

AGRICULTURAL PLANT DIVERSITY IN TURKEY
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Abstract

Turkey is one of the significant country in the world from the plant genetic diversity/resources point of view. Two of Vavilov's Centres of Origin (Mediterranean and near East) overlaps into Turkey. This indicates that Turkey is the centre of origin and/or centre of diversity of several crop plants, besides being microgene centre for some crop species. Moreover, Turkey is also one of the domestication centre where ancient agriculture started. Species endemism is also high. Presumably this factor is connected with the climatic and topographic diversity of Turkey, and the limited extend of Pleistocene glaciation. Therefore, Turkey has very rich and interesting flora with existing bio-diversity and/or genetic diversity. Biodiversity conservation , *ex situ* and *in situ* , of plant diversity are conducted within the framework of “National Program on Conservation of Genetic Resource/Diversity” since 1960s. The Turkish Constitution, Laws and Regulations and international conventions in the field of nature conservation provide the legal framework for seeking the strategy for continuity of biodiversity/genetic diversity in Turkey. In this report conservation and protection studies of plant/crop diversity in Turkey will be discussed with emphasise the backgrounds, actions and measures.

***Keywords:* Biodiversity, endemism, *in situ*, *ex situ*, conservation.**

1. Background

1.1. Policy Context

The Turkish Constitution, Laws and Regulations and international conventions in the field of nature conservation (i.e., NEAP, Paris, Ramsar, Bern, CITES, Combat Desertification etc.) provide the legal framework for seeking the strategy for continuity of biodiversity in Turkey. The Turkish Constitution (1982) stipulates that “the State shall take the necessary precautions towards the protection and utilization of natural resources” and it has some general clauses broadly related to its conservation. For example, Article 56 states that citizens have the right to live in a healthy environment. Article 63 states the principle of protecting cultural and natural resources.

Although the some of the agricultural policy affect the plant diversity the conservation of plant diversity is an important strategy in Turkey. a legislation on “Collection and Utilization of Plant Genetic Resources” which published in 1992 regulates the principles of conservation of plant diversity exist in Turkey, and organize the responsibilities and activities of conservation and utilization of plant diversity. The “National Plan on *In situ* Conservation of Genetic Diversity of Turkey” published in 1998, covers all actions in systematic plan to protect *in situ* the plant genetic diversity in their natural habitat and in their agro-ecosystems. This is a plan which incorporate the agricultural policies sets the relevant policy objectives, specimens priorities protection, management and public awareness activities. The Regulation and the national plan are incorporation with “National Biodiversity Strategy Action Plan” as its components. Various institutions, ministries and organizations have undertaken duties and responsibilities for conserving the biological diversity.

Since 1960s the conservation of plant diversity is become extensively government policy. The red data book of Turkey for endemic and non-endemic plant species is also revised and published in 2000. This is an important document for protection of endangered species and their habitats and ecosystems.

“The National Plant Genetic Resources Conservation Program” involves many research area related to protection of existing plant diversity and their habitat and agro ecosystem. The National Cooperation of this program exists among the formal and informal sector including NGOs. Through this program Turkey members the various crop and regional networks. Regarding the biodiversity and/or nature protection, Turkey is also partner of various agreements and conventions given below:

- Convention for the Protection of Birds (Paris Convention) (1966)
- Convention for the Protection of the Mediterranean Sea Against Pollution (Barcelona Convention) (1988)
- Convention Concerning the Protection of the World Cultural and Natural Heritage (1983)
- Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention) (1984)
- Convention on the Protection of the Black Sea Against Pollution (Bucharest Convention) (1994)
- Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar Convention) (1994)
- Convention on Biological Diversity (1996)
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES Convention) (1996)
- United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification Particularly in Africa (1998)
- European Landscape Convention (2000)

1.2.Environmental Context and Ecosystem Diversity

Turkey has many different ecosystems and habitat with species rich communities various attempt have been carried out to protect the environment. For this respect many different agencies involved in various actions and projects.

Economic pressures due to population increases in rural areas and lack of legislation preventing the fragmentation of farms into less than optimal units has resulted in decrease of farmers’ already low income. This forces the small farmer to illegal forest clearing, heavy grazing, plowing of range lands, as well as large scale uncontrolled gathering of plants leading to destruction of biodiversity.

