ETHIOPIA:

COUNTRY REPORT TO THE FAO INTERNATIONAL TECHNICAL CONFERENCE ON PLANT GENETIC RESOURCES

(Leipzig,1996)

Prepared by:

Plant Genetic Resources Center

Addis Abeba, April 1995

Note by FAO

This Country Report has been prepared by the national authorities in the context of the preparatory process for the FAO International Technical Conference on Plant Genetic Resources, Leipzig, Germany, 17-23 June 1996.

The Report is being made available by FAO as requested by the International Technical Conference. However, the report is solely the responsibility of the national authorities. The information in this report has not been verified by FAO, and the opinions expressed do not necessarily represent the views or policy of FAO.

The designations employed and the presentation of the material and maps in this document do not imply the expression of any option whatsoever on the part of the Food and Agriculture Organization of the United Nations concerning the legal status of any country, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

Table of contents

CHAPTER 1
Introduction to Ethiopia and its Agricultural Sector

1.1 PHYSIOGEOGRAPHIC AND CLIMATIC FEATURES

Ethiopia is located in the horn of Africa between 3º and 18º North latitude, 33º and 48º east longitude, and lies within the tropics. It has diverse Physiogeographic features with high and rugged mountains, flat topped plateaux, deep gorges, incised river valleys and rolling plains. The altitudinal variation ranges from 110m below sea level in same areas of Kobar Sink, to 4,620 meters above sea level (masl) at Ras Dashen. The great rift valley runs from northeast to southwest of the country and separates the western and southeastern highlands. The high lands on each side of the rift valley give way to extensive semi-arid lowlands to the east, south and west of the country.

The highlands cover the central lava highlands and massifs consisting of the Gondar, Wello and Gojam highlands; and the southwestern plateau of Gamo Gofa, Illubabor and Wellega. In the South-Eastern parts are found highlands of Arsi, Bale, Hararge and Sidamo. These highlands have high mountains on their western rim with continuous slopes running from the highest peak of Mt. Batu towards the southeastern lowlands (Map).

Ethiopia is a tropical country with varied macro and micro-climatic conditions that have contributed to the formation of diverse ecosystems inhabited with a great diversity of life forms of both animals and plants. The rain fall distribution is seasonal and is mainly governed by the inter annual oscillation of the surface position of the Inter-Tropical Convergence Zone (ITCZ), that passes over Ethiopia twice a year. This causes variations in the wind flow patterns and the onset and withdrawal of winds from north and south.

The mean annual rainfall patterns range from 500 mm to 2,800 mm. The South western region receives the heaviest annual rainfall which goes up to 2,800 mm in some areas. The central and northern central regions receive moderate rainfall that declines towards northeast and eastern Ethiopia, and the southeastern and northern regions receive an annual rainfall of about 700 mm and 500 mm. respectively. The relative humidity regimes that closely follow the rainfall pattern, the rainfall pattern itself and the high variation in temperature ($> 30^0$C and $< 10^0$C) influence types and diversity of the vegetation and their distribution over the country.

1.2 POPULATION

Ethiopia has an estimated population of approximately 53 million, and about 88 percent of the total population is considered as rural dwellers. The estimated population growth is about 2.9 percent per annum. The settlement pattern of the population is influenced by environmental factors such as altitude, climate, soil fertility and by the economic activities which altogether skewed the population distribution towards the highlands. The Ethiopian highlands (>1,800 masl) which covers 37 percent of the total area is inhabited by about 77 percent of the population. Hence, the highlands of the country are densely populated, resulting in over-grazing and severe degradation of the vegetation, while the lowlands, being affected by insufficient rainfall and high temperature are sparsely populated. This skewness in human population distribution is one of the important factors that have impacts on the productivity of agricultural lands and the conservation and management of biological resources.

1.3 MAJOR FARMING SYSTEMS

The Ethiopian region is characterised by a wide range of agro-climatic conditions with diverse cultural and farming practices that can be grouped in to three major agricultural systems: *The highland mixed farming system, The low plateaux and valley mixed agriculture* and *The pastoral livestock production of the arid and semi-arid zones.* Agriculture in Ethiopia is a basis for the entire socio-economic structure of the country and has a major influence on all other economic sectors and development processes of the country. It provides for the country about 80 percent of the total employment and generates about 40 percent of the country's earnings from export. Of the total area, which is 122 million hectares, 84 million hectares (69 percent) of the total area is classified as an agricultural land suitable for crop and livestock production. Of this, about 14 million hectares (17 percent) is cultivated, where as about 8 million hectares of it fall under major crop production.

1.3.1 The highland mixed farming system

This farming system is typically found in areas of higher elevation which is usually above 2,000 masl. Crop production under this farming system is diverse and multiple cropping with limited inter-cropping is intensively employed. Traditionally, continuous cropping is exercised through crop rotation, where cereal production alternates with the production of legume crops as a means of maintaining soil fertility. Types of crops/plants and its diversity grown for food and as a source of cash income and for other purposes is highly varied being influenced by diversified agro-climates, and diverse social and cultural nature of the people. The highland mixed farming system includes the mixed crop livestock complex. The livestock component within this system is a strong element where animals are used for ploughing and transport, and their products serve as a major source of fuel, food and manure for soil fertility. Livestock is kept throughout the year on natural pasture and stubble.

1.3.2 Low plateaux and valley mixed agriculture

This is a sedentary agriculture of the intermediate or low highlands, mountain foothills and upper valleys, often practised at an altitude ranging from 1,500 to 2,000 masl. Under this system, both crop and livestock production are economically important. However, the diversity of crops grown and the degree of integration of crop and livestock production is less pronounced. Sorghum and maize dominate the crop production with some oil crops, wheat and tef. Within this farming system, the livestock is usually shifted off the cropping zone during the crop growing season and is brought back after the harvest of the crops where animals are partly fed with crop residues kept as a stock.

1.3.3 Pastoral livestock production of the arid and semi-arid zone

Pastoral agriculture is practised mainly at an elevation below 1,500 masl and with annual rainfall of below 450 mm. In the arid zone, nomadic and semi-nomadic pastoral livestock production dominates with camels and goats as important components. In the semi-arid, semi-nomadic or semi-sedentary zone, livestock production is practised. The major components of the livestock production here are cattle and sheep, although camels and goats are found. Both water and range development are important elements to improve livestock production in here. The main crop in this area is maize. Low moisture is the major production constraint particularly in the arid zone. In this zone, there is a high potential for irrigated agriculture, specially for production of fibre crops, sugar cane, oil seeds, horticultural and forage crops.

1.4 CURRENT STATUS OF THE AGRICULTURAL SECTOR

The highlands of Ethiopia comprise a vast area of the country and receive reasonably good rainfall for crop production. In Ethiopia, farming system at small scale farmers level are traditional and managed with simple production technology. Ploughing is usually oxen driven and weeding and harvesting is made using simple farm tools. Traditionally, farmers select seeds for various traits and purpose, and also exchange seeds through traditionally established networking. Large scale farming was managed until recently, by state farms for large scale production of seeds of improved varieties.

Due to several reasons, crop production in Ethiopia has not yet been able to be maintained along with the rate of the population growth. Among the major factors attributed to low crop production is the topography, which is dissected, and makes the land vulnerable to degradation, and restricts the availability of suitable lands for farming. The situation has been exacerbated by the cultivation of very sleepy slopes and over grazing. Crop production under the diverse agro-ecological conditions of the country, in addition to the traditionally adopted landrace seeds, requires seeds of a number of modern varieties that could fit to diverse ecologies. On the other hand the existing breeding and seed multiplication capacity does not allow to fully overcome the critical seed problem at national level. Thus, the trend in the past few years had been towards a stagnated production level that caused decline in per capita food availability.

The national average yield of the major crops has also been very low due to, *inter alia*, changes in environmental conditions and indiscriminate diffusion of seeds of varieties of wrong adaptation. Over the years, most of the efforts with regard to seed production and distribution, remained very centralised and uncoordinated, and only few regions of the country could be covered with seed distribution and with little or no penetration into the off the road sites. Currently, the recognition of the seriousness of the problem has led to the formulation of a National Seed Policy that emphasises the multi-strategic seed system, in order to overcome seed shortage and sustain food production.

CHAPTER 2
Indigenous Plant Genetic Resources

2.1 VEGETATION

The flora of Ethiopia is estimated to be between 6,500 and 7,000 species. Ethiopia is among African countries known for endemism of wild plant and animal species and 12% of Ethiopia's flora is considered to be endemic. Endemism is reportedly high on the plateaus, mountains, in the Ogaden region and in the western and southwestern woodlands. The centre of endemism on the highlands of Ethiopia can be identified as follows:

- the southwestern centre, which is characterised by endemism of montane rainforest and evergreen bushland;
- the central plateau centre, which contains endemic deciduous woodland and montane grassland;
- the eastern escarpment and southeast slop centre, which has species such as *Spiniluma oxycantha* in dry evergreen forests and bushlands;
- the high mountain centre, which contains endemic ericaceous bushland and Afroalpine grasslands such as *Jasmimium staus* and *Rosularia semiensis*.

Forests compose the major portion of the flora of the country and are found in the regions of moist and wet intermediate altitude, moist and wet high altitude and in moist low altitude. About 25 percent of families of close relatives of cultivated crops are distributed in the forest areas of the country. This resource is sharply declining because of over exploitation of the natural forests, woodlands and bushlands, at a rate higher than the natural regeneration. Therefore, developing sound environmental policies and strategies, proper planning and implementation of conservation programmes, development and restoration of the natural vegetation have become areas of immediate concern to Ethiopia. The 23 vegetation types in Ethiopia, as recognised by Pichi-Sermolli, Friiss and other authors, and compiled as a National report to UNCED in Rio are grouped into the following major categories:

2.1.1 Desert and semi-desert scrubland

This vegetation type occurs between the semi-arid and arid lowland zones. The most common plant species found in this zone include *Heliotropism longiflorum, Euphorbia scordifolia, Elusine flagellifera, Panicum turgidum and Comeelina forskaolei.* The soil in this zone is vulnerable to wind and water erosion. The vegetation in the area is also threatened because of over grazing by both domestic and wild animals. Soil salinity is a potential environmental problem in the area. In general, this zone is liable to be converted into a desert if the current human activities continue unabated, and the drought conditions continue. Example is the Ogaden region, which is floristically the most species-rich area in Ethiopia and is ravaged as a result of overuse and harsh environmental conditions. The Maji-lower Omo Plains are the wettest of the arid areas where the population is entirely nomadic. Although there is an occasional failure of rain causing famine, the area is comparatively less threatened by desertification.

