FOREST GENETIC RESOURCES CONSERVATION STRATEGY OF ETHIOPIA

Forest Genetic Resources Conservation Project

German Development Cooperation (GTZ)

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1. INTRODUCTION

Ethiopia covers a total land area of 1.12 million km^2, with diverse geo-physical features. It has a wide range of altitudes, varying between 126 meter below sea level and 4620 meter above sea level that has resulted in a wide range of climatic conditions and a multitude of agro-ecological zones. This varied ecological setting has enhanced evolution of various life forms including more than 7000 species of vascular plants, of which about 12 % are believed to be endemic. The total number of woody plants (including trees, shrubs, bushes and lianas) is estimated to be 1000 out of which about 300 are estimated to be tree species.

Different studies indicated that all vegetation types of Ethiopia are under severe threat. The highest pressure, however, is being exerted on the high forest areas which are mainly located in the densely populated highlands, as evidenced by the high rate of deforestation. Since the population in the highlands is growing at the highest rate in the country, it is believed that the pressure on the high forest will increase in the future. The major reasons for the fast depletion of the forest resources are search for new farm and grazing land and the need for wood for fuel and construction purposes.

Past and present efforts to conserve the forests of Ethiopia are inadequate to halt the process of deforestation and forest degradation in the country. Deforestation of natural high forests and other vegetation types continues unabated. Therefore, it is time for concerted action of all stakeholders to halt the rapid degradation of forest ecosystems and the resulting loss of forest genetic resources.

The overall objective of this strategy is to conserve and attain sustainable utilization of the country's forest genetic resources, as a contribution to the maintenance of productive, stable and

diverse forest ecosystems. This strategy focuses on the conservation of diversity at ecosystem, species and genetic level. The strategy is also meant to identify ways and means for appropriate conservation measures and to define priorities for conservation measures in view of the limited resources of the country.

To meet the above objective, the legal frame work for forest genetic resources conservation was examined and amendments were made, appropriate conservation measures that are practically applicable were designed, criteria for prioritization of species were set, possible stake holder cooperation's were identified, public awareness programs that includes participation of local communities were identified, research areas were recommended, follow up tasks were identified and risks with possible solutions were sought in this document.

It is believed that this strategy can serve as a guide for the future to perform various forest genetic resources conservation activities. The strategy is built on the existing knowledge and will be updated whenever new information is acquired.

2. FOREST RESOURCE BASE

The various vegetation types of Ethiopia have been grouped in to nine major categories in the Conservation Strategy of Ethiopia (C.S.E.). These are:

1. Afroalpine and Subafroalpine Vegetation
2. Dry Evergreen Montane forest
3. Moist Evergreen Montane forest
4. Wetlands
5. Evergreen Scrub
6. Combretum-Terminalia (Broad-leaved deciduous) woodland
7. Acacia-Commiphora (Small-leaved deciduous) wood land
8. Lowland Dry Forest (semi-deciduous forest)
9. Lowland Semi-desert and Desert areas

These vegetation types were regrouped for the purpose of this strategy paper into 5 major forest resources. According to the Ethiopian Forestry Action Program (EFAP, 1994), the following broad categories of the country's forest resources were identified:

- Natural high forests
- Woodlands (including bush lands and shrub lands)
- Farm forests
- Man-made Forest Plantations (including industrial plantations, peri-urban plantations, community plantations and catchments /protection plantations)

According to the EFAP classification, riparian forests are either part of the woodlands or of the high forest areas, depending on the area they occur. However, for this strategy it was found appropriate to treat them as an independent fifth category because of their richness in biodiversity and wide distribution in the country.

The forest resource base of Ethiopia had been estimated to cover some 27.5 million ha of land. Out of this total forest resources, 2.3 million ha (8.34 %) are natural high forest, 5 million ha (18.2 %) are woodland, 20 million ha (72.7 %) are bush land and 0.2 million ha (.7 %) are plantation (EFAP, 1994).

2.1 Natural High Forests

Natural high forests are commonly defined as land covered by a closed stand of trees with a more or less continuous canopy rising 7 to 40 m, and a sparse ground cover of few grasses (EFAP, 1994). About 35 % of the land area of Ethiopia was believed to be once covered with high forests, and it is now estimated that less than 2.7 % of the land is covered with high forests. The annual loss of the high forest area has been estimated between 80,000 and 200,000 ha, a rate at which in few years time the remains of these high forests would be found scattered in the inaccessible areas (EFAP, 1994). Ethiopia's remaining natural high forests include two types of montane forests named Moist Evergreen and Dry Evergreen Montane Forests, and Lowland Semi-Deciduous forest. These forest areas are concentrated in the less populated southern, western and southeastern part of the country. The central and northern parts are almost completely deforested. Moist Evergreen Montane Forests occur in the southwestern plateau of Ethiopia, with characteristic tree species of *Afrocarpus falcatus, Prunus africana, Olea capensis, Schefflera abyssinica* as major species and *Hagenia abyssinica* at higher altitudes. The southwest forests are broad-leaved with *Pouteria adolfi-friederici* as the main emergent growing up to 40 m. *Bamboo (Arundinaria alpina*) is found in clumps within the high forests. The Dry Evergreen Montane Forests occur roughly above 1500m and below 3200m.a.s.l. in altitude. The drier eastern and higher altitude forests mostly consist of *Juniperus procera* and/or *Olea europaea* subsp *cuspidata* as the main trees with *Acacia*

abyssinica or *Acacia negrii* predominating the escarpments. Other large trees, such as *Afrocarpus falcatus, Olea capensis* subsp*. hochestetteri, Prunus africana, Apodytes dimidiata*, also occur. The Lowland Semi-Deciduous Forests are concentrated in the less populated areas of the Baro lowlands in Gambella region. This Lowland Semi-Deciduous Forest is characterized by the presence of species like *Baphia abyssinica, Alstonai boonei, Antiaris toxicaria* on the canopy layer and *Argomuellera macrophylla* in the under story*.*

2.2 Woodlands and Bushlands

This broad category comprises lowland woodland types, namely the Broad-Leaved Deciduous (Combretum-Terminalia) and the Small Leaved Deciduous (Acacia-Commiphora) woodlands, the highland woodlands of the Afro alpine and Sub Afro alpine vegetations, the Evergreen Scrub and Lowland Semi-Desert and Desert areas that represent a variety of woody vegetation types.

Woodlands are defined in Ethiopia as land covered by an open stand of trees taller than 5 m and up to 20 m in height and a canopy cover of more than 20%. Bush lands are land covered by an open stand of trees and/ or taller shrubs 2 to 5 m tall and a canopy cover of more than 20 % (EFAP, 1994). In Ethiopia, woodlands and bush lands are largely restricted to the agro-pastoral and pastoral zones.

The Afro alpine and Sub-afro alpine vegetation is found on the highest mountains in the country This type of vegetation is found in the Simen, Bale, Chilalo and Choke mountains and on Mt. Abune Yoseph, the Guna massif and Mt. Gughe. This area is grazed on nomadic basis with scattered shrubs of *Lobelia rhyncopetallum*. Lower down in altitude in the Sub Afro alpine zone the most extensive vegetation is Erica Scrub. In areas where the soil is thick, woody plants like *Hypericum revolutum,*

Gnidia glauca and *Myrsine mellanophloëos* do exist. In the highland woodlands, the main components are *Protea* sp, *Cussonia* sp*, Hypericum* sp, *Hagenia abyssinica, Erica arborea, Acacia abyssinica* and *Juniperus procera.*

The Evergreen Scrub includes montane evergreen thickets and scrubs. It consists of a dense and dominant shrub stratum of evergreen plants, 3-5 m tall and small trees that include *Dodonaea angustifolia, Acokanthera schimperi*, Carissa *edulis, Euclea schimperi and Myrsine africana.* Other tree species include *Teclea nobilis, Croton macrostachyus, Bersama abyssinica and Ficus* sp*.* The Evergreen Scrub is not economically attractive, be it for grazing, agriculture and firewood. They are found on steep rock slopes and gullies for example in the volcanic ash areas of central Ethiopia. The woody vegetation is however well developed, mostly consisting of plants with small, tough and leathery leaves.

The Lowland woodland consists of two major vegetation types named Acacia-Commiphora (Small-Leaved Deciduous) and Combretum-Terminalia (Broad-Leaved Deciduous) woodland. The characteristic plant species in Acacia-Commiphora woodland includes drought tolerant trees and shrubs: *Acacia tortilis*, *Acacia mellifera, Balanites aegyptiaca*, *Commiphor*a sp., etc. This vegetation type occurs in southern and eastern parts of the country in the rift valley. This area is used for grazing and cleared for agriculture. Deforestation has been increasing particularly in recent years, due to the intensification of agriculture and cutting of woody plants for fuel wood and charcoal production.
The characteristic plant species in Combretum-Terminalia woodlands include lowland bamboo (*Oxytenanthera abyssinica)*, *Combretum* sp.*, Terminalia* sp and *Stereospermum kunthianum*, etc. The under storey is a combination of herbs and grasses. This vegetation type occurs in the northwestern, western and southwestern parts of the country. The vegetation has developed

under influence of fire. Deforestation is increasing as a result of expansion of small holders farming and demand for fuel wood and charcoal production. However, it has been indicated that the vegetation type is perhaps the least affected of the wooded vegetation types due to the rugged topography that makes mechanized farming very difficult.

The Desert and Semi-desert vegetation types consists of deciduous shrubs mostly *Acacia species*, which are often interspersed with less frequent evergreen shrubs and succulents. The area around water points is bound to be under great grazing pressure from wild animals. The Danakil depression, the Ogaden area, and the Maji lower Omo plains are covered by this vegetation type. The characteristic species are, *Acacia* sp., *Ziziphus* sp., *Cadaba* sp.*, Maerua* sp. etc.

