

資 料

Forests and Forestry in Kenya

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ケニアにおける森林と林業

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ACRONYMS/ABBREVIATIONS

EATEC	East Africa Tannin Extract Company
EN	Extension Nursery
FD	Forestry Department
FESD	Forest Extension Services Division
FTC	Forestry Training College
ICRAF	International Center For Research in Agroforestry
ITTO	International Timber Trade Organization
JICA	Japan International Cooperation Agency
KARI	Kenya Agricultural Research Institute
KEFRI	Kenya Forestry Research Institute
KFMP	Kenya Forestry Master Plan
KIFCON	Kenya Indigenous Forest Conservation
KPLC	Kenya Power and Lighting Company
KPTC	Kenya Posts and Telecommunications Corporation
KWS	Kenya Wildlife Service
ODA	Official Development Assistance
PFN	Permanent Forest Nursery
TN	Temporary Nursery
UNEP	United Nation Environment Programme

Preamble

Forest conservation and sustainable management has become a major issue in every country that has or once had a forest. In Kenya, since the days of our ancestors, forests have had a central role to play in people's lives due to the varied products that accrue from them. Forests and trees seem to have had great cultural values as evidenced by sacred trees, groves and forests in many areas of Kenya today. This is particularly true of the medium to high potential areas.

In this cultural context most Kenyan communities have learned the value of conservation and sustainable utilization of forests or forestry dependent resources since time immemorial.

Certain cultural values have therefore been clearly defined and given due consideration under the forest act, Chapter 385 of the laws of Kenya. At present, about 3% of Kenya's total land area is covered by natural and plantation forests. There is concerted effort by both the Government and non governmental organizations (NGOs') to ensure that the area does not decrease. Currently, 170,000 ha of manmade forest exist with most being over 10 years old. The younger growing stock is low particularly due to the change in the system of tree establishment over ten years ago.

Provision of support to forested areas to continue providing resource is of utmost importance to the Kenya government. There is a feeling of responsibility particularly when we consider that sustainability is the key word for many renewable natural resources.

This book has been prepared to serve all people whose interest is forestry. Concise explanations have been given where possible. The book will be particularly useful to students of forestry, researchers, policy makers and many other people who may want to have a general overview of Kenya's Forestry.

Part I: General Description of Kenya's Forests

1:1 The Forest Resource

Kenya has about 1,640,000 ha of forests. These consist of about 170,000 ha of plantations and about 1,200,000 ha of natural indigenous forest covering a total of about 3% of the total land area. There are about 810,000 ha of forests outside the gazetted forest area. The growing stock is currently estimated at 21,000,000 m³ for plantations and 726,000,000 m³ for natural forest giving a total of 747 million cubic meters (KFMP 1994). It is hereby noted that Kenya's forests can be broadly divided into four regions, though the subdivision is subjective due to overlap in some cases.

Western region: This area consists of about 43,000 ha of closed canopy indigenous

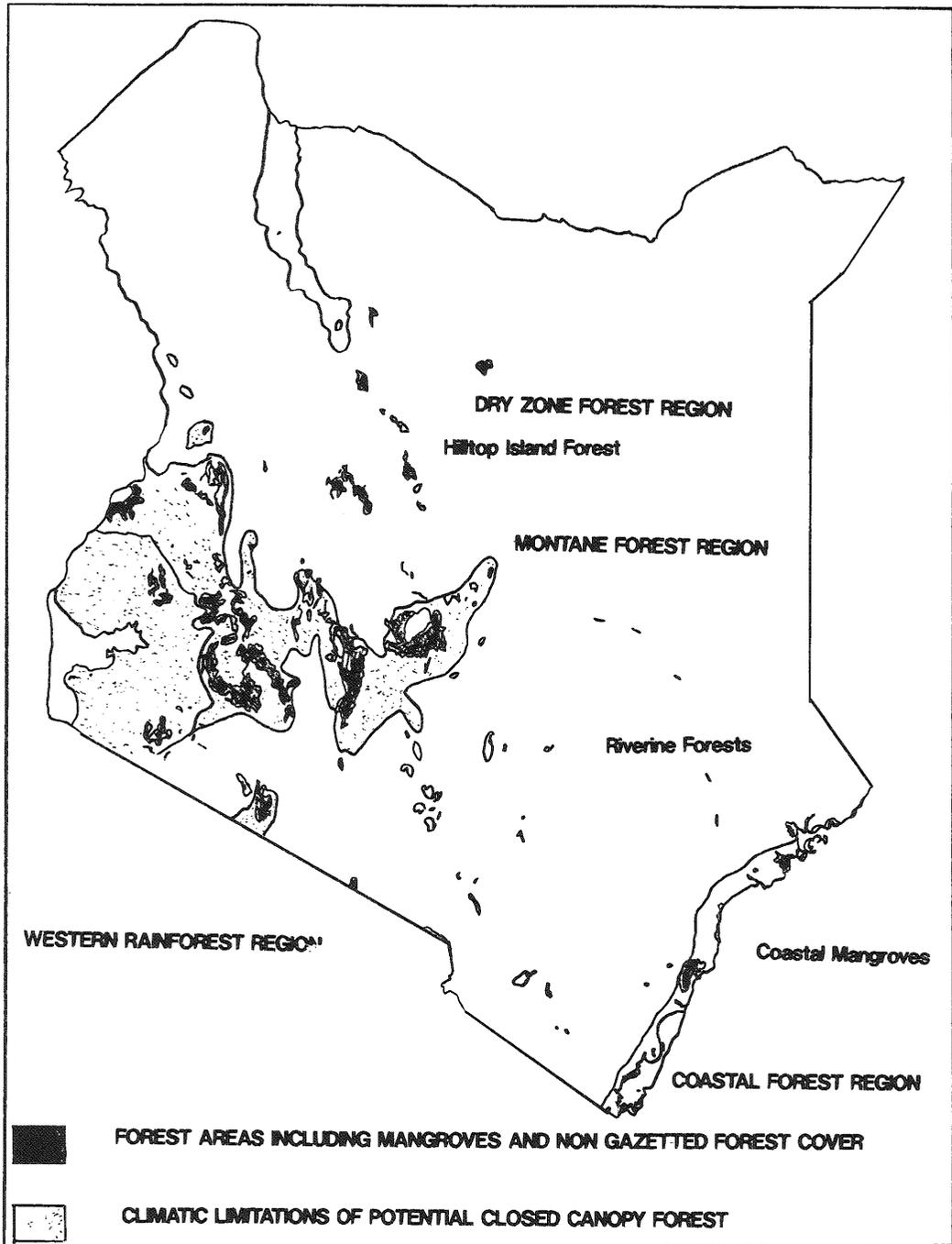
forest and 18,600 ha of forest plantation. These forests are to be found around Mt Elgon and Kakamega areas. Kakamega forest for example, is reputed to be the Eastern-most remnant of the tropical rain forest similar to those found in central African republics, for example in the Democratic Republic of Congo, formerly Zaire.

Montane region: This area is about 748,000 ha of closed canopy indigenous forest, with about 102,000 ha of forest plantation. Montane kind of forests is mainly confined to the central highlands of Kenya; Mt Kenya forest being the greatest contributor to this region.

Dry Zone region: This area has about 163,000 ha of closed canopy forest and 8, 200 ha of forest plantations. Dry zone region forests are ideally found on hilltops and the surrounding lowlands are mainly bushland though with a potential to make closed canopy forest if well managed. It is estimated that about 47,000 ha is occupied by other woody plant associations.

Coastal region: The area of closed canopy indigenous forest within this region is about 82,000 ha with an additional 3,200 ha of forest plantation, (Wass 1995). The main contributors to these forests are the Arabuko Sokoke forests. The Bamburi Portland cement with its plantation can not pass unmentioned for their contribution to the coastal area forest. Although the size of Bamburi forest may be small, it plays a major role in Eco-tourism and education.

Map 1: Forest Regions, Forest Areas and Climatic Limits of Closed Canopy Forest



Source: Wass 1994

The earliest legislation relating to forest management was introduced in 1891. The purpose of this legislation was to protect the mangrove swamps at Vanga bay. This was followed in 1897, by the Ukamba woods and Forest Regulation which established a reserved strip running two miles each side of the Uganda railway line (Mombasa-Kisumu-later to Kampala) under the control of the District Officer and the Railway administrator. In 1902 the first conservator of forests was posted to Kenya and the East Africa Forest Regulations, 1902, was established. These regulations allowed for the gazettement and de-gazettement of forest and control of forest exploitation through a system of licenses and fines. By 1908, most of the major forest blocks had been declared forest areas, under the control of the colonial government and surveying of boundaries commenced.

In 1932 a total of 32 forests were defined as government forest covering an area of 830,000 ha. By 1940 the gross total area gazetted without deductions for excisions had increased to 1,050,000 ha and by 1990 this had increased to 1,930 000 ha. Gazettements and excisions have not come to an end. Excisions have taken more than 200,000 ha leaving about 1,600,000 ha. There are proposals to gazette a further 530,000 ha particularly for river Rhine forest strips.

In the past 64 years, which have been of great importance in the governance of this country, the total gazetted forest area has changed from 685,032 ha in 1932 to the current cumulative balance of 1,666,555 ha. (See Table 1 for changes.) Generally speaking, there has been a decline in area under natural forest as the area under plantation has increased. However it is not easy to obtain figures to back up this line of thinking, as they are not readily available. Although there has been a remarkable increase in the area under plantation, there has been enormous need to carry out weeding, clearing and thinning and pruning with the eventual result in high value paper and pulpwood and also timber.

The Forest Act, chapter 385 of the laws of Kenya, and the Kenya Forest Policy, have also undergone changes over time leading to legislation and policies that call for greater involvement of the people living around the forest in forest management. More emphasis to supplement wood production is being put on farm forestry. According to Okowa and Mwangi 1996, the current annual supply of fuel wood estimated to be about 18.7 million tones has 28% from the gazetted forest, 47% from farmlands, and 25% from range lands. Therefore, farmlands contribute almost half the national supply for fuel woods

Table 1: Cumulative Changes in Gazetted forest areas (ha) from 1932 to 1991 on a decade basis.

Year	Gazetted	Excised	Added	Proposed Excision	Effective Balance
1932	685,032	0	0	0	685,032
1942	1,033,656	762	2,139	0	1,035,033
1952	1,501,439	150,975	4,430	0	1,354,894
1962	1,957,402	170,063	8,038	0	1,795,377
1972	1,989,853	303,380	15,771	1,160	1,701,084
1982	2,010,726	334,582	31,717	3,756	1,704,104
1992	2,015,532	343,464	34,706	40,219	1,666,555

Source: KIFCON 1991: Miscellaneous lists.

1:2 Plantation Forestry in Kenya

There are more than about 170,000 ha of manmade forests in Kenya. Added to this are 70,000 ha of wattle and Eucalyptus plantation forest owned by such multinationals as Lonrho. The two combined therefore is 14.6% of the total forest area. According to Birnie, 1992, most of the plantation species are conifers such as *Cupressus lusitanica* 60%, *Pinus patula* 30%, *Pinus radiata* 10%, and these make a large portion of the manmade forest. The Other plantation species include *Eucalyptus spp* and *Acacia mearnsii* on non-gazetted forestland. Indigenous trees have not been widely planted in manmade forest except where they are established as seed orchards. The reason seems to be that their slow growth curtails utilization for a community that is gradually industrializing and developing a market economy. This view may be true if we consider that most of the plantation harvesting is for pulp, paper, and sawn wood. In most cases the by-products of logging get in to the subsistence consumption.

1:3 Indigenous Natural Forest

The area of natural forest is about 1,200,000 ha as previously indicated. The forests are

varied in composition and as they are to be found in different altitude levels in Kenya. Natural forests therefore occupy about 87% of the total forest area. The area has undergone changes in the last 64 years from 685 032 ha in 1962, to the current hectarage. More changes are expected in the area as population increases and inadequate enforcement policies are experienced.

Without a firm policy on natural forest management, Kenya will see a decrease in the area and quality of its forest at the dawn of the new century.

1:4 Functions of Forests in Kenya

1:4:1 National and International level.

Many governments in the world do not give forestry the value it deserves. National accounts often ignore the economic contribution of forestry. Kenya apparently does not include the forestry resource in national accounting and planning. At the national or government level, and also the international level, forest functions should be considered in totality. Some use values may be weighted against national interests. This may contrast with other users who may only consider their own use as of paramount importance. The other uses for small users of forest products may be irrelevant unless if they contribute to enhancing the usage that is given priority.

Forests play various roles in national development. However, values in general can be broadly classified as:

1. Use values.

These includes direct use, indirect use and option values of the forest.

For the direct uses, outputs are directly consumable and these include food, biomass, recreation and health. Indirect uses are functional benefits of forests and trees and include flood control, storm protection and nutrient cycles. Optional values are future direct and indirect values and entail Bio-diversity and habitat conservation.

2. Non use values.

This includes the bequest values and the existence values. Bequest values are use and non-use values of environmental legacy and include conservation of habitats and prevention of irreversible change. If the changes were allowed to occur, then the current generations would not have anything to bequest to future generations.

3. Existence value:

This is value from knowledge of continued existence. Knowledge of existence of habitats, species, and genetic ecosystems is valued by many that might never come in direct contact with them. Knowledge of existence of certain resources is important because it influences behavior of current generations for the better of future generations.

Table 2: Use and non-use values of Forests.

USE VALUES			NON USE VALUE	
DIRECT VALUES	INDIRECT VALUES	OPTION VALUES	BEQUEST VALUE	EXISTENCE VALUE
DIRECT FOREST USE	ENVIRONMENTAL FUNCTIONS	PREMIUM TO ENSURE FUTURE USE	BEQUEST VALUE	INTRINSIC VALUE
(Output directly consumable e.g. food Biomass recreation and health) Timber Non Wood Products Recreation Education Habitat Plant and animal genetics	(Functional benefits e.g. flood control storm protection and nutrient cycles) Carbon store Air pollution reduction Watershed catchment protection Nutrient cycling Regulation of microclimate	Future direct and indirect use, Bio-diversity, Conserved habitats	(use and non use value of environmental legacy) Habitats prevention of irreversible change	(Value from knowledge of continued existence)-habitats, species, genetic, ecosystem Cultural Aesthetic Heritage

Source : UNEP Environmental Economics Series No. 14 (Modified)

From the Forest Departments' point of view, Kenya's forests play the following roles and can hence be subdivided thus:

1. Prevention of disaster.
2. Conservation of water resources.
3. Conservation of peoples environment.
4. Provision of tangible products (Timber) and intangible products-cultural and recreation.

This is the ideal situation for many industrialized countries. However the Kenya Forestry Department has failed to clearly subdivide its forests in to clear functional benefits and areas

as listed above. Most forests therefore serve more than two functions and sometimes the usage of the forests is determined at the political level. There have been instances whereby certain decrees have had adverse effects on plantation as well as natural forests. If these decrees are not adequately addressed by legislation they may affect forestry with disastrous effects on their usefulness to local national and international beneficiaries.

1:4:2 Lower Level and other interest groups

At a lower level, many Kenyans are likely to identify the following listed uses of forests and trees. Viz.: Timber, poles and posts, fuel wood, fruits, medicine, fodder, bee keeping, shade, soil formation and conservation. Others are employment, pulp and paper, carvings and handicrafts, oils and resins, amelioration of climate, catchment protection, and Wildlife habitat.

Timber:

Forests in Kenya are the main sources of timber especially the one consumed in urban areas for construction and high value furniture. Some timber also goes into bridge construction and other architectural structures. Even where houses are constructed of stone one is likely to find wooden doors and ceilings. This is because of the ease of blending stone and wood to create a higher aesthetic value house. Timber and the resulting off-cuts are also important in construction of livestock pens and for fencing.

Poles and Posts:

The majority of Kenyans stay in rural areas. These people require shelter and it is common to find that in some places over fifty percent of the dwelling walls are made of wood and soil or related material. With the exception of Central province, most of the other rural parts of Kenya rely heavily on poles and posts for house construction. In some cases, the housing structures have to be replaced after about 7 years or less, as in the case of grass thatched houses, hence making poles and posts even more necessary.

Posts are also used in making of live fences for the rural dwellers' livestock and sometimes to mark boundaries. The Kenya Power and Lighting Company (KPLC) and the Kenya Posts and Telecommunications Corporation (KPTC) are also major users of poles for transmission of power and telephone respectively. Any other alternative at the moment would prove very expensive for the two corporations. Two alternatives available are underground cables and use of concrete poles. Sharing of poles would significantly reduce the costs of transmission or delivery of these two services.

Wood fuel:

This is the main source of energy for over 80% of Kenya's households. More than fifty percent of arrests for illegal entry into the forest are from women who enter the forest to gather fuel wood. Most of the charcoal produced in the rural areas is used in urban areas hence the inclusion of urban areas as users of forests that may be far removed from forest areas. Wood fuel is used mainly for cooking and warming of houses. Forests therefore play an important role in production of wood fuel though the emphasis and greatest potential lies in on-farm production or community based production systems and not in the gazetted forest areas. Apart from domestic users, many institutions of learning use wood fuel in preparation of meals. With the availability of improved stoves, this resource is becoming more valuable than other sources of cooking fuel.

Fruits:

Many indigenous trees and shrubs are a source of fruits. There is a big food potential in this. However, little research and emphasis has been on the forests as potential sources of food and a supplement to the more conventional fruit sources. Rural communities living a round forests are quite knowledgeable in the fruits that are available in the forests near them. With proper research, and development of markets, natural forest fruits may contribute more to food security either from ex or in-situ sources. Other non-tree products that can act as food supplements are also found in forests in Kenya.

Medicines:

Trees, shrubs, and herbs found in the forest are important sources of medicine for man and his livestock. Recently, it is common to find various medicines obtained from forest plants and areas on sale in major cities like Nairobi. What remains for Kenya therefore, is for the government to put more emphasis on the research into the potency of these medicines. There is potential for the government to save a lot money that is used in buying conventional medicines not to mention the potential benefits from patenting. The current trend in Kenya is to try modern medicine and when it has failed the patient tries herbs from herbalists or self-prescription. Herbs are usually obtained from forests or other herbaceous plant related sources.

Fodder:

This is not well developed and documented. However it is common knowledge that some animals browse on forest tree species. There is need for more investigation to be carried to find out what species are good as fodder for livestock. However it can not pass without

mention that gazetted forest areas provide feeding grounds for livestock in many parts of Kenya. In some forests livestock grazing is done to reduce the growth of grass and hence reduce the spread of fires in dry seasons. In some cases, catchment area residents on obtaining a license from the local forester are allowed to cut grass for their animals. With proper record keeping, it should be possible to establish how much revenue the Forest Department generates from the sale of grass every year. In rural some areas, it has been claimed that meat from goats that browse on various plant species is more delicious than that from goats fed on grass only. This if scientifically proven can go along way in helping in animal nutrition. The benefits of the herbaceous material may be passed over to man.

Bee keeping:

This is a common activity in areas where there are people still residing in the forest. This is the case for the Southwest Mau forest where the average number of bee hives in the forest per household is seven (Lubanga 1991). Bee keeping may actually be done outside the forest and therefore is one of the least harmless uses of the forest. However proximity to flowering plants in the forest may be of great importance. Projects aiming at reducing pressure on the forest may consider bee keeping by adjacent communities as an alternative to direct extraction.

Shade:

This may not be a direct use of the forest by man. However there are cases where if one neighbors a forest area, then one is likely to benefit from the shade provided by the forest. However, when grazing in the forest trees do provide shade for man and his livestock. Forests also provide shade for the many living organisms to be found in the forest and which play an important role in the ecosystem. The ecosystem in turn supports mans other benefits from the forest. In homesteads however, trees are definitely important in protection of man against the scorching tropical sun in the dry season.

Soil formation and conservation:

Forests and trees in particular play a very important role in soil formation. It is common knowledge that trees and forests have been used in land rehabilitation. In Kenya, the case of Bamburi Portland Cement Company is a clear example using *Casuarina equisetifolia*. By their roots, trees absorb mineral nutrients from lower reaches of the ground, and through photosynthesis are able to form leaves and other tree parts. These parts with age fall down and decay thus helping in soil formation. In other cases, trees play a role in breaking down hard pans and thus contribute to soil nutrient availability. By creating a suitable microclimate for

the thriving of other soil macro and microorganisms, trees play an indirect role in soil formation.

In conservation, trees and forests are important in soil and water conservation. Trees reduce the impact of raindrops on the soil surface hence reducing the rate of soil erosion. Trees and forests also reduce wind speed and incidences of wind erosion.

Kenya's fertilizer consumption between 1968 and 1970 was 42,000 tones, and between 1988 and 1990 was 119,000 tones. Trees can provide manure instead of artificial fertilizers that are always imported. There would be an enormous saving of foreign exchange if trees would be promoted as sources of manure either through fodder or through decay of organic matter. Many progressive farmers are to be found using trees as elements of soil conservation. This is more common in areas where Agroforestry has taken root.

Employment:

Forests and forestry in general play a very important role in providing employment. In Kenya the Forest Department is the leading employer in the forestry sector with a work force of about 17 000. Added to this are the private sector forestry employees numbering about 14, 000. These are to be found working in saw mills, paper mills, transportation and self-employed persons like carpenters. There is an even higher multiplier effect given that each of the employees in the forestry sector supports at least five other Kenyans. In some parts of Kenya, as part of self-employment, farmers grow Eucalyptus, which they sell to obtain income.

Pulp and Paper:

This is the most important industrial product of forests in Kenya. The soft wood plantations in Kenya provide the bulk of the material used in the making of pulp and paper. Without forests, and more so, the gazetted forests, the private sector can not manage to sustain the present paper industries. By having paper mills, roads are graveled and thus creates jobs in this sector of road construction. This means that the positive externalities may trickle down to the lower levels of society.

Wood carvings and Handicraft:

Carving in Kenya is an activity that is important especially as an appendage to the tourist industry. Most of the wood for carving, except for the coastal regional is obtained from arid and semiarid parts of the country and therefore in a strict sense they are not from the forest. However, for other handicrafts the materials may be obtained from the forest e.g. Bamboo and rattan. Most of these products end up being sold to tourists. Using this as a form of

export, Kenya may argue its case for joining ITTO. This way the forest is likely to benefit from certification of timber products.

Oils and Resins:

This is an industry that has potential. However at the moment very few people are involved in usage of the forest for extraction of oils and resins. There is need for more information on this and to promote the forest as source of these two essential products. In dry areas, *Acacia senegal* for example may be useful for the production of gum arabic. Gum arabic is a valuable additive in beer, confectionery and pharmaceuticals.

Amelioration of Climate:

This is mainly at the micro level. However, in areas where the forest is large and serves as shelter against wind, this may be significant if looked at from the viewpoint of savings for the country, against losses that may occur due to damage to peoples property. Some farmers and communities in recognition of the role of trees as wind breaks, plant them to protect banana crops.

Catchment Protection:

This is a very important function of the forest, though it is not given prominence at the planning level. Most of the water catchment areas would be destroyed without maintaining and possibly increasing the forest cover that we have. With this, would be the attendant floods and the destruction of fishing grounds downstream. Therefore, forests play a major role in catchment protection. In the 1960s to 1980s, some farmers deliberately left areas near streams and rivers uncultivated. With the abandonment of this system of agriculture and lack of adequate policies from the government, some streams are drying out.

Wild life habitat:

Forests in Kenya are a major habitat for most of the wild animals and plants that we have today. Without forests in Kenya there would be little wild life. The realization of the importance of forests has even resulted in a memorandum of understanding between the Forest Department and the Kenya Wildlife Service for joint management of plant and animal resources. This benefit though not of direct benefit to the forest adjacent dwellers, satisfies needs of other stakeholders. Table 3 below gives the current status of plant and animal taxa.

Kenya is the fifth in terms of percentage of rare or threatened species of plants in Africa, per the total of taxa. The fact that this is given prominence shows the extent to which there

is commitment to preserving species for future use. With the importance attached to the wildlife habitats, is the issue of protected areas. The following data is a rough guide to status of protected areas as at 1992. Table 3. shows the status of species in various taxa.

