system. This will ensure that the communities benefiting from the *shamba* play a role in protection and management of the forest. The FD will be expected to recognise the important role of these communities and gradually increase the benefits they get from the forest. The efforts need to be backed by the necessary legal, policy and institutional changes.

### 3.8 FORESTRY AND ENVIRONMENT

#### 3.8.1 Forest Cover

In Kenya, the total forested area is 39.1 million ha. Out of this, there are areas of woodland and wooded grassland totalling 37.6 million ha. In addition, indigenous forests cover 1.3 million ha, while forest plantations cover 0.16 million ha. There is 9.5 million ha of farms, settlement and urban lands which have wooded biomass growing stock of 9.3 m<sup>3</sup>/ha (KFMP, 1994).

Forests in Kenya cover an area of about 1.7 million ha, which is about 2.6% of the country's total area. This area is composed of 1.22 million hectares of closed indigenous forest and plantation forest and 0.5 million hectares of protective bush and grassland.

### 3.8.2 Forest and Biodiversity Conservation

Forests in the country sustain very high levels of forest Biodiversity. This refers not only to diversity of species but also to genetic variation within and between species and to the diversity of the forest ecosystems within which they occur. The functions of the forest ecosystem highly depend on the Biodiversity therein.

Forest ecosystems offer complex dynamic economic natural resources. This is through provision of environmental goods and services. The goods and services offered range from timber to non-wood products and environmental services. The goods and services offered by the forest highly depend on its Biodiversity.

### 3.8.3 Forest Values

Forest values range from material products, environmental services to roles in research and education.

*Environmental services:* Forests in Kenya offer a lot in terms of regulating the environments. Its capacity to regulate water flow, soil erosion control, nutrients recycling, carbon sequestration, and capacity to modify the environment for survival of other organisms will depend on its type and structure.

*Watershed Protection:* In Kenya all the river systems originate from forests. The main river systems in the country are:

- Tana River System whose source is Mt. Kenya and The Aberdares Forest ecosystems
- Athi river system whose source is the Aberdares and Ngong Hills ecosystems
- Ewaso Nyiro river system whose source is Mt. Kenya and Aberdares forest ecosystems
- Lake Victoria basin river system whose source is Mt. Elgon, Cherangani Hills, Mau Forest and Nandi Hills forest ecosystems
- Turkwel gorge river basin whose source is Mt. Elgon forest reserve and Cherangani Hills

Any unsustainable management practices in these forests would affect forest structure, catchments functions and could contribute to drying of rivers that originate from them.

Carbon Sequestration: Kenyan forests affect the net carbon change in the country. Consequently, changes in land use from forest to other uses may result to imbalance in the carbon cycle resulting in accumulation of excess carbon dioxide in the atmosphere. Given this important role, it is therefore necessary that increase in forest cover be stepped up.

Habitat Role: Forests in Kenya act as safe havens for wildlife during dry periods. They also offer different habitat regimes for migratory species.

Aesthetic Value: Most of the Kenyan forests provide unique sceneries which ideal for recreation.

Research and Education: Kenyan forests provide unique setting for research and education in environment.

## **4. CONCLUSIONS AND RECOMMENDATIONS**

### **4.1 RECOMMENDATIONS**

#### **4.1.1 Policy and Institutional Changes**

Policy and institutional reforms are already in progress. A new forest policy and forest bill are at an advanced stage. There should however be a close follow-up to effect speedy completion. It is expected that the completion of the new forest policy and bill, will lead to the strengthening of the capacity especially expertise and logistical capability in the institution which will be charged with the management of the forest resource.

To stream line the administration and management of the forest plantation, it is suggested that the following actions be undertaken:

- Medium term (5-15 years) will involve full transfer of management of forest plantations to a new efficient management organization
- Long term (15-25) years will ensure that the long-term objectives of the programmes are being met sustainably.

#### **4.1.2 Investment in Forestry**

In order to achieve sustained forest management, there will be a need to carry out a well-focused investment in the following areas:

- Forest valuation
- Capacity building in resource assessment, planning and management, impact assessment, geographical information systems, monitoring and evaluation
- Research in non-wood tree products to enhance their economic potential
- Development of credit support to private forest investments
- Improving data and information for management planning through regular surveys and forest inventories
- Developing and improving marketing of forest products
- Modernization of forest industries to improve efficiency
- Dry land silviculture

#### **4.1.3 Forest Management**

To effect sustained forest management, the following actions will be under taken:

- Capacity building in resource assessment, planning and management, impact assessments and GIS, monitoring and evaluation
- Research in non-wood tree products to enhance their economic potential.
- Forest inventory (Farm forestry, Indigenous forests and Dry land forests)
- Social and economic valuation of the forestry sector
- Development of management plans for all forest blocks

- Institutional linkages to partners in forest industry
- Acquisition of technologies especially in tissue culture
- propagation of commercial tree species, utilization and processing of NWFPs
- Research on tree improvement and growth modelling
- Identification and domestication of fast growing commercial tree species to broaden the resource base
- Vigorous promotion and utilization of new and renewable sources of energy with a view to substituting fuel wood, agricultural waste and animals waste

## 4.2 CONCLUSION

Given the current state of the forestry sector in Kenya, unless changes in regulatory mechanisms such as legislation and policy are put in place in good time, we are likely to continue losing our forest cover to other land uses. It is expected that the changes in the policies and legislation will address problems associated with changes in land use, funding of the forestry sector and stakeholder involvement.

In view of the critical importance of the role of indigenous forests in soil and water conservation, Biodiversity conservation and contribution to the country's socio-economic development, it is imperative that the current destructive trend should be reversed. It is in this light that new management strategies be put in place.

Forests in ASALs have been ignored for a long time despite their huge economic potentials. It is in view of this that investment in resource utilization and processing, tree improvement and domestication, new management strategies, and adoption of appropriate technology are strongly advocated for.

Plantation forestry has been the backbone of industrial wood production since the beginning of the last half of the 20<sup>th</sup> century. Due to mismanagement under the current scenario, their continued contribution to the sector is unsustainable. It is therefore proposed that their management be commercialised within the short-term framework.

The future of forestry in Kenya lies outside the gazetted forests. To this end, farm forestry is expected to provide the bulk of wood resources for domestic and industrial use. It has been noted already that the investment trend has shifted towards the development of farm forestry and this has led to increase in tree cover on the farms. The recognition of the involvement of the private sector in this development endeavour is fundamental to the divestiture programme currently being undertaken by the government.

In the past, management initiatives and research programmes have ignored development of NWFPs especially in the dry areas. Current reality indicates that NWFPs have great socio-economic potentials especially in ASALs. This potential can be exploited objectively as incentives to effect sustainable forest resources management.

This report clearly confirms that if proper management strategies of forest resources are put in place, the sector can contribute significantly to national economy. The main challenge is to put these strategies in place.