Among traditional and unsustainable agricultural practices, plowing-under of grazing land to gain arable land is one of the most important threats to biodiversity in the steppes. Major losses of natural habitat, has been observed on over 15 million hectares of grazing lands that have been ploughed. Common stubble burning practices to facilitate the next planting is a threat to soil microorganisms, many small animals and insects, reducing the organic content and fertility of soil.

Turkey has a total surface area of 77,482,000 hectares. Land use pattern of Turkey is given in table 1. With its rivers and lakes covering approximately 10.000 square kilometres, Turkey has significant inland water resources important for sustaining its biodiversity. There are seven drainage basins including 26 river basins in Turkey and groundwater is estimated to be 94 billion cubic metres. Annual average rainfall is 652.5 mm. of which approximately one-third reaches the water table and contributes to the wetland environment. In Turkey, it is agriculture that consumes the most water. The estimated size of irrigation areas is 3.860.000 hectares, with 3.440.000 hectares irrigated with surface water resources and 420.000 hectares with groundwater resources.

Table 1. Land use pattern of Turkey (1995)

Land use class	Area (ha)	Percentage (%)
Arable	27,118,000	35
Grassland	21,245,000	28
Forest	15,496,000	20
Lakes and water surface	1,286,000	1.6
Others	11,932,000	15.4
Total	77,482,000	100.00

Turkey consists of three different biogeographic regions, each with its own endemic species and natural ecosystems. These are: the Caucasian mountain *forests* with the temperate deciduous forest, including alpine meadows; Central and Eastern Anatolian *Steppe* grasslands and the Mediterranean region, which includes the world's largest remaining Cypress forests. The steppe ecosystem is perhaps the most important of all from the point of view of economics, as a large number of food crops have been derived from their wild species native to Turkey. *Wetland ecosystems* provide suitable breeding, feeding environment and habitat, and are second to tropical forests regarding biodiversity levels. Wetlands are vitally important for many endangered and endemic species. Significant degradation exists in each of the mentioned ecosystems, and each of them has endemic, endangered, threatened, or extinct species. The similar factors affect the ecosystem to threat lost of species.

Forests ecosystem: There are two main forest: Temperate Coniferous Forest and Temperate Deciduous Forest. Sub-grouping of these forest types can be done according to woody species (i.e. pine forest, cedar forest, fir forest, beech forest or mixed beech and oak forest), ecosystem characteristics (i.e. forest in transition zone into steppe and forest in humid, semi-arid and arid zones) and regions (Mediterranean forests, Eastern Black Sea forests, Western Black Sea forests).

Forest ecosystems include high-mountain and alluvial forests and cover 15.496.000 hectares where almost 50% are degraded. Deciduous forests are prevalent in Turkey and coniferous forests are found at varying altitudes from sea level to timberline. Humid, sub-humid coniferous, and dry forests (oak, black and red pine) as well as shrubs and maquis, are found in the Aegean and Mediterranean regions. Forests in Turkey include, three distinct and different floristic regions. This ecosystems are very important for the habitats of wild relative of crop species, such as wild relative of cereals and legumes and also wild fruit species.

Steppes: Grasslands, which can be defined as: the areas covered with herbaceous plants, occupies 21.745.000 ha. This figure was 44.300.000 ha in 1935 and 37.800.000 ha in 1950. The figures show a steady decrease in the amount of grasslands. There are several reasons for that. No doubt primary reason is the anthropogenic effect. Most of the grasslands have been plown to gain agricultural areas in the past to meet the food demand of the increasing population. This trend has come to an end in the recent years because almost all potential-areas have already been invaded. What's left now is only the marginal areas with no potential to be used as agricultural areas. Steppe areas which, are considered as being the total of grasslands and the marginal areas, now account over 28.000.000 ha.

Cultivated areas (27.100.000 hectares) cover 35% of the total area of Turkey, the majority being in the steppe ecosystem. Of the total agricultural area, field crops account for 70%, fruits, 5%; vegetables, 2.7%, vineyards, 2% and olive fields, %2.2. The remaining 18% of the cultivated area is used as fallow

annually within the cereal growing system. The steppe ecosystem is perhaps one of the most important from the point of view of economics. A large number of food crops, which have been derived from the wild species, which are endemic to Turkey. These have evolved in the region over the ages from wild species, many of which are now responsible for feeding the majority of humankind.

