THE STATE OF THE WORLD's FOREST GENETIC RESOURCES

COUNTRY REPORT

KENYA

This country report is prepared as a contribution to the FAO publication, The Report on the State of the World's Forest Genetic Resources. The content and the structure are in accordance with the recommendations and guidelines given by FAO in the document Guidelines for Preparation of Country Reports for the State of the World's Forest Genetic Resources (2010). These guidelines set out recommendations for the objective, scope and structure of the country reports. Countries were requested to consider the current state of knowledge of forest genetic diversity, including:

- Between and within species diversity
- List of priority species; their roles and values and importance
- List of threatened/endangered species
- Threats, opportunities and challenges for the conservation, use and development of forest genetic resources

These reports were submitted to FAO as official government documents. The report is presented on www. fao.org/documents as supportive and contextual information to be used in conjunction with other documentation on world forest genetic resources.

State of Forest Genetic Resources in Kenya

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EXECUTIVE SUMMARY

Kenya's forest resources are of immense importance for the environmental and ecosystem services they provide, for their contribution to economic development, for their contribution to rural livelihoods. The contribution of forests in water catchments is critical to Kenya's rural and urban water supplies, and approximately 70% of power is hydro generated. Much of Kenya's biodiversity and wildlife resources depend on forests, woodlands and bushland forest, and are a major factor in attracting tourism. A large rural population depends on woodland and bush resources to provide firewood, charcoal and other forest products which are critical to rural livelihoods.

The ecosystem services provided by forests are crucial for agriculture that is the mainstay of Kenya's economy and the sustainability and growth of the sector is crucial to the country's overall economic and social development. However the destruction of forests in Kenya over the past decade has greatly affected the performance of the agricultural sector contributing to itself failure to ensure food security. This trend has led to increased incidences of food insecurity, raised poverty levels, declining incomes, loss of employment and a shift from self-sufficiency to reliance on importation and food aid. The same impact has also been observed in other sectors too such as increasing reliance on electricity generated through thermal plants.

Kenya has a rich plant diversity held by a range of habitats. There is an estimated total of over 7 000 plant species growing naturally in the country among them 1100 tree species. Of these, about 475 are national endemics while 258 are threatened. The diversity of forest genetic resources (FGR), like diversities of other life forms in Kenya has in the recent past been on the decline due to genetic erosion brought about mainly by desertification, population pressure on land, changes in land use, over-exploitation, and environmental-insensitive development policies. Although no comprehensive study has been undertaken to quantify the level of genetic erosion, reports indicate that over the last decade, a lot of genetic erosion has taken place mainly due to indigenous forests clearance and degradation.

In situ and on-farm conservation instruments have unfortunately not been fully utilized to enable the conservation of existing diversity. For instance, human population increases and subsequent increase in demand for plant-based products and land for settlement and farming continues to threaten wild flora thereby rendering these conservation strategies ineffective. Adoption and promotion of exotic and preference for fast growing tree species has led to the decline in on-farm tree species diversity.

Although *ex situ* conservation is undertaken, it is still far behind. The germplasm conservation facilities have concentrated more on the plantation species and a few agroforestry species which are mainly exotic.

Ex situ and *in situ* conservation initiatives in Kenya are undertaken by such institutions as Kenya Forest Service, Kenya Forestry Research Institute, Kenya Agricultural Research Institute, National Museums of Kenya, , public universities, and to a small extent, various private organizations. Ex situ conservation involves use of such specialized facilities such as cold
stores or chest freezers. Alternatively, materials may also be conserved in the field as seed stands, hedges, botanic gardens or arboreta as living collections.
The National Genebank of Kenya (KARI) is the only long- term seed conservation facility in the country. KEFRI has cold rooms where seed storage is undertaken, however, the bulk of the germplasm is that of plantation and agroforestry use mainly of exotic tree species. There are also seed stands and hedge plants that supply the seeds in addition to serving as live genebanks. KFS also has a number of plantations of valuable indigenous tree species.
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The Kenyan National Plant Genetic Resources Programme was established in 1988. The National Genebank collaborates with a number of institutions and stakeholders including, KFS KARI, KEFRI,

NMK, Kenya Wildlife Services, relevant government ministries and departments such as Ministry of Environment and Natural Resources, Ministry of Agriculture, as well as local public Universities, CBOs, NGOs and farmer groups. Whereas all the stakeholders collaborate at institutional and individual levels in the implementation of specific plant genetic resources activities, overall coordination among them is weak. There is no particular institution or agency charged with the responsibility of coordination. There is need for an Authority to coordinate plant (including forest) genetic resources matters in the country.

In the last decade, the country has signed several international agreements that are relevant to FGR and enforced several important legislations. These include, the Convention on Biological Diversity (1994), the International Treaty on PGRFA (2003), the Environmental Management and Coordination Act (1999), the Industrial Property Bill (2001), the National Biotechnology Development Policy (2006), the National Environment Action Plan (NEAP), The Seeds and Plant Varieties (National Performance Trials) Regulations, 2009, The Environmental Management and Co-ordination (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations, 2006, the National Biodiversity Strategy and Action Plan (NBSAP) and the National Bio-Prospecting Strategy (2011). In addition, there are other pieces of Bio-safety Act 2010.

Kenya is also party to several regional and international initiatives part of whose endeavour is seek to address FGR issues. Of particular significance is the Eastern Africa Plant Genetic Resources Network (EAPGREN) which deals with issues of PGR (including FGR). Others include Intergovernmental Authority on Development (IGAD), Common Market for Eastern and Southern Africa (COMESA), East African Community (EAC) – Environmental Natural Research and NEPAD besides several ASARECA networks. There is however need to strengthen the networks in order to increase their efficiency in PGR (including FGR) conservation and utilization.

At the national level, there is a raft of legal, administrative and policy instruments dealing directly or indirectly with FGR. The Forest Act 2005 does not have direct provision on issues related to Access and Benefit Sharing (ABS) related to FGR. However, the Environment Management and Coordination Act, 1999 which is a general environmental law and through the Environmental Management and Co-ordination (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations, 2006 provide provision for managing ABS. A lot of work still needs to be undertaken to ensure the legislation is not restrictive but facilitates bio-prospecting and exchange of genetic material. The Environmental Management and Co-ordination (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations, 2006.

The following are the constraints and needs in the management of FGR in Kenya.

- Improve the countries capacity to assess genetic diversity, genetic erosion and vulnerability through provision of necessary equipment and training.
- Establish comprehensive baseline data on the status of the countries' FGR and establishment of a mechanism of monitoring and early detection of genetic erosion.
- Develop and adopt reliable methods for assessing genetic diversity at the national level.

- Priority areas for genetic resource erosion should be quickly identified at the national level.
- There is need to harmonize and co-ordinate inventories within the same ecosystems or habitats to avoid duplication of efforts.
- Training and capacity building: There is need for capacity development in most institutions involved in inventories, in particular, capacity for methods and technology applications, specialists in taxonomy among others.
- Limited resources: Inventories and surveys are expensive; hence adequate funds should be available to the institutions concerned.

- There is need for interoperability of data formats and geo-referencing of data for communication purposes across lead agencies.
- Relevant policies and legal instruments should be developed to guide surveys and inventories and ABS.
- There is need for greater recognition and support at national level for programmes dealing with or prioritizing FGR and host habitats for conservation.
- Standardized methodologies for surveys and inventories should be emphasized.

- There is need for strengthening the seed (especially native species) handling and storage capacity of the seed bank facilities to meet national needs through provision of equipment.
- Diversity enrichment for those field genebanks that already exist through germplasm collections.
- Value addition and enhancement of conserved materials through characterization, evaluation and pre-breeding.
- Increasing the infrastructural capacity to do regeneration, characterization and multiplication of germplasm.
- The establishment of regional gene-bank probably in the Eastern Africa region for safety duplication and longterm storage of the regions base collections.
- Constituting core collections which is an important *ex situ* conservation strategy
- Providing adequate financial resources for conservation activities
- There is need to develop stronger links between conservation and use of conserved germplasm.

Below are some of the potential interventions to overcome these constraints

- Training of staff to empower them with skills to conduct seed dormancy, storage and viability monitoring studies.
- Strengthening the infrastructural capacity of institutions to conduct experiments and routine tests through for example, the purchase of incubators.
- Morphological and molecular characterization to enable selection of core collections and hence add value to the conserved germplasm.
- Conducting preliminary evaluation in order to add value on the conserved materials
- Providing adequate financial resources to undertake research in propagation techniques.
- There is need for proper/effective coordination on issues relating plant genetic resource including FGR. This may be achieved through;
  - Strengthening the National Biodiversity Centre hosted by the NMK and expanding its mandate and probably membership.
  - The National Information Sharing Mechanism35 (NISM) which served a very important in building a network of institutions dealing with plant genetic resources should be strengthened.

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SECTION II: INTRODUCTION TO THE COUNTRY AND FOREST SECTOR

More than 80% of the land area of Kenya consists of arid and semi arid lands (ASALs) where population density is low and livelihoods are mainly based on livestock. Woody vegetation in those areas is sparse and consists of dry bush and open wooded grassland. Most of the rural population lives in the remaining 20% where rainfall is higher and soils are suited to agriculture and this is also the area where most of the closed canopy forest occurs. Only about 12% of the land area is climatically suited to closed canopy forest, with current closed canopy forest occurring on just 2% of the land are due to progressive clearance for agriculture. Much of this area is protected, either as Forest Reserves managed by the Kenya Forest Service (KFS), as National Parks managed by Kenya Wildlife Service (KWS), or as trust land forests managed by Local Authorities.

In addition to the indigenous forests, there are approximately 107,000 ha of publicly owned industrial plantation forests under the management of KFS and an estimated 90,000 ha of private industrial plantations and fuelwood plantations serving mainly the tea industry (**Figure 2.2**). Plantations are located mainly in the higher elevations, and in many cases were planted as buffers surrounding indigenous forest reserves that were conserved for their water catchment and biodiversity values. The plantations are located in areas with high agricultural potential with high rainfall and fertile volcanic soils, where rural population densities are high.

Table 2.2 Forest ownership and area (FRA)

Forest ownership	**Area ('000 ha)**
Public	1364
Private	90
Others – Local Authority/Trustlands	2013
TOTAL	**3467**

The trends in forest area in the past is reducing with loss of indigenous closed canopy forest of about 50,000ha between 2000 and 2010, Public plantation forests 27,000ha with the highest change in the bushland of 126,000ha. However, there was an increase of Private plantations of 12,000 ha and this trend is increasing. Due to the recent developments, the area under closed canopy is bound to increase with recoveries of illegally excised and settled/encroached lands.

Table 2.3 Forest areas between 1990 to 2010.

Major Forest Types	**Area ('000) & Year**		
	1990	**2000**	**2010**
Indigenous closed Canopy	1 240	1 190	1140
Indigenous Mangroves	80	80	80
Open woodlands	2150	2100	2050

Public Plantation Forests (1)	170	134	107
Private Plantation forests (1)	68	78	90
Sub-total (Forests)	**3708**	**3582**	**3 467**
Bush-land	24800	24635	24 510
Grasslands (40%)	4292	4194	4140
Sub-total (OWL)	**29092**	**28829**	**28 650**
Grasslands (60%)	6438	6291	6 210
Settlements	8256	8192	8202
Farms with Trees	9420	10020	10 385
Sub-total (OL)	**24114**	**24503**	**24 797**

The forests play a very important role in the provisions of forests products and services. They are key in provision of water that supports so many sectors among them being agriculture that is the backbone of Kenya's economy, electricity generation (upto 70% of generation), tourism (directly and indirectly), non-timber forest products such as honey, and medicinal herbs among others. The forests have supplied the timber, pulp and paper industries with wood, For a period, only for companies had access to the plantations until 2010 when the ban on harvesting was lifted. During the life of the ban, the demand for forest products especially timber and fuelwood was met from private plantation/forests, on-farm, imports from neighbouring countries and to a low extent illegal tree cutting from government forests.

