

# **National Report on the State of Plant Genetic Resources in Armenia**

**MINISTRY OF AGRICULTURE OF THE REPUBLIC OF ARMENIA**

**Y E R E V A N – 2008**

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### ***List of Acronyms and Abbreviations***

<b>Acronyms</b>	<b>Full name</b>
ACIAR	Australian Centre for International Agricultural Research
CAC	Central Asia and the Caucasus
CIMMYT	International Maize and Wheat Improvement Center
CIP	International Potato Center
CWR	Crop wild relatives
CHM	Clearing House Mechanism
GEF	Global Environmental Facilities
ICARDA	International Center for on Agricultural Researches in Dry Areas
MEC	Ministry of Education and Science
MNP	Ministry of Nature Protection of the Republic of Armenia
MoA	Ministry of Agriculture of the Republic of Armenia
NAS	National Academy of Sciences
NBSAP	National Biodiversity Strategy and Action Plan
NSPA	Nature Specially Protected Area
PGR	Plant Genetic Resources
PGRFA	Plant Genetic Resources for food and agriculture
RA	Republic of Armenia
SC	Scientific Center
SNCO	State non –commercial organization
SNSPAAP	Strategy on the development of Natural Specially Protected Areas in Armenia» and Action Plan
UNEP	United Nations Environment Programme
USDA	United States Department of Agriculture
VIR	N.I.Vavilov Institute of Plant Industry, St. Petersburg, Russia
WB	World Bank

# INTRODUCTION

## 1. General Information

- **Geographical Location and Borders**

The territory of the Republic of Armenia is located in the verge of Southern Caucasus and Asia Minor, occupying about 10 percent of north-eastern part of Armenian plateau.

The territory of RA is situated between 35° 50" – 40° 15" of north latitude and 43° 27" – 46° 37" of eastern longitude. Armenia borders Georgia in the North, Azerbaijan in the East, Iran in the South and Turkey in the West.

- **Natural Climatic Conditions**

The Republic of Armenia is a typical mountainous country with a complex geographical structure. The total space of the country is 29,740 square kilometers. The highest peak is Mount Aragatz (4090m above sea level) and the lowest points are the banks of Debed River (375m). Relative altitude fluctuates from 1500-2000 to 3700 meter. The average altitude of the territory is 1850 meters. Such altitudinal variation results in a great diversity of climates and landscapes.

Water resources in the country are quite limited. The largest lake is Lake Sevan, it's a natural source of drinking water for the region. Rivers are small and shallow.

Armenia is characterized by mountainous continental climate, peculiar for its dryness. Average highest annual temperature is 14<sup>0</sup>, and the lowest is – 2,7<sup>0</sup>. The hottest average temperature is observed in July – August in Ararat valley and pre-mountain zone is 24<sup>0</sup>C – 26<sup>0</sup>C; in mountain zones is 15<sup>0</sup>C – 20<sup>0</sup>C; in high altitude regions is 10<sup>0</sup>C – 15<sup>0</sup>C and lower.

Average lowest temperature in January fluctuates between -18,9<sup>0</sup>C and -3,1<sup>0</sup>C. The amount of annual precipitations on the territory is about 600-1000mm. High altitude zoning is demonstrably obvious. In winter a long-lasting snow cover exists above 1300 m.

- **Population**

The population of Armenia is 3.2 million people. Urban population is about 2 million, the rest live in rural areas. About 1.1 million people live in the capital, Yerevan.

- **Administrative units**

The administrative units of the Republic are *marzes* and communities. *Marzes* consist of rural and urban communities. Armenia is divided into 11 marzes. The town of Yerevan has a status of a *marz*. There are 48 urban and 866 rural communities in the Republic.

## 2. Brief Outline of Agriculture

The agro-food is one of the most important sectors in the economy of the Republic of Armenia, contributing to about 30% of the GDP, where the share of agriculture is about 17% (2007).

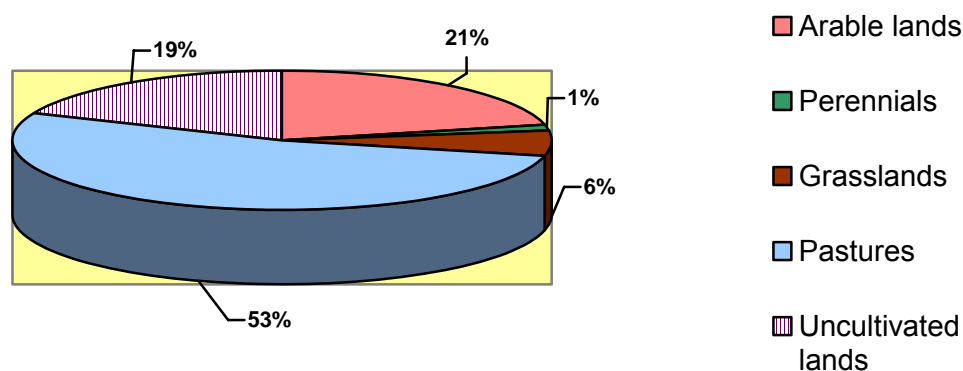
The share of agriculture accounted in average for 20% of the country's gross domestic product in the last five years, which creates favorable conditions for the gradual increase of the level of the country's food security. These challenges are prior for the country's economic policy.

After declaration of independence in 1991, radical changes have occurred, and a market based economic system was established through a privatization policy. At present about 340,000 private peasant farms, trade organizations, a great number of privately owned services, agricultural produce marketing and processing organizations exist in the country. 71.7% of arable land, 78,3% of perennial plantations, 48,4% of grassland has been privatized by farms. Now the prevailing (more than 98%) part of the agricultural gross product is produced by the private sector.

## 3. General Description of Plant Production Sector

About 40% of the territory of the Republic is not suitable for agriculture. In 2007, of the 2,1 million ha in use for agriculture, 452 thousand ha are arable lands, 29,6 thousand ha perennial plantations,

127,5 thousand ha grassland, 118,3 thousand ha pastures and 394,6 thousand ha is uncultivated lands (*Diagram 1.*).



**Diagrame 1.** Distribution of agricultural lands by types

Cultivated lands have been fragmented into more than 1,2 million plots. Presently each farm has on average 1,4 ha of land, of which 1,1ha are arable land.

Agricultural production is mainly conditioned by the relative altitude of the area and its temperature conditions. On the base of these factors three main agricultural production zones can be identified: the Ararat Valley up to 1200 m, the pre-mountain zone (1200-1800 m) and the mountain zone, higher than 1800 m. Cultivated plants occur from the lowest areas up to 2300-2400 m.

In the conditions of the Republic, taking into account the economic blockade of the country, cereal crops (wheat, barley, emmer wheat) are of strategic significance as the prior source of food security. At present they occupy a major part of the areas sown by agricultural crops. Winter wheat is the most widespread cereal crop, as it ensures more sustainable and higher yields comparing to other cereal crops (spring wheat, winter and spring barley, emmer wheat).

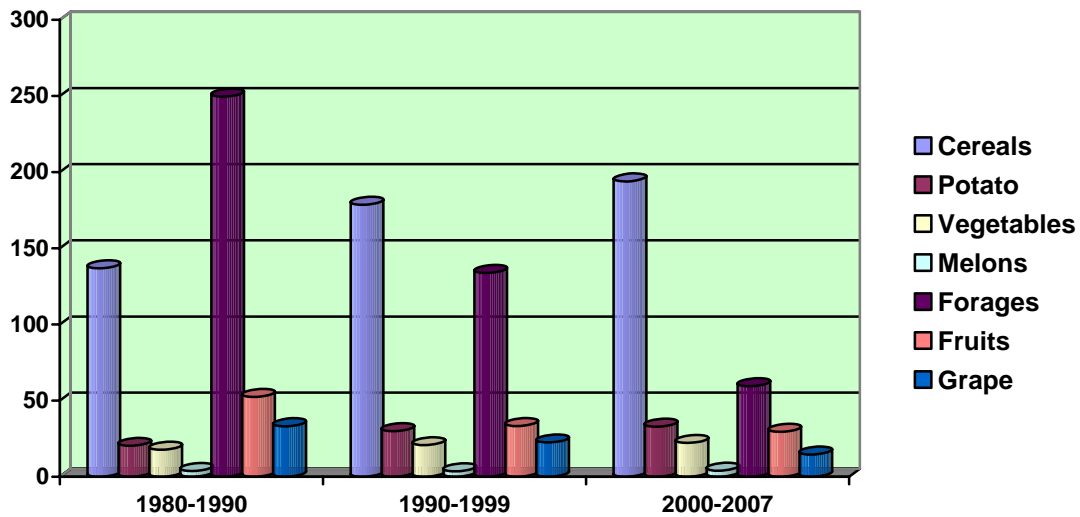
Potato is considered the second crop in terms of importance in Armenia; its high food significance ensures high profitability as well.

Vegetable plants (tomato, egg-plant, cucumber, pepper, cabbage), grape and fruits (mainly apricot, apple, peach) are also important crops whose production also serves as a raw material in the processing industry. Vegetable crop production is strictly differentiated according to the altitude gradient. Thus, tomato, pepper, cucumber, egg-plant, early ripening cabbage, haricot, marrow are mainly cultivated in low-altitude zones; cabbage, partly carrot, beet and radish, in mountain zones. Melon, water-melon and squash are mainly cultivated in Ararat valley.

Fruit growing is the oldest and most profitable branch of the country's agriculture. Various fruit species are cultivated in the Republic – apricot, peach, plum, cherry, apple, pear, quince, nut, almond, fig, pomegranate, etc., eastern persimmon and, recently, kiwi.