Status of protected areas as at early 1992

Nationally protected areas

Number	Area (ha)	% of total land area	Biosphere reserves	Area (ha)	Ramsar wetlands
36	3470226	6.0	4	851359	(1) 18800 Ha

Table 3: Diversity and current status of animal species and plant taxa

Taxa	No. of species known	No. of species threatened
Mammals	309	17
Birds	1,067	18
Reptiles	187	2
Amphibians	88	0
Plants	6,500	144

Source : World Resoueces Institute 1994

Carbon Sequestration:

As the Kenyan economy continues to grow, and Kenyans tend to enjoy higher standards of living, there are some negative externalities. Among them is the burning of fuels and release of carbon gases. Table 4 shows the level of Carbon dioxide emissions in Kenya;

The carbon so released ends up in the atmosphere. This leads to air pollution if the release is not controlled. Trees play a very important role in carbon sequestration. They utilize most of the carbon dioxide. They are better converters of atmospheric carbon dioxide than other plants because they convert it into fibrous materials. It is sad for Kenya, when forests near towns are decimated, in favor of construction or flower farms yet in the cities or towns is where there is the highest release of carbon gases. Consciously or unconsciously, the leafy parts of Nairobi, viz. Muthaiga, Lavingtone, Runda Karen and adjacent areas have the highest number of car concentration per household. They also have many trees. Yet slowly

Table 4: National emissions of Carbon dioxide from anthropogenic source 1960–1990

Total 10 ³ t Ca ⁻¹	Year	Emission
	1960	663
	1970	760
	1980	1,691
	1990	1,590
Per unit GDP Kg ca ⁻¹	1990	0.21
Per capita t ca ⁻¹	1990	0.07

Source: United Nations Programme. Data Report 1993/1994

by slowly these areas are being subdivided and turned into concrete jungles. This is definitely bad for carbon sequestration. The city center on the contrary has few trees. Carbon Dioxide is not static hence may be sequestered anywhere. This may call for more avenue planting.

Estimated Economic value of the Functions Above

No detailed work has been done to cover all of Kenya's forests but for the few that have been done the values are as indicated:

With a GNP of about Kenya shillings 165 billion, the four items listed from indigenous forest account for about 0.8%. This may seem negligible but for an economy like Kenya's, it is not. There is need for Kenya, whose economy relies up to 20-39% on Agriculture to include forestry in its national accounting system. Pressure for privatization of forest resources should also take this into account. A casual observation reveals that Saw millers and some of the timber merchants are very rich people in Kenya. This is a pointer that forestry can help create wealth. With proper management, the Forestry Department should contribute more than it does now to the treasury.

Table 5: Sustainable Yield and Values for timber, Fuel wood and poles (Indigenous Forest only)

Item	Volume m ³	Royalty value		Economic value	
		Ksh/m ³	Ksh (million)	Ksh/m ³	Ksh (million)
Timber	380,300	334	127	7,116	2,706
Fuel wood	769,100	32	25	487	375
Pole wood	470,600	32	15	1,500	706
Total	162,000		167		3,787

Source : Wass 1994

Table 6: Household Use of Non Timber Forest products (Ksh '000)

Item	Value	%
Fibers	149,700	18
Grazing	322,300	38
Honey	139,200	16
Hunting	172,200	20
Others	68,900	8
Total	852,300	100

Source : KFMP 1994

The Forest Department should give prominence to the values above. Although these values (Table 6). are estimates, they give a fairly accurate representation of the reliance of some people on non-timber forest products. The Forest Department through the relevant division, should take amore keen role in this sector. Where possible, domestication should be done, product promotion properly carried out and value added products should be encouraged. There should be greater local community involvement in this activity.

Part II: Forest Management System

The current forest department structure is as shown below:

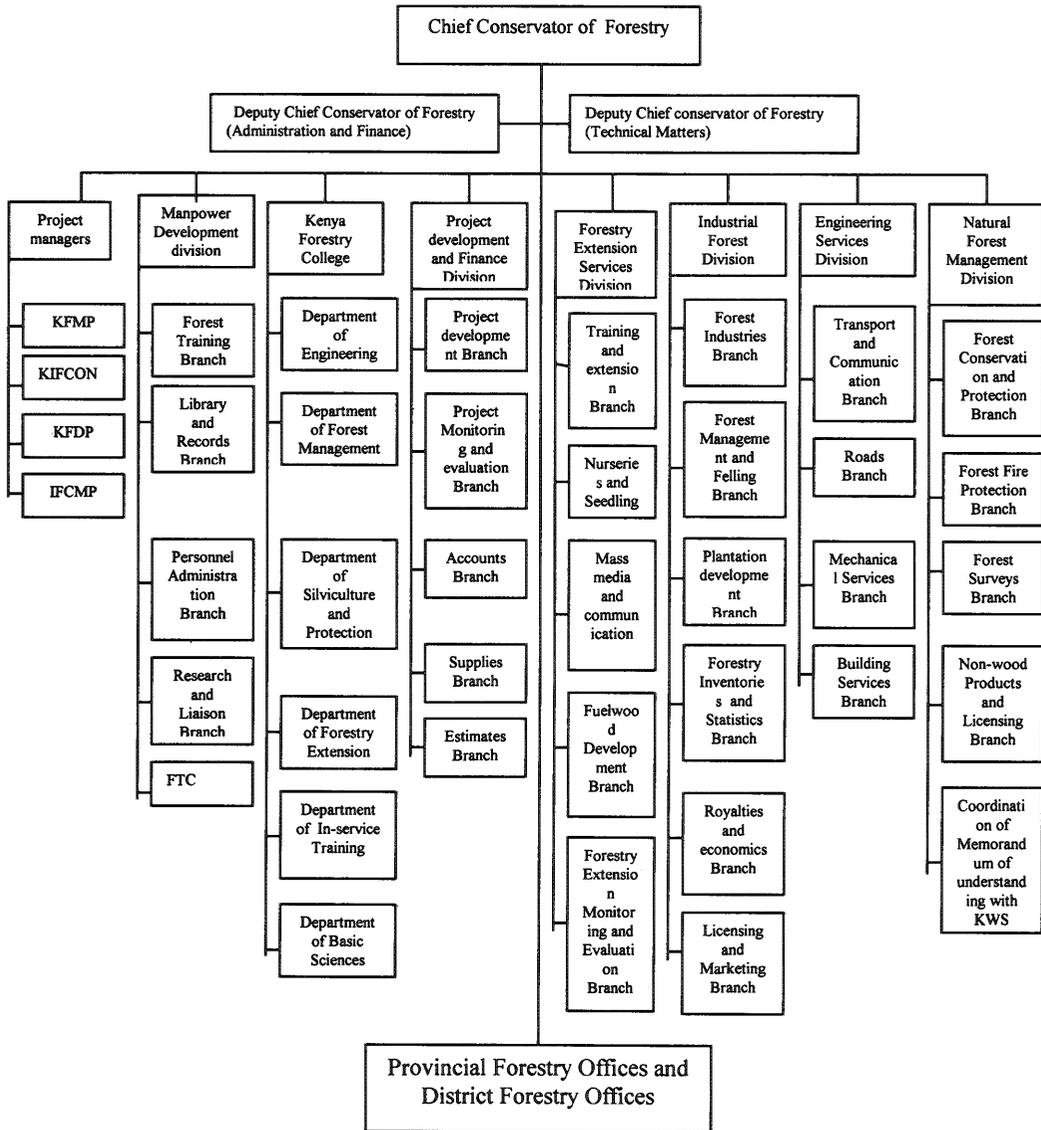


Figure 1: Organizational Structure of the Forestry Department

The Forest Department was established way back in 1902, and Mr. C. F. Elliot appointed Chief conservator with an office in Nairobi under the Director of Agriculture. In 1906, FD was moved to the office of the commissioner of lands. By 1914 the department had grown as indicated in Table 7:

Table 7: Forest Department Staff strength at 1914.

Staff designation	Staff strength
Conservator	1
Assistant Conservator	4
Foresters	11
Assistant Forester	1
Forest guards	80
Spear man	41
Accountant	1
Seed man	1
Clerk	1
Typist	1
Total	143

Source: KFMP 1994

The country was divided into four divisions, namely: Nairobi, Mombasa, Nyeri, and Londiani each headed by an Assistant Conservator of Forests (ACF). In 1962, the country was divided into eleven divisions and seven special branches. Each division was headed by an Assistant Conservator of Forests and divided into several forest stations headed by a Forester.

Just before independence, the department was placed under the Ministry of Natural Resources under the same administrative organization of the Chief Conservator of Forests. In 1971, it was realized that due to the increase in population, there was a need of expanding and diversifying the departments' activities to give service to the local community in their farms. This was to promote self-reliance in tree products and reduce demand on the few established plantations and natural forests. The Forestry Department, the same year, started forestry extension work in sample districts.

The policy of District focus for rural development became officially operational in July

1983. The department adopted the policy and established posts for Provincial and District Forestry Officers in charge of supervision of all Forestry stations and Forest extension in the provinces and districts. To facilitate the implementation, each District Forest Officer has two assistants, in charge of forest management and extension and a number of subordinate staff. In 1996/7, the FD structure was changed. This involved abolishing of the then titles for officers and reverting to the old titles. The Director hence became the Chief Conservator. Although all these changes were good, the fruits of the changes remain to be seen. However as already stated before, the changes that take place at the micro level if not backed by changes at the macro level will not achieve much. Therefore apart from the change of titles for officers, improved efficiency will not be seen. Another problem dogging the FD is overstaffing in offices. There are too many officers in the offices as compared to those who are out in the field. This problem may need to be addressed as a cost saving measure for the

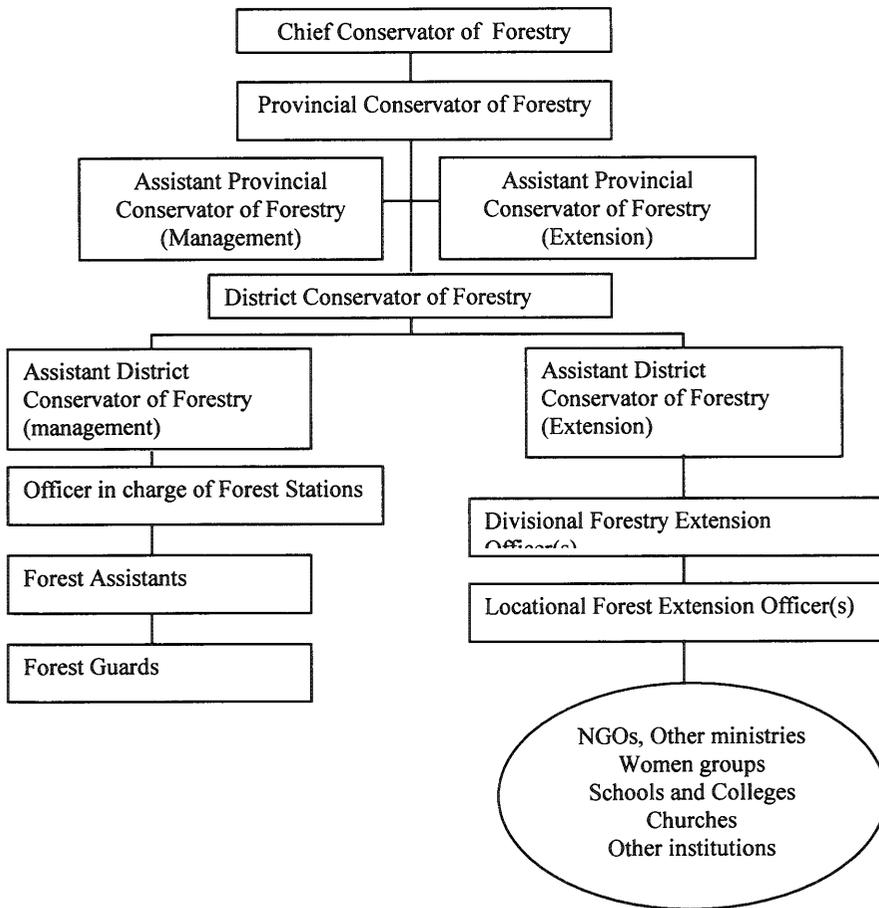


Figure 2: Organizational chart of the Forest Department field offices
Source: Kenya Forestry Master Plan 1994. Development Programmes.

FD.

2:1 Targets for Forest Improvement.

The targets are clearly set out in the Kenya Forest policy, 1994. These areas: -

1. Increase the forest and tree cover in order to ensure an increasing supply of forest products and services for meeting the basic needs of present and future generations and for enhancing the role of forestry in Socio-economic development
2. Conserve the remaining habitats and the wildlife therein, rehabilitate them, and conserve their Bio-diversity.
3. Contribute to sustainable agriculture by conserving the soil and water resources by tree planting and appropriate forest management.
4. Support the government policy of alleviating poverty and promoting rural development, by income based on forest and tree resources, by providing employment, and by promoting equity and participation by local communities.
5. Fulfil the agreed national obligations under international environment and other forest related conventions and principles.
6. Manage the forest resource assigned for productive use efficiently for the maximum sustainable benefit, taking into account all direct and indirect economic impacts; also review the ways in which forests and trees are valued, in order to facilitate management decisions.
7. Recognize and maximize the benefits of a viable and efficient forest industry for the national economy and development.

Policies or targets must be followed by strategies. The FD may have a few strategies. However the strategies rely heavily on donor support, and this is not sustainable. It is therefore a tall order to expect the FD to achieve its objectives. A clear example that goes against the stated objectives of the FD is the ethnic cleansing that has been going on in the Rift Valley since 1991. During this period the Rift valley province has been badly hit by this political crime. As a result, many saw-millers were indirectly coerced into supporting one of the parties by the threat of withdrawing their operating licenses. This of course interferes not only with the saw-miller but also with the activities of the FD.

After the clashes, the Kikuyu refugees have been resettled on forestland. This is very good on humanitarian grounds and the government should be commended for that. However such an action leads to the declining forest area. The most logical thing would have been for the government to gazette the land, which these have left behind in Olenguruone and such places as forestland. By so doing, there would be no losing of forestland.

The targets for forest improvement can not be easily met since the government fails to give clear-cut projections of what is to be done, when and how. The methods of achieving the

goals are therefore left in the hands of well-trained but poorly motivated staff. The only exception is in felling and planting where it is expected that 4 000 ha will be planted but 3 000 ha harvested annually (FD pers com).

Table 8: Land distribution and changing usage

	1968-1970	1988-1990
% cropland	4	4
% Meadows and pastures	67	67
Forest and woodland	5	4

United Nations Environment Programme. Data report 1993-1994

The table below shows the changing usage of land over a period of time in Kenya.

Based on this data there was a decrease in the area under forest and woodland over the years.

2:2 Forestry Planning System

As previously indicated through the Forest Department structure, planning tends to be a departmental affair with the consultation of the Conservator of Forestry. However it is imperative to mention that there has never been a clear policy guideline as to who should plan for the forest sector in Kenya. This is further complicated by the ambiguity as to whether forests in national parks and forests on private land have any connection with the FD. However as a guide, to what goes on in the Forest Department, the structure hereby shown represents the various decision-making levels in the forest department. One big problem with the FD is that recommendations of officers in the field are usually ignored if they appear to curtail the vested interests of the senior officers in the department.

The Forest Department through the Kenya Master plan has proposed some roles for the various players in forestry development. If these players were involved in planning for Natural resources, may be there would emerge a much better forestry sector than the one that has been in place for along time.

The following table shows the proposed distribution of roles between the private and public sector. This was proposed under the Kenya Forestry Master Plan. A close look at the roles indicates planning at the macro level. There is no indication for planning at the micro level. If this will be the case in the future in the future, then the problems that have bedeviled forest

Table 9: Proposed Distribution of Roles Between the Public and Private sector

Development Partner	Indigenous Forest	Dry-land Forestry	Farm Forestry	Plantation Forestry	Forestry Industry
Public Authorities, National Authorities	Policy and Legislation Finance and audit	Policy And legislation. Access to Finance	Policy And legislation. Access to Finance	Policy and Legislation. Finance and Audit	Policy and Legislation. Access to finance
Forest Department	Policy formulation, Macro level planning, Resource use licensing, Enforcement. Resource use monitoring. Training and extension	Policy formulation. Macro level Planning. Resource use monitoring. Training and extension.	Policy formulation. Macro level Planning. Resource use monitoring. Training and extension.	Policy formulation. Macro level Planning. Resource use licensing. Enforcement. Resource use monitoring. Training and extension	Policy formulation. Macro level Planning. Extension.
Forest Enterprises	Conservation. Management (with forest users)	Support in conservation and management.	Support in conservation and management	Conservation. Management	Supply of raw materials
Kenya wild life Service	Wildlife management. Park/Tourism management	Wildlife management. Park/Tourism management	Support in conservation. Control of damages	Conservation. Management	

Other agencies and Institutions	Law enforcement. Industry and trade licensing. Land use monitoring. Education. Research. Collaboration in extension	Law enforcement. Industry and trade licensing. Land use monitoring. Education. Research. Collaboration in extension	Law enforcement. Industry and trade licensing. Land use monitoring. Education. Research. Collaboration in extension	Law enforcement. Industry and trade licensing. Land use monitoring. Education. Research. Collaboration in extension	Law enforcement. Industry and trade licensing. Land use monitoring. Education. Research. Collaboration in extension
Private sector	Authorized utilization. Participation in conservation	Support to conservation. Utilization.	Support to conservation. Utilization	Management. Utilization	Management
Local people	Participation in management. Authorized utilization. Participation in Conservation	Management. Utilization. Conservation (as organized and recognized user groups)	Management. Utilization. Conservation	Participation in activities as non resident cultivators or as hired labor.	Labor relations.

NGOs	Extension.	Extension.	Extension.	Extension.	Extension.
Community	Social action research.	Social action research.	Social action research.	Social action research.	Social action research.
	Advocacy of private rights.	Advocacy of private rights.	Advocacy of private rights.	Advocacy of private rights.	Advocacy of private rights.
	Capacity and skill building	Capacity and skill building	Capacity and skill building	Capacity and skill building	Capacity and skill building
	Participation in conservation, management	Participation in conservation,	Participation in conservation,	Participation in conservation,	Participation in conservation,

Adapted from Kenya Forestry Master Plan. Development programmes 1994

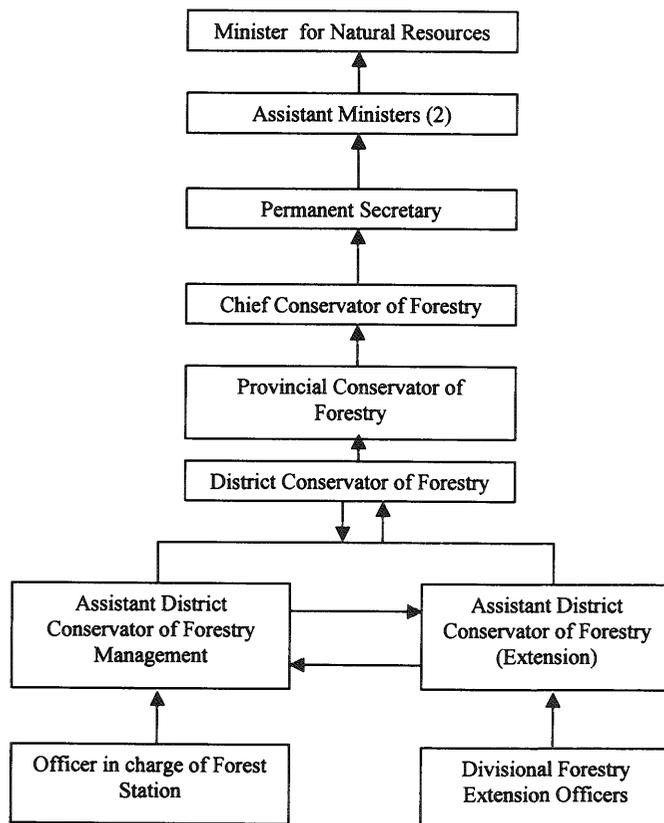


Figure 3: Structure of the Ministry of Natural Resources: Forestry branch planning levels.

utilization will continue well into the next century.

One major handicap in planning in Forestry, at the higher level above Chief conservator is that the other cadres of officers are usually laymen and therefore may ignore professional advice from their juniors. Giving the right people the right jobs can solve this problem. It would be of immense importance if professionalism were given priority in not only the forestry sector but in all public sectors. The permanent secretary for example should be someone who is well learned in the matters of the ministry that s/he is dealing with.

2:3 Forestry Land Development System

Forest land development means to increase productivity per unit area of forestland. Land development for forestry in Kenya is directly under the District Conservator of Forestry (DCO) in consultation with the Forestry Department headquarters. The DCOs and Foresters at the station then implement the activities. Implementation activities have greatly been hampered due to lack of resources from the government.

2:4 Protection Forest and Forest Land Conversion System

As mentioned earlier, Kenya's forests, like others in the world, comprise protection forests. They provide protection against landslides, mud, stone fall, etc. It has however been observed that these protection forests are found growing in areas close to human settlement. Due to high demand for land, some forest areas are excised for agricultural development and human settlement. Some land is excised for political reasons and others for the greed of the shortsighted leaders. For example Karura forest is diminishing due to its proximity to Nairobi, as the political opportunists jostle and hassle to grab land for self-aggrandizement. It is ironical that large chunks of alternative land to the south of Nairobi are left untouched especially to the left of Mombasa road. In some cases, land conversion from any form of forestry clearly ignores traditional cultural values. This has been observed especially at the coast, with Kayas. Degazettement from national monument has at times been done without proper consultation. This is bound to create conflicts and should not be done. One way to control this corrupt behavior would be by enacting a law stating that excision can only be done with approval of two thirds of members of parliament. Each case would then be viewed in the plan and with consultation of the people's representatives.

Part III: Forest Ownership

3:1 Ownership

Broadly speaking, Kenya's forests classified by ownership, fall into three categories; private, public and national.

Private forests cover an area of about 70,000 ha and are owned by two or more separate bodies including individuals, companies and communities.

In 1981, Satellite images and aerial photography showed the total forest area to be 1.37 million hectares both gazetted and not including national parks, reserves, county council, trust land and plantations. Nyayo Tea Zone occupies an area of about 11,000 hectares, Sawn wood working cycle an area of 103,000 ha and pulp woodworking circle of 21,000 ha.

In terms of standing woody biomass, in the low potential areas the average standing woody biomass volume is 4.87 m³/ha with a district wise range of 1.97 Marsabit to 10 m³ for Narok. In the high potential areas the average standing woody biomass volume is 16.4 m³/ha with an average range of 4.7 to 36.2. Of that volume about 25% is planted while 75% is found in natural woodlands. Out of the total volume, only about 20% are found in the form of wood lots.

Out of the total country estimate of 560 millions m³ two thirds are found outside actual forests. Planting volume is increasing by 4-5% annually.

Beijer Institutes survey on Energy and development in Kenya gives a total area for large farms at 2,753 million hectares of which 2.26 million ha were cropped implying that a total of about 400 000 ha is under trees or is forested. Small farms occupy 5.037 million ha of which 2.58 million ha were cropped. This may imply that a total of 2.457 million ha is under forest. This therefore indicates that there is more forest area on people's farms than there is in public land. If concerted efforts were made by KEFRI and FD to establish dry zone forest, the area of forestry could be higher. With proper planning, resources from the dry areas can satisfy demand in the bread basket areas of the country. It is a fact for example that at the moment a lot of charcoal consumed in towns is from the dry zones.

Map 2: Forest Reserves in Kenya



Source: KFMP 1994

3:2 National Forests

These are about 1,666,555 ha and constitute about 3% of Kenya's total land area. These government-gazetted forests can be categorized into:

3:2:1 Land conservation and forest-plantation forests

Kakamega forest is hereby provided as an example.

Kakamega forest is one of the gazetted forests of Kenya lying to the west of the country. It lies in the Forest area referred to as the western rain forest region of Kenya. This region is made up of a total of 49,000 ha of closed canopy forest, 18,000 ha of which are plantations. The other forests apart from Kakamega that are found in this area are the Nandi North and Nandi South forests.

Kakamega is about 24,000 ha of the total gazetted forest in the western rain forest region. In this forest is to be found Kakamega National Reserve that covers an area of about 4,400 ha. This forest is important as a site for birds where the Guiono-Congolian intermix with afro-Montane species and where forest and savanna species occur side by side. 350 species have been recorded. Many tree species occur, a few of which are threatened in Kenya. Some of the important hard wood species found in this forest are *Maesopsis emini*, *Olea welwitschii* and *Bridelia micracantha*. Kakamega is too small to support viable population of the most threatened mammals, and only about 35 De Brazzas monkeys still occur in the adjacent Kisere forest 460 Ha. Small population is also a concern especially if forest fragmentation and clearance continues. Wass 1994.

3:2:2 Nature preservation forests

Arabuko Sokoke forest provides an example in this case.

The Arabuko-sokoke forest is the last remaining tract of lowland forest in Kenya. The forest reserve is in Kilifi District of the coast province. It lies between 10 and 25 m above sea level and covers an area of about 41,000 ha.