Institutional arrangements in the forestry sector

A significant change introduced in the forestry sector by the new Forests Act 2005 was the creation of the Kenya Forest Service (KFS) as the institution responsible for the forestry sector. Under the new Act, the KFS is a ―body corporate under the Ministry of Forestry and Wildlife that reports to a Board. The Board is drawn from a wide base and about half of its membership consists of *ex-officio* members with the remainder appointed by the Minister responsible for Forests. The *ex-officio* members are the Permanent Secretaries of the Ministries responsible for Forestry, Water, Finance and Local Government; the Directors of KFS, KWS, KEFRI and NEMA. The members directly appointed by the Minister are eight other persons representing forest industry, forest communities, law enforcement, Kenya Forestry Society, environment related NGOs, forestry education and research, and conservation. The KFS became operational in 2007. The organizational structure is devolved to Conservancies.

The KFS has a broad mandate that includes regulation of the sector, management of natural and plantation forests, protection of forests and forestry extension. Currently KFS manages most of the reserved forests but under the new Act can devolve its forest management functions to communities, private companies, individuals or other entities through concessions or other arrangements. Significant areas of gazetted forests are currently under the management of Kenya Wildlife Service (KWS) and Local Councils.

Technical competence within the forestry sector in Kenya is high due to a long history in forestry and well established institutions offering technical forestry education. Moi and Kenyatta Universities offer degree courses in forestry, and The Forestry College at Londiani offers certificate and diploma

courses. There is a large number of trained foresters working both in the technical forestry institutions such as KFS and Kenya Forestry Research Institute (KEFRI) and in civil society organizations who have an interest in forests and natural resources management.

Capacity of civil society organizations working in the forestry sector in Kenya is strong and is a valuable resource for the management of forest resources including FGR. Civil Society is effectively represented in the sector through several well established and highly competent local organizations such as Forest Action Network (FAN), Kenya Forest Working Group (KFWG), Nature Kenya, The National Alliance of Community Forest Associations, the Greenbelt Movement, and the local offices of WWF and IUCN. Those organizations played a strong advocacy role on behalf of the forest sector stakeholders during the late 1990s when there were serious public concerns about increasing forest destruction and its negative environmental impacts including FGR loss. At that time KFWG, FAN and the Forestry Department together prepared the Forests Bill (2000) which for the first time placed strong emphasis on Community Participation in the future of forest management.

The principal drivers of deforestation and forest degradation may be summarized in order of importance, as follows;

i. clearance for agriculture (linked to rural poverty) through degazzettement of forest land for settlement;
ii. unsustainable utilization (including timber harvesting, charcoal production, grazing in forests; and
iii. poor governance and institutional failures in the forest sector.

Chapter 1: The Current State of the Forest Genetic Resources

1.1 Introduction

Forests contain lowland rain forest in western Kenya, and montane forest in the central and western highlands and on higher hills and mountains along the southern border (Summarized in Table 1.1). Many of these largest forested mountain blocks are of recent volcanic origin and are relatively species poor. The most widespread montane associations are the moist *Ocotea-Polyscias* and drier *Podocarpus-Cassipourea* forests. *Juniperus-Olea* dominate the upper slopes. In addition, there are some coastal mosaic forests; some forests occur mainly in strips bordering rivers and some are fairly extensive mangroves along the coast, particularly at Lamu and the mouth of the Tana River. Highest diversities are in the coastal forests, the western plateau forests such as Kakamega, and especially in the tiny, geologically older mountains at the northern end of the Eastern Arc of Block Mountains – the Taita hills and Kasigau (Sayer et al. 1992).

Table 1.1: Major forest type categories and main tree species

Major Forest Types	**Area (covered by forest type)**	**Main species for each type**	
		Trees	**Other species if applicable**
Indigenous closed Canopy	1140	*Ocotea-Polyscias, Podocarpus-Cassipourea, Juniperus-Olea, Yushania alpina*	
Indigenous Mangroves	80	*Rhizophora mucronata, Ceriops tagal, Avicennia marina, Bruguiera gymnorrhiza*	
Open woodlands	2050	*Acacia*	
Public Plantation Forests (1)	107	*Cupressus, Pinus, Eucalyptus*	
Private Plantation forests (1)	90	*Eucalyptus*	*Acacia mearnsii*
Sub-total (Forests)	3 467		
Bush-land	24 510	*Acacia – Commiphora*	
Grasslands (40%)	4140		
Sub-total (OWL)	28 650		
Grasslands (60%)	6 210		
Settlements	8202		
Farms with Trees	10 385	*Eucalyptus, Grevillea etc*	
Sub-total (OL)	97		

1.2 The high volcanic mountains and high ranges

The volcanic mountains contain sub-montane forests: evergreen seasonal forests and evergreen forests Deciduous species, e.g *Calodendrum capense* and *Ekebergia capensis* and the association of the *Cassipourea malosana-Setaria plicatilis* agg., are common in evergreen seasonal forests and the *Cassipourea malosana-Popocarpus latifolius* and the *Cassipourea mallosana-Olea capensis ssp. hochstetteri* communities in evergreen forests. The Elgon Mountain forests contain *Rapanea rhododendroides* and *Hagenia abyssinica*. Mt. Kenya forests contain *Hypericum keniense* and *Hypericum revolutum* (Virtanen 1991). The Mau is the largest single block of forest in East Africa (Sayer et al. 1992:153).

1.3 Western plateau

Kakamega Forest is considered to be the easternmost outlier of the Guinea-Congolian forest. According to some resources (Virtanen 1991, Marttila & Virtanen 1998), it would be the only tropical

rainforest remnant (35 km² area) in Kenya. Kakamega Forest has indigenous tree species such as Elgon teak *Olea capensis*, Red stinkwood *Prunus africanum* and African satinwood *Zanthoxylum gillettii* (Noad 1990). Kakamega forest has unique plant species, such as *Aningeri altissima, Cordia millensii* and *Entandrophragma angolense*. It also has unique animals, e.g L´Hoest´s monkey *Cercopithecus ihoesti*, which only occurs in Kagamega forest, and two globally threatened bird species: Turner´s eremomela *Eremomela turneri* and Chapin´s flycatcher *Muscicapa lendu* (Sayer et al. 1992). According to Marttila (1998:82), Kakamega Forest is home to as many as 400 butterfly species.

1.4 Coastal forests

The coastal forests are considered to be the last refuges of an ancient forest mass that covered most of Central Africa between the Atlantic and the Indian Ocean. A long history of anthropogenic activity resulted in the patchy structure of small fragile forests, which is encountered today. Corresponding to the geological underground, some major types occur on the flat parts of coastal plateau – highly diverse *Sterculia-Chlorophora-Memecylon* lowland rainforest, *Chlorophoro-Strychnatalia* and *Chlorophora-Lovoa forests.*

The coastal forests are diverse in wildlife as well. Two bird species are endemic in the Arabuko-Sokoke Forest: the Sokoke scops owl (*Otus ireneae*) and Clarke´s weaver (*Ploceus golandi*). In addition, the forest has a number of endangered and rare animal species such as Golden rumped elephant shrew *Rhynchocyon chrysopygus*, the Sokoke bushytailed mongoose *Bdeogale crassicauda omnivora* and Ader´s duiker *Cephalophus adersi*, and six bird species are rare or threatened.

The coral rag coastal forests are dry, containing the margin Diani forests. Typical species occurring there are, for example, *Antiaris toxicaria, Milicia excelsa* and *Cussonia zimmermannii* (Virtanen 1991). The estuarine parts of the coast, where fresh water and seawater mix, are excellent habitat for mangrove forests.

1.5 Southern Hills

1.5.1 The Taita Hills

The Taita Hills mist forests are scattered forest fragments of different sizes, ranging from 200 ha to 1 ha. The Taita Hills forest forms the northernmost part of the Eastern Arc Mountains, a group of isolated mountains stretching from southeast Kenya through south central Tanzania. The age and geologic origin of these mountains, the high rainfall and the moisture-laden southeast trade winds originating from the Indian Ocean have contributed to the very diverse and unique biota. The Taita Hills forests are a centre of endemism. They host several endemic tree/shrub species: *Milletia oblata ssp teitensis, Memecylon teitense, Coffea fadenii* and other plant species: *Ceropegia verticilliata, Chassalia discolor ssp teitensis, Impatiens engleri ssp. teitensis, Impatiens teitemsis ssp. teitensis, , Psychotria petitii and Zimmermannia ovata* and to one of the critically endangered African violet species, *Saintpaulia teitensis* (Sayer et al. 1992; Eastern Arc 2002). It contains critically endangered endemic bird species – Taita thrush *Turdus helleri,* Taita apalis *Apalis (thoracica) fuscigularis* and Taita white eye *Zosterops (poliogaster) silvanus*. Records also include the Sagalla *Caecilain Boulengerula niedeni*, Dickerson´s forest gecko *Cnemaspis dickersonii*, which is only found in Taita

Hills and several endemic reptile species, e.g. the Taita reed frog *Hyperolius viridiflavus* and *Amblyodipsas teitana*, and a butterfly *Cymothoea teita.*

1.5.2 Shimba Hills

Shimba Hills are evergreen lowland forests. They contain endemic plants, like *Dichapetalum fructuosum*. Two endemic amphibians, *Afrixallus Sylvaticus* and *Hyperolius rubrovermiculatus*, are confined to the Shimba Hills, which also house several restricted range species such as the black-and-rufous elephant shrew *Rhynchocyon petersi*, east coast akalat *Sheppardia gunningi*, and plain- backed and Uluguru violet-backed sunbirds *Anthreptes reichenowi* and *Anthreptes neglectus*.

1.6 Riverine forests

A narrow belt on the floodplain along the Tana River contains mainly evergreen forest. The extent of the forest depends on the water table, which subsides rapidly as one moves farther from the river. The width of the forests extends approximately 1-3 km on either side of the river (Kaarakka 1996). Lower Tana River forests have two endemic species: Tana River red colobus *Procolobus rufomitratus rufomitratus* and Tana River mangabey *Cercobus galeritus galeritus* (Sayer et al. 1992:153). In addition to Tana, other rivers also maintain riverine forests some of which are only very narrow belts on the riverside.

The priority tree/woody species for action are listed in Table 1.2. The reasons for priority are presented which include threat arising from over-exploitation (illegal) and low or no natural regeneration.

Table 1.2: Priority species (scientific names)

Priority species			**Reasons for priority**
Scientific name	**Tree (T) or other (O)**	**Native (N) or exotic (E)**	
Ocotea usambarensis	T	N	Threatened and Economic
Brachylaena huillensis	T	N	Threatened and Economic
Dalbergia melanoxylon	T	N	Threatened and Economic
Juniperus procera	T	N	Threatened and Economic
Milicia excelsa	T	N	Threatened and Economic
Olea capensis	T	N	Threatened and Economic
Vitex keniensis	T	N	Threatened and Economic
Ocotea usambarensis	T	N	Threatened and Economic
Osyris lanceolata	T	N	Threatened and Economic
Prunus africana	T	N	Threatened
Prosopis juliflora	T	N	Invasive (priority for control)
Lantana camara	O	E	Invasive (priority for removal)

A number of trees species (Table 1.3) are managed for various purposes. Exotic tree species are widely grown especially for government plantations for production of timber and pulp. From the most recent inventory undertaken of plantations, *Cupressus lusitanica* was leading in coverage followed by *Pinus patula* and *Eucalyptus sp.* A number of other species (native) are on trial under plantation or mono-culture conditions. There are also a number of tree/shrub species that are grown on-farm for various purposes from timber, poles, firewood and fuelwood and even fodder production.