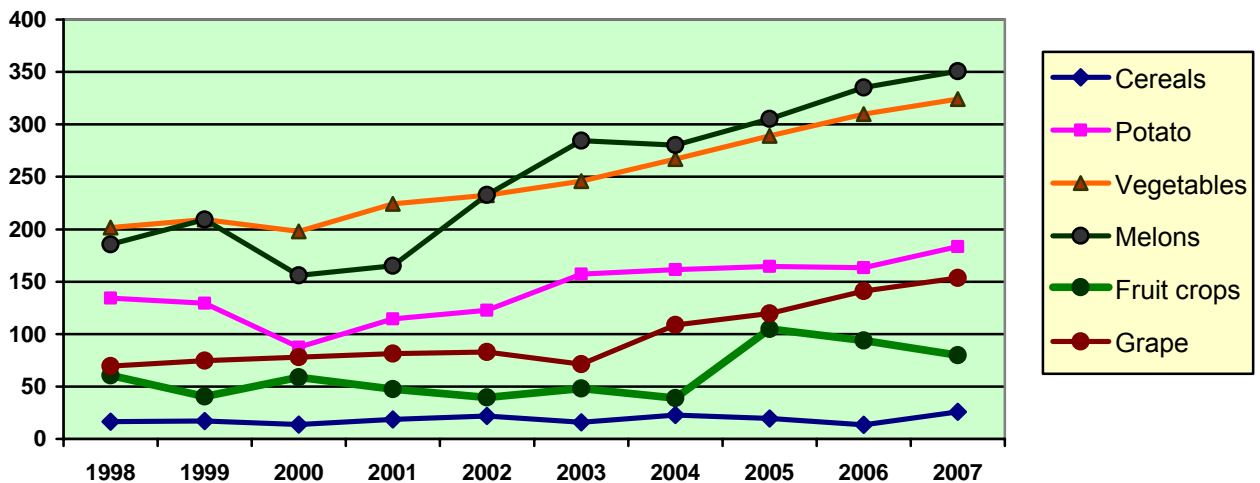
After land privatization the radical changes that have occurred, posed a serious threat to fruit and grape cultivations. Only 60% of vineyards and about 5% of fruit orchards have survived in post-soviet period. These were replaced by cereal crops (especially wheat) whose production area has increased by 30% since independence.

However, in recent years this trend appears reversed. Data on sown lands of main cereal crops reveal a reduction of cereal crop sown lands during 1998-2006. Fruit orchards from 22,474 ha in 1999 have increased to 38.0 thousand ha in 2007 (*Diagram 2.*).



**Diagram 2.** Crops sown area (hectar)

As a rule crop productivity varies because of climate conditions fluctuations. Overall, yield capacity could be significantly increased, by sorting out a number of factors, including constraints in seed-production system, lack of fertilizers and plant protection products, poor implementation of efficient agronomical techniques. In general crop-rotation is seldom applied. This is progressively leading to a decrease of soil fertility and greater soil surface erosion processes. The Government policy of recent years and the implementation of some important projects on land reclamation, development of irrigation system, watering of natural pastures, centralized pests control of agricultural crops, etc., has given positive results in the field of cereal, potato and vegetables production. However, the increase of gross production of cereals, vegetables and potato has occurred mainly due to the increase of sown area. The growth rate of horticulture is conditioned by application of intensive technologies of cultivation and use of the more productive varieties. (Diagram 3.).



**Diagram 3.** Agricultural crops average yield in 1998-2007 (centner/hectare)

Agricultural areas fragmentation which results in small cultivable plots, hamper the rapid development of agriculture, as it limits the application of intensive technologies and running of profitable farming systems. Low level of intensification of agriculture, insufficient use of fertilizers and plant protection products, as well as limited availability of high quality seeds impede rise of crops yield.

# CHAPTER 1.

## THE STATE OF BIODIVERSITY

### 1.1. Basic Main Value of the Plant Genetic Resources

Landscape diversity of Armenia and its relief peculiarities are a decisive factor enhancing plant diversity. On a territory of about 30 000 km<sup>2</sup>. Armenian flora comprises about 3,600 species of vascular plants, which makes about half of entire Caucasian flora.

Having been one of the centers of cultivated plants origin, Armenia is famous for the indigenous diversity of numerous species of cereals, vegetables, in particular cucurbits, oil-bearing plants and fruit crops. According to paleontological studies, wheat, barley, rye, oat, pea, melon, water-melon, apricot, grapes, pomegranate, quince have been cultivated in Armenia since the most ancient times. Plant genetic resources for food and agriculture are represented in the Republic by different plant species of economic value, crop wild relatives, old local varieties and wild edible plants. PGRFA are an essential source of variation in plant breeding, contribute to economical growth and food security and are part of our national heritage and sovereignty. At the same time PGRFA play a great role in maintaining environmental balance.

Lack of awareness, increased human impact, increased pests and diseases virulence, climate changes and environmental disasters are the main factors that seriously threaten our PGRFA and their diversity. The effective conservation of our agrobiodiversity and its sustainable use must be a priority for Armenia as it intends to reinforce its economic power through sustainable agricultural development.

The role of PGRFA, their conservation and sustainable use is nowadays getting increasingly importance across the world as they are one of the most essential components in agricultural and environmental protection policies.

### 1.2. Diversity Within and Between Crops

#### 1.2.1. The State of Diversity of Major Crops

Agrobiodiversity of Armenia ranges from cereal crops to grain legumes, fodder crops, vegetable-melon and oil-bearing groups. The *Poaceae* L., one of the most important taxonomic families for human food security, is represented in the country by 106 genera and 336 species.

**Cereals** group includes:

- ♦ 13 species and about 360 varieties of wheat. Wild one-grain, urartu and wild two-grain species, growing in Armenia, are 3 out of the 4 world famous wild wheat species which are characterized by the large intra-specific diversity (more than 110 varieties)
- ♦ *Aegilops* genus – presented by 9 species and a large intra-specific diversity
- ♦ rye (*Secale*)– presented by cultivated, field-weed and wild annual and wild biennial species
- ♦ barley (*Hordeum*) – presented by 8 wild species with high intra-specific diversity and by two-row, intermediate and multirow cultivated species
- ♦ oat (*Avena*) – 7 species are registered; it is not widely spread and cultivated in separate peasant farms
- ♦ millet (*Panicum*) – 2 species are found in the wild. It is not cultivated in large scale
- ♦ sorghum (*Sorghum*) – 2 species are registered, cultivated in separate peasant farms
- ♦ maize (*Zea maize*) – local and imported bred varieties, are cultivated

In the conditions of the Republic of Armenia, taking also into account the country's economic blockade, cereal crops (wheat, barley, emmer wheat) are of strategic importance as a primary source for food security. Because of this they represent a dominant crop in agricultural production systems of the country. Among cereal crops, winter wheat is the most widespread, as it ensures

higher and more sustainable yield compared to other crops of this group (spring wheat, winter and spring barley, emmer wheat).

**Grain legumes** are represented by lentil, wild species of chick-pea and pea.

**Fodder crops** are represented by numerous species, ecotypes and forms from the *Poaceae* and *Fabaceae* families. About 346 plant species of the *Fabaceae* family are reported in Armenia, among them meadow (*Lathyrus*) – 23 species, alfalfa (*Medicago*) – 14 species, sainfoin (*Onobrychis*) – 24 species, etc. Mainly indigenous species and forms are cultivated.

**Vegetable-melons** in Armenian flora are represented by numerous species of the *Solanaceae*, *Brassicaceae*, *Liliaceae*, *Chenopodiaceae*, *Cucurbitaceae*, *Apiaceae*, *Asteraceae*, *Portulacaceae*, *Lamiaceae*, *Malvaceae* families.

As per country needs, priority vegetable plants includes tomato, cabbage, cucumbers, bulb onion, egg-plant, pepper. They make 61, 9% of all vegetable plants grown in the country. Besides these, beet, carrot, garlic, vegetable marrow and green pea are also cultivated.

Vegetable crops are grown in almost all regions and their cultivation areas are distributed according to an altitude gradient. Thus, tomato, pepper, cucumber, egg-plant, early-ripening cabbage, cauliflower are mostly cultivated in lower zones, while cabbage, partly carrot, beet and reddish are cultivated in mountainous zones. Melons, water-melon, squash and marrow are mainly cultivated in the Ararat valley.

Widely distributed vegetable-melon crops such as beet, carrot, melon, onion, garlic, egg plant, asparagus, wild horse radish, artichoke, leavy vegetables (prickly lettuce, spinach), spicy plants (coriander, parsley, hoary cress, basil, wild mustard, bladdery, mint, etc.) are represented by different species, forms and ecotypes of their wild relatives.

**Oil-bearing plants** are presented of cultivated and wild flax, glabrpus fals flax, hemp, oriental poppy and many other species, ecotypes and forms.

**Fruits and berries** have wild spread in Armenian flora. Cultivated crops primarily belong to Rosacea family: pear (*Pyrus*) – 32 species, 12 of them are Armenian endemic plants; almond (*Amygdalus*) – 2 species, apple (*Malus*) – 1 specie, medlar (*Mespilus*) – 1 species, plums (*Prunus*) – 17 species, hawthorn (*Sorbus*) – 15 species. Besides, Armenian flora comprises pomegranate (*Punica granatum*), fig (*Ficus carica*), currant (*Ribes*) – 5 species, goose berries (*Grossularia reclinata*), date plum (*Diospyros lotus*), dogwood (*Cornus mas*), Elaeagnus (*Elaeagnus*) – 2 species, mulberry (*Morus*) – 2 species, grape (*Vitis sylvestris*) and others.