Vegetation Distribution.

There has been a lot of description of this forest by both researchers and surveyors. The description below mainly follows Britton and Zimmerman (1979) as quoted in Mogaka 1991.

1. Brachystegia Woodland

This type of vegetation is largely dominated by the Brachystegia species (*Brachystegia spiciformis*). At maturity, these trees attain a height of 18 m to 20 m. They represent well over 70% of the dominant tree species and to some extent an even greater proportion of the total biomass.

The density of the trees varies from one point to another, but generally they are very

well spread as to conform to the Miombo woodland of Tanzania and with a herbaceous ground cover and scattered shrubs. The cycads, *Encephalartos hildebrandtii* are more abundant in this *Brachystegia* woodland where there is a lower, more closed canopy, with other under-storey and ground flora. In respect to rainfall, this habitat receives about 600 mm-1000 mm per annum (Britton and Zimmerman, 1979 quoted in Mogaka 1991).

This woodland covers about 18% (70 km²) of the Forest reserve. *Brachystegia* spp is considered to be one of the most important of Africa's vegetation type. In the Sokoke forest, it grows well where there is deep, loose, light gray to buff, medium to coarse sands (Moomaw 1960). *Brachystegia* spp is useful for timber and firewood among other uses.

2. **Cynometra-Manilkara-Brachylaena Vegetation.**

More than half of the forest reserve at Arabuko is above 60 m contour on Magarini sand soils. This area is majorly dominated by *Cynometra-Manilkara-Brachylaena* species. The dominant species are *Cynometra*, *Webberi*, *Manilkara sulcata*, and *Brachylaena huillensis*, with *Cistanthera parvifolia*, *Oldfieldia somalensis*, *combretum schumannii* and *Grewia* spp. The under-storey of the above vegetation is dominated by *Croton pseudopulchellus*, *Memecylon verruculosum*, *M. melidense*, *Notobuxus obtusifolia*, and also of the cycad *Encephalartos hildebrandtii*, (Moomaw 1960 quoted in Mogaka 1991).

With the interference of man to the forest flora, the density of these species is likely to have changed quite significantly. But the composition is not significantly altered by mans exploitation of the Forest resource.

This type of vegetation is largely developed from the significantly reduced and structurally different *Cynometra* thicket that occupies the northeastern part of the forest reserve.

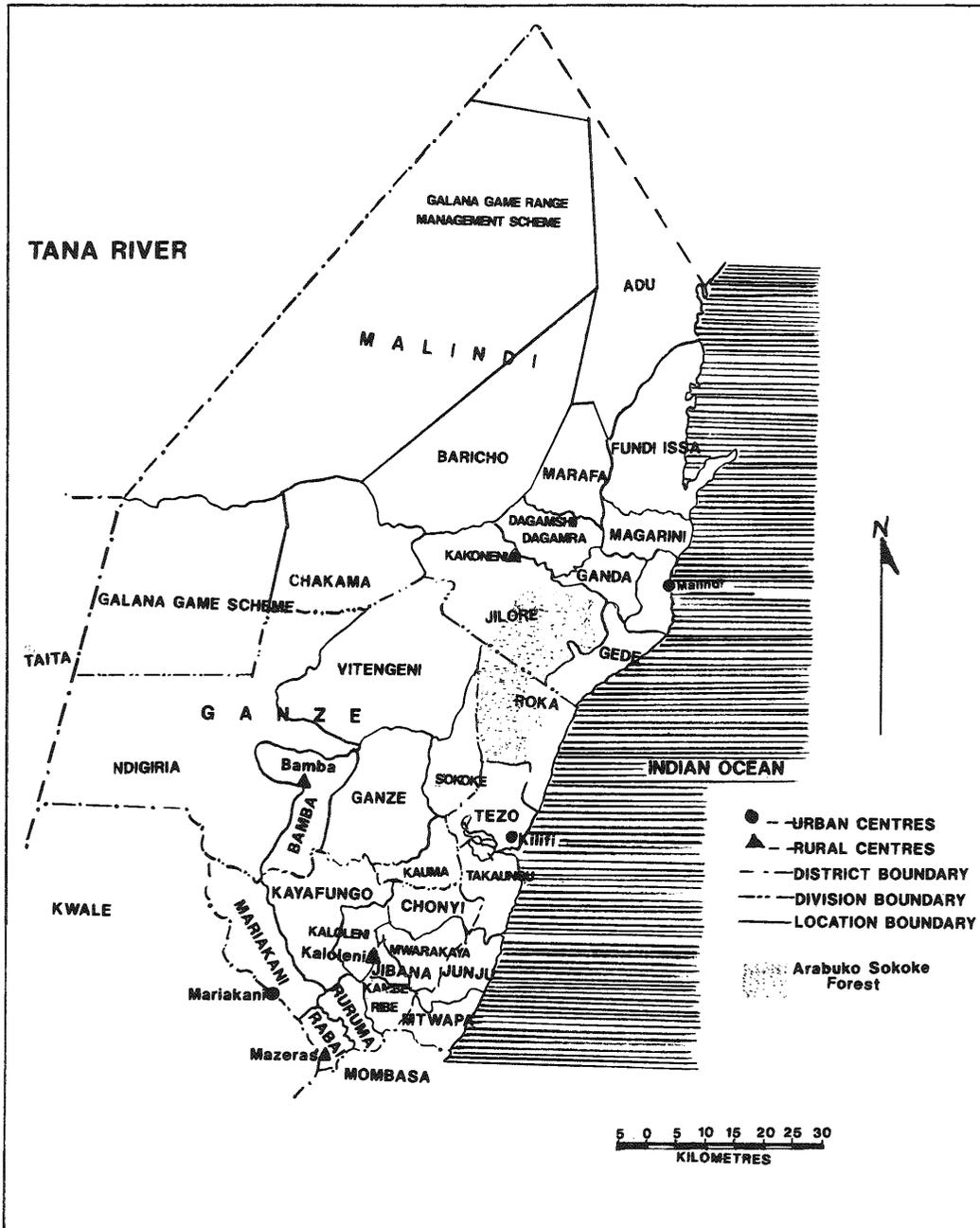
3. **Cynometra thicket.**

This type of vegetation includes individual tress mainly *Brachylaena huillensis*, which attain heights up to 10 m, though the vegetation mainly comprises of a thick shrub and sapling tangle from 3 m to 6m tall. Also common are *Strychnos dryophylla* and fruit laden *Manilkara sulcata*.

4. **White soil Cynometra-Afzelia forest.**

This area is generally described as "*Afzelia* forest" (Britton and Zimmerman 1989). It

Map 3: Location of Arabuko-Sokoke forest reserve in Kilifi district



Source : Mogaka 1991 Local utilization of Arabuko-Sokoke forest

largely includes the nature reserve bordering on the *Cynometra* thicket in the north-west. This area varies a great deal in species composition due to the fact that it borders with all other vegetation types. This area requires more studies in terms of vegetation composition. The dominant species are *Azelia quanzensis*, *Trachylobium verrucosum*, *Julbernardia magnistipulata*, *Hymenaea verrucosum* and *Strychnos decussata*.

5. Low land rainforest/*Azelia* Forest

This is the type of vegetation, which replaces *Azelia* forest in areas with higher rainfall, more than 100 mm per annum on similar soils. This type of forest has been modified a great deal due to mans activity, especially the earlier extraction of valuable timber species like *Sterculia appendiculata*. Also at Mida-Gede, characteristic tree species include *Combretum Schumannii*, *Sorindeia obtusifoliata*, *Lannea Stuhlmannii*, *Lecaniodiscus fraxinifolius* and the *Diospyros spp.*

3:2:3 Multiple utilization forests

Mt Kenya Forest is hereby provided as an example.

Mount Kenya forest covers a gazetted area of about 200,870.9 ha at an altitude of between 2000 and 2900m. It lies in Embu (18,393ha), Meru (92,860.6ha), Kirinyaga (29,215.3 ha), and

Table 10: Forest Vegetation Types of Mt Kenya Forest

Forest Vegetation Type	Approximate Area (Ha)	Location
<i>Ocotea</i>	27,500	East/South Low Altitude
<i>Albizia/Neobutania/Polyscias</i>	6,500	South Low Altitude
<i>Croton/Brachylaena/Calodendrum</i>	1,000	Southwest Low Altitude
<i>Newtonia</i>	Small remnants	Eastern Riverine Valleys /Low slopes
<i>Podocarpus latifolias</i>	Large Tracts	North West
<i>Juniperus/Muxia/Podocarpus falcatus</i>	Large tracts	West
<i>Juniperus/Olea</i>	Large tracts	Northwest/West Low Altitude

Adapted from Lubanga 1992 and in Trapnell and Brunt 1974

Nyeri (60,420 ha) Districts. Mt Kenya forest was gazetted in 1943. The forest forms the catchment of the Tana and the Ewaso Nyiro watersheds. (Lubanga 1992)

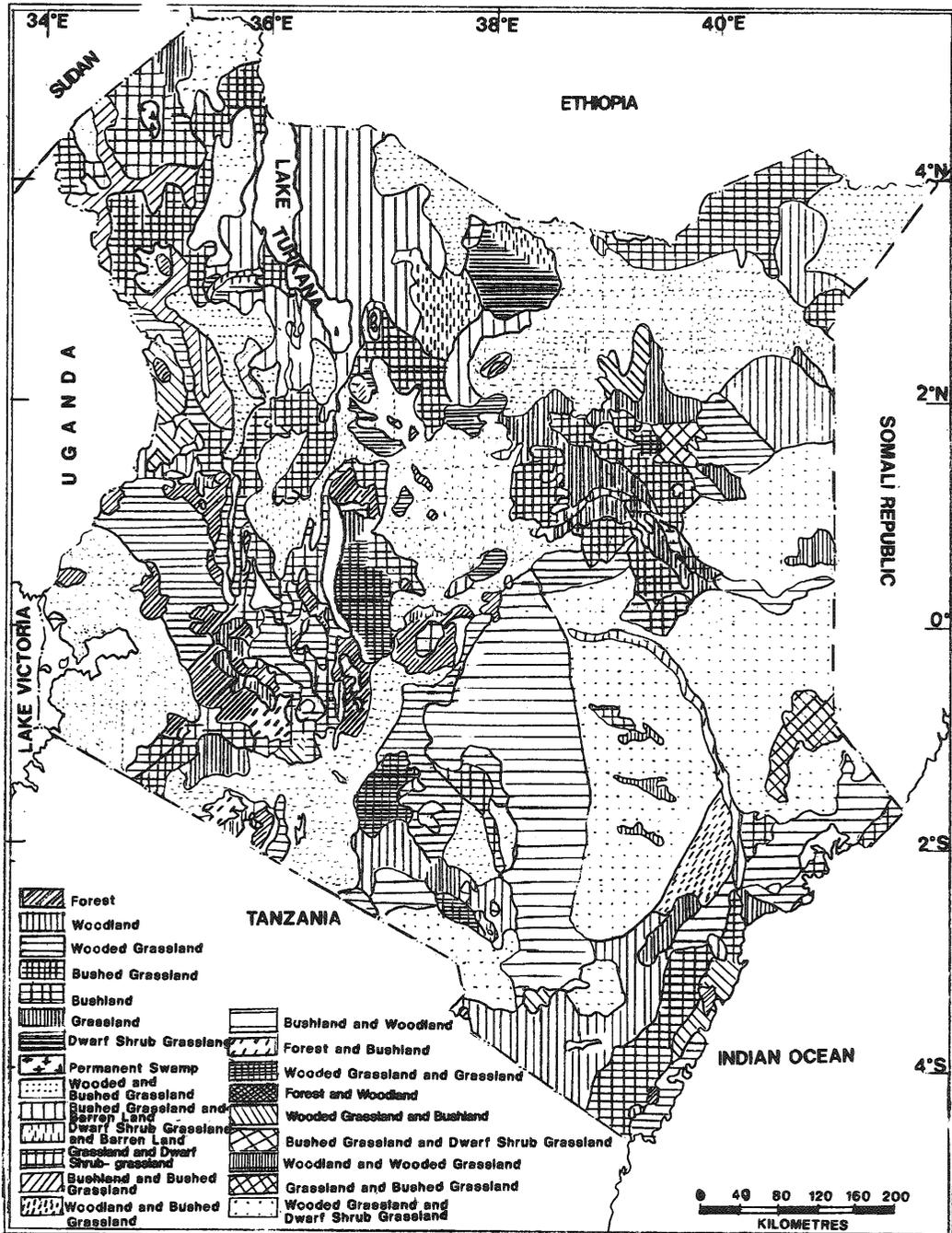
3:2:4 Timber Production Forests

These are mainly found in the rift valley province. The area in and around Nakuru is famous for soft wood production in Kenya. Therefore, most timber is produced here. Among these are areas like Kaptagat, Kikuyu escarpment, Lugari, Molo, Nabkoi, Timboroa etc.

3:2:5 Other Forests, County Council, National Parks

Example here include Montane forests and associated habitats, Mt Kenya National Park, Aberdare National Park, Mt Elgon National Park, Oldoinyo Sabuk National Park, Marsabit National Park and Mount Kulal Biosphere reserve all contribute to the forest of Kenya. Around Mt Elgon, there are other forests, which lie on people's farms. These are un-gazetted forests.

Map 4: Vegetation of Kenya



Source: KFMP 1994

Part IV: Forestry Activities in Kenya

4:1 Silvicultural Activities

4:1:1 Introduction

Tree seed can be sown directly in the field only when afforestation site conditions are particularly favorable. It is more usual to raise young trees in nurseries and plant them out when they are large enough to survive weed competition and other field conditions. The nursery stages represents 5-20% of the costs of raising a plantation and must be done efficiently.

There exists a large variety of forest tree nurseries ranging in size from temporary beds of a few square meters producing only a few hundreds or thousand seedlings to large ones. The need for forest nurseries emphasizes an important difference between agriculture and forestry. Although the overall objective of any nursery is to raise good quality, healthy plants at the lowest cost, most nurseries produce plants for a specified programme, thus seedlings must be:

- (i) of the required species,
- (ii) ready at the right time for out-planting at the onset of the rains,
- (iii) of the right size and sturdiness; and
- (iv) produced in sufficient numbers for the planting programme.

There are normally three main types of forest nurseries. A permanent forest nursery (PFN) that supplies seedlings for many years and usually in large numbers. A temporary nursery (TN) or 'flying' nursery, which is established for a short period, mostly in less than five years, to meet a specific, but temporary local. need. The third type, an extension nursery (EN), rarely forms part of a regular plantation programme but is established to provide plants of many species useful to the local community/individual farmers for various end uses e.g. amenity, fuel wood, fodder, posts and poles. Here, priority is given to issues relevant to the third type, which is usually encountered by the extension workers. The reason for this is that the future of PFNs is uncertain with the evolving policy in forestry in Kenya.

4:1:2 Siting a Nursery Site

In industrial forestry, a good nursery site has to meet the following considerations:

- a) Be close to the planting area and accessible by motor vehicle.
- b) Close to a permanent source of water.

- c) Be located at a site with good soil topography and microclimate.
- d) Human labor should be easily available.

While such a site has been easy to locate within the forest estate, under farm forestry, it is quite difficult to find land to commit under a tree nursery. The four factors normally considered in siting an industrial forestry tree nursery all become limiting. In the arid and semi arid lands (ASALs) water is mainly the limiting factor.

With increased participation of the people in raising their own seedlings, the extension personnel should emphasize “small” nurseries that would support even few hundred seedlings distributed over many farmers plots. Where possible however, nurseries should be located near water sources and in secure areas away from livestock damage.

4:1:3 Soil Mixture

It is advisable for a nursery to develop a potting mixture to suit the local conditions and using the nearest available components to save on transport costs. Potting mixture trials to suit different species, based on statistically balanced designs, are informative in indicating beneficial components. This requires a closer working relationship between KEFRI, FD and farmers.

In Nigeria, it was found that the best mixture for Eucalyptus was of 2 parts cow dung to 4 parts sand, or 3 parts cow dung to 4 of sand. Cow dung however, for both Tanzania and Nigeria was found to be harmful to *Pinus caribea*. The best results have been obtained from 1 to 4, or 2 to 3, parts of top forest soil to sand, with the addition of 1 kg of super phosphate per cubic meter of soil.

In Kenya what was commonly referred to as “Muguga Soil Mixture” was developed. This is composed of

- 5 parts forest soil (topsoil from natural forest)
- 2 parts local peat
- 1 part crushed clay
- 1 part decomposed compound manure
- 1 part crushed stone

To this soil mixture, 140 grams of Nitrogen, Phosphorous and Potassium (NPK) fertilizer were usually added to 1 m³ of soil. However away from Muguga, this mixture was modified to utilize the locally available ingredients.

The continued utilization of forest soil in nurseries, even those far from any forest reserve makes the overall cost of seedling production very high. To overcome this problem extension

workers should stress the use of local topsoil with good drainage. The fertility can be enhanced by use of manure. This is quite similar to what the vegetable farmers practice on a day to day basis.

4:1:4 Nursery Containers

The choice of the size of container depends on field conditions. While in the high potential areas, small container seedlings are appropriate, in semi arid areas, slightly larger tubes are preferred.

In a farm forestry scenario, varying types and sizes of containers have been utilized. They range from school milk containers to half drums. However, it is important to point out that the price of a seedling should be kept as low as possible to make seedlings affordable to most people. Individual farmers can still produce high quality seedlings using open beds (Swaziland beds) as practiced by the Forest Department in the high potential areas. This is mainly because the distance the seedling is transported at the time of planting is minimal and thus survival can be assured.

Another factor determining the size of container is the species and its growth pattern. Most of the exotics such as *pines* and *cypress* attain the desired planting size after only six months while indigenous species require over one year. Therefore the exotic species may well be planted in small containers as opposed to indigenous which require more plant nutrients over the long period in the nursery.

4:1:5 Shading

Shading of nursery seedlings helps to maintain moist conditions of the soil, which consequently improve survival and growth of the seedlings. In humid areas, shading is necessary immediately after pricking out. However, in hot arid and semi arid areas, shading has to be extended for a longer period after pricking out.

It is however, essential to point out that over-shading should be avoided. For small nurseries, siting them next to a big tree provides the required shade. The shaded seedlings must be un-shaded gradually for a period of about three weeks before planting out. If this is not done they suffer great shock when taken directly from shade to the field for planting.

4:1:6 Watering

Watering is one of the most important operations in the nursery. It is carried out by hand using a fine-rose can. Where costs prohibit, farmers have been known to make their own unique watering cans from 2-kilogram tins of Kimbo. The soil should be porous allowing easy drainage or otherwise be disturbed to facilitate passage of water.

With containers, they should be punched to provide drainage otherwise water logging may occur. The amount of water will mainly depend on type of soil, the weather and the shade provided. Usually, watering twice a day is recommended, early in the morning and late in the afternoon. Watering must never be done during the hot part of the day.

4:1:7 Cultivation and Weeding

Weeds are undesirable plants that compete for water and nutrients with tree seedlings. They should thus be eliminated soon as they appear. In small nurseries, this may be done manually taking a short while. However, inducing weed germination through watering the soil to stimulate weed growth may drastically reduce this and then re-mixing the soil thus killing germinated weeds. This should be done before putting the soil in containers.

Soil in beds or containers may tend to form a surface crust when the proportion of clay is high. Cultivation improves infiltration and aeration of such soils. Great care, should however, be taken to avoid damaging young seedlings.

4:1:8 Root Pruning

The aim of this operation is usually to curtail development of long taproots and promote growth of a mass of fibrous roots. For containerized seedlings, the mere act of shifting them regularly prevents the growth and establishment of the taproot on the ground. Alternatively, the root may be severed with a sharp knife.

However, with proper timing seedlings may not require any root pruning as they are planted just before extended growth of the tap root. This is very important with species that are sensitive to the operation especially the indigenous species. The extension officer should be able to provide advice to farmers in this regard. This will avoid lose of the meagre resources that farmers and government alike invest in forestry activities.

4:1:9 Hardening off

This is the process of conditioning seedlings to the field conditions. It is done by gradual reduction of the amount of water applied or by removal of shade. However, heavy watering of seedlings must be carried out before planting. Always use healthy sturdy seedlings in any planting programme to attain a high survival rate.

4:2 Nursery Period

The longer the duration the seedlings are retained in the nursery, the higher the production cost in terms of labor for watering, weeding and even change of containers. Therefore, proper timing of sowing of seeds is important to ensure ready vigorous planting stock at a specified

planting time. Different species at different places behave differently and thus local experience is necessary. Examples of treatment of certain species have been given in the following sections. Though the explanation given in technical orders apply to FD plantations, they are also relevant to farmers needs.

4:2:1 Protection

It may be necessary to fence the nursery to protect it against winds. If the area is prone to strong winds there may be damage to young seedlings and a general reduction in growth rate. In such cases, a shelterbelt of trees should be planted on the wind ward side of the nursery and smaller dividing hedges should be planted at the time of nursery establishment. As a temporary measure, screens of straw mats or woven bamboo can be effective.

Seedlings may be protected against rodents with poison, baits, traps or anything else. For protection against man and livestock, a barbed wire or mesh wire fence is often used. Where thorny species abound, these are very useful and do not cost the nursery owner a lot of money.

Insecticides may be added to the soil potting mixtures for protection against termites, particularly for Eucalyptus species, for example use of *Azadirachta indica* while others may be sprayed onto the seedlings in case pests are observed. As far as possible, use of locally available protection methods should be encouraged. This will minimize environmental damage and save the farmers resources.

4:2:2 Factors Influencing Seed Germination and Seedling Growth Seed Size

In general, small seeds germinate slower than large ones although this does not hold true in all cases. On the other hand, several studies have suggested that larger seeds influence the seedling size because of the large embryo and greater initial leaf areas. They also have more cotyledons to give the initial shoot a bigger kick.

Thus assuming “ceteris paribus”, unless otherwise known, large seed should be used.

Orientation of the Seedbed

The seedbed must be level otherwise if sloping, all the seeds will be washed to one side and usually cause it to be buried too deep.

Depth of Sowing

It is usually recommended to cover the seed to a depth twice its own diameter. However, in some experiments it was shown that deep-sowing causes delayed germination and thus 6 mm was considered the absolute maximum depth. However it should be noted that there is no rule of thumb applicable for all species. Some species will germinate prolifically when

placed on the surface of the seedbed. While others should be partially covered such as *Araucaria spp.*

Sowing Density

Dense sowing can result in losses caused by early-germinated seedlings dislodging and exposing the roots of later germinated seedlings. Also the risk of damping off is much higher in such situations. For fine tiny seeds, it is necessary to mix one volume of seed with two of sand and thoroughly mix to ensure even distribution on the seedbed during sowing.

Quantity of Water

Excess watering has several effects on the germination of seed. It causes the dislodging of seeds thus interfering with the germination. The water lowers the soil temperature thus inhibiting germination to some extent.

If the seed bed is waterlogged this may cause some seeds to rot or encourage attack by fungi or bacteria all resulting in poor germination. Therefore watering should be carried out to ensure a moist condition prevails most of the times without any water remaining stagnant on the surface.

Seedbed Medium

Sand has been found to be the best suitable medium. This is especially so during the pricking out operation when the young root easily come out without breaking. However in small nurseries mixture of charcoal and soil make a very porous medium, which also facilitate pricking out. Some medium such as clay soil should be avoided as it holds the roots firmly while such medium as cow dung manure may have very high temperatures due to microbial activities thus killing the seeds. Furthermore, germinating seeds do not require nutrients provided by manure.

4:3 Other Important Factors

It is recommended that certified seeds should be used. However, if this is not possible, general collection should be avoided from malformed, diseased, too young, too old, inferior or poor quality trees. When in doubt, it is advisable for the farmer to contact the local extension officer. The Forestry Officers are now even in locational levels hence should be easy to reach.

Keep simple records of the nursery activities to guide future management. These include date of sowing the seed, the date of first germination, date of pricking and number pricked out; not to mention the species and source of seed.

However, though direct seeding has given good results with some species in particular areas such as *Acacia nilotica* and *A. Senegal* in the Sudan, *Eucalyptus camaldulensis* and *E. Tereticornis* in Katanga and Zambia, afforestation by this method is extremely limited in Kenya to only *Acacia mearnsii*. However recent observations indicate that farmers are using the method in the establishment of live fences with species such as *Croton Megalocarpus*, *Cupressus lusitanica*, and *Dovyalis caffra*. It should be noted that this technique is only possible where cheap local seed source has been identified otherwise it's very wasteful in terms of seed.