Table 1.3: Forest species currently used in the country

Species (Scientific name)	Native (N) or Exotic (E)	Current uses (code)	If managed, type of management system (e.g. natural forest, plantation, agroforestry)	Area managed if known (ha)
Cupressus lusitanica	E	1	Plantation	58006
Pinus patula	E	1, 2	Plantation	22719.1
Other Pinus species	E	1, 2	Plantation	3932.1
Eucalyptus sp	E	1, 2, 3	Plantation	13316.1
Mixed sp	E		Plantation	12107.3
Prunus	N	Trials	Plantation	178.74
Juniperus procera	N	Trials	Plantation	199.8
Podocarpus	N	Trials	Plantation	452
Croton megalocarpus	N	Trials	Plantation	203
Vitex kiniensis	N	trials	Plantation	524
Mixed	N	trials	Plantation	143.84
Grevillea robusta	E	1, 3	On-farm	
Leucaena leucocephala	E	3, 5	Agroforestry	
Calliandra sp	E	3, 5	Agroforestry	

A number of tree species are used for provisions of certain environmental services as shown in Table 1.4. Majority of the trees for various uses varying from soil and water conservation to herbal medicine. The majority of these are native species

Table 1.4: Main tree and other woody forest species providing environmental services or social values

Species (scientific name)	Native (N) or Exotic (E)	Environmental service or social value (code)
Yushania alpina	N	1
Cupressus lusitanica	E	5
Erythrina abyssinica	N	1, 2, 5
Grevillea robusta	E	1, 2,
Juniperus procera	N	1, 3, 7 (herbal medicine)
Markhamia lutea	N	1, 2, 7 (herbal medicine)
Milicia excels	N	1, 2, 7 (herbal medicine)
Milletia dura	N	1, 3
Prunus africana	N	3, 7 (herbal medicine)
Ocotea usambarensis	N	7 (herbal medicine)
Newtonia hildebrandtii	N	7 (herbal medicine)
Podocarpus falcatus	N	5, 7 (medicine)
Dendrocalamus giganteus	E	1, 5

Services and values include:*1 Soil and water conservation including watershed management, 2 Soil fertility, 3 Biodiversity conservation, 4 Cultural values, 5 Aesthetic values, , 6 Religious values, 7 Other (please specify)*

There are over 7000 plant species in Kenya with over 800 tree species out of which about 265 trees endemic to Kenya. The following are some of the endemic species; *Canthium keniensis, Premna maxima, Croton alienus, Milletia oblata ssp. Teitensis, Coffea fadenii*

Table 1.5 presents a list of woody or tree species threatened in Kenya. These were derived from various literatures including the IUCN Redllist that has categorised various species in threat levels. Although KFS does not have a programme for regular assessment of the status of a threatened species, information on the state is obtained through collaborators among them government institutions and the civil society.

Currently, there is an inventory taking place for all the indigenous forests but this will not go in the aspects of forest genetic information. The survey includes mainly the tree species, volumes, distribution and from this the distribution of various species may be deduced.

There are no programmes or strategies developed specifically for genetic conservation for specific forest tree or woody species. However, there are activities ongoing aimed at conserving some species such as *Osyris lanceolata* that is facing serious threat due to harvesting for the perfume industry. The activities include a Presidential decree outlawing its harvesting and trade, research into its propagation and management and an inventory to determine its national quantity.

1.7 Assessment of major gaps, needs and priorities

- Improve the countries capacity to assess genetic diversity, genetic erosion and vulnerability through provision of necessary equipment and training.
- Establish comprehensive baseline data on the status of the countries' genetic diversity. This will assist in monitoring future trends on the state of diversity in the country.
- Establish mechanisms of monitoring the current diversity and the changes in it. This should also include monitoring genetic erosion and establish systems that can help detect any impeding genetic erosion early enough.
- Develop and adopt reliable methods for assessing genetic diversity at the national level.

Table 1.5: List of tree and other woody forest species considered to be threatened in all or part of their range from genetic conservation point of view.

Species (scientific name)	*Area (ha) of species' natural distribution	Average number of trees per hectare	Proportion of species' natural distribution (%)	Distribution: widespread (W), rare (R), or local (L)	Type of threat (Code)	Threat category		
						High	**Medium**	Low
Milletia oblata spp teitensis	430		100%	Local	1	√		
Prunus africana			<50%	W	2, 3		√	
Sorindeia calantha			50%	L	2			√
Euphorbia tanaensis			100%	L	2	√		
Combretum tenuipetiolatum			50%					
Brucea macrocarpa			100%	L	2	√		
Bauhinia mombassae			100%	L		√		
Polyscias stuhlmannii	430		50%	L	1, 2	√		
Macaranga conglomerata	430		50%	L	1, 2	√		
Cynometra sp. A	430		50%	L	1, 2	√		
Dasylepis integra	430		50%	L	1, 2	√		
Memecylon teitense	430		50%	L	1, 2	√		
Syzygium micklethwaitii	430		50%	L	1, 2	√		
Ouratea schusteri	430		50%	L	1, 2	√		
Leptonychia usambarensis	430		50%	L	1, 2	√		
Zanthoxylum chalybeum			<50%	w				√

Warburgia ugandensis			<50%	w	15 (medicinal use)		√	

Type of threat: *1 Forest cover reduction and degradation, 2 Forest ecosystem diversity reduction and degradation, 3 Unsustainable logging, 4 Management intensification, 5 Competition for land use, 6 Urbanization, 7 Habitat fragmentation, 8 Uncontrolled introduction of alien species, 9 Acidification of soil and water, 10 Pollutant emissions, 11 Pests and diseases, 12 Forest fires, 13 Drought and desertification, 14 Rising sea level, 15 Other (please specify)*

Table 1.6: Annual quantity of most commonly used seeds produced and current state of identification of forest reproductive material of the main forest tree and other woody species.

Species		**Total quantity of seed used (Kg)**	**Quantity of seeds from documented sources (Provenances/delimited seed zones)**	**Quantity of seeds from tested provenances (provenance trials established and evaluated)**	**Quantity that is genetically improved(from seed orchards)**
Scientific name	**Native (N) or Exotic (E)**				
Cupressus lusitanica	E	600	700	None	70
Pinus patula	E	250	250	None	None
Markhamia lutea	N	150	200	None	None
Eucalyptus grandis	E	650	900	None	20
Vitex keniensis	N	300	500	None	None
Eucalyptus saligna	E	200	235	None	None
Croton megalocarpus	N	200	300	None	None
Cassuarina equisetifolia	E	150	150	None	None
Podocarpus falcatus	N	300	350	None	None
Gmelina arborea	E	220	230	None	None

Chapter 2: The State of *in situ* Genetic Conservation

2.1 Introduction

The Convention on Biological Diversity (CBD) defines *in situ* conservation as "the conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings, and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties." Environmental problems are likely to intensify as human populations increase coupled with climate change, deforestation, desertification and other processes. By conserving genetic diversity where it occurs naturally *(in situ),* we can facilitate the natural processes of evolution and adaptation, thus mitigating the effect of these problems.

2.2 Forest genetic resources inventories and surveys

Currently, there is no coordinated and systematic surveying and inventorying based on national priorities. Lead institutions involved in one way or another in forest/plant management conduct inventories and surveys of forest/plant genetic resources include the Kenya Forestry Service (KFS), Department of Resource Surveys and Remote Sensing, Kenya Wildlife Service (KWS), Kenya Forestry Research Institute (KEFRI), and National Museums of Kenya (NMK). Each institute works within its mandates, needs and priorities. This has resulted in very little survey or inventory work being carried out on FGR especially in protected areas compared to other components of biodiversity in these areas. This is principally due to the nature of mandates of the lead institutions. Inventories have tended to be project-based and especially areas of interest such as biodiversity hotspot areas such as the Taita hills, the Coastal forests, Mt. Kenya, Mau forest and Kakamega forests. Currently, KFS is undertaking an inventory of all the indigenous forest in the country employing remote sensing and groundtruthing methods. However, this will not go to the genetic level but will include timber volumes and species distribution etc.

In addition to lack of coordination and unclear responsibilities, which have already been cited, other challenges to systematic surveying and inventorying include lack of funding, lack of human resources, skills and knowledge, low national priority, inaccessibility of *in situ* areas, and difficulties in obtaining necessary permissions. Due to the threats posed by wild animals, entry into some protected areas requires guidance (armed rangers) and the cost met by the surveyor/researcher.

2.3 Conservation of forest genetic resources within protected areas

Kenya has a network of protected areas in form of gazetted forest reserves, national parks and game reserves. The gazetted forests are managed by the KFS while the National Parks and game reserves are managed by KWS. There is a significant amount of forests gazetted as National Monuments and managed by the National Museums of Kenya, and others occurring in Trustlands managed by County Councils and yet others on private land managed by companies or individuals.

2.3.1 Protected areas

Gazetted forest area comprises 1.7 million ha of which 1.38 million ha are closed canopy forests including 0.135 million ha of exotic species plantations established mainly in the high potential areas of the country. The remaining 0.18 million ha comprises of open canopy forest which also occur in the wet zones of Kenya. Figure 2.1 shows the distribution in Kenya of the main closed forests.

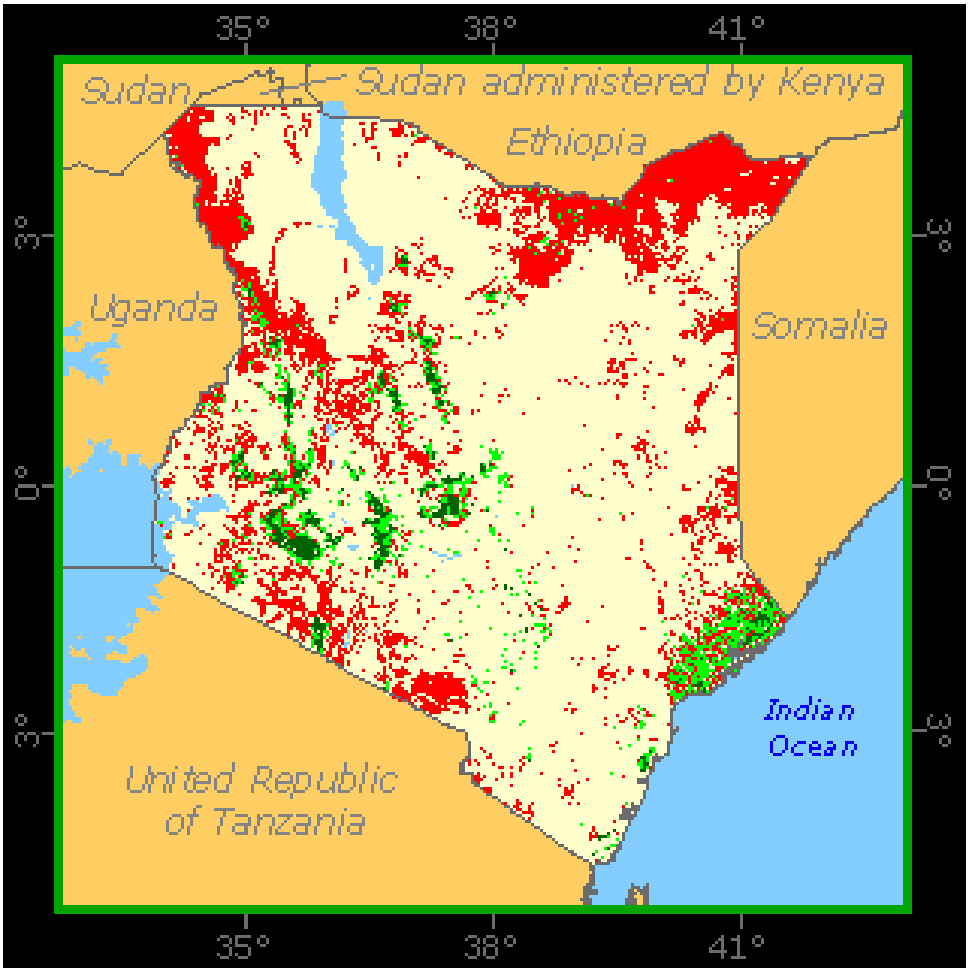

Fig 2.1: **Various ecosystem types – blue-water, black-closed forest, green-open/fragmented forest, red – other wooded land and cream other land cover *(Source FRA 2010. Kenya Report).***

Kenyan forests are the repository for over 50% of biodiversity. The most important ones include Mau Forest Complex, Mt. Kenya, Mt. Elgon, Cherangani, Aberdares and Nandi. These forests are also important as water catchment areas. Others such as the Coastal forests including the Taita hills are important areas for endemism. There is also Kakamega (a remnant of the Congolian forest) and Marsabit forests that are areas for forest genetic resource conservation.

