THE STATE
OF THE WORLD's
FOREST GENETIC RESOURCES
COUNTRY REPORT

TURKEY

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

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

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

TURKEY:
First National Report on Forest Genetic Resources

Country Report for the FAO First State of the World's Forest Genetic Resources

Compiled by:
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Photographs by Gaye KANDEMİR (Cover Photograph, Aladağ, Bolu)

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FOREWORD

Forests are one of the most important pools of biological diversity. They provide economic, aesthetic and ethical values for humans. Conservation of forest biological diversity, which comprises forest genetic resources, is essential for sustaining the productive value of forests. Effective conservation, improvement and management of forest genetic resources are basic to sustainable forest management. The significance of forest genetic resources has been recognized for many years and various approaches have been applied to preserve and utilize them efficiently. Both *ex situ* and *in situ* conservation techniques have been used for conservation of forest genetic resources.

This country report of existing data and information has attempted identification of future requirements and gaps about Forest Genetic Resources in Turkey. The document will serve as a strategic tool to guide national efforts to enhance the conservation and sustainable use of forest genetic resources.

İbrahim ÇİFTÇİ

General Director of Forestry

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SECTION I

EXECUTIVE SUMMARY

Turkey is situated in Eastern Europe and Western Asia. Total land area is 77 846 000 ha and forests comprise 27.6 % (21 537 091 ha) of the country. Turkey is a populous country with the population of 74 million. Despite the decreasing on the growth rate (1.35 % in 2011; 2.17 % in 1990), there is an increase in the population with its 1,20 % growth rate. Parallel to the increased population the demand for wood raw material is increasing.

90% of forest area in Turkey is natural forest. When classified as high forest and coppice forest; high forests comprise 77 % and coppice forests 23 % of Turkey's forests. Forests are also categorized as productive or degraded forests according to their canopy cover. Forests with 11-100 % canopy cover account for 50 % of the total forests area. Other 50 % is classified as degraded forest. In recent years, reforestation and rehabilitation activities help to turn those degraded forests into productive forests. Forest area in Turkey has been increasing with protection, rehabilitation, maintenance and afforestation activities while there is a constant decrease in the forest areas in the world. Forestland area was 20 199 296 ha in 1963-1973, 20 763 248 ha in 1999, and 21 188 747 ha in 2005. With the data in 2010 (21 537091 ha), it was identified that there had been an increase of approximately 1 400 000 ha within the last 40 years. Current annual increment of forests in Turkey is 36.2 million m^3, and annual wood production amounts to 16.2 million m^3. In Turkey, the public owns 99.9 % of the forest area. The remaining 0.01 % belongs to private ownership and organizations with legal entity.

Turkey is divided into 3 major regions in terms of plant diversity. Those regions, also known as floristic or phytogeographical regions, are Irano-Turanian, Euro-Siberian and Mediterranean

phytogeographical regions. Intersection of these three phytogeographical regions is a rare occasion. And also it is one of the reasons why approximately 9000 plant species inhabit in Turkey, of which almost 3000 of them endemic. This diversity in plant species is also true for the forests as they are home for over 100 species of trees.

Forest Tree Seeds and Tree Breeding Research Institute Directorate that is under "General Directorate of Forestry" and "General Directorate of Nature Conservation and National Parks" are responsible for selection, protection and management of forest genetic resources.

Gene conservation forests, seed stands, national parks, nature protection areas, biosphere reserve areas, natural monuments, protection forests, nature parks, specially protected areas are *in situ* conservation areas in Turkey. *In situ* gene conservation activities major on gene conservation forests and seed stands, since other units are selected for different purposes together with gene conservation function. There are 238 **gene conservation forests** as *in situ* conservation areas. They consist 42 species (162 coniferous and 76 broadleaved), which covers 35 000 ha. **Seed stands** are also important as other *in situ* conservation areas. There are 349 (284 is coniferous and 65 is broad leaved) seed stands in 35 species across the country. Almost all of the seed stands are natural, and they cover 46 369 ha.

Seed orchards, clone parks, progeny trials, provenance trials, genetic orchards and seed stock centers are *ex situ* genetic conservation areas in Turkey. Additionally, botanical gardens and arboretums manage several field collections of forest genetic resources of native and exotic tree species.

Tree breeding activities in Turkey systematically started in 1969, and National Tree Breeding Programme was prepared in 1993. At the beginning, in this Porgramme, the most widespread and valuable five species *Pinus brutia, Pinus nigra, Pinus sylvestris, Cedrus libani* and *Fagus orientalis* were selected, and breeding and seed transfer zones for these species were determined. Of these species, *Pinus brutia* is mostly use for tree breeding activities.

The factors threatening biological diversity in Turkey's forests, in consequence forest genetic resources can be listed as; unplanned and over urbanization, poor silvicultural interventions, pollution and climate change, forest fires, inappropriate management of forest areas in the past, pressures resulted from the life style of populations living in and near forests based on forest products, mining activities, inappropriate reforestation and afforestation practices in the past, over-harvesting of the natural species having economic value, gaps in the forest cadastre.

Determination of conservation strategies of forest gene resources in Turkey is basically related with the identification of genetic diversity of the species. The most significant factor affecting Turkish forest gene resources conservation is that genetic structure of ecological and economically important

species has not known yet. Thus, this gap causes difficulties on the identification of gene conservation strategies.

In Turkey, technical staffs that are responsible for the protection and management of forests working at the Ministry of Forestry and Water Affairs are mainly forest engineers. The number of Forest Faculties has increased last years and there are nine Forest Faculties within the structure of different universities. Although the increase in forestry faculties, the courses and researches related to "forest genetics" at those faculties are limited. This insufficiency leads to difficulty to meet the needs required for specialized staff for forest genetics.

Turkey is a member of EUFORGEN (European Forest Genetic Resources Programme). In years 1994, 2000 and 2009, three meetings of this programme were held in Turkey. In the context of this programme, common action plans are determined concerning protection and sustainability of forest gene resources. Furthermore, Turkey provides data regarding *in situ* conservation areas in the database of EUFGIS (Establishment of a European Information System on Forest Genetic Resources).
Turkey has signed a number of legally binding agreements on the conservation and sustainable use of forest genetic resources as a United Nations (UN) country.
In Turkey, Forest Genetic Resources have the potential to decrease poverty by supplying the most basic needs for sustainable development of the forest dependent villagers. Forest genetic resources in Turkey have made adequate contributions providing economic, social and environmental benefits.

SECTION II

INTRODUCTION:

TURKEY

AND FOREST SECTOR

Turkey is located in Asia and Europe on both Anatolian Peninsula and Thrace. Turkey is situated between 36° - 42° Northern latitude and between 26°-45° Eastern longitude. The total area is 77 846 000 ha with 74 million population. The forests cover 27, 2 % of the total area. 99, 9 % of forestland is owned by the public. The remaining 0.01 % belongs to private ownership and organizations with legal entity. Of this total forest area, 34 % is agricultural land, 27 % meadows and pastures, and 11 % settlement areas, roads and other facilities, and 1 % lakes. The recorded forests in Turkey include the areas under forest as the land use and some areas recorded as forests while not under tree cover, such as rocks, inland water bodies etc. (ANONYMOUS 1, ANONYMOUS 2) According to the FRA 2010 forest definition forest land of Turkey is 11 334 000 ha.(ANONYMOUS 4).

Table 1. Forest characteristics and areas

Main forest characteristics	Area (ha)
Primary forests	1 334 000
Naturally regenerated forests	5 648 609
Planted forests Afforestation Reforestation	2 238 505
Other (tending, coppice forest etc)	12 315 977
TOTAL	21 537 091

ANONYMOUS 1, ANONYMOUS 2 (Forestry statistics, 2011)

90 % of forest area in Turkey is natural forest. Forests are divided into two groups according to the canopy cover. Forests with canopy cover of 11-100 % are productive forests while 1-10 % are called as degraded forests. Productive forests comprise 50 % and the other 50%, are called as degraded forests of the total forest area.

Rehabilitation and afforestation activities in Turkey's forests are carried out in the forests with low canopy cover (11-40%) and in the degraded forests. It is aimed to convert these forests into productive forests. Accordingly, 50-60 ha of afforestation and rehabilitation activities are carried out per year, and recently this figure has reached 100 ha per year. Forest area with canopy cover of 1-10 % accounts for 11 202 837 ha, forest area with canopy cover of 11-40% amounts to 2 343 524 ha and forest area with canopy cover of 41-100 % amounts to 10 334 254 ha. 13 158 774 ha of the forests is coniferous and 8 378 317 ha is broad-leaved. Current annual increment of forests in Turkey is 36.2 million m^3, and annual wood production amounts to 16.2 million m^3.

Turkey is divided into 7 geographical regions, namely Black Sea Region, the Marmara Region, Aegean Region, Central Anatolia Region, Mediterranean, East Anatolia Region and South-east Anatolia Region. Black Sea Region has the largest forest area distribution (total productive and degraded forest area) with 24 %. 14 % of Turkey's forest area is in the Marmara region, 18 % in Aegean Region, 11 % in Central Anatolia, 19 % in Mediterranean, 8 % in East Anatolia and 6 % in South-East Anatolia (ANONYMOUS 1; ANONYMOUS 2).

Forest area in Turkey has been increasing with protection, rehabilitation, maintenance and afforestation activities while there is a constant decrease in the forest areas in the world. Forestland area was 20 199 296 ha in 1963-1973, 20 763 248 ha in 1999, and 21 188 747 ha in 2005. With the data in 2010 (21 537091 ha), it was identified that there had been an increase of approximately 1400 000 ha within the last 40 years (ANONYMOUS 1; ANONYMOUS 2).

Table 2. Forest ownership and area

Forest ownership	**area (ha)**
Public ownership	21 516 897
Private ownership	20 194
Others	-

ANONYMOUS 2 (Forestry statistics, 2011)

Figure 1. Distribution of forest areas in Turkey (reference: Directorate of Forest Mapping and Photogrametry, General Directorate of Forestry)

SECTION III

CHAPTER 1

CURRENT STATE OF FOREST GENETIC RESOURCES

In terms of biological diversity and richness of genetic resources, Turkey has an important place in the world. It is estimated that there are approximately 100 000 species belonging to plant, animal and other living groups. This amount includes almost 12 000 plant species which have been identified. It can be said that Turkey is the same level with the European Continent in this regard. A great majority of microorganism, fungus, plant and animal species live in forests, and thus forests, home for a great deal of organisms (DAVIS 1965, DAVIS et al 1988, GUNER et al 2000) .

When looked at flora integrity, Turkey is located in the three phytogeographical regions. These are Euro-Siberian in the north, Irano-Turanian in the East and Central Anatolia, Mediterranean phytogeographical region in the South and West (Figure 2).

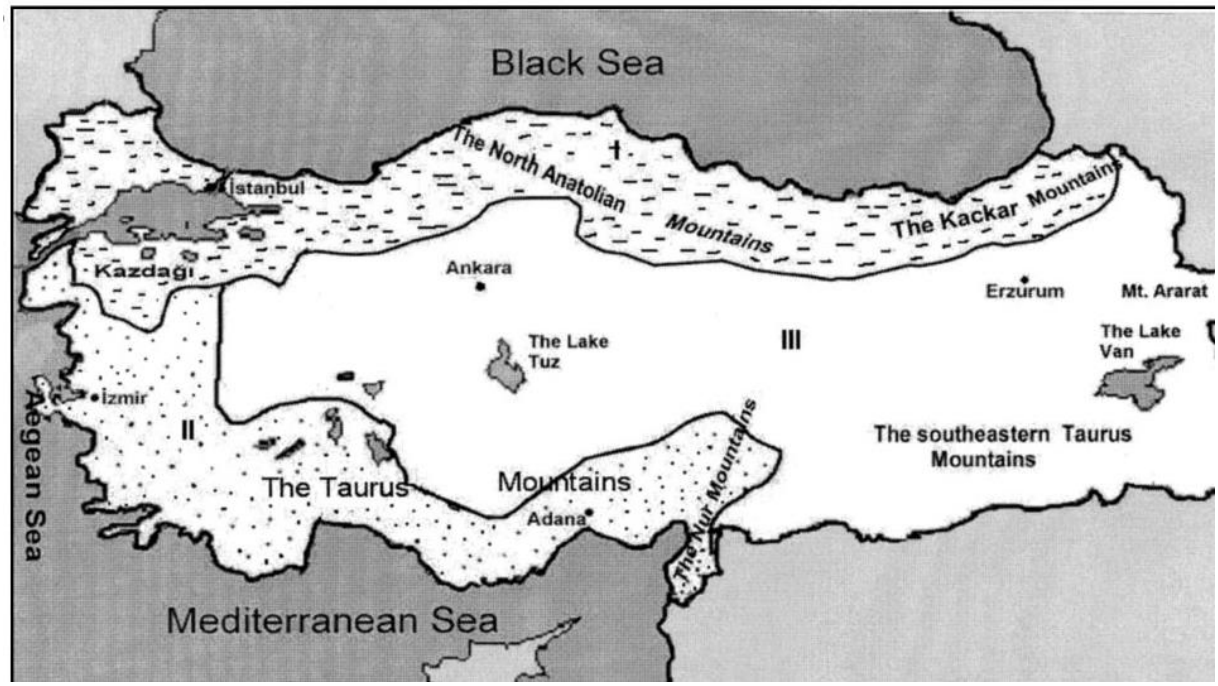

Figure 2. Phytogeographic regions of Turkey. I. Euro-Siberian II. Mediterranean III. Irano-Turanian phytogeographical regions

Turkey's forests and main species in these forests are shown in Table 3. Climatic classifications in Table 3 were composed based on Emberger's Method (AKMAN, 1993). Climatic and geographical features change within short intervals of space due to its position as a bridge between two Europe and Asia continents. Topography of the country is quite variable especially mountain zones because of the altitude, slope and aspect often change in the short range. Accordingly, regional climatic conditions occurring in the mountain zones have caused vegetation composition to gain special distinction in the short distance. Rough topography and strong isolation in these areas enables relict plants to survive and many endemic species to exist (AKMAN 1993; ATALAY 1994; ŞENSOY and DEMİRCAN 2010; KAYA and RAYNAL 2001).