Because of habitat similarity and other climatic factors, Kenya's silvicultural activities have centered mainly on *Pinus* spp and *Cupressus lusitanica*. Typical Silvicultural activities carried out are hereby discussed:

4:4 Other Silvicultural Activities

4:4:1 Land Preparation

This is the first step to plantation establishment. In high forest, there is no need to over clear the land but it is necessary to remove material that would cause competition. Site preparation in Kenya is done by hand. There are many stumps left after harvesting which are uneconomical to uproot to allow for mechanical land preparation. Material removed from land clearing should be sold for fuel wood. Any other remaining rubbish should be burned to kill weeds or put aside to rot. Burning has disadvantages in that any other useful species that may have grown naturally is destroyed, humus on the surface is also lost and nitrogen is lost as a gas or washed off in ash if it rains immediately. In short therefore, land preparation involves:

- Felling of trees and using all woody material for wood fuel,
- Removal of all stumps over 7 cm diameter to below 40 cm in the ground where feasible,
- Small roots and branches are removed and burnt out,
- Stump holes are filled to ground level, and the land is ready for ploughing.

In pioneer ploughing, this is done to a depth of 20 cm. This ensures that rainfall is able to penetrate, as the ground is rough. As the rains increase the ground is ploughed again by a wheel disc to break the clods of earth and the tilth is down to 15 cm. It is generally recommended that below 20 ha, land should be prepared manually. A single tractor is adequate for 20 to 100 ha. All forestry tractors should be stronger and tougher than agricultural tractors. If there are hard pans, a ripper is used to break them.

A calendar is necessary to help a Forester in the activities of the year.

The above activities are best suited for Savannah types of climate in Kenya. High altitude

wet grassland and steep land merits slightly different consideration. This is briefly discussed in the following sections.

Table 11: Principles of a calendar

Calendar	Activities
Start of the rains after 1,000 mm are recorded	Knockdown, stumping, wind rowing, ploughing can begin between wind rows
20 days after end of rains	Stop knockdown, complete windrows clean up.
Near end of dry season	Burn if necessary
Beginning of rains	Ploughing and harrowing
Start of rains after first 100 mm	Planting

High altitude grassland—above 2000 m

This is very cold comparatively with low evapo-transpiration rates. This area is not easy to clear as compared to Savannah. Strip ploughing is carried out as the soil is turned in just single lines.

If it is sloppy, strip ploughing is done along the contour where planting will be done. This is common in some parts of Kenya and is cheaper than total ploughing.

Wet grassland

These are waterlogged soils. It is necessary to choose species that are tolerant to water logging. It is also possible to improve on drainage. Ploughing is by ridging. The tractor goes to the right, throws soil, and next to the left, throws soil, thus ridges are formed. Tractors with big blades are preferable. The ridge is better drained, aerated and the low areas allow water to drain. Manually, mounds can be made but this is laborious hence expensive.

Steep land

The land is very steep and only hand cultivation is possible, as Kenya is not well technologically endowed to allow for sophisticated machinery. Steep land is very susceptible to erosion and this can lead to damage of agricultural land in the low areas. This land dictates that small terraces should be made all round the hill. The terraces should be made three to four meters apart. Planting is done on the mound of soil created. If trenches are used, make

cross tiles (walls) so that water does not flow to cause gully erosion. The contour trenches should be 50 cm wide and 30 cm deep and the crossties should be 10 m apart. The ideal distance will depend on the gradient of the slope.

After the rains have wet the planting site, planting is done. If it's possible to use the Shamba system, then this is used to establish the plantation.

4:4:2 Planting

What is the best time of planting?

Time of Planting:

The right time is when there will be enough rainfall for trees to survive. By collecting data on rainfall, we know the best time. Every forest station has to record the daily rainfall and the temperature in their meteorological station. However this has always been neglected and the frequent transfers in Forestry Department negate the theory of experience. The values of the two can then be drawn on a graph and where the rain fall graph is below the temperature graph, then this is a dry spell. Its is important to plant early as soon as 20-30 cm deep of the ground is wet.

Planting distance:

This has to be well planned. Economic, Silvicultural and other management factors govern it. The choice depends on:

1. Species form and rate of growth. Large crown trees require large areas and high rates of growth require greater space.
2. Availability of soil moisture. There is a guiding formula viz. $2450/\text{Annual rainfall in mm}$ which gives a very good guide to spacing.
3. Sensitivity of species to weed competition and the system of weeding that will be used.

Table 12: Spacing as influenced by the Amount of rainfall

Rainfall (mm)	Spacing (m)
1,500	1.6*1.6
1,250	2.0*2.0
100	2.5*2.5
750	3.3*3.3
500	4.9*4.9

Eucalyptus species are sensitive to grasses.

4. End purpose of the trees planted, for example poles, posts, pulp and paper. Plantations established as seed orchards may be treated differently.

The planting operation:

Mark out the planting site with pegs. This is very important especially in the Shamba system. By properly trained people this is not necessary. The trees have to be planted in very straight lines to create ease of other operations. Planting site is divided into blocks using a baseline with offsets. Mark off the planting distance on the offsets. A rope is used and this should have tags showing the distance between plants. The rope is moved on finishing one line. This method avoids the use of pegs and is suitable for big plantations.

If using Swaziland plants or container plants, we have to do pitting. Dig the pits using a hoe and ensure that the soil does not fall off the roots. The root collar should be at the same level with ground. If the soil is fertile, dig a hole big enough for the plant. If it's poor, climate is harsh; there should be a bigger pit. Cattle manure should be added if it is available. Survival rate generally should be 90% and beating up should be done early so that there is enough rainfall for replacement. If survival is 50% or below replant afresh in the next rain season, if sure of attaining 90% survival in the second planting.

4:4:3 Weeding Control and Tending Operation

Weeding is necessary once planting has been done. In high forests, (tropical), in the first year spot weeding is done. In the second, and third, line cleaning should be done, i.e. only cut those growth that are going to top the trees.

Climbers should be removed during cleaning up and should be removed off the tree as they are tough and will cause infirmity if left. Other species such as *Macaranga* are very fast growers and should be uprooted in the first year. Hand weeding is generally recommended but it is a high time Kenya tried oxen and tractors where applicable. For purposes of job creation, and local involvement in forestry, hand weeding reigns supreme. KEFRI is currently involved in research on cheap alternative weeding methods. Already positive results have been seen in Turbo but discussion is beyond the scope of this text.

Protection of the Forest:

1. Man and His/her Livestock

The forester should have dialogue with the rural and urban people and convince them that the trees are for the welfare of every body. The forester should build good public relations. He should have posters, educate by shows, and give lectures to schools. Alternatively, fences and trenches can be used to keep away livestock but this is not sustainable. Many foresters

have attempted to educate local people especially through public meetings.

2. Improper operations

This is for example by careless drivers who bash into trees when carrying out operations. Drivers should be trained and motivated to appreciate trees. In many forestry institutions in Kenya, it's only the professional staff who are concerned, that have wide knowledge in Forestry. There should be in house training of all cadres of employees in the forestry sector. In many forestry and research institutions in the public sector, workers who usually have little to do waste afternoons. This time could be used for training purposes. This kind of activity could be made compulsory for institutions like KEFRI and KARI. It could then spread to other institutions like FD and KWS.

3. Fire Protection

This is important in Savannah areas and especially for *Pines*, *Eucalypts* and *Cypresses*. Pruning is therefore necessary to reduce fire risk. It is important also to educate the public about fire hazards. Firebreaks need regular maintenance and fire hazard boards should be appropriately placed and in good condition.

4. Wild animals

Damage is severe if the forest is close to a national park. There should be close working relationship through the Memorandum of understanding Mou with the KWS so that damage is reduced. For the case of Kenya this has already been done. What remains to be seen is the proper implementation of this MoU.

4:5 Thinning

This is an indispensable aspect of ensuring healthy forests. To promote growth of under vegetation (for soil erosion control) and also growth of the tree in diameter, thinning has to be done. Different forest areas need this silvicultural treatment at different times. It is therefore not possible to accurately pinpoint which areas require thinning. From 1987-1995 the total revenue earned from thinning can not be ascertained due to lack of proper records from the forestry stations where these activities are carried out. Treatment of some plantation will be discussed in the following chapters.

When trees are young, they do not fully occupy the site but on growing they do occupy and compete. At this stage, trees tend to grow taller but no diameter increase is noted. If trees are grown for poles no thinning is required. Thinning is therefore the silvicultural activity of removing some trees in order to leave enough space for the remaining trees to grow in diameter. Thinning therefore has twin advantages, by allowing the trees to grow in diameter

and secondly we can sell the thinning. After the first thinning the rate of growth in diameter is high but after some time it stops hence necessitating another thinning. Every tree has its threshold value but generally in the tropics thinning should be done after every five years.

Thinning is done to meet certain objectives e.g.:

- i) To produce high quality saw logs.
- ii) To maximize use of thinning.

Useful Terminology in thinning

Thinning schedule:

This prescribes in a management plan, a thinning cycle. The schedule also tells you how much you should remove e.g. 10% of the basal area.

Thinning Yield

Is the amount of thinning we remove and is also referred to as the thinning weight.

Thinning intensity

The thinning weight divided by the thinning cycle is the thinning intensity.

Thinning method

This tells us how we are going to do the thinning.

Objectives of thinning:

This can be purely silvicultural or purely economic as already indicated. The two, however, always have interaction to get the best of bio-ecological and economic returns. Working plan objectives may also dictate thinning for example when we want to develop super or plus trees for future use especially in seed production. In this case we may not make any profit from thinnings or final product (logs).

Foresry research should set up thinning trials in all ecological regions so as to know how much thinning to carry out for every major species. From the experiments we can know the ideal cycle and yield. This has not been done in many tropical countries. The trials should be maintained and replicated throughout the rotation. From proper trials we should then be able to know when to carry out the first thinning. In the absence of this, common sense and experience should prevail. The first thinning should not be so soon as the trees may not have reached the threshold value. We should not thin below the threshold value. We may have a steep curve if we did so.

Thinning schedule

This ideally depends on research as earlier indicated. Where no research has been done, we set up an interim thinning schedule using common sense. The schedule covers

a) When to start thinning.

This is when competition is so intense that basal area increase is almost zero. It varies with species. After thinning in the first ten years for *Pines* and *Cypress*, you can identify well growing trees to leave for timber.

If thinning is delayed, we lose diameter increment and the crown size is also reduced. The trees will be long with very small crowns and even if thinning is done, the crown is too small to cause any significant diameter growth. There is also a danger from windfall if trees are too long.

In hard woods, for example *Tectona grandis*, Teak, if we neglect for a long time then carry out thinning, the tree may respond by producing new branches called epicormic branches and other sprouting from below. In the tropics, neglect is mainly attributed to economic reasons but we should carry out thinning even if we result into pre-commercial thinning that can not be sold but can be left to rot in the forest. This has environmental benefits. In a properly functioning forestry system, thinnings could be turned over to the pulp and paper industry.

b) What is the best intensity?

If we have not done our own research then we can use literature from other countries. Other wise, our guess must be very intelligent. Scientifically, when thinning, we look at how much basal area we are removing. It is not easy for inexperienced staff to understand how much basal area to remove for example 3 m³ per hectare. In Kenya and East Africa in general, schedules indicate numbers of stems to remove. This is a limitation because workers may remove all the big stems and leave the small ones or vice versa. This is not a scientific way. Therefore its important to consider volume.

Calipers may be used to find out the diameter of trees and calculate volume prior to thinning. If this is not applicable displacement methods by the use of a Relascope may be employed. A number of trees therefore, are removed to leave the desired volume.

Market factors related to thinning

If the primary objective of our timber is for saw logs, and there is a ready pulping market, this can get the thinnings. Alternatively they could be used for chipboard. Therefore it is important to plan our thinning with the market in mind. If there is no market then we can plant trees far enough such that no thinning will be done.

3. Thinning methods

a) Systematic or mechanical thinning

This is whereby a whole line is removed or every third tree for example.

b) Random or selective thinning

This is the opposite of selective thinning. The idea is to remove any suppressed trees.

c) Selection thinning

The big trees are removed and sold to provide space for the younger ones. In natural forest, improvement felling or refinement of natural high forest is done. The objective is to bring a natural forest into a high state of productivity. The choice of thinning method therefore varies from one place to another and will depend on the local conditions.

4:6 Pruning

Conifers require pruning as compared to tropical hard woods. Branches on a tree can be divided into:

- i) Dead crown-shaded dead branches,
- ii) Live crown, which is further, divided into sun crown, and shade crown.

Dead branches should be removed to avoid dead knots. Biologically, pruning is important as it helps the wound to heal up as the tree grows. The healed wound is referred to as callus.

25% of the live crown can be removed as this involves removal of the shade crown. The sun crown should not be removed, as this is the productive part of the tree. If we prune 35% of the live crown, we lose increment up to three years. But we can remove 50% of the total live crown without serious effect on the tree. Pruning is restricted to soil classes 1 and 2 but not 3 as this would be uneconomical.

Types of pruning

1. Access pruning.

This allows easier movement, improves quality of final crop, and avoids danger of fires.

2. High pruning:

The objective is to produce knot free timber. Studies are needed before embarking on this pruning to find out if the benefits outweigh the costs.

4:7 Regeneration Cutting

This is done in cases where there is need to improve the forest and in some cases where this method is preferable for establishment. It is also commonly done in regeneration of Eucalyptus.

4:8 Harvesting

This is the final silvicultural operation done before wood is converted. For some species this may be termed regeneration cutting. For some, after harvesting they coppice, while for

others, natural regeneration has to occur. Among the coppicing ones is *Eucalyptus* spp. The non-coppicing ones but with ability to regenerate from seed are *Cupressus* spp and *Pinus* spp.

The following sections describe in detail the silvicultural operations for some species. This is based on the technical orders provided by the Forest Department in 1996.

4:9 Treatment of Some High Value Species as per Forest Department Technical Orders of 1996

4:9:1 Treatment of Cypress Plantations

1. Pertinence of order

- a) This order will apply to all plantations of *Cupressus lusitanica*, Mill. (C. Lindley, Klotsch and *C. benthamii*, Enld, are regarded as varieties of *C. Lusitanica*).
- b) While this order is not designed to prescribe treatment for the slower growing species of Cypress such as *C torulosa* Don, *C arizonica*, Green. and *C. sempervirens*, L., the Silviculture of this species is similar and treatments prescribed should be generally suitable.
- c) Exempted from this order are:
 - i) Those experimental plots which are subject to silvicultural prescriptions by specialist officers. A red label in the compartment register indicates the presence of these plots. Red labels indicate Registered Experiments and seed stands while blue labels indicate sample plots. Written instructions will be received from specialist officers if an experimental plot must be treated differently from the instructions in this order.
 - ii) Any plantations expressly exempted from the order by the Director¹ of forestry.
- d) In plantations which are designated as seed stands, treatments will be prescribed in consultation with Silviculturalist and the Head, Kenya Forestry Seed Center (KFSC) and are indicated by a red label in the compartment register.

2. Silvicultural Practices

Unless otherwise specified, in this order, Silvicultural practices will be carried out in accordance with standing instructions.

3. Management Categories

- a) A Cypress plantation falls in one of the two management categories.
Category I: Pulpwood
Plantations established for the production of pulpwood.
Category II: Saw Timber

¹Conservator of Forestry

Plantations established and managed for the production of timber.

b) Geographical distribution of Cypress Management Categories

Category I: Pulpwood

All plantations established from 1966 onwards in the following districts:

Kaptagat, Nzoia, Lugari

Kipkabus Turbo, Serengoni

Nabkoi, Sengalo, Sabor and Pennon

Timboroa

Category II: Saw Timber

All plantations that do not fall under category 1.

4. Authority to carry out prescriptions.

- a) The District Forest Officer must authorize each and every treatment.² Authority will be in the form of the District Forest officer's initials under the prescribed treatment in the compartment register.
- b) In each management category, proper execution of the prescribed treatment will lead to achievement of the management objective. However, in plantations where any one action has not been executed properly, or not on time, subsequent prescriptions may have to be modified in order to achieve the management objective.
- c) The District Forest Officer is authorized to modify prescriptions where he or she deems necessary. If large areas of plantation are neglected or prescribed actions delayed, modifications should be decided in consultation with the Director of Forestry and specialist officers (typically, areas where management objectives are changed).
- d) The Forester will carry out establishment checks, top height samples, espacement checks or density counts, which ever is necessary, will be carried out in accordance with standing instructions.

I. Establishment of Crop

1. Restriction of planting

a) *C. macrocarpa*: not to be planted under any circumstances

b) *C. lusitanica* var *benthamii* and *Lindleyi*

2. Other species of cypress

Not more than one percent of the annual planting any highland forest division will be planted to other species of cypress unless specific authority is received from the Director of Forestry.

3. Seed and Nursery

²District Conservator of Forestry

- a) Seeds will be obtained by submitting a seed indent to the Kenya Forestry seed Center (KFSC). Under no circumstances will locally collected seeds be used to raise planting stock.
- b) Nursery practice will be in accordance with standing instructions.
4. Plantation management.
 - a) A high standard of cleanliness will be maintained throughout the period of establishment.
5. Espacement
 - a) The initial espacement will be as follows
Category I (Pulpwood): 2.75 m x 2.75 m (1320 s. p. ha)
Category II (Saw Timber): 2.5 m x 2.5 m (1600 s. p. ha)
The District forest officer may authorize other forms of espacement giving equivalent or less area per tree for special purposes.
 - b) Staking will be carried out in accordance with standing instructions.
6. Planting
Planting will be carried out in accordance with standing instructions
7. Beating up
Beating up will be carried out in accordance with the standing instructions. Plants used for beating up will be of the same age as those used for the original planting and therefore enough stock must be raised to allow for this.

III Care of the crop: 0-2 Years

- a) Weekly inspection by forest guards and patrolmen for game damage and rat damage, occurrence of climbers and for encroachment by couch and Kikuyu grasses will be made and immediate action taken by the forester on receipt of adverse reports.
- b) In the case of rat damage, grass and undergrowth must be cleared from around the butts of trees and the crop pruned to one third of their height. Heavy infestation of rats will be dealt following instructions in Technical order on Establishment of Forest Plantations on Grasslands ("Rodent Damage to exotic Soft wood Species in Kenya"). In districts where rat damage occurs regularly, pruning will be carried out one year after planting.
- c) Inspection for rat damage and grass encroachment will continue until the first pruning.

IV. Pruning and Thinning-General

1. Timing of Treatments

- a) After the first two prunings will take place two and four years, subsequent prunings will be based on the top height and age of the crop or thinning interval. Top height is defined as the average height of the 100-m largest diameter, defect free, un-forked trees per hectare.
- b) Appendices B and C³ of this order give age schedules for crops in the two management categories.
- c) To find the age schedule which is to be followed:
 - i) Consider the management category of the crop, age and top height.
 - ii) Determine age and top height.
 - iii) Plot top height versus age for crop on graph⁴.
 - iv) Read off schedule number to be used from the graph.
 - v) Find the ages from the table below the graph (P3=Third pruning; S=Select for high pruning; T2=Second thinning; C=Cleaning).
- d) It is strongly recommended that top height measurements be repeated up until the last pruning. The top height curves in the appendices represent average trends from which deviations are common.
- e) If a pruning and a thinning are prescribed in the same year, the pruning will be carried out first so that trees are marked for thinning as they are pruned.

2. Marking and selection schedules

- a) Selection of trees for high marking and pruning will be carried out in accordance with standing instructions.

V. Pruning

1. Pruning and Selection of schedules

- a) In pulp wood crops, (Category I), no selection of trees for high pruning will take place and all standing trees will be pruned three times. In saw timber crops, (Category II) five prunings will be done the last three on selected stems only.
- b) the basic pruning schedules are as follows:
- c) Pruning Heights

The proportional pruning height prescribed will apply to each tree individually. For the third and later prunings, a pruning gauge will be used. The pruning gauge is

³This can be seen from the Forest Department technical orders of 1996.

⁴This is as provided in the technical orders.

Table 13: Basic pruning schedule: *Cupressus spp*

Top Height or age	Pruning Heights	No of trees to be pruned	
		Cat I	Cat II
2 years	1/2 H, but not over 2 m	all	all
4 years	1/2 H, but not over 4 m	all	all
9.25 m.	2/3 H,	all	533
11.25 m	2/3 H,	N/A	533
13.75 m.	22/3 H, Max 11 m; Min 9 m	N/A	533

described in the technical orders.

d) Cleaning operations

The third pruning in all categories will be accompanied by a cleaning operation during which all dead, dying, diseased and forked trees will be cut down.

e) Season of pruning

All prunings will take place during the long rains immediately planting has been completed.

f) Occurrence of *Oemida*

Plantations in which abundant indigenous material remain at the time when third or later pruning are due and *Oemida* hazard is high must be reported to the forest entomologist KEFRI.

VI. Thinning

1. Thinning schedules

a) Thinning schedules by age, in tables, in **Appendices B and C**⁵ are derived from basic schedules that prescribe a first thinning at a certain top height. Subsequent thinnings are prescribed at certain intervals or at specific crop ages

b) Basic thinning schedules are as follows:

2. Objectives of thinning

a) The purpose of thinning prescribed in this order is to increase the value of the final crop. During the first two thinnings stand hygiene will be promoted by removal of

⁵This can be seen from the forest department technical orders.

Table 14: Basic thinning schedule: *Cupressus spp*

Treatment	Top height or age	Stems per hectare after treatment	Leave no. of trees =..... No of planting spots

Category I (pulpwood)

Plant		1,322	
Clear felling or	15-20 years	-	-
Thinning	15 years	880	2/3

Category II (Saw Timber)

Plant		1,600	
Thin	11.25 m but not before age 6 years	888	5/9
Thin	5 years after 1st thinning was prescribed	533	1/3
Thin	10 years after 1st thinning was prescribed	355	2/9
Thin	15 years after 1st thinning was prescribed	266	1/6

dead, dying, diseased and forked trees. Trees competing with those selected for high pruning should be removed.

- b) The third and fourth thinning have the dual purpose of improving the value of the remaining crop and yielding revenue. Products from the second thinning can also be

sold. This is achieved by removing trees of inferior quality and size, leaving the prescribed number of trees of best form and largest size.

3. Timing of thinning

- a) Silvicultural thinning must be carried out at the prescribed time.
- b) Commercial thinning may be delayed until the produce can be sold , with the provision that second thinning will not be delayed for longer than two years in saw timber crops (saw timber plantations).
- c) Thinnings at age 15 prescribed for pulpwood will only be carried out if the planned clear felling is delayed until after age 20 years.

4. Extraction Rides

Extraction rides may created at the first commercial thinning. Extraction rides will be marked in accordance with standing instructions.

5. Disposal of Silvicultural thinnings.

Silvicultural thinnings where *Oemida gahani* has been observed will be disposed of as follows:

- i) Felled trees will be cut into pieces throughout their length.
- ii) Trees after cross cutting , if necessary to allow for easy handling will be laid carefully along the planting lines so that they are in contact with the ground throughout their length. On slopes logs must be laid along the contour.
- iii) Branches will be piled as flat as possible beside the logs , and if necessary on top of them.

VII. Clear felling

1. Authority to clear fell

Clear felling will only be done in accordance with an approved felling plan or by special permission from the Director of Forestry.

2. Maturity

A saw timber crop will be considered mature when trees have reached an average diameter of 48 cm at breast height (1.3 m above the ground). Mature crops that are not included in a felling plan must be reported to the Director of Forestry.

3. Stem Crack

A clear felling or thinning will be delayed if a licensee complains about the high incidence of stem crack in a plantation. A special mill test will be arranged by the Director of Forestry to determine whether a defect allowance should be applied.