2.3 Farm Forests

Farm forestry is a term used to describe all land-use systems and practices in which tree and shrub species are deliberately grown on lands also used for crops and pasture. Despite the fact that farm forestry practices are not well studied and documented, traditional practices exist in various forms through out the country (EFAP, 1994) In parts of Ethiopia, farmers have traditionally used farm forestry practices such as retaining of frees on farms and on pasture land, homestead tree planting, field tree planting, farm boundary planting, trees and shrubs planted for wind breaks and on soil conservation structures. Characteristic species are *Acacia albida, Croton macrostachyus, ,Ziziphus spina-christi, Moringa stenopetala, Cordia africana,* and *Ficus* sp.

2.4 Riparian Forests

Riparian forests are complex plant communities growing in proximity to rivers which are either seasonal or carry water all

year round (EFAP, 1994). They also include forests on banks/shore of lakes.

The riverine forest vegetation of the country is variable and the floristic composition is dependent on altitude and geographic location. The forest along Awash River has a canopy of about 20-m high, the dominant species are *Acacia tortilis*, *Diospyros mespiliformis, Ficus sycomorus* and *Mimusops kummel*. The riverine forest of Dawa river Melca Guba on the SE slope of the SE high lands consists of dominantly *Ficus sycomorus, Tamarindus indica* and *Trichilia emetica*. Along the upper part of Abay many types of species are occurring, among which are *Tamarindus indica, Apodytes dimidiata, Carissa edulis, Ficus vasta* and *Millettia ferruginea* are the dominant ones. The extensive riverine forests of lower Omo valley, the riverine forest along Dedesa and the wetland forest complex on the western escarpment in the catchments of the Baro and Akobo rivers exhibit a canopy of 10-15 meter high consisting of *Ficus vasta, Ficus vallis-choudae, Celtis zenkeri, Cordia africana* and *Tamarindus indica*. In general, the status of this vegetation type is not well studied and documented but the pressure on the area is grazing both by wild and domestic animals. Fire wood collection and charcoal burning is another major threat to the riverine forests.

2.5 Forest Plantations

Plantations include industrial and peri-urban plantations established and operated by the Government, as well as community wood lots and catchment / protection plantations. They cover an area of about 200,000 ha (EFAP, 1994) *Eucalyptus* and *Cupressus spp* are the main species in industrial plantations (58% and 29%, of total planted area respectively), followed by *Juniperus procera* (4%), *Pinus* sp (2%) and other species (7%). Per-urban plantations, created to supply urban

centers with poles and fuel wood, are located around Addis Ababa and other major towns. (E.g. Nazreth, DebreBerhan, BahirDar and Gonder) Community woodlots are plantations created and managed by groups of farmers or a community. They can be either protection-oriented or production-oriented (e.g. wood lots for fuel wood). The community woodlots, similar to the peri-urban plantations, consist mainly of *Eucalyptus globulus* and *Eucalyptus camaldulenesis.* The rate of afforestation and reforestation has significantly increased during the last decade. The major problem is low survival rates due to drought and insufficient tending operations.

3. IMPORTANCE AND PROBLEMS OF FOREST RESOURCES AND THEIR MANAGEMENT

3.1 Importance

Ethiopia is a country predominantly inhabited by farmers and pastoralists who depend on natural resources for subsistence. Forests provide products and services. The major products that can be obtained from forests are logs (timber), fuel wood, poles, food fodder, tannin, spices/condiments, medicinal plants, resin, fiber, oils, gum and incense/olivanum. These products are economically important from individual family level to national level.

The service roles of forests are mainly environmental amelioration and protection like carbon sequestration that influence global warming effect, water quality improvement, maintenance of hydrological cycle and soil erosion control. Forests also play an important role in soil fertility maintenance. They maintain and increase organic matter, some trees fix nitrogen and take up leached nutrients by their root system. Forests physically protect soils from erosion and improve physical soil properties that could allow more percolation and infiltration of water.

3.2 Problems regarding Forest Management and Conservation in Ethiopia

The high rate of population growth coupled with low agricultural productivity, low living standard of the people and lack of alternatives are the underlying factors responsible for the decline of forest areas of Ethiopia. This leads to increasing demands for crop and grazing lands, construction materials, fuel wood and charcoal. The lack of appropriate land use and forest policies and the absence of corresponding laws also aggravated the situation.

In the last couple of decades, since security of land tenure and access to the natural resources were undermined by unpopular policy measures such as redistribution of land, restrictions in cutting and utilizing trees even in ones own backyard, resulted in serious destruction of forests. Illegal settlements and encroachment in forest areas are increasing from time to time and has resulted in the conversion of forest land to farm and other land uses. Deliberate setting of fire to the forest for clearing of debris, to fumigate the bees in honey collections, and to force wild animals to flock and move in to the desired direction for illegal hunting resulted also in destruction and degradation of forests. At present, some of the national regional governments are leasing the Moist Evergreen Montane Forests to investors to convert it to coffee and tea plantations. This is a new threat to the few remaining moist high forests of the country.

4. IMPORTANCE OF GENETIC DIVERSITY

Apart from plantations, which were mainly established with exotic species, forested ecosystems in Ethiopia consist in contrary to agricultural crops mainly of wild populations, which are only influenced by human interference to a limited extent.

Genetic Diversity is a precondition for evolutionary processes. It is the basis for adaptability of species and, hence, for their long-term survival. Genetic diversity is an integral part of biological diversity and the basis for:

- diversity of ecosystems,
- species diversity and
- intra-specific diversity.

Genetic diversity is important for reasons as follows:

– **Ecological reasons**

Genetic diversity is a precondition for adaptiveness to the various biotic and abiotic factors and impacts. This holds particularly true for long-living lifeforms as trees and shrubs that are bound to a specific location and unable to escape adverse living conditions. Furthermore, it contributes to the adaptability of woody species and, therefore, to the maintenance of species diversity and diversity of ecosystems and their further development under changing environmental conditions (evolution).

– **Economic reasons**

A large genetic diversity and species diversity ensures that the needs and demands of future generations can be met, also under possibly changed or changing environmental conditions. It also ensures that traits that are presently insignificant from an economic point of view but may gain importance in future will be available for future use and development. Forest genetic diversity is a precondition for sustainable, high productive, low-risk and multi-purpose forest management.

– **Ethical and cultural reasons**

Genetic diversity has to be maintained for ethical reasons out of responsibility for future generations. Ecosystems, species and populations have to be passed on to these generations with highest possible diversity, as an expression of the diversity of life.

5. THREATS TO DIVERSITY OF FOREST GENETIC RESOURCES

Human activities and the environmental stresses and changed environmental conditions caused by them have a short-term impact as compared to the entire evolutionary process. There is a threat that genetic mechanisms of trees and shrubs are not sufficient to compensate incurred genetic erosion and to safeguard adaptability. This can pose threats of different degrees to the different trees and shrubs, leading to the eradication of vulnerable species in extreme cases. Even if a species does not become extinct, its genetic diversity may diminish to such an extent that it will loose its adaptiveness and become threatened by extinction later on. Furthermore, well-adapted local populations may become extinct, although the species as such is not endangered.

Threats to genetic diversity have an impact on all three levels of biological diversity of forest ecosystems. In most cases the eradication of species is preceded by severe erosion of genetic diversity of that species.

5.1 Deforestation and Fragmentation

Since time immemorial forests in Ethiopia have been cleared for agricultural expansion. This has lead to large-scale deforestation, a process that still continues unabated. The conversion of forestland for settlements and infrastructure development has also contributed to this process. Ongoing re-afforestation efforts were mainly carried out with exotic species. While these efforts compensated for some of the forest area lost, the original populations of tree and shrub species could not be recovered by such measures.

There is a high likelihood that deforestation has lead to the eradication of species and locally adapted populations. Furthermore, through the fragmentation of tree and shrub populations the flow of genes amongst populations is inhibited. This may have led or may lead to a severe reduction of the gene pool of species and their populations.

5.2 Overexploitation

Forest ecosystems are exploited for a number of reasons and products. Certain species are in higher demand than others and will with increased demand decline in numbers. In extreme situations they might disappear altogether from a certain area. For timber production certain traits as for example healthy stems with straight and branchless boles are preferred. Creaming of such specimen will lead to higher relative abundance of lower quality trees. The genetic information of these trees will, hence, be more represented in future generations. Genetic information, which might have controlled preferred phenotypic characteristics, which mainly determine the value of species for a certain use, might get lost.

5.3 Habitat Alteration/Forest Degradation

Forest degradation has lead to an opening of forest canopies. While hardly any research has been carried out on the impact of the species' capacity for natural regeneration, it can be assumed that climax forest species will be disadvantaged as compared to pioneer species from this development. This will lead to a different structure of follow-on generations and less representation of climax species. While for many species the reproductive system has not been researched, habitat alteration might also have a negative impact for all those species, which depend on biotic vectors for pollination and/or seed dispersal.

5.4 Climatic Change

The effect of the anticipated climate change (e.g. global warming or increased UV radiation) on trees and shrubs are not yet known. However, losses of genetic diversity can be expected in the mid to long term due to:

- Changes in inter-specific competition between tree and shrub species;
- Higher virulence of pests and diseases and a change of their geographic ranges, coupled with decreased vitality of trees and shrubs will lead to increased damages;
- Increased frequency of natural disasters (droughts with subsequent wild fires, storms and gales);
- Direct damages of plants through increased UV radiation;

Genetic diversity is the more at risk the faster the anticipated climatic changes occur. The main difference to natural climatic changes is the high pace of the anthropogenic climatic changes and the combination with other stress factors mentioned above.

5.5 Wildfires

The devastating wildfires of the 2000 fire season have shown the vulnerability of forest ecosystems. Forest degradation has led to increased fuel loads in forest ecosystems and made them vulnerable to fire in case of droughts and extended dry seasons. Many forest species are not adapted to fire and are at risk of being eradicated from a certain area due to fires.