2.1.2 Acacia - Commiphora woodland

The Acacia-Commiphora woodland is mainly found in the north, east, south and central parts of the country. The zone occurs between altitudes of 500 and 1,900 masl with annual temperature ranging from 18^0 to 27^0C, and annual rainfall between 410 mm and 820 mm. The common species in this vegetation type include various species of *Acacia Commiphora, Zizyphus, Maerua, Cadaba, Boscia, Euphorbia, Aloe, and Sansevieria.* The savanna type in the Rift Valley is mainly open tree savanna. The trees include *Acacia tortilis, A. etbaica, A. seyal, A. abyssinica, A. spirocarpa subsp. spirocarpa, A. mellifera, Ballanites eagyptica* and *Erythrina, Aerva spp., Acalypha spp., and Barleria spp.*

The small-leaved deciduous woodlands have traditionally been grazing areas. Since the area is sometimes continuously dry for as long as 10 months, the zone is sensitive to over grazing. The vulnerability of the area is aggravated by recent development of irrigated farming. The Rift Valley in Shewa is a good example, where intensive agricultural activities and tree harvesting for fuel wood and charcoal have left the area nearly bare.

2.1.3 Wet evergreen forest

The evergreen forest is subdivided into the humid mixed forest and the humid broad-leaved forest. The humid mixed forest occurs in the east of the Rift Valley (Arsi, Bale, Hararge and Sidamo) at an altitude ranging from 1,500 to 2,600 masl. These areas have the annual temperature between 15^{0}C - 20^{0}C and mean annual rainfall of 700-1,500 mm.

The humid broad-leaved forest occurs mainly in the southwestern parts of the plateau in southern Wellega, Illubabor and western Kefa, at an altitude ranging from 1,500-2,500 masl, with annual temperature of 18^{0}C - 20^{0}C, and an annual rainfall between 1,500 and 2,000 mm. Floristically, it is a rich forest with a number of endemic species. It is also a major coffee area. The natural vegetation is threatened by the expansion of commercial coffee plantations. The common species in the zone include L. *Aninngeria adolfi-friedericii, Trilepsium spp., Morus mesozygia, Mimusops kummel, Podocarpus gracilior, Coffee arabica,* and *Galiniera coffeoides.*

2.1.4 Lowland (Semi-) evergreen forest

This type of low land forest has been identified very recently and occurs in small areas in Gambela, in the western part of the country. It is found at an altitude of 450 to 600 masl, having annual maximum temperature between 35^{0}C and 38^{0}C, and minimum annual temperature between 18^{0}C and 20^{0}C. The annual rainfall is between 1,300 mm and 1,800 mm. The common species found in here include *Baphia abyssinica, Celtis toka, Diospyros abyssinica, Malacantha alnifolia, Trichilia spp., Zanha golungensis and Alstonia boonei, Antiaris toxicaria, Celtis gomphophylla,* and *Milicia exelsa.*

2.1.5 Broad-leaved deciduous woodland

This vegetation type occurs in the Northwestern and western parts (Gojam Wellega, Illubabor) and south western region (Gamo Gofa, Kefa). The upper altitudinal limit is about 1,900 masl and the lower about 500 masl. The common species include *Boswellia papyrifera, Anogeissues leiocarpa, Terminalia brownii, Combretum collinum, Balanites aegyptiaca, Commiphora africana, Erythrina abyssinica, Stereospermum kunthianum, Gardenia lutea, Lannea schimperi, Piliostigma thonningii,* and *Lonchocarpus laxiflorus.*

2.1.6 Dry evergreen montane forest and montane grassland

In the extreme north, where the climate is much hotter and drier than further south on the plateau, the lower limit for the dry evergreen montane forest is about 2,100 masl. The area receives an annual rainfall of 400 mm to 700 mm with an annual temperature between 18^{0}C and 20^{0}C. In the western and central parts (Gojam, Shewa, Wello and Tigray plateaus) the lower altitudinal limit is about 1,900 masl with an annual rainfall of 500 mm - 1,500 mm and annual temperature of 14^{0}C -18^{0}C. The upper altitudinal limit in these areas is about 3,200 masl.

In the south and southeastern of the country (Sidamo, Bale and Hararge) this forest type occurs at altitudes between 1,500 and 2,200 masl with an annual rainfall of 400-700 mm and temperature between 20^{0}C and 25^{0}C. The dominant tree in all cases is *Juniperus procera*, a tree well adapted to dry conditions. This zone, with a long history of sedentary cereal-based mixed agriculture is densely populated. As a result, the area is seriously deforested and the degradation is more severe in the north than in the south and eastern parts of the zone. The common trees grown here are *Olea europea subsp. cuspidata, Hagenia abyssinica, Prunus africana and Juniperus procera, Podocarpus gracilior, Teclea nobilis, Croton machrostachys and Cordia africana, Ekebergia rueppeliana, Mimusops kumel, Millettia ferruginea, Arundinaria alpina* and *Acacia abyssinica.*

The dominant shrubs include *Acokanthera schimperi, Carissa edulis, Euclea sp., Rhamnus staddo, Myrsine africana, Dodonea angustifolia, Rhus sp., Calpurnia aurea, Jasminium abyssinicum Osyris lanceolata, Ximenia americana, Protea guguedi, Calpurnia aurea, Grewia sp., Hypericum lanceolatum, Bersama abyssinica. Peterlobium stellatum, Buddleja polystachya, Rosa abyssinica, Otostegia integrifolia, Echinops sp.*

Some of the common grasses and other herbs are *Pennisetum schimperi, Hyperrhenia hirta, Andropogon spp., Kniphofia sp., Scadoxus multiflorus*. The above indicated evergreen scrub, consisting of mostly the shrubby plants, occur in the lower parts of the dry evergreen montane forest and montane grassland.

2.1.7 Afroalpine and sub-Afroalpine

These zones consist of areas which are higher than 3200 masl. It include all the slopes and tops of highest mountains on either side of the Rift Valley. Mountain ranges of Gondar, Gojam, Wello, Shewa, Arsi, Bale and Gamo Gofa fall under these zones. The natural vegetation in the area is threatened by grazing, barley cultivation and fire. The most common plant species in the zone are *Lobelia rynchopetallum, Alchemilla spp.* and *Helichrysum spp., Festuca sp., Erica arborea, Phillipia trimera, Hypericum lanceolatum, Rosa abyssinica, Rapanea simensis, Myrica salicifolia, Protea gaguedi.*

2.1.8 Riparian and swamp vegetation

This type of vegetation is found along banks of perennial rivers and shorelines of some inland lakes. Its occurrence is attributable to the high soil moisture. It includes the common species on the river banks of a number of rivers including Nile river system, and the vegetation of the Lake Tana and the Rift Valley Lakes. The common species occur along these river banks are *Ficus sycomorus, F. vasta, Tamarindus indica, Syzygium guineense, Acacia sieberiana, Salix subserrata, Tamariz aphylla, Trichilia emetica, Sesbania punctata, Canahia lanifolia, Ficus glumosa, Ficus salicifolia, Cordia africana, Diospyros mespliformis* and *Chasmanthera dependent.*

In the Nile river system, the common species include *Syzygium guineense, Apodytis dimidiata, Pittosprum abyssinicium, Millettia ferruginea, Mimusops kummel, Ficus vasta, Maytenus serrata, Carissa edulis, Euclea schimperi, Pitosporum abyssinicum, Phoenix reclinate* and *Cyperus papyrus.* In the Awash Valley, the vegetation consists of mainly *Diospyros mespliformis, Ficus sycamorus, Mimusops kummel, Tamarindus indica, Zizyphus mucrnata, Maytenus senegalensis, Rhamnus sp. Acacia oerfota, Triumfetta spp., Acalypha, Salvadora persica, Solanum adoense, Hibiscus sp., Sacrostemma viminale, Tamarix sp., Acacia nilotica, Acacia tortilis subsp. sprocarpa, Acacia albida, Acacia asak,* and grasses such as *Cynodon sp., Sorghum virigatum* and *Sporobolus spp.*

Along the river banks of Wabi Shebelle, the common species are *Phoenix reclinate, Acacia seyal, Acacia asak, Kigelia aethiopica, Mooringa ruspoliana, Cordia sp., Commiphora spp., Croton pulchellus* and *Pistacia lentiscus.* The large riverine forest in the Lower Omo Valley is consisted of *Celtis toka, Celtis zenkeri, Haplocoelum foliolosum Melanodiscus oblongus, Tamarindus indica, Terminalia brevipes, Trichilia emetic* and *Zizyphus pubesens.* Along the shore lines of the rift valley lakes, the common species include *Cyperus papyrus, Typha angustifolia, Juncus fontanesii, Scripus sp., Aeschynomone elaphroxylon, Nymphaea coerulea, Acacia albida, Phoenix abyssinica, Euphorbia abyssinica, Acokanthera schimperi, Kigelia aethiopica, Todalia*

asiatica and *Phragmitis maxima.* The riverine forest in the western rivers' banks contain *Baphia abyssinica, Celtis toka, Malacantha alnifolia, Tapura fischeri, Trichilia retusa* and *Zizyphus pubescens.* Along the coast of Lake Tana and the islands, the common species include *Mimusops kummel, Syzygium guineense, Albizia schimperiana, Ficus ovata, Flacourtia indica, Phoenix reclinata, Cyperus papyrus* and other *Cyperus spp.*

Although much is lost, the remaining flora of Ethiopia is still considered to be rich both in species diversity and endemicity. However, though the potential economic importance of different forest species, wild relatives of cultivated crops and plants of traditional medicine has been recognised, pragmatically, there has been very little progress made in their systematic conservation and utilization. A well compiled and complete information on species abundance in general and genetic diversity in particular is still lacking. Areas of high endemism and are in a critical need of conservation include the Ogaden region, the Afroalpine and sub-Afroalpine regions, the evergreen forests of the west and southwest, the central plateau and the eastern escarpment. These areas are currently threatened by human activities, environmental changes and other natural variables.

2.2 ETHIOPIAN LANDRACES

There is a tremendous diversity in Ethiopia's landrace germplasm. The Ethiopian wheat has an extremely high morphogenetic diversity including polymorphism. All characters and forms of barley existing in Africa and Europe are highly concentrated in Ethiopia's landrace barley. The Ethiopian sorghum is one of the most diverse crops distributed over a wide range of ecological variation in the country, 400-3,000 masl. Intermediate as well as several wild and weedy forms of sorghum are there. Legumes of Ethiopia possess high diversity including some dominant genes responsible for unique characters that are rare or not common to many parts of the world.