APPENDIX A

Geographical Distribution of Cypress Management Categories

Category I: Pulpwood

All plantations established from 1966 onwards in the following forest districts:

Kaptagat, Nzoia, Lugari
Kipkabus, Turbo, Serengoni
Nabkoi, Sengalo, Sabor and Pennon
Timboroa

Category II-Saw Timber

All plantations that do not fall under category I

4:9:2 Treatment of *Eucalyptus* Plantations

(Previous to No 57)

I Introduction

1. Pertinence of the order will apply to all plantation of *Eucalyptus* although it has largely been designed for *Eucalyptus saligna* and *E. grandis*.
2. Exempted from this order are:
 - a) Experimental plots which are subject to prescriptions by KEFRI scientists. The presence of these plots should be indicated by red or blue label in compartment register. Red labels indicate Registered Experiments (RE) and seed stands while blue labels indicate sample plots. Written instruction will be received from KEFRI scientists if an experimental plot must be treated differently from instructions in this order.
 - b) Any other plantations expressly excluded from the order by the Director of Forestry.
 - c) In plantations that are designed as seed stands, treatments will be prescribed in consultation with the Silviculturalist and the Kenya Forestry Seed Center (KFSC).
3. Management objectives
 - a) The management objectives are production of poles, woodfuel, pulpwood, plywood, and fiberboard where possible.
 - b) Appendix "A" of this order gives the geographical areas under various management objectives.
4. Silvicultural practices
Unless otherwise specified in this order, Silvicultural practices will be carried out in accordance with standing instructions.
5. Authority to carry out Prescriptions

- a) The District Forest Officer must authorize each and every treatment. Authority will be in form of District Officers initials under the prescribed treatment in the Compartment Register.
- b) In each management category, proper execution of the prescribed treatment at the right time will lead to achievement of the management objective. However if for certain reasons no activity has been executed properly, or not on time, subsequent prescriptions may be modified in order to achieve the management objective.
- c) The District Forest Officer is authorized to modify the prescription where he deems it necessary. If large areas of plantation are neglected, modification should be decided upon in consultation with the Provincial Forest Officer and KEFRI scientists.
- d) The forester will carry out establishment checks, top height samples, espacement checks, density counts or stump mortality will be carried out in every plantation before the District Forest Officer prescribes treatment.

I Establishment

1. Restriction of Planting.

- a) The major plantation species will be:
 - i) *E. camaldulensis* at elevation of 0-1200 m above sea level but mainly in semi arid areas.
 - ii) *E. grandis* and *E. saligna* at elevation of 1200-2200 m above sea level in areas receiving not less than 900 mm of rainfall per year.
 - iii) *E. regnans* and *E. globulus* at elevations above 2200 m and in arid areas with rainfall of not less than 900 mm per year.
 - iv) On drier sites with rainfall of 600-900 mm per year and at elevation of over 1200 m *E. maculata* will be the main species.
- b) **Appendix "B"** of this order lists other species that will be planted on small scale and at appropriate sites.
- c) In pulp wood areas *Eucalyptus* will occupy 30% of the annual planting programme. In other areas, they will occupy 20% of the annual planting programme. However the Director of Forestry may authorize more planting (or less) from time to time.
- d) *Eucalyptus* will not be planted on grassland sites with no special site preparation as indicated in Paragraph 3(a) below.

2. Procurement of Seed and Nursery Management

- a) Seed will be obtained by submitting a seed indent to Kenya Forestry Seed Center at KEFRI who will supply seed or issue appropriate instructions if seed will not be

available.

- b) In the nursery seed will be sown in a sandy medium. Other nursery activities will be in accordance with standing instructions.
 - c) Seedlings will be considered ready for planting when they are 30-50 cm tall and it takes 4-5 months to raise stock of this size.
3. Site preparation
- a) Eucalyptus is very sensitive to competition from all types of weeds in the early years. It is therefore essential to prepare planting sites properly using one of the following methods:
 - i) Shamba system;
 - ii) Complete ploughing, carried out and completed during the dry season;
 - iii) Strip ploughing done during the dry season;
 - iv) Pitting on stony or sloppy sites. Pits will be centered in well cultivated, holed and not cleaned patches of at least one meter diameter and;
 - v) On grassland sites, pitting will be carried out if it is not possible to prepare the planting site by methods (i) and (ii) above. However this will only be done with special permission from the director of Forestry.
4. Spacing
- a) The initial spacing of plants per hectare will be as follows:
 - Pulpwood 2.5 x 2.75 m (1455 s. p. h)
 - Plywood 2.75 x 2.75 m (1320 s. p. h)
 - Others
(Woodfuel, pulpwood in other areas, poles and Fiberboard) : 2.5 x 2.5-m (1600 s. p. h)
 - b) The District Forest Officer may authorize other forms of espacement giving equivalent area per tree.
5. Staking
- Staking and creation of firebreaks will be carried out in accordance with standing instructions. On site prepared by strip ploughing it will not be necessary to carry out staking but planting sticks (of lengths of equivalent to appropriate spacing) will be used during the planting time.
6. Planting and beating up
- Planting and beating up will be done in accordance with standing instructions. Plants used for beating up will be of the same age as those for original planting and therefore enough stock must be raised to allow for this.

III Care of Crop) -3 years

1. Weeding

Trees will be kept free of weeds or until they are about 1.5 meters high. Trees will be weeded by spot hoeing (one-meter diameter) and slashing carried out about four times in the first year. In extensive plantations, e. g in pulpwood areas, hand weeding may be supplemented by tractor harrowing between the lines (wide row). However this will only be possible of fully cultivated sites.

2. Shamba management

- a) A high standard of Shamba hygiene will be maintained throughout the period of cultivation . Agricultural crops will not be grown too densely or too close to the planted trees.
- b) The forester and action taken on adverse reports will make regular inspection for damage by rats, domestic or wild animals and occurrence of creepers or climbers.

IV Thinning

- a) Thinning will not be carried out on crops grown for pulpwood, poles, wood fuel and for production of fiberboard material.
- b) Crops grown for plywood and timber will be thinned as follows:
- c) In thinning, the best trees with good form must be left. All thinning must be carried out as prescribed. The first thinning will be sold as withies or fuel wood but later thinning may be sold as poles.
- d) Crops, which are currently out of step with the above thinning schedule, will be treated in consultation with the Silviculturalist KEFRI.
- e) Unwanted coppices after thinning will be removed manually. Brushing the stump with used motor engine oil during the thinning operations may prevent coppicing.

V Management of Coppice crops

1. Restriction

- a) The following crops or coppices will not be regenerated or managed by coppicing:
 - (i) Crops of *E. regnans* and *E. fastigata*
 - (ii) Crops which are 30 years or more from the time of planting. Plywood will fall under this category of crops.

2. Felling of crops.

Where possible, felling will be carried out during the wet season. The trees will be felled with saws and not axes. The stump height will be as close as possible to the ground and will not exceed 10 cm in height. Care must be taken not to damage or loosen the bark of the stumps. Stumps will not be left covered with slash as this obstruct the coppice shoots and may prevent them from growing straight. Burning of areas to be regenerated

by coppicing will not be allowed.

3. Selection of coppice shoots

Coppice shoots that dominate and have the best form and attachment to the stump will be selected. The selected shoots should also be as lower down as possible and as wide apart as practicable. The shoots on the wind ward side will be preferred.

4. Coppice reduction

About six months after felling, coppice shoots should be reduced to the best three. One year later these should be reduced to one to two shoot(s) per stump in pulpwood plantations at Turbo and between two to three shoots per stump in plantations managed for other objectives (poles, wood fuel, fibre-board and pulpwood outside Turbo).

VI Rotation

- a) The rotation ages for seedlings and coppice crops will be as in appendix "C".
- b) For production of Fuel wood there will be four coppice rotations. However on good sites, it might be possible to have more than four coppice rotations and this will be done with the authority from the Director of Forestry.

VII Clear felling

Mature crops will only be felled in accordance with an approved felling plan or by permission from the Director of Forestry. Crops grown for Timber are expected to attain average diameter (d.b.h) of 75 cm at the prescribed rotation age.

VIII Treatment of old stumps

After the last coppice has been clear felled, old stumps will either be dug out or used for charcoal burning or they will be killed using arboricide. Frill cuts around the stump will be made before applying the chemical. Where these two methods have proved expensive to use, coppice shoots will be removed repeatedly during the weeding of the next crop. Good establishment of the new crop will easily suppress the shoots of the old stumps and the stumps will eventually die.

APPENDIX “A”

Geographical Distribution of Eucalyptus Managed for Various Objectives

Pulpwood

The following areas:

Turbo

Kaptagat

Mt. Elgon

Nabkoi

Timboroa

Kipkabus

Saboti

Fibre board

Forest areas in Nakuru District but mainly round Elburgon.

Plywood

Forest areas in Timboroa, Nabkoi, Elgeyo, Elburgon and Nyangores.

Poles and Woodfuel

All forest areas

Farmland

Table 15: Thinning of Crops Grown for Plywood and Timber (*Eucalyptus spp*)

Treatment	Top height (m) or Age (Years)	Stems per hectare after treatment
Plant	0	1,320
Thin	12.0 m but not before the age of three years	850
Thin	3 years after first thinning was prescribed	600
Thin	6 years after first thinning was prescribed	400
Thin	9 years after first thinning was prescribed	250
Thin	15 years after first thinning was prescribed	160
Clear fell	20-30 years	0

Table 16: List of *Eucalyptus spp*, which may be planted on Limited Scale at Various Elevations

Elevation of 0 –1,200 m	Elevation of 1,200-2,200 m	Elevation of over 2,200 m
	<i>E. alba</i>	
<i>E. deglupta</i>	<i>E. bicostata</i>	<i>E. decaisneana</i>
<i>E. maculata</i>	<i>E. botryoides</i>	<i>E. delegatensis</i>
<i>E. tereticornis</i>	<i>E. citriodora</i>	<i>E. fastigata</i>
	<i>E. cloeziana</i>	<i>E. grandis</i>
	<i>E. globulus</i>	<i>E. maidenii</i>
	<i>E. microcorys</i>	<i>E. saligna</i>
	<i>E. nitens</i>	<i>E. urophylla</i>
	<i>E. paniculata</i>	
	<i>E. pilularis</i>	
	<i>E. robusta</i>	
	<i>E. urophylla</i>	

Table 17: Rotation ages for Seedling and Rotation crops

Management objective	Rotation of seedling crops (years)	Rotations	Coppice crops			
			Years of felling			
			1st coppice	2nd coppice	3rd coppice	4th coppice
Fuelwood	6-8	4	12-14	18-20	24-36	30-32
Pulpwood	8	3	16	24	32	-
Fiberboard	8	3	16	24	32	-
Timber	20	possibly 2	20-25	40-50	-	-
Plywood	30	-	-	-	-	-

4:9:3 Treatment of *Pinus patula* Plantations

(Previous to No. 53)

I Introduction

1. Pertinence of order

This order will apply to all plantations of *Pinus patula* (Schl. et Cham.) with exception of the following:-

- a) Experimental plots which are subject to silvicultural prescriptions by specialist officers. Red or blue labels in the compartment register indicate the presence of these plots. Red labels indicate Registered Experiments (R. E) and seed stands while blue labels indicate sample plots. Written instruction will be received from specialist officers if an experimental plot must be treated differently from instructions in this order.
- b) Any other plantations expressly excluded from the order by the Director of Forestry.
- c) In plantations, which are designated as seed stands, treatments will be prescribed in consultation with the Silviculturalist and the Kenya Forestry Seed Center. (KFSC).

2. Silvicultural Practices

Unless otherwise specified in this order, Silvicultural practices will be carried out in accordance with standing instructions.

3. Management Criteria

- a) A *Pinus patula* plantation falls in one of the following three Management categories.
 - i) Category I: Pulpwood
Plantations established for production of pulpwood.
 - ii) Category II: Saw Timber
Plantations established for production of saw timber.
 - iii) Category III: Plywood
Plantations either established or managed for the production of plywood (veneer/peeler logs) or plantations diverted from production of saw timber and pulpwood to production of plywood.
- b) **Appendix “A”** of this order gives the geographical distribution of the management categories.

4. Authority to carry out prescriptions

- a) The District Forest Officer must authorize each and every treatment. Authority will be in the form of the District Officers initials under the prescribed treatment of the Compartment Register.
- b) In each management category proper execution of the prescribed treatment will lead to achievement of the management objective. However, in any one plantation where any action has not been executed properly, or not on time, subsequent treatments may have to be modified to in order to achieve the management objective.
- c) The District Forest Officer is authorized to modify prescription where he deems necessary. If large areas of plantation are neglected or “out of step”, modification should be decided in consultation with the Director of Forestry and specialist Officers (typically, areas where management objectives are changed).
- d) The Forester will carry out establishment checks, top height samples, espacement checks or density counts in every plantation before treatments are prescribed.

II Establishment of Crop

1. Restriction of planting

- a) Category I: Pulpwood

- i) In highland sites, *Pinus patula* will occupy 55% of the annual planting programme in each forest station.
- ii) In other areas where shallow soils are widespread and severe drought are frequent, *Pinus patula* will not occupy more than 25% of the planting programme. In such areas, *Pinus patula* will be planted on the best sites and the Silviculturalist KEFRI should be consulted before selecting such sites.

b) Category II: Saw Timber

As *Cupressus lusitanica* Mill and other species will be given preference in the saw timber working cycle, *Pinus patula* will not occupy more than 20% of the annual planting program. However the District Forest Officer may authorize more planting of *Pinus Patula* where he deems it necessary after consulting the Director of Forestry.

c) Category III: Plywood

Pinus patula will occupy about 2% of the annual planting program or simply half the annual planting programme of this species alone for plywood production.

- d) *Pinus patula* plantations will occupy a minimum of ten hectares unless otherwise authorized by the Director of Forestry.
- e) Prior to establishing *Pinus patula* crops on cleared indigenous forest sites by direct planting method, the Head Forest Pathology, KEFRI should be consulted as *Pinus patula* is susceptible to attack by *Armillaria mellea*.

2. Seed Nursery

Seed will be obtained by submitting seed indent to Head of KFSC. Under no circumstances will locally collected seed be used to raise seedlings for plantation purposes.

3. Espacement

Planting espacement will depend on the management categories (See Paragraph VI.3).

4. Beating up.

Beating up if done within six months of planting should be done with stock of the same age as that used for original planting. Enough stock must be raised to allow for this.

III Care Of Crop: 0-4 Years

- a) Weekly inspection for game, livestock and rat damage, occurrence of creepers and climbers, encroachment by couch and Kikuyu grass will be made by the Forester and immediate action taken on receipt of adverse reports.

- b) In Districts where rat damage occurs regularly, the crop will be pruned to half height one year after planting. In these Districts hawk patches will be erected in grassland plantings.
- c) In the case of rat damage, grass and undergrowth must be cleared from around the butts of trees and trees should be pruned to half height. Heavy infestation by rats will be dealt with following instructions in the Technical Note on Establishment of Forest Plantations on grasslands.
- d) creepers and other climbers are best dealt with by pruning to 1/2 height.

VI Pruning and thinning-General

1. Timing of Treatments

- a) Thinning and pruning schedules in *Pinus patula* crops are scheduled based on age of the crop, top height, or interval of years since the last treatment. Top height is defined as the average height of 100 trees of largest diameter, defect free, in-forked trees per hectare.
- b) For management category II (Saw Timber) and category III (plywood), schedules can be derived from basic pruning and thinning schedules. These age schedules are given in Appendix "B" of this order.
- c) To find the schedule to be followed:
 - i) Determine age of crop;
 - ii) Determine top height;
 - iii) Plot top height versus age of crop on a graph
 - iv) From the graph read the schedule number; and
 - v) Find the ages for treatment from the Table on the next page of the graph (in this table P3=Third pruning; S=Select for high pruning; T2=Second thinning; C=Cleaning).
- d) It is strongly recommended that top height measurements be repeated till the last pruning. The top height curves are presented in Appendix 'C'⁶.
- e) In crops in which pruning has been completed, top height does not need to be measured. Thinning in these crops is prescribed at intervals of years after the first thinning. (Saw timber and plywood).
- f) If it is suspected that the first thinning in category II, (saw Timber) and Category II (plywood) crops were not carried out at the prescribed time, the crop can be

⁶See technical orders of the Kenya Forestry department 1996

placed on one edge of the schedules in the table in Appendix 'B' by using top height trends in younger plantations in a similar site. The time at which thinning of this plantation is prescribed should then be a compromise between specified intervals after the first thinning and specified age given in the age schedule.

- g) If a pruning and a thinning are prescribed in the same year, pruning will be carried out first, so that trees are marked for thinning and are not pruned.

V Pruning

1. Pruning and selection schedules

- a) In pulpwood crops (Category I) there will be only one pruning.
 b) In saw timber (category II) and plywood (category III) crops, four prunings will be done the last three on selected stems only.

2. The basic pruning schedules are as follows:

Table 18: Basic Pruning schedule for *Pinus patula*

Top Height or Age	Pruning Height	No of tree per ha to be pruned	
		Category I	Categories II and III
3 years	1/2 H plus one whorl	N/A	all
4 years	1/2 H plus one whorl	all	all
8 m	1/2 H plus one whorl	N/A	600
12 m	1/2 H plus one whorl	N/A	600
16 m	10.0	N/A	600

3. Pruning heights

The proportional pruning height will apply to each tree individually. For the second and later pruning, a pruning gauge will be used.

⁷See technical orders of the Forest Department 1996

4. Cleaning operation.

The second pruning in Category II (Saw timber) and Category III (plywood), crops will be accompanied by a cleaning operation during which all dead, dying forked, diseased and ox-tailed trees will be cut down.

5. Season of pruning

All pruning will take place during the dry season.

6. Selection for thigh pruning.

Selection for high pruning in Category II (Saw timber) and Category III (plywood) crops takes place before the second pruning.

7. Conversion of Standing crops to new Pruning Schedule

For Category II (saw timber) and Category III (plywood) crops the following changes will be prescribed:

- a) For crops due for first pruning: No change that is, pruning all trees to 1/2 height plus one whorl at the age of four years.
- b) For crops due for second, third and fourth pruning: A top height of 8 m, 12 m and 16 m respectively, select 600 stems per hectare and prune selected stems only.

8. Under saw timber and plywood pruning schedules in paragraph V.2 the selection before the fourth pruning at top height of 16 m also serves as the marking for the first thinning (see paragraph VI, 1 b).

VI. Thinning

1. Thinning schedules

- a) The basic thinning schedules prescribe a first thinning at a certain top height for category II (Saw timber) and Category III (Plywood) crops and at a certain age for category I (pulpwood Crops). Subsequent thinning for category II (saw timber) and category III (plywood) crops follow at age intervals. The basic thinning schedules are as follows:

Table 19: Basic thinning schedule for *Pinus patula*

Treatment	Top height or Age	Stems per Ha after treatment	Leave Fraction No. of trees/No of planting spots
Category I (pulpwood) <u>Old Crops</u> Planted at Thin <u>New crops</u> Plant	12 years	1,320 or 1,666 980 1,110	3/4 or 3/5 no thinning
Category II(saw Timber) and Category III (Plywood) Plant		1,110	
Thin		600	1/2
Thin	5 years after the first thinning was prescribed	400	1/3
Thin	10 years after the first thinning was prescribed	250	2/9
Thin (plywood crops only)	15 years after the first thinning was prescribed	170	3/20

2. To accommodate the changes in paragraph VI (1) b, the following thinning treatments will be prescribed:

a) Category I Pulpwood

In category I crops which are 12 to 15 years old will be thinned to 980 stem per hectare.

b) Category II Saw Timber

i) Crops due for thinning will be thinned to 600 stems per hectare at top height of 12.

ii) Crops due for second thinning will be thinned to 400 s.p. ha eight years after the first thinning was prescribed.

iii) Crops due for third thinning will be thinned to 250 s.p. ha 13 years after the first thinning was prescribed.

c) Category III: Plywood

i) Standing saw timber to be diverted to Category III (plywood) crops will be treated as under (b) above. However crops due for clear felling will be thinned to 170 s. p ha 18 years after the first thinning was prescribed.

ii) Pulp wood crops with top height of over 16 m and which are being diverted to plywood crops will initially be treated in consultation with the Silviculturalist, KEFRI.

3. The leave fraction shown with the thinning schedules will be used in crops that are established at the following espacement:

Category I (Pulpwood): 2.75 x 2.75 m and 2.0 x 3.0 m

Category II Saw Timber): 2.44 x 2.44, 2.5 x 2.5 m and 3.0 x 3.0 m.

In crops with different original densities, leave fractions must be adjusted to leave the prescribed number of stems per hectare.

4. Objective of thinning

The purpose of thinning prescribed in this order is to increase the value of the final crop. During the first two thinning, stand hygiene will be promoted. This will be done by removal of dead, dying and diseased trees. In Saw timber crops, trees selected for high pruning will remain after the first thinning.

a) The third thinning and in many districts the second thinning, has the dual purpose of improving the value of the remaining crop and yielding revenue. The first thinning may also be marketable.

b) In commercial thinning and indeed any type of thinning, larger trees of best form

must be left and smaller trees of inferior quality will be removed.

5. Timing and thinning

- a) Silvicultural thinning must be carried out at the prescribed time.
- b) Commercial thinning may be delayed until the produce can be sold with the provision that subsequent thinning in Category II (Saw timber) and Category III (plywood) crops will not be delayed for longer than two years.

VII. Clear felling

1. Authority to clear fell

Clear felling will only be done in accordance with the approved felling plan or by permission from the Director of Forestry.

2. Rotation age

The rotation ages will be as follows:

a) Category I: Pulp wood

The rotation will be after 18 years, but the Director of Forestry may authorize premature clear felling at Turbo and other areas with similar conditions.

b) Category II: Saw timber

After 30 years, a saw timber crop will be considered mature when trees have reached the following average diameter (diameter at breast height of 1.3 m):

Final crop of 356 s.p. ha: 37.0+/-3.0 cm.

Final crop of 250 s. p. ha : 48.0 cm.

c) Category III: Plywood

After 35 years a crop will be considered mature when trees have reached average diameter (dbh) of 51 cm.

3. Mature crops, which will not have been included in approved felling plans, must be reported to the Director of Forestry.

Appendix 'A'

Geographical Distribution of *Pinus patula* Management Categories

Category I-Permanent Pulpwood

All plantations established from 1966 onwards in the following Forest Districts:-

Kaptagat

Kipkabus

Nabkoi

Timboroa

Category II-Temporary Pulpwood

All plantations established before 1966 not at present committed to saw mill licenses in the following Forest Districts: -

Kaptagat

Kipkabus

Nabkoi

Timboroa

Category II-Saw timber

All plantations that do not fall in category I, II, or IV.

Category IV-Pulpwood-Turbo

All plantations in the Turbo Afforestation Scheme.

4:10 Afforestation and Reforestation

Many afforestation and reforestation activities were started way back in the late 1940's to rehabilitate forest land degraded by cutting of indigenous forests and to satisfy the needs of the then colonial rulers for wood for the railway. The main species promoted for this purpose was *Eucalyptus*. As one of the governments policies in 1960's, conversion of low productive broad leaved natural forests used mainly for fuel wood production, into high yielding coniferous forests was promoted to cope with the increasing demand for timber in the rapidly growing economy of Kenya. It should be remembered that in the sixties GDP growth was much higher than the recent years. The main species for plantations have been *Pinus patula* and *Cupressus lusitanica*. Some *P radiata* was being grown but due the attack by *Dothistroma pinii* planting was stopped.

4:11 Wood Harvesting

Wood harvesting has been banned in natural forests but still goes on illegally. Some natural forest wood is harvested due to excisions and there are exceptions for harvesting in some cases. Harvesting is done for the intended end use and the forest ownership. In most plantation forests, wood is harvested for timber, pulp and paper and for tannin. Along the coastal areas, harvesting of mainly mangroves and *Casuarina equisetifolia* is done for construction wood. Illegal harvesting of natural forest trees targets mainly *Polyscias kikuyuensis*, *Azalia quanzensis*, *Milicia exelsa*, and *Juniperus procera*.

Licensing of forest operators

The Forestry Department issues both subsistence and commercial licenses—subsistence licenses are issued monthly hence a user of the ticket has to renew monthly if there is need. Subsistence licenses are for firewood, grass extraction and a nominal fee affordable by the rural household is charged.

A licensing committee of the Forestry Department issues commercial licenses. For timber, annual licenses are issued to about 450 sawmills. The final approval is by the Minister for Environment and Natural Resources. Licenses are issued for the extraction of plantation produce and include Fuelwood, pole wood, quarrying, bee keeping, and medicinal plants.

Some forests in Kenya are stocked with trout and licenses for angling are issued by the Fisheries Department but with consultation with the Forestry Department, (Wass 1996). The only exception to all these procedures seems to be the Pan African Paper Mills (PPM) at Webuye in Western Kenya. PPM has a 31-year operating license from 1973 to 2003. It has a five-year operating plan which shows the compartment to be cut every year.

4:12 Production of Non-Wood Forest Products

Non wood forest products, can be defined as products including charcoal other than wood produced from forests. This definition therefore encompasses flora, fauna, and abiotic products. These products though not reflected in the national picture of forest products are important to communities living around forests and recently to migrant workers who are descendants of those communities living around forests. For example in the South West Mau forest, the value of non-wood forest products is estimated at Ksh 8,711 per household (Lubanga 1991). Non wood forest products include charcoal, Soil, Sand, herbs, mushrooms, wild meat, gums, resins, fruits, and thatch honey, tannin, fibers, tubers. A mention of to important products is given below.