5.6 Forest Grazing

Grazing of livestock in forest areas is an important product function of forest ecosystems. If not managed properly, this will

lead to damages to natural regeneration of forest species, through trampling and browsing. Browsers have a preference for palatable species, leading to a decline in their numbers and hence, the genetic diversity of these species. In particular rare and preferred browse species are at threat.

6. LEGAL FRAMEWORK FOR FOREST GENETIC RESOURCES CONSERVATION

During the last decade a number of policies, legislation, action programmes and strategies have been developed on national and international levels which have a bearing on the conservation of genetic diversity of forest ecosystems. On international level, the development of the legal framework was triggered by the clear evidence of forest genetic erosion, incurred in particular through the dramatic destruction and decline of global forest resources.

6.1 International Framework

``Among the international conventions ratified by Ethiopia and relevant to the conservation of forest genetic resources are the Convention on Biodiversity (CBD). This convention takes a comprehensive approach to the conservation and sustainable use of biological resources. The convention includes a preamble, 42 Articles and three Annexes. The following six articles are particularly relevant for the endeavor of FGRC in Ethiopia.

- Article 6. General Measures for Conservation and Sustainable: This article requires each state to develop a national strategy, plan or programme for the conservation and sustainable use of its biological resources and integerate, as far as possible and as appropriate, the conservation and sustainable use of biological diversity into

relevant sectoral or cross-sectoral plans, programmes and policies.

- Article 8. *In situ* conservation: The CBD views *in situ* conservation as the main priority for conservation of biodiversity as this maintains the dynamic interactions of ecosystems and species.
- Article 9. *Ex situ* conservation: *Ex situ* conservation is taken to be complementary to *in situ* conservation, and not as an end on its own. Taken together, *in situ* and *ex situ* measures should contribute to comprehensive programs for the conservation of species and genetic resources
- Article 13. Public Education and Awareness: Environmental education and awareness is vital for safeguarding the environment and the biological diversity it contains. The contracting parties shall promote and encourage understanding of the importance of, and the measures required for, the conservation of biological diversity, as well as its propagation through media, and the inclusion of these topics in educational programmes.
- Article 14: An Environmental Impact Assessment (EIA) should be done as early as possible in the design of a project.
- Article 15: Access to Genetic Resources: The Convention on Biological Diversity assumes that when a state allows access to a sample of genetic resources, it is, in turn, entitled to insist on a number of benefits. Research activities on the genetic resources it provides have to be done in its territory to help it build capacity. All the information generated by research on that genetic resources must be repatriated. Any biotechnology applied on the genetic resources must be made accessible to it. A fair and equitable share of benefits accruing from the use, including from commercial gains, of the genetic resources must also be given to it.

The UNCED Forest Principles and Agenda 21 call for the international community to implement sustainable forest management as the primary means of reducing deforestation and forest degradation. In addition, the Cairo Conference on Population and Development and the Beijing Conference on Women stressed the importance of incorporating population aspect and gender issues into forest conservation and development programmes.

In addition, Ethiopia is signatory to the Convention on Climate Changes, the Convention to Combat Desertification, and the Convention on International Trade in Endangered Species of Wild Fauna and Flora.

6.2 National Framework

A defined national policy framework is a prerequisite for the proper planning and implementation of the conservation of forest genetic resources of a country.

Among the national policies which are in effect and relevant to the conservation of forest genetic resources are the Environmental Policy of Ethiopia and the National Policy on Biodiversity Conservation and Research. Other relevant programmes and projects include the Ethiopian Forestry Action Programme, National Biodiversity Conservation and Research Programme and the Seed zone system of the National Tree Seed Project. There is no formal forest policy at present but a forest policy draft has been developed and is yet to be approved by the government.
One of the constraints in the endeavor of forest genetic resources conservation in Ethiopia is absence or inadequacy of appropriate laws and regulations to enforce policies. Proclamation No. 94/1994 for example, prohibits the felling of *Hagenia abyssinica, Cordia africana, Afrocarpus falcatus*, and *Juniperus procera*. However, felling of these species is continuing due to lack of

mechanisms to enforce the law. The regulatory mechanisms for the export and/or import of forest genetic resources are also inadequate.

The implementation of other policies has effect on the forest genetic resources of the country. The Environmental Policy of Ethiopia clearly stipulates that any development programmes and projects recognize any environmental impacts early and incorporate their containment into the development design process. The Investment Policy of Ethiopia encourages private investors to invest on many sectors in Ethiopia. However, various investments are taking place on the natural forests of Ethiopia with out an Environmental Impact Assessment. As a result vast areas of natural forest in southwestern Ethiopia has been thinned or cleared for coffee and tea plantations.

7. CURRENT ACTIVITIES IN THE AREA OF FGRC AND INSTITUTIONAL SETTING

The following institutes used to be or are presently directly or indirectly involved in the conservation of forest genetic resources in Ethiopia.

7.1 Institutes directly involved in the conservation of FGRs*

1. **The Ministry of Agriculture:** has designated 58 National Forest Priority Areas (NFPA) in 1980 for their production, protection and biological conservation services. Due to the federal government system that Ethiopia is following, the administration and management of 57 of the NFPAs is now transferred to the Regional Bureaus of Agriculture. Only one NFPA (Menagesha-Suba) is under the Ministry of Agriculture. The NFPAs are meant for sustainable management

and they can best be used for *in situ* conservation. However, the present contribution of the forest priority areas to forest genetic resources conservation is limited due to lack of legal protection and inadequate representation of the country. In the absence of the enforcement of proper management regulations, legal and illegal exploiters are "creaming" all accessible good specimens of valuable timber species, while leaving the diseased and deformed ones. This inevitably will lead to a genetic decline. In some areas, the Ministry of Agriculture and the Bureaus of Agriculture practice enclosure and catchments plantings. These activities have helped in the conservation of some indigenous woody species.

2. **The Ethiopian Wildlife Conservation Organization and the Regional Bureaus of Agriculture:** manage the protected areas (National parks, Sanctuaries, Game reserves, etc) of the country. While the prime objective of the protected areas is nature conservation, and great emphasis was given to the protection of larger fauna, it is assumed that the flora within these protected areas will be also conserved. One of the objectives of the Bale Mountains National Park management plan, for example, is to conserve plants that are found only in Ethiopia. However, the conservation status of forest genetic resources in the protected areas is very poor.
3. **The Ethiopian Agricultural Research Organization (EARO):** has carried out research on silviculture, management and forest seeds. The outputs of these researches can be used for the purpose of FGRC. The National Tree Seed Project (NTSP) has been establishing seed stands of both indigenous and exotic species, which can serve as *ex situ* conservation sites. The project has stored the seeds of more than 50 woody species (about one-third are indigenous) in its

gene bank. The NTSP identified and delineated 21 major seed zones and 41 sub-zones in Ethiopia. The major purpose of establishing the seed zoning system for NTSP was the establishment of a general system for guidelines on the transfer of tree seeds (*i.e.* choice of tree seeds and provenance). Forest gene resources conservation was of secondary importance in the process of establishing the tree seed zones. However, the existing seed zones can be considered as the basis for planning FGRC in Ethiopia. These activities of the NTSP have helped in the conservation of some indigenous tree species in Ethiopia.

4. **The International Livestock Research Institute (ILRI):** has stored in its gene bank 2,500 accessions of browse plants of which 300 accessions are native to Ethiopia. This activity has helped in the conservation of these plants.
5. **Religious Institutions:** The Ethiopia Orthodox Churches and mosques (Islamic symmetry) have a long tradition of conserving indigenous trees, especially in the most deforested areas of the northern and central highlands. Some tree species, for example *Olea europaea* subsp *cuspidata* is mostly found in the compounsd of churches and monasteries in the northern parts of the country. Traditional religious societies like the "Kalu" and "Aba Geda" in Oromia have a long-standing tradition of conserving trees in their surroundings. Planting of some tree species is also practiced in some religious areas. These "sacred forests" are important as future sources of seeds genetic materials and as sites for *in situ* conservation.
6. **Rural Communities:** Traditional conservation practices in Ethiopia such as the farm forestry practices in the central, south and southwest, tree-based soil and water management practices in Konso, and forest-based

resource management in Borena contributed to the conservation of forest genetic resources. *Faidherbia* (*Acacia*) *albida*, for example, is deliberately left on farmlands in rift valley, Guder, Enfranz and Adwa surrounding for both service and production roles and hence being conserved naturally.

7. **The Institute of Biodiversity Conservation and Research (IBCR):** has collected and stored about 804 accessions of seeds of the following tree and shrub species in cold storage facility: *Aeschynomene abyssinica, Calpurnia aurea, Dodonea angustifolia, Embelia schimperi, Heteromorpha trifoliata, Moringa stenopetala, Myrsine africana, Oxytenanthera abyssinica, Phytolacca dodecandra, Premna schimperi, Ricinus communis, Solanum incanum*, and *Tamarindus indica*. The Institute also maintains about 1181 accessions of *Coffea arabica* in the field gene bank in Oromia region.
8. **Wondo Genet College of Forestry:** has about 500 ha of protected natural high forest.
9. Universities and Colleges are doing basic and applied research on indigenous trees. The Biology Department of Addis Ababa University, for example, is doing propagation studies on some indigenous trees and shrubs. The results of this research can be used in the endeavor of FGRC. The arboreta of Alemaya University and Wondo Genet College of Forestry can serve as ex-situ conservation stands.

∗ Institutes which are involved in the actual implementation of FGRC

Currently, the Institute of Biodiversity Conservation and Research (IBCR) is mandated to undertake, coordinate and strengthen conservation of biological resources in Ethiopia. IBCR was

established by Proclamation NO. 120/1998. The objective of IBCR is to undertake and ensure the appropriate conservation, research, development and sustainable utilization of the country's biodiversity.