Nut bearing trees cultivated in the Republic include walnut (*Juglans regia*), hazel (*Corylus avellana*, *C. colurna*) and chestnut (*Castanea sativa*). People uses also the fruits of beech (*Fagus orientalis*). Wild species of almond (*Amygdalus nairica*, *A. fenzliana*, *A. urartu*) and pistachio (*Pistacia mutica*) are also grown in the country.

Fruit-trees growing is an old and profitable practice of the country's agriculture. Soil-climatic diversity conditioned by the orography of the territory creates a favorable environment for multiple fruit spices cultivation – apricot, peach, plum, cherry, sweet cherry, apple, pear, quince, walnut, almond, pomegranate, figs and in recent years – eastern date plum and kiwi.

### **1.2.2. Diversity of Minor Crops and Underutilized Species**

As crop diversity in Armenia is very wide, some species are used on a limited scale. These include plants of local/community and traditional significance, such as medlar and holly among the fruit species, rhubarb out of vegetables, some condiments and fodder crops.

### **1.2.3. Wild Crop Relatives and Wild Plans for Food Production**

Agrobiodiversity in Armenia is notable for a diversity of economically valuable species, which can be divided into the following groups, according to their importance in terms of use:

- Edible plants are presented by more than 200 species and 10 species of mushrooms.

- Forage – more than 2000 species
- Medicinal plants make more than 10% of the entire flora
- Melliferous plants – about 350 species
- Volatile-oil-bearing plants – 120 species
- Vitamin plants – 30 species
- Resin plants – 60 species, etc.

Due to abundance of wild relatives of cultivated plants the territory of republic was defined by N.I.Vavilov as center of cultivated plants diversity. At present territory of country is considered as Western Asia center of cultivated plants origin (soft and durum wheat, pea, lentil, grape). High concentration of wild progenitors of cultivated plants represents very rich gene pool for creation new crop varieties resistant to diseases, drought, cold and possessing other adaptive characteristics.

A very high inter- and intra-specific diversity of wheat can be observed in the Western Asian center of genetic diversity. Three out of four wild *Triticum* species occur in Armenia. These are *Triticum boeoticum* Boiss., *T. urartu* Thum. ex Gandil. and *T. araraticum* Jakubz. The diploid self-pollinated wild wheat *T. urartu* has genomic similarities with the tetraploid hard wheat *T. turgidum* and the hexaploid bread wheat *T. aestivum* is identified as the closest diploid sources of the A genome of these polyploid wheat. This wild wheat species is growing on tertiary red clays and on basalts at altitudes of 1300-1400 m above sea level as a component of the semi-arid, herbaceous vegetation. Wild einkorn wheat *T. boeoticum* due to the fully inter-fertility and homology of its chromosomes is considered the direct progenitor of *T. monococcum*. This species is often met in mixed populations with other wild wheat (*T. urartu*, *T. araraticum*) and several species of *Aegilops*. *T.araraticum* a tetraploid self-pollinated wild wheat grown in semi-desert and mountain steppe conditions has been identified as the progenitor of cultivated *T. timofeevii* Zhuk. wheat. Along with other wild wheat species it is protected in the Erebuni state reserve (Gabrielian and Zohary, 2004).

Nine *Aegilops* species with wide interspecific diversity have been found in the Republic. The great breeding interest to *A. tauschii* Cosson (*A. squarrosa* L.) is due to the fact that this annual diploid self-pollinated species is the donor of D genome of modern hexaploid wheat. *A. tauschii* is widely distributed in the Republic. It can be found in semi-desert and steppe environment at an altitude ranging from 700 to 1300 m above sea level. Eight other species of goatgrass (*A. // ujube// // cal* Host, *A. triuncialis* L., *A. triaristata* Willd., *A. crassa* Boiss, *A. biuncialis* Vis., *A. columnaris* Zhuk., *A. mutica* (Boiss.) Eig. /*Amblyopyrum muticum* Boiss./, *A. umbellulata* Zhuk.) can be considered as a rich reservoir of genes for drought-resistance, poor soil tolerance, as well as pest and disease resistance.

As for other cereals, two species of wild rye: annual *Secale vavilovii* Grosch. and perennial *S. montanum* Guss. (36 varieties of which have been identified) and eight species of wild barley have been found. Wild two-rowed *H. spontaneum* C.Koch and *H. bulbosum* L. are of special interest for breeding.

Numerous indigenous forms of cultivated legumes have been also identified, as well as wild forms, such as:

- lentil species – annual diploid wild lentil *Lens orientalis* (Boiss.) Hand., which is closely related to the lentil crop species, and *L. ervoides* Grande. a rare and distant form of the crop lentil species
- two widely distributed wild forms of pea *Pisum sativum* L. – *P. elatius* M. Bieb. [= *P. sativum* L. subsp. *elatius* (M. Bieb.) Aschers.& Graebn.] and *P. sativum* L. subsp. *humile* (Holmb.) Greut., Matthäs & Risse [= *P.sativum* L. subsp *siriacum* Berger], and one more distant from crop alpine perennial pea *Vavilovia formosa* (Stev.) Fed., which is rare and insufficiently studied
- wild forms of bitter vetch *Vicia ervilia* (L.) Willd. widely distributed in Armenia at altitude ranging from 1300 to 2000 m

- two species of liquorices – widely distributed *Glycyrrhiza glabra* L. which occupies mainly swampy, sometimes saline areas, and *G. echinata* L. a comparatively rare species

Armenia is also a primary and secondary center of origin for many vegetable plants. 280 vegetable species are reported on the territory of the Republic. These include beet (widely distributed wild and weedy forms of *Beta vulgaris* subsp. *maritima* (L.) Arcang [= *B. perennis* (L.) Freyn.], diploid *B. lomatogona* Fisch. et C.A.Mey and *B. macrorrhiza* Steven, tetraploid wild species *B. corolliflora* Zoss. ex Battler), carrot, purslane, watermelon, melon, species of lettuce, asparagus and sorrel.

Some wild species of oil-bearing plants occur in Armenia, including:

- different wild and weedy forms of flax (*Linum* L.) usually referred to as *L. bienne* Mill.[= *L.usitatissimum* L. subsp. *angustifolium* (Huds) Thell.]
- wild and weedy forms of hemp (*Cannabis sativa* L.) identified for eight floristic regions within bounds of 700 -2000 m above sea level
- locally grown in few places wild and weedy forms of gold of pleasure (*Camelina sativa* L.),
- weedy forms of turnip (*Brassica rapa* L. [= *B. campestris* L.]
- species of safflower: growing in five floristic regions and infesting crop sowings *Carthamus oxyacanthus* M. Bieb., *C. gypsicola* Iljin occupying clays rich in gypsum, as well as saline places and dry stony slopes, and *C. lanatus* L. sbs. *turkestanicus* M.Pop.
- wild-growing weedy rape forms (*Brassica napus* L.) etc.

Eighteen species of condiments are distributed in Armenia. Most of them are used as aromatic leaves or seeds (caraway, summer savory, tarragon, sumac, brown mustard, hop, coriander), as well as for medicinal purposes (thymus, mints, lemon balm) or extraction of essential oils (oregano, wormwood).

Western Asia is the native land of fruit species such as grape, pear, cherry plum, sweet cherry, pomegranate, walnut, almond and fig. Species of *Pyrus* with remarkable diversity and variety of forms constitute mixed pear-groves on the territory of Armenia. Wild species of pears present in their gene pool drought and cold resistance and poor soil tolerance; they can be useful in pre-breeding and breeding activities as parental materials for hybridization and as matrix for grafting. The genus *Sorbus* is represented by about 13 polymorphic species with a great diversity of forms. A special emphasis should be given also to the genus *Crataegus* with its extremely polymorphic species with breeding, ornamental and medicinal importance.

The list of the most important, from the economical and conservation points of view, crop wild relatives of Armenia is presented in *Annex 1*.

### **1.3. Diversity of Modern Selection Varieties**

The country's diversity in soil and climatic conditions provides for the cultivation of a large amount of different crops. Both full-scale and adaptive breeding activities are carried out in the Republic. At present both foreign and local breeding varieties, as well as a limited number of old traditional varieties are cultivated in the country.

The list of crops and the number of registered varieties included in the official register (2008) by the "Seed Agency", which is responsible in the Republic for variety testing and releasing, is presented in *Table 1*.

Table 1.

## List of the main crop species and number of registered varieties

Crop name	Number of registered varieties		Crop name	Number of registered varieties	
	total	in last 10 years (1998-2008)		total	in last 10 years (1998-2008)
Wheat ( <i>winter, spring soft wheat</i> )	23	15	Potato	42	41
Rye ( <i>winter</i> )	1	1	Tomato	31	24
Emmer wheat	3	1	Pepper	10	8
Triticale	1	-	Cucumber	7	5
Barley ( <i>winter and spring</i> )	14	7	Egg-plant	7	5
Maize	5	3	Marrow	1	-
Sorghum	1	-	Onion	2	-
Pea	3	-	Cabbage	3	2
Lentil	2	-	Cauliflower	1	-
Haricot	7	5	Beet	2	-
Soybean	2	2	Water-melon	5	4
Chick pea	5	4	Melon	3	2
Vetch	2	-	Pumpkin	3	1
Clover	3	-	Patison	1	-
Alfalfa	5	2	Okra	1	-
Sainfoin	3	1	Radish	3	-
Couch-grass	1	-	Sugar beet	3	2
Timothy	1	-	Pear	9	-
Cocksfoot	1	-	Apple	12	-
Fescue	1	-	Apricot	7	5
Fodder beet	2	1	Quince	6	1
Ground nut	1	-	Plum	7	-
Tobacco	5	1	Cherry	2	-
Parsley	1	-	Peach	17	2
Lettuce	1	-	Grape ( <i>table, technical, universal</i> )	71	17
Spinach	1	-	Pomegranate	2	-
Geranium	2	-	Fig	2	-
Flax	2	-	Kaki	2	-
Olive	2	-	Sweet cherry	4	-
Lemon	1	-	Raspberry	2	-
Almond	2	-	Strawberry	3	-
Cherry-plum	5	-	Currant	2	-

Besides registered varieties there is a number of introduced varieties of crops which are cultivated, but not officially registered. Their exact number is unknown.