National parks, game reserves and wildlife conservancies are also protected areas containing an appreciable amount of forest cover. In contrast, the highest population density and diversity of Kenya's wild fauna is found in the dry zones of the country and about 90 % of the over 50 gazetted national parks, sanctuaries and game reserves are located in the arid and semi-arid areas (ASALs) (Fig.2.2). To date, Kenya has 26 national parks and 30 national game reserves (including one game sanctuary); thus 8% of Kenya's land is under some form of protection (Fig 2.1 & 2.2). In addition, there are several private game sanctuaries, primarily set aside for the protection of the endangered Black Rhinoceros *Diceros bicornis* among other animals.

The indigenous forests (1.38m ha) are managed primarily for biodiversity conservation and provision of catchment and other environmental services. The form of utilisation permitted is of a non-consumptive nature such as water abstraction, eco-tourism, non-timber forest products such as bee-keeping, research and education activities among other similar ones. Major activities such as eco-tourism, water abstraction, wayleaves etc require the preparation of an Environmental Impact Assessment before licensing or approval. Kenya is in the process of preparing either Ecosystem management plans (25 year) or Strategic Management Plans (10yr) for the major forest areas important for conservation of biodiversity. Areas where the plans have been prepared or in the process include Arabuko Sokoke, Kakamega, Mt. Kenya, Mt. Elgon, Aberdare and Cherangani forest. In addition, the integration of the local communities in forest management is underway with 320 Community Forest Associations having been formed and several Participatory Forest Management Plans either prepared or under preparation. Over 10 Forest Management Agreements have been signed.

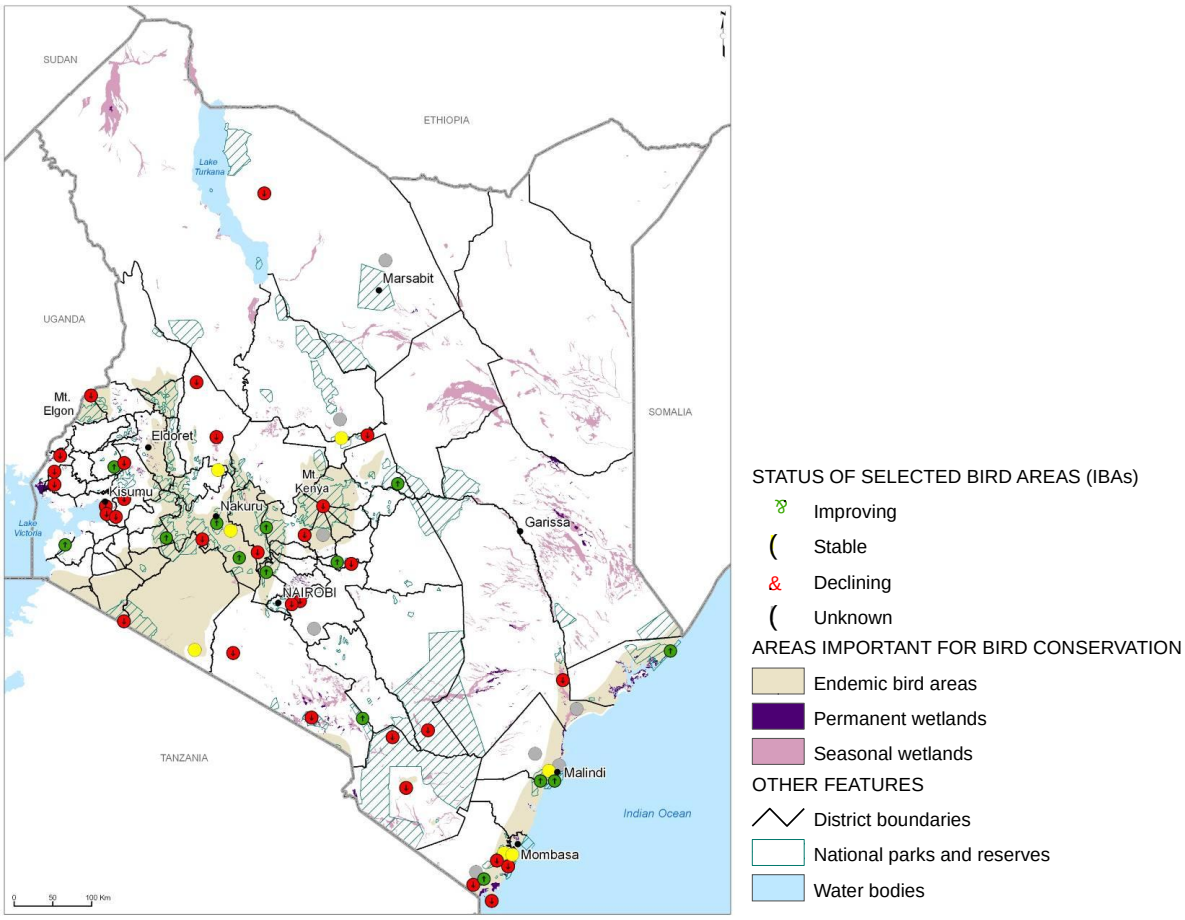

Fig. 2.2: **National parks and games reserves in Kenya**.

Enhanced protection of important forest areas is being undertaken which includes electric fencing and increased number of security personnel (forest rangers and community scouts) and better equipping. There is increased effort in rehabilitation of degraded forest areas through either protection for regeneration or replanting with native tree species depending on the situation and recovery of illegally excised forests or encroachment.

In the effort to conserve *Milletia oblata spp. teitensis* endemic to the Taita Hills, National Museums of Kenya raised seedlings of the species and planted around Ngangao forest to boost its population. Other species such as *Prunus africana* and *Melia volkensii* have been replanted by EAWLS under the East African Cross-Border Biodiversity Project , KEFRI and KFS.

Conservation of forest-dependent fauna are also being undertaken in various areas. One such activity is the conservation of endemic and critically endangered birds found in the Taita hills and Sagalla. For the birds in Taita hills (Taita Apalis and Taita Thrush), research undertaken had indicated that one of the sub-populations of Taita Thrush in Chawia forest had experienced a genetic-bottleneck (losing about 50% alleles) and the sub-population of Taita Apalis in Ngangao having experienced a population crash. These findings/observations have been attributed to

isolation of sub-populations of these forest-specialist birds. In order to rectify the situation, a *Least-Cost Forest Connectivity Model"* for the Taita hills forest patches was developed aiming at the long-term conservation of these birds (Mwangi *et. al. 2011*). Currently indigenous forest rehabilitation efforts of the forest patches are being undertaken together with the establishment of "paths" and "stepping-stones" as per the prescriptions of the model. This is being undertaken by the local community and a local CBO (Taita Taveta Wildlife Forum - TTWF) with support from the Critical Ecosystem Partnership Fund, the Community Development Trust Fund and with technical support from KFS. Similar activities are being undertaken in Sagalla for the conservation of the Sagalla caecilian (*Boulengerula niedeni*) through the rehabilitation of the forest and riverine vegetation by the community with support from TTWF (partnering with the Zoological Society of London) and technical support from KFS.

2.3.2 National Monuments

Some forests are gazetted as National Monuments and are managed by the NMK. They comprise the sacred forests which are traditional forests and woodlands respected by local people. The sacred forests are more common in the coast and are referred to as the "Kaya" forests.

These forests are set aside by *the miji kenda* (meaning "nine tribes/villages") for performing rituals according to their traditional and customary laws. In addition they are the source of traditional foodplants and medicines. There are 23 such kayas mainly in Kilifi and Kwale Counties in the coast. The total area of major "kaya" sacred forests distributed along the coast is about 21,480 ha. Areas of some smaller kayas have not been established. The Coast sacred forests (kayas) are remnants of the northern most elements of the Zanzibar-Inhambane phyto-geographical region, which stretches along the East African coast from northern Mozambique to southern Somalia (White,1983). There is substantial body of botanical and zoological evidence to indicate that it was part of a more extensive coast forest system. The climate of this type of vegetation is semi-humid to semi-arid.

The greatest role of the Kayas is the conservation of the most threatened species that includes: *Afzelia quanzensis, Brachystegia spiciformis, Brachylaena huillensis, Julberardia* and *Manilkara* species, all of which have been over-exploited. *Milicia excelsa and Sterculia appendiculata* have already been eliminated from the forest reserves through commercial logging.

Table 2.1: Protected national Parks and Reserves Containing Significant forest areas

National Park	Area (ha)	Ecological Zone/District
Mt. Kenya	59,000	Humid – Nyeri and Meru
Aberdares range	76,570	Humid to semi humid - Nyeri and Muranga
Al Ndonyo Sabuk	1,800	Semi-arid – Machakos
Mt. Elgon	16,900	Humid to semi-humid – Trans Nzoia
Chyulu	47,100	Semi-arid to arid – Makueni
Marsabit	36,000	Arid – Marsabit
Total	**237,370**	
National Game Reserves		
Marsabit	113,000	Arid – Marsabit
Shimba Hills	19,200	Humid to semi-humid – Kwale
Tana River Primate	16,900	Semi-arid - Tana River
Boni	133,900	Semi-arid – Garissa
Dodori	87,700	Semi-humid to semi-arid – Lamu
Kakamega	4,470	Humid – Kakamega
Total	**375,370**	

*Source: Kigomo, NB. 2001

Table 2.2: Nature Reserves in Gazetted Forests

Nature Reserve	Area (ha)	Ecological Zone/Location
Kisere	484	Humid - North Kakamega
Yala	469	Humid - Central Kakamega
Kakamega Station	210	Humid - Kakamega Forest
S.W. Mau	43,032	Humid to semi-humid - S.W. Mau
Arabuko-Sokoke	4,332	Semi-humid - Arabuko-Sokoke Forest
Langata	96	Semi-humid - Nairobi West
North Nandi	3,434	Semi-humid - North Nandi Forest
Uaso Narok	1,575	Semi-arid – Nyahururu East

2.3.3 Private forests

An appreciable amount of forest cover is found on private land and in particular companies involved in production of tea, coffee, horticulture or fruit farming. A number of companies such as Unilever Tea (K) Ltd (Githiru *et. al. 2009)* have maintained indigenous forest cover along streams, in strips as part of an effort to undertake sustainable farming. Others have established plantations replacing tea in certain areas – especially exotic plantations for provision of fuelwood and as windbreaks.