IBCR developed National Biodiversity Conservation and Research Programme which includes Forest Plant Genetic Resources Conservation and Research programmes. Four programs are formulated under the forestry sector: High Forest programme; Woodland and bushland programme; Riverine forest programme and Farm forest programme. All the four programmes have got four major activities: (i) Inventory and collection, (ii) characterization, (iii) Evaluation and Research and (iv) Conservation. Due to shortage of manpower and financial resources, the implementation of the programmes will be on a priority basis according to agreed criteria. The programme has been reviewed by relevant stakeholders and will be implemented upon approval by the IBCR Management Board.

IBCR launched a Forest Genetic Resources Conservation Project in July 1998. The goal of the project is sustainable development of the economic, socio-cultural and ecological values of the forest ecosystems. The project is currently surveying the existing forest genetic resources including socio-economic information. It is expected that a priority list of indigenous woody species will be identified for the purpose of conservation in due course.

*7.2 Institutes indirectly** involved in the conservation of FGRs*

1. The Ethiopian Heritage Trust maintains a nature park of about 1000 ha, where the remaining vegetation is to be protected and rehabilitated. A certain area of the park will be put aside for the establishment of *ex situ* stands of threatened species.

2. The National Herbarium of Addis Ababa University has the scientific backstopping of the actual implementation of FGRC

As it has been discussed above, the limited activities on the conservation of forest genetic resources until recently have been scattered among different institutions with no mechanism to coordinate the efforts. Though the achievements from such scattered activities are remarkable, the resources continue to disappear at an alarming rate. Since IBCR is now mandated for the conservation of forest genetic resources, it should play a leading role in coordinating these scattered activities and should also embark on practical conservation activities.

8. STRATEGY OBJECTIVES

8.1 General objective

The general objective of Forest Genetic Resources Conservation is to contribute towards attaining a sustainable development of the economic, socio-cultural and ecological values of the forest ecosystems of Ethiopia.

** Institutes which are involved in promotion, service and scientific backstopping of the actual implementation of FGRC

8.2 Specific objectives

Forest Genetic Resources Conservation has the following specific objectives.

- Conservation of prioritized tree and shrub species (species diversity).

- Conservation of the variation within prioritized tree and shrub species (genetic diversity).
- Restoration of viable population of prioritized tree and shrub species.
- Conservation of prioritized forest ecosystems (ecosystem diversity).
- Sustainable utilization of forest genetic resources of the country.

9. STRATEGIES FOR FOREST GENETIC RESOURCES CONSERVATION

The conservation of genetic resources is based on two different concepts, namely *in situ* and *ex situ* conservation methods. For actual implementation of these conservation methods a sound knowledge of the genetic structure and the mating system of the tree/shrub species to be conserved is necessary. This knowledge will guarantee that the applied conservation measures will cover the genetic variation of that particular species.

In spite of being necessary for the implementation of the conservation measures, there is limited information on the tree and shrub species of Ethiopia. However, this lack of information does not rule out the implementation of measures to conserve such species. In case of limited or no knowledge, the decision on a suitable strategy is to be based on informed guesses about the genetic structure using, for example, ecological characteristics of a species as a guideline. Besides this, for the realization of the conservation methods, the conservation objects have to be identified and evaluated in terms of their conservation status and socio-economic importance. In view of limited resources priorities on different levels (ecosystem and species level) have to be defined in order to direct available resources to those conservation objects, which most urgently require attention.

9.1 Conservation worthiness

Before deciding on any conservation activity every potential conservation object will be evaluated for its genetic worthiness. In the evaluation process, the first consideration is adaptation and adaptive capacity of the material to be conserved under various ecological conditions. This adaptation and adaptive capacity has been developed through long evolutionary processes. It can be taken as given for all indigenous species. In the Ethiopian context,

indigenous tree/shrub species are at higher risk of genetic erosion due to the rapid decline of the natural forests. Taking this into account, the conservation activities will emphasize on the indigenous tree/shrub species of the country. Exotic species will be accorded second priority. Conservation measures for these species will be only foreseen, if they are well adapted to the given site conditions and at the same time threatened and socio-economically important (refer to 9.2). The second consideration is whether a species is endemic or not. Endemic species will receive special priority amongst the indigenous species. Besides these, populations surviving under special ecological condition will also get special priority.

9.2 Conservation urgency

The degree of threat or of damage and the socio-economic importance as well as the ecological, genetic and silvicultural importance of a population or species are basic criteria for determining the necessity of gene conservation. These criteria are the basis in setting priorities on conservation objects. The process of priority setting will be carried out on two subsequent levels, namely the ecosystem and the species level as described below.

9.2.1Prioritization of broad Vegetation types

The conservation of Ethiopia's forest genetic resources is a very demanding and complex task. While the strategy equally considers all major vegetation types, these need to be prioritized in view of limited available resources. For this purpose, the nine major vegetation types of the country (refer to chapter 2) were ranked according to the level of threat imposed on them. This has resulted in the following priority classes for conservation measures[1]:

[1] Preliminary priorities for different forest types were identified during the Forest Genetic Resources Conservation Strategy Development Workshop in June 1999. The workshop was attended by most

First priority (high level of threat - high priority for conservation)

- Moist ever green montane forest
- Dry ever green montane forest
- Lowland Wet forest (Lowland semi-evergreen forest)

Second priority

- *Acacia Commiphora* woodland (small-leaved deciduous woodland), particularly the *Acacia* dominated sub- type which occurs for example in the Rift Valley.

Third priority

- Wetlands/riparian vegetation
- Afro alpine and sub afro alpine vegetation

Fourth priority

- Broad-leaved deciduous woodland (*Combretum-Terminalia* woodland)
- Low-land semi-desert and desert vegetation

Fifth priority

- Evergreen scrub

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relevant stakeholders, including a strong representation of regional forest professionals. Subsequently, the outputs of the workshop were further discussed during the first meeting of the FGRC Working Group and the above presented priority classes were agreed upon.

9.2.2Selection of priority species

For the selection of priority species for conservation efforts two main criteria will be considered with equal importance, namely

- the socio-economic and environmental importance of a given species and
- the degree of threat of the species in concern.

In order to operationalize the prioritization process, a species scoring matrix was developed. The scoring matrix and a description of its different parameters and of the scoring method is presented in Annex 1.

The scoring matrix will be filled in for all woody species and the species list sorted according to the total scores obtained. The resultant Species Priority List will constitute an integral part of this strategy and will be attached as Annex 2 as soon as the data are being processed. The Species Priority List will be continuously updated with information obtained from inventories or other sources.

9.3 Identification and evaluation of potential conservation objects

The basis for all gene conservation measures is the identification and evaluation of existing forest genetic resources. Secondary data sources such as inventory reports, lists of approved and candidate seed sources and research data should be reviewed for this purpose. In addition, it will be necessary to conduct a countrywide inventory of woody plant diversity, in combination with socio-economic surveys. Due to the magnitude of this task inventories will be carried out in accordance with the priorities delineated under chapter 9.2.1 of this strategy.

The inventory will provide information on the conservation status and socio-economic importance of the respective species. These data will be used for filling the species scoring matrix (refer to chapter 9.2.2 and Annex 1).

9.4 Conservation measures

The selection and implementation of conservation measures is dependent on the biology of tree and shrub species (e.g. storage capability of seeds, possibility for propagation by means of cuttings), the condition of the genetic material (e.g. stand age, flowering, fructification) and upon the technical methods available. All measures should warrant that a representative sample of the genetic diversity of a given species is being conserved. In doing this, regional and species-specific differences have to be considered.

The two internationally accepted conservation methods to conserve the forest genetic resources are the *in situ* and *ex situ* methods and under each of these main methods there are a number of measures which can be applied.

9.4.1*In situ* conservation measures

***In situ* conservation** is the conservation of ecosystem and natural habitats, for maintenance and recovery of viable populations of species in their natural surroundings.

Wherever feasible and applicable, priority should be given to *in situ* conservation measures. These measures combine the advantage of conserving a maximum of genetic diversity with little costs and research requirements under natural selection. The genetic resource conservation could be best achieved when conservation is done in its respective site condition and it is under this site that a sufficiently large number of adapted populations

exist. The existence of populations can best be safeguarded by conserving these stands and letting natural regeneration to take its course with a possibility of supplemental seeding and planting, using local reproductive material. *In situ* conservation can be realized using different implementation techniques. The most widely employed conservation measure of *in situ* methods are presented as follows:

A. Conservation of natural stands

This conservation measure comprises the delineation and preservation of natural stands with the appropriate management. Depending on the size and structure of stands for the tree/shrub species in question, it must be decided whether conserving the stands is sufficient. Stand age and location are especially important.

This technique is comparatively simple. A large genetic diversity can be conserved under conditions of natural selection. The disadvantage of this measure is that it is very much dependent on the environmental site conditions with only slight possibilities for improving the site. Poor silvicultural practices may also impair the measure.

B. Natural regeneration

This conservation measure entails the delineation and preservation of undisturbed populations. Depending on the size and structure of the range of respective tree species, the stands have to be analyzed as to the possibility of successful natural regeneration. Management operations are geared at promoting natural regeneration (e.g. freeing of mother trees from competing trees, scarifying of soils, clearing of weeds, fencing, etc.). The technique can be well integrated with sustainable forest

management operations and a large genetic diversity can be conserved under natural selection conditions.

The disadvantage of this technique is that it is very much dependent upon on given site conditions with limited possibilities for improving the site. The measure may also be impaired by lacking or insufficient flowering and fructification of the parent stand and by inadequate silviculturural know-how.