Table 3. Basic forest categories and main species (Figure 3 shows the seven geographical regions).

Basic forest types	Main species	
	Forests and shrubs	Other Species *
Rainy Mediterranean Bioclimatic Layer (Central Black Sea Region, some parts of Black Sea, Marmara and Thrace, Western part of Mediterranean Region and, Iskenderun Bay)	*Abies nordmanniana,* *Abies cilicica,* *Acer campestre,* *Acer divergens,* *Acer trautvetteri,* *Alnus glutinosa,* *Arbutus unedo,* *Betula litwinowii,* *Betula medwediewii,* *Buxus sempervirens,* *Carpinus betulus,* *Carpinus orientalis,* *Castanea sativa,* *Celtis australis,* *Cerasus avium,* *Cerasus mahaleb,* *Cornus mas,* *Cornus sanguinea,* *Corylus avellana,* *Corylus colurna,* *Daphne ponticum,* *Euonymus europeaus,* *Euonymus latifolius,* *Fagus orientalis,* *Frangula alnus,* *Hippophae rhamnoides,* *Ilex colchica,* *Laurocerasus oficinalis,* *Ligustrum vulgare,* *Lonicera caucasica,* *Mespilus germanica,* *Osmanthus decorus,* *Padus avium,* *Picea orientalis,* *Pinus brutia,* *Pinus nigra,* *Pinus sylvestris,* *Populus tremula,* *Pyracantha coccinea,* *Quercus macranthera,* *Quercus pontica,* *Quercus robur,* *Rhododendron caucasicum,*	

	Rhododendron ponticum, *Salix rizeensis,* *Sambucus nigra,* *Sorbus torminalis,* *Staphylea pinnata,* *Taxus baccata,* *Tilia argentea (Tilia tomentosa),* *Ulmus glabra,* *Ulmus minör,* *Viburnum orientalis*	
Little-rainy Mediterranean Bioclimatic Layer (Inlands of Black Sea Region, Western Thrace, South of Marmara, Aegean Region, inlands of Mediterranean Region, some parts of East and South-East Anatolia)	*Abies cilicica,* *Acer sempervirens,* *Acer undulatum,* *Amygdalus arabica,* *Arbutus andrachne,* *Capparis spinosa,* *Cedrus libani,* *Ceratonia siliqua,* *Cercis siliquastrum,* *Colutea cilicica,* *Cotinus coggyria,* *Cupressus sempervirens,* *Ficus carica,* *Fontanesia phillıraeoides,* *Juniperus drupacea,* *Juniperus excelsa,* *Juniperus foetidissima,* *Juniperus phoenicia,* *Laurus nobilis,* *Myrtus communis,* *Olea europaea,* *Ostrya carpinifolia,* *Persica vulgaris,* *Phillyrea latifolia,* *Phoenix theophrasti,* *Pinus brutia,* *Pinus halepensis,* *Pinus nigra,* *Pinus pinea,* *Pistacia lentiscus,* *Pistacia terebinthus,* *Platanus orientalis,* *Populus tremula,* *Punica granatum,* *Quercus aucheri,* *Quercus cerris,* *Quercus coccifera,*	*Liquidambar orientalis,* *Alnus glutinosa, Juglans regia,* *Salix alba,* *Salix cinerea,* *Tamarix gracilis,* *Platanus orientalis,* *Populus alba,*

	Quercus infectoria, *Quercus pubescens,* *Quercus trojana,* *Quercus vulcanica,* *Rhus coriaria,* *Styrax officinalis,* *Ziziyphus jujuba*	
Semi-arid Mediterranean Bioclimatic Layer (Central Anatolia Region East of Aegean Region, Lakes Region around Isparta and some parts of East and South-East Anatolia)	*Amygdalus communis,* *Armeniaca vulgaris,* *Celtis tournefortii,* *Cerasus mahaleb,* *Colutea melanocalyx,* *Crataegus monogyna,* *Crataegus orientalis,* *Elaeagnus angustifolia,* *Fraxinus angustifolia,* *Fraxinus excelsior,* *Juniperus communis,* *Juniperus excelsa,* *Juniperus oxycedrus,* *Laurus nobilis,* *Lycium anatolicum,* *Pinus nigra,* *Prunus divaricata,* *Pyrus elaeagnifolia,* *Quercus infectoria,* *Quercus ithaburensis subsp. macrolepis,* *Quercus petraea,* *Quercus pubescens,* *Quercus robur,* *Quercus vulcanica,* *Rhamnus hirtellus,* *Rhamnus pallasii,* *Ribes nigrum, ,* *Rosa canina,* *Ulmus minör,* *Viburnum opulus,*	*Alnus glutinosa, Juglans regia, Malus sylvestris, Platanus orientalis, Populus alba, Populus nigra, Populus tremula, Populus euphratica, Morus alba, Quercus virgilliana, Rosa arvensis, Salix cinerea, Zizyphus jujuba,* *Salix alba, ,* *Tamarix tetragyna,*
Arid Mediterranean Bioclimatic Layer (Eastern Anatolia Region: Ağrı Iğdır provinces, Central Anatolia Region: Konya, Karaman provinces)	*Amelanchier parviflora,* *Amygdalus arabica,* *Amygdalus communis,* *Amygdalus orientalis,* *Armeniaca vulgaris,* *Celtis caucasica,* *Celtis tournefortii,* *Cerasus avium,* *Cerasus mahaleb,*	*Alnus glutinosa, Juglans regia,* *Salix alba,* *Salix cinerea,* *Tamarix gracilis,* *Platanus orientalis,* *Populus alba,*

	Crataegus monogyna, *Crataegus orientalis,* *Elaeagnus angustifolia,* *Lycium anatolicum,* *Morus alba,* *Morus nigra,* *Pistacia eurycarpa,* *Pistacia khinjuk,* *Pistacia terebinthus,* *Pterocarya fraxinifolia,* *Pyrus anatolica,* *Pyrus elaeagnifolia,* *Quercus brantii,* *Quercus cerris,* *Quercus infectoria,* *Quercus ithaburencis subsp. macrolepis,* *Quercus libani,* *Quercus petraea,* *Quercus pubescens,* *Rhamnus pallasii,* *Rosa arvensis,* *Rosa canina,* *Zelkova carpinifolia*	
Continental climate (Kars, Ardahan, Erzurum)	*(Quercetea pubescentis)* *Juniperus communis* *Juniperus excelsa* *Picea orientalis,* *Pinus nigra,* *Pinus sylvestris,* *Pistacia atlantica,* *Quercus pubescens,*	*Alnus glutinosa, Juglans regia,* *Salix alba,* *Salix cinerea,* *Tamarix gracilis,* *Platanus orientalis,* *Populus alba,*
Oceanic climate: (Eastern Black Sea and the coasts of Western Black Sea)	*Abies bornmuelleriana,* *Alnus glutinosa,* *Buxus sempervirens,* *Carpinus betulus,* *Carpinus orientalis* *Castanea sativa,* *Cornus mas,* *Corylus avellana,* *Diospyros kaki,* *Diospyros lotus.* *Fagus orientalis,* *Ilex colchica,* *Phillyrea media,* *Picea orientalis,* *Pinus nigra* subsp. *pallasiana,*	

	Pinus sylvesteris, , *Laurocerasus officinalis,* *Quercus cerris,* *Quercus ilex,* *Quercus macranthera,* *Quercus petraea,* *Rhododendron caucasicum,* *Rhododendron flavum,* *Rhododendron ponticum,* *Taxus baccata,* *Tilia rubra,* *Tilia tomentosa* *Vaccinium arctostaphylos,* *Vaccinium myrtillus,*	

*species grow in the streams and valleys.
(AKMAN 2011; DAVIS 1965; DAVIS et al 1988; GUNER et al 2000; KAYA and RAYNAL 2001)

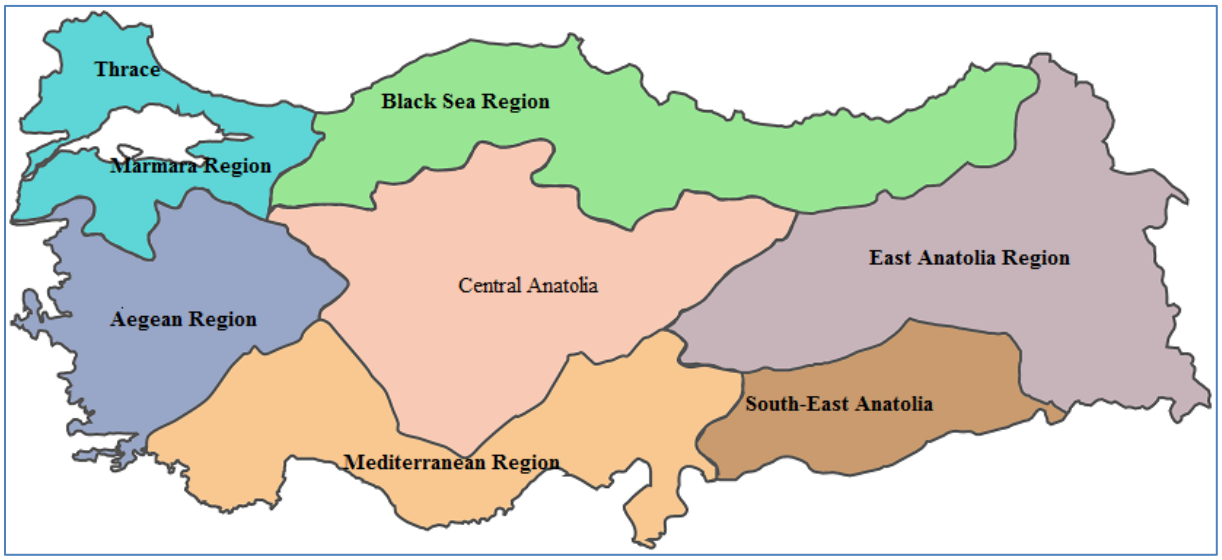

Figure 3. Geographical Regions of Turkey.

Priority species in forests are given in Table 4.

Table 4. Priority species.