Until the 1970's, the diversity in the landraces was unaffected significantly. However, due to repeated drought in some areas of high crop diversification in the country, and diffusion of exotic seed varieties that has been displacing the landraces, the pace of genetic erosion was tremendously increased after 1970's. Displacement of indigenous landraces by genetically uniform varieties, changes in crop pattern and land use have largely affected the magnitude of the genetic diversity in the indigenous crops. Arisi and Bale are seriously affected areas with modern agricultural exercises for over the last three decades. In these and other regions, the native barley is suffering a serious genetic ero-

sion due to gradual displacement of the crop by other crops, especially by introduced varieties to the region. Durum what is giving way to Tef (*Eragrostis tef*) and new bread wheat varieties, particularly in areas where extensive wheat breeding activities have occurred since the sixties.

In the Central Highlands including northern Shewa and Gojam region, introduced varieties of oats have replaced a wide range of crops grown in these areas. Certain places in which the so called surplus production programme was conducted over the last decade or so, have amazingly lost a larger portion of their diversity within a very short period. Seeds of certain varieties introduced to these areas through various imposed programmes are now attacked by disease, and have lost adaptation to the locality through time.

Although much of the diversity is still in the hands of farmers, a lot of it has already been lost and the impact of the threat has also been extended to the traditional management systems of varieties of crops developed and used by the local people through generations. The situation therefore, has created an awareness that long-term food security depends on the ability to systematically maintain and use the existing genetic diversity of the indigenous crops. As one of the strategies to meet the challenge, the Ethiopian Gene Bank has developed *in situ* landrace conservation and enhancement programmes, that involve breeders, farmers and others, in several stages of maintenance, restoration and improvement processes of traditional crop varieties. The major landrace crops of Ethiopia include the following:

2.2.1 Cereals

Barley (*Hordeum vulgare).* Barley has no wild relative in Ethiopia. Nevertheless, the crop has an extremely high morphological diversity - regular; irregular and deficiens barley types. Many authors have identified Ethiopia as a centre of diversity for barley. In addition to phenotypic diversity, the Ethiopian barley is important source of genes for barley yellow dwarf virus resistance, high lysine, drought resistance, resistance to diseases such as powdery mildew, leaf rust, spot blotch, septoria, loose smut and barley stripe mosaic virus.

Wheat (*Triticum spp.*). According to Vavilov, the diversity in Ethiopian wheats, comprises six wheat species: *T. durum subsp. Abyssinicum*; *T. turgidum subsp. abyssinicum; T. dicoccum; T. aestivum; T. polonicum* and *T. compactum.* Currently, the five Vavilov's tetraploid species listed above are classified under *Triticum turgidum*. All these species of wheat observed by Vavilov in the mid-1920s are still grown by farmers as landraces. Although Vavilov regarded the Ethiopian region as a Centre of origin and diversity for tetraploid wheats, the absence of wild relatives and lack of archaeological evidences suggest that Ethiopia could be a secondary centre of origin. The di-

ploid einkorn and the hexaploid wheat do not seem to be native to the Ethiopian gene centre.

Sorghum (*Sorghum bicolor*). Ethiopia has a diverse wealth of sorghum germplasm adapted to a range of altitudes and rainfall conditions. Of the five morphological races of sorghum (*bicolor, guinea, caudatum, durra,* and *kafir*) all except kafir are grown in Ethiopia. Important traits reported from Ethiopian sorghum include cold tolerance, drought resistance, resistance to sorghum shoot fly, disease and pest resistance, grain quality and resistance to grain mould, high sugar content in the stalks, and high lysine and protein content.

Tef (*Eragrostis tef*). Tef is an Ethiopian domesticate and is grown under a range of altitudes, rainfall and soil types. Although, its genetic diversity is not well studied, it has an immense phenotypic diversity in plant height, size and compactness of panicle, and seed colour. Among several wild Eragrostis species, *E. pilosa,* the possible progenitor of the cultivated species, seems to be the closest relative of the cultivated tef.

Finger millet (*Eleusine coracanaa*). It is very likely that finger millet is of Ethiopian origin. At present, it is mainly grown in the north-western parts of the country and shows less diversity compared to other indigenous cereals. The wild species, *E. africana*, the possible progenitor of the cultivated species, occurs as a weed in finger millet fields. Pearl millet (*Pennisetum americanum*), though less important in production, is believed to have been originated in Ethiopia.

Oats (*Avena* sap.) There are two wild/weedy tetraploid oat species (*Avena Abyssinia* and *Avena vaviloviana*) which are endemic to Ethiopia.

Rice (*Oryza* sap.) Two wild rice species (*Oryza barthii and O. longistaminata*) are found in the country. *O. barthii* is found in the western plains of the country and *O.longistaminata* occurs in the north, around Lake Tana in swamps and marshes up to 2500 masl.

2.2.2 Oil Crops

Gomenzer (*Brassica carinata*). Gomenzer (Ethiopian mustard) grown extensively in the highlands has a considerable diversity for several vegetative traits. Since no wild relative of gomenzer is known, the hypothesis is that gomenzer is a tetraploid hybrid between *Brassica nigra* and *Brassica oleracea*. There are weedy forms of brassica growing throughout the highlands of Ethiopia which are gathered to be eaten as leafy vegetables.

Noog (*Guizotia abyssinica*). Noog is one of the classical Ethiopian domesticates, and is an important oilseed in the highlands. There is little research on this indigenous oil crop with a very high edible oil quality. The phenotypic diversity in noog is more obvious for characters related to flowering, maturity and head size and other morphological characters. The wild/weedy related species *G. scabra* is commonly observed around noog fields.

Linseed (*Linum usitatissimum*). Ethiopia is considered as a centre of diversity for linseed. Linseed, grown for oil production has relatively high variability in flower colour, plant height, flowering and maturity duration, and capsule size and wilt resistance.

Sesame (*Sesamum indicum*). Sesame, the third most important oil crop in the country, and occurs both as cultivated and wild. Sesame in Ethiopia shows a high phenotypic diversity for number of days to maturity, plant height, pod shape and size, and for seed size and colour.

Safflower (*Carthamus tinctures*). Some authors consider Ethiopia to be the probable centre of domestication of safflower. At present the crop is grown in small scale. No sufficient research is done on this crop.

Crambe (*Crambe abyssinica*). Both cultivated fields and wild population of crambe are observed in the highlands of Ethiopia. However, the distribution now is shrinking and crambe fields are rare at present, indicating that there are conditions that threaten the existing diversity.

2.2.3 Pulses

Faba bean (*Vicia faba*). Ethiopia is probably one of the primary centres of diversification for faba bean. Although the small-seeded type of the Ethiopian faba bean is not well studied, there are some reports of tremendous diversity in protein content, chocolate spot and leaf rust resistance.

Field pea (*Pisum sativum*). Field pea, one of the oldest crops in the country, has a unique subspecies developed in Ethiopia-*P. sativum subsp. abyssinicum*. The existing field pea germplasm in the country has a phenotypic diversity and tolerance/resistance to disease.

Chickpea (Cicer arietinum). Chickpea is one of the ancient crops in Ethiopia. Archaeological evidence in Lalibela caves has indicted an age of 500 B.C. Ethiopia also is considered by some authors as a centre of origin and diversity for chickpea. The phenotypic diversity observed in farmers' fields is considerable particularly in flower color, seed colour, anthocyanin in the leaves, disea-

se and drought resistance. Related wild species of chickpea (*C. cuneatum*) has been found in northern Ethiopia.

Lentil (*Lens culinaris*). There are conflicting reports as to the origin of lentil. Some authors regard Ethiopia as a Centre of origin/diversity whereas some have reported lentil to be an early introduction to Ethiopia. The Ethiopian germplasm at present is diverse in earliness, seed yield, harvest index, number of seeds per pod and cold tolerance. The wild species *L.ervoides* grows in montane grassland in the north and central regions of the country.

Cowpea (*Vigna unguiculata*). Cowpea is mainly cultivated in Konso and Gambella, southwest and western part of the country. The two cultivated subsp. *V. unguiculata* and *V. cylindrica* are found as landraces in the eastern part of the country. The two wild subspecies *V. aconitifolia* and *V. vekillata* are found in the northern, southwestern and southern part of the country. Although there is no sufficient information on the magnitude of the diversity in this crop, it is believed that the African species might have been domesticated in Ethiopia. The species is divided into three cultivated and two wild subspecies.

Fenugreek (*Trigonella foenum-graecum*). This crop, locally used as a pulse, spice and medicinal plant, has a long history in Ethiopia. Even though the hectareage is limited, the species has a considerable genetic diversity in seed colour, maturity and other morphoagronomic characters.

Grasspea (*Lathyrus stativus*). Diversity information on grass pea is limited. The crop commonly grown in the highlands has an important trait of drought resistance. The wild species *L. pratensis* and *L. sphaericus* are found in upland grassland.

Yeheb (*Cordeauxia edulis*). Yeheb, a semi-desert bush, is native to Ogaden region. It grows well in altitudes ranging from 300 to 1,000 masl where the annual rainfall is below to 400 mm. The seed is important in the diet of the local people especially during drought periods. It is also a good source of forage for animals.

Hyacinth bean (*Lablab purpureus*). This crop is grown in Konso. Though this is under dispute, some authors have regarded Ethiopia to be the centre of origin/diversity for this species.

Pigeon pea (*Cajanus cajan*). There is no common agreement on the centre of origin of pigeon pea. Nevertheless, Vavilov and other authors have indicated Ethiopia as a probable centre of origin.

2.2.4 Root and Tuber Crops

There are several indigenous cultivated or semi-cultivated root and tuber crops in Ethiopia. These crops have important place in the diet of the population.

Enset (*Ensete ventricosum*). Enset is endemic to Ethiopia and occurs throughout the country both wild and cultivated at altitudes ranging between 1,000 and 3,000m. It is an important staple to a large number of people. Although the plant is propagated vegetatively, there are tremendous variation in several characters including colour of pseudostem and leaf midribs, earliness, disease resistance and product quality.

Oromo dinich (*Coleus edulis*). It occurs both as wild and cultivated species. The genus *Coleus* has about 30 wild species in Ethiopia. The cultivated species is grown in the wetter south and south western of Ethiopia whereas the wild species are found throughout the country.

Anchote (*Coccinia abyssinica*). Anchote is an endemic species found both cultivated and wild in Ethiopia. Although the genus in Ethiopia is not well studied, there are more than eight taxa recorded, distributed throughout the country.

Bagana (*Amorphophallus abyssinicus*). *Amorphophallus abyssinicus* and two other species are endemic. Bagana grows wild in southern Ethiopia at altitudes ranging from 900 to 1,200 masl. It is drought tolerant and the tubers are edible particularly during times of food shortages.

Carrot (*Dacus carrota*). The wild *D. carrota* var. *abyssinica* and a second species *D. hochstetteri* which is endemic to Ethiopia occur in several regions of the country.