Wetlands: Wetlands of Turkey display a wide variation of characteristics reflecting the diversity of climate, topography, elevation and soil conditions. Surrounded on three sides by seas and with approximately 1.280.000 hectares of wetlands, while 200.000 ha of wetlands was lost due to drying since 1960's. Wetlands provide habitats for large numbers aquatic and hallofitic species. There are around 250 wetlands, of which many have international significance. Wetlands are threatened due to different human uses such as pollution, illegal fishing, excessive use of water for agricultural purposes, dam construction).

1.3. Genetic Diversity

Two Vavilovian Centre of Origin (Mediterranean Centre and Near eastern Centre, each important for the origin of field crops as well as horticultural plants) overlaps in Turkey. Therefore, *Linum*, *Allium*, *Hordeum*, *Secale*, *Triticum*, *Avena*, *Cicer*, *Lens*, *Pisum*, *Vitis*, *Amygladus*, *Prunus*, *Beta*, etc. were originated in Turkey. Turkey is considered as minor gene centre for many of crops species which are originated from other centres.

The land races which maintain a high level of genetic heterogeneity, are still grown in transitional zones and mountain areas where the agricultural lands are small and the modern farming in not possible. Transitional zones appear to have retained traditional farming methods to higher degree than the intensively cultivated coastal region or Anatolian plateau. The farm population in the region is fully integrated into national economy and culture of Turkey. "Agricultural Development Programmes" have been providing improved varieties through the seed corporation, which causes the landrace plantations to decline. Fragmentation of holding allows farmers to manage several fields and to cultivate land races in at least one field. Marginal agronomic conditions especially steep slopes and heterogeneous soils of mountainous lands make landraces competitive with improved varieties Farmers keep local races in fields that are relatively margined and poorer soils, steeper slopes and higher altitudes. Economic isolation in the mountain part creates market imperfections and lessens the competitive commercial advantage of improve varieties. Cultural and traditional demands and preferences for diversity cause farmers to maintain land races. But in some of the Other areas, some of the modern farmers also still prefer to grow the land races for their conceptions.

Gene flow from cultivated to wild species can affect the genetic diversity for this reason to prevent the gene flow the agricultural can be far from wild populations. (e.g. the chestnut plantation is not permitted nearest to chestnut forest) This rich genetic diversity becomes important to plant breeding programs. Especially, the land races are utilized to improve the varieties. The wild crop relatives which are in the first gene pool of crops are also used easy in variety improvements. Many registered varieties are release from those plant genetic collections of Turkey. Especially most of the vegetables, industrial crops, fruits, and forage varieties has been released from the land race collections of Turkey.

The registered varieties (1963-2000) are shown in Table 2. Most of the recently registered varieties are in market now.

1.4. Species Diversity

Turkey has 75% of the total number of plant species found in the whole of Europe. One third of Turkish flora, which is more than twice as diverse as that of neighboring countries are found only in Turkey. Cherries, apricots, almonds and figs all originated in Turkey. Turkish flora includes many wild

relatives and genetic diversity of important domestic species (e.g. wheat, chickpea, lentil, apple, pear, apricot, chestnut, and pistachio). Turkey is also home to a number of ornamental flowers, the most notable being the tulip. Among continental countries, Turkey ranks 9th in terms of biodiversity richness with over 33% of its flora being endemic. Number of species shown are given in Table 3 and The Threatening (IUCN) Categories of Endemic and Non-endemic Plant Species in Turkey are given in Table 4.

Table 2. Number of registered varieties in turkey

Crops	Years	
	1963-1984	1985-2000
Cereals	124	209
Fodder crops	24	34
Grapes		4
Fruits		45
Industrial Crops	74	127
Oil seeds	4	95
Pulses	20	39
Root crops (Potato)	17	38
Vegetables	75	95

Table 3. Number of Species in Turkey

Plants	Described Species	Endemic Species
Ferns	86	1
Gymnospermae	23	3
Monocotyledons	1423	249
Dicotyledons	7415	2509

Table 4. IUCN Categories of Endemic and Non-endemic Plant Species (2000)

	EX	EW	CR	EN	VU	LR (lc)	LR (cd)	LR (nt)	DD	NE
Endemic	12	-	171	774	688	769	470	347	270	3
Non-endemic	1	-	10	69	769				244	3
TOTAL	13	-	181	843	1457	769	470	347	514	6

Turkey is very rich in species diversity because of:

- Three floristic regions (Mediterranean, Irano-Turania and Euro-Siberian) .
- Seven climatic regions are exist with many different micro-climatic regions.

- Different agro-ecosystem conditions with different type of farming system exist.