#### 1.4. Diversity of local varieties

More than 20 local varieties of wheat were cultivated in Armenia before 1950. At present only 2-3 local varieties of wheat are still in production, the others, due to their low productivity, have disappeared from the farmers' fields. Local varieties of wheat are characterized by a number of important traits, which makes them valuable as parental breeding material. For example, local varieties such as "Spitakahat", "Galgalos", "Deghnazard", "Tavtukhi" are known for their draught-resistance; "Deghnazarda", "Gmani" for their resistance to fungus related diseases; "Giulgan", "Alti-aghaj" for cold resistance, etc.. Unfortunately, the majority of local varieties is on the edge of extinction. They are almost not preserved in seed collections.

“Nutans”, a local variety of barley still cultivated, presents characteristics of drought resistance and adaptability to poor soil conditions.

Among perennial fodder crops (*Fabaceae*) the following varieties are widely distributed: “Aparan local”, a variety-population of alfalfa, “Sisian local”, a variety-population of sainfoin, “Stepanavan local”, a variety-population of clover.

Only a limited amount of traditional varieties of vegetable crops such as cucumber, pepper, egg-plant, haricot, asparagus, cabbage, carrot, bulb onion and melon is cultivated, while almost all spicy and leafy vegetables are still of local origin.

Armenian uplands, being areas of origin for many crops, are famous for fruit specific and varietal diversity. Some local varieties of apple (40), pear (15), apricot (15), peach (8) and of cherry have been preserved in a few separate farms.

### ***1.5. Factors influencing the State of the Plant Genetic Diversity***

Factors influencing the state of the plant genetic resources in the country are directly or indirectly conditioned by the human impact upon agrobiodiversity:

- natural population of wild crop relatives and plant communities are decreasing because of anthropogenic influence, environment deterioration and climatic changes
- genetic erosion, due to the introduction of new varieties resulting from modern breeding programmes and/or illegal import of plant species and hybrids. It is necessary to note that a great deal of introduced varieties not adapted to local agro-ecological conditions, result unfit for cultivation and contribute to spreading crop diseases
- over exploitation of useful plant populations, pastures and grasslands
- untimely and unsustainable harvesting of wild edible plants, which significantly affects their natural regeneration

## CHAPTER 2.

### THE STATE OF *IN SITU* MANAGEMENT

#### 2.1. PGRFA conservation in protected wild areas

*In situ* conservation of plant genetic resources in Armenia is undertaken both in nature specially protected areas (NSPA), where about 60% of existing flora and fauna species can be found, and outside these protected areas – mostly in state owned land plots.

##### ▪ **History and classification of NSPA**

The establishment of the current network of NSPA started in 1958 after the creation of the state reserves “Khosrov Forest” (former “Khosrov”), “Dilijan” (which became a national park in 2001) and “Shikahogh”. During the same period, growing areas of yew, datura, plane, Greece nut, pear, apple, juniper and dogwood wild fruit species, as well as the forest farms Martuni, Gyulakarak, Jermuk and Her-Her were declared as state protected areas. Up to 2007, other state protected areas were also created (Annex 1), with different aims of *preservation* of biodiversity.

In Armenia NSPAs are classified according to their:

- importance as international, national and local NSPAs; and
- statute – state reserves, national parks, state protected areas and nature monuments.

Currently the network of NSPAs in Armenia includes:

- 3 state reserves (“Khosrov Forest”, “Shikahogh” and “Erebuni”) which correspond to IUCN “Ia” category
- 2 national parks (“Sevan” and “Dilijan”) which correspond to IUCN II category, and are divided into reserve, specially protected area, recreational and economical zones
- 230 nature monuments of IUCN III category
- 25 sanctuaries (nature reserves) correspond to IUCN IV category.

#### 2.1.2. State reserves

The “**Khosrov Forest**” was officially declared a state reserve in 1958. “Khosrov Forest” was established in 330 AD by the Armenian King Khosrov II, as reported by the V century Armenian historian Movzez Khorenatzi.

Currently the territory of the reserve occupies 29,196 ha with 16% of forest coverage. Clearings, brush woods, bushes and open forests occupy about 20% of the territory. Different types of mountain xerophytes plant communities are found on the other 64% of the territory.

An open forest of juniper and oak, pears, mountain xerophytes, mountain steppe and semi desert formations with prevailing wormwood (*Artemisia fragrans Willd.*) is preserved here, –together with some wild crop relatives, fruits such as wild pear, apple, plum, cherry, mountain ash, hawthorn, almond (*Amygdalus fenzliana*), peanut (*Pistacia mutica*) and cereals – Vavilov rye, etc.

Eleven endemic plant species grow on the territory of the reserve (*Allium schchianae*, *Centaurea arpensis*, *Campanula bayerniana ssp. choziatowskyi*, *Cephalaria armeniaca*, *Astragalus holophyllus*, *Cotoneaster armenus*, *Pyrus elata*, *P.chosrovica*, *P.tamamschianae*, *P.sosnovskyi*, *Rosa zangezura*).

The “**Shikahogh**” **state reserve**, also established in 1958, is located in the basin of Tzav and Shikahogh rivers and occupies about 12,137 hectares.

The unique naturally forest (Mtnadzor gorge) is situated here. The primary targets for conservation here are oak, hornbeam and oak- hornbeam forests, as well as rare plant communities, such as yew grove (*Taxus baccata*), the only small beech grove found in the south of Armenia, and a plane grove (*Platanus orientalis*).

**“Erebuni” state reserve** was created in 1981 with the aim of preserving wild cereals, including more than 100 varieties of wild wheat and their habitat. The reserve is located in the south-western part of Yerevan at the altitude of 1300-1400 m above sea level on the transition between semi-desert and mountain-steppe zones, covering 89 ha territory.

Despite the reserve is relatively small, its flora includes 292 higher flowering species of 196 different genera belonging to 46 botanical families. Among them the number of wild crop relatives is 39. 93,2% (272 species) of the reserve flora are grasses, 146 species of which (53, 7%) are annuals and biennial plants.

Three out of four species of wild-growing wheat known in the world occur in the reserve: wild one-grain wheat (*Triticum boeoticum* Boiss.), wild Urartu wheat (*T. urartu* Thum. ex Gandil.) and wild two-grain Ararat wheat (*T. araraticum* Jakubz). Among wild cereals, seven species of wild barley (*Hordeum spontaneum* C. Koch., *H. bulbosum* L., *H. glaucum* Steud., *H. murinum* L., *H. maritimum* Huds., *H. geniculatum* All., *H. hrasdanicum* Gandil.), two species of wild rye (*Secale vavilovii* Grossh., *S. montanum* Coss.), several species of aegilops (*Aegilops tauschii* Cosson., *A. cylindrica* Host., *A. triuncialis* L., *A. columnaris* Zhuk., *A. trivialis* Zhuk., *A. mutica* Boiss) grow in the reserve. Almond trees (*Amygdalus fenzliana*), planted before it was declared a reserve in 1981, can also be found.

The plant species included in the Red Data Book also grow on the territory of the reserve including *A.crassa*, *S. vavilovii*, *H. spontaneum*, *T. araraticum*, *T. boeoticum*, *T. urartu*, *Gladiolus atroviolaceus*, *Actinolema macrolema*, *Iris elegantissima*, *Merendera trigyna*, and others..

**“Dilijan” National Park** was organized in 2002 within the boundaries of “Dilijan” National Reserve and the nearby territories.

The Park is situated in the northern part of the country. Its territory of 22,765ha, spreads onto Pambak, Aregun, Miapor, Ijevan and Halab areas. The protected areas is 11,063ha. Wild fruits such as Caucasian pear (*Pyrus caucasica*), Eastern apple (*Malus orientalis*), plum (*Prunus divaricata*), blackthorn (*P.spinosa*), nut (*Juglans regia*), common hazelnut (*Corylus avellana*), dogwood (*Cornus mas*), different species of hawthorn (*Crataegus*), medlar (*Mespilus germanica*), bird cherry tree (*Padus*), etc. are conserved here. The place abounds in a diversity of berries – currant (*Ribes*), blackberry (*Rubus caesius*), raspberry (*R.idaeus*), gooseberry (*Grossularia*), etc.

The flora of the national park and its protected zone comprises 1,200 species of vascular plants, of which 977 species grow in the park zone. 51 of them are trees, 47 bushes, 696 perennial grasses, 176 annual and biennial plants, 7 parasites. Five of these species, namely *Bupleurum kozopoljanskyi*, *Rosa sosnovskyana*, *Linaria zangezura*, *Scrophularia olgae*, *Merendera mirzoevae* are endemic of Armenia. 54 species of the national park are medicinal and 41 edible plants.

**“Sevan” National Park**, created in 1978, is situated in the central part of Armenia. The park occupies a territory of 147,343 ha including the lake surface, and 22,585ha without it. The territory of the protected zone is 342,920ha.