Currently, patches of indigenous forests in communal lands are being mapped around Kakamega and the Cherangani forests with a view of having them recognised as Community Conserved Areas and getting them protected under appropriate legal instruments.

2.3.4 Traditional agro-forestry parklands systems

A number of indigenous tree species are usually left behind during vegetation clearing for cultivation. Such practices are mostly found in the Eastern and northern Kenya, and are valued as component species in the dryland farming system. The main parkland systems are scattered over the 80% of the country's arid and semi-arid lands. The few main tree species usually left on farms are *Faidherbia albida, Erythrina abyssinica, Balanites aegyptiaca, Adansonia digitata, Acacia tortilis, Acacia nilotica, Terminalia brownii, Melia volkensii, Phoenix reclinata,* among others.

Farming systems along the traditional parklands in dry areas is by fallowing where land is left for a couple of years to rejuvenate its fertility levels for improved productivity of cultivated crops, mostly the cereals.

2.4 Criteria for *in situ* genetic conservation unit identification

While there is no formally documented criterion for identifying units or areas for *in situ* conservation, there are a number of general considerations that include;

1. The number of plant species i.e. species richness,
2. The presence of endemic species and its conservation status (IUCN Redlisting),
3. The severity of threat either to a species or its habitat.

For individual species, the following is used in prioritization for action;

1. Social use/popularity of the species according to stakeholders including users,
2. The distribution of the species in an area; a more widely distributed species being favoured,
3. Commercial contribution in terms of products trade, marketing and services,
4. Species easier to work with and likely to be improved through genetic manipulation being selected.
5. The degree of threat on the species influence its selection especially as it relate to a need for conservation.

2.5 Major constraints to in situ conservation.

- Priority areas for genetic resource erosion should be quickly identified at the national level through a gap analysis evaluation i.e. protected versus unprotected areas.
- There is need to harmonize and co-ordinate inventories within the same ecosystems or habitats to avoid duplication of efforts.
- Training and capacity building: There is need for capacity development in most institutions involved in inventories, in particular, capacity for methods and technology applications, specialists in taxonomy among others.
- Limited resources: Inventories and surveys are expensive; hence adequate funds should be available to the institutions concerned.
- There is need for interoperability of data formats and geo-referencing of data for communication purposes across lead agencies.

- Relevant policies and legal instruments should be developed to guide surveys and inventories. There is critical and urgent need for a policy on indigenous vegetation on unprotected land.
- There is need for greater recognition and support at national level for programmes prioritizing FGR and host habitats for conservation.
- Standardized methodologies for surveys and inventories should be emphasized.

Chapter 3: The State of *ex situ* Genetic Conservation

3.1 Introduction

Ex situ conservation is the most commonly applied and developed method of germplasm conservation in Kenya. These activities and initiatives are widespread in the country and the main institutions include; Kenya Agricultural Research Agricultural Research Institute (KARI), National Museums of Kenya (NMK), Kenya Forestry Research Institute (KEFRI), public universities, Kenya Forest Service (KFS) and various botanic gardens. The main methods employed in *ex situ* conservation are in the form of specialized facilities, such as cold stores, freezers, or in the field. Kenya has one of the largest, most developed and leading genebank in the sub-Saharan region.

Forest tree species included in *ex situ* conservation programmes in the country varies with the greatest emphasis placed on plantation species (exotic and indigenous) (Table 3.1).

Table 3.1 Forest tree species in *ex situ* conservation programmes.

Exotic Tree Species	**Methods of Conservation**
Pinus patula	Seed storage, seed stands, plantations, botanic gardens
Cupressus lusitanica	Seed storage, seed stands, plantations, botanic gardens
Eucalyptus saligna	Seed storage, seed stands, plantations, botanic gardens
E. grandis	Seed storage, seed stands, plantations, botanic gardens
E. camaldulensis	Seed storage, seed stands, plantations, botanic gardens
Grevillea robusta,	Seed storage, seed stands, plantations, botanic gardens, on-farm
Calliandara spp	Seed storage, seed stands,
Sesbania spp	Seed storage, seed stands,
Markamia lutea	Seed storage, seed stands, plantations, botanic gardens
Moringa oleifera	Seed storage, seed stands,
Araucaria sp	Plantation stand
Indigenous Tree Species	
Prunus africana	Seed storage, seed stands, plantations, botanic gardens
Juniperus procera	Seed storage, seed stands, plantations, botanic gardens
Ocotea usambarensis	seed stands, plantations, botanic gardens
Podocarpus milanjinus	Seed storage, seed stands, plantations, botanic gardens
Vitex keniensis	Seed storage, seed stands, plantations, botanic gardens
Croton megalocarpus	Seed storage, seed stands, plantations, botanic gardens
Polyscias kikuyuensis	Seed storage, seed stands, plantations, botanic gardens
Olea spp.	Seed storage, seed stands, plantations, botanic gardens
Albizia gummifera	Plantation stand
Bischofia javonica	Plantation stand
Maesopsis eminii	Plantation stand

There are at least 14 gene-banks (seed storage) facilities in the country and are classified into 3 storage categories; short-term (7), medium-term (6) and long-term (1) storage capacity.

3.2 Institutions involved in ex situ conservation.

3.2.1 Kenya Forestry Research Institute

Kenya Forestry Research Institute (KEFRI) operates a Seed Centre which was established in 1985 with support from German Technical Co-operation Agency (GTZ) of the Republic of Germany. The overall goal of the Centre has been the provision of site appropriate, high quality tree seed in sufficient quantities. The Centre maintains a national system of seed orchards and seed stands. The main tree seed collected are those of plantation species (*Cupressus lusitanica, Pinus patula, Eucalyptus grandis, Eucalyptus saligna* and *Eucalyptus camaldulensis* among others). Also seeds of agroforestry tree species are stocked among them: *Grevillea robusta, Calliandara spp, Sesbania spp. Markamia lutea, Moringa oleorifera,* among others. The Kenya Tree Seed Centre stocks about 7000Kg of various tree seeds in its cold and warm storage facilities.

3.2.2 Kenya Forest Service

The KFS maintains under protection, native forests, which may be termed the major pool of forest genetic resources in addition to plantations with exotic tree species (mainly *C. lusitanica, Pinus sp., Eucalyptus sp.)* forming the bulk and those of native species (*Prunus africana, Juniperus procera, Bischofia javonica, Croton megalocarpus, Vitex keniensis*) forming close to 6% (about 7868 ha).

Table 3.2 *Ex-situ* conservation stands

Species	**Area**	**Pure/Mixed Stand**
Prunus africana	218.74	23 stand pure, 6 stand mixed
Juniperus procera	3827	20 pure, 9 mixed
Podocarpus latifolia	492	34 pure, 5 mixed
Croton megalocarpus	203	
Vitex keniensis	558.2	
Albizia sp.	23.5	
Araucaria sp.	82.6	
Ocotea usambarensis	0.9	
Warbugia ugandensis	32.2	
Ilex mitis	12.2	
Dombeya goetzenii	5.5	
Syzygium guinensis	14	
Markhamia lutea	48.0	

3.2.3 National Museums of Kenya

The National Museums of Kenya (NMK) has a number of *ex situ* conservation related activities, principally under the umbrella of its Centre for Biodiversity. These activities specifically target threatened and endangered species and ecosystems. Where necessary, NMK is able to undertake limited storage of seed germplasm and conduct replications. The seeds are stored in aluminium packets in a freezer at - 20^0C. NMK also houses a plant nursery display garden, the National

Botanic Garden and the East African Herbarium. These departments contain a wealth of information, both current and historic. The botanic garden is able to assist in propagation and reintroduction activities where necessary. The PCPU is a key element in these *ex situ* conservation strategies.

3.2.4 Kenya Agricultural Research Institute

Within the framework of KARI is the National Genebank of Kenya (GBK) which is the only long term conservation facility in the country. It was established with financial and technical support of the German Technical Co-operation Agency (GTZ) and became operational in July 1988. This was as a result of recommendations from FAO and Bioversity International catalyzed by threat to the global genetic erosion. During the first phase of the establishment of the Genebank, five cold stores were established in various agricultural research centres affiliated to KARI. These were short/medium term storage facilities to provide breeding work with controlled storage facilities for the day to day working germplasm stocks. The Genebank maintains duplicate samples of the same in base collection from all the KARI Centres. Besides conservation of crop germplasm, the Genebank targets other plant species with medicinal, socio-economic and cultural value. The goal of the Genebank is to enhance conservation and sustainable utilization of agro biodiversity in Kenya. It therefore strives to conserve plant genetic resources using appropriate and improved technologies for the benefit of present and future generations.

3.3 Botanical gardens

There are several botanical gardens mostly situated in or near towns or within premises of forestry institutions and universities and even firms such as the tea estates. Nairobi (Box 1), Mombasa, Nakuru, Kisumu and other major towns have Arboretums of tree species. Most of the species planted in the Botanical gardens are those suitable for the local climatic conditions and are also common in the plantation stands and residential compounds.

In four (Muguga, Nairobi, Gede near Malindi and at Nyeri Kenya Forest Service) of the major arboretums, planting is done according to plan and with the purpose of testing species performance. Assessments are done and data analysed to determine growth rates under the prevailing conditions.

Tea firms such as Unilever Tea of Kenya (Githiru *et. al. 2009)* established arboreta as part of the *Sustainable Agriculture Programme* aimed at maintaining productivity on tea firms utilizing minimal agro-chemical input while encouraging the existence of biodiversity.

The dominant arboretum species in the humid and semi-humid are: *Cupressus lusitanica, Acacia mearnsii, Grevillea robusta, Eucalyptus spp, Olea europaea, Croton megalocarpus, Teclea nobilis*. The dominant species in the coast are: *Afzelia quanzensis, Casuarina equisetifolia, Eucalyptus spp* etc. Garden and Arboretums situated in drier towns are popular with *Acacia* species, *Grevillea robusta, Casuarina* species, *Croton, megalocarpus*, *Terminalia* spp and *Eucalyptus* species adapted to dry areas.

Box 1. Nairobi Arboretum

The Nairobi Arboretum, set in the centre of the capital of Kenya consists of 30 ha containing a large collection of trees and shrubs from the tropics both native and from throughout the world. It has developed from a trial arboretum at the beginning of the twentieth century to a green refuge from the bustle of the city and a place for learning about biodiversity.

265 plants (4%) are endemic to Kenya. For instance, *Canthium keniensis* is quite common in the arboretum and is endemic to Nairobi and Machakos forests. Two species described as Rare to Vulnerable in the arboretum. are *Premna maxima* (Muchichiu),once used for furniture, is endemic to north east Mount Kenya and Marsabit forests and *Croton alienus* are found, endemic to central Kenya, few remain in that area due to intense cultivation. There are old plantings of four tall Mvuli (*Milicia excelsa*), widely traded as Iroko. This tree has the most attractive timber for quality furniture and was extensively used by early settlers and also harvested for export. It is now totally overexploited in Kenya with only a few trees remaining in moist forests such as Kakamega and Shimba Hills.