Some of the wild species potential to agriculture new crops. Some of these wild species diversity in recent years used to introduce the new plants/crops to groves such as medicinal and aromatic plants, ornamental plants species. The scientist to use the Turkish collections carries out the research on production/ growing methods and breeding system/reproduction biology. Potential crops species from Turkish collection to marginal lands are also investigated. To prevent the disease movement from one region to another some restrictions are exist. (e.g. to prevent the spread of ink disease of chestnut.).

The plant species diversity lost or threats is depending on the farming practices, growing pressure (heavy grazing), heavy collection from wild for commercial sell, introduction of non-native or exotic species, and other factors, such as conversion of forest to agriculture or non agricultural effects.

2. Indicators and actions

2.1. Genetic and Species Diversity

The Turkish National System for conservation and utilization of Genetic Resources is well organized and operated since 1960s. In 1970s and 1990s the system is revised and the “Regulation of Collection, Conservation and Utilization of Genetic Resources” is prepared and published in official Newsletter in 1992. The National program on Plant Genetic Resources/ Diversity is responsible to conduct the related activities and research on the conservation and utilization plant genetic resources not only in agriculture but also other wild species (including endemic species) found in Turkish flora. The collection activities are systematically planned annually and all survey collections, conservation and evaluation results are well documented. Within the framework of National Program the different ministries of formal sectors and different agencies of informal sector cooperates. The annual surveys and collection activities is conducted in nine groups: cereals, forages and pasture plants, industrial crops/plants, vegetables, food legumes, ornamental plants, medicinal and aromatic plants, fruits and grape, endemic and endangered species. The Aegean Agricultural Research Institute (AARI) of Ministry of Agriculture is responsible on the coordination of the “National Program on Conservation of Plant Genetic Resources/Diversity” and to carry out the activities and research.

Ex situ conservation activities has been undertaken since 1964. It is still on process within the framework of the “National Program on Conservation of Plant Genetic Resources/Diversity”. The *ex situ* conservation is implemented both for generative and vegetative collections which are preserved in seed gene bank and field gene banks respectively. The vegetatively propagated genetic resources material, mainly fruit genetic resources are kept in field gene banks at 13 institute (including AARI). Garlic, some medicinal and aromatic plants and ornamental collections are also kept as field collection at AARI. The national collection contain the landraces, wild and weedy relatives (both for seed and vegetative collections), other wild species which are especially economically important plant and endemic species. The main users of the material are the plant breeders and researchers both from Turkey and abroad. There are some research activities on the *in vitro* storage techniques of some vegetatively propagated plant species.

The “*In situ* Conservation of Plant Genetic Diversity Project” initiates and develops a mechanism to foster the on going National Plant Genetic Resources Research Program for identifying, designating and managing the areas specifically for *in situ* conservation of nationally and globally significant wild crop relatives and wild fruit species which are originated in Turkey. The project also aims to make *in situ* conservation integrated with existing *ex situ* conservation program of Turkey. Various Gene management Zones (GMZs) for wild relatives of crops and wild fruits from diferen ecosystems were identified and their management plans were prepared to manage.

The other project on *in situ* conservation is “*In situ* conservation and management of ecosystems of endangered plant. This project mainly related to steppe ecosystem and its endangered species. The overall objective(s) of the project are: Conservation and management of steppe ecosystems which are important plant areas for endangered herbaceous plant species listed in Appendix of the Bern Convention.

“*In situ* Conservation of Agricultural Biodiversity”. The main objectives of the project are (1) to support the development of framework of knowledge on farmer decision-making processes that influences *in situ* conservation of agricultural biodiversity, (2) strengthen links among the formal, informal sectors and farmers for the planning a new implementation of conservation for agricultural biodiversity, and (3) to broaden the use of agricultural biodiversity and participation in its conservation by farming communities and other groups.

For the conservation and Protection of genetic and species diversity:

- The “National Biodiversity Strategy Action Plan” is prepared,
- The “Red Data Book (Red list) of Plant Species in Turkey” is published,
- The “Regulation of Collection, Conservation of Genetic Resources” is published,
- “The national Plan for *In situ* conservation of Plant Genetic Diversity” is published. This plan covers:

- List of crops/plant species (priority list) for on farm conservation of agro biodiversity and *in situ* conservation of wild crop relatives and their ecosystems.
- Management of conservation sites of target species and their ecosystem
- Monitoring of Gene Management Zones (GMZs)
- Public Awareness strategies

2.2.Environmental and Ecosystem Diversity

Both government and non-government organizations have been carrying out programs for conservation of biological diversity by various means for a long time (Table 5). This has been done by (i) *in-situ* conservation programs such as National Parks, Nature Reserves, Nature Parks, Wildlife Reserve Areas, Natural Assets, Natural Entities, Specially Protected Areas, Gene Management Zones (GMZs) of *in situ* conservation of genetic diversity, and (ii) *ex-situ* conservation in Seed and Field Gene Banks, Arboreta, Botanical Gardens.