Yam (*Dioscorea spp.*). *Dioscorea* spp. might have their origin in Ethiopia. Even though yams are not staple crops in Ethiopia, there are ten species recorded, distributed throughout the country. Some of the species have both cultivated and wild forms. It is reported that aerial tubers are common than root tubers in western Ethiopia. Some of the species are highly drought resistant.

2.2.5 Vegetables

Okra (*Abelmoschus esculentus*). Several authors have indicated that okra might have been domesticated in Ethiopia. It has high diversity in Ethiopia and it is an important vegetable in some parts of the country particularly in the Southwestern low lands (550 to 650 masl) region. In addition to the cultiva-

ted species, the distribution of two other species *A. manihot* and *A. moschatus* are reported recently.

Cabbage tree (*Moringa stenopetala*). This is an important vegetable tree in the konso area of southwestern Ethiopia. Five species of this genus are recorded in Ethiopia. One of this five species is horse-radish tree (*Moringa oleifera*) which is used as a source of oil and for the purpose of purifying water.

2.2.6 Stimulant and Industrial Crops

Coffee (*Coffee arabica*). Coffee is found throughout the country mostly between 1,500 and 2,000 masl. It can also occur as low as 1,000m in extremely wet areas and as high as 2,500 masl in gardens and backyards. The phenotypic diversity of arabica coffee, originated in Ethiopia, is over whelming for both qualitative and quantitative characters. There is an extremely high variability in disease and pest resistance, liquoring quality and other traits. It grows as wild, as moist montane forest shrubs, as semi-wild crop, as cultivated crop in shade under rainfed conditions and as garden plants planted with fruit trees and herbs in the backyards.

Chat (*Catha edulis*). Chat was domesticated in Ethiopia. Though there is no much information on its diversity, striking diversity in its leaf colour can be observed in the southeastern Ethiopia.

Cotton (*Gossypium spp.*). There are indigenous diploid cultivated species and indigenous wild species of cotton in Ethiopia. It is believed that *Gossypium herbacium var. acerifolium* might have been domesticated in Ethiopia. The indigenous cultivated species include *G. arboreum* and *G. herbaceum*, and the distribution of the wild species of the B. genome, *G. anomalum* as subsp. *semarense* and those of the E. genome, *G. somalense, G. bricchettii* and *G. benadirense* are recorded.

Kenaf (*Hibiscus spp.*). Kenaf is reported by many authors of being an Ethiopia origin. *Hibiscus cannabinus* occurs wild in a range of habitats. The cultivated species is *Hibiscus sabdariffa*. In addition to these six wild *Hibiscus spp.* have been observed in Ethiopia.

Vernonia (*Vernonia galamensis*). Thirty different species of vernonia have been identified in Ethiopia. *V. galamensis* is a semi-arid plant. The seed contains about 42% oil of which ca. 3/4 is vernolic acrid. The oil characteristics make it suitable for industrial use in plastic formation and coating industry.

Castor bean (*R.icinus communis*). Both cultivated and wild, weedy types of castor bean are widely distributed under a range of ecological conditions in

Ethiopia. Because of the immense diversity in plant, fruit and seed characters, some authors were led to consider Ethiopia as the origin of cultivated castor bean.

2.2.7 Spices

There are several important spices which are of Ethiopia origin. The most important species include:

Aframomum corarima, Trachysperumum ammi, Coriandrum sativum, Nigella sativa, Capsicum spp., Cuminum cyminum, Diplolophium abyssinicum, Anethum graveolens, Ocimum basilicum, Allium cepa, Foeniclum vulgare, Ruta chalapensis, Piper longum.

2.2.8 Aromatic and Perfume Plants

There are number of indigenous and introduced aromatic and perfume plants in Ethiopia. Some of these are:-*Commiphora spp., Boswellia spp., Cinnamomum cassia, Juniperus procera, Echinops spp., Olea europaea subsp. africana, Otostegia spp., Ocimum spp., Artemisia spp., Cymbopogon citratus,, Cyperus bulbosus, Myrtus communis.*

2.2.9 Forage species

The Ethiopian agriculture is heavily dependant on animals where forage and browse for all the animals comes from natural vegetation and crop residues. The Ethiopian flora is rich in grass and legum forage species. Although the magnitude of the diversity in the indigenous forage crops is not well studied, recent observations indicate that Ethiopia is a centre of diversity for Trifolium where of its twenty six indigenous species, ten are found to be endemic. The list of the major forage species includes: *Stylosanthes spp., Neonotonia wightii, Alysicarpus spp., Indigofera spp., Tephrosia spp., Acacia spp., Erythrina spp., Pennisetum spp., Rhynchosis spp. Trifolium spp., Brachiaria spp., Cortalaria spp.*

2.3 WILD SPECIES AND WILD RELATIVES OF CROP PLANTS IN ETHIOPIA

The domestication of plants takes place through a series of stages of intensified usage of plants while it is found in a wild state, and under the process of its development in an isolated distance from its wild relatives. There are many wild plants which are used for food, specially during food shortage, in time between seed sowing and harvest. The majority of such plants are those used as leafy vegetables and those with edible fruits, tubers or roots. *Corchorus olitorius.L.* for example has nine species found in Ethiopia that are collected at a young stage and eaten as a cooked vegetable, although, none of them are cultivated. There are also grass forms such as *Snowdenia polystachya* whose seeds are used in a similar way to tef in some parts of the country. Examples of semi-domesticated plants are *Avena abyssinica* and *Coccinia abyssinica.*

Environmental degradation and modern agriculture have contributed to the disappearance of traditional crops and their wild relatives. Some of the domesticated plants still occur with their wild relatives in some parts of the country. Examples are *Thymus spp.* in the Afro-alpine regions of the country, *Enset ventricosum* which occurs both in wild and cultivated state in the medium to higher altitudes, *Gossypium spp*. in the lowlands, as wild and cultivated, and *Sesamum spp*. which is found both cultivated and wild at an elevation below 1,800 masl. There are other wild plants currently attracting attention as potential crops, primarily for their use value. *Vernonia spp*. with thirty species identified in Ethiopia is a potential source of industrial oil, *Cordeauxia edulis* which is used in the arid areas as both feed and food source, *Amaranths spp*. found as common weeds in some parts of the country of which young plants are cooked as vegetable and seeds used for porridge and local beer, are among few of them.

There is a considerable wealth of plants of various importance used by Ethiopians, though it is not fully possible to tell their current status of use. Those plants that are used in the traditional medicine are among plant species of important social and economic value. Although it is estimated that the traditional medicinal plants cater for the health care needs of over 80 percent of the population, the major medicinal plants of Ethiopia are not cultivated except few herbs that are grown in the backyards. Among the major known Ethiopian plants of medicinal value are *Hagenia abyssinica*, *Glinus lotoides* which are used as a source of taeniacide, and *Taverniera abyssinica* for treating stomachache, headache and fever in the traditional health care system. *Senecio spp., Adhatoda schimperiana*, *Chenopodium spp., Dioscorea spp., Solanum spp., Datura stramonium, Aloe spp., Ricinus communis, Plantago lanceolata,* and many other wild species are used as a source of traditional medicine.

The Ethiopian region is also rich in resins and gums which mainly come from the three genera :- *Acacia*, *Boswellia* and *Commiphora*. *Accasia senegal* is a source for the true gum arabica, and is widely distributed in the lowlands of Ethiopia. *Boswellia* and *Commiphora* have their centre of diversity and a very distinctive vegetation in the Bale, Sidamo, Hararge, and Gamo Gofa regions. Fifty two species of *Commiphora* were recorded in Ethiopia, and thirty five of these are found in south and southeastern Ethiopia.

CHAPTER 3
National Plant Genetic Resources Conservation Activities

Ethiopia still has a rich diversity important to the World in both domesticated and wild plant and animal species that occur in variable and unique micro- and macro-ecosystems. Degradation of Environment and other threats to components of ecological systems is the most serious environmental problem Ethiopia is facing at present. The ecosystems are threatened due to destruction of habitats, introduction of species that are unfit to the natural ecosystem, re-curring drought and other problems of various nature. The problems are many and complicated and require a well established and prioritised approaches in the conservation and management of biological resources at gene, species and ecosystem level.

Proper conservation of diverse ecosystem and genetic resources in country like Ethiopia, can only be achieved through a well established system, under which biological resources are sustainably exploited for immediate use and species continue to evolve with the dynamic force of their habitat. Despite limitation in resources to achieve immediate solutions for minimising the rate of the loss of biological resources, Ethiopia is making all possible efforts including the formulation of policies for the maintenance and sustainable use of genetic resources. Strategies are designed to effect conservation for domesticated and wild flora and fauna within natural and human managed ecosystems, with due regard to the genetic variation within and among species.

To strengthen the existing efforts, to correct gaps and to establish integrated mechanisms for the conservation, development and sustainable use of plant genetic resources, a National Plant Genetic Resources policy is formulated. Within the existing efforts of establishing a sound biodiversity conservation system, the already existing Plant Genetic Resources Centre is promoted to a National Institute of Biodiversity and five plant genetic resource programmes are organised within it. These are programmes for Crop Genetic Resource (already existing strong programme), Medicinal Plant Genetic Resources, National Herbarium (upgrading the existing one), Forest Genetic Resources (upgrading the existing one), and Microbial Genetic Resources programme.

This is a major step towards the conservation of biological resources, and a considerable move forward, with regard to the fulfilment of the global commitment such as The Convention on Biodiversity. However, it is also a strong challenge to a resource limited country like Ethiopia, to materialise the newly designed programmes and maintain the existing ones, without a strong financial, technical and material support.

3.1 *IN SITU* CONSERVATION

Although much has not been achieved in totally protecting the natural vegetation areas from maximum human interference, conservation of natural forests is developing through the establishment of protected areas and national parks. About 57 National Forest priority areas are identified, and attempts to study the general floristic composition of the natural forest and other protected areas are under way.

There are 10 national parks, 13 wild life resources and bird sanctuaries, and 14 controlled hunting areas. There are also protected forest areas and proposed ones. The Menagehsa-Suba natural forest, which has been heavily exploited for many decades has now been declared a protected forest. The Megada natural forest in the southern part of the country is a protected forest where no forest exploitation is allowed, mainly, owing to failure in natural regeneration and poor under-growth establishment. The Wof-Washa natural forest, because of ruggedness of the terrain and poor regeneration, is also considered a protected forest where no exploitation is allowed.

In situ conservation areas for coffee have been identified in six administrative regions. The implementation of this approach can be of a great help not only for the conservation of the wild coffee alone, but also for the forest and other plant species, as well as for the fauna. Medicinal plants on which 80 percent of the Ethiopian population depend is mainly derived from forest plant species, and thus, *in situ* conservation schemes would help safeguard the nation's pharmacopoeia from being lost.