Bee Products

Main bee products include bees wax and honey. The total annual production of bee's wax and honey is approximately 20,000 and 30, 000 tones respectively. Existing potential market for these products is about 100, 000 tones. Honey products have a wider potential market due to the varied uses to which honey can be put. Honey can also be sold in supermarkets unlike other products which are either too bulky or may need special permits e.g. herbs and medicines. Around Kakamega forest for example, there has been an attempt by an NGO, Association for Better Land Husbandry to promote honey production. Excepting the seasonality of production this activity has been largely successful. This is one activity that can go on even after the NGO has pulled out hence meeting the need for sustainability of

forestry activities.

Tannin Products

Although most woody plants species contain tannin, and at least thirty Kenyan species contain useful amounts, there is only one species *Acacia Mearnsii* (wattle) which is actually being used commercially in Kenya, (KFMP).

There are two factories in Kenya that extracts wattle tannin: Kenya Tannin Extractors Co LTD (KTE) at Thika and the East African Tannin Extract Co. Ltd.(EATEC) at Eldoret. The installed capacity for KTE factory is 75 tons of dry bark per day but they are processing only 50 tons. The annual production of the factory is 39,000 tones, 50% of which is solid and the rest in form of tannin extract. About 2.75 tones of solid dry bark yields 1 ton of extract. KTE does not have plantations of its own but buys bark from farmers. Their aim of setting up own plantations is hampered by lack of land or the difficulty of obtaining secure tenure.

EACTEC is a broad-based industry dealing with not only tannin but other products as well. It has about 18,000 hectares of land of which 8,300 is under *Acacia mearnsii* plantations. In 1991 it produced 12,800 tones of bark and bought an additional 3,000 tones from farmers. Marketing of wattle bark is well organized as it is being done by the private sector. The tannin extract companies buy the bark from the farmers in their fields, paying Ksh 850 per tone of green bark or Ksh 1,100 to 1,300 per tone of dry bark. Some farmers sell dry bark at the factory. There is great scope in the export of tannin to Asian markets.

4:13 Forest Road Construction

In Kenyan forests since the seventies, this activity has been slow or non-existent. In earlier years each district had equipment for road construction and a lot of work was done in this area. The scenario is quite different now despite there being very poor roads in the forest estates. The total forest road network can not be ascertained, as there are no records readily available and accessible. The situation of forest roads is likely to worsen given that the national roads in the 1990s have collapsed. Forestry roads are non-priority roads. Some NGOs also argue that development of good roads in forest areas may speed up overexploitation. This may be true. However, the picture may not be as grim as it appears. Felling requirements indicate that it should be done in the rainy season. For PPM, therefore they maintain their own roads in the forest. Large scale saw millers also do the same. This makes it easier for them to harvest. Small scale saw millers have been worse hit especially if they are allocated areas that are not close to large-scale millers.

4:14 Forestry Workforce

The total work force in the forestry public sector is estimated at 17,800. The private forestry industries employ about 24,000 persons. Our main concern is public service workforce. There are 155 professional, 675 technical, and about 15,000-support staff. The 1980's and early nineties saw great expansion in numbers of professional staff.

The down ward trend in labor productivity in Forestry Department despite heavy financial injections during the 1980's has invited strong and justified criticism among financier and authorities in Kenya. According to the criticism (World Bank), the labor productivity was better in the early 1980's, the deterioration accelerated around 1989/90 onwards. The issue has been investigated on various occasions in the recent past with a purpose to find out ways and means of remedy. No sustainable solution has been found and at the moment the excessive wage bill compared to the yielding revenue threatens to demoralize FD fully and to erode its credibility completely. Because of the critical character of the labor productivity question KFMP has decided to deal with it as an emergency issue. We hope to see changes when and if they ever come.

So far the true staff strength has been disputed. In May 1991 the total strength was reported to be 21,405 persons. After carrying out a thorough manpower survey and investigation of the manpower record keeping, the total staff has proved to be below 17,867 divided into the following categories:

Professional staff	155
Diploma Holders	492
Certificate Holders	183
Vocational	2,007
Technical support staff	414
Administrative support staff	669
Sub ordinate staff	13,947

The statistics show a reduction of about 3,500 persons per year. The number of the subordinate staff can be decided after studies of the optional prescribed work load by stations, working methods and the review task rates accordingly.

4:15 Mechanization in Forestry

In Kenya this aspect of forestry is only limited to land preparation and haulage. During land preparation, tractor ploughs are used. The same may be used for harrowing. Planting and pitting are done manually. Felling and sawing activities also involve machinery and log

transportation too.

Part V: Wood Demand and Supply

5:1 Wood Products: Fuelwood

About 71% of the energy consumed in Kenya annually comes from wood, mainly as fuel wood for cooking and heating in rural areas and charcoal in urban areas. Bees 1989, concluded that past studies in fuel wood and charcoal use tended to over-estimate consumption. Using high estimated consumption rates, studies often predicted that a serious Wood fuel crisis was going to happen. One was predicted to have happened starting in the late 1980's. This would have greatly depleted the countries growing stock of woody biomass. Thus far there have been only localized deficits. Trees on and around farms have rather multiplied in number and in volume. Although the indigenous forests have decreased, in both area and stand density, this has been mainly because of other causes.

Per capita consumption of charcoal and fuel wood for 1990 is based on Bess 1989. Urban per capita consumption is expected to decrease so that from a range of 68 to 120 kg (or on average 90 kg) per capita in 1990, charcoal consumption in 2020 would range from 64 to 68 Kg (or on average 67 Kg) per capita. Real per capita charcoal consumption in 1990 is small (8 to 36 kg or on average 13 kg) and it is projected that this would remain the same through 1990 to 2020. Per capita fuel wood consumption, is projected to decrease so that from a range

Table 20: Projected Demand for Charcoal, Fuel wood and Wood fuel (million t)

Year	Charcoal demand	Fuel wood demand	Wood fuel Demand
1990	0.64	9.08	13.95
1995	0.83	10.69	16.73
2000	1.09	12.57	20.18
2005	1.34	14.81	23.84
2010	1.64	17.29	27.89
2015	1.96	19.84	32.02
2020	2.32	22.45	336.23

Source: KFMP 1994

of 324 to 402 kg excluding Nairobi which has a much lower consumption or on average 372 kg per capita in 1990 fuel wood consumption in 2002 would range from 287 to 356 kg (or on average 322 kg) per capita.

It is difficult to get the true annual figures therefore this result in using only estimates. The

Table 21: Projected annual demand for construction wood ('000 m³)

Year	Construction poles	Transmission poles	Total
1990	960	75	1,035
1995	1,072	101	1,173
2000	1,232	134	1,366
2005	1,337	180	1,517
2010	1,504	240	1,744
2015	1,588	322	1,910
2020	1,670	422	2,092

Source: KFMP 1994

Table 22: Projected Annual demand for different mechanical wood products ('000 m³)

Year	Sawn soft wood	Sawn hard wood	Plywood	Fiber board	Particle board
1995	215	21	41	7.1	6.9
2000	270	26	52	9.1	8.9
2005	342	33	66.8	11.8	11.6
2010	414	40	81.7	14.5	114.3
2015	486	47	96.5	17.3	17
2020	591	58	118.5	21.4	21.1

Source: KFMP 1994

Table 23: Projected Demand for Paper Products

Year	1990	1995	2000	2005	2010	2015	2020
News print	15.4	19.6	25	30	39	50	60
Printing and writing	32.9	42.0	52	66	85	109	140
Unbleached packaging	9.3	10.8	13	15	17	20	25
Liner	22.2	25.8	30	35	40	47	55
Soft Kraft	14.6	16.9	22	25	29	33	40
Boards	5.1	5.9	9	10	12	14	18
Tissue	9.0	11	14	19	24	30	37
Total	129.5	158.8	199	246	304	376	468

Source: KFMP 1994

results may therefore not be a true picture of what is happening.

The table shows a general increase in both construction and pole wood demand. However with Kenya's aim of being an NIC in 2020, there should be change from use of wood to other material such as concrete poles in power transmission. This system is widely used in Japan and may not involve buying the patent. Telephone lines and power lines could share the same transmission line. It is possible also to pass the lines underground.

The general trend shows an increase in demand for these products. There is need for more vertical integration of companies to utilize what may be considered as waste in other industries. Pushing wood recovery rate beyond the current 30% would benefit the forestry sector immensely.

For the products above, there exist very little alternative. However for packaging materials, polythene bags could be a perfect substitute if recycling could be done efficiently. Newsprint can also be recycled hence reducing the pressure on forest. However Kenya's recycling industry is still in its infancy.

The table shows a general increase in demand for these products. Under a proper and efficiently operating forestry system, some of these products can be obtained from farms.

Table 24: Projected demand for pulp ('000 t)

	1990	1995	2000	2005	2010	2015	2020
<u>Current trends</u>							
Mechanical pulp	8	17	17	17	17	17	17
Unbleached chemical pulp	34	34	34	34	34	34	34
Bleached soft wood pulp	14	18	18	18	18	18	18
Bleached hard wood pulp	7	6	6	6	6	6	6
Other fibers	1	1	1	1	1	1	1
Recycled fibers	38	61	61	61	61	61	61
Total	101	137	137	137	137	137	137

Source: KFMP 1994

<u>Master plan¹</u>							
Mechanical pulp	8	17	24	31	32	50	57
Unbleached chemical pulp	33	34	37	48	56	65	74
Bleached soft wood pulp	14	18	20	25	26	45	51
Bleached hard wood pulp	7	6	6	7	8	11	12

¹Master plan: In 1990 consumption of paper and paperboard exceeded production by 36,000 tones. The most important imported paper grades were newsprint and writing papers and carton boards. For this scenario, it is projected that the domestic consumption of paper and paperboard would cover the main part of consumption in future. Part of the demand for printing and writing grades as well as carton boards and small volumes of tissue and other packaging grades would be imported. During the period 2000-2020 domestic production would cover on average about 84% of the domestic consumption of paper and paperboard. The total production estimates used in this scenario are in line with the opinion of Pan Paper Mills officials.

Other fibers	1	1	15	22	25	37	41
Recycle fibers	38	61	77	110	130	167	197
Total	101	137	179	243	277	375	432
<u>Self sufficiency²</u>							
Mechanical pulp	8	17	32	40	49	55	69
Unbleached chemical pulp	33	34	43	48	55	64	77
Bleached soft wood pulp	14	18	27	33	39	54	68
Bleached hard wood pulp	7	6	7	9	12	13	17
Other fibers	1	1	19	26	32	47	57
Recycle fibers	38	61	62	120	151	186	232
Total	101	137	220	276	338	419	520

Table 25: Projected demand for industrial round wood by grade ('000 m³)

	1995	2000	2005	2010	2015	2020
<u>Current Trends</u>						
Pulpwood	367	367	367	367	367	367
Soft wood logs	594	745	939	1137	1335	1624
Hard wood logs	52	65	82	100	118	145
Ply logs	124	124	124	124	124	124
Total	1137	1301	1512	1728	1944	2260

²Self sufficiency: This scenario is also hypothetical as it assumes that all of Kenya's demand for paper and paper board would be satisfied with domestic production. This scenario also assumes that all fiber raw materials needed in the production of paper and paperboard would be produced or recovered domestically. This scenario acts as the ceiling for wood raw materials demand.

<u>Master plan</u>						
Pulpwood	367	454	485	646	768	774
Soft wood logs	594	836	1,067	1,300	1,546	1,895
Hard wood logs	52	62	73	82	94	116
Ply logs	124	194	194	260	260	374
Total	1,137	1,546	1,819	2,288	2,668	3,159
<u>Self sufficiency</u>						
Pulpwood	367	508	599	713	871	1,078
Soft wood logs	594	708	829	959	1,101	1,340
Hard wood logs	52	62	73	82	94	116
Ply logs	124	155	208	247	292	359
Total	1,137	1,433	1,709	2,001	2,358	2,893

Source: KFMP 1994

FORESTS AND FORESTRY IN KENYA (L. MAKANJI)

Table 26: Projected consumption of construction and industrial wood

	1995	2000	2005	2010	2015	2020
<u>Current trends</u>						
Pine	677	756	849	951	1,047	1,180
Cypress	565	672	800	937	1,069	1,257
Eucalyptus	792	917	1,015	1,163	1,271	1,389
Other Hardwoods	277	322	365	421	467	526
Total	2311	2,667	3,029	3,472	3,854	4,352
<u>Master plan</u>						
Pine	677	896	1,024	1,,289	1,483	1,721
Cypress	565	757	917	1,126	1,321	1,559
Eucalyptus	792	926	1,025	1,187	1,303	1,425
Other hardwoods	277	333	370	430	471	547
Total	2,311	2,912	3,336	4,032	4,578	5,252
<u>Self sufficiency</u>						
Pine	677	854	1,012	1,187	1,393	1,686
Cypress	565	692	807	939	1,087	1,309
Eucalyptus	792	928	1,034	1,191	1,311	1,446
Other hardwoods	277	325	373	428	477	543
Total	2,311	2,799	3,226	3,745	4,268	4,984

Source: Kenya forestry Master plan 1994

The three species remain the dominant species in the plantations. With proper research, there is scope for introduction of other species that may have comparative advantage to these species.

Table 27: Projected procurement of construction and industrial wood ('000 m³)

	1995	2000	2005	2010	2015	2020
Current Trends						
State plantations	1,571	1,837	1,534	1,772	2,000	2,322
Private plantations	509	565	610	610	610	610
Other sources	230	265	886	1,090	1,244	1,420
Total	1,310	1,667	3,030	3,472	3,854	4,352
Master Plan						
State plantations	1,562	2,016	1,784	2,433	2,884	3,325
Private plantations	520	632	744	855	967	1,079
Other sources	228	264	808	744	727	848
Total	1,310	2,912	3,336	4,032	4,578	5,252
Self Sufficiency						
State plantations	1,562	1,911	1,663	2,144	2,560	3,040
Private plantations	520	632	744	855	967	1,079
Other sources	228	256	820	745	742	865
Total	1,310	2,799	3,227	3,744	4,269	4,984

Source: Kenya forestry Master plan 1994

The prediction of increasing availability of these resources from the forest may have unwanted externalities. With the ever-improving management of wild animal resources by KWS, it will be difficult to establish plantations as the animals increase in number. Establishment of private plantations requires a lot of re-education. It will be difficult to establish plantations on land that is sometimes held for speculative purposes. Short-term high return agricultural crops may be produced instead.

5:2 Wood Import

Kenya does not import any wood at the moment. Any wood coming in, is in processed form e.g. furniture, wood carving, and newsprint. Some hard wood may also be coming in illegally from neighboring countries. Processed or finished goods are only imported by the rich and by some NGOs that have access to large amounts of foreign exchange.

5:3 Export of Wood Products

Kenya's main wood export is in the form of woodcarvings. Tourists on visiting the country mainly buy these.

The Akamba handicraft is famous for this at the coast. One of the main species used for carving is *Brachylaena huillensis*. This species has begun showing signs of scarcity. The fact that wood is exported in any one form from Kenya, may be a good point for Kenya to seek membership of ITTO. In so doing there may be certification procedures and these may benefit Kenya's forest in the long run.

Part VI: Support for the Forestry Sector

6:1 Threats to Forestry in Kenya

Major underlying causes of deforestation.

1. Socio-economic factors.
 - a) Population growth therefore the need for more food leading to clearing of forest land for agriculture
 - b) Poverty. Reducing effective land utilization, then some people have to resort to forest destruction as a source of products to sell to earn some income.
 - c) Unfair trading and business practices of the developed countries that impact negatively on land based produce from less developed countries.
2. Physical and Environmental factors.
 - a) Distribution of forests. Most forests are close to humanity hence utilization occurs.
 - b) Distance from urban centers. Sometimes this is an incentive for forest exploitation,

because agricultural produce lacks market and may be perishable unlike some forest products.

- c) Soil fertility. The decreasing fertility on farms makes it hard for farmers to satisfy their food needs therefore cut down forest to gain more fertile land. This is a sure way of increasing deforestation.
3. Government policies.
- a) Inadequate agricultural policies and where adequate, implementation is wanting.
 - b) Forestry policies. These may exist but are inadequate or not in harmony with other land use policies.
 - c) Blind implementation of World Bank policies that result in more poverty in less developed nations, Kenya included.

6:2 Role of the Government in the Forestry Sector

The forestry sector to a large extent in Kenya is seen as the responsibility of the government. Given that all gazetted forests belong to the central government, it is only fair that the government shoulders the responsibility of maintaining them unless if the rules of the game are changed.

In professional circles however, it has been noted that individual or private owners may play a major role in the future of forestry in this country. It is therefore imperative that government device ways of supporting these other players in forestry to promote forestry; this support may also come in form of :

1. Subsidy programme: Support Silvicultural works and rural access roads. Subsidy may be targeted to municipal governments and especially in rural areas where there is abundant land that can be converted to forestry. These may be possible in marginal lands where the population is still low and there is abundant land.
2. Loan programme: This may be availed to support individuals and entrepreneurs for processing and marketing of their produce.
3. Tax exemption: This system could be used to encourage public participation in tree planting. The private sector involved in afforestation may be exempted from taxation hence the accruing benefit is channeled to forestry development activities.
4. Compensation Programme: The government should undertake to guarantee up to 50% of the loans that the private lending institutions are willing to lend to the private sector for forestry development.

Table 28: Selected measures of economic development 1990 (unless otherwise stated)

Total GDP 10⁶ US\$	7540
Agriculture %	28
Industry %	21
Services %	51
GDP Growth rate 1980-1990 % per year	4.2
GNP per capita	370
Real GDP per capita 1989 PPP	1,023

Source: UNEP Environmental Data Report 1993–94

From the Table above, forestry is lumped together with Agriculture. However an ideal situation would require that forestry is separated and treated on its own merit. Estimates however show that forestry makes a contribution of 3% to the GDP. This in my opinion is under estimated. A total economic valuation of the forestry sector may yield higher values. This may awaken the Kenya government and public to give more support to the forestry sector. Carrying out a total economic evaluation may also form the basis for compensation for people who may want to set a side their land for water conservation or catchment areas.

6:3 Forestry Departments Budget Structure

Forest Departments' annual budget (GoK funding) in 1990/91 was of the order of Ksh 400 million (the official estimate was Kenya shillings 426 m and that for 1991/92 Ksh 598 m). The actual expenditures are usually lower, varying between 75-85% of the approved budget. Approximately 85% of the budget is for personnel emoluments and 15% for other expenditure. Approximately 65% of the budget is for plantation forestry and the rest for other forestry works. The industrial plantations segment it is to be noted also covers the bulk of the emoluments for Forestry Departments permanent labor force. Given the competing demand for government support from the various ministries it is unlikely that the budgetary

allocation for the Department will increase in the near future. (KFMP)

6:4 Forest Extension, Education and Popular Participation in Rural and Urban Forestry

The subject of forestry is not widely taught in our education system. It may be remotely taught in Geography and other related subjects but only in passing.

In Kenya however, there is forestry training at both graduate and undergraduate levels at Moi University. Other trainees at certificate and diploma level are accommodated at the Kenya Forestry College Londiani. Various organizations also carry out in-service training in forestry. For the last 10 years the leading organization has been the Kenya/Japan Social forestry training Project at the Kenya Forestry Research Institute. Since 1987 more than 1,700 officers have been trained at KEFRI both at Muguga and at Kitui. There may be need to establish another level of training to cater for people engaged in the tourism sector. For the institutions engaged in Forestry work there is need for frequent in-service training for all officers. Its not uncommon to find officers in the administration wing of research institution and FD who have no idea what forestry is all about. An institution like KEFRI for example has a senior and middle level Administration and management staff strength of 23. All these senior members of staff do not hold even a single certificate of training in Forestry. The situation is therefore worse at the lower levels. There is need for induction courses for all these people both in KEFRI and other forestry institutions

People's participation in forestry can not pass unmentioned. The main agent for extension and popular participation in forestry in this country has been the Forest Department through first the, Rural Afforestation and Extension Services (RAES) division and later through the Forest Extension Services Division (FESD). One thing that needs commendation is that now in Kenya, it is possible to find forestry officers even at the location level. This would compare very well with the spread of agricultural officers. However forestry extension officers are usually at a disadvantage. They lack bicycles and motor bikes that may assist them in visiting more farmers than they do now. With the changes proposed in the civil service, it should be possible to have agricultural officers performing the duties of forestry officers. This would avoid duplication of effort.

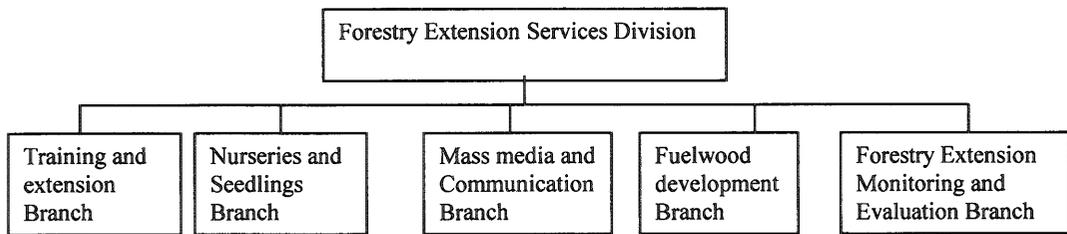


Figure 4: The structure of the FESD

In terms of organizational structure, this is as previously indicated. The structure would be like shown in Figure 4.

It is also worth noting that other organizations (NGOs) have been and continue to be actively involved in Forestry extension. In fact a number of NGO's have been the driving force financially in a number of districts. People's participation has been mainly limited to tree planting on farms and for urban forestry, on own plot. There is little participation of the urban community in tree planting during the tree-planting week. Sensitization may be called for.

In the past, rural communities had working systems of environmental management. People therefore knew what, when and why to do it. There was less constraint on natural resources as compared to today. Modernization has been a major threat to the people's way of life and a direct effect on the natural resources on which our forefathers and mothers have depended for along time. This has therefore brought about new challenges. There is need therefore to approach resource management in a holistic manner so that we are able to preserve the beneficial aspects of the remaining indigenous systems for their non-tangible benefits. As the syllabus for the 8-4-4 education is changed and hopefully improved, provision of forestry education to all institutions of learning around the forest areas may be of utmost importance. Special curricula can be developed for this. In the long run we would have a population that knows more about forestry hence reduce resource we conflicts. It may also impart skills for on-farm conservation and create entrepreneurship among some people particularly in special forest products.

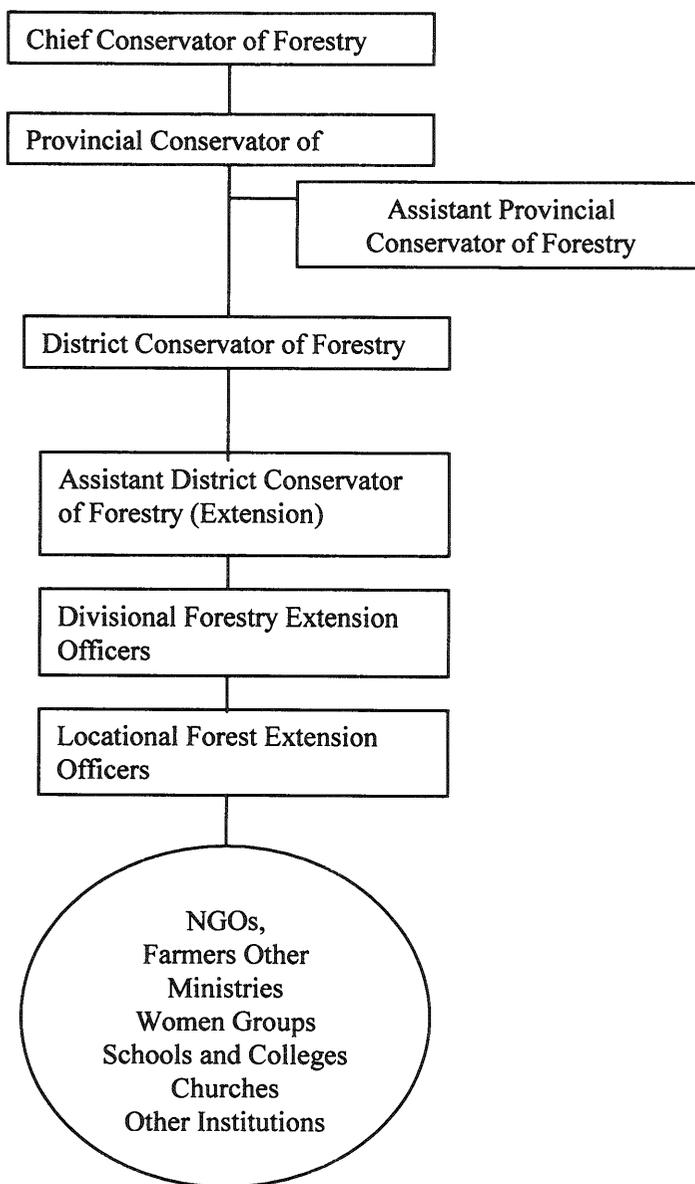


Figure 5: Organizational Structure of the extension services division.