Latin name	Native(N), Exotic(E)	Priority reason
Abies bornmulleriana	N	Economic
Abies cilicica	N	Economic/endemic
Abies equi-trojani	N	Economic/endemic
Abies nordmanniana	N	Economic
Abies olcaiana	N	Economic
Acacia cyanophylla	E	Economic
Acacia farnesiana	E	Economic
Acacia hazida	E	Economic
Acacia karroo	E	Economic
Acer campestre	N	Economic
Acer cappadocicum	N	Economic
Acer divergens	N	Threatened
Acer hyrcanum	N	Economic
Acer monspessulanum	N	Economic
Acer negundo	N	Economic
Acer platanoides	N	Economic
Acer pseudoplatanus	N	Economic
Acer sempervirens	N	Economic
Acer tataricum	N	Economic
Acer trautvetteri	N	Economic
Acer undulatum	N	Threatened / endemic
Albizia julibrissin	E	Economic
Alnus glutinosa subs. Antitaurica	N	Endemic
Alnus glutinosa subs. antitaurica	N	Endemic
Alnus orientalis	N	Economic
Alnus tenuifolia	N	Threatened
Amelanchier parviflora	N	Economic
Amorpha fruticosa	N	Economic
Amygdalus arabica	N	Economic
Amygdalus communis	N	Economic
Amygdalus kotschyi	N	Economic
Amygdalus orientalis	N	Economic
Arbutus andrachne	N	Economic
Arbutus unedo	N	Economic
Armeniaca vulgaris	N	Economic
Betula browicziana	N	Threatened
Betula litwinowii	N	Threatened
Betula medwediewii	N	Threatened
Betula pendula	N	Economic
Betula pubescens	N	Economic

Betula recurvata	N	Economic
Buxus balearica	N	Threatened
Buxus sempervirens	N	Economic
Caesalpinia gilliesii	E	Economic
Camellia sinensis	E	Economic
Capparis spp.	N	Economic
Carpinus betulus	N	Economic
Carpinus orientalis	N	Economic
Castanea sativa	N	Economic
Casuarina equisetifolia	E	Economic
Catalpa bignonioides	E	Economic
Cedrus deodara	E	Economic
Cedrus libani	N	Economic
Celtis australis	N	Economic
Celtis caucasica	N	Economic
Celtis glabrata	N	Economic
Celtis tournefortii	N	Economic
Cerasus avium	N	Economic
Cerasus erzincanica	N	Endemic/economic
Cerasus mahaleb	N	Economic
Ceratonia siliqua	N	Economic
Cercis siliquastrum	E	Economic
Chamaecyparis lawsoniana	E	Economic
Chamaecytisus gueneri	N	Endemic
Colutea arborescens	N	Economic
Colutea armena	N	Economic
Colutea cilicica	N	Economic
Colutea istria	N	Economic
Colutea melanocalyx subsp. melanocalyx	N	Endemic/ Threatened
Cordia myxa	N	Economic
Cornus mas	N	Economic
Cornus sanguinea	N	Economic
Corylus colurna	N	Economic
Cotinus coggyria	N	Economic
Cotoneaster franchetti	E	Economic
Crataegus aronia	N	Economic
Crataegus davisii	N	Economic
Crataegus monogyna	N	Economic
Crataegus spp.	N	Economic
Crataegus tanacetifolia	N	Economic
Cuppressus arizonica var. glauca	E	Economic
Cuppressus sempervirens	N	Economic
Cydonia oblonga	E	Economic
Cytisus laburnum	E	Economic

Daphne ponticum	N	Economic
Diospyros kaki	E	Economic
Elaeagnus angustifolia	N	Economic
Epigaea gaultherioides	N	Economic
Eriobotrya japonica	E	Economic
Eriolobus trilobatus	N	Economic
Eucalyptus camaldulensis	E	Economic
Euonymus europeaus	N	Economic
Euonymus latifolius	N	Endemic
Euonymus nanus	N	Economic
Euonymus verrucosus	N	Economic
Fagus grandifolia	E	Economic
Fagus orientalis	N	Economic
Fagus sylvatica	N	Economic
Ficus carica	N	Economic
Flueggea anatolica	N	Economic
Fontanesia phillíraeoides	N	Economic
Frangula alnus	N	Economic
Fraxinus angustifolia	N	Economic
Fraxinus excelsior	N	Economic
Fraxinus ornus	N	Threatened
Fraxinus pallisae	N	Economic
Gleditsia triancanthos	E	Economic
Genista sandrasica	N	Endemic
Halostachys belangeriana	E	Economic
Hibiscus syriacus	E	Economic
Hippophae rhamnoides	N	Economic
Ilex aquifolium	N	Economic
Ilex colchica	N	Economic
Juglans regia	N	Economic
Juniperus communis	N	Economic
Juniperus drupacea	N	Economic
Juniperus excelsa	N	Economic
Juniperus foetidissima	N	Economic
Juniperus oblonga	N	Economic
Juniperus oxycedrus	N	Economic
Juniperus phoenicia	N	Threatened /endemic
Juniperus sabina	N	Economic
Koelreuteria paniculata	E	Economic
Laurocerasus officinalis	N	Economic
Laurus nobilis	N	Economic
Ligustrum vulgare	N	Economic
Liquidambar orientalis	N	Threatened /endemic
Lonicera caprifolium	N	Economic

Lonicera etrusca	N	Economic
Lonicera iberica	N	Economic
Lonicera implexa	E	Economic
Lonicera xylosteum	E	Economic
Lycium anatolicum	N	Economic
Maclura pomifera	E	Economic
Magnolia grandiflora	E	Economic
Mahonia aquifolium	E	Economic
Malus sylvestris	N	Economic
Melia azedarach	E	Economic
Mespilus germanica	N	Economic
Morus alba	N	Economic
Morus nigra	N	Economic
Morus rubra	N	Economic
Myrtus communis	N	Economic
Nicotiana glauca	E	Economic
Olea europaea	N	Economic
Osmanthus decorus	N	Economic
Ostrya carpinifolia	N	Economic
Padus avium	N	Economic
Paulownia tomentosa	E	Economic
Persica vulgaris	N	Economic
Philadelphus caucasicus	E	Economic
Phillyrea latifolia	N	Economic
Phoenix canariensis	E	Economic
Phoenix dactylifera	E	Economic
Phoenix theophrasti	N	Thretened
Picea abies	E	Economic
Picea orientalis	N	Economic
Picea pungens	E	Economic
Pinus brutia	N	Economic
Pinus elderica	E	Economic
Pinus halepensis	N	Economic
Pinus nigra	N	Economic
Pinus pinaster	E	Economic
Pinus pinea	N	Economic
Pinus radiata	E	Economic
Pinus sylvestris	N	Economic
Pistacia atlantica	N	Economic
Pistacia eurycarpa	N	Economic
Pistacia khinjuk	N	Economic
Pistacia lentiscus	N	Economic
Pistacia terebinthus	N	Economic
Platanus orientalis	N	Economic

Poncirus trifoliata	E	Economic
Populus alba	N	Economic
Populus euphratica	N	Economic
Populus tremula	N	Economic
Prunus cocomilia	N	Economic
Pseodotusuga taxifolia	E	Economic
Pterocarya fraxinifolia	N	Economic
Punica granatum	N	Economic
Pyracantha coccinae	N	Economic
Pyrus anatolica	N	Economic
Pyrus elaeagnifolia	N	Economic
Pyrus serikensis	N	Economic
Pyrus yaltirikii	N	Economic
Quercus aucheri	N	Economic
Quercus brantii	N	Economic
Quercus cerris	N	Economic
Quercus coccifera	N	Economic
Quercus frainetto	N	Economic
Quercus hartwissiana	N	Economic
Quercus ilex	N	Economic
Quercus infectoria	N	Economic
Quercus ithaburensis	N	Economic
Quercus libani	N	Economic
Quercus macranthera	N	Economic
Quercus petraea	N	Economic
Quercus pontica	N	Economic
Quercus pubescens	N	Economic
Quercus robur	N	Economic
Quercus trojana	N	Economic
Quercus virgiliana	N	Economic
Quercus vulcanica	N	Endemic
Rhamnus alaternus	E	Economic
Rhamnus hirtellus	N	Endemic
Rhamnus kayacikii	N	Endemic
Rhamnus pallasii	N	Economic
Rhamnus petiolaris	N	Endemic
Rhododendron ungernii	N	Economic
Rhus coriaria	N	Economic
Ribes alpinum	**N**	Economic
Ribes biebersteinii	**N**	Economic
Ribes multiflorum	N	Economic
Ribes nigrum	N	Economic
Ribes orientale	N	Economic
Ribes uva-crispa	N	Economic

Robinia pseudoacacia	E	Economic
Rosa arvensis	N	Economic
Rosa canina	N	Economic
Salix acmophylla	N	Economic
Salix alba	N	Economic
Salix apoda	E	Economic
Salix caucasica	N	Economic
Salix cinerea	N	Economic
Salix fragilis	N	Economic
Salix myrsinifolia	N	Economic
Salix rizeensis	N	Economic
Salix trabzonica	N	Economic
Sambucus nigra	N	Economic
Schinus molle	E	Economic
Sequoia sempervirens	E	Economic
Sophora japonica	E	Economic
Sorbus aucuparia	N	Economic
Sorbus baldaccii	E	Economic
Sorbus domestica	N	Economic
Sorbus torminalis	N	Economic
Sorbus umbellata	N	Economic
Staphylea pinnata	N	Economic
Styrax officinalis	N	Economic
Tamarix gracilis	N	Economic
Tamarix octandra	N	Economic
Tamarix tetragyna	N	Economic
Taxus baccata	N	Threatened
Thuja orientalis	E	Economic
Tilia argentea	N	Economic
Tilia cordata	N	Economic
Tilia platyphyllos	N	Threatened
Tilia rubra	N	Economic
Tilia tomentosa	N	Economic
Trachycarpus fortunei	E	Economic
Ulmus campestre	N	Threatened
Ulmus carpinifolia	N	Threatened
Ulmus glabra	N	Threatened
Ulmus laevis	N	Threatened
Ulmus minor	N	Threatened
Viburnum lantana	E	Economic
Viburnum opulus	N	Economic
Viburnum orientale	N	Economic
Viburnum tinus	E	Economic
Washingtonia filifera	E	Economic
Zelkova carpinifolia	N	Economic
Zelkova carpinifolia subsp. yomraensis	N	Economic

Zizyphus jujuba	N	Economic
Zizyphus lotus	E	Economic

(ANONYMOUS 2; ANONYMOUS 3; DAVIS 1965; DAVIS et al 1988; GUNER et al 2000)

Table 5. Forest species actively used and managed in Turkey.

Species name	**Native (N) Exotic (E)**	**Current use**	**Natural (N) Plantation (P) Agriculture (A)**
Abies bornmulleriana	N	1,2,3,4,6	N
Abies cilicica	N	1,2	N
Abies equi-trojani	N	1,2,3,4	N
Abies nordmanniana	N	1,2,3,4,6	N
Abies olcaiana	N	1	N
Acacia cyanophylla	E	5(apiculture),6	P, A
Acacia farnesiana	E	5 (apiculture)	PA
Acacia hazida	E	5 (apiculture)	P,A
Acacia karroo	E	5 (apiculture)	P, A
Acer campestre	N	1,6	N
Acer cappadocicum	N	1	N
Acer divergens	N	1	N
Acer hyrcanum	N	1	N
Acer monspessulanum	N	1	N
Acer negundo	E	1,6	N
Acer platanoides	N	1,6	N
Acer pseudoplatanus	N	1,6	N
Acer sempervirens	N	1	N
Acer tataricum	N	1,6	N
Acer trautvetteri	N	1	N
Acer undulatum	N	1	N
Albizia julibrissin	E	7	N
Alnus glutinosa	N	1,2,4	N
Alnus orientalis	N	1,2,4	N
Amygdalus arabica	N	4,5	N,A
Amygdalus communis	N	4,6	N,P,A
Amygdalus kotschyi	N	4	N,P,A
Amygdalus orientalis	N	4	N,P,A
Arbutus andrachne	N	3,4	N
Arbutus unedo	N	3,4	N,P
Armeniaca vulgaris	N	4	N,P,A
Betula browicziana	N	1,6	N
Betula litwinowii	N	1,6	N
Betula medwediewii	N	1,6	N
Betula pendula	N	6	N
Betula pubescens	N	6	N