3.2 *IN SITU* LANDRACE CONSERVATION

A practical measure has been taken with regard to on-farm *in situ* conservation programme of landraces that was initiated in 1989. The major objective of this Ethiopian *in situ* for landraces is to support the farming communities in their efforts of maintaining crop/plant diversity, and producing food for their family and for the country as a whole. The *in situ* maintained landraces serve as a source of materials of wide range of adaptation, famine mitigating traditional varieties, and at the same time used as a basic material from which farmers select special lines to meet their changing needs. The nature of the Ethiopian crop *in situ* is such that diversity in crop species, multicrop association, and cultural practices and factors contributing to the disruption of the traditional way of maintaining diversity are strongly considered. Traditional crop variety improvement components are integrated into the conservation and multiplication activities, to fill the existing production gaps in the utilization processes of landrace population. Under this system, joint formal and informal efforts in crop selection, in which prebreeding work to enhance landraces is incorporated, serve as a compromise between the need to utilize high-input varieties on the one hand, and sustainable production through the use of better adapted materials on the other.

Integration of the formal and informal crop improvement technologies, and promotion of community based seed networking is another component used to fill the gaps. Through community seed system, farmers are supported to control the choice of crop types and cultivars they want to grow, having at the same time, reliable access to planting materials adapted to their local crop growing conditions. The community seed system has also seed production/multiplication, marketing and distribution and community seed banks as components. The community seed banks serve as important mechanism to increase the number of options for using diverse crop types, and to decrease vulnerability to seed shortage and genetic erosion.

Ethiopian *in situ* for cultivated crops is decentralized and broader participation of farmers and other groups is its unique character. It is also complemented by *ex situ* conventional preservation system for crops, which at the same serves as a source of genetic diversity for restoration and introduction of suitable landraces. Farmers participating in the programme perceive benefit to be involved in the *in situ* conservation and enhancement activities not through direct payment, but with long-term benefit including incentives of various nature, based on the interest of the community within a given locality. The principle of the incentives is that farmers themselves must perceive an advantage in continuing to grow traditional crops, and their participation in conservation of their folk varieties must be self sustaining. This condition howe-

ver, requires at certain stage, a minimum of centralised support or subsidiary to certain farmers or farm communities, that have been detached of their landraces because of its displacement through modern agricultural practices or genetic erosion.

3.3 *EX SITU* GERMPLASM PRESERVATION

Ethiopia has a well organized gene bank (the Plant Genetic Resources Centre), established in 1976 through the bilateral agreement between the Ethiopian Government and Government of the Federal Republic of Germany. The Centre, located in Addis Ababa, the capital city of Ethiopia, was established to rescue Ethiopia's crop genetic resources from being lost. The major objectives of the Centre are to:

- promote collection, evaluation, documentation and scientific study of crop germplasm in Ethiopia, East Africa and adjacent regions;
- preserve/conserve germplasm using various conservation strategies;
- provide germplasm and pertinent to it information for national breeding programmes;
- introduce new and appropriate crop germplasm in to the country;
- survey and document Ethiopia's genetic diversity and indigenous knowledge associated with it.

3.3.1 Germplasm Collection

The collections of the Ethiopian gene bank are composed of indigenous landrace germplasm including unique breeders' collections and lines. There are also some accessions repatriated from countries that hold a large number of Ethiopia's genetic material, some of which are not seen in the fields of Ethiopian farmers at present. Most of these germplasm materials were collected in the past without leaving the duplicate samples in Ethiopia, and in the situation where duplicate samples left behind, in some cases, they have been partly or totally lost because of poor storage condition. The holdings of the Ethiopian Gene Bank at present reaches some 54,000 accessions of 106 crop/plant species.

Priority in a collecting operation is governed by the economic and social importance of the crop/plant, its genetic state of development and the degree of genetic erosion which affects the genetic diversity of the given crop/plant. The collection is composed of cereals, pulses, oil crops, spices and seeds of species of plants of medicinal and industrial value. Strictly followed major factors in setting priorities for collecting are vulnerability of crops/plants to genetic erosion, breeders activity, the rate of diffusion of improved varieties, clearing of natural vegetation, market and agricultural policy, natural disaster and resettlement programmes. In most of the cases, the collecting strategy is based on broad or non-crop specific rather than pointed collecting. Collecting expeditions are based on well defined priorities of action for crops and localities, and are conducted in close collaboration with plant breeders and other users of germplasm. Information is always gathered through exploration mission and from other sources, such as National Meteorology Institute, in order to update the priority list regularly. Specific collecting is made depending on the vulnerability of the crop/plant and also on demand for collecting specific traits required for evaluation and utilization of genotypes for resistance/tolerance to stresses, diseases, pest and other traits desired for breeding programmes.

In Ethiopia, source of germplasm for national breeding programmes is mainly indigenous germplasm and one of the responsibilities of the gene bank is to make germplasm available for breeding purpose. At an average, the centre dispatches about 6000 accessions for local research activities, and about 80 percent of these accessions is used for national crop improvement activities of various nature. International research centres such as ICARDA, ICRISAT, ILCA are among the potential users of Ethiopian crop germplasm. For national programmes of other countries germplasm is distributed upon formal request and negotiation.

3.3.2 Storage facilities

Effective maintenance of germplasm material depends on the system of preservation used, which is affected by the quality and efficiency of the existing facilities and technical know-how. Safety of the germplasm, frequency of its rejuvenation and flow of samples for various purposes depend on the size and the effectiveness of the storage facilities. A reliable power supply is also critical. The Ethiopian gene bank has two independent power supply and a stand by generator.

The type and quality of equipment required for a gene bank activities vary according to the nature of the preserved species and the number of samples to be stored. For the maintenance of diverse species held at the Ethiopian gene bank, there is an assortment of equipment for processing and germinating seeds of species of different germination behaviour. Seeds are dried before storage at the temperature of 15^{0}C - 20^{0}C, with a relative humidity ranging from 15-18%. The required storage seed moisture content is 5-7% for cereals, 4-6% for oil cops and 6-8% for legumes. The total number of seeds required for heterogenous sample is 8,000 seeds for seeds with Thousand Seed Weight (TSW) between 5 and 200 grams and 3,200 seeds for genetically homogeneous materials. For pragmatic and economic reasons, the sample size for species with TSW greater than 200 g is reduced to a reasonable level of maintaining the initial genetic integrity of a sample. The base collection for a population sample is 3,000 seeds and 800 seeds for a homogeneous sample. This is logical and accepted economical standard for a sample collected with sufficient care in capturing maximum variation in a given collecting site.

Planning for processing seed samples depend on the number and the nature of samples collected, multiplied or regenerated. This helps in avoiding long-time shelf life of newly coming materials to the gene bank. The storage temperature for long-term purpose is -10^{0}C and for the short-term, it is +4^{0}C with 35% relative humidity. Samples are kept in laminated aluminium foils for long-term, and in paper bags for short-term storage. The storage system is computerised with an easy access for monitoring the decline in sample size. Monitoring of decline in viability is made every 5-7 years, and no significant changes have been recorded under the storage conditions of the Ethiopian gene bank.

Except forage germplasm held by ILCA (ILRI), there are no other separate, and purposely duplicated samples in other gene banks for various reasons, among which the reliability of the facilities and the management of some of those gene banks are the major ones. Based on the designation of the Ethiopian gene bank by the African Genetic Resources Network, the Centre makes space available for those African countries, that do not have effective or no storage facilities. The Centre was also once designated to maintain world base collection for finger millet and brassica, though it was not materialised.

For species, seeds of which can not be kept under the conventional seed storage condition, there is a field gene bank at large scale, and small sized fields in various research stations of the Institute of agricultural research and University colleges. The plan of immediate future is to increase the number of field gene banks in different agro-ecological sites in the country. Community gardens and back yards, and holy places are considered to be included in the future plan. Spices, root and tuber crops, medicinal plants are species that require such management at large, and with full involvement of the local communities.

3.3.3 Germplasm Characterization and Evaluation

Characterization is an important tool to gather basic information on accessions under preservation. It is carried out to collect data on mainly morph-agronomic performance of the collected accessions. Characters taken for observation are those that are highly heritable, expressed in all environments and can easily be detected visually. Accessions are characterised where possible, at their original places or in areas with the similar environmental conditions the material is collected from.

Characterization is conducted in the fields of the Institute of Agricultural Research (IAR), Agricultural University and Colleges, where breeders are involved and have access to choose materials of their interest for further research or breeding. Discriptors for characterization are developed jointly with national breeders, and those issued by the International Plant Genetic Resources Institute (IPGRI) are followed as long as they are relevant to the local conditions, for recording morphological data.

Population samples are not always convenient for purpose oriented research or evaluation. To make germplasm entry into the national crop improvement simple and palatable, population samples are split in to morpho-agronomic components that are kept separately from the base collection. In away, these components duplicate the mother sample, and is very necessary in the Ethiopian case, to support research programmes for which immediate objectives to be achieved within a short period of time are projected.

Evaluation of germplasm, as confused with recording of mropho-agronomic characters in some cases, is separately done. Evaluation activities include testing of genotypes for tolerance/resistance to stresses such as drought, salinity, soil acidity, response to inputs and studying of constituent content such as protein and oil. Screening for disease and pest tolerance/resistance is carried out together with national breeders under various conditions.

Germplasm materials, lacking information are difficult to be used, and unless germplasm is used, it is difficult to identify the value of germplasm. Data from all kinds of evaluation and characterization activities are always accompanying germplasm materials channelled to national crop improvement programmes. This minimises cost and time of breeding programmes, where the breeding programme is dependent on this information. In the Ethiopian situation, germplasm conservation/preservation and utilization are integrated and duplication of efforts and resource use among institutes is avoided as much as possible. Most of the indepth type of evaluation activities are conducted by IAR and Agricultural University, and data is channelled to the Centre. There are also certain research programmes carried out by the Centre, to document basic information on the held germplasm materials.

3.3.4 Germplasm Regeneration

Regeneration is amongst the expensive tasks of gen banks. It is expensive in both cost wise, and in its risk in narrowing the genetic base of the original population. Poor storage condition, and low germination level of the stored sample increase the frequency of exposure of a sample to regeneration, there by maximising the risk of narrowing the genetic base of the initial collection due to genetic drift.