A few examples of native species with medicinal, poisonous, stimulant properties are *Zanthoxylum* spp. which have a characteristic, thorny bark with medicinal properties. A single tree of *Z. gillettii* has been repeatedly hacked for its bark despite protective wire around the trunk. A large number of Miraa trees (*Catha edulis*) grow well in the arboretum; young shoots contain an effective drug. This has been a profitable export product for Kenya until recent control measures

Some timber trees of Kenya in the arboretum include the Silver oak (*Brachylaena huillensis*) which thrives and regenerates in the arboretum, Red stinkwood (*Prunus africana*), was a quality timber tree exported from Kenya but today it is better known for the medicinal properties of its bark, treating prostate problems, the East African yellow-wood (*Podocarpus* spp.) provided much high quality timber in Kenya but again too many have been removed, Mukui (*Newtonia buchananii*) its durable timber has been used for canoes and Meru oak (*Vitex keniensis*) endemic to the Meru slopes of Mount Kenya. Meru oak is now protected in the wild but is being planted in plantations and elsewhere; its quality timber like "oak" is harvested after 100 or more years, and makes beautiful furniture.

Exotic timber trees have been planted as demonstrations of economic trees around the world such as the African mahogany (*Khaya anthotheca*), growing in wet forests from Sierra Leone across to Uganda and south to Mozambique (its hardwood timber is imported to Kenya) and mahogany trees (*Sweitenia mahogoni*) from Central America. Other exotic trees include 35 species from Australia and over 40 from the Americas. Most exotic trees were planted because of their colourful blossom such as the Flame kurrajong (*Brachychiton acerifolium*) and Cigar cassia (*Senna brewsteri*). From the old Forest Annual Reports it is clear that a large number of introduced plants did not survive. An exception was the Mexican weeping pine (*Pinus patula*), now used extensively for paper and as a plantation softwood. Exotic bamboos thrive and the arboretum has palm trees from several countries as well as the

3.4 Main constraints to improving ex situ conservation.

There are a number of issues hindering improvements in *ex situ* conservation in the country. Of top priority is for the country to strengthen its technical capacity for *ex situ* conservation and utilization of forest genetic resources at the national levels, with a special focus on:

- Strengthening of human resource capacity in areas of taxonomy, pathology, GIS, molecular techniques, database management and inventory.
- There is need for strengthening the seed (especially native species) handling and storage capacity of the seed bank facilities to meet national needs through provision of equipment.

- Diversity enrichment for those field genebanks that already exist through germplasm collections.
- Value addition and enhancement of conserved materials through characterization, evaluation and pre-breeding.
- Increasing the infrastructural capacity to do regeneration, characterization and multiplication of germplasm.
- The establishment of regional gene-bank probably in the Eastern Africa region for safety duplication and longterm storage of the regions base collections.
- Constituting core collections which is an important *ex situ* conservation strategy
- Providing adequate financial resources for conservation activities
- There is need to develop stronger links between conservation and use of conserved germplasm.

Other constraints that have hampered efforts to sustain the existing *ex situ* collections include:

- Unknown viability status of the conserved germplasm (especially native species) due to limited capacity to conduct viability tests
- Limited information on seed storage behaviour of some species especially the native ones
- Inadequate capacity in terms of staff and facilities to rejuvenate and multiply stored germplasm. This leads to low viability levels and limited sample sizes hence limiting their availability for distribution to interested users including low demand.
- Inadequate information on the diversity of the conserved germplasm
- Inadequate information on the potential value of the conserved germplasm hence limiting its use by interested users such as tree breeders
- Inadequate information on appropriate seed testing protocols especially for native species

Below are some of the potential interventions to overcome these constraints

- Training of staff to empower them with skills to conduct seed dormancy, storage and viability monitoring studies.
- Strengthening the infrastructural capacity of institutions to conduct experiments and routine tests through for example, the purchase of incubators.
- Morphological and molecular characterization to enable selection of core collections and hence add value to the conserved germplasm.
- Conducting preliminary evaluation in order to add value on the conserved materials
- Providing adequate financial resources to undertake research in propagation techniques.

Chapter 4: The State of Use and Sustainable Management of Forest Genetic Resources

4.1 Introduction

Forest genetic resources (FGR) form the base for adaptation of forests to future environmental conditions and societal demands. Appropriate use and sustainable management of FGR is therefore of utmost importance.

Germplasm is assembled both for long-term conservation and immediate utilization. Immediate utilization ranges from direct introduction on farm to plant breeding, scientific research and education. Some local varieties are often important socially and culturally. The National Genebank of Kenya and The Kenya Forestry seed centre (KFSC) stores and distributes tree seeds every year, both within and outside the country for utilization mainly in tree improvement and basic research. The absence of data on economic returns coupled with the perception that only limited number of accessions out of the total conserved have actual use are threatening continued support for conservation efforts in many countries, including Kenya.

4.2 Distribution and use of plant genetic resources

At the NGBK and KFSC, when germplasm is distributed to various users, the ensuing information is captured in the documentation system both in the computer and manual files. In a recent survey supported by Bioversity International, which attempted to document the constraints for effective utilization of genetic resources conserved *ex situ*, it was revealed that despite knowledge of existence and functions of the NGBK, most potential users never acquired materials because they lacked adequate information about the material conserved or they felt that material appropriate for their work was not available. Other constraints identified to the use included lack of adequate information on performance or evaluation data especially for biotic and abiotic stresses; poor linkages between the NGBK and potential users; inadequate information (taxonomy, passport and characterization data) accompanying the distributed material; small sample sizes offered to the clientele and complexity and long delays in obtaining germplasm from the NGBK.

4.3 Species and Provenance trials

It is not easy to list separately experiments meant for provenance testing and those whose objectives are for species selection trials. Objectives of testing are recorded as both for species selection, testing and provenance trials although there are a few cases of just species trial experiments.

The following species are included in experimental testing of species and provenances. Majority of the tests and much of the area cover are on provenance testing. The largest cover and number of provenance trials are on *Calliandra calothyrsus, Eucalyptus grandis, Grevillea robusta, Eucalyptus camaldulensis, Eucalyptus tereticornis*, and *Acacia* spp the later three in the dry areas. Provenance trials of agroforestry species have increased recently while there has been a drop of new provenance trials of industrial plantation tree species.

Some species trials have been established to assess the suitability and growth performance of various species in different sites/areas. These consist of mainly imported germplasm and few local hybrids. The species include; *Pinus caribaea, P. tecunuminii, P. maximinoi,* several pine hybrids and Eucalyptus hybrids (imported and local).

Table 4.1: Distribution of species and Provenance trials.

Ecological Zone	Species under Species/Provenance trials	Total appropriate area
Humid to semi-humid	*Cupressus lusitanica, Eucalyptus grandis, E. saligna, E. regnans, E. fastigata, Pinus patula, P. radiata, P. pseudostrobus, Casuarina funghuhniana, Acacia koa, P. taeda, P. maximinoi, Casuarina equisetufikuam, P. patula sub-species tecunumanii, C. macrocarpa, E. urophylla, Olea welwitschii, A. mearnsii, A. melanoxylon, Eucalyptus spp., Agathis robusta, Prunus africana, Grevillea robusta, Sesbania sesban, Markamialutea, Croton megalocarpus* among few others.	121.5 ha
Semi-humid to semi-arid	*Pinus elliotti, P. oocarpa, P. caribaea, E. camaldulensis, E. urophylla, Casuarina equisetifolia, Grevillea robusta, Croton megalocarpus, E. tereticornis, Calliandra scabrela, Populus ilicifolia, Senna siamea, Dalbergia melanoxylon, Melia volkensii, Pinus kesiya, Azadirachta indica, Leucaena* spp.	60.6 ha
Semi-arid to arid	*Acacia nilotica, A. tortilis, A. eriobola, A. karoo, Faidherbia albida, Dalbergia melanocylon, Acacia polyacantha, Acacia xanthophloea, Terminalia pruniodes, Albizia spp, Azadiracta indica, Eucalytus tereticornis, Schinus molle, Pinus bruita, E. alba, Parkinsonia aculata, Prosopis chilensis, Pinus caribaea*.	20.3 ha

4.4 Vegetative propagation experiments

There are vegetative propagation experiments on *Populus ilicifolia, Eucalyptus grandis, Eucalyptus grandis* × *Eucalyptus camaldulensis* hybrid, several bamboo species, *Melia volkensii, Grevillea robusta, Pinus patula* and *P. radiata*. The objectives of such experiments are mass propagation to increase production of a particular species in high demand, which have shown difficulties of obtaining enough seedlings through seed eg. *Melia volkensii* and tree improvement of selected species. Clonal experiments of *Pinus patula, P. radiata, Eucalyptus grandis, Grevillea robust* and *Eucalyptus grandis* × *Eucalyptus camaldulensis* have been in progress for several years now. Many indigenous fruit trees in the dry zones are raised through vegetative propagation methods. The area of vegetative propagation experiments is specifically not easy to pin point since planting out has been mixed up with the species/provenance trial experiments. Actual area of vegetatively propagated experiments is however relatively negligible.

Table 4.2: Forest improvement programmes.

Species		Improvement programme project					
Scientific name	**Native (N) or Exotic (E)**	**Timber**	**Pulpwood**	**Energy**	**MP***	**NWFP****	**Others**
Cupressus lusitanica	E	√	√				
Pinus patula	E		√				
Melia volkensii	N	√					
Eucalyptus grandis	E	√		√			
Grevillea robusta	E	√		√	√		
Vitex keniensis	N	√		√			
Eucalyptus hybrids	E	√		√			
Pine hybrids	E	√	√				
Faidherbia albida	N			√	√		
Acacia xanthophloea	N			√	√		
Acacia polyacantha	N			√	√		

* MP: Multipurpose tree improvement program
**NWFP: Non-wood forest product

4.5 Species improvement and characterization

The most notable tree improvement efforts have been directed to *Cupressus lusitanica, Pinus patula, Eucalyptus grandis, Eucalyptus hybrids and Pinus radiata* which are the most widely planted industrial plantation species since some five decades ago. Starting in 1962, a national tree improvement was initiated in Kenya, which ended up in selecting plus trees nation-wide and establishing two live tree seed banks. A system of seed stands was identified for seed collection using well researched traits, useful in identifying good tree forms for timber production. Stem taper, stem form, wood grain angle, stem branches, susceptibility to key diseases, among others, were considered in the selection of trees for a national tree improvement programme.

There has been an extensive testing of the plus trees, exotic provenance trials and progeny testing on the three species. Eventually a network of seed orchards was established. *Pinus radiata* was however later dropped from the national tree planting programme due to serious attack of the tree by needle bright disease (*Dothistroma pinii*). On the average a net improvement of 30% increment in growth and volume has been achieved through the national tree improvement programme of the three species.

Recently efforts in tree improvement have been directed to the *Eucalyptus spp.* especially, *E. grandis, E. grandis* × *E. camaldulensis* and *E. urophyalla* and pine hybrid. It has not been easy to keep track records of imported plating materials since little information is available in the

literature. Improvement efforts have been started on *Vitex keniensis*, *Grevillea robusta* and *Melia volkensii* growing in semi-humid and semi-arid to arid areas respectively. Selection of plus trees and establishment of hedge banks has been performed and improvement programmes are in progress.

Table 4.3: Seed orchards.