Betula recurvata	N	6	N
Buxus balearica	N	1,4,6	N
Buxus sempervirens	N	1,4,6	N
Camellia sinensis	E	4	P,A
Capparis spp.	N	4	N,P,A
Carpinus betulus	N	1,2,3	N
Carpinus orientalis	N	1,2,3	N
Castanea sativa	N	1,2,3,4,5	N,P
Casuarina equisetifolia	E	5,6	P
Catalpa bignonioides	E	6	P
Cedrus deodara	E	6	P
Cedrus libani	N	1,2,3,6	N,P
Celtis australis	N	3,4,6	N
Celtis caucasica	N	6	N
Celtis glabrata	N	6	N
Celtis tournefortii	N	6	N
Cerasus avium	N	1,4,5	N,P,A
Cerasus erzincanica	N	4,6	N
Cerasus mahaleb	N	4	N
Ceratonia siliqua	N	4,5,6	N
Cercis siliquastrum	N	5,6	N,P,A
Cornus mas	N	4	N
Cornus sanguinea	N	4	N
Corylus colurna	N	1,4,5	N,P,A
Cotinus coggyria	N	4,6	N,A
Cotoneaster franchetti	E	4,6	N,A
Crataegus aronia	N	4,6	N,A
Crataegus davisii	N	4,6	N,A
Crataegus monogyna	N	4,6	N
Crataegus spp.	N	4,6	N
Crataegus tanacetifolia	N	4,6	N
Cuppressus arizonica var. glauca	E	6	P
Cuppressus sempervirens	N	1,5,6	N,P
Cydonia oblonga	E	4,5,6	P
Cytisus laburnum	E	6	P
Daphne ponticum	N	1,4,5,6	N
Diospyros kaki	E	4	P,A
Elaeagnus angustifolia	N	4,5,6	N,P,A
Epigaea gaultherioides	N	6	N
Eriobotrya japonica	E	4,5	P,A
Eriolobus trilobatus	N	6	N
Eucalyptus camaldulensis	E	1,3,6	P
Euonymus europeaus	N	6	N
Fagus grandifolia	E	6	P
Fagus orientalis	N	1,2,3,4,6	N
Fagus sylvatica	N	1,2,3,4,6	N
Ficus carica	N	4,6	N,P,A
Flueggea anatolica	N	6	N
Frangula alnus	N	4	N
Fraxinus angustifolia	N	1,2,6	
Fraxinus excelsior	N	1,2,6	N
Fraxinus ornus	N	1,2,6	N

Fraxinus pallisae	N	1,2,6	N
Gleditsia triancanthos	E	5,6	P
Hibiscus syriacus	N	4,5,6	N,P
Hippophae rhamnoides	N	4,5	N,P
Ilex aquifolium	N	6	N
Ilex colchica	N	6	N
Juglans regia	N	1,2,3,4,5	N,P,A
Juniperus communis	N	6	N
Juniperus drupacea	N	4,6	N
Juniperus excelsa	N	1,3	N
Juniperus foetidissima	N	1,3	N
Juniperus oblonga	N	1,3	N
Juniperus oxycedrus	N	1,3	N
Juniperus phoenicia	N	4,6	N
Juniperus sabina	N	6	N
Laurocerasus officinalis	N	4,5,6	N,P,A
Laurus nobilis	N	4,5,6	N,P,A
Ligustrum vulgare	N	6,	N,P
Liquidambar orientalis	N	4,5,6	N,P
Lonicera caprifolium	N	5,6	N
Lonicera etrusca	N	6	N
Lonicera iberica	N	6	N
Maclura pomifera	E	5,6	P
Magnolia grandiflora	E	6	P
Malus sylvestris	N	4,5	N
Melia azedarach	E	4,5,6	P
Mespilus germanica	N	4,5	N
Morus alba	N	1,3,4,5	N,P,A
Morus nigra	N	1,3,4,5	N,P,A
Morus rubra	N	1,4,5,6	N,P,A
Myrtus communis	N	4,5	N
Olea europaea	N	4,5	N,P,A
Ostrya carpinifolia	N	1,3	N,P,A
Paulownia tomentosa	E	2	P
Persica vulgaris	N	4,5	N,P,A
Phillyrea latifolia	N	3,6	N
Phoenix theophrasti	N	4,6	N
Picea abies	E	6	P
Picea orientalis	N	1,2,3,6	N,P
Picea pungens	E	6	N,P
Pinus brutia	N	1,2,,3,4,5,6	N,P
Pinus elderica	E	1,2	P
Pinus halepensis	N	1,2,5	N,P
Pinus nigra	N	1,2,3,4	N,P
Pinus pinaster	E	1,2,3,	P,A
Pinus pinea	N	1,2,4,5,6	N,P,A
Pinus radiata	E	1,2	P,A
Pinus sylvestris	N	1,2,3	N,P
Pistacia atlantica	N	4,5	N,P;A
Pistacia eurycarpa	N	4,5	N
Pistacia khinjuk	N	4,5	N
Pistacia lentiscus	N	4,5	N

Pistacia terebinthus	N	4,5	N
Platanus orientalis	N	1,3,6	N
Populus alba	N	1,2	N
Populus euphratica	N	1,2	N
Populus tremula	N	1,2	N
Populus tremula	N	1,2	N
Prunus cocomilia	N	1,2	N
Pseodotusuga taxifolia	E	6	P
Pterocarya fraxinifolia	N	1,2,6	N
Punica granatum	N	4,5,6	N
Pyracantha coccinae	N	6	N
Pyrus anatolica	N	4	N
Pyrus elaeagnifolia	N	4	N
Pyrus serikensis	N	4	N
Pyrus yaltirikii	N	1,4,5	N
Quercus aucheri	N	1,3	N
Quercus brantii	N	1,3	N
Quercus cerris	N	1,3	N
Quercus coccifera	N	1,3	N
Quercus frainetto	N	1,3	N
Quercus hartwissiana	N	1,3	N
Quercus ilex	N	1,3	N
Quercus infectoria	N	1,3	N
Quercus ithaburensis	N	1,3	N
Quercus libani	N	1,3	N
Quercus macranthera	N	1,3	N
Quercus petraea	N	1,3	N
Quercus pontica	N	1,3	N
Quercus pubescens	N	1,3	N
Quercus robur	N	1,3	N
Quercus trojana	N	1,3	N
Quercus virgiliana	N	1,3	N
Quercus vulcanica	N	1,3	N
Rhamnus alaternus	E	4,6	P
Rhamnus hirtellus	N	4,6	N
Rhamnus kayacikii	N	4,6	N
Rhamnus pallasii	N	4,6	N
Rhamnus petiolaris	N	4,6	N
Rhododendron ponticum	N	3,4,5 6 (apiculture)	N
Rhododendron ungernii	N	3,4,5,6 (apiculture)	N
Rhus coriaria	N	4,6	N
Rhus coriaria	N	4,6	N
Ribes alpinum	N	4,6	N
Ribes biebersteinii	N	4,6	N
Ribes multiflorum	N	4,6	N
Ribes nigrum	N	4,6	N
Ribes orientale	N	4,6	N
Ribes uva-crispa	N	4,6	N
Robinia pseudoacacia	E	1,3,4,5,6	P
Rosa arvensis	N	1,4,5,6	N
Rosa canina	N	1,4,5,6	N
Salix acmophylla	N	1,6	N

Salix alba	N	1,6	N
Salix apoda	E	1,6	P
Salix caucasica	N	1,6	N
Salix cinerea	N	1,6	N
Salix fragilis	N	1,6	N
Salix myrsinifolia	N	1,6	N
Salix rizeensis	N	1,6	N
Salix trabzonica	N	1,6	N
Sambucus nigra	N	4,5,6	N
Schinus molle	E	5,6	P
Sophora japonica	E	4,6	P
Sorbus aucuparia	N	4,6	N
Sorbus baldaccii	E	4,6	P
Sorbus domestica	N	4,6	N
Sorbus torminalis	N	4,6	N
Sorbus umbelleta	N	4,6	N
Staphylea pinnata	N	6	N
Styrax officinalis	N	6	N
Tamarix gracilis	N	6	N
Tamarix octandra	N	6	N
Tamarix tetragyna	N	6	N
Taxus baccata	N	1,4,6	N
Thuja orientalis	E	6	P
Tilia argentea	N	1,4,5,6	N
Tilia cordata	N	4,6	N
Tilia platyphyllos	N	1,4,5,6	N
Tilia rubra	N	1,4,5,6	N
Tilia tomentosa	N	1,4,5,6	N
Ulmus campestre	N	1,4	N
Ulmus carpinifolia	N	1,4	N
Ulmus glabra	N	1,4	N
Ulmus laevis	N	1,4	N
Ulmus minor	N	1,4	N
Viburnum lantana	E	6	N
Viburnum opulus	N	6	N
Viburnum orientale	N	6	N
Viburnum tinus	E	6	P
Washingtonia filifera	E	6	P
Zelkova carpinifolia	N	6	N
Zelkova carpinifolia subsp. yomraensis	N	6	N
Ziziphus jujuba	N	4,5,6	N
Ziziphus lotus	E	4,6	N

1. Solid wood products
2. Pulp and paper
3. Energy (fuel)
4.Non wood products (food, fodder, medicine, etc.)
5. Used in agroforestry systems
6.Other (landscape etc.)

(ANONYMOUS 7; 8; EKİM et al. 2000; KAYA, 1998; KAYA et al. 1998)

Table 6. Main tree and other woody forest species providing environmental services or social values

Species name	Native (N) Exotic (E)	Environmental or social value
Buxus sempervirens	N	4,5
Cercis siliquastrum	E	4,5
Cordia myxa	N	4,5
Cupressus sempervirens	N	5,6
Eucalyptus camaldulensis	E	1,5
Laurus nobilis	N	4
Liquidambar orientalis	N	4,5
Sytrax officinalis	N	4

Services and values include:

1. Soil and water conservation including watershed management
2. Soil fertility
3. Biodiversity conservation
4. Cultural values
5. Aesthetic values
6. Religious values
7. Other (…)

(ANONYMOUS 3; 7; 8; EKİM et al. 2000; KAYA, 1998; KAYA et al. 1998)

Abies cilicica, Abies equi-trojani, Corylus colurna, Juniperus phoenicia, Liquidambar orientalis, Phoenix theophrasti, Rhamnus petiolaris and *Quercus vulcanica* are endemic species in Turkey.

Table 7 shows the threatened species in Turkey. The species in this table are selected based on the data in the Red Book of Plants in Turkey (EKİM et al. 2000) and Guidelines on Integration of Biological Diversity into Management Plans (ANONYMOUS 7).

Table 7. Threatened Species in terms of genetic conservation

Species name	Area (ha)	Distribution of the species in Turkey (%)	Distribution of the species Widespread (W), Rare(R), local (L)	Threat code	Threat category		
					High	Medium	Low
Acer undulatum	NA	NA	R	1,2,15		x	
Alnus tenuifolia	NA	NA	W	1,2,3,7,10,13,15			x
Betula browicziana	NA	NA	R	1,2,10,11,13	x		
Betula litwinowii	NA	NA	L	1,2,15			x
Betula medwediewii	NA	NA	L	1,2,15			x
Buxus balearica	NA	NA	L	1,2,7,13,15		x	
Cerasus erzincanica	NA	% 100	L	1,2,13,15	x		
Cerasus incana var. velutina	NA	% 100	L	1,2,13,15		x	

Fraxinus ornus	NA	NA	W	1,2,13,15			x
Juniperus phoenicia	NA	NA	L	1,2,7,12,13,15			x
Liquidambar orientalis	NA	%100	L	1,6,7,9,13,14,15	x		
Malus sylvestris subsp. orientalis var. microphila	NA	% 100	L	1,2,13,15	x		
Phoenix theophrasti	NA	%100	R	1,2,6,7,13,14,15	x		
Quercus pontica	NA	NA	W	1,2,5,15			x
Purunus kurdica	NA	%100	R	1,2,13,15		x	
Pyrus anatolica	NA	%100	R	1,2,13,15		x	
Pyrus salicifolia var serrulata	NA	%100	L	1,2,13,15		x	
Pyrus serikensis	NA	%100	L	1,2,5,7,11,12,13, 15	x		
Pyrus yaltirikii	NA	%100	L	1,2,13,15		x	
Sorbus caucasica var serrulata	NA	NA	R	1,2,7,12,13,15		x	
Salix purpurea subsp. leucodermis	NA	%100	L	1,2,13,15		x	
Salix rizeensis	NA	%100	L	1,2,5,7,13,15	x		
Salix trabzonica	NA	%100	L	1,2,5,13,15	x		
Taxus baccata	NA	NA	W	1,2,7,13,15			
Tilia platyphyllos	NA	NA	W	1,2,13,15			x
Ulmus campestre	NA	NA	W	1,2,11,13,15			x
Ulmus carpinifolia	NA	NA	W	1,2,11,13,15			x
Ulmus glabrata	NA	NA	L	1,2,11,13,15			x
Ulmus laevis	NA	NA	L	1,2,11,13,15			x
Ulmus minor	NA	NA	L	1,2,11,13,15			x

(EKIM et al 2000; ANONYMOUS 7; 8)

Threats

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

Table 8 a. Annual quantity of seeds produced and current state of identification of forest reproductive material of the main forest tree and other woody species in the country.