In areas, which are highly degraded and disturbed by human and cattle interference, area closures can be applied as one alternative conservation measure for the forest genetic resource conservation. This conservation measure aims at restoring natural populations and their natural habitats, by ways of excluding human and cattle influence on the area and, hence, promoting their natural regeneration. The utilization of these areas has to be planned and initiated as soon as satisfactory state of recovery has been reached. The technique is relatively simple, but it requires that sufficient mother trees of those species to be conserved are in or in the vicinity of the area.

C. Artificial regeneration with defined material (seeding and planting *in situ*)

Seeding and planting *in situ* comprises the collection of germplasm from a given site, propagation of seedlings in a nursery and subsequent planting of the produced seedings in a delineated area where the germplasm was obtained from. Alternatively, direct seeding could be applied. It has to be ascertained through application of proper sampling and seed harvesting procedures that the genetic structure of the parent stand is well represented in the subsequent generation.

This technique allows the conservation of comparatively large genetic diversity under natural selection conditions. There is a

close link with forest management and no additional areas are required. The site can be improved more easily than under natural regeneration.

9.4.2*Ex situ* conservation

***Ex situ* conservation** is the conservation of components of biological diversity outside their natural habitats.

Generally, there are two possible ways: conservation under natural site conditions (field condition) and conservation under artificial conditions (controlled condition). Conservation under artificial condition requires the facility called “gene bank”. It serves the conservation of genetic resources under artificial conditions for as long a period as possible. It deals in particular with the storage of seed, pollen, plants, parts of plants & tissue. The most widely employed conservation measures of the *ex situ* method are presented as follows.

9.4.2.1 Ex situ conservation in natural conditions

A. *Ex situ* conservation stands (seeding and planting *ex situ*)

Seeding and planting *ex situ* is the establishment of conservation stands for rare and endangered species on similar sites as its original mother tree/shrub species. This measure of conservation may be employed for specific threatened populations of all tree/shrub species. An early and detailed selection of sites should be done. The advantage of this technique is that it facilitates the conservation of a comparatively large genetic diversity under natural selection conditions and a better possibility for improvement of the site. The disadvantage is that it is not easy to get land in suitable and accessible locations (ownership problem).

B. Seed orchards

The establishment of Seed orchards is one of the *ex situ* conservation measures under natural condition and based on the plant material used for establishment, seed orchards are divided into two categories; namely the seedling and clonal seed orchards.

- Seedling seed orchard: is a seed orchard established from the seedlings of superior mother trees.
- Clonal seed orchard: is a seed orchard established by vegetatively propagated material in which the genetic material of the mother tree is identical to the offspring with the intention of duplicating a superior tree/shrub species.

The advantage of seed orchards is that a direct control of the plantation is possible and through intense measures of protection and tending, the conditions of survival can be improved. Further more, the site suitability is known. The disadvantage of this method is that since the establishment is from selective tree/shrub species and, hence, the genetic diversity that could be conserved is low.

C. Clone archives (vegetative propagation)

Clone archive entails the conservation of the genetic material by producing cuttings and planting them on suitable sites. Conservation of genotypes through propagation by cuttings may exceed the natural life span of the basic material (i.e., the tree/shrub species). The clones have to be propagated continuously to avoid aging. The advantage of this technique is that by vegetative propagation, genotypes that have already been tested, may be conserved and they can be propagated quickly. The disadvantage is that the technique cannot be implemented

for all tree/shrub species and that the conserved genetic diversity is limited.

9.4.2.2 Ex situ conservation in controlled conditions

Storage of seed, pollen, plants & parts of plants

These conservation measures entail the storage of seeds, pollen, plants and parts of plants by rejuvenating them in recommended time intervals. Collecting and storing seeds can theoretically conserve the largest number of genotypes. The storage of pollen requires very small space. However, its successful implementation requires the availability of female partners.

The advantage of these measures is that the conservation of a relatively large genetic variety in small space storage is possible and it can be utilized simply and quickly. The disadvantage of this measure is it does not allow evolutional process and it might not adapt to changing environment and there may be a danger of technical failure in gene banks and risk of loss.

9.5 Criteria for the selection of conservation measures

For all genetic resources in need of conservation, the guiding principle is to maintain them *in situ* as long as possible. However, there are conditions where *in situ* conservation is not feasible or not sufficient to warrant the success of the conservation effort. In such cases *in situ* measures have to be supplemented or replaced by *ex situ* measures.

There are a number of conservation measures under these two principles and the choice of the suitable conservation measures depends on the following criteria:

- genetic conservation objectives;
- ecological requirements and mating system of the species in question;

- resource requirements (costs, research needs) of the respective conservation measure;
- number of genotypes of a given conservation object;

9.5.1Suitable Conservation Methods for different Conservation Objectives

The relative ranking of the various conservation measures for the various conservation objective is presented in table 1 (Erikssen, 1998: Cited in Wolf, 1999). A well-organized registry that indicates selected conservation measures for each priority species should be developed [a sample is attached (annex 4)].

Table 1: Relative ranking of different conservation methods according to the conservation objectives

Measure	**Objective of conservation activities**						
	Ecosystem	Species	Populations				Breeding
			Endangered	Marginal	Reference	Adaptability	
In situ							
Nature	1			1	1	3	

Conservation area							
Gene conservation forest	2	1	1	2	2	2	
Ex situ							
Ex situ conservation stand	3	2	2	3	3	1	1
Seedling/ Clone seed orchard			3	4			2
Seed/pollen storage		6*	5	6			
Clone archive		5					

*pollen storage

9.5.2Suitable Conservation Measures in Relation to the Number of Genotypes

In the process of deciding on the appropriate conservation measures, the number of individuals in a given conservation object is of prime importance.

9.5.2.1 Individuals and small Groups

Individuals and groups containing up to 20 individuals (genotypes) should not be conserved by generative methods in order to minimize self-pollination and inbreeding effects and to keep genetic drift as low as possible. Therefore, priority should be given to the establishment of clone archives and seed orchards through means of vegetative propagation (cuttings or grafting) for

such conservation objects. Exceptions to this rule might be required in case of very rare and endangered species or varieties. In order to stabilize the genetic diversity of such objects *in situ* plantings of generatively propagated genetic material from these objects should be established.

9.5.2.2 Stands

Conservation objects with 20 or more individuals (genotypes) can be conserved *in situ* through natural regeneration or planting of seedlings. Other pre-conditions for the applicability of this measures is suitable spatial distribution of the individuals within one pollination unit and the appropriateness of the site conditions for the given species (soil, climate, human pressures). If these conditions are not met, seeding and planting *ex situ* or in case of species with orthodox seeds, long-term seed storage should be applied.

9.5.3Double Strategy

Back up conservation measures should be foreseen as much as possible. This way the risk of failures of conservation efforts due to other selection conditions can be minimized. For species with orthodox seeds the long-term storage of seeds in addition to *in* situ and/or *ex* situ conservation stands is recommended for this purpose. Application of different conservation measures for a different species will also help to attain the highest possible genetic variation and to minimize the risk of loss of genetic information. On the other hand duplicate samples of *ex situ* measures should be placed in different places to avoid risks due to failures in genebanks.

9.6 Prioritization and selection of conservation sites

On the actual establishment of conservation sites especially *in situ* conservation sites, difficulties may arise due to the presence of more than one forest site for conservation of a priority species. Therefore, to choose the best conservation site, a set of criteria needs to be developed. The conservation site for a priority species will be selected based on the following criteria (the detailed description of these criteria is presented under Annex 2):

1. Number of priority species existing in the forest
2. The presence of unique/endangered/endemic populations
3. Accessibility of the forest
4. Degree of disturbance (threat) to the area
5. Species richness of a given site
6. Attitude of the local people towards conservation

9.7 Strategies for the implementation of conservation measures

9.7.1Identification and evaluation of potential conservation objects

Strategy

- Generate essential data on the composition, ecological and socio-economic importance of the indigenous woody plant species;
- Establish a priority list of tree/shrub species using the defined selection criteria;
- Determine suitable conservation measures for every tree/shrub species on the basis of available knowledge

and/or subsequent research findings concerning their biology and genetic structure.

9.7.2*In situ* conservation

Strategy

- Give special priority to the *in situ* conservation of the tree/shrub species;
- Establish proper legal basis for the protection of *in situ* conservation sites;
- Combine conservation with sustainable utilization of forest resources.
- Support the development and implementation of mechanisms for managing forest plantations to minimize impacts on adjacent natural ecosystems and provide technical advice to communities and private plantation owners regarding the conservation of biological diversity, and where appropriate offer incentives to promote genetic resources conservation and development;

9.7.3*Ex situ* conservation

Strategy

- Ensure the conservation and sustainability of the genetic resources of tree/shrub species with special emphasis to endangered species;
- Give special consideration to species having recalcitrant and intermediate seeds during establishment of *ex situ* conservation stands;
- Establish the necessary facilities such as cold rooms for the storage of seeds, pollen and vegetative parts of plants.

9.8 Integration of Forest Genetic Resources Conservation in sustainable Forest Management Operations

The conservation methods described above are solely geared at forest genetic conservation. However, sustainable forest management practices also contribute positively. Purpose-tailored integration of certain *in situ* conservation tasks into the natural forest management programs will enhance a country-wide extension of the intended gene conservation impact. In order to have such an impact, the programs should be based on the principles of sustainable forest management, especially with respect to the regeneration, thinning and harvesting operations.

9.8.1Natural Regeneration and Forest Propagation

There is a marked difference between natural regeneration and artificial propagation regarding their impact on genetic diversity. Priority should be given to natural regeneration in all cases where the parent stand is adapted to the site conditions, produces a sufficient number of viable seeds and possesses desired phenotypic characteristics. Long regeneration cycles should be promoted which increase the chances of participation of a maximum number of parent trees.

When artificial propagation measures are applied the following principles should be observed in order to conserve maximum genetic diversity:

- Priority should be given to local provenances and site-appropriate/ adapted provenances.
- Genetic material for artificial propagation should be harvested from a variety of stands with a sufficient number of parent trees.