The formal media could play an important role in the dissemination of and preservation of indigenous knowledge by documenting indigenous knowledge through field research, developing information packages, educating the public about the merits of indigenous knowledge and disseminating this information through the print and electronic media. It is sad that the formal media puts great emphasis on political information than on educational information.

In Japan for example, one daily carries a caption and some information on some flora or fauna species almost on a daily basis.

Many actors have been active in trying to assist the local people in resource management and conservation. Assistance has come from Non Governmental Organizations (NGOs), and government extension services where available.

The Permanent Presidential Commission on Soil and Water conservation and Afforestation (PPCSWCA) has for example mounted many campaigns that have contributed to public awareness in soil conservation and tree planting.

Non Governmental Organizations have contributed through: conducting training, workshops and seminars on tree planting, donating seeds, polythene tubes and simple nursery tools, and offering technical advise and making up follow up visits through their extension mechanisms. There are about 75 NGOs involved in tree planting activities. Some have been successful while others have had little impact. One problem with NGOs that needs urgent attention is their employment policies. A lot of money is wasted on the salaries of the "Expatriates" in these NGOs. Up to 80% of their expenditures in sometimes spent on salaries. Cutting down expatriate staff and employing more local staff could redress this. The money saved thus could go into supporting other areas of their work. For example, money saved in dry areas could go into dam construction which complements tree-planting activities. There is a marked difference in the lives of the former and current NGO employees as seen in the kinds of houses and cars they have as compared to civil servants and the recipient communities where they have worked. But little difference is seen in Communitiies where they Served.

6:5 Training in Forestry in Kenya

Moi University

This is the only institution of higher learning in Kenya that offers graduate and postgraduate training in Forestry. Forestry training activities at Moi University dates back to 1986 when the university was established with the Faculty of Forestry and Wild life being the pioneer faculty in the university. Since then, the department of Forestry has grown and now offers graduate courses in Forestry. Prior to the establishment of Moi University, Forestry training was carried out at Nairobi University. Moi University as any other University has also trained students from other parts of East Africa.

Egerton University

This university or college as previously known has been offering training at Diploma level and continues to do so today. Apart from Diploma in Forestry, the university also offers a degree course in Natural resource management which is a closely related to Forestry. This university was first set up as an agricultural college and was immensely successful in this field. With a little improvement in the curriculum of its degree programme, it's my opinion that much better natural resource managers can emerge from here.

Londiani Forestry College

As the name implies, this is a college of the Forestry Department that offers training for low cadre of officers in the Forestry department. Graduates from here are awarded certificates and diplomas in Forestry. Most are employed as Foresters in the Forestry Department. Recently the college is offering higher diploma for its former graduates.

In-service Training

This is offered by several organizations depending on their needs. However of great significance over the last ten years, is the Kenya Japan Social Forestry Training project. Through this project which is a joint Kenya-Japan initiative, over 1,700 Forestry, Agriculture, Education, Social services, Livestock and non Governmental officers have been trained. Officers trained have been drawn from all over the republic, from Provincial to locations through school level. The main subject of training has been Social Forestry and Agroforestry. The courses offered have mainly been geared to promoting tree planting by the rural small-scale farmers. Emphasis was put on creating awareness in other institutions of learning hence the multidisciplinary source of the trainees. With JICA pulling out the training activities at the end of the second phase of the project, KEFRI could still provide training if the government is committed to providing information in forestry. Other courses in forestry could be decentralized to provincial level using farmers training centers and other colleges.

Part VII: International Forestry Cooperation

7:1 International Agreements in Forestry

Kenya has made efforts in international forestry cooperation. She is a signatory to the various International agreements relating to the Environment and has a bearing to forestry.

Agreements are only integrated into national law when ratified. Kenya therefore still has some way to go in this respect.

7:2 Kenya's Role in International Environment Related Bodies.

Kenya is one of the few less developed countries that play a major role in the affairs of the environment.

Apart from being a signatory to a number of treaties, it's the headquarters for UNEP and ICRAF.

She is also a member of a number of bodies that are involved in forestry activities for example IUFRO. There have been and are many donors interested in assisting Kenya in its

Table: 29 Selected International agreements relating to the Environment

Convention	s	r	c	a
Conservation and natural resources		0		
African nature and Natural resources		0		
Ramsar convention -Wet lands		0		
World cultural and natural heritage		0		
CITES-Endangered species		0		
Plant genetic resources		0		
Biological diversity	0			
Atmosphere				
Vienna convention -Ozone layer		0		
Montreal protocol-Ozone	0	0		
UN climate change	0			
MARINE				
London dumping convention		0		
UN law of the Sea		0		

S=signed r=ratified, c=consultative party a=Acceding party

Source: UNEP Environmental Data Report 1993-94

afforestation programs. The total donor support for forestry since independence runs into billions of shillings. However there is little success in all the projects so far undertaken and especially targeting the rural areas. Recently it has become common to abandon a project midstream. The KIFCON and Kenya Finland Forestry projects are clear examples. . How does the local person relate to any other projects in future when such things happen? This is an issue that needs to be addressed.

Table 30: International Conventions

Convention	Year	Cp. S A Others
Wetlands Ramsar	1971	Cp.
World heritage	1972	S
Endangered species (CITES)	1973	Cp.
Bio-diversity	1992	Cp.
Ocean dumping	1972	Cp.
Ship pollution	1978	Cp.
Law of the Sea (a)	1982	Cp.
Ozone layer	1985	S
CFC control	1987	Cp.
Climate change	1992	S
Biological and toxic weapons	1972	Cp.
UNEP regional seas		East African convention
Other Regional Agreements		AFC African Conservation Convention

Cp=Contracting party S=Signatory A=Accedimy party

Source: UNEP Environmental Data Report 1993-94

7:3 Some Specific Donor Funded Programs in Forestry

The projects undertaken so far can be grouped into three follows:

1. Technical support by KEFRI.

This is one of the latest efforts in international forestry cooperation. Under this programme KEFRI through the assistance of JICA has been hosting participants from other African countries. Training has been provided by the Kenya Forestry Seed Center in all aspects of seed technology and the Social Forestry Division. These activities have meant that KEFRI provides the personnel and facilities to carry out the training. It be termed as the greatest achievement of KEFRI since inception. It is anticipated that a total of 16 sub Saharan countries will benefit from this training in KEFRI.

2. Multilateral Cooperation

There have been efforts targeted at multilateral agencies. Among these, FAO and EEC stand out as the biggest benefactors of the forestry sector in Kenya. ICRAF, with its headquarters in Kenya, has benefited the country a lot as much research has been done in Kenya.

3. Bilateral cooperation:

This may be the most common and relatively more successful compared to the former. Bilateral donors have been mainly EU countries and the Asian giant Japan. Some support has also come from Canada, New Zealand and Switzerland. Some of these projects have been very successful particularly when considered against the following:

1. Project type Technical cooperation that consists of dispatch of experts, acceptance of trainees and provision of machinery and equipment. These have been very successful, experts come, trainees go to the donor countries, and machinery and equipment are bought.
2. Grant aid for construction of infrastructure and facilities-KEFRI, Kenya Forestry College Londiani and KWS being examples. A lot of grant support has also gone into construction of Moi University.

It is however regrettable to note that most forestry projects in Kenya have achieved little of their intended objectives. Projects for the rural poor have been the least successful. Some projects have ended prematurely e.g. Embu-Meru-Isiolo (EMI project), KIFCON, NORAD-Turkana project. It is even worse when we consider that though there is willingness to support forestry, the area under forestry in Kenya has continued to diminish from about 8% in 1980 to the current level of less than 3%.

Of all the money spent on Africa, Kenya was one of the leading beneficiaries as she had a fairly stable government since independence.

Table 31: ODA Disbursement in Forestry and Forest Sector 1990

Donor	Total Amount disbursed in US\$ million	Asia	Africa	Latin America
German	194.2	55.7	53.3	85.1
Japan	114.5	99.4	7.1	8.0
USA	75.7	30.3	17.7	27.8
Sweden	62.3	35.0	17.0	10.
Canada	60.0	15.6	29.4	15.0
EEC	44.5	7.0	36.6	0.9
Netherlands	44.3	13.7	18.2	9.4
France	37.4	2.5	33.2	1.7
Others	128.7	47.5	66.2	15.1
Total	758.6	306.7	278.7	173.3

Source: FAO

Of all the money spent on Africa Kenya was one of the leading beneficiaries as she had a fairly stable government since independence.

Part VIII: Forest Policy

8:1 History of the Kenya Government Policy in Forestry

In Kenya, the forests have been in existence even before the migration of the current occupants of the country into the places where they now occupy. However, it important to note that people have always relied on the forest for their livelihood and had developed systems of management that suited their needs and their descendants. Under traditional systems, various communities and councils of elders were in-charge of the various activities that were happening in the forests. Elders set rules of utilization and the rules of conserva-

tion. There were modes of punishment for offenders. We can therefore say that there were policy guidelines though unwritten that governed use and conservation.

The next period is of the entry of the colonialists in the nineteenth century. This was the period when the British pronounced proclamations on what should be done with the forest resources in Kenya. This was coupled with forest gazettelement and introduction of exotic species. Various laws and rules were made and policies were also proclaimed on the basis of the laws that existed at that time.

The next phase was the independence phase, in the 1960's, when the government inherited the rules and the policies that had been put in place by the colonialists. The policies have remained largely unchanged over long periods of time. Improvements have been made but implementation of some of the policies has not been done.

In the 90's there has been a move to try to establish policies that are inline with the modern scientific changes and this is largely by going back to role of the communities living around the forest and the role of the NGOs and the international community in forestry issues. Therefore recently there is a move towards involvement of all stakeholders in forestry matters.

8:2 Policy Framework

The management of forest resources is governed by the Kenya Forest Policy. This is mainly implemented through the Forest Department since most of the forestland falls within the jurisdiction of the gazetted forest areas. The role of the Forest Department and its policy is further complimented by the Wildlife Management and Conservation Act under the relevant act and policy. In 1991 the Forest Department signed a memorandum of understanding for 25 years of joint management of the forestry resources that are common to both institutions.

The policy can not stand-alone. There have to be ways and means of carrying out activities. Therefore, since the colonial era, there have been technical orders, technical notes and the forestry general notes that have provided the technical and scientific basis of carrying out the forestry activities.

8:3 The National Forest Policy

The first policy was written way back in 1957 when Kenya was still under colonial rule. It was subsequently amended in a Forest Policy for Kenya (Government of Kenya 1968). Over the years, many changes have occurred in Kenya, and as such there was need to develop a policy that would be more user friendly and applicable to the modern times. The new policy came into effect in June 1994. Before the publication of these two most important policy

documents, there were certain documents that helped guide the management of forestry resources since the creation of the Forest Department in 1902.

Forest Policy 1968

The objectives.

1. The reservation of forest areas for catchment protection and in terms of soil and water conservation and to provide timber and other forest produce.
2. The protection of forest by strict control of fire and grazing, and by the eradication of private rights over forest.
3. The management of the forest on a sustained yield basis as far as was consistent with primary aims of forest reservation above.
4. The development of forest industry.
5. The provision of adequate funds for implementation of policy.
6. The provision of employment, in particular under the *Shamba system* for re-forestation and forest maintenance.
7. The designation of forest areas to be managed by the County councils and council areas, though these would not include forests of national significance.
8. The establishment of private forests including wood lots, for protection as well as production.
9. The promotion of recreation and the conservation of flora and fauna.
10. The promotion of research and education.

Implementation of the 1968 Forest Policy

This policy focused more on catchment protection and timber production, with strong emphasis on government control of the forestry sector. The majority of the forest have remained relatively intact and still fulfill their role in catchment protection. However most of the objectives have not been met. The policy may not have been a problem. The problem may have been the strategy to implement it.

The 1994 Forest policy

The policy objectives of this current policy are: -

1. Increase the forest and tree cover of the country in order to ensure an increasing supply of forest products and services for meeting the basic needs of present and future generations and for enhancing the role of forestry in socio-economic development
2. Conserve the remaining natural habitats and the wildlife therein, rehabilitate them and conserve their bio-diversity.

3. Contribute to sustainable Agriculture by conserving the soil and water resources by tree planting and appropriate forest management.
4. Support the government policy of alleviation of poverty and promoting rural development, by income based on forest and tree resources, by providing employment and by promoting equity and participation by local communities.
5. Fulfill the agreed national obligations under international environmental and other forestry related conventions and principles.
6. Manage the forest resource assigned for the productive use efficiently for the maximum sustainable benefit, taking into account all direct and indirect economic and environmental impacts; also review the ways in which forests and trees are valued in order to facilitate management decisions.
7. Recognize and maximize the benefits of a viable and efficient forest industry for the national economy and development.

Policy statements.

1. Policy on land management for production and sustainable forestry. The policy statement covers farm forestry, forest plantations on public land, indigenous forest, woodlands and bush lands and the general management principles.
2. Policy on Forest products and industries. The policy statement is concerned with self reliance, priority forest products, rural emphasis, and wood processing and trade in forest products
3. Policy on supportive institutions. This covers issues on improving the efficiency of forest management, institutional development, funding of non-profit forest activities and Non Governmental Organizations and professional associations.
4. Policy on other concerns related to forestry development. This covers coordination with related policies traditional rights and livelihood, gender issues, forestry research, education and training, multiple effects of reforestation and afforestation and Eco-tourism in indigenous forests.

The forest policy can not stand alone without legislative support. There are various Acts of parliament that compliment the forest policy. These are:-

Forest Act, Cap 385 of 1962, revised in 1982 and in 1992.

The Timber Act, Cap 386 of 1972

Wildlife (conservation and management) Act, Cap 376 of 1976

Antiquities and Monuments Act Cap 215 of 1984, which also covers the Kaya forest, found along the coast.

Fisheries Act, Cap 378 of 1989

Agriculture Act, Cap 318 of 1980 revised 1986

Registered land Act, Cap 300 of 1985 revised in 1989

Trust land Act, Cap 288 of 1962 and revised in 1970

Land adjudication Act, Cap 284 of 1968 and revised in 1977

Land Group representatives Act, Cap 287 of 1968 and revised in 1970

The Chiefs Act, Cap 128 of 1970, revised 1988 and may be repealed to be replaced with the Administrative officers act

Trespass Act, Cap 294 of 1963 and revised in 1982.

Part IX: The Future of Forestry in Kenya

It is hard to predict the future of forestry in Kenya. This is because the macro policies are still not in place to give support to micro-policies. Predictions have it that at current rates of exploitation, Kenya's forests will disappear. On the contrary however there is increasing global concern about tropical forest. This may help salvage the forestry sector in Kenya. With adequate donor support and proper leadership, Kenya's forest will survive for many generations to come.

The future is very challenging. There are a many problems in the forestry sector that will need to be addressed before the sector can be on the road to recovery. Currently the rate of deforestation does not match planting. There is also assault on the forest from land hungry politicians and their supporters. With population increase, there is also pressure for agricultural land. The national research institutions in forestry have failed to produce any results on which development policies can be based. The NGOs too have failed to make any breakthroughs. All these factors looked into in totality point to a very gloomy picture of the forestry sector. However there is still hope on forestry as practiced by farmers own initiative and the following priorities listed may also help awaken those responsible to the realities facing forestry.

Priorities for the Governments of Kenya.

1. Increase support for small farms by providing technical advice incentives.
2. Promote large scale Agriculture more carefully as most of it may promote monoculture, which lead to loss of genetic diversity. In western Kenya, the government should for example control the expansion of sugar cane zones in a manner that does encourage conservation of tree species.

3. Develop an integrated land use policy that may replace any conflicting land use policies in existence. There are many laws related to land in Kenya, which may benefit from harmonization.
4. Revise and publish forest policies, but these have to be closely linked to other conservation related policies for example the Wild life conservation and management policy. This is already underway.
5. Strengthen forest departments considering their potential contribution to the GNP. The civil service reform programme should also take into consideration the Forestry needs.
6. Revise concession agreements and fees to give forest products the right value. This may be painful as it may hurt the poor of the poor but reforms are always painful.
7. Develop a national conservation strategy incorporating as many players as possible. The government is still far off in this sense.
8. Ensure a strong environment ministry. There still need for professionalism in this sense.
9. Improve monitoring of natural resources. This can be done jointly by various departments.
10. Cooperate in devising new conservation funding mechanisms. Funding of forestry activities may have to come under one body for proper coordination of Forestry activities.
11. Revise social and economic policies. This is very important and may be addressed as the constitution is reviewed.
12. Increase environmental component of national development strategies.
13. Improve planning techniques. This calls for involvement of the various stakeholders in forestry and especially the people who stay near and use the forests.
14. Reform land tenure to have equitable distribution of land resources. There is still a long way to cover in this area.

Priorities for governments of developed countries.

1. Support positive developments in tropical countries. Development should be approached with an open heart and not with hidden agendas as is the case now.
2. Avoid negative or discriminatory policies especially those relating to trade, as they tend to impoverish developing countries. This may involve support to wider sectors without discrimination against some countries.
3. Support new funding mechanisms which help to promote rural and industrial development. There should be respect of local knowledge and talent.

Priorities for international agencies

1. Improve environmental procedures. This may call for a more scientific approach in carrying out activities.
2. Extend environmental accounting. This will help capture all economic roles of forestry in national development.
3. Ensure consistent policies. There should be more transparency on the side of NGOs so at donor funds are not wasted.
4. Establish a continuous global satellite monitoring system for the tropical forests. This will go along way in helping countries that may not have the capability to monitor what is happening in their borders.

Appendix 1: A brief Overview of the Forest Act cap 385.

The Forest Act is under review from time to time due to the changing socio-economic situation of the country. However this is a brief outline of the contents of the Act.

An Overview of the forests Act cap 385 of the laws of Kenya

The Laws of Kenya

Revised edition 1992

Arrangement of sections

1. Short title
2. Interpretation.
3. (repealed)
4. Forest areas.
5. (Repealed)
6. Nature reserves.
7. Licensees
8. Various prohibitions
9. Counterfeiting or unlawfully affixing marks etc.
10. Compounding offences.
11. Search , arrest etc.
12. Rewards to informer.
13. Presumption concerning forest produce.
14. Penalty.

15. Rules.

Chapter 385
The Forests Act

Commencement 1st March 1942

An act of parliament to provide for the establishment, control, and regulation of Central forests, forests and forest areas in the Nairobi area and on unalienated government land.

1. This act may be cited as the Forests Act.
2. Interpretation. This defines cattle, Director of forestry,⁸ firewood, forest area, forest officer, Forest produce, timber, trees and unalienated government land.
3. Repealed by legal notice 236/1964.
4. Forest areas. This gives the minister in-charge the power to declare forest areas.
5. Repealed by legal notice 236/1964.
6. Nature reserves. This gives the minister the power to create nature reserves within the forest areas. S/he may also declare that an area is no longer a nature reserve.
7. Licenses. This gives the authority for the Director of Forestry to issue licenses.
8. Various prohibitions. This gives the terms and conditions under which activities are prohibited in the forest.
9. Counterfeiting or unlawfully affixing marks etc. This creates the situation where an offense would be deemed to have been done if these activities are carried out.
10. Compounding offenses. This looks at the offenses that may be done by illegal users and the penalty.
11. Search arrest etc. This considers when it may be necessary for a search to be done and for arrests to be made.
12. Rewards to informers. This looks at the rewards that are to be given in case one provides information leading to the arrest of an offender.
13. Presumption concerning forest produce. This presupposes that a product is from the forest unless otherwise proven.
14. Penalty. This sets out the penalty for not complying with the provision of this act.
15. Rules. This gives the minister the powers to make rules concerning the forest that are covered by this act.

Subsidiary Legislation

⁸This title was changed to Chief Conservator of Forestry in 1997 along with other officers' titles.

This covers areas that are listed as Nature reserves. These are Kisere, Forest station, Yala River, Arabuko sokoke, North Nandi, Uaso Narok, Southwestern Mau, and Mrima nature reserves.

The Forests (General) Rules

This section covers definitions of cubic meter, defect allowance, Director of forestry, forest, ground scaling, licensee, mid diameter, pruned logs, royalty sawmill, and stumpage sale. It goes ahead to list the royalty payable for different items under the various species available in the forests.

The Forests (closing) rules.

This looks at when the forest may be completely closed to human traffic and the exceptions thereto.

The Forests (Fish hatcheries) Rules

These rules give the minister the powers to establish fish hatcheries in the central forests.

The Forests (Controlled entry) Rules

These deal with controlled entry into the forest and there are forests listed under this schedule to which these rules may apply.

The Forests (closing of roads) Rules.

These rules govern the situation under which roads traversing the forest can be closed. This is done by the Director or by an officer appointed by him.

The Forests (Nairobi Arboretum) Rules.

These rules govern and apply to the Nairobi arboretum.

Other rules that are specific to forest areas are Nandi, Elgeyo, Tugen-Kamasia, West Pokot, Kakamega, Meru, and Kwale.

The Forests (Workmen's residences) Rules.

These rules look at the welfare of workmen, when in-service and out of service for given periods of time. These rules also consider what should be done in case of the death of a workman.