The exclusive endemic animal and plant communities of Lake Sevan’s basin are the main targets of protection. The Artanish Peninsula is the largest terrestrial part of “Sevan” National Park with a territory of 2,500 ha. It has rich plant diversity and is covered with artificially planted forests which house pine, poplar, apricot, oleaster, sea-buckthorn as well as other tree and bush communities. 1145 species of vascular plants grow in the park zone, 4 of which are endemic species of Armenia (*Cousinia fedorovii*, *Astragalus coelestis*, *Acantholimon gabrielliana* and *Tragopogon segetus*).

100 species of edible plants are spread in “Sevan” national park and its protected zones (*Chaerophyllum bulbosum*, *Falcaria vulgaris*, *Hippomarathrum microcarpum*, *Asparagus officinalis*, *A. verticillatus*, *Hippophae rhamnoides*, *Thymus kotschyanus*, *Rumex scutatus*, *Rosa sp.* – 10 species, *Sorbus aucuparia*, *Crataegus meyeri*, *C. orientalis*, *C. pseudoheterophylla*, etc.).

**2.1.3. Sanctuaries and nature monuments** (Annex 2.) have been established to conserve biodiversity and natural ecosystems and keep ecological balance.

Nature monuments are the nature objects of specific scientific, historical-cultural, aesthetic importance. The list of natural monuments includes the «Tandzut» nature monument, which is the habitat of *Pyrus syriaca* and *P. caucasica* species.

#### **2.1.4. NSPAs and Ecosystem Management**

The authority of NSPAs management in the RA according to the RA “Law on Specially Protected Nature Areas” (2006) is imposed upon the Ministry of Nature Protection, at present some protected areas operate under the supervision of other Ministries:

1. Reserves, national parks and 8 sanctuaries (Plane Grove, Akhnabat Yew Grove, Gilan, Khor-Virap, Goravan Sands, Ghihae open forest, Sev Lich and Vortan Karmir) are subject to the Ministry of Nature Protection of RA.

The above-mentioned NSPA’s activities, including conservation of wild crop relatives, scientific researches, monitoring and utilization are brought into effect in:

- “Khosrov Forest” reserve, “Khor-Virap” and “Goravan Sands”– by “Khosrov Forest” state reserve NSCO;
  - “Sevan” National Park and “Ghihae open forest” sanctuary by “Sevan National Park” NSCO;
  - “Dilijan” National Park and “Akhnabat Yew Grove” sanctuay by “Dilijan National Park” NSCO;
  - “Erebuni” state reserve, “Sev lich” and “Vortan Karmir” sanctuaries by “Reserve-Park complex” NSCO
2. “Aragatz Alpine” sanctuary operates under the supervision of the Institute of Physics within the Ministry of Economy.
3. 2 of the sanctuaries, namely, Hankavan (hydrological), and Jermuk (hydrological) are beyond the administrative authorities of administrative division communities. They are located in state owned territories though within the region boundaries so the question of their subjection still remains open.
4. The other 14 sanctuaries operate within structure of “Hayantar” (Armenia Forests) NCSO which depends from the Ministry of Agriculture. They are included in forestry branches – forest farms as forest units.

The Bioresources Management Agency was established within the Ministry of Nature Protection in 2002 (Government Decree No. 1236-N, August 8, 2002). “Sevan” and “Dilijan” National Parks, “Khosrov Forest”, “Erebuni”, “Shikahogh” reserves, “Vortan Karmir”, “Sev Lich”, “Akhnabat Yew Grove”, “Ghihae open forest” and “Pine Grove” sanctuaries are under the authority of the Agency since then. The Agency also maintains the activities on the support management of protected areas both in-situ and ex-situ («Jrvej» forest park, “Sochut” in Stepanavan, “Soranner” in Vanadzor and Berd, Ijevan dendroparks) with the help of appropriate regulatory divisions of NSPA and dendroparks management.

Scientific research and monitoring carried out by the staff of divisions of the above-mentioned NCSOs promote the management of the CWR population.

#### **2.1.5. In Situ Management of PGRFA outside of NSPA**

*In situ* management of PGRFA outside of NSPA is carried out mainly in forests and natural land types (pastures and grasslands), under the Law of RA and other outcoming regulatory acts.

Apart from the regulations directly related to the preservation of the biodiversity there is a number of other regulations addressing natural resources. There are provisions targeted on prevention of negative impact of natural resources utilization on biodiversity in general and plant genetic

resources in particular (Land Code of RA /2002/, Entrails Code of RA /2002/ Water Code of RA /2002/) or on compensation of the caused damage (Criminal Code of RA, RA Administrative Violations Code /1985/, “Law on Amendments in the Administrative Violations Code of the Republic of Armenia” (2002), Criminal Code of RA /2003/)

## **2.2. In-situ related projects (Inventories, Surveys and Research)**

### **2.2.1. Research projects, surveys, management plans**

At present activities targeting biodiversity conservation and sustainable utilization are fully introduced in a number of strategic documents approved by the Government.

Biodiversity conservation in NSPAs, including a number of measures on CWR inventory and research is envisaged by NSPAs management plans and/or by mid-term and annual programmes of SNCOs implementing conservation and utilization activities. Systematic inventories of PGRFA have failed to be carried out due to the shortage of financial resources, absence of proper coordination, failure of application of monitoring indicators and proper methodology. This has brought about some difficulties in strategically planning their conservation and sustainable utilization. A number of research activities and surveys have been carried out by different institutions in Armenia:

- accessions collections organized within frames of appropriate scientific themes, field explorations, including joint collection missions by scientific personnel of the Institute of Botany of NAS, Armenian State Agrarian University and recently involved Scientific Center of Agrobiotechnology
- an inventory of species found in the «Sevan», «Dilijan» and «Khosrov Forest» National Parks has been worked out in the framework of the state reserve management plans of the above-mentioned sites
- a number of activities targeted on conservation, reproduction, research, monitoring, sustainable use, awareness raising, establishment of national and international information system of 99 CWR taxa are envisaged by the work plan of UNEP/GEF “*In situ* conservation of crop wild relatives through enhanced information management and field application” project coordinated by Bioversity International
- an inventory of wild edible and spice vegetable species (240 species) has been published in the framework of the project «Development of a full project for *in situ* conservation and sustainable use of agrobiodiversity in Armenia».

The research priorities of PGRFA are defined based on the scientific institutions mandate and the objectives of the implementing research projects. The conservation priorities are mainly based on the available data on growth areas and the status of a given species resulting from the research work.

### **2.2.2. Participatory Management**

The project on “Development of Sevan” and “Dilijan” national parks’ participatory management plan” is implemented within the framework of the component “Management of protected areas and biodiversity conservation”. This is a part of the “Natural resources management and poverty reduction” project which targets poverty reduction through the development of mechanisms of sustainable management of natural resources and participatory management plans. The project on “Development of Sevan” and “Dilijan” national parks’ participatory management plan” has as a primary goal the conservation of plant biodiversity in these areas. Communities are directly involved in the activities related to the implementation of the management plans, taking into consideration their experience, traditions and knowledge.

Within the framework of component “Community-based management of watershed basins”, sustainable management methods to ensure the conservation of vegetation in high mountain sub alpine and alpine zones have been applied on 9,500ha of pastures in 59 communities from two marzes.

Representatives of local self governance bodies and communities are permanently involved in the program activities, which, in particular, include the introduction of sustainable agricultural practices, development of ecotourism, and of plans for the sustainable utilization of natural resources.

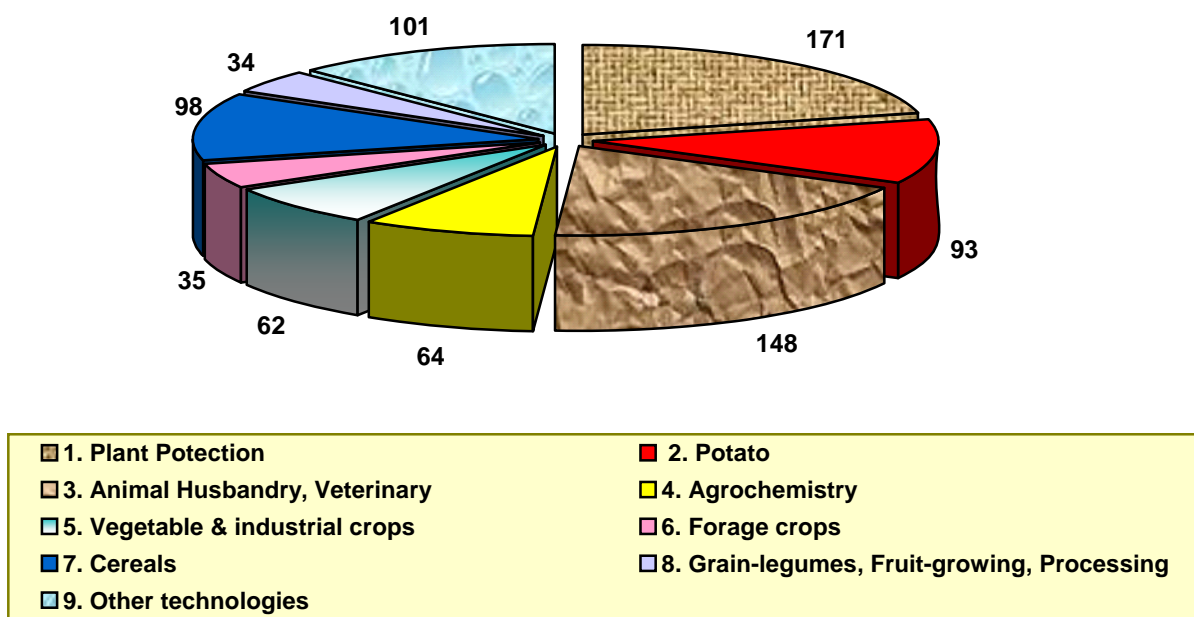
The development of forest management plans within the framework of the “State forest management” project (the third component of the “Natural resources management and poverty reduction” project) is carried out through a participatory process, which actively involves local communities. Meetings and trainings held are mainly focused on traditional methods of management of natural resources and analysis and exchange of experience.