- When using vegetatively propagated genetic material a sufficient number of this has to be produced from a maximum number of clones.
- Establishment of plantations should be carried out with a sufficient planting density.
- Available research results regarding the site-appropriateness of proveniences have to be considered in provenance/ site selection.

9.8.2Tending and Harvesting Operations

Selective thinning or harvesting operations may lead to changes in the genetic structure of forest stands. In case of strong selective felling operations genetic diversity may be endangered.

Promotion of rare species or species with little inter-specific competition capabilities will have a positive impact on the conservation of genetic diversity. This should be particularly observed in forest fringes, where different light regimes might favor the occurrence of a wide range of species.

During harvesting operations due attention should be given that harvested specimen have had sufficient opportunities for natural regeneration. This is particularly important in the case of harvesting systems, which are based on minimum dbh and for rare species. Fructification of such specimen should be promoted by removing competing specimen and subsequently enough time should be allowed for their natural regeneration.

9.9 Sustainable Utilization of Forest Genetic Resources

The sustainable utilization of forest genetic resources is key to the establishment and maintenance of multi-purpose forest management, i.e. for the maintenance of the productive, protective and cultural functions of forest ecosystems. Apart from the site conditions and applied silvicultural systems and/ or treatments, high genetic diversity is a precondition for this to be achieved. High adaptability and adaptive capacity of the species warrant the stability of forest ecosystems. Resistance against biotic and abiotic stress factors increases with higher biological diversity. The strategy is to sustain ably utilize genetic diversity at all levels, i.e., species diversity, diversity of provenances and genetic diversity within provenances. The genetic materials conserved using various conservation methods will be used to

enrich the genetic diversity, as well as the species diversity of forest ecosystems.

9.9.1Sustainable production and supply of timber and other forest products

The economic basis of forestry is to provide sustainable production and supply of quality products, in terms of both timber and other forest products. The quality and quantity of wood is dependent on a number of genetically determined properties: growth characteristics, type and quality of stem and other physical properties (density, strength, branching, calorific value, etc.). The strategy will, therefore, provide opportunities for an objective-oriented selection of suitable tree/ shrub species/provenance, in order to meet the following needs.

- Guarantee a continuous supply of quality forest products.
- Ensure optimum productivity on various site conditions
- Supply the market with an assortment of wood products, which is in line with what demands in terms of quality, quantity and species demands.
- Ensure sustainable use of Non Wood Forest Products (NWFP) (seed, fruits, honey, fiber, mushrooms, wildlife, etc.)

9.9.2Production and supply of quality seeds and wildlings

The use forest genetic resources for the purpose of producing seed and wildlings has the following goals:

- To supply reproductive material, which possess broad genetic base in order to establish stable and productive stands.
- To pass over the genetic information of trees and shrubs to subsequent (future) generations.

- To provide the forest owner with an opportunity for supplemental income.

9.9.3Utilization of genetic materials for species conservation

For the conservation of rare and endangered species and populations, the genetic resources are used for:

- Establishing plantations with respective representative materials to maintain them *in situ* in their natural range.
- Establishing seed orchard breeding populations through planting; and
- Increasing genetic variability in decimated populations through planting.

9.9.4Promotion of protective and socio-cultural functions of forests

The protective functions of the forest i.e., water, soil, nature and species protection and as carbon dioxide sink is of high recreational, cultural, social, ecological and economic value. Planting of adapted species and provenances serves the following purposes in a sustainable manner.

- Maintaining a pleasant and variable landscape for recreation and tourism;
- Improving water supply;
- Reducing soil erosion and avalanches;
- Protecting against air pollution;
- Maintaining and creating habitats for endangered flora and fauna in the forest.

9.9.5Provision for tree breeding

Tree breeding is dependant upon the use and conservation of forest genetic resources and their high variability. The main objective of tree breeding is to provide forest reproductive material, with a high degree of adaptability, good growth potential, resistance to stresses and high quality. Through breeding programmes, reproductive material with special quality, stability and productive characteristics can be used for tree improvement in forestry.

9.9.6Provision for potential future uses

Forest gene resources additionally possess a potential for possible use in the future. Certain presently unrecognized/ unknown properties of plant species may suddenly become important in the future (e.g. medicinal or industrial use, resistance to disease, pests or pollutants.) The basis for such future use is an existence of broad genetic base.

9.10 Stakeholder co-operation

9.10.1 Local community

For an effective implementation of conservation on forest genetic resources, the participation of local communities should be promoted. For this purpose, suitable collaboration mechanism should be created.

Strategies

- Recognize and maintain the close and traditional dependence of many local communities on forest genetic resources, and the desirability of sharing equitably benefits arising from the use of traditional knowledge, innovations and practices relevant to the conservation of forest genetic resources and its sustainability.

- Establish a mechanism to encourage all concerned individuals and communities to actively get involved in the planning and implementation of forest genetic resources conservation to ensure sustainability
- Recognize and encourage the vital role that women can play in the conservation and sustainable use of forest genetic resources and affirming the need for full participation of women at all levels of policy-making and implementation for forest genetic resources conservation.

9.10.2 Other stakeholders

For an effective implementation of conservation and research on forest genetic resources, the efforts of various stakeholders should be coordinated and collaboration mechanisms should be created. The list of various relevant institutions and their areas of collaboration is depicted in annexes 5, 6, 7 and 8.

Strategies

- Ensure that relevant institutions from the federal down to the community level actively participate in forest genetic resources and other cross-sectoral planning and implementation issues.
- Orient/reorient professionals employed in forest resources development and conservation to embrace participatory development, and to strengthen their communications skills so as to more effectively disseminate both the results of scientific researches and the practical experience of local communities with regard to the conservation of genetic resources.
- Create/Establish functional forest genetic resources twinning and networking arrangements at national, regional, federal and international levels with bodies involved in forest genetic resource conservation.

9.11 Public awareness

The public's lack of awareness of the importance of forest genetic resources, their relevance to everyday life, the benefits from the use of its components and the consequences of their loss is a major constraint which must be overcome if forest genetic resources conservation and sustainable use efforts are to succeed. This however, cannot be successful without the support of local communities living in or near the forests. Furthermore, according to article 13 of the Convention on Biological Diversity, environmental education and awareness is vital for safeguarding the environment and forest genetic resources. Since better public understanding would lead to better public support the local people, officials, investors and students have to be oriented on the reasons to conserve forest genetic resources.

Strategies

- Promote and encourage the understanding of the importance of and the measures required for the conservation of forest genetic resources through mass media and inclusion of forest genetic resources conservation and sustainable use related topics into the curricula of primary and secondary schools and relevant colleges, Institutes and universities.
- Establish a co-operation mechanism, as appropriate, with other states and international organizations in developing public awareness programs.
- Initiate, encourage and facilitate the active participation of local communities including women, and religious leaders in training, public awareness campaigns, formal and informal education and decision-making.

- Target the public, particularly those involved in public and private sector activities for environmental education and awareness programs.

9.12 Risk Assessment

Whenever conservation measures are planned possible risks that could hamper the conservation activities or destroy the conservation measure should be detected before hand. This will help to look for preventive measures and to consider other mitigation measures.

Field level risks

The various risks on *in situ* and *ex situ* conservation measures under field condition may arise as they are exposed to different natural and man made calamities and disasters. The various risks may include:

- Natural hazards like pests and diseases, floods, drought, land slides, thunder storms, hails, frost, wild fire and grazing by wild animals may cause unexpected damage to the conservation objects, which would result in unpreferable changes in the genetic make up of the species.
- Human interference in the form of agricultural encroachment, illegal cutting of trees, deliberate setting of fire, infrastructure development, livestock grazing and browsing and vandalism that may alter the genetic make up of or destroy the conserved objects.

The risks can be minimized by designing the necessary measures such as:

- Careful site selection
- Site duplication;

- Pest and diseases control;
- Establishing physical barriers like fences;
- Establishment of firebreak and fire lines;
- Establishment of well equipped fire-fighting brigades;
- Awareness creation;
- Enabling local communities to participate in the process of planning, implementation, monitoring and benefit sharing;

Gene bank risks

Gene banks may fail because of various reasons such as fire, unreliable electricity supply and poor documentation.

To minimize such risks, the following measures are recommended:

- Fire prevention, detection, information and suppression mechanism;
- Automatic back-up electric generator;
- Well-trained information technologists;
- Save duplicate copies in other genebanks (refer also to selection 9.5.4)

9.13 Research needs

In order to guarantee the success and sustainability of the genetic conservation programs, it is essential to develop and implement specific conservation strategies for each species in question. On this account, a sound knowledge of the genetic structure and mating behavior of the tree/ shrub species is necessary for the selection of appropriate conservation measures to achieve species specific conservation objectives.

A national strategy document for research on forest genetic resources (FGRs) of Ethiopia was developed by the Forest Genetic Resources Conservation Project. In line with this, a comprehensive review of the existing information, either directly or indirectly relating to research on forestry resources was made. Consequently, the available information and the associated gaps have been identified. To this effect, it has become evident that the overall scope of the existing knowledge with regard to the country's FGRs remains highly limited, not only in terms of the number of tree/shrub species covered, but also in terms of its relevance to the objectives of genetic conservation.

In consideration of the above, the Research Strategy document proposed a series of main and sub-thematic areas for research on FGRs of Ethiopia. This proposal was further amended following deliberations and prioritization exercises conducted on a workshop held (in Nov.2000) to review the draft document. To this end, the workshop prioritized and adopted the main research thematic areas (see table 2). Each of these is made to consist of various sub-thematic areas (for further information refer to the Research Strategy document (2001).