In the Ethiopian Gene Bank, the initial accepted viability for a long-term storage is above 85 percent. Samples with viability less than 85 percent are processed and are kept at -10^{0}C until regeneration. Regeneration priority depends on the level of initial viability, available budget, land and personnel. In the case of critical decline in viability and sample size, regeneration is of a high priority, in order to avoid or minimise genetic erosion in the gene bank itself. The Centre has qualified personnel and has developed viable mechanisms of blocking gene contamination during regeneration and multiplication of seeds of small sized samples. Maximum care is taken to minimise or avoid the risk of genetic drift due to various factors in the field. Randomised sampling of initial accession is used for regeneration and sampled lots are not all taken out to the field at a time, in order to avoid the risk of unpredictable loss of materials in the field. Old and fresh seeds from regeneration are not mixed, while fresh seeds from regeneration of randomised sample lots are mixed at the end.

3.3.5 Documentation

Compilation of pertinent information starts right from the collecting field. Data on morpho-agronomic characters, on seed moisture content, germination percentage, TSW and information on indepth evaluation such as drought, salinity, soil low ph and constituent content is recorded. In the farmers field and during sampling from market, farmers are important source of information on the collected germplasm. The information collected at this level include, those on sowing season, length of maturity, gastronomic value, local names of the variety, resistance to disease, pests and to stresses, information on storability, soil types and altitude.

All collected information through the entire process is documented and computerised with an easy access to utilizer upon formal requests. Information is released in any convenient form to the utilizer through consultation, delivery of printout or by letter, except in cases where repatriated or donated materials are coming without or with poor information that does not match the standard of the gene bank.

The Centre now has highly upgraded its documentation system and is in preparation to establish a national germplasm data base in the country. Source of information will be *in situ* maintained sites including parks and protected areas. Data from *in situ* conservation for landraces include information on indigenous knowledge such as traditional agronomy, farming systems and ethnobotany. In this process is included recording of information on wild relatives and plant species of traditional medicine. The activity requires more expertise in the fields of taxonomy and ethnobotany as well as a well trained bare-foot local/traditional experts to be involved. More financial and material resources and integrated efforts are also required.

Though the Ethiopian Plant Genetic Resources Centre is designated to coordinate the African Genetic Resources Network, gene bank activities are not well developed in the region specially in terms of facilities and infrastructure. Thus it is difficult to say that a strong information network has been set within the region at the moment. The Centre has once a close collaboration with Intranational Livestock for Africa (ILCA) in duplicating information which was discontinued some years back, due to mainly shortage of fund.

3.4 FOREST GENETIC RESOURCES CONSERVATION AND DEVELOPMENT

Forest genetic resources conservation and development programmes have been dealt with by the Ministry of Agriculture previously and by the Ministry of Natural Resources Development and Environmental protection at present. The forestry programme in general has the following components:

- state forest conservation and development;
- protected areas for wildlife conservation;
- community forest and soil conservation and development;
- forestry research;
- forestry training institutions.

The state forest conservation and development activities are mainly concerned with economically important state-owned forests, distributed over medium and high plateau as well as in the semi-arid lowlands. Under this scheme, there have been certain priority forest areas protected and managed by the Ministry, in the effort to minimize or stop the loss of forest genetic resources.

The loss of the forest resources was especially severe in the Ethiopian highlands. The very high reduction in forest cover of the country is accompanied with an increase in the grass and shrub vegetation. The transformation is most advanced in the northern and eastern part of the country facing with high concentration of human population since many years back. Though agricultural development and resettlement pressure is in the process of accelerating the loss, it is only in the southern and southwestern part of the country that many forest blocks remain. The major forces behind deforestation and forest degradation are population growth and economic pressure linked to increased demands of more land for growing crops and pasture, and wood for construction and fuel. The current rate of loss of the high forest areas is so frustrating that at this rate, all that would remain in a very near future is predicted to be scattered forest remains in hardly accessible areas.

3.5 FOREST GENETIC RESOURCE BASE

The existing natural high forest include different types of montane forests in the less populated Southern and Western parts of the country. The central and northern parts are almost completely deforested. Humid mixed forests occur in Southern Ethiopia and Hararge province, with *Podocarpus, Croton, Olea, Schefflera,* and *Hagenia growing* at higher altitudes. In the southwest, broadleaves forests are found with *Aningeria adolfifriederici* growing as high as 40 m. Of more than 300 tree species in the Ethiopian high forests, 25 are regarded as commercial species and about 30 as potentially useful species for mechanical wood industry.

Woodlands and bush lands are largely restricted to the agro-pastoral and pastoral zones occupying large areas in the Rift Valley, in the Southwest and Western part, and on the slopes of the Eastern and Central highlands. The lowland woodlands contain various species of *Acacia, Boswellia, Commiphora, Balanites, Euphorbia, Combretum*, and *Croton.* In the mountain woodlands the main components are *Acacia abyssinica, Protea, Cussonia, Hagenia abyssinica, Erica arborea, Hypericum.*

There are also species used for community woodlot and for catchment/protection plantation, and those used for industrial and peri-urban plantations established and managed by the state. The majority of the industrial plantations are found within the boundaries of the National Forest Protection Areas (NFPAs). *Eucalyptus* and *Cupresssus* are the main species for commercial and industrial plantations, followed by *Juniperus procera*, *Pinus* and other species. The community woodlot mainly consist of *Eucalyptus globulus* and *Eucalyptus camaldulensis.* Though Eucalypt is highly productive, its indiscriminate plantation is of a high ecological concern, and requires caution with regard to the plantation objectives and its ecological impacts.

3.6 DATA BASE ON FOREST GENETIC RESOURCES

Although efforts have been made to study the forest composition of the country at different times and by different researchers, it is hard to have information on a systematised survey and broad mapping of habitats including lists of species. Indexed inventories for species of potential economic significance and for endangered species found in critical need of conservation has not been systematically done. The same is true for a systematically collected seeds for *ex situ* preservation. The available information on the currently existing Ethio-

pia's forest resource has its own limitations. There is no adequate information on location, extent and volume of the standing growth stock, annual growth rates, or rates at which the remaining part of the forest resources are being depleted.

Effective management of the remaining forest resources of Ethiopia depends, among others, on the implementation of a well designed comprehensive programme to survey and inventory the existing forest genetic resources. There is an expectation that the Woody Biomass Inventory and Strategic Planning Project makes survey of Ethiopia's woody biomass reserve and assesses distribution, volume, and density of various biomass resources. If extended over the entire country, this effort would produce a strong base for planning detailed forest inventories.

The recent surveys on land use and forest and woody vegetation are the imagery surveys made by FAO in 1984, and by Cesen in 1986. Because of the extensive deforestation over the last few years, this information seems to be outdated. Later review made based on field inspections and available information indicated that the remaining area of natural high forest was between 2.5 and 3.0 million ha [de Vletter (1989)]. According to the estimate made by the State Forest Conservation and Development Department (SFCDD) in 1990, the natural high forest covers 3.5 million ha. There seems that because of different classifications used by FAO, Cesen, and SFCDD, there is no consistency in the available information on forest resources.

In various parts of Ethiopia, farmers have traditionally been practising farm forestry such as homestead tree planting, field tree planting, and farm boundary planting. However, information on such kinds of practices and its extent in the country is limited. Tree growing by private sectors as important component of the forest resource base, was poorly encouraged. For plantations, little information is available regarding the areas actually planted or the survival rates of the seedlings. Estimates are based on the number of seedlings produced in the nurseries or on seedling production targets set by central planning units. There are no records of areas lost due to encroachment and illegal cutting. SFCDD estimate of plantation area in 1989 was 463,400 ha. A recent investigation concludes that the total plantation area of Ethiopia, as of 1992, was about 200,000 ha. Of this, 95,000 ha. and 35,000 ha. are industrial and peri-urban plantations respectively, and 70,000 ha. are community woodlot.

Recognising the problem, a study has been conducted and based on it a National Forestry Action Plan has been prepared with the financial support provided by UNDP, EC, GTZ, FAO and SIDA. At the request of the Government the World Bank has also executed the preparatory study. At present the report of the study of the Action Plan is produced in four volumes.

CHAPTER 4
In-Country Uses of Plant Genetic Resources

Plant Genetic Resources of immediate use in Ethiopia include wild and semi-wild species, diverse cultivated crops and its wild relatives. Root crops, spices, forage crops are widely utilized part of the country's plant genetic resources. About 80 percent of the demand for medicine is covered by using traditionally developed medicinal plants.

4.1 GERMPLASM DISTRIBUTION

Indigenous germplasm is the basic source of genetic materials for national crop improvement programmes. The national germplasm collections comprise of 54,000 accessions of 106 plant species at present, and future collecting is planned for more representative species and diversity. Some of the major crops intensively used in the national crop improvement programmes include the following:

Cereals: wheat, barley, sorghum, millet and tef.
Oil crops: Noog, flax, sesame, rape seed and castor bean
Legumes: faba bean, peas, chick pea, lentils and grass pea.

Table 1 Gene bank's crop germplasm distribution for national research and crop improvement programme over the last three years

Crop type	Distribution % total holding	Total holding
Barley	19	14257
Wheat	12	12239
Sorghum	11	7761
Maize	52	597
Tef	2	3842
Noog	95	1071
Rape seed	46	1200
Faba bean	28	1572
Pisum	86	1424
Chick pea	64	883

Some time back, intensity of using local collections by the national crop improvement programmes was limited due to lack of evaluation data. The breeding or crop improvement policy was also not inviting national breeders to make more use of the existing diversity. As a result, breeders did show low interest or shun the diversity in the landrace materials, and were strongly biased towards the improvement of the adaptability of imported, uniform and high input varieties to the local agro-ecological conditions. At present the situation is changed and the current breeding policy gives great emphasis to the use of the diversity in the indigenous landraces.

Currently, there are important preliminary information on inherited morpho-agronomic characters on almost all major food crops held by the National Gene Bank. The availability of such information has attracted the attention of national breeders, and has made the utilization of landraces in the crop improvement programmes easier. Many accessions held by the gen bank are already incorporated into the crop improvement programmes through the national yield trails and are also widely used in breeding for resistance/tolerance to environmental stresses and diseases.

One of the major strategies in crop genetic resources activities at present is the restoration of the displaced farmers varieties, and introduction of appropriate landrace materials into various agro-ecology. In this strategy is also incorporated the improvement and enhancement of farmers varieties with full participation and decision of farmers. The strategy is supported by the National Plant Genetic Resources Policy, and emphasis is on making this approach operational over a wider range of agro-ecological condition in the country. In the future, the plan is to extend such approaches to other species of economic and social importance. The germplasm maintained under conventional *ex situ* system will be used as a source of materials for restoration and duplication of these germplasm under *in situ* system. Community seed bank at community level is one of the major components of such approach. It will be used as a seed repository and grain reserve having market component within it.