### 2.3. On-farm management

On-farm management related activities are limited because of the lack of stakeholders’ awareness concerning on-farm conservation of agrobiodiversity.

The conservation of old traditional varieties of different crops as well as under-utilized and little-spread crops under the conditions of peasant farms is an essential process for the management of diversified agricultural production. The on-going «Agrarian technologies assessment» project aims to provide solutions to these problems. Project activities encourage the interlink between science and production, promote the development of agricultural production, expand the links between collections holders of genetic resources and users, help the development of national breeding and private seed production farms, and ensure extension of research programs.

The project is coordinated by the Agriculture Support Republic Center. 806 programs on introduction of agrarian technologies and 59 diverse demonstrated programs were undertaken within the framework of the “Agricultural Reforms Support Project” during 2001-2006, and, since 2005, of the Rural Enterprise and Small-Scale Commercial Agricultural Development Project. These projects were implemented in farms of all marzes of Armenia (*Diagram 4*).

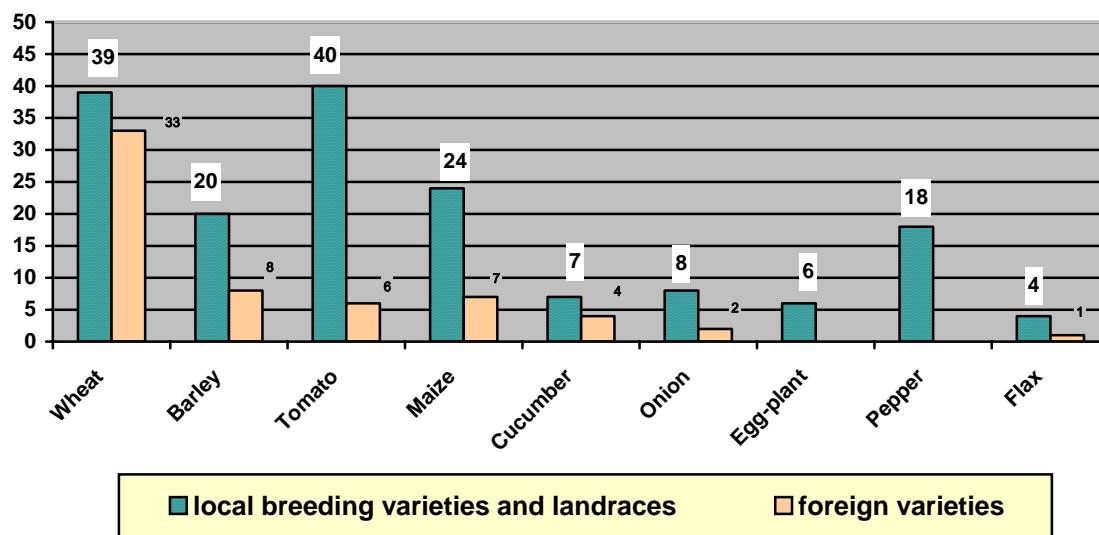


**Diagram 4.** Number of agrarian technologies introduced in farms in 2001-2006

Activities targeted at the realization of 41 programs on the assessment of agrarian technologies are in progress now. The agrarian technologies introduced in farms (*Diagram 4*) are mainly aimed at providing solutions to urgent problems in agriculture.

The conservation of plant genetic resources for food and agriculture is of utter significance for varieties improvement, development of new highly productive varieties. Consequently, work has also been directed towards these activities in the framework of the introduction strategy of new technologies.

40 and more crops have been investigated. New varieties of crops were introduced under different natural climatic conditions and ensured about 15% increase in yield. Local varieties demonstrated a sustainable yield under the impact of severe weather changes and extreme climatic factors. The technologies of high interest are presented in *Diagram 5* by crop varieties of local and foreign origin.



**Diagram 5.** Agrarian technologies introduced in farms in 2001-2007 by crops varieties of local and foreign origin

Field days, demonstrations, etc. were organized by the project to raise awareness and provide all necessary information to stakeholders, farmers interested in the adoption of tested crop varieties and cultivation technologies.

The implemented technologies contributed to enhance on farm conservation and effective use of a number of varieties from different crops (vegetable, industrial, cereals) of local and foreign origin.

#### **2.4. Restoring Agricultural Systems after Disasters**

The territory of RA is considered a high risk zone for agricultural production. Agriculture bears drastic losses from droughts, hailing, floods, early spring frosts and other natural disasters. On average, damages suffered by agriculture amount to 15-20 mln \$ US per year.

Different zones face natural disasters almost every year, which causes on average a 20-25% annual yield reduction.

With the aim to evaluate disaster caused damage and undertake some support actions to farms the Government of the Republic forms an Inter-ministerial Commission.

At present there are no formal mechanisms in place for restoring agricultural systems after disaster situations. In general after disaster situations, the Government and donor organizations provide different types of support, including provision of seed material or fertilizers, liberation from soil and irrigation taxes, etc.

However, natural disasters may affect not only farms, sown areas but also wild flora, wild edible plants and wild crop relatives. To restore them it is necessary to implement monitoring, to fill collection gaps, to undertake a series of propagation activities.

## **2.5. *In situ* conservation of Wild Crop Relatives and Wild Plants for Food Production**

CWR conservation in NSPA is guaranteed by the legislation of the RA in accordance with the defined conservation procedures. The inventory, registration and studies of wild crop relatives are envisaged by NSPA management plans and/or by state financed mid-term and annual programmes of the SNCOs implementing conservation and utilization activities.

The priorities of CWR and wild food plants conservation are mainly determined by the available data related to plant habitat and to the plant species status based on the research results. A number of provisions of strategies and national programs determine conservation and sustainable utilization of CWR as a component of biodiversity:

- “Food safety policy of the Republic of Armenia” chases an objective to ensure effective management and use of agriculture genetic diversity, especially fodder plants, as well as evaluation, monitoring and rehabilitation

- In terms of improvement of management of plant genetic resources, including CWR, the Agriculture Sustainable Development Strategy (2006) and list of activities for 2006-2015 annexed to it is of ultimate importance. The tasks that the Strategy is targeted on are as follows:

- improvement of land types (pastures) and watering programme implementation. The programme will facilitate the increase of yield capacity of natural pastures and net profit which will benefit poverty reduction
- support to conservation of wild crop relatives which is to be implemented in the following directions:
  - establishment of a gene bank of crops and their wild predecessors
  - improvement of pastures and grassland, watering of pastures
  - establishment of plantations and nurseries for the spices of economic value forest regeneration
  - forecast, prevention and development of comprehensive activities directed to mitigate the negative impact of natural disasters (draught, dry wind, spate, flood, soil salinization, etc.)
  - sustainable, well balanced utilization of natural resources.
  - conservation of crop wild relatives.

*In situ* conservation of CWR is mainly carried out in “Erebuni” state reserve, its management plan development is expected within the framework of the UNEP\GEF project on «*In situ* conservation of crop wild relatives through enhanced information management and field application».

## **2.6. *Improvement of In Situ Management, Priorities and Needs***

### **2.6.1. *Recent year achievements***

The «National Biodiversity Strategy and Action Plan» (NBSAP) were developed with the GEF support in 1999 where NSPA *in situ* management improvement got a particular attention. NBSAP strategic activities which were to be carried out in 2000-2004, started to be implemented in 2001, connected with the implementation of GEF/UNDP project on «Assessment of capacity building

needs for biodiversity of Armenia and establishment of CHM structure». In the framework of the above-mentioned-project the country's capacity in the field of conservation of biodiversity including genetic resources and the utilization of nature resources have been assessed.

The "Strategy for access to genetic resources and equitable benefit sharing" as well as the «Strategy on the development of Natural Specially Protected Areas in Armenia and Action Plan» (SNSPAAP) (2003-2010) has been developed. The latter was approved by the Governmental Decree in 2002. The following activities in the field of *in situ* conservation are envisaged in the SNSPAAP as priority actions:

- improvement of the system of nature specially protected areas management
- clarification of specially protected areas net
- training of the specially protected areas staff
- direct assistance to nature protecting activities in specially protected areas.
- expansion of the net of specially protected areas
- conservation and rehabilitation and of landscapes and ecosystems
- conservation and restoration of species and plant communities.

Similar activities directed at the improvement of *in situ* management are also included in SNSPAAP. At present the programs for the establishment of "Gnishik", "Jermuk", "Arevik" and "Arpi Lich" national parks, "Vorotan" and "Kirantz" sanctuaries as well as "Khor Virap" sanctuary have been developed by the Ministry of Nature Protection.

Activities on natural monuments inventory, registration and documentation, as well as development and validation of the list of natural monuments have been implemented.

The precise definition of the boundaries of "Shikahogh" state reserve and the size of "Plane Grove" state sanctuary were adopted by a Governmental Decree in 2006. With a contribution of World Bank and Global Environment Facility (GEF), the management plans of "Sevan" and "Dilijan" National Parks were developed under the "Natural Resources Management and Poverty Reduction" project and approved by the Government. Plant and animal studies, technical assistance, awareness raising and other actions have been carried out in "Sevan" and "Dilijan" national parks. The draft management plans of "Khosrov Forest" and "Shikahogh" state reserves have been developed with the state and WWF financial support.