Table 2: Prioritized Main Thematic Areas for Research on Forest Genetic Resources

S/N	Major Research Thematic Areas	Priority Rank	Remarks
1	Reproductive and Conservation Biology	I	
2	Botany and Forest Ecology	II	
3	Indigenous Knowledge	III	
4	Conservation Genetics and Tree Breeding	IV	
5	Silviculture and Forest management	V	

6	Forest Protection	VI	
7	Gender Issues	VII	
8	Forest Economics and Policy	VIII	
9	Forest Product Utilization	IX	

Source: National Strategy for Research on Forest Genetic resources of Ethiopia (2001)

However, considering the pertinent need for developing and implementing species specific conservation strategy, nothing but only a purpose - tailored assessment of the species specific research needs would guarantee effective decisions. In this regard, the processing and analysis of the field data, generated through the inventory of woody plant species diversity (WPI) and the socio-economic surveys (SES) of selected forest areas will be used to produce the information required for the identification, evaluation, prioritization and selection of the would be final list of priority tree/ shrub species. More pragmatic assessment of the actual research needs will, therefore, be carried out and the result will be presented in the format shown, in table 3 below.

Table 3: Prioritized thematic areas for research on forest genetic resources for conservation

S/N	Priority species	Rank	**Research needs**								
			I	II	III	IV	V	VI	VII	VIII	IX
1											
2											
3											
4											
5											

Note: The roman numbers, I, II, III,…., IX, are the priority ranks, assigned in respect of the main research thematic areas, as in Table 2, above.

9.14 Monitoring of Forest Genetic Resources

Long-term monitoring of forest genetic resources is essential for detecting possible spatial and temporal changes in the genetic structure of tree and shrub species and their populations.

Monitoring of species diversity in conservation objects by conducting regular inventories and or case studies, with respect to the floristic richness, structure and regeneration status should be considered essential.

The monitoring results shall serve to support decisions for forest management and nature conservation measures aimed at the conservation of forest ecosystems and their sustainable utilization.

9.15 Regulation of the Use, Movement and Trade with Forest Genetic Materials

Sustainable success of genetic improvement programmes also depends on the existence of adequate legal regulation for forest reproductive materials. In particular, a minimum standard for the quality seed comprising: species name, identity of provenance or population genetic quality and variation, as well as, health, viability and vigor should be set by the federal legislation. In this regard the legal regulation should include mechanisms for control of the movement of genetic materials in and out of the country.

10. IMPLEMENTATION ARRANGEMENTS

Successful implementation of this strategy can not be expected, without a clearly designed institutional mechanism, for pursuing the whole spectrum of the intended gene conservation tasks. In this regard, one possible option could be considered, as briefly described here under.

As proclamation No. 120/1998 provides, IBCR is responsible for ensuring that the entire gene conservation tasks are properly implemented in accordance with the relevant federal policy and approved implementation plan.

To fulfill that responsibility, IBCR will initially undertake some of the envisaged tasks. However, it will be able to delegate the authority to carryout some or all conservation functions, concerning a particular gene conservation activity to another competent agency. In particular, if a relevant region acquires the financial, organizational and human resource capacity to undertake proper implementation of a particular gene conservation program, then IBCR and the region may enter into agreement, in accordance with the agreed implementation plan.

Under such an implementation agreement, IBCR will remain an active participant in the planning process and it will also have a monitoring role, with the intention of helping the regions to improve their implementation capacities. By mutual agreement, IBCR could second staff, provide advisory and other services and assist capable regions to raise funds for conservation.

However, IBCR must have the right to rescind/ cancel the agreement, if there are major deviations from the implementation plan or, if implementation is far short of the standards of other similar gene conservation activity/ areas. The success of these initiatives will be monitored and evaluated, before deciding if and how to enter into future agreements.

Continuing the theme for conservation of genetic resources, IBCR or a region may enter a formal agreement with other competent agencies to carryout various conservation measures, relating to gene conservation tasks/ areas.

These agencies may be:

- Local community groups,
- NGOs (Local or international)
- Research/ Higher Learning Institutions (esp. EARO, AAU, SU, WGCF)
- Religious Institutions (esp. monasteries/ mosques/ traditional religions),
- Private sector organizations,

IBCR will assist regions to develop their capacity to administer gene conservation areas/ the activities there of, and hence be able to enter into implementation agreements, with other relevant/competent partners.

At present none of the regions have adequate capacity in terms of skilled manpower organizational capacity or finance to implement the essential elements of this strategy. Although IBCR's capacity too is still very limited, opportunities for improvement are much higher.

Recognizing these limitations IBCR will negotiate with the relevant region the possibility of delegating the administration of, one or two, designated gene conservation areas (genetic conservation forests, set aside for *in situ* conservation of priority tree/shrub species). The implementation of these pilot conservation sites will be monitored and evaluated before deciding if and how to enter further implementation agreements, with other regions and/or other partners.
Depending on the success, the experience gained from the pilot conservation sites will be documented and, hence extended to other regions or similar gene conservation objects/ sites.

Attachment to proposed action plan

Annex 1: Scoring matrix for the selection of priority species

Forest Genetic Resource Conservation Project has developed the following scoring matrix to prioritize tree and shrub species:

Species list	**Socio-economic Importance**								**Threa**			
	Major end uses				Contribution to export		Total Socio Economic Score	SE Importance Class	Total no. of individuals	Important Value Index	Population structure	Regene stat
	1	2	3	4	5	6	7	8	9	10	11	12

Note: Endemic species should receive priority if they fall under the same category with other species

DESCRIPTION OF THE PARAMETERS

Major actual and potential end uses

1. Industrial wood

(Saw logs/timber, plywood, pulpwood, chip and particleboard, transmission poles, etc.,)

2. Non-industrial wood products

(Construction poles, posts, fire wood charcoal, tool making, wood for carving, tooth brushes, walking sticks etc.,)

3. Non-wood forest products

(gums, resins, oils, tannins, rubber, dyes/pigments, fiber, detergents, food, medicine, fodder, stimulants, adhesives, repellents, chewing gum, etc.,)

4. Service roles

(land reclamation, mulch, green manure, erosion control, shade, shelter, windbreak, ornamental, live fences, boundary planting, hedges, ritual, ceremonial, subject of mythology, etc.,)

Scores are given for each end uses as scales of 1-4, whereas: 1 = unknown; 2= low;
3 = average; 4 = high

Contribution to export

5. Current contribution to export
6. Potential contribution to export

Scores are given for each type of export contribution as scales of 1-4, whereas: 1 = unknown; 2= low; 3 = average; 4 = high

7. Total scores of Socio-Economic values (1+2+3+4+5+6)

8. Socio-Economic Importance Class

All species under consideration will be grouped under five classes based on their total scores; class 5 being socio-economically the most important species whereas class 1 will be the least important species. Out of the 5 Socio-Economic importance classes, species that fall under classes 3 to 5 will be given special consideration.

9. Total number of individuals

Estimates of the total number of individuals of a given species in the country

Scores: 1 = more than 10 million 2 = 5-10 million 3 = 1-5 million
4 = 100,000- 1 million 5 = less than 100,000

10. Important Value Index (IVI)

Important Value Index is the sum of relative density, relative frequency and relative dominance of a given species. The higher the IVI of a given species, the less priority will be given to that species. All species under consideration will be grouped under five classes based on their IVI scores; class 1 being relatively abundant species whereas class 5 will be relatively rare species.

11. Population Structure:
All species under consideration will be grouped under three classes based on their Population Structure classes; class 1 being highly threatened. Class 2 being relatively threatened and class 3 being not threatened.

12. Regeneration Status:
All species under consideration will be grouped under three classes based on their, regeneration status classes; class 1 being highly threatened, Class 2 being relatively threatened and class 3 being not threatened (abundant).

Representation in Protected Areas

13. National Parks
14. Sanctuaries
15. Forest Priority Areas

Scores: 1 = High representation
2 = Low representation
3 = Not represented

Representation in Research Program

16. Research programs (including provenance, progeny and clone trials)

Scores: 1 = The species is in comprehensive research programs
2 = The species is in relatively small research programs
3 = The species is not in research programs

17. Logging intensity

Scores: 1 = Was not logged or not under logging
2 = Slightly logged or under slight logging
3 = Heavily logged or under heavy logging

18. Total scores of threat category values (9+10+11+12+13+14+15)

19. Threat Category/Conservation status Classes

All species under consideration will be grouped under five classes based on their total threat category scores; class 1 being relatively abundant species whereas class 5 will be relatively rare species. Out of the 5 conservation status classes only classes 3 to 5 will be considered with priority for conservation; for class one species no conservation measures are required for the time being, for class 2 species only monitoring of their status is required.

20. Grand total score: The sum of the total Socio-Economic scores (7) and the total Threat category scores (16). The grand total score ranks the species. A species with the highest grand total score will receive the highest priority for conservation and vise versa.
Finally, the overall conservation status of a given species will be judged as per IUCN criteria based on the total threat category scores of the species. IUCN identified the following categories among others:

Abundant/common species: a taxon is abundant when it does not satisfy any of the other categories described below and it is evaluated to be of no present risk.

Near threatened species: Taxa that are close to qualify for vulnerable

Vulnerable species: a taxon is vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium –term future.

Endangered species: A taxon is endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the immediate future.

Critically Endangered species: A taxon is critically endangered when it is facing an extremely high risk of extinction in the wild in the immediate future.