Appendix 2: Easy Look Up-Example of Tree Species and Families in Kenya

Species	Common name	Family
<i>Anacardium occidentale</i>	Mkanju (Swa) /Cashew nut	Anacardiaceae
<i>Mangifera indica</i>	Mwembe (Swa) /Mango	
<i>Ozoroa insignis</i>	Mwaalika(Swa) /Tropical Resin tree	
<i>Pistacia aethiopica</i>	Muheheti (Kikuyu)	
<i>Rhus natalensis</i>	Muthigi (Kikuyu)	
<i>Acokanthera oppositifolia</i>	Mururu (Kikuyu)	Apocynaceae
<i>Adenium obesum</i>	Mdiga/Mdagu(Swa) Desert Rose	
<i>Carisa edulis</i>	Mukawa (Kikuyu)/Carisa	
<i>Nerium oleander</i>	Oleander	
<i>Plumeria rubra</i>	Frangipani	
<i>Cussonia holstii</i>	Muroha (Kikuyu)/Cabbage Tree	Araliaceae
<i>Cussonia spicata</i>	Mwenyiere (Kikuyu) /Elephants toothbrush	
<i>Polyscias kikuyuensis</i>	Mutati (Kikuyu)/ Parasol tree	
<i>Schefflera actinophylla</i>	Queensland Umbrella Tree	
<i>Araucaria angustifolia</i>	Parana Pine	Araucariaceae
<i>Araucaria bidwillii</i>	Bunya Bunya Pine	
<i>Araucaria columnaris</i>	Cooks Araucaria	
<i>Araucaria cunninghamiana</i>	Hoop pine	
<i>Araucaria heterophylla</i>	Norfolk Island pine	
<i>Balanites aegyptica</i>	Ol-ngoswa(Maasai)/Desert date	Balanitaceae
<i>Balanites glabra</i>		
<i>Balanites wilsoniana</i>		

Species	Common name	Family
<i>Jacaranda mimosifolia</i>	Jacaranda	Bignoniaceae
<i>Kigelia africana</i>	Muratina (Kikuyu)	
<i>Markhamia lutea</i>	Olusiola (Luhya) /Markhamia	
<i>Spathodea campanulata</i>	Omutsulio (Luhya) Nandi flame	
<i>Tecoma stans</i>	Tecoma	
<i>Adansonia digitata</i>	Mbuyu (Swa)/ Baobab	Bombacaceae
<i>Ceiba pentandra</i>	Msufi (Swa) /Kapok Tree	
<i>Chorisia speciosa</i>	Chorisia/ Bombax	
<i>Cordia africana</i>	Muringa(Kikuyu)/Large leaved Cordia	Boraginaceae
<i>Cordia ovalis</i>	Mukuu (Kikuyu)Sand paper Cordia	
<i>Cordia sebestena</i>	Geiger Tree	
<i>Cordia subcordata</i>	Mbongolo (Swa)	
<i>Ehretia cymosa</i>	Murembu (Kikuyu)	
<i>Commiphora africana</i>	Iguu(Kamba)/Mbambara(Swa)	Burseraceae
<i>Acrocarpus fraxinifolius</i>	Indian Ash, Australian Ash, Shingle Tree	Caesalpinioideae
<i>Azelia quanzensis</i>	Mbambakofi(Swahili)	
<i>Bauhinia tomentosa</i>	Msaponi	
<i>Bauhinia variegata var variegata</i>	Orchid Tree	
<i>Caesalpinia decapetala</i>	Mubage (Kikuyu) Mauritius Thorn	
<i>Warbugia ugandensis</i>	Muthiga(Kikuyu) Kenya green heart	Canellaceae
<i>Boscia coriacea</i>	Mnafisi (Swa) Boscia	Capparaceae

FORESTS AND FORESTRY IN KENYA (L. MAKANJI)

Species	Common name	Family
<i>Maerua triphylla</i> spp.johannis	Mutumburu (Kikuyu)	
<i>Casuarina cunninghamiana</i>	Casuarina/Australian Beef wood	Casuarinaceae
<i>Casuarina equisetifolia</i>	Mvinje (Swa) Whistling pine	
<i>Catha edulis</i>	Muirungi (Kikuyu) Miraa, Khat	Celastraceae
<i>Elaeodendron buchananii</i>	Mutanga (Kikuyu) Elaeodendron	
<i>Mystroxydon aethiopicum</i>	Rurigi (Kikuyu)	
<i>Maytenus senegalensis</i>	Muthuthi (Kikuyu)	
<i>Combretum molle</i>	Mukura (Kikuyu)	Combretaceae
<i>Combretum schumannii</i>	Mgurure (Swa)	
<i>Terminalia brownii</i>	Muhutu (Kamba)	
<i>Terminalia catappa</i>	Mkungu (Swa)/Indian almond	
<i>Terminalia kilimandscharica</i>	Muhuku (Kamba)	
<i>Brachylaena huillensis</i>	Muhuhu (Swa)/Silver Oak	Compositae
<i>Tarchonanthus camphoratus</i>	O-leleshwa (Maasai)	
<i>Ipomoea arborescens</i>	Morning Glory Tree	Convolvulaceae
<i>Cupressus lusitanica</i>	Mexican cypress	Cupressaceae
<i>Cupressus macrocarpa</i>		
<i>Cupressus arizonica</i>		
<i>Cupressus funebris</i>		
<i>Juniperus procera</i>	Mutarakwa(Kikuyu)/ Pencil cedar	
<i>Encephalartos hildebrandtii</i>	Mkwanga,Msapo(Swa) /Cycad	Cycadaceae
<i>Diospyros abyssinica</i>	Muiruthi (Kikuyu)/Giant Diospyros	Ebenaceae
<i>Euclea divinorum</i>	Mukunyai(Kikuyu)/Euclea	

Species	Common name	Family
<i>Croton dichogamus</i>	Kererwa (Kikuyu)/Orange leaved Croton	Euphorbiaceae
<i>Croton macrostachyus</i>	Mukindu wa njora (Kikuyu)	
<i>Croton megalocarpus</i>	Mukinduri(Kikuyu)/Croton	
<i>Euphorbia candelabrum</i>	Muthuri (Kiku)/Candelabra Euphorbia	
<i>Euphorbia tirucalli</i>	Eshikhoni(Luhya)/Finger Euphorbia	
<i>Dovyalis abyssinica</i>	Mukambura(Kikuyu)	Flacourtiaceae
<i>Dovyalis caffra</i>	Kei-apple	
<i>Oncoba spinosa</i>	Mwage(Kikuyu)/Fried egg tree	
<i>Oncoba routledgei</i>		
<i>Rawsonia lucida</i>	Mutendera (Kikuyu)/Rawsonia	
<i>Trichocladus ellipticus</i>	Mubarakira (Kikuyu)/ White witch Hazel	Hamamelidaceae
<i>Apodytes dimidiata</i>	Muganyoni(Kikuyu)/Pear wood	Icacinaceae
<i>Ocotea usambarensis</i>	East African Camphor wood	Lauraceae
<i>Persea americana</i>	Avocado	
<i>Aloe bainesii</i>	Tree Aloe	Liliaceae
<i>Aloe volkensii</i>		
<i>Dracaena ellenbeckiana</i>	Kedong Dracaena	
<i>Dracaena steudneri</i>	Ithare(Kikuyu)/Steudners dracaena	
<i>Buddleia polystachya</i>	Ruti (Kikuyu)/Buddleia	Loganiaceae
<i>Nuxia congesta</i>	Muchorwe (Kikuyu)	
<i>Strychnos henningsii</i>	Muteta (Kikuyu)/Coffee Bean Strychnos	
<i>Strychnos usambarensis</i>	Mutikani (Kikuyu)	
<i>Strychnos spinosa</i>	Mtonga(Swa)	

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Species	Common name	Family
<i>Lagerstroemia indica</i>	Pride of India	Lythraceae
<i>Lawsonia inermis</i>	Mkokoa, Mhina (Swa)/Henna	
<i>Michelia champaca</i>	Orange champak	Magnoliaceae
<i>Michelia fuscata</i>		
<i>Hibiscus schizopetalus</i>	Coral hibiscus	Malvaceae
<i>Lagunaria patersonii</i>	Norfolk Island Hibiscus	
<i>Azadirachta indica</i>	Mwarubaini/Neem	Meliaceae
<i>Ekebergia capensis</i>	Mununga (Kikuyu)/Dogplum	
<i>Melia azedarach</i>	Bead tree/Persian lilac/Chinaberry	
<i>Melia volkensii</i>	Mukau (Kikuyu)/Melia	
<i>Toona ciliata</i>	Indian Mahogany/Toona Tree	
<i>Acacia brevispica</i>	Mwikunya(Kikuyu)/Wait a bit thorn	Mimosoideae
<i>Acacia drepanolobium</i>	Whistling thorn/Ant-galled Acacia	
<i>Acacia hockii</i>	Luua (Maasai)	
<i>Acacia mellifera</i>	Muthia(Kamba) Hook thorn	
<i>Acacia nilotica</i>	Mgunga(Swa)	
<i>Artocarpus altilis</i>	Mshelisheli (Swa)/Breadfruit	Moraceae
<i>Artocarpus heterophyllus</i>	Mfenesi(Swa)	
<i>Milicia excelsa</i>	Mvule(Swa)	
<i>Ficus benjamina</i>	Java fig/Weeping fig	
<i>Ficus elastica</i>	Indian rubber plant	
<i>Moringa oleifera</i>	Mzunze, Mrongo(Swa)/Drumstick Tree	Moringaceae
<i>Moringa stenopetala</i>		
<i>Callistemon citrinus</i> var <i>splendens</i>	Bottle brush	Myrtaceae

Species	Common name	Family
<i>Callistemon rigidus</i>		
<i>Eucalyptus ficifolia</i>	Flowering gum	
<i>Eucalyptus saligna</i>	Sydney blue gum	
<i>Eucalyptus camaldulensis</i>	Red river Gum	
<i>Ochna holstii</i>	Mungarima (Kikuyu) /Forest Ochna	Ochnaceae
<i>Ochna ovata</i>	Butter cup bush	
<i>Chionanthus battiscombei</i>	Musharagi (Kikuyu)	Oleaceae
<i>Fraxinus pennsylvanica</i>	Mexican ash, Green ash	
<i>Olea africana</i>	Mutamaiyu (Kikuyu) Brown olive	
<i>Olea hochstetteri</i>	Musharagi(Kikuyu)/East African Olive	
<i>Olea welwitschii</i>	Mutukuyu (Kikuyu)/Elgon Olive	
<i>Borassus aethiopum</i>	Mvumo (Swa) /African Fan palm	Palmae
<i>Cocos nucifera</i>	Mnazi (Swa)/coconut palm	
<i>Hyphaene compressa</i>	Mkoma(Swa)/Doum palm	
<i>Phoenix reclinata</i>	Mukindu(Kikuyu)/Senegal palm	
<i>Pandas kirkii</i>	Mkadi (Swa)/Walking palm	Pandanaceae
<i>Calpurnea aurea</i>	Muchungiri(Kikuyu)/E. African laburnum	Papilionoideae
<i>Craibia brownii</i>	Mukubu (Kikuyu)/Craibia	
<i>Dalbergia melanoxydon</i>	Mpingo(Swa)/African Ebony	
<i>Erythrina abyssinica</i>	Omurembe(Luhya)Flame tree	
<i>Millettia dura</i>	Muhatia (Kikuyu)/Millettia	
<i>Pinus patula</i>	Mexican Weeping Pine	Pinaceae
<i>Pinus radiata</i>	Monterey Pine	

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Species	Common name	Family
<i>Pinus caribea</i>	Cuban Pine	
<i>Podocarpus falcatus</i>	Podo	Podocarpaceae
<i>Podocarpus latifolius</i>	Podo	
<i>Faurea saligna</i>	Mutorothua(Kikuyu)/Beech wood	Proteaceae
<i>Grevillea robusta</i>	Grevillea	
<i>Hakea saligna</i>		
<i>Macadamia tetraphylla</i>	Macadamia nut	
<i>Maesopsis eminii</i>	Muterere(Luhya)	Rhamnaceae
<i>Scutia myrtina</i>	Murangari (Kikuyu)/Cat thorn	
<i>Ziziphus abyssinica</i>		
<i>Ziziphus mucronata</i>	Mkunazi (Swa)/Buffalo thorn	
<i>Cassipourea malosana</i>	Muthaithi (Kikuyu)/Pillar wood	Rhizophoraceae
<i>Rhizophora mucronata</i>	Mkoko(Swa)/Red Mangrove	
<i>Cotoneaster pannosa</i>	Chinaberry	Rosaceae
<i>Eriobotrya japonica</i>	Mutsabibu (Luhya)/Loquat	
<i>Hagenia abyssinica</i>	Muthithiku(Kikuyu)/Hagenia	
<i>Prunus africanum</i>	Muiri (Kikuyu)/Red stinkwood	
<i>Prunus puddum</i>	Himalayan Bird cherry	
<i>Canthium keniensis</i>	Mubiru-wathi (Kikuyu)/Wild coffee	Rubiaceae
<i>Coffea arabica</i>	Arabian coffee	
<i>Gardenia ternifolia</i>	Mukumuti (Kamba)	
<i>Rothmannia urcelliformis</i>	Mukombokombo(Kikuyu)	
<i>Terenna graveolens</i>	Muthigetu(Kikuyu)	

Species	Common name	Family
<i>Calodendrum capense</i>	Muroroa(Kikuyu)/Cape chestnut	Rutaceae
<i>Clausena anisata</i>	Mutathi(Kikuyu)/Clausena	
<i>Teclea nobilis</i>	Teclea	
<i>Teclea simplicifolia</i>	Munderendu(Kikuyu)/Teclea	
<i>Teclea trichocarpa</i>	Furry fruited Teclea	
<i>Dodonea angustifolia</i>	Murema-muthua(Kikuyu)/Sand Olive	Sapindaceae
<i>Filicium decipiens</i>	Kamiti (Kikuyu) Thika palm	
<i>Pappea capensis</i>	Mubaa(Kamba)/Pappea	
<i>Manilkara discolor</i>	Mugambwa (Kikuyu)/Manilkara	Sapotaceae
<i>Mimusops kummel</i>	Red milkwood	
<i>Datura suaveolens</i>	Moonflower/Angels trumpet	Solanaceae
<i>Solanum macranthum</i>	Brazilian Potato tree	
<i>Solanum mauritanium</i>	Asian Bug Tree	
<i>Brachychiton acerifolium</i>	Australian flame	Sterculiaceae
<i>Brachychiton populneum</i>	Australian Bottle Tree	
<i>Dombeya goetzenii</i>	Mukeu(Kikuyu)/Dombeya	
<i>Dombeya rotundifolia</i>	Mutoo(Kikuyu)/White Dombeya	
<i>Ravenala madagascariensis</i>	Travellers palm	Strelitziaceae
<i>Strelitzia augusta</i>	Great white Strelitzia	
<i>Grewia bicolor</i>	Mulawa(Kamba)	Tiliceae
<i>Grewia similis</i>	Mutheregendi (Kikuyu)	
<i>Obetia pinnatifida</i>	Stinging Nettle tree	Urticaceae

FORESTS AND FORESTRY IN KENYA (L. MAKANJI)

Species	Common name	Family
<i>Clerodendrum myricoides</i>	Munjuga-iria (kikuyu) / Butterfly flower	Verbanaceae
<i>Duranta repens</i>	Pigeon berry	
<i>Lantana camara</i>	Lantana/Curse of India	
<i>Vitex keniensis</i>	Meru oak	

Appendix 3: Forest Areas in Kenya and their Status and Sizes

FOREST	STATUS	AREA (Ha)
Aberdare	G	103,315
Arabuko sokoke	G	41,676
Bahati	G	10,101
Baomo East	NR	16
Baomo South	NR	206
Boni	G	11,537
Buda	G	670
Bunyala	G	808
Buyangu	G	3,857
Chebartigon	G	102
Cheboit	G	2,527
Chemorogok	G	1,338
Chemurokoi	G	3,979
Chepalungu	G	9,565
Chepkuchumo	G	327
Cherial	G	40
Chyulu range	NP ¹	7,945
Congolani	NR	56
Dagoretti	G	774
East Ngamba	G	1,205
Eastern Mau	G	66,067
Eburu	G	8,736
Eldoret	G	152
Embakasi	G	591
Embobut	G	21,689

G=Gazetted

NR=National Reserve

¹ National Park

FORESTS AND FORESTRY IN KENYA (L. MAKANJI)

Endau	G	6,915
Figi	NG ²	1
Fururu	NG	17
Gaikuyu	G	3,258
Gembe Hills	G	2,716
Gonja	G	861
Goye	NG	10
Guru East	NR	6
Guru North	NR	42
Guru South	NR	66
Gwasi	NG	4,958
Ikilisa	G	80
Imba-Chakuyu	G	750
Jombo	G	887
Kabarak	G	1,395
Kabiok	G	14
Kabonge	NG	29
Kaisungor	G	1,089
Kakamega	G	17,838
Kalimani	G	192
Kamatira	G	1,944
Kamiti	G	171
Kapasret	G	1,008
Kapchemutwa	G	8,874
Kapchorwa Block I	G	141
Kapchorwa Block IV	G	141
Kapkanyar	G	5,764
Kapolet	G	1,625
Kaptagat	G	12,985

2 Non-Gazetted

Kaptaroi	G	318
Kaptimom	G	96
Karura	G	1,045
Katende	G	933
Katimok	G	2,019
Kenze	G	189
Kerrer	G	2,241
Kessop	G	1,971
Ketnwan	G	44
Kiagu	G	1,361
Kiambere	NG	693
Kiambu	G	149
Kiangombe	NG	1,427
Kianjiru	NG	1,025
Kibithewa	G	239
Kieiga	G	573
Kierera	G	777
Kiganjo	G	172
Kijabe hill	G	740
Kijege	G	3,303
Kikingo	G	1,203
Kikuyu escarpment	G	37,619
Kilala	G	161
Kilombe hills	G	1,534
Kilulunyi	NG	1
Kilungu	G	145
Kimojoch	G	762
Kingatua	G	62
Kinyesha Mvua	NG	57
Kinyo	G	339

FORESTS AND FORESTRY IN KENYA (L. MAKANJI)

Kiongwani	G	37
Kioo	G	44
Kipipiri	G	5,077
Kipkabus	G	6,760
Kipkunurr	G	15,892
Kiptaberr	G	12,801
Kirima	NG	512
Kirimiri	NG	174
Kisere	NR	457
Kitalale	G	2,070
Kitale Township	G	343
Kitere	G	11
Kiteta	G	28
Kithendu	G	248
Kitondu	G	1,093
Kitoo	G	37
Kitumbuni	G	74
Kiu (Ngungu)	G	83
Kotim Range	NG	3,332
Kulundu	NG	0
Kyai	G	109
Kyawe	NG	61
Kyemundu	G	147
Lambwe	NG	2,455
Lariak	G	4,988
Lelan	G	14,516
Lembus	G	16,927
Leroghi	G	91,794
Loima Hills	G	9,520
Loita	NG	41,480

Loitoktok	G	690
Londiani	G	106
Lower Imenti	G	2,477
Lugari	G	2,193
Lungi	G	33,001
Lusoi	G	268
Maasai Mau	NG	46,373
Maatha	G	632
Macha	NG	18
Magumo North	G	240
Magumo South	G	364
Mai	NG	494
Maji Mazuri	G	7,809
Makere West	NR	18
Makongo	G	2,615
Makuli Nguuta	G	1,676
Maluganji	G	1,685
Maranga	NG	238
Marenji	G	1,519
Marmamet	G	22,648
Maroni East	NR	203
Marop	G	211
Marsabit	G	15,778
Mataa	G	48
Mathews Ranges	G	97,392
Mau Narok	G	810
Mbili	NG	12
Mbooni North	G	40
Mbooni South	G	207

FORESTS AND FORESTRY IN KENYA (L. MAKANJI)

Mchelelo East	NR	31
Mchelelo West	NR	12
Mchungunyi	NG	8
Mdengu	NG	1
Menengai	G	5,737
Metkei	G	1,958
Mkongani North	G	1,165
Mkongani West	G	1,408
Mlaba	G	721
Mnazini	G	115
Mnjonyi	NG	131
Modogache	NG	4
Molo	G	915
Momandu	G	144
Mosegem	G	205
Motunyi Hill	NG	1,973
Mount Elgon	G	73,089
Mount Kenya	G	1,995,338
Mount Kulal	NG	45,942
Mount Londiani	G	30,152
Mount Nyiro	G	45,496
Mrima	G	390
Mtarakwa	G	110
Mtege	NG	1
Mugugu	NG	225
Mukobe	G	747
Mukogodo	G	29,931
Mumbaka	G	444
Munguni	G	189
Muringato Nursery	G	24
Muruai	NG	717

Museve	NG	54
Mutejwa	G	1,318
Mutharanga	G	293
Mutiluni	NG	567
Mutito	G	1,975
Mutula	G	578
Muumoni	NG	11,031
Mwachi	G	381
Mwachora	NG	6
Mwaganini	NG	35
Mwakamu A	NG	1
Mwakamu B	NG	1
Mwandongo	NG	705
Nabkoi	G	3,033
Nairobi Arboretum	G	30
Nakuru	G	631
Namanga Hill	G	11,904
Namuluku	G	10
Nanyungu	G	22
Ndare	G	5,627
Ndatai	G	15
Ndiwenyi	NG	5
Ndotos range	G	93,205
Nduluni Kalani	G	106
Ngaia	G	4,314
Ngamba (Trust)	G	1,141
Ngangao	NG	149
Ngomeni	NG	0
Ngong Hills	G	3,081
Ngong Road	G	1,116

FORESTS AND FORESTRY IN KENYA (L. MAKANJI)

Njuguni	G	1,987
Njukiini East	NG	110
Njukiini West	NG	195
North Nandi	G	11,345
Nothern Tinderet	G	26,285
Nthangu	G	845
Ntugi	G	1,386
Nuu	G	2,532
Nyambeni	G	5,453
Nyamweru	G	803
Nyeri	G	1,214
Nyeri Hill	G	200
Nyeri Municipal	G	12
Nzau	G	1,001
Oi Arabel	G	9,738
Oi Bolossat	G	3,269
Oi Lengishu	NG	4,674
Oi Pusimoru	G	17,258
Ololua	G	639
Pemwai	G	132
Perkerra Catchment	G	4,414
Rangwe (Kaksingiri)	NG	1,011
Ronge	NG	315
Rumuruti	G	6,551
Saimo	G	727
Sanao	G	292
Sekenwo	G	863
Sekerr	NG	7,890
Sehendu	G	804
Shimba Hills	G	19,120

Sifa East	NR	229
Sifa West	NR	10
Sogotio	G	3,555
Sokta	G	170
South Laikipia	G	3,500
South Nandi	G	19,568
South West Mau	G	84,129
Southern Mau	G	128
Susu	NG	2
Tambaras	G	475
Taresia	G	375
Thunguru hills	G	554
Thuuri	G	732
Timboroa	G	5,913
Tinderet	G	28,167
Tingwa hills	G	905
Toropket	G	120
Transmara	G	34,457
Tulimani	G	328
Tumeya	G	577
Turbo	G	10,814
Tutwon	G	11
Uaso Narok	G	1,996
Upper Imenti	G	10,402
Ururu	G	438
Utangwa	G	56
Utunene	G	174
Waiya	G	300
Wanga	G	95
Weni Mbogo	NG	3

FORESTS AND FORESTRY IN KENYA (L. MAKANJI)

Weni Mwana	NG	6
Wenje East (Central)	NR	180
Wenje East (North)	NR	191
Wenje East (South)	NR	53
West Molo	G	277
western Mau	G	22,748
Witu	G	4,002
Yale	NG	22

Appendix 4: Land Use Data for Some sub-Saharan Countries.

Country	Area Sq. Km	% Cultivated	% Pasture	% Forest wood land
Angola	1,246,700	3	23	43
Benin	112,622	16	4	33
Botswana	575,622	2	73	2
Burkina Faso	274,122	10	36	25
Burundi	27,834	47	33	2
Cameroon	475,500	15	17	53
Cape Verde	4,033	10	6	0
Central African Republic	624,977	3	5	58
Chad	1,284,700	2	35	10
Comoro	2,238	43	7	16
Congo	342,000	2	29	62
Djibouti	23,000	9	0	0
Equatorial Guinea	28,051	8	4	47
Ethiopia	1,023,050	11	37	23
Gabon	267,667	2	18	75
Gambia	10,689	15	8	17
Ghana	238,305	12	14	36
Guinea	245,855	6	12	42
Gun-Bissau	36,125	8	35	30
Ivory Coast	322,463	12	9	24
Kenya	582,644	4	6	6
Lesotho	30,344	10	66	0
Liberia	111,370	3	3	34
Madagascar	594,180	5	58	26
Malawi	117,112	20	16	39
Mali	1,240,142	2	24	7

FORESTS AND FORESTRY IN KENYA (L. MAKANJI)

Mauritania	1,030,700	0	38	15
Mauritius	1,865	58	4	31
Mozambique	784,754	4	55	19
Namibia	824,293	1	64	22
Niger	1,267	3	7	2
Nigeria	923,850	34	23	16
Reunion	2,515	22	4	35
Rwanda	26,330	38	16	19
Sao Tome and Principe	964	ND	ND	ND
Senegal	196,722	27	29	30
Seychelles	453	25	0	18
Sierra Leone	72,278	25	31	29
Somalia	630,000	2	45	14
South Africa	1,184,827	11	65	3
Sudan	2,505,815	5	22	19
Swaziland	17,366	8	66	6
Tanzania	939,762	5	37	45
Togo	56,785	25	4	26
Uganda	236,578	28	21	25
Zaire	2,345,410	3	4	75
Zambia	752,617	7	47	39
Zimbabwe	390,759	7	12	61

Adapted from Biodiversity in Sub Saharan Africa and its Islands. IUCN.1990.

ND= No Data

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和 文 要 旨

天然林および人工林を合計したケニアの森林面積はおよそ164万 ha である。これは国土面積の3%に相当する。森林は西部、山岳、乾燥、沿岸の4地帯に区分され、気候の違いおよび人為的な影響の強弱を反映して、それぞれの樹種の多様性と構成が異なる。いずれにおいてもこれらの森林は広く一般の人々に、またより直接的には地域住民に、有形・無形の恩恵をもたらしている。前者の事例として生物資源の保全などを通して利益をもたらし、また後者としては木材、小径木、燃材、果実、飼料、蜂蜜、薬草などを提供する。

本研究の目的はケニアの森林および林業の現状を紹介することにある。ケニアの林業について部分的に触れた書物はこれまでに多数見られたが、ここでは断片的な情報をまとめてほぼ全分野を網羅することを企画した。その際に、改革が望ましいと思われる点に関しては著者の意見も述べた。ここで取り上げるのは、森林、森林経営システム、森林所有の概要である。中でもケニアの造林は、比較的長い歴史を有していることから詳細に述べた。そのほかに、木材の需要と供給、林業部門に対する外部からの支援、林業への国際協力、森林政策についても説明している。そして最後に、ケニアの森林が永続できるよう、ケニア政府のみならず、NGOを含む国際社会がこれから取るべき行動について若干述べた。

著者はこの研究が、ケニアの森林および林業についてその大枠を把握したい者、またケニアやそれ以外の地域で林業を勉強する学生諸君の役に立つことを希望するものである。