Species		Total quantity of seeds (Kg)
Scientific name	**Native (N) or Exotic (E)**	
Abies spp	N	204
Acer spp	N	1 755
Ailanthus althissima	E	358
Alnus spp	N	50
Amygdalus spp	N	314
Castanea sativa	N	4 543
Cedrus libani	N	258 898
Ceratonia siliqua	N	816
Crataegus spp	N	565
Cupressus spp	N	796
Elaeagnus angustifolia	N	4 084
Fagus orientalis	N	5 651
Fraxinus spp	N	5 422
Juglans spp	N	10 042
Juniper spp.	N	2 707
Laurus nobilis	N	364
Picea orientalis	N	14
Pinus brutia	N	152 108
Pinus halepensis	N	28
Pinus nigra	N	24 315
Pinus pinaster	E	475
Pinus pinea	N	11 081
Pinus radiata	N	11
Pinus sylvesteris	N	10 249
Platanus spp	N/E	375
Pyrus yaltirikii	N	174
Prunus mahaleb	N	1 758
Quercus spp	N	33 291
Robinia pseudoacacia	E	3 948
Sophora japonica	E	122
Thuja spp	E	405
Tilia spp	N/E	1 290
Ulmus spp	N	200
Other forest tree seeds(broad-leaved)	N/E	27 071
Other coniferous species	N/E	210

(ANONYMOUS 2; ANONYMOUS 5)

Table 8 b. Annual number of seedlings (or vegetative propagules) planted and the state of identification of the reproductive material used for the main forest tree and other woody species in the country.

Species		Total quantity of seedlings planted
Scientific name	**Native (N) or Exotic (E)**	
Acer negundo	N	16 298 298
Betula spp.	N/E	1 981 435
Capparis spp	N	8 500
Castanea sativa	N	259377
Cedrus libani	N	76 064 040
Ceratonia siliqua	N	909 409
Cupressus sempervirens	N	4 616 446
Cupressus arizonaca var. *glauca*	E	3 194 625
Eucalyptus spp.	E	118 683
Fagus orientalis	N	4 762 901
Juglans spp.	N/E	1 278 763
Juniperus spp	N	1 870 394
Ligustrum	N	4 063 268
Picea pungens	E	745 250
Picea orientalis	N	2 078 031
Pinus brutia	N	44 270 728
Pinus nigra	N	112 135 422
Pinus pinea	N	5 059 756
Pinus pinaster	E	1 315 085
Pinus sylvester	N	55 524 713
Populus spp.	N	41 688
Populus clones	N	120 568
Pseudotsuga menziesii	N	2 206
Quercus spp.	N	3 777 981
Robinia pseudoacacia	E	18 563 697
Rosa canina	E	337 045
Thuja spp.	E	3 892 428
Other coniferious species	E,N	5 223 143
Other landscape species	N/E	2 364 255

(ANONYMOUS 2; ANOYMOUS 5; ANONYMOUS 6)

Table 9. Forest species for which genetic variability has been evaluated (Native: N, exotic: E).

Scientific name	(N) (E)	Morphological traits	Adaptive and production traits	Molecular characterization
Abies equitrojan	N	Seedling characteristics		Isoenzyme, SSR, ITS
Abies bornmulleriana	N	Seed characteristics		
Abies cilicica				Isoenzyme
Abies normaniana		Seed and seedling characteristics,		Isoenzyme
Castenia sativa	N	Seedling characteristics,		
Cedrus libani	N	Seed and seedling characteristics,	Drought tolerance	RAPD Isoenzyme
Fagus orientalis	N	Seed and seedling characteristics,	Wood density	SSR
Liquidambar orientalis	N	Seedling characterisrics		RAPD,mtDNA, isoenzyme
Laurocerasus officinalis	N			RAPD
Picea orientalis	N			Isoenzyme, SSR
Populus alba	N	Seedling characteristics	Volumediameter, wood density	DNA fingerprinting
Populus nigra	N	Seedling characteristics	Volume, diameter, wood density	DNA fingerprinting
Pinus brutia	N	Seed and seedling characteristics,	Volume, diameter, drought tolerance, cold tolerance, wood density	Isoenzyme, SSR, RAPD
Pinus nigra	N	Seed and seedling characteristics	Volume, diameter, drought tolerance, cold tolerance, density, polen characteristics	Isoenzyme, RAPD
Pinus sylvester	N	Seed and seedling characteristics	Volume, diameter, density	Isoenzyme, RAPD
Pinus halepensis	N	Seed and seedling characteristics		RAPD, ITS
Pinus pinea	N			RAPD
Pinus pinaster	N			RAPD
Prunus mahaleb	N			RAPD
Quercus vulcanica	N	Seed and seedling characteristics		
Taxus baccata	N			RAPD

Exponentially increasing population in Turkey correlated to demands on natural recourses threatens the biodiversity of the nation's natural ecosystems, including forests. The factors threatening biological diversity, in consequence forest genetic resources can be listed as; unplanned and over urbanization, poor silvicultural interventions, pollution and climate change, forest fires, inappropriate management of forest areas in the past, pressures resulted from the life style of populations living in and near forests based on forest products, mining activities, over-harvesting of the natural species having economic value, gaps in the forest cadastre (KAYA and RAYNAL 2001; UBSEP 2007). Additionally, inappropriate afforestation and silvicultural activities in the past caused negative impacts since they result in genetic pollution and change genetic structure of populations.

Figure 4. Balıkesir Nursery

PART II

THE STATE OF *IN SITU* GENE CONSERVATION

Main *in situ* gene conservation areas in Turkey are gene conservation forests, seed stands, national parks, nature protection areas, biosphere reserve areas, natural monuments, protection forests, nature parks, specially protected areas. All these areas are the examples for *in situ* conservation. The mentioned conservation areas, *in situ* gene conservation activities major on gene conservation forests and seed stands since other units are selected for different purposes together with gene conservation function.. For most of the forest tree and shrub species, these protected areas meet the goal of conserving the genetic diversity of their populations, because the strategy for these protected areas is to conserve the entire ecosystem.

Gene Conservation Forests:

These are natural stands which are selected and managed with the purpose of *in situ* conservation of the genetic diversity of the species. With gene conservation forests, it is aimed to protect genetic diversity in the nature for the next generations.

Selections of gene conservation forests initiated in 1993 with the National Tree Breeding and Seed Production Programme for the purpose of *in situ* conservation. Today, there are 238 gene conservation forests (162 coniferous, 76 broad-leaved), which amounts to approximately
35 000 ha as *in situ* conservation areas.

While gene conservation forests are selected, following criteria are taken into account:

a) the stands of primary forests minimum human interventions,

b) forests located in the horizontal and vertical boundaries of natural distribution areas of species,

c) forests which differ in terms of growth and quality,

d) marginal and isolated populations,

c) forms having rare aesthetic and economic values,

d) representing different growing place is selected and *ex-situ* conservation activities in these forests are to be carried out.

The number of gene conservation forests changes based on the distribution of the species. Of gene conservation forests, *Pinus brutia* has the highest number. There are 57 gene conservation forests belonging to that species (Table 10). *Pinus nigra* (38), and *Fagus orientalis* (23) rank first with gene conservation forests.

Seed Stands:

Seed stands are the areas with trees having highest quality in terms of required characteristics under existing conditions. They are located in a specific geographical region, and subject to special management and operation for seed production. It is intended to produce quality and sourced-identified seeds with seed stands.

Seed stands are of great importance to the first stage of tree breeding, and they are primary forests with phenotypic characteristics as seed source or afforestation areas. Seed stands are used for seed sources, and they are the basis of plus tree selection while establishing seed orchards. It is tried to sample geographical variations of the species for the selection of seed stands (Table 10). **Seed stands** are also important as other *in situ* conservation areas. There are 349 (284 is coniferous and 65 is broad leaved) seed stands in 35 species across the country. Almost all of the seed stands are natural, and they cover 46 369 ha.

Table 10. Species under *in situ* conservation

Latin Name	Conservation purpose	Number	Area (ha)
Abies bornmulleriana	Protection	14	680,3
Abies cilicica subs cilicica	Protection/	2	59,6
Abies equitrojana	Protection/seed production	3	400,6
Abies olcaina	Protection	1	105,6
Abies normaniana	Seed production	12	2056
Abies cilicica isaurica	Seed production	3	344,2
Acer trauvetti	Protection/Seed production	2	110,5
Acer platanoides subs campestre	Protection	1	463,5
Acer monspessulanum subs	Protection	1	199

turcomanicum			
Acer platanoides	Protection	2	387,4
Alnus glutinosa	Seed production	4	325,5
Alnus glutinosa subs glutinosa	Seed production	1	50,6
Alnus glutinosa subs barbata	Seed production	2	27,7
Alnus orientalis	Protection	1	157
Betula pendula	Protection	1	202
Buxus baleria	Protection	2	97,5
Buxus sempervirens	Protection	1	75
Castanea sativa	Seed production/Protection	7	967,3
Cedrus libani	Protection/Seed production	41	6327,5
Coryllus colurna	Protection	2	1278,2
Cupressus sempervirens	Protection	1	100,5
Eucalyptus sp.	Seed production	1	91,0
Fagus orientalis	Protection/Seed production	51	6482,5
Fraxinus angustifolia	Protection/Seed production	2	206,7
Fraxinus angustifolia subs oxycarpa	Seed production	1	47,5
Fraxinus exelciour	Seed production	2	130,1
Juniperus exelsa	Protection/ Seed production	9	789,7
Juniperus exelsa Juniperus foetiddissima	Protection	5	161,5
Juniperus foetiddissima	Protection	2	84,7
Juniperus oxycedrus	Protection	1	46,5
Liquidambar orientalis	Seed production	2	200,8
Liquidambar orientalis	Protection	4	419
Ostrya carpinifolia	Protection	1	64,5
Phoenix theophrasti	Protection	2	17
Picea orientalis	Seed production	12	1390,0
Picea orientalis	Protection	2	158
Pinus brutia	Protection/seed production	139	20902,9
Platanus orientalis	Protection/Seed production	4	314,3
Pinus halepensis	Seed production	2	193,0
Pinus nigra	Protection/Seed production	117	16254,3
Pinus radiata	Seed production	2	10,8
Pinus pinaster	Seed production	4	295,3
Pinus sylvestris	Protection /Seed production	55	4710,2

Pinus pinea	Protection /Seed production	13	4835,8
Populus tremula	Protection	1	108
Prunus avium	Protection	4	300
Pseudotsuga taxifolia	Seed production	1	1,6
Pseudotsuga menziesii	Seed production	1	7,6
Pterocarya fraxinifolia	Protection	2	4
Quercus cerris	Protection/ Seed production	7	630,2
Quercus libani	Seed production	1	80,5
Quercus petrea	Protection/Seed production	10	825,4
Quercus petrea subs. iberica	Seed production	2	101,4
Quercus vulcanica	Seed production	1	106,2
Quercus vulcanica	Protection	2	337
Quercus cerris x iberica	Protection	1	120,6
Quercus robur x infectoria	Protection	1	101
Quercus coccifera	Protection	1	53,7
Robinia pseudoacacia	Seed production	1	156,0
Sorbus tormunalis.	Protection	1	400
Sorbus aucuparia	Protection	1	86
Taxus baccata	Protection	1	70
Tilia tomentosa	Protection/Seed production	4	302,3
Tilia argentea	Protection	1	180
Ulmus glabra	Protection	1	8

National Parks:

There are 41 national parks in Turkey. All of the national parks cannot be called as forest genetic resources; since there are some areas under protection by taking into account the cultural values, archeological relics, wetlands and geomorphologic characteristics.

Biosphere Reserve Areas:

Biosphere reserves are areas of terrestrial and/or coastal marine ecosystems, internationally recognized under the UNESCO Man and the Biosphere (MaB=Man and Biosphere) Programme. Biosphere reserves are the areas where the practices to protect biological diversity, economic and cultural values are tested, selected and improved. In Turkey, there is only one biosphere reserve area. Artvin-Borçka Camili Biosphere Reserve was declared in 2005. However, a number of works were carried out to convert many areas into biosphere reserves, and there are some ongoing works in this regard.

Natural Monuments:

There are 106 natural monuments in Turkey. Information regarding the names and source values of these monuments is available in Annex 2. Old monumental trees as well as unique beauties and scientific values distinguish natural monuments from other areas. Some of the natural monuments comprise of living trees and the trees, which are able to protect their genetic characteristics for the sake of the next generations. In addition, the rest are the areas having natural beauty and geological importance.

Nature Parks:

With outstanding flora and wild life, nature parks are suitable for recreational activities for the society.