Extinct in the wild: A taxon is Extinct in the wild when it is known only to survive in cultivation, in captivity or as naturalized population well outside the past range

Annex 2: Criteria for the selection of *in situ* conservation sites

Descriptions of the criteria (Max.) Score 10	**Grand total**
1 Number of the priority species in the prioritized area max. score3	
Presence of < 20 individuals of the prioritized species 0	
Presence of 20-25 individuals 2	
Presence of 26-30 individuals 2.5	
Presence of > 30 individuals 3	
2 The presence of unique/ endangered/endemic populations max. score 1	
Presence of unique/ endangered populations 1	
Absence of unique/ endangered / endemic populations 0	
3 Accessibility of the forest max. score1	
Accessible 1	
Inaccessible 0	
4.Degree of disturbance (threat) of the area max. score 2	
Highly disturbed 0	
Moderately disturbed 1	
Slightly disturbed 1.5	
Undisturbed 2	

5 Species richness	**max. score 2**
Low	0
Medium	1
High	2
6 Attitude of the local people towards conservation	**max. score 1**
Negative attitude	0
Indifferent	. 5
Positive attitude	1

Annex 3: National policies relevant for FGRC

1. The National Conservation Strategy

In 1990 Ethiopia embarked on the formulation of a multi-sectoral National Conservation Strategy (NCS). In essence, it is a draft policy framework for the integration of environmental objectives into general development planning. In the NCS draft (vol. 5) a number of projects under the heading of conservation of biodiversity are compiled, including Forest Genetic Resources Conservation. Of particular relevance for FGRC are:

- Legislation for protection of genetic resources
- Genetic diversity study: *Afrocarpus falcatus*
- Biodiversity study outside protected areas
- National /regional botanical gardens/zoological parks/aquaria
- Wild plant conservation: traditional and modern institutions
- Ecosystem conservation in sw ethiopia: local government
- Biodiversity conservation & medicinal plants

2. The Ethiopian Forestry Action Programme

The Ethiopian Forestry Action Programme (EFAP) was issued in 1994. The EFAP is viewed as the first sectoral development programme prepared under the NCS. It provides a practical framework for generating a much higher level of awareness and political commitment and major actions to conserve the forest resources and to use the full potential of the forest resources for development. The EFAP document states four objectives for forestry development, namely:

- Increased production of forest products on a sustainable basis

- Increased agricultural production through reduced land degradation and improved soil fertility
- Conservation of forest ecosystems and genetic resources
- Improved welfare of rural communities

3. National Policy on Biodiversity Conservation and Research

IBCR developed a National Policy on Biodiversity Conservation and Research in 1998. The policy document consists of a Preamble, 9 Objectives, and 14 Policy Directives. One of the objectives stated in the policy document is to ensure that the Ethiopian plant, animal and microbial genetic resources and ecosystems as a whole are conserved, developed, managed and sustainably utilized. The following policy directives are included in the National Policy.

- The government of the Federal Democratic Republic of Ethiopia will enact, and update as necessary, legislation to protect, conserve and sustainably utilize the biological resources in Ethiopia.
- The government will give due attention to the exploration, collection, conservation, characterization, evaluation and utilization as well as to promoting research and development of the flora, fauna and microbial genetic resources.
- Recognizing the fact that Ethiopia has sovereign rights over its genetic resources any exploration, inventory, collection, movement, exchange, repatriation and the use of these genetic resources will be governed by the laws and regulations of the country as well as bilateral and/or multilateral agreements.
- The Federal and Regional Governments will ensure the integration of biodiversity conservation and sustainable use related education into the educational system and the

creation of awareness on biodiversity issues at the individual, family, and community levels.

- Community participatory approach in the decision making processes and the creation of community-based systems which recognize resources rights of the local people and enable them to get economic benefits from jointly and sustainably managed natural resources will be ensured.
- The government of Federal Democratic Republic of Ethiopia will put the administration and management of *in situ* conservation areas (national parks and other categories of designated protected areas) under the Federal or Regional Government)
- The National Policy for Biodiversity Conservation and Research will be integrated with and supported by policies and strategies on the national economy, agriculture, industry, health, education, population and urbanization, energy and construction, resource management and environmental protection. The policies in these sectors shall be harmonized to enhance sustainable production systems and to encourage the development of alternative resources and sustainable management systems in order to reduce the pressure on and avoid degradation of the biological resources.
- In order to plan, develop and reorient the different biodiversity conservation and development-related activities in the country and create an integrated national biodiversity program, a functional national biodiversity networking system will be created.
- The government of the Federal Democratic Republic of Ethiopia shall take the necessary steps to discharge its obligation under international treaties concerning the protection, conservation or utilization of biological resources.
- The federal and regional governments shall receive and distribute revenues generated from biodiversity exclusively for the benefit of communities associated with or

participating in the conservation of biological resources, and the costs of administering, developing and managing biodiversity.

4. The Environmental Policy of Ethiopia

The Environmental Protection Authority in collaboration with the Ministry of Economic Development and Cooperation developed the Environmental Policy of Ethiopia in 1997. The policy document has five sections: The Resources Base and the Need for Policy; The Policy Goal, Objectives and Guiding Principles; Sectoral Environmental Policies; Cross-sectoral Environmental Policies; and Policy implementation. Among the sectoral policies are included Forest, Woodland and Tree Resources Policy and Genetic, Species, and Ecosystem Biodiversity Policy.

Among the policy statements included in the Genetic, Species and Ecosystem Biodiverity are:

- To promote *in situ* systems (i.e. conservation in nature reserve, farmer's field, etc.) as the primary target for conserving both wild and domesticated biological diversity; but also promote *ex situ* systems (i.e. conservation outside the original or natural habitat) in gene banks, farms, botanical gardens, ranches and zoos as supplementary to *in situ* conservation.
- To ensure that the importation, exportation and exchange of genetic and species resources is subject to legislation.
- To ensure that factors such as the level of vulnerability, uniqueness, importance and economic and environmental potential of the genome be taken into account in determining priorities in conservation.
- To ensure that the conservation of genetic resources *in situ* maintains a dynamic system of genetic variability in an environment of constant selection pressure that is normally

present in the natural or human made ecosystem as the case may be.

- To promote the involvement of local communities inside and outside protected areas in the planning and management of such areas.

Annex 4: Conservation measures registry for priority tree/ shrub species

S/N	List of Species	Priority rank	*In situ* Measures				*Ex situ* Measures			
			Conser-vation stands	Natural regener-ation	Planting/ seeding *in situ*	Area closure	Seeding/ planting *ex situ*	Conserv-ation seed orchards	Vegetat-ive propag-ation	Storage of genetic materials
1										
2										
3										
3										

Annex 5: Institutions and areas for collaboration in implementing forest genetic resources conservation activities

S/N	**List of Institutions**	**Collaborative Conservation Measures**	
		***In situ* conservation**	**Ex- situ conservation**

		Conserv-ation stands	Natural regener-ation	Planting seeding *in situ*	Area closure	Planting/ seeding *ex situ*	Conserva-tion seed orchards	Clone archive	Storage of genetic materials
1.1	Regional BoA	X	X	X	X	X	X		
1.2	MoA	X	X	X	X	X	X		
1.3	EWCO		X						
1.4	IBCR	X	X	X	X	X	X	X	X
1.5	CTA	X							
2.1	Church/ monasteries	X	X	X	X				
2.2	Cultural/sacred places		X		X				
2.3	Mosques		X		X				
3.0	Local Com. Institutions	X	X	X	X	X	X		
4.0	NGOs					X			
4.3	Private agencies	X	X	X		X			
5	CARE/Ethiopia					X			

Annex 6: Institutions and prioritized thematic areas for collaboration in research on FGRs

S/N	List of institutions	Prioritized Research Thematic Areas								
		I	II	III	IV	V	VI	VII	VIII	IX
1.0	Higher Institutions									
1.2	DU - WGCF	X	X	X	X	X	X			X
1.3	AAU	X	X	X	X	X	X			X
2.0	Research Institutions									
2.1	EARO/ FRC	X	X	X	X	X	X	X	X	X
2.4	ARARI	X	X	X	X	X	X	X	X	X
2.5	MRC,	X	X	X	X	X	X	X	X	X
2.6	ILRI	X								
3.0	IBCR	X	X	X	X	X	X	X	X	X
4.0	MoA	X	X	X	X	X	X	X	X	X
5.0	EWCO	X								
6.0	Regions/BoAs	X	X	X	X	X	X	X	X	X
7.0	Relevant NGOS			X			X	X	X	

Note: 1. Source: extracted from the national strategy to research on forest genetic resources of
Ethiopia, compiled by Demel Teketay (2001).

1. The Roman numbers, I,…,IX, respectively represent priority research thematic areas
(for further reference see table -1- in Annex - 3.1 -)

Annex 7: Possible collaboration for developing Public Awareness and Community Participation

S/N	List of possible institutions	**Public Awareness Raising Modules**					
		Regular education Curriculum	Informal Education	Mass media	Publi cat-ions, etc	Action days / weeks	Knowledge and Experience Sharing
1.0	Federal Agencies						
1.1	IBCR	X	X	X	X	X	X
1.2	EPA						
1.3	MoE/	X	X		X	X	X
1.4	MoI			X		X	X
1.5	MoA		X		X	X	X
1.6	Publishing agencies				X		
2.0	Regional Agencies					X	

2.1	BoAs		X				X
2.2	BoE	X			X	X	X
2.3	BoI			X			
2.4	Local administration					X	
3.o	Relevant NGOs		X		X		X

Annex 8: Institutional arrangement for promoting community participation

S/N	Institutions	Potential collaborative role				
			Enabling	Facilitation	Actors	Coordination
1.0	Federal gov. Agencies					
1.1	IBCR	X	X	X		X
1.2	MoA		X	X		X
1.3	EWCO		X	X		X
2.0	Regional gov. Agencies:					
2.1	Admin Counsils/ all levels		X	X		
2.2	BoAs/all levels	X	X	X		X
3.0	NGOs					
3.1	Local NGOs			X		
3.2	International NGOs	X		X		
4.0	Local People					
4.1	Traditional/community institutions			X	X	
4.2	Forest/Village dwellers			X	X	X
4.3	Kebele Administration.			X		X

4.4	Religious/ trad. institutions			X		X

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