At present the process of adoption of the reserves management plan by the Government is in progress. In the framework of this process the boundaries and the size of the occupied territory are to be fixed.

### **2.6.2. Needs and obstacles**

Despite the fact that numerous programs concerning *in situ* management improvement have been carried out for the last 10 years, there are still difficulties to face:

- very few activities related to public awareness and trainings have been implemented
- no systemized inventory and registration have been carried out during the last decades; though scientific potential is available in the country, the absence of technical and financial capabilities prevents the implementation of the necessary activities
- monitoring and analysis of the changes in the ecosystems, the study of the structural changes in vegetation haven't been thoroughly implemented. Structural changes in flora are particularly significant for the discovery of invasion by alien species
- the legal, administrative and other measures necessary for ensuring of country's biosafety are not in place
- the legal field for regulation of use of wild plants is not complete, the procedures of wild plant collection and storage are not in place
- as a result of financial shortage, activities envisaged by management plans fail to be successfully implemented and don't include precise activities aimed at sustainable utilization of CWR

- sanctuaries mainly don't have statutes to determine their preservation procedures. There are no separated organizations to ensure their conservation and utilization functions
- special programs developed for newly-created NSPA can't be implemented because of lack of financial resources.

The exact data concerning the boundaries of habitats, components of biodiversity of protected areas and composition of CWR species are not available yet. Actions on clarification of the protected area boundaries and its mapping have started since 2006 and are to be completed in 2008. At present boundaries for only four sanctuaries – “Plane Grove”, “Gilan” (118 ha), “Khor Virap” (53,28 ha) and “ Sands of Goravan” (95,99 ha) have been adopted by the Governmental Decrees.

### **2.6.3. Priorities for future**

In case the above mentioned problems get their solution, the following activities are suggested with the aim of *in situ* management improvement:

- CWR study (spreading, inventory, precise definition of habitats and mapping, store registration and evaluation) and monitoring implementation
- development of evaluation indices of human and natural impact on CWR
- inventory of alien plant species
- introduction of legal and administrative mechanisms for ensuring of biosafety
- technical assistance for on-working *in situ* management bodies; establishment of administrative bodies for protected areas management
- development of charters and management plans for all sanctuaries
- implementation of programmes on new NSPAs establishment
- development of instructions/guidelines for widely used natural resources
- working out of management plant for all forest farms
- development and implementation of awareness and educative programs concerning wild plant resources including woody forest material, and sustainable utilization of pastures and grass lands
- development and implementation of awareness and education programmes on agrobiodiversity on-farm conservation for peasant farms.

## CHAPTER 3.

### THE STATE OF THE *EX SITU* MANAGEMENT

#### 3.1. Sustaining and Expanding *Ex situ* Collections

##### 3.1.1. Main *ex situ* Collections

*Ex situ* conservation is an essential element of a successful strategy for agrobiodiversity conservation. It enables to preserve important plant genetic resources for food and agriculture, to protect them from threats that affect *in situ* conditions, to access them easily for in depth studies, improvement, multiplication and exchange.

About 11,676 accessions of the seed collections are conserved in seven scientific institutions operating within different Ministries (*Table 2.*). All necessary equipment and conditions for long and mid-term conservation of germplasm are available only at the Gene Bank of the Scientific Center of Agrobiotechnology of the Ministry of Agriculture.

The seed collections of the Armenian State Agrarian University, the Scientific Centers (SC) of the Ministry of Agriculture, namely SC Agrobiotechnology, SC of Vegetable and Industrial Crops, SC of Viticulture, Fruit-growing and Wine-making include mainly local varieties or landraces and locally bred varieties. The seed collections of the SC of Agriculture and Plant Protection and Gyumri breeding station of the MoA consist of breeding lines from the ICARDA and CIMMYT nurseries.

*Table 2.*  
*Number of accessions of seed collections stored at scientific institutions of Armenia*

Organization name	Conserved plants	Maintenance conditions	Number of accessions
1	2	3	4
Gene Bank of the Scientific Center of Agrobiotechnology of the MoA	Most common Armenian crops of high economic value and their crop wild relatives	- short-term: +4 °C, seed conservation in foil aluminium packets - long-term (-18 °C) – will soon be operational - in vitro	<b>2130</b>
Scientific Center of Agriculture and Plant Protection of the MoA	wheat, barley, chickpea, lentil, soybean, ground-nut	working collection are maintained under the room conditions in paper packets (temperature and humidity are not regulated)	<b>2071</b>
Scientific Center of Vegetable and Industrial Crops of the MoA	vegetable, melon crops and their wild relatives, industrial crops (soybean, flax, tobacco)	working collection are maintained under the room conditions in paper packets and cardboard boxes (temperature and humidity are not regulated)	<b>1491</b>
Laboratory of Plants Gene Pool and Breeding, Armenian State Agrarian University	cereals, vegetable crops, grain-legumes, and their wild relatives, forage	seed collection are maintained under the room conditions in paper packets and cardboard boxes (temperature and humidity are not regulated)	<b>4140</b>
SC of Viticulture, Fruit-growing and Wine-making of the MoA	wild grape, fruits	working collection are maintained under the room conditions in paper packets (temperature and humidity are not regulated)	<b>30</b>

1	2	3	4
Institute of Botany, Botanical Gardens of NAS	cereals, vegetables, grain-legumes, forage grasses	working collection are maintained under the room conditions in paper packets (temperature and humidity are not regulated)	<b>1048</b>
Gyumri Breeding Station of the MoA	wheat, barley, chick- pea	working collection are maintained under the room conditions in paper packets (temperature and humidity are not regulated)	<b>766</b>
<b>TOTAL</b>			<b>11 676</b>

### 3. 1.2. PGRFA Gene Bank

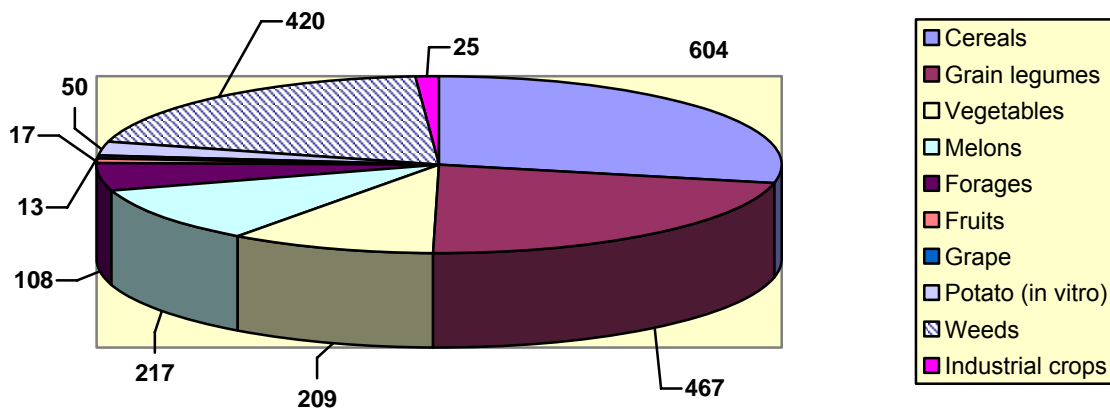
Paying particular attention to conservation of plant genetic resources for food and agriculture, the PGRFA Gene Bank was established in 2006 at the Scientific Center of Agrobiotechnology under the initiative and support of the Ministry of Agriculture. This seed storage is a unique facility in Armenia. ICARDA and USDA provided considerable material that contributed to the Gene Bank establishment.

The Gene Bank maintains agricultural crops of primary importance for the country and their wild relatives, paying particular attention to the crops of Armenian origin (*Diagram 6.*). At present seeds are conserved at +4°C conditions (refrigerator). Soon the seeds will be placed for long-term conservation under deep freezing conditions, which will supposedly conserve them for 50-100 years. The seeds are dried before conservation, reaching humidity of 5-6% and placed into vacuum-closed aluminum foil packets

Active and base collections are available in the Gene Bank. The active collection includes accessions used for breeding and distribution. The accessions of the base collection are not used or distributed, they just serve as a backup in case those in the active collection are lost.

*In-vitro* conservation plays an important role for the conservation and multiplication of vegetatively propagated species. 100 accessions of six crop species are conserved in the Gene Bank under *in-vitro* conditions.

Gene Bank activities include collecting and/or acquisition of plant species from scientific centers, farms, markets, international research centers, the wild, etc), documentation, plant health control, characterization, evaluation, conservation, regeneration, multiplication and distribution.



**Diagram 6.** National Genebank structure

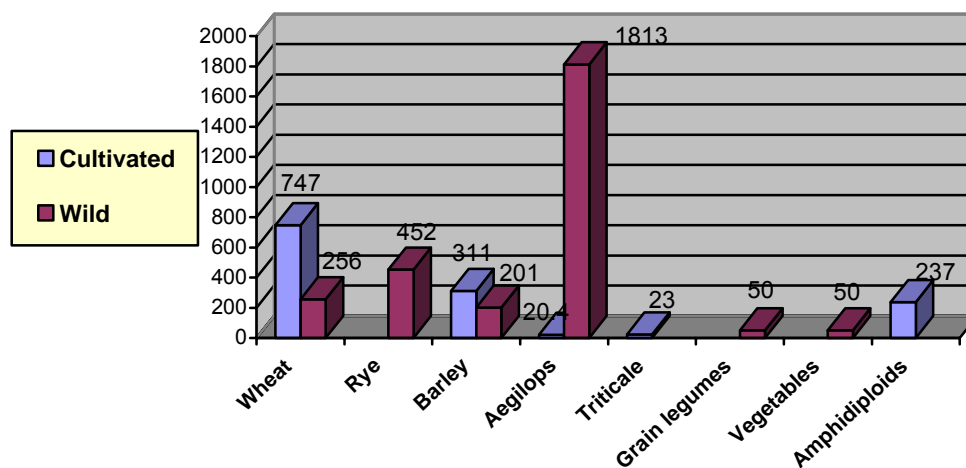
It is planned that accessions stored in all scientific institutions will be placed under long-term storage at the Genebank of the SC of Agrobiotechnology. About 1,000 accessions have already been provided to the Genebank from the different working collections. In addition, repatriation of germplasm originally collected in Armenia and stored at different foreign gene banks, *inter alia*, the N.I.Vavilov Institute of Plant Industry and ICARDA, is being pursued through bilateral agreements with these organizations in order to ensure a good *ex situ* coverage of the country diversity.