Nature Protection Areas:

Nature protected areas comprise of rare ecosystems and species subject to threats and almost extinction and of outstanding samples created by natural events, having importance in terms of science and education. These areas are only allocated for the sake of science and education and should be strictly protected. There are

Protection Forests:

Protection forests may comprise of the areas which are exposed to the threats of landslides and rain-wash, the areas protecting main roads and railways against dust and sand storms, and the areas preventing riverbed fillings or public forests which are considered obligatory to be protected for national defense, as well as the areas covered by brushwood and shrubs. Also public forests, which are permanently destroyed or subject to fires may be considered as protection forest until they become production forests. There are 58 protection forests in Turkey.

Specially Protected Areas:

Ministry of Environment and Urbanization is responsible from these areas. These areas are not necessarily forests ecosystems, but also include different ecosystem types like steps, lakes, deltas etc.

Activities

National parks, nature parks, natural monuments and nature protection areas are under protection in the framework of the regulations which regulate National Parks Act. Any operations on these areas along with any and all activities which may injuriously affect the natural balance, integrity of landscape and the nature itself are forbidden.

Research studies on conservation of forest gene resources in Turkey are carried out by the Ministry of Forest and Water Affairs and by universities. There are also some joint studies conducted in cooperation with the Ministry and the related universities. The research subjects are determined in line with the demands of the implementation units under the Ministry and in the framework of 5-year plans. Research institutions under the Ministry are main responsible units.
Research studies on *in situ* conservation are primary based on the identification of genetic diversity of the populations. Because insufficient information about genetic diversity of the species seen especially when tree breeding activities started. With the outcomes of the research about genetic diversity of species, recommendations are submitted to the related units regarding protection strategies to be developed, and the outcomes are published. In addition, as dissemination of the outcomes of research and giving briefings to the related organizations under the Ministry are carried out to.

In the gene conservation activities, the same strategies are used with EUFORGEN in Turkey. EUFGIS is also actively used, and the data obtained concerning gene conservation units are provided to the system. In this context, data concerning about seed stands and gene conservation forests are available at EUFGIS. However, there are some information gaps regarding genetic diversity of the populations, especially the species with limited distribution areas.

In Turkey, several of the forest genetic resources are conserved in farmlands or in home gardens (*circa situ*). These species are both exotic and native species like poplar, eucalyptus, paulownia species and *Pinus pinea*. They are also used for agroforestry purposes, but a variety of extra measures should be taken in protected areas, especially for the species subject to agroforestry.

In Turkey it is possible to see traditional agroforestry practices since past times. These agroforestry applications are not appropriate for forestry techniques but oriented for the producers. However, agroforestry has been carried out more technically for the last 10 years. Different techniques and different agricultural plants and animals are used according to regions and distribution of species. Especially, beekeeping-forestry activities are the issues gained a special importance recently. Honeydew honey production by honeybees from the secretion of the insect "*Marchalina helenica"* living on *Pinus brutia*, *Pinus halepensis* and *Pinus pinea* is a good example for the agroforestry. Moreover, it is often seen that fast growing species like poplar and agricultural crops are grown together (poplar–crop interplanting). Particularly in Eastern Black Sea Region, because of the scarcity of agricultural lands, local people, try to grow agroforestry products their sloped lands to get maximum productivity. Furthermore, agricultural production is carried out on the degraded forests especially on the oak coppice.

Constraints

The main constraints to improving *in situ* genetic conservation activities in Turkey comprise (1) limited numbers of researchers and technical staff specialized about forest genetics, (2) inadequate knowledge about the biology, ecology and genetics of species (3) in sufficient research and inventory studies. All these constraints are related mainly with high species diversity.

Since almost the entire Turkish forests are owned by the public, there are not major problems regarding the protection with landowners. However, in many parts of the country, forest villagers directly or indirectly depend on forests (non-wood forest products) for their livelihoods may negatively affect the protection activities. In addition, there are some illegal utilization from forests for raw material and fuel.

The major restriction on *in situ* genetic conservation studies in Turkey is the lack of research and inventory studies because of the great deal of species diversity. Genetic diversity studies are being carried out by a limited number of scientists working in this field.

Priorities

In Turkey, there is a priority of identifying gene conservation unit for more species. For the selection of populations for *in situ* gene conservation accurately, it is important to know genetic basis of them. Additionally, it is also essential to identify methods according to the species and its distribution for silvicultural interventions to be carried out on the existing *in situ* conservation areas.

By high lightening the importance of this issue in terms of capacity development, academic studies concerning conservation subject at universities should be advice. *In situ* conservation activities should be encouraged and announced in a way to catch the attention of the society. Capacity development should include not only researchers but also technical staff shortage, which is a major problem. Identifying the data regarding genetics, ecology and population dynamics of a variety of species is one of the priority issues.

Trends

Selection of gene conservation forests are increasing especially in some regions, which there are high species diversity. In addition, there is a rising of interest on the conservation and use of genetic resources particularly on specific forms and varieties of trees and shrubs.

In Turkey, number of conservation units of some species, especially broad-leaved ones. Therefore, an action plan is to be in preparation for “development and conservation of broad-leaved gene resources”. In addition, there is a tendency to protect; productivity and sustainability of gene conservation units

particularly seed stands. For this reason, an action plan is also on preparing stage to ensure the continuation of *in situ* gene conservation units.

Figure 5. Mixed forests in Turkey, Bolu.

(Information in the CHAPTER based on ANONYMOUS 8; DİRİK 1997; HUSS and KAHVECİ 2009; KAYA 1998; IŞIK 1996; KAYA et al 1998; UPSEP 2007)

CHAPTER 3

EX SITU CONSERVATION AREAS

In Turkey, seed orchards, clone parks, progeny trials, provenance trials, genetic orchards and seed stock centers are *ex situ* gene conservation areas.

Seed orchards:

Clonal seed orchards are *ex situ* conservation areas established by plus trees selected from gene conservation forests or seed stands. The main aim of establishing is to use as seed source. The main production site of improved genetic material is the seed orchards for the species that their vegetative production is not economic. Since seed orchards are established in ecologically more favorable sites and intensive culture techniques are applied, there are very and more frequent intervals of seed production than natural stands. In addition, the genetic gain is more because it is possible to exchange of genes between the selected individuals. Seed orchards and the area their covered is shown in Table 11a.

Table 11 a. *Ex situ* conservation areas (seed orchards)

Latin Name	Number	Area(ha)
Alnus glutinosa	1	5
Cedrus libani	10	58,8
Liquidambar orientalis	1	2,2
Picea orientalis	9	31,1
Pinus brutia	68	479,1
Pinus halepensis	2	8,2
Pinus nigra	55	446,2
Pinus pinea	4	47,2
Pinus sylvestris	21	109,4
Sorbus torminalis	1	1,7
TOTAL	**172**	**1188,9**

Clone parks:

Clone parks are one of the most important for the basis of tree breeding activities. They are established with grafting or plants produced by other vegetative methods as clonal seed orchards. Clone parks established so far are 10 from 5 species and their total area is 21,7 hectares. (Table 11b.)

Table 11 b. *Ex situ* conservation areas (Clone Parks)

Clone Park No	Tree Type	Origin	Clone Number	Ramet number	Area (ha)
1	*Pinus brutia*	ANTAKYA-KIZILDAĞ (ULUÇINAR)	27	244	1.7
2	*Pinus brutia*	SİLİFKE-ŞEHİTLER (KIZLARDAĞI)	25	230	1.6
3	*Pinus brutia*	GÖLHİSAR-KOÇAŞ (GÖLHİSAR)	28	544	3.2
4	*Pinus nigra*	ALANYA-SÖĞÜT	2	226	0.5
5	*Pinus pinea*	SALİHLİ-POYRAZKÖY	1	180	1.1
6	*Picea orientalis*	MAÇKA-MAÇKA(KAPIKÖY)	35	1800	0.7
7	*Pinus sylvestris*	Seed stand	152	608	3.0
8	*Pinus brutia*	Seed stand, gene conservation forest	141	1177	7.5
9	*Pinus brutia*	Seed stand	84	328	1.6
10	*Pinus sylvestris*	Gene conservation forest, seed stand	128	512	0.8
Total			**623**	**5849**	**21.7**

Provenance trials:

Provenance trials, which form the basis of tree improvement programs have been initiated for *Pinus brutia* first. Provenance trials were established in a variety of natural and exotic types. The information about it is shown in Table 11c.

Table 11 c. *Ex situ* conservation areas (Provenance trials and family numbers)

Species name	Native (N) exotic E	Number of test area	Origin number
Abies spp.	N	2	24
Alnus spp.	N	6	34
Cedrus libani	N	16	40
Cupressus semperviensis	N	3	17
Fagus orientalis	N	2	12
Larix spp.	E	5	33
Picea abies	E	5	23
Picea orientalis	N	8	16
Picea sitchensis	E	4	9
Pinus brutia	N	26	50
Pinus contorta	E	1	9
Pinus nigra	N	6	36
Pinus pinea	N	6	26
Pinus sylvester	N	11	34
Pseudotsuga taxifolia viridis	E	4	16

Progeny trials:

Progeny trials are established with the aim of providing a basis for tree breeding programme. Because the main part of breeding programme requires that individuals in breeding populations be sorted according to their genetic values. In species that cannot be produced vegetatively the base of this order is the breeding values of individuals. The most common genetic testing method used to determine the breeding values is progeny trials.

These studies will also provide the estimation of genetic gain from breeding activities, other genetic parameters and dissemination of results for practitioners' implementations.

Progeny trials are divided into two parts as "open-pollinated progeny trials" and "controlled-pollinated progeny trials". In "Turkey's National Tree Breeding and Seed Production Programme (1994-2003)" (KOSKİ and ANTOLA 1993) it is envisaged the open-pollinated progeny trials be established. Forest Tree Seeds and Tree Breading Research Institute Directorate came into force the most comprehensive progeny trials projects in Turkey with indigenous forest tree species. In the framework of this program, the priority was given to *Pinus brutia*. In addition to *Pinus brutia* progeny trials are made with *Pinus sylvester* selected from natural origins are established.

Pinus brutia progeny trials were established by taking into account the breeding zones. *Pinus brutia* progeny trials are measured at four-year intervals. (Table 11 d).

Pinus sylvester progeny trials are established in Western Central Anatolia Breeding Zone. The breeding values of *Pinus sylvesteris* progeny trials were measured at ages of 6 and 10. The information on progeny trials is shown in Table 11d.

Table 11 d. Progeny trials and family numbers used in testing

Species	Breeding Zone	Number of testing areas	Family number
Pinus brutia	Low Elevation Breeding Zone of Mediterranean Region (0-400m)	6	168 (first series) 140 (second series)
	Middle Elevation Breeding Zone of Mediterranean Region (401-800m)	4	270 (first series) 74(second series)
	Low Elevation Breeding Zone of Aegean Region (0-400m)	6	168 (first series) 25 (second series)
	Middle Elevation Breeding Zone of Aegean Region (401-800m)	2	320
	Marmara Region Breeding Zone (200-600)	6	158 (first series) 160 (second series)
Pinus sylvesteris	Western Central Anatolia Breeding Zone (1300-1700m)	2	246

Genetic orchards:

Seed orchards established by taking their phenotypic features are tested with progeny trials, and they are classified as genetic orchard in the reestablished orchards with superior ones.

Seed Stock Centers:

There are 20 seed stock centers for forest tree seeds in Turkey, and distribution of seeds to the nurseries according to the seeding programme is carried out by these centers. Seed stock centers are situated in different parts of Turkey such as Ankara, Antalya, Antakya, Bolu, Bursa, Devrek (Zonguldak), Dursunbey (Balıkesir), Elazığ, Eğirdir (Isparta), Ereğli (Konya), Erzurum, Eskişehir, Ezine (Çanakkale), İstanbul, Muğla, Muradiye (Manisa), Ordu, Osmaniye, Torbalı (İzmir) and Trabzon. Seeds selected according to their origins are stocked these centers under appropriate storage conditions. Generally, coniferous species seeds are stocked more than broad-leaved species. The primary stock center for broad leaved is Ezine. However, different scientific samples and seeds should be kept in seed banks and DNA banks since seed stock centers do not provide long-term storage conditions.

Arboretums and botanic gardens:

There are three arboretums and botanic gardens in Turkey, although botanic gardens are not meet completely with scientific purposes.

Atatürk Arboretum is a forest sub-district directorate affiliated to Istanbul Regional Directorate of Forestry under General Directorate of Forestry and managed by an advisory committee. Forestry Faculty of Istanbul University holds the scientific authority of the advisory committee, and General Directorate of Forestry has the administrative authority. There are varieties of tree and shrub species in Atatürk Arboretum, which cover 38 ha of land. Besides, there is a seed collection of exotic and native species in the arboretum. Karaca Arboretum covers 13,5 ha of land, and there are wide range of native and exotic tree and shrub species in the arboretum. Additionally, there are 146 native and 28 exotic tree and shrub species in Nezahat Gökyiğit Botanic Garden.