Projects for the conservation of wetlands are conducted by the Ministry of Environment. These projects are mainly on inventory and management plans oriented. Inventory studies of Ecological and Biological Research of Internationally Important Wetlands (lakes, deltas etc.) in Turkey has been completed. In the project areas physical and chemical analyses has been made, current situations assessed, biological and ecological wealth has been identified. This information is thought to be used for the "Wetlands Database", which is planned to be constructed. At the same time, in the contexts of projects environmental problems and other developments threatening environmental values has been identified and pollution maps have been made. All the information gathered will be used as a guiding light for future implementations as well as in solution advises and precautionary measures for existing problems. Two Wetland Management Plan including the natural environmental characteristics, use of natural resources and socio-economical characteristics of those two wetlands have been prepared and assessed.

Ecological agricultural practices (organic agriculture) have been started in 1945 in Turkey. In 1991 Turkey followed the regulation of EEC/2052/91 on ecological production and in 1994 a regulation on “Plant and Animal Ecological Production” has been published to follow up by farmers. This regulation is under revise in 2001. The statistics of 1999 shows that 12435 farmers utilize the ecological methods in

44552 hectares of lands. The figures of organic agricultural production is given below table 6. (Source Ministry of Agriculture and Rural Affairs, 1999).

Table 5. Protected areas and Responsible agencies.

Protection Areas	Responsible Agency	Number.	Total Area (ha)	Establishment Year (since)
National Parks	MOF	33	641.753	1958
Nature Parks	MOF	16	52.256	1983
Nature Reserves	MOF	35	85.303	1987
Nature Monuments	MOF	54	333	1988
Wildlife Reserve Areas	MOF	123	1.851.317	1966
Conservation Forests	MOF	53	365.884	1950
Gene Conservation Forests	MOF	163	23.408	1994
Seed Stands	MOF	344	46.348	1969
Specially Protected Areas	MOE	12	418.850	1988
Ramsar Sites	MOE	9	159.300	1994
Natural Assets	MOC	750	-	1973
Natural Entities	MOC	2370	-	1973

Table 6. Organic agricultural Products

Groups of Crops	Farmers/ Producers	Acreage (Ha)
Nuts	7364	22771.9
Fresh Fruits	829	1970.8
Vegetables	77	363.1
Field Crops	1238	10718.4
Grapes and Berries	957	586.6
Medicinal and Aromatic Plants	421	4136.8
Other Crops	1549	40005.1
TOTAL	12435	44552.6

Beside this productions it is obvious that the farmers who grow the land races are also use the ecological farming (traditional farming system with manure and without chemical) in their production. Various research on ecological farming are also conducted by scientist to solve the local problems and needs of the farmers. Consumers and the farmers become aware the ecological farming products.

The factors of environmental threats have been identified and as summarized below:

1. unsuccessful pasture management
2. Plowing grasslands and opening the forest for cultivation;
3. Misuse of agricultural and grass lands (Excessive use of fertilizers and chemicals, over-grazing);
4. Diminution of farm lands;
5. Acceleration of erosion;
6. Changing the agricultural farming systems
7. Destructive effects of road and dam construction;
8. Over collecting plants of economic importance;
9. Forest fires introduction the alien (invasive) species to forest ecosystem;
10. Improper mining;

The future actions should be strictly follow the National Biodiversity Strategy Action Plan and other regulation related the conservation and protection of agricultural biodiversity.

To ensure the protection of existing biodiversity the below points should be considered::

- Strong cooperation among related institutions of formal and informal sectors,
- Awareness of public and policy makers,
- Well documented databases to identify the status of agrobiodiversity (including, impacts to agroecosystem, farming system and socio-economic status of farming and local community, seed exchange mechanism, local marketing etc.),
- Well Identified conservation/protection strategies and legal status of protection/conservation,
- Monitoring mechanism of ecosystems in interest.

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