Species (Scientific name)	Seed orchard(s)		
	Number	**Generation**	**Area (Ha)**
Cupressus lusitanica	3	2nd	9
Pinus patula	1	1st	2
Grevillea robusta	3	2nd	8
Eucalyptus grandis	2	1st	8
Pinus radiate	2	1st	4

4.6 Assessment of major Gaps, Needs and Priorities

- In order to increase utilization, more efforts need to be put towards characterization and evaluation of conserved germplasm. Breeders have shown preference for materials whose characterization and evaluation data is available as this saves on time and resources for doing these activities.
- The links between the National Genebank of Kenya and breeders should be strengthened. The level of awareness on the existence of the Genebank remains lows and hence a publicity campaign is needed in order to raise the level of awareness.
- There is need for capacity building in the area of plant breeding. While the world has embraced modern technologies in plant breeding, the country continues to rely heavily on traditional/conventional techniques. These modern techniques can make an immense contribution in the development of new varieties and hence in the attainment of food security.
- The country has so many underutilized and neglected species which are of great economic importance. The level of awareness of the importance of these species is increasing each day. In order to increase utilization of these species, more research is needed on their nutritional importance and other useful traits.
- There is also a need for more fully integrated systems at the national level that provide for effective linkages between conservation, breeding and seed production and distribution, in order to bring the benefits to the farmers themselves, in the form of improved seed.

Chapter 5: The State of National Programmes, Research, Education, Training and Legislation

5.1 National programmes for forest genetic resources

The main institutions involved in forest genetics work include KFS, KEFRI, KWS and NMK. However, KEFRI has a more active engagement in field and laboratory work that includes work to improve species for timber production, disease resistance and domestication of endangered species such as *Osyris lanceolata*, *Melia volkensii* among others. However, Kenya has not developed a formal national programme for FGR bringing together various stakeholders.

The Kenyan National Plant Genetic Resources Programme was technically established in 1978. The programme that is a network of institutions undertaking plant genetic resources work in the country and includes the GBK, KEFRI, NMK, Kenya Wildlife Services, the Kenya Forest Service, relevant government ministries and departments such as the Ministry of Environment and Natural Resources, the Ministry of Agriculture, local public universities, CBOs, NGOs and farmer groups. The key institutions have specific roles and responsibilities in line with their mandates and missions.

The main functions and or objectives of the national PGR programme are:

- Promoting the conservation of biodiversity in ecosystems and to preserve their cultural values.
- Enhancing sustainable utilization of resources and ecosystems for the benefit of the present and future generations.
- Ensuring that development policies, programmes and projects do take environmental consideration into account from the onset.
- Initiating and sustaining well coordinated programmes of environmental education and training at all levels of the society.

5.2 National legislation

In the last decade, the country has passed several important legislations that are relevant to FGR. These are briefly discussed in the following paragraphs.

5.2.1 Forests Act 2005

The conservation of FGR is contained within the Forests Act 2005 which compels KFS to manage forests for biodiversity conservation. It provides for the gazettement of Nature Reserves in Section 32 – where the Minister responsible for Forestry may declare a forest or woodland of particular significance either environmental, scientific or cultural to be a nature reserve for the conservation of its biodiversity and natural amenities. Under section 34, it provides for the protection of any tree, or family of tree species in the whole country through a Presidential decree. Section 36 also gives provision for conservation of biodiversity.

5.2.2 The Environmental Management and Coordination Act 1999

The Environmental Management and Coordination Act is the key statutory instrument regulating access to genetic resources in Kenya. It was enacted in 1999 and came into force on 14th January 2000. Section 7 of the Act establishes the National Environment Management Authority as a

body corporate with perpetual succession. Section 53 stipulates that the Authority shall issue guidelines and prescribe measures for the sustainable management and utilization of genetic resources of Kenya for the benefit of the people of Kenya. The guidelines shall specify appropriate arrangements for access to genetic resources by non-citizens, including the issue of licenses and fees to be paid for that access. Guidelines shall also be made for the sharing of benefits derived from genetic resources of Kenya.

5.2.3 The industrial Property Act, 2001

The main object of this Act is to provide for the promotion of inventive and innovative activities, to facilitate the acquisition of technology through the grant and regulation of patent, utility model, technovation and industrial design. Section 3 of the Act establishes the Kenya Industrial Property Institute (KIPI). This law is, in conformity with the Trade Related Intellectual Property Rights (TRIPS) Agreement.

Section 26 (a) of the Act stipulates that plant varieties as provided in the Seeds and Plant Varieties Act cap 326, but not parts thereof or products of biotechnological process are not patentable. It is clear from this provision that plants varieties have been excluded from patentability. Recognizing that there is an obligation to protect new Plant varieties, Kenya already has in place a Seeds and Plant Varieties Act that fulfils this obligation. The country therefore provides for protection of plant varieties by an effective *sui-generis* system under provisions of the UPOV convention.

5.2.4 The national biotechnology development policy, 2006

The Kenyan government has approved a biotechnology policy, which gives details on research, development and application of biotechnology in the country. The National Biotechnology Development Policy 2006 was approved by the cabinet on 28th September 2006 and marked the go-ahead for the use of the technology in the country. It outlines the safety procedures for biotechnology in the context of research and development, technology transfer and commercialization of products that would result from research undertaken in Kenya. The document recognizes the role that biotechnology can play in poverty reduction, enhancing food security and conservation of the environment and biodiversity. The policy outlaws human cloning, terminator technologies and any other technology found to be entailing unethical scientific practice. Any use of biotechnology in Kenya must receive the approval of the designated authority and meet the requirements of Kenya's Environment Management and Coordination Act of 1999.

5.2.5 The seeds and plant varieties (national performance trials) regulations, 2009

The regulations give the procedures required for varieties to undergo National Performance Trials (NPT), an exercise that is conducted by KEPHIS. The regulations require that all varieties of crops listed in schedule 1 must undergo NPT before commercialization. Under the regulations, a Trial Committee whose mandate is to among other things, oversee the conduct of NPTs is to be established. For a variety to pass the NPTs, it must be Distinct, Uniform and Stable after which it is forwarded to the National Variety Release Committee for official release.

5.2.6 Environmental management and co-ordination (conservation of biological diversity and resources, access to genetic resources and benefit sharing) regulations, 2006

Section 53 of The Environmental Management and Coordination Act, 1999 stipulates that the Authority shall issue guidelines and prescribe measures for the sustainable management and utilization of genetic resources of Kenya for the benefit of the people of Kenya. It is in reference to this provision that the Environmental Management and Co-ordination (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations, 2006 were developed. According to the regulations, any person intending to access genetic resources for any purposes must apply to NEMA by filling application forms for an access permit. Such an application must be accompanied by necessary fees as specified in the regulations. The regulations also require the application to be accompanied by evidence of Prior Informed Consent from interested persons and relevant lead agencies, and a research clearance certificate from the National Council for Science and Technology.

5.3 Training and research

As indicated in Table 5.1, a number of government organizations are involved in research and training on forest genetic resources. Topics on forest genetic resources are taught both at the college and university depending on the levels of training. Nairobi, Mombasa and Eldoret polytechnics train technicians at diploma and advanced diploma level. Londiani College teaches forestry to certificate and diploma level while polytechnics produce a small number of technicians with applied biology.

Several universities and university collages offer degree courses in forestry and forest related courses. These include; Chepkoilel, Kabianga, Karatina, Southeastern, Narok and Kitale university collage, Nairobi, Egerton, Kenyatta, Maseno and Jomo Kenyatta Universities have departments of botany or natural sciences that offer training relevant to forestry, biological diversity and plant genetics. The capacities produced are different in the various universities and with the recent crash programme on parallel degrees by almost all the above national universities, the statistics on capacities produced has not been easy to record or confirm with certainty. Kenya institutions of higher learning have, however, made great contribution to the human capacities in forestry and biological sciences in the eastern and southern Africa region, especially Lesotho, Swaziland, South Africa, Botswana and Namibia.

Table 5.1: Organisations involved in Development and issues of forest genetic resources.

Organisation	Role in FGR Development
Kenya Forest Service	Manage indigenous, plantation forests, nature reserves and control their use
Kenya Wildlife Service (KWS)	Manage national parks, game reserves, sanctuaries and marine parks in the country
County Councils	Manages over 350,000 ha of mainly woodlands under the trust land
Kenya Forestry Research Institute (KEFRI)	Undertake research and advisory services in the areas of natural forests, forest plantations, farmlands and dry lands. Also disseminates information on tree and forestry development.
National Museums of Kenya (NMK)	Manages the network of national herbarium, collect plants materials and manage national monuments. Hosts the National Biodiversity Centre

National environment Management Authority (NEMA)	Regulate environmental management law and ensure compliance according to regulations, rules and environment impact assessment for development initiatives.
Kenya Plant Health Inspectorate Services (KEPHIS)	Regulates import and export of plant products through ensuring health Controls
African Centre for Technology Studies (ACTS)	Undertake studies on biodiversity policy, MTAs, and trade in biotechnology materials and related issues.
Local Universities	Research in natural resources and plant sciences. Training in plant biodiversity, genetics and plant breeding.
ICRAF, IPGRI, IRLI, etc	Research in Agroforestry and conservation of on-farm germplasm and fodder for agricultural and livestock development in collaboration with national institutions and NGOs
NGOs and Community Based Organizations (CBOs)	Several involved in lobbying for conservation and sustainable management of forests. CBOs are involved in the implementation of mostly conservation projects in collaboration with local communities
Ministry of Agriculture	Through the Farm Forestry Rules 2009 require farms to maintain at least 10% tree cover.

*source of information (Kigomo,BN. 2001)

Table 5.2 Needs for developing forest genetic resources legislation.

Needs	Priority level			
	Not applicable	Low	Moderate	High
Improve forest genetic resources legislation	√			
Improve reporting requirements				√
Consider sanction for non-compliance		√		
Create forest genetic resources targeted regulations		√		
Improve effectiveness of forest genetic resources regulations			√	
Enhance cooperation between forest genetic resources national authorities				√
Create a permanent national commission for conservation and management of forest genetic resources		√		

Table 5.3: Forest genetic resources awareness raising needs.

Needs	Level of priority			
	Not applicable	Low	Medium	High
Prepare targeted forest genetic resources information			√	
Prepare targeted forest genetic resources communication strategy			√	
Improve access to forest genetic resources information				√
Enhance forest genetic resources training and education				√
Improve understanding of benefits and values of forest genetic resources				√

5.4 Assessment of gaps, needs and priorities

There is need for proper/effective coordination on issues relating plant genetic resource including FGR. This may be achieved through;

- Strengthening the National Biodiversity Centre hosted by the NMK and expanding its mandate and probably membership.
- The National Information Sharing Mechanism35 (NISM) which served a very important in building a network of institutions dealing with plant genetic resources should be strengthened.

Chapter 6: The State of Regional and International Agreements and Collaboration

6.1 Introduction

It is a well known and appreciated fact that all countries of the world are interdependent in so far as FGR are concerned. This interdependence therefore calls for collaboration both at the international and regional levels. In the pursuit of this collaboration, Kenya has joined hands with a number of countries and institutions in the development of forests, environment and natural resources, which are important sectors relevant to the conservation and management of forest genetic resources. These collaborative efforts and arrangements have to a great extent helped the country improve its capacity in the conservation and sustainable management of FGR. This chapter examines some the networks, fora and associations and other mechanisms for promoting and supporting collaboration at the regional and international level.

6.2 Regional and international collaborations

Kenya has joined hands with a number of countries and institutions in the development of forestry, environment, natural resources and agriculture, which are important sectors relevant to the conservation and management of forest genetic resources. Table 6.1 summarizes the most important regional and international co-operation relevant to the pursuit of forest genetic resources and environmental development.

Table 6.1: Co-operation in FGR related Development.