In Turkey, such issues as germplasm production, its certification and trade at home and abroad are regulated by Trade of Forest Reproductive Material Legislation (1999/105/Ec) with a view to conserving forest gene resources.

Constraints

Turkey is one of the rich in countries by means of species diversity. For this reason, there is a wide range of species required to conserve the outside of their natural habitats. As well as existing *ex situ* conservation areas, there are species under risk that should be protected.

The most necessary conservation method should be decided by taking into account the spread of species and its biology; both when the genetic structures are subject to degeneration because of fragmentation especially in the areas under anthropogenic effects and the conditions where *in situ* conservation is not effective.

Priorites

Some species categorized as threatened in the Red Data Book of Turkish Plants, like *Abies cilicica, Abies nordmandiana, Acer* species, *Alnus* species, *Betula browicziana, Liquidambar orientalis* should be given priority in *ex situ* conservation. In addition, priority should also be attached to other threatened species whose reproduction either clonal or seed is difficult. Because of limited information on genetic structure of the said species, while deciding on the populations to be conserved, distribution and risk priority of them should be taken into account. Ranges of dispensing that species are exposed to intense anthropogenic impacts, should be protected as *ex situ* areas to ensure the continuity of the populations, especially in the fire-sensitive regions.

For better management practices and breeding activities, sufficient population size, appropriate growing place and renewable materials should be used in *ex situ* conservation areas. This implies that

ecological and phytogeographic studies should be intensified. Moreover, the works carried out in genetic material at molecular level (DNA, RNA etc.) should be applied to a great number of species.

Trends

For *ex situ* conservation activities, there are requirements of long-term responsibility together with financial support and qualified staff. The General Directorate of Forestry has to decrease on the gap of *ex situ* conservation, raising plantations activities for the long-term sustainability of the genes. There is also a trend to increase the "plantation forests".

For the future use of genetic materials, there is an awareness of requirement a gene bank. It is present in the future plans of the Forest Tree Seeds and Tree Breeding Research Institute Directorate.

Figure 6. ***Pinus brutia*** **progeny trials, Ceyhan- Adana.**

CHAPTER 4

USE OF FOREST GENETIC RESOURCES AND THEIR SUSTAINABLE MANAGEMENT

Forests were managed only for wood raw material production in the past but now they are the areas where different species are managed with the valuation of non-wood forest products. Nevertheless, the primary reason for tree breeding is wood raw material production because of the scarcity.

Table 12. Seed and vegetative propagules transferred internationally per annum (source: 2011 values of General Directorate of Forestry)

Species		Quantity of Seed (kg) 2011 values		Number of vegetative propagules		Number of seedlings		Goal
	Native (N), Exotic (E)	import	export	import	export	import	export	
Abies bornmulleriana	N	NA	1874,4	NA	NA	NA	NA	commercial
Abies nordmanniana	N	NA	345,85	NA	NA	NA	NA	commercial
Abies cilicica	N	NA	3	NA	NA	NA	NA	commercial
Abies equi-trojani	N	NA	84	NA	NA	NA	NA	commercial
Acer campestre	E	0,891	NA	NA	NA	NA	NA	commercial
Acer saccharum	E	1	NA	NA	NA	NA	NA	commercial
Acer palmatum	E	5	NA	NA	NA	NA	NA	commercial
Araucaria heterophylla	E	4	NA	NA	NA	NA	NA	commercial
Betula pendula youngii	E	0,75	NA	NA	NA	NA	NA	commercial
Cedrus atlantica	E	10	NA	NA	NA	NA	NA	commercial

Cedrus libani	N	NA	131,6	NA	NA	NA	NA	commercial
Cercis canadensis	E	15	NA	NA	NA	NA	NA	commercial
Cupressus sempervirens	N	NA	2	NA	NA	NA	NA	commercial
Fagus orientalis	N	NA	0,5	NA	NA	NA	NA	commercial
Gingko biloba	E	20	NA	NA	NA	NA	NA	commercial
Juglans nigra	E	154,6	NA	NA	NA	NA	NA	commercial
Liquidambar styraciflua	E	0,5	NA	NA	NA	NA	NA	commercial
Liriodendron tulipifera	E	10	NA	NA	NA	NA	NA	commercial
Magnolia grandiflora	E	1	NA	NA	NA	NA	NA	commercial
Nandina domestica	E	2	NA	NA	NA	NA	NA	commercial
Pinus brutia	N	NA	9,3	NA	NA	NA	NA	commercial
Pinus nigra	N	NA	13,1	NA	NA	NA	NA	commercial
Pinus nigra var.	N	NA	68	NA	NA	NA	NA	commercial
Pinus pinea	N	NA	2	NA	NA	NA	NA	commercial
Pinus mugo	E	2,786	NA	NA	NA	NA	NA	commercial
Picea orientalis	N	NA	5	NA	NA	NA	NA	commercial
Picea abies	N	40	NA	NA	NA	NA	NA	commercial
Picea pungens	E	60	NA	NA	NA	NA	NA	commercial
Platanus x acerifolia	E	2	NA	NA	NA	NA	NA	commercial
Quercus rubra	E	45	NA	NA	NA	NA	NA	commercial
Sequoia sempervirens	E	0,2	NA	NA	NA	NA	NA	commercial
Pinus pinaster	E	NA	2	NA	NA	NA	NA	commercial
Tilia cordata	E	3	NA	NA	NA	NA	NA	commercial
Tilia americana	E	3	NA	NA	NA	NA	NA	commercial
Wisteria floribunda	E	1	NA	NA	NA	NA	NA	commercial

The tree improvement programme in Turkey has mainly concentrated on increase in volume of timber, since prime requirement is timber deficiency. Although there are some species in Table 13 have different improvement purposes, these programme are not intensive as timber production.

Table 13. Forest tree improvement programme

	Improvement programme objective						
Scientific Name	Native (N)/exotic (E)	Timber	Paper	Energy	Multi-functional	Non-wood forest products	Other, plywood, latex
Pinus brutia	N	x					
Pinus sylvester	N	x					
Cedrus libani	N	x					
Pinus pinea	N					x	
Cupressus semperviensis	N					x	
Pinus nigra	N	x					
Fagus orientalis	N	x					
Larix spp.	N	x					
Picea sitchensis	E	x					
Picea orientalis	N	x					
Alnus spp.	N					x	
Abies spp.	N				x		
Pinus contorta	E	x					
Pseudotsuga taxifolia viridis	E				x		
Picea abies	N				x		

Table 14. Tree Improvement Trials (progeny and provenance trials)

Species	Native (N)/exotic (E)	Number of Test Areas	Family Number
Abies spp.	N	2	24
Alnus spp.	N	6	34
Cedrus libani	N	16	40
Cupressus semperviensis	N	3	17
Fagus orientalis	N	2	12
Larix spp.	E	5	33
Picea abies	E	5	23
Picea orientalis	N	8	16
Picea sitchensis	E	4	9
Pinus brutia	N	50	1533
Pinus contorta	E	1	9
Pinus nigra	N	6	36
Pinus pinea	N	6	26
Pinus sylvester	N	12	280
Pseudotsuga taxifolia viridis	E	4	16

Table 15. Seed Orchards

Latin Name	Native (N)/exotic (E)	Number	Area(ha)
Alnus glutinosa	N	1	5
Cedrus libani	N	10	58,8
Liquidambar orientalis	N	1	2,2
Picea orientalis	N	9	31,1
Pinus brutia	N	68	479,1
Pinus halepensis	N	2	8,2
Pinus nigra	N	55	446,2
Pinus pinea	N	4	47,2
Pinus sylvestris	N	21	109,4
Sorbus torminalis	N	1	1,7
TOTAL		**172**	**1188,9**

Forest Tree Seeds and Tree Breeding Research Institute Directorate has collected data from the origin and location of the plus trees and breeding material (progeny trials) and their performance in the trials. Forest reproductive materials from progeny trials are not available yet for commercial purposes. The reproductive materials from the seed orchards and vegetative reproduction are available for use of forest departments, farmers and other research organizations. For the international request, Ministry of Forest and Water Affairs permission is required.

Table 16. Type of reproductive material available (improved)

Species	Type of Material	Available for national requests only		Available for international requests(Ministry of Forest and Water Affairs Deciding)	
		commercial	research	commercial	research
Alnus glutinosa	seed	x	x		
Cedrus libani	seed	x	x		
Liquidambar orientalis	seed	x	x		
Picea orientalis	seed	x	x		
Pinus brutia	Seed	x	x		
Pinus halepensis	Seed	x	x		
Pinus nigra	Seed	x	x		
Pinus pinea	Seed	x	x		
Pinus sylvestris	Seed	x	x		
Populus spp	cuttings	x	x		

Figure 7. *Pinus sylvestris* seed orchard, Kastamonu.

CHAPTER 5

THE STATE OF NATIONAL PROGRAMMES, RESEARCH, EDUCATION, TRAININIG AND LEGISLATIONS

Forest Tree Seeds and Tree Breeding Research Institute Directorate under the Ministry of Forest and Water Affairs is responsible unit for the selection, protection and management of forest genetic resources seed stands, gene conservation forests, seed orchards, clone parks, genetic orchards, progeny trials. National parks, nature parks, nature protected areas, natural monuments are under the responsibilities of General Directorate of Nature Conservation and National Parks.

Scientific studies on the structure of forest gene resources are carried out by Research Institutes affiliated to Universities and the Ministry. There are 9 Forestry Faculties in the Universities across the country, all of which are State universities. Also in some Universities without forest faculty, studies on forest gene resources are carried out in Biology Departments. Forestry research studies are carried out by 12 Research Institute Directorate under the Ministry of Forest and Water Affairs. These research institutes are located in different regions. Names and brief information of the institutions and non-governmental organizations which are carried out studies on forest gene resources are listed on Table 7.

Table 17. Institutions involved in conservation and use of forest genetic resources.

Name of Institution	Type of Institution	Activities or Programs	Contact Information
Forest Tree Seeds and Tree Breeding Research Institute Directorate	Government, Ministry of Forest and Water Affairs	Gene conservation forests, seed stands, progeny trials, breeding activities, genetic diversity studies	www.ortohum.gov.tr
Poplar and Fast Growing Forest Trees Research Institute Directorate	Government, Ministry of Forest and Water Affairs	Progeny trails, origin trails	www.kavak.gov.tr
Central Anatolia Forestry Institute Directorate	Government, Ministry of Forest and Water Affairs	Provenance trails	www.oae.gov.tr
Eastern Mediterranean Forestry-Research Institute Directorate	Government, Ministry of Forest and Water Affairs	Genetic diversity, non-wood forest products,	www.doa.gov.tr
Western Mediterranean Forestry-Research Institute Directorate	Government, Ministry of Forest and Water Affairs	Progeny trials, non-wood forest products, genetic diversity, adaptive characteristics of species	www.baoram.gov.tr
Aegean Forestry-Research Institute Directorate	Government, Ministry of Forest and Water Affairs	Progeny trials, Origin testings, non-wood forest products	www.efri.gov.tr
Western Black Sea Forestry-Research Institute Directorate	Government, Ministry of Forest and Water Affairs	Provenance trials, genetic diversity, non-wood forest products	www.boluarastirma.gov.tr
Eastern Black Sea Research	Government, Ministry of	Provenance trials	www.dkoa.gov.tr

Institute Directorate	Forest and Water Affairs		
Eastern Anatolia Forestry Research Institute Directorate	Government, Ministry of Forest and Water Affairs	Regional conservation activities	Phone:(+90 442) 233 06 77
South-East Anatolia Research Institute Directorate	Government, Ministry of Forest and Water Affairs	Genetic diversity	www.seafri.gov.tr
Forest Soil and Ecology Research Institute Directorate	Government, Ministry of Forest and Water Affairs	Soil ecology, sampling characteristics	www.ormanekoloji.gov.tr
Marmara Forestry-Research Institute Directorate	Government, Ministry of Forest and Water Affairs	Regional conservation activities	Phone: (+90 212) 262 77 10
Middle East Technical University	University, Biology Department	MS and PhD thesis, Research projects	http://www.bio.metu.edu.tr/
Akdeniz University	University, Biology Department	MS and PhD thesis, Research projects	http://biyo.fen.akdeniz.edu.tr/tr
Süleyman Demirel University	University, Forest Faculty	MS and PhD thesis, Research projects	http://orman.sdu.edu.tr/
İstanbul University	University,Forest Faculty	MS and PhD thesis, Research projects	http://www.orman.istanbul.edu.tr/
Artvin, Çoruh University	University, Forest Faculty	MS and PhD thesis, Research projects	http://orman.artvin.edu.tr/
Bartın University	University, Forest Faculty	MS and PhD thesis, Research projects	http://bof.bartin.edu.tr/
Black Sea Technical University	University, Forest Faculty	MS and PhD thesis, Research projects	http://www.orman.ktu.edu.tr/
Çankırı Karatekin	University, Forest Faculty	MS and PhD thesis,	http://of.karatekin.edu.tr/