4.2 CROP IMPROVEMENT PROGRAMMES

The major objective of the national plant breeding programme is to develop crop/plant varieties that help in meeting the need to secure adequate national food supply and develop industrial crops of different purposes. The agricultural crops/plants cover a wide range of genetic diversity including landraces of diverse adaptation as well as uniform and high input varieties of various species. The Ethiopian agro-ecosystem is complex and is influenced by diverse and interacting environmental factors.

Although, formal breeding has been practised well over three decades, the major portion of the country's food production still heavily depends on the traditional varieties and farming practices. The excuse for low level success in modern plant breeding in the country has been the limited capacity to produce varieties that meet the diverse cultural practices and complex agro-ecological environments. Regardless the availability of sufficient wealth of crop genetic diversity in the country, the search for appropriate varieties within the local landraces that have a very location specific adoptability was given poor attention for a long time. The impact has significantly affected the efforts made in improving the national capacity in food production.

Cognizant of the problem, the national crop/plant breeding strategies have recently been corrected to adopt the principle of using genetically wide based indigenous crop genetic resources, with careful attention to the traditional agricultural systems, to the indigenous technical knowledge and to the better involvement of farmers. The effort in crop genetic resources conservation, use and production is fostered with appropriate scientific approaches in varietal development as well as in hybrid breeding. The strategy in general is to conduct appropriate selection activities across different environments, and develop a well organised breeding programmes to cater for production problems such as disease and pest, drought, water lodging, soil fertility, salinity and frost.

To overcome the long lived seed distribution problem, a National Seed Policy is formulated to strengthen the role of public seed enterprises and private seed growers including farmers. To solve the problems of shortages of seeds of different genetic level, mechanisms have been developed for the continuous multiplication of breeders and basic seeds, with a well maintained genetic purity, uniformity, and stability. Improvement and enhancement of elite landraces by farmers is also among the major areas with a strong national emphasis.

4.3 ETHIOPIA'S GERMPLASM USE OUTSIDE ETHIOPIA

Plant breeders and explorers from different countries of the world have long recognised the importance of Ethiopian crop diversity to world agriculture. Since the first exploration of H.V. Harlan, in 1923, dozens of international expeditions have been made to Ethiopia to collect barley and many other crops. Vavilov's collections of Ethiopian Wheat in 1927 have been extensively used by breeders in many East and West European countries as well as in North America. A large number of samples of various species representing a wide range of diversity, have also been collected and extensively utilised by international programmes such as Livestock Centre for Africa (ILCA), the International Centre for Agricultural Research in the Dry Areas (ICARDA), the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT) and etc. Ethiopian germplasm has therefore, actively been utilised in breeding works of various nature world wide, at times a good deal more than Ethiopia is given credit.

Over 1,800 accessions of Ethiopian wheat were introduced to CIMMYT from gene banks in the USA, Germany and Italy. ICARDA holds over 2,500 systematically collected accessions of Ethiopian barley, mostly 6-rowed and deficient types, which have a high value in early heading and maturity as well as high protein content. It also holds, among others, over 900 accessions of Ethiopian chick pea and over 375 accessions of lentil used in its breeding programme. More than 300 accessions of minor millet and 4,500 sorghum accessions of Ethiopian material are held by ICRISAT, of which the sorghum line E 35-1 has been selected from a zera-zera landrace sorghum of Ethiopia which is introduced for direct cultivation and breeding programmes to various countries.

Through International Research Centres, that hold Ethiopia's germplasm material, many national programmes of the developing countries including various seed companies of these countries have secured full access to Ethiopia's germplasm materials. In this process of using and distributing Ethiopia's genetic material, though it is a donor of the germplasm, it is hardly that Ethiopia comes into the picture at all. In general, genes from varieties of Ethiopian farmers have widely been used in many countries to sustain crop production, while insignificant or not any of the benefit derived from the use of these germplasm materials is accrued to Ethiopia.

CHAPTER 5
National Goals, Policies, Programmes and Legislation

5.1 PGR POLICY

Ethiopia being the major centre of origin/diversity for many plant species has still a diverse wealth of plant genetic resources. This resource is vital to the economic, social and environmental development of the country. However, as is the case common to many parts of the world, the diversity in this resources is threatened because of mismanagement and environmental degradation that have caused selective and total loss of genetic diversity. The absence of clear policy guidelines on plant genetic resources for many years has contributed to the loss of valuable indigenous genetic resources, introduction of disease, pest, weeds and genetic material unfit to the local agro-ecological systems.

At present, it is recognised that conservation and development of genetic resources is unlikely to succeed without a national commitment through an appropriate government policy. To this effect, a National Policy for the Conservation and Development of Plant Genetic Resources is formulated based on the rational that the conservation of plant genetic resources is one of the basis for the overall socio-economic development and sound environmental management goals. The main objectives of the National Policy for Plant Genetic Resources Conservation and Development are to:

- ensure that the Ethiopian plant genetic resources are conserved, developed, managed, and sustainably used;
- assert national sovereignty over genetic resources, and develop mechanisms that will ensure the effective control of movement and management of genetic resources;
- build scientific capacities in order to explore, collect, assess, study, systematize, introduce, improve, manage and sustainably use biological resources; develop capacities for the improvement, generation, development and sustainable use of biotechnology and its transfer;
- integrate programmes for PGR conservation and development into national and regional development strategies and plans;

- recognise, foster and augment the traditional methods and the knowledge of local communities relevant to the conservation, development and sustainable use of PGR; and encourage the participation and support of local communities in PGR conservation and development, and insure that farmers/communities share the benefits accrued as a result of using indigenous germplasm;
- create a functional and efficient organizational structure and inter-institutional linkage to facilitate cooperative action and coordination in PGR conservation and development;
- promote international and regional cooperation in PGR conservation and development.

For the implementation of the national conservation programmes, the existing institutional structures are adjusted and strengthened, and the new ones are established together with available budget and trained human resources. The Ethiopian Plant Genetic Resources Centre is promoted to National Biodiversity Institute having its own board, that guides the institute and advises the government on policy matters. However, though significant measures have been taken to establish a sound national biodiversity conservation strategy, a lot remains to be done, specially in the areas of capacity building in terms of trained human resource, facilities and infrastructure.

With regard to *ex situ* conservation programme the Plant Genetic Resources Centre of Ethiopia has high level of expertise and has been training technicians for other African, Asian and Latin American countries. Till 1994, over 144 personnel from various countries have been trained in areas of conservation, development and utilization of plant genetic resources. In addition, Ethiopia has also been offering assistance to other developing countries, in the formulation of conservation projects and programmes at various level. With better financial and material assistance, Ethiopia can still offer much of its experience to other countries particularly, through training of personnel and designing of strategies for conservation.

Currently Ethiopia's new conservation programmes are better organised and more widened that a number of trained professionals are needed in the fields of taxonomy of both plants and animals, terrestrial and aquatic ecology, conservation biology and management of genetic resources, biotechnology and biosafety, anthropology and ethnobotany including management of data on biological resources. Thus, being a country with diverse ecology and problems, but with limited financial and technical capacity, it would be difficult to expect a greater achievement with out external financial and technical assistance.

5.2 OTHER POLICIES AND NATIONAL LEGISLATION

Ethiopia's conservation policy recognises the integration of conservation efforts with other national development activities at all levels. Some of the national policies that have been negatively affecting the efforts in conserving and sustaining the use of natural resources are in the process of being corrected.

National Environment Protection, Seed and Quarantine Lows are already in place. The policy and strategy for plant genetic resources conservation and use are there. Rules and regulations for the flow of genetic resources into and out of the country will be functional in the nearest future. To put the general picture, within its environmental low Ethiopia will have legislations for biological resources conservation which will deal with the definition of commitments of the Central and Regional Governments, with the rights and obligation of communities and citizens, with ownership and use rights, and with monitoring, development and sustainable use of plant genetic resources.

In line with national seed legislation, the crop genetic resources legislation will define legal provisions for germplasm ownership and control, accessibility, exploration, collection, conservation, distribution, introduction, regeneration, testing, exchange, utilization, and rights of Ethiopia's farming communities and plant breeders. The existing legal instruments regarding plants of traditional medicine will be adjusted to sustain the conservation, development and use of medicinal plants and to define obligation and intellectual property rights of local traditional medicine practitioners. The legislation on flora and vegetation will address ownership and control, accessibility, exploration, landscape and ecosystem conservation; and ecological restoration of degraded landscapes, ecosystems, biological communities and species. Legal environment for the sustainable management of protected areas; participation, responsibilities, rights and obligations of the communities and individuals; accessibility, introduction and exchange, monitoring, ownership and use rights of the communities and individuals will be defined. Legal instruments dealing with the conservation, importation, translocation, development and use of microbial genetic resources, and products of biotechnology and biosafety mechanisms to minimize public and environmental risks will be set.

CHAPTER 6
International Collaboration

The Ethiopian Plant Genetic Resources activities have various global and regional links to different institutions. Research Institutions such as Institute of Agricultural Research (IAR) and Alemaya University of Agriculture have various collaborative research activities in the areas of crop improvement. CGIAR Centres such as ICARDA, CYMMIT and ICRISAT are among the collaborators. The Plant Genetic Resources Centre of Ethiopia has a cooperative link with IPGRI specially in the development of conservation techniques, data management and training. Through this collaborative link IPGRI had financially supported two M.SC and two short-term training in Birmingham, in the UK. ICARDA and ICRISAT have also been supporting some short-term training programmes. There is also a strong collaboration with certain international and regional NGOs directly or indirectly involved in the plant genetic resources activities.

Most of the research programmes have germplasm collection as a major component and have been using Ethiopian germplasm materials, where in some cases duplicates of these material have been deposited outside Ethiopia through various programmes and activities. Certain collaborative research programmes are some times not based on a long-term programme and rarely leave developed local capacity and facilities behind for the continuation of the initiated activities and programmes. The existing experience shows that national programmes hardly benefit from such collaborative research activities and this remains one of the gaps to be corrected in the implementation of joint research programmes.

Through regional intergovernmental initiatives such as African Ministerial Conference on Environment (AMCEN), Ethiopia plays an important role in the regional biodiversity activities and serves as coordinating unit of African Biodiversity Network and the Community Biodiversity Development and Conservation (CBDC) programme for Africa. CBDC is a global programme for Africa, Latin America and Asia where various government institutions and non-governmental organizations are working together at global, regional and national level.