- **Safety Duplication**

At present there is not an ad hoc plan for the safety duplication of existing *ex situ* collection. However it should be noted that all the collection in the National Gene Bank is currently duplicated in the active collections of the different Scientific Centers and a large part of it is also been stored under long term conditions in foreign gene banks such as VIR in Russia, the Institute of Plant Production in Ukraine, the Research Institute of Crop Production in Czech Republic, Kansas State University of USA, ICARDA, World Vegetable Center, etc. In this regard, preliminary discussions with some foreign institutions (e.g. N.I.Vavilov Institute of Plant Industry, Center for Genetic Resources in Netherlands (CGN)) for the safety duplication of Armenian accessions are on-going.

- **Wild Crop Relatives Seed Collection**

The very first seed collection of wild crop relatives was established in 1981 by the initiative of prof. P.A.Ghandilyan in the Laboratory of Plant Gene Pool and Breeding of Armenian State Agrarian University (formerly Armenian Agricultural Institute). At present the laboratory maintains (under short-term conservation conditions seeds, spikes, spikelets) 4140 accessions of cultivated and wild wheat, barley, rye, aegilops, wild vegetable plants (beet, carrot, onion, etc.), leavy vegetables and grain legumes (vetchling, lentil, vetch, clover, alfalfa, etc.). (*Diagram 7.*)



**Diagram 7.** Seed collection of the Armenian State Agrarian University

### 3.1.3. Field Collections and Botanical Gardens

- **Field collections**

Field collections of PGRFA are available at the Nalbandyan Experimental Station of the SC of Viticulture, Fruit-growing and Wine-making, at the Eraskhaun Experimental Station of the SC of Soil, Agrochemistry and Melioration, Yerevan Botanical Gardens and private farms. Field collections established in research institutions and private farms comprise 342 accessions, out of which 268 accessions are maintained in research institutions (*Table 3.*)

Table 3.

## Number and size of existing living collections

Organization name	Crops	Accessions number		Occupied area (ha)
SC of Viticulture, Fruit-growing and Wine-making of the Ministry of Agriculture, Nalbandyan experimental farm	grape	70	133	15,0
	apricot	25		1,2
	peach	20		1,0
	pomegranate	18		0,5
SC of Soil, Melioration and Agrochemistry of the Ministry of Agriculture	grape	67	92	13,0
	fruits	25		5,6
Botanical Gardens of NAS	grape	18	43	1,5
	fruits	25		3,0
<b>Total</b>			<b>268</b>	<b>40.8</b>
<b>Demonstration and collection orchards established in private farms by the support of the state and donor organizations</b>				
Tavush Marz, Bagratashen Avan	peach		15	2,0
	apricot			0,5
Tavush Marz, Aygehovit community	fruits	40		1,5
Aragatsotn Marz, Oshakan community	peach	12		1,2
	apricot	7		0,5
<b>Total</b>			<b>74</b>	<b>5.7</b>

The grape collection of the SC of Viticulture, Fruit-growing and Wine-making embraces local breeding varieties; as for fruits (apricot, peach, pomegranate) the field collections include both local and foreign breeding varieties and clones. Grape varieties and clones of local origin prevail in the grape collection of the SC of Soil, Agrochemistry and Melioration.

- **Botanical Gardens**

Botanical gardens and dendroparks also contribute to plant genetic resource conservation and spreading by managing important living plant collections. These collections are grown in open air and greenhouses and are mainly used for demonstration and research purposes. Open air collections of trees, bushes and woody lianas and flowering plants were created taking into consideration taxonomic, geographical, ecological and decorative criteria.

Overall about 6,000 plant species are grown and conserved under ex-situ conditions in Botanical Gardens and dendroparks. 5,000 of them are held in the Yerevan Botanical Garden where, besides 1200 tree-bush and 2000 flower species growing in the open, about 1000 species of tropical and subtropical plants are conserved in greenhouses. The dendrarium of the Yerevan Botanical Garden of NAS established on eco-geographical criteria, with species from the Caucasus, the Crimea, Euro Siberia, Eastern Asia, the Far East and North America. Exceptional importance is also given to site of aboriginal flora in living conditions, which is introduced by 800 species.

A number of dendroparks also exist. These are distributed within different administrative and floristic regions of the Republic.

### 3.1.4. Documentation System of the Ex situ Collections

Overall the state of documentation of the existing *ex situ* collections is far from being satisfactory. Even though since their establishment, documentation activities have always been part of the standard management in scientific centers, the information on maintained accessions is presently still recorded mainly in registration books.

The works on creation of a centralized database for managing information on plant genetic resources was started with ICARDA's support in 2001. Now the Database of plant genetic resources, which keeps a national inventory of PGRFA for *ex situ* collections is maintained by at the Gene Bank of the Scientific Center of Agrobiotechnology. The Database is not accessible now for researchers and breeders because of absence of internet and intranet facilities in research institutions. The database is expected to be available for all stakeholders next year through designing and launching the Gene Bank web site.

The central Database includes passport information for 4976 accessions, and characterization and evaluation data for about 500 accessions of the *ex situ* collections of RA. Passport information is based on the FAO-IPGRI Multicrop Passport Descriptors List (2001)

Information of the Laboratory of Plant Gene Pool and Breeding of the Armenian State Agrarian University is managed through MS Access. Passport data of wheat accessions have been correlated according European Wheat Database format. PGRFA information of the Scientific Center of Vegetable and Industrial crops is kept under MS Excel program. All remaining scientific centers record accessions data in registration books only. *Ex situ* collections data are periodically uploaded into the EURISCO internet search catalogue.

### **3.1.5. Improvement and expansion of the *ex situ* conservation: needs and priorities**

Some anthropogenic factors, environment worsening and climatic changes put pressure on *in situ* and on farm plant genetic resources by narrowing their distributional range and population size.

Agriculture and breeding development results in the gradual marginalization and replacement of local crop varieties with new improved ones. This occurs because the new varieties are in general either more productive and/or suitable to modern cultivation techniques than the local ones, which nonetheless still represents an extremely valuable and in some cases indispensable source of characteristics of adaptability to local conditions, tolerance and/or resistance to biotic and abiotic factors. Under this scenario, the loss of these plant genetic resources would have disastrous effects on future progress and development of the country agricultural economy. The conservation of our plant diversity is therefore becoming one of the important components of the country's policy.

Activities of PGRFA *ex-situ* conservation including research studies have been implemented for years by relevant scientific institutions (SC of Agriculture and Plant Protection, SC of Vegetable and Industrial Crops, SC of Agrobiotechnology, SC of Viticulture, Fruit Growing and Wine-Making, SC of Soil Science, Agrochemistry and Melioration, Institute of Botany of NAS, Armenian State Agrarian University, Yerevan State University). These have addressed population dynamics, surveying and collecting, taxonomy, characterization, evaluation, breeding and conservation. Research activities and their results are reflected in various scientific publications, theses and proceedings of scientific conferences and meetings.

Financing of research has been made in accordance with priorities defined by the Agricultural sustainable development strategy, which focused on plant gene pool conservation, expansion of genebank of cultivated plants and their wild relatives, establishment of economically valuable species plantations and nurseries, and the sustainable use of natural resources. The primary objectives of the agricultural strategy in the field of horticulture development include the regeneration of fruit crops, local traditional and breeding varieties of grape, as well as the restoration of the collection of grape landraces.

Orchards and nurseries were established in 2000-2004 in state experimental and private farms with the aim of supporting and expanding fruit crops living collections (*Nalbandyan experimental farm of the SC of Viticulture, Fruit-growing and Wine-making – 1.5 ha with 10 varieties of peach and 0.3 ha with 5 apricot varieties, 0.8 ha grape living collection in private farm in Aygehovit community of Tavush Marz with 6*).

Evaluation activities of abiotic factors resistance in wild wheat and vegetable plant collections are presently being carried out.

The three year project on “Elaboration and introduction of the technologies of conservation, evaluation, characterization and documentation of autochthonic (local origin) plant genetic resources for food and agriculture in Armenia” has been approved by the Government in 2008. It aims at expanding available seed collections, enhancing opportunities for reliable conservation, providing relevant technical means to carry out research and study expeditions, exchange and conservation of genetic material.

- **Need and Priorities**

The following measures and activities are considered as essential to ensure reliable PGRFA conservation and the expansion of *ex situ* collections:

- to provide institutions holding *ex situ* collections with appropriate laboratory equipment and technical facilities including computers;
- to adequately train staff involved in *ex situ* conservation and data base management
- to ensure reliable internet connection to relevant institutions in order to facilitate communication and accessions related data exchange
- to enhance facilities for *in vitro* regeneration and maintenance of recalcitrant seeds
- to increase public awareness concerning PGRFA