University		Research projects	
Kastamonu University	University, Forest Faculty	MS and PhD thesis, Research projects	http://www.kastamonu.edu.tr/Akademik/Orman.html
Düzce University	University, Forest Faculty	MS and PhD thesis, Research projects	http://www.of.duzce.edu.tr/
Kahramanmaraş Sütçü İmam University	University, Forest Faculty	MS and PhD thesis, Research projects	http://orman.ksu.edu.tr/
Scientific and Technological Research Council of Turkey	Governmental Organization	Research, Research fund	http://tubitak.gov.tr/
The Research Association of Rural Environment and Forestry	Non-governmental organization	Research project	http://www.kirsalcevre.org.tr/
Doğa Derneği	Non-governmental organization	Research project	http://www.dogadernegi.org/
TEMA	Non-governmental organization	Research project	http://www.tema.org.tr/
Nature Protection Centre	Non-governmental organization	Research project	http://www.dkm.org.tr/
WWF Türkiye	Non-governmental organization	Research project	http://www.wwf.org.tr/

Of research institutes, Forest Tree Seeds and Tree Breeding Research Institute Directorate is the main centre which carries out tree breeding and genetic studies and ensure the selection, designation and control of gene conservation forests, seed stands and progeny trials. It works in coordination with other research units.

In Turkey, National Forestry Programme which deals with general policy, strategy and action recommendations of Turkish forestry in the period of 2004-2023 was prepared by the joint contributions of forestry organization, related institutions and organizations, forest villagers, non-governmental organizations, other ministries, universities and private sector. National Forestry Plan highlights the function and importance of genetic diversity conservation as an essential step to

conserve biodiversity. Also the value of non-wood benefits of forests as genetic source is emphasized in this Plan (ANONYMOUS 8).

Shortage of wood raw material in Turkey due to the population growth brings out the necessity of breeding activities. Especially resulting from abundant diversity of species, the need to overcome the lack of information on genetic diversity and to accelerate the activities that will set basis of tree breeding has enabled to further support the research projects. In the last decade, there was an increase in the projects on forest genetic resources, conservation and the counterpart projects supported by the Ministry and TUBITAK (Scientific and Technological Research Council of Turkey).

Table 18. Needs for developing forest genetic resources legislation.

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

Table 19. Awareness raising needs

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

It will be possible to accelerate the studies on forest gene resources if we have experienced scientists and technical staff in this field. The major problem in Turkey is the shortage of staff experienced in forest genetic. In this regard, faculties should give high importance to this issue. In Forestry Faculties offer a four-year Bachelor courses, Masters and PhD programme. Forest genetic resources and forest genetics are mentioned explicitly in several courses like plant genetics, plant breeding, forest tree breeding in forestry faculties but these subjects are not studied specifically such as "must course". These courses are studied as compulsory courses in some faculties, but they are optional in some forestry faculties. Furthermore, forest genetic is included in silviculture courses. It should be good to increase the number of the courses on forest genetic in the faculties specifically and make them compulsory with a view to improving the perspective of the conservation, utilization and development of forest genetic resources. Moreover, the major problem regarding forestry education is that students do not prefer to study on forestry. Limited number of students study in these faculties because of the limited employment opportunity in this field.

In Turkey, "Forest Reproductive Material Legislation" was drawn up, and it is being implemented. This legislation was prepared in accordance with the "Forest Reproductive Material Legislation" which is issued by European countries.

Programmes related to forest gene resources conservation are "National Biodiversity Strategies and Action Plan" and "National Tree Breeding Programme". National Biodiversity Strategies and Action Plan (UBSEP) is response to commitment to draw up a national strategy to guide the implementation of Convention on Biological Diversity. As known, Convention on Biological Diversity aims to ensure

conservation of biological diversity, sustainable use of biological resources, and fair and equitable sharing of benefits arising from utilization of genetic resources.

Documentation of forest genetic resources has primary necessity. More research is required to reveal genetic diversity, characterization to use in breeding programs and conservation strategies.

Figure 8. Balıkesir Nursery

CHAPTER 6

THE STATE OF REGIONAL AND INTERNATIONAL COLLABORATION

Membership of International and Regional Organizations

Turkey has signed a number of legally binding agreements on the conservation and sustainable use of forest genetic resources.

As a UN member country, Turkey is a member of many organizations affiliated to the UN such as the UNEP and the FAO in particular and of the bodies created within those organizations such as the International Commission of Plant Genetic Resources. In addition, it also participates in other international organizations such as the International Plant Genetic Resources Institute (IPGRI, Italy), the International Centre for Agricultural Research on Dry Areas (ICARDA) and the International Union of Forest Research Organizations (IUFRO) and in regional bodies such as the European Forest Genetic Resources Programme (EUFORGEN) and the European Cooperation Programme in Plant Genetic Resources (ECP/GR). These memberships are an indication of the importance attached by Turkey to the conservation of biological diversity.

At the Summit of EU Heads of State and Government held in Helsinki on 10-11 December 1999, Turkey was unanimously accepted as a candidate member of the European Union. In the light of the Accession Partnership Document formally adopted by the European Council on 8 March 2001, the National Programme for the Adoption of the Acquis was prepared on 19 March 2001. To achieve harmonization with the environmental acquis of the EU and to implement legislation effectively, the National Environmental Strategy (NEP) was completed in 2006. In the nature conservation sector, the NEP aims to strengthen the existing nature conservation system with a view to the fundamental goals of protecting biological diversity, ensuring its sustainable use and preventing the loss of biological diversity.

International Conventions

The international conventions to which Turkey is party have the force of law and are part of national legislation. The international conventions for the conservation of the environment and biological diversity to which Turkey is party are as follows:

- UN Convention on Biological Diversity (CBD) (1997) and the Cartagena Protocol on Biosafety (2004)
- UN Framework Convention on Climate Change (FCCC) (2004)
- Vienna Convention for the Protection of the Ozone Layer (1988) and the Montreal Protocol on Substances Depleting the Ozone Layer (1990)
- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (1994)
- UN Convention to Combat Desertification (CCD) (1998)
- Convention on Wetlands of International Importance, Especially as Waterfowl Habitat (RAMSAR) (1994)
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (1996)
- Convention for the Protection of World Cultural and Natural Heritage (1983)
- International Convention for the Prevention of Marine Pollution from Ships (MARPOL) (1990)
- International Convention on Plant Genetic Resources for Food and Agriculture (2006)
- Convention on Long-Range Transboundary Air Pollution and the Cooperative Programme for Monitoring and Evaluation of the Long-Range Transmissions of Air Pollutants in Europe (EMEP) (1983)
- Convention for the Conservation of European Wildlife and Natural Habitats (BERN) (1984)
- European Landscape Convention (2001)
- The Convention for the Protection of Marine Environment and the Coastal Region of the Mediterranean (Barcelona Convention) (1981) and its protocols including the Protocol on Special Protected Areas and Biological diversity in the Mediterranean (1988)
- Convention for the Protection of the Black Sea Against Pollution (Bucharest) (1994) and its protocols including the Protocol for the Protection of Biological and Landscape Diversity in the Black Sea (2004)

Was mentioned above; Turkey became a party to the agreements which are related directly or indirectly about conservation of forest gene resources.
Turkey participates in a number of regional forest genetic resource based or thematic networks, which are listed in Table 20.

Table 20. Overview of the main activities carried out through networks and their outputs

Network name	**Activities ***	**Genus/species involved (scientific names)**
EUFORGEN	Technical guideline	*Fagus orientalis, Liquidambar orientalis, Pinus brutia, Pinus nigra, Quercus cerris*
EUFGIS	Development of shared databases, establishment of gene conservation units	All species which have gene conservation units
International Poplar Commission (FAO)	Information exchange	*Populus* spp.
Silva Mediterranea (FAO)	Information exchange	Forest tree species relevant to Mediterranean Region

Table 21. Awareness raising needs/ Needs for international collaboration and networking

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

Figure 9. ***Cedrus libani*** **cones**.

CHAPTER 7

ACCESS TO FOREST GENETIC RESOURCES AND SHARING OF BENEFITS ARISING FROM THEIR USE

Access to forest genetic resources and sharing benefits arising out of their use:

Those foreign researchers who will do researches in Turkey are subject to the Requirements for those Foreigners or those applying on behalf of Foreigners and for Foreign Members of the Press who will Do Scientific Research and Examination and Record Film in Turkey, which were put into force by the Resolution of the Council of Ministers No. 8/12839 of 4 April 1988. By the Resolution of the Council of Ministers No. 2003/6270 of 6 October 2003 amending articles 2, 3 and 7 of the above-cited Resolution of the Council of Ministers, the authorization to issue research permits other than those concerning archeological excavations and surface researches was granted to the relevant authority. Therefore, the Ministry of Forestry and Water Affairs in Turkey receives and finalizes any applications for research permits for living natural resources, including forest genetic resources. The permits do not entail gathering materials and taking samples from the wild.

The Forest Law (No:6831) prohibits the collection and taking out the seeds and other materials of forest trees from state forests. The movement of forest genetic resources into or out of the country for the purpose of scientific research is subject to permit of the Ministry.

Communiqué on restrictions of export of goods (2009/11) prohibits export of forest genetic materials. Bilateral and multilateral agreements may improve the access. For example, Turkey fulfill its obligations concerning access to genetic resources and benefit sharing as being a member of the European network (EUFORGENE) for Forest Trees, and obeying the Material Transfer Agreements on access to genetic resources.

Sharing of benefits arising out of the use of forest genetic resources:
Turkey is a party of European Patent Convention, therefore recognizes IPRs in the framework of EPC. On the other hand, supports international effort for disclosure of origin of genetic resource in patent applications to safeguard rights of the country of origin on genetic resources.

Turkey has very restricted access to other countries' genetic resources in forestry sector and this access is based on agreements on material transfer and therefore Turkey shares benefit with the resource-provider country.

CHAPTER 8

THE CONTRIBUTION OF FOREST GENETIC RESOURCES TO FOOD SECURITY, POVERTY ALLEVIATION AND SUSTAINABLE DEVELOPMENT

In Turkey Forest Genetic Resources have the potential to decrease poverty by supplying the most basic needs for sustainable development of the forest dependent villagers. Forest genetic resources in Turkey have made adequate contributions providing economic, social and environmental benefits. The trends indicate that planted forests and trees outside forests will also provide an increasing share of forest products.

Turkey is an important country as possessing vital resources for people's food security and has the responsibility to protect and use this important wealth rationally for the welfare of the future generations. Forests and trees also contribute indirectly to food security because they have a major role in the sustainability of agricultural production systems. Species, which use for poverty reduction can also be important for food security. Some of the important fruit yielding woody species (Table 22) are utilized by the local household and form a major income source for the forest dependent communities. Since Turkey is an agriculture country, crops are mainly use for the reduction of poverty instead of forest origin resources.

Table 22. List of trees and other woody species those are important for food security or livelihoods

Species		Use for food security	Use for poverty reduction
Scientific name	**Native (N) or exotic**		
Amygdalus spp.	N	NA	x
Armeniaca vulgaris	N	NA	x
Camellia sinensis	E	NA	x
Capparis spp.	N	NA	x
Castanea sativa	N	NA	x
Cerasus spp.	N	NA	x
Ceratonia siliqua	N	NA	x
Cornus sanguinea	N	NA	x
Corylus colurna	N	NA	x
Cotoneaster franchetti	N	NA	x
Crataegus spp.	N	NA	x
Eucalyptus spp.	E	NA	x
Ficus spp.	N	NA	x
Juglans spp.	N	NA	x
Laurocerasus officinalis	N	NA	x
Mespilus germanica	N	NA	x
Phoenix spp.	N/E	NA	x
Pistacia spp.	N	NA	x
Rosa canina	N	NA	x
Sorbus torminalis	N	NA	x
Ziziphus spp.	N	NA	x

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