Ethiopia has been supporting the role of the FAO Plant Genetic Resources Undertaking and has also been playing an important role in its activities. Ethiopia's interest in the Undertaking is the creation of an efficient global mechanisms for properly addressing issues of genetic resources such as use, ownership rights, and fair and equitable sharing of benefits deriving from

plant genetic resources. These issues are also well addressed by the Convention on Biological Diversity, and the role of FAO in supporting the developing nations in the process of implementing the Convention is significant. FAO may start its active role in the realization of the Resolution 3 of the Nairobi Final Act, where among other things, Farmers Rights and the *ex situ* collections excluded from the Convention are matters of a great concern for the developing nations. It will also be appropriate for FAO to strengthen its system and capacity to create functional complementarity of the Undertaking, the International Cod of Conduct for Plant Germplasm collecting and transfer and the Convention on Biological Diversity. In this process, FAO is expected to strongly support and facilitate the protection of the neglected interest of the farming and indigenous communities of the developing nations.

Like all other developing nations that have signed the Convention on Biological Diversity, Ethiopia expects that FAO develops strong mechanisms and the courage of taking the responsibility of protecting the gene donors rights. Obviously, it is the right of having access to their germplasm materials held under the CGIAR systems and by National Governments of others, including their right of sharing benefits of any form deriving from the use of these materials.

Ethiopia is making efforts to fulfil its commitments of International agreements such as Agenda 21 and the Convention on Biological Diversity. At the moment, policies are formulated to meet the commitments and institutional structures are organised to effect policies and strategies. It is also a firm position of Ethiopia that all Nations prepare themselves to fulfil the International Agreements they are adhered to. Developed Nations and the International Communities are expected to support the developing Nations in materialising different Global commitments. However, support coming through international fund should be based on country driven programmes and priorities rather than being top-down, donor commanded programmes, as some of the past experiences teach us.

CHAPTER 7
National Needs and Opportunities

The lack of conservation policy and strategy to promote and integrate conservation with other development policies had been recognised as a major bottleneck in the national biological resources conservation. Recognising the problem, a policy on National Plant Genetic Resources Conservation and Development has been formulated to reinforce the conservation and utilization, promotion of research and development in crop breeding, medicinal plants, flora and vegetation, forest genetic resources, microbial genetic resources, biotechnology and biosafety. Studying of the dynamics of the species ecosystem for the development of sound management strategies and collecting of data on species biology, taxonomy, ecology, distribution and population dynamics are the priority areas of the national conservation strategy.

Developing a comprehensive documentation system and national capacity for mapping and survey of ecological systems, and collecting data on species known for their potential value such as medicinal ones, and indexed inventory of other species of immediate and future economic value, including those found in an endangered state are among priority activities need to be carried out under the national programme for conservation. Environmental impact assessment which requires a multidisciplinary approach in economical, cultural and ecological aspects, is another important component of the national conservation strategy.

- Though appropriate policy and national commitment in the identification of conservation problems and potential solution is a key to the success in the process, conservation calls for a concerted action both at regional and international level. Many conservation programmes require support and collaboration specially in the areas of training skilled human resources and problem analysis. The following are among the national needs to be met:
- developing a viable plant genetic resources conservation programmes where *in situ* and *ex situ* systems complement each other and work effectively;
- build national capacity through the development of trained human resources, facilities and infrastructure, scientific and technical skills to effectively undertake the national programmes in crop genetic resources, genetic resources of medicinal plants, flora and vegetation, forest genetic resources, microbial genetic resources, biotechnology and biosafety;

- develop research programmes in various fields of genetic resources and biotechnology;
- promote public awareness and involvement in the conservation activities and encourage local community participation at all levels of the conservation processes;
- develop an integrated national data base and information system for biological resources conservation and development;
- develop sound technic and approaches to the restoration of degraded ecosystems and threatened species and genotypes;
- acquire germplasm of Ethiopian origin that has been displaced from the farmers field but held in various national gene banks of other countries and in the international research centres;
- establish mechanisms to address the issues of rights and rewards for farming and other communities for their past, present and future contribution to the genetic resources conservation and development.

CHAPTER 8
Proposal for a Global Plan of Action

Global effort in conserving and sustainably using genetic resources is better effected by developing a common global concern to assure respecting and caring for each other. The nature of any kind of development effort should consider the protection of natural environment, should be based on the objectives of satisfying the interest of all whether rich or poor, and should be conservation oriented. The existing global experience proves that some live friendly with nature and others disrupt it, and in the name of development but worsening the situation. Under such circumstances, where options for existence get narrower and narrower for many, making the present life and that of the future much difficult, the claim for biological resources as common human heritage' remains meaningless.

It is critical that the national and global policies and legal frameworks responsible for such trend are corrected in order to avert irresponsibilities and unfair sharing of both benefits and risks. In most of the cases, investments for supporting and promoting developments are poorly based on National derives and are also full of imposition with little or no regard to the nature of the problems and interest of the support recipient. Worst is that much of such development assistance neglect or poorly address the maintenance and the protection of biological resources, and under the process of such irresponsible development activities some contribute to the destruction of the natural environment. At times, resources of various kinds are drained through development assistance leaving behind not any or insignificant base which help the support recipient in building local capacities. With all these and other gaps and constraints in the process of human to human and human to environment relationships, it is hard to think of solely action plans to determine the fate of the coming future.

As past and recent experiences teach us, what ever the cause is, and who ever does it, the consequence of violating natural systems is at most far beyond being controlled within any of human made political boundaries, and the baring of the risk in most cases extends to all. Learning from these experiences, there are still rooms to carefully look in to the future and genuinely plan to overcome problems at national, regional and global levels. Among the important measures to be considered in developing Global Action Plan for sustainable conservation, utilization and development of biological resources are :

- developing international mechanisms that assure the commitment of all, to correct the national and international policy frameworks that negatively affect the sustainability of biological resources conservation and use;
- empowering the global policy frameworks and regulatory mechanisms with a capacity to detect actiones of negative impacts to the environment that are caused by public and private sectors, or international communities;
- support to the developing countries in establishing mechanisms to monitor and regulate the importation and use of environmentally risky agricultural inputs and industrial products;
- develop better international system by which the agricultural interest of the developing nations is protected better, and their role, potential and contribution to the international agricultural development is recognised.
- for the better development and common concern with regard to the protection of the environment, establish not only systems that assure the commonness of the concern but also mechanisms which govern the fair and equitable sharing of benefits and accountability for violating the system of natural environment.

References

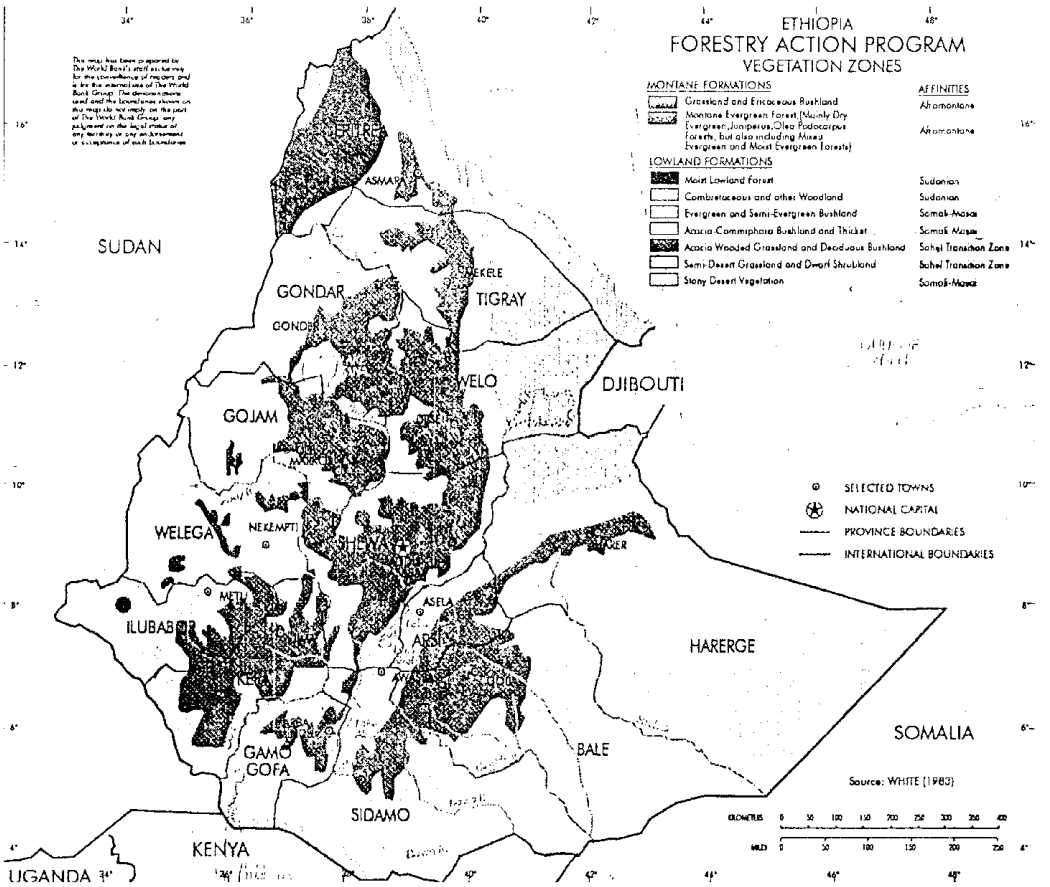
National Policy for Plant Genetic Resources Conservation and Development. 1994.

National Seed Industry Policy. 1993.

Ethiopian Forestry Action Plan. 1993.

Ethiopian Science and Technology Policy. 1994.

National Conservation Strategy. 1994.


ETHIOPIA
FORESTRY ACTION PROGRAM
VEGETATION ZONES
MONTANE FORMATIONS
AFFINITIES
Grassland and Ericaceous Bushland
Afromontane
Montane Evergreen Forest (Mainly Dry Evergreen Juniperus-Olea Podocarpus forests, but also including Mixed Evergreen and Moist Evergreen Forests)
Afromontane
LOWLAND FORMATIONS
Moist Lowland Forest
Sudanian
Combretaceous and other Woodland
Sudanian
Evergreen and Semi-Evergreen Bushland
Somali-Masai
Acacia-Commiphora Bushland and Thicket
Somali-Masai
Acacia Wooded Grassland and Deciduous Bushland
Sahel Transition Zone
Semi-Desert Grassland and Dwarf Shrubland
Sahel Transition Zone
Stony Desert Vegetation
Somali-Masai
SELECTED TOWNS
NATIONAL CAPITAL
PROVINCE BOUNDARIES
INTERNATIONAL BOUNDARIES
Source: WHITE (1983)
SUDAN
ERITREA
ASMARA
GONDAR
GONDER
TIGRAY
MEKELE
WELO
DJIBOUTI
GOJAM
WELEGA
NEKEMPTI
SHEWA
METU
ILUBABOR
ASELA
ARSI
HARERGE
SOMALIA
GAMO GOFA
BALE
SIDAMO
KENYA
UGANDA