Network name	Partner Institution/Country	Nature of Cooperation
East Africa Community (EAC)	Kenya, Uganda, Tanzania, Rwanda and Burundi	The regional cooperation, based in Arusha, Tanzania, has an agenda on forest sector and issues of biodiversity, management, trade, MTAs in forestry will be addressed
Intergovernmental Authority on drought and Development (IGADD)	Kenya, Somalia, Djibouti, Ethiopia, Eritrea, Sudan and Uganda	Forest sector development is an important agenda within the "Development of environmental protection and agricultural research".
Association of Forestry Research of East Africa (AFREA)	Sudan, Eritrea, Ethiopia, Djibouti, Kenya, Uganda, Tanzania, Rwanda, Burundi	Co-operation in research in forestry focusing on priority areas and sharing of information for development in the region.
Global Forest Information System(GFIS)	Global. In Africa nodes at Kenya, Ghana, Zimbabwe, Senegal, Madagascar	Global sharing and exchange of information in forestry and institutional strengthening information technology for forestry development.
Sub-Saharan Programme on Forest Genetic Resources (SAFORGEN)	IPGRI, FAO, DANIDA, ICRAF, Regional member countries	Research and development in forest genetic resources. Capacity building in FGR

6.3 Regional and international agreements

Kenya has ratified or signed several international agreements relevant to access to FGR, transfer and sharing. These include;

a. Nagoya Protocol on Access and Benefit-sharing signed on 2012-02-01
b. Cartegena Protocol on Biosafety signed in 2000 and ratified in 2003.
c. World Intellectual Property Organization WIPO
d. African Regional Intellectual Property Organisation –ARIPO
e. Trade Mark Law Treaty- now Singapore Treaty on the Law of Trademarks since 28th March 2006.
f. Paris convention for protection of Industrial Property.
g. Madrid Union (Madrid Agreement & Protocol) on International Registration of Marks.
h. We are about to join Nice Agreement on classification of Trade and Service Marks.
i. We use Vienna Classification although not members of Vienna agreement (There is provision in Trademarks Act for both Nice and Vienna classifications)
j. Patent cooperation treaty PCT
k. Berne convention on Copyright
l. Nairobi Treaty on the Protection of the Olympic Symbol
m. UPOV for New Plant varieties
n. Trade Related Aspects of Intellectual Property Rights (TRIPS).

Table 6.2: Awareness raising needs/ Needs for international collaboration and networking.

Needs	Level of priority			
	Not applicable	**Low**	**Medium**	**High**
Understanding the state of diversity			√	
Enhancing in situ management and conservation				√
Enhancing ex situ management and conservation				√
Enhancing use of forest genetic resources			√	
Enhancing research				√
Enhancing education and training				√
Enhancing legislation			√	
Enhancing information management and early warning systems for forest genetic resources.			√	
Enhancing public awareness			√	
Any other priorities for international programmes				

Chapter 7: Access to Forest Genetic Resources and Sharing of Benefits arising from their Use

7.1 Regulations

The protection of Kenya's natural landscapes and biodiversity as well as their enhancement continues to be guided by the Environmental Management and Coordination Act (EMCA), 1999. This act stipulates that the National Environmental Management Authority- NEMA coordinates the management of biodiversity resources in Kenya. Lead institutions (KFS, KEFRI, KWS and NMK) achieve this through the enactment of their respective acts of parliament. Under the new constitution, the current legislation if found deficient, may be strengthened by policies and guidelines developed by the National and respective County governments. In this regard, NEMA enacted subsidiary regulations (Legal Notice No. 160 of 2006) to regulate issues related to access to FGR and sharing of benefits arising from their use. The legal notice covers issues related to Environmental Impact Assessment License, the Conservation of threatened species, inventory of biological diversity, monitoring of status, protection of environmentally significant areas, the requirement for access permits, the mandatory requirement of a Material Transfer Agreement before materials are taken out of the country, and the issue of Benefit Sharing.

The Forests Act 2005 takes recognition of the importance of forests as the locus of Kenya's biological diversity in its *Preamble* and in the Legal Notice No. 165. The Forests Act, 2005 (No. 7 of 2005) and The Forests (Participation In Sustainable Forest Management) Rules, 2009 requires the preparation of a Cost/Benefit Sharing mode for benefits arising out of the products and services arising out of joint management of a forest.

Other institutions relevant to access and benefit sharing include the Kenya Industrial Property Institute (KIPI), a body corporate in the Ministry of Trade and Industry administers the Industrial Property Act 2001 of the laws of Kenya covering Patents, Trademarks, Service marks, Industrial designs and Utility models. Copyright is administered by the Copyright Board of Kenya an office in the Attorney General Chambers under the Copyright Act 2001 of Kenya. The Plant varieties Act of Kenya is administered by the Kenya Plant Health Inspectorate Services KEPHIS.

The practical implementation of the CBD provisions on ABS within national (and/or regional) spheres has not been an easy task for most countries including Kenya. Save for the shortage or lack of needed capacity, the peculiarity of the interests involved has made the legislating exercise very complicated and exhausting. Due to, on the one hand, encroaching, and on the other, contradicting laws/rights, and the failure of the CBD to commit the effort of user countries in the realization of measures of provider countries, the latter is often prompted to rely on stringent laws so as to counter bio-piracy and illegal post-export usage of acquired biological resources, as well as traditional knowledge, and ensure compliance. Unfortunately, this approach seems to hurt the provider countries more frequently than the user countries. Kenya's ABS legislation entered into force recently. Its provisions seem to be a conscious or unconscious adoption of the stringent approach applied by forerunner provider countries. Although no practical case of its impact on either basic or commercial bioprospecting projects exists, it is easy to predict that the procedure created by its provisions for application of an access permit will most likely repel potential projects. The procedure is too long and has the tendency of becoming very

cumbersome, exhausting and expensive depending on the scope of the applicant's interests. It also creates a feeling of uncertainty for future activities of newly initiated projects.

In its current state, Kenyan ABS (Kamau 2009) legislation creates hurdles to access rather than facilitating it. Its practical application would most likely be in conflict with Article 15.2 of the CBD and hence against CBD's objectives. Consequently, it needs to be revised to make it more proactive (rather than reactive) and workable and thereby conform to the CBD ABS provisions. Some bioprospecting projects play a vital role in research and development. Creating hurdles for them would be self-created injustice to the country apart from running counter to the objectives of the CBD. That does not imply the legislation should be loose enough to allow irregularities and illegal utilization of genetic resources and traditional knowledge. Nonetheless, a long, exhausting and/or expensive procedure does not necessarily produce compliance. There are loopholes which if sealed could produce positive results that stringent laws are not capable of achieving. Instead of granting provisional licenses of access, for example, it is better to shorten the application procedure. There are also conflicting and contradicting mandates, duplicated procedures and costs, which should be eliminated by unifying (harmonizing) the process. This will simplify it and render it more attractive for applicants. Compliance should be sought at the research and export levels through monitoring and control, as well as effective sanctions.

7.2 Main stakeholders

The main stakeholders are the local community – although modalities or mechanisms are still being refined. The Forests Act 2005 has made provisions for the recognition of the local community and their integration in forest management. The other stakeholders are the Government institutions involved in managing forest – KFS, KEFRI, KWS and NMK - that are lead agencies for forests gazetted as forest reserves, national parks or national reserves and cultural forests "*Kayas"*, respectively. Other stakeholders include the civil society (INGOs, NGOs, CBOs etc) involved in forest management in one way or another.

Chapter 8: The Contribution of Forest Genetic Resources to Food Security, Poverty Alleviation and Sustainable Development

8.1 Forest and Agricultural Sustainability

Sustainable utilization and conservation of forest genetic resources can and has been used to address challenges of poverty, food insecurity, environmental degradation, malnutrition and other health related problems. In addition FGR offers immense opportunities in income generation for the communities dealing with or living around them. Human population increases and subsequent demand for more land for settlement and farming has threatened FGR. Land degradation, deforestation, overgrazing and invasive species are among the greatest threats to FGR. Sustainable management of FGR is critical to agricultural development that is ecologically sound, economically viable and socially just, and one that aims to produce the food, and/or the income needed to achieve food security.

8.2 Food Security and Poverty Alleviation

Poverty alleviation and sustaining development are among the highest priorities under the Millennium Development Goals (http://www.un.org/millenniumgoals/). The environment is an important component of these goals. Kenya is endowed with a variety of habitats and ecological systems that makes it a custodian of a unique heritage of biodiversity. In addition to forests, this rich biodiversity includes wildlife, farmlands, vegetation, wetlands, marine life forms and micro-organisms. Properly utilized, these resources are a vital component in reducing environmental degradation. Recent events in various parts of the country clearly indicate the importance of FGR in climate regulation among other ecosystem services. The failure of the *7th Wonder of the World* – the Wildebeest migration and the drying up of Lake Nakuru, Lake Naivasha and the drying up of boreholes in Egerton University, Njoro demonstrated the effects/impact of the destruction of the Mau Forest Complex coupled with climate change. This had a major impact on the livelihood of the communities living around these areas and beyond. As the livelihoods of the local communities are threatened and so is the existence of some woody plants such as *Oysris lanceolata* (African sandalwood) that is threatened due to demand in the cosmetic industry and its difficult propagation and limited dispersal and harvesting system. FGR have a positive impact on microclimates and buffer the effects of desertification. These resources also help to check run off and soil erosion, control flooding, purify water and protect against wind.

FGR also play an essential role in dietary nutrition and health. This is particularly evidenced in times of drought where communities in the dry parts of the country rely on trees such as *Adansonia digitata*, livestock grazing in forests such as Mt. Kenya. A recent study by the World Bank reported that 70% (21million) of the country population is not covered by the national healthcare system and depend on traditional forms of medication which include FGR. Important (commercialized to some extent) medicinal plants being produced in the country include *Ocimum kilimandscharicum, Mondia whytei* and *Prunus africana*.

FGR are being targeted to play a major role in the bio-fuel industry (especially bio-diesel) in the provision of feedstock. Among the potential native species is *Croton megalocarpus* and *Jatropha curcas*. Kenya has developed a National Bio-diesel Strategy that among other issues seeks to provide direction to avoid competition of bio-diesel crops with food crops for land by confining

it to the arid and semi-arid lands which are only marginal for agricultural production. The strategy promoting sustainable bio-fuel production, including:

1. The application of guidelines and standards in the framework of the ecosystem approach;
2. The application of biodiversity-inclusive guidelines on environmental impact assessment and strategic environmental assessment;
3. The development of sound policy frameworks that contribute to both the mitigation of greenhouse gas emissions and the conservation and sustainable use of biodiversity; and
4. The promotion of research to improve the economy and yields of energy biomass.
5. Enhancing awareness on issues relating to bio-fuels among policy makers, farmers, business, and other stakeholders, to enable fully-informed decision making.

Table 8.1: Tree and other woody species that are important for food security or livelihoods.

Species		**Use for food security**	**Use for poverty reduction**
Scientific name	**Native (N) or Exotic (E)**		
Acacia nilotica	N	√	
Acacia tortilis	N	√	
Acacia senegal	N	√	√
Acacia seyal	N	√	√
Azadirachta indica	N		√
Balanites aegyptiaca	N	√	√
Eucalyptus camaldulensis	E		√
Eucalyptus tereticornis	E		√
Faidherbia albida	N	√	
Hyphaene compressa	N		√
Melia volkensii	N	√	√
Moringa oleifera	N	√	
Moringa stenopetala	N	√	
Sclerocarya birrea	N	√	
Tamarindus indica	N	√	√
Terminalia brownii	N		√
Ziziphus mauritiana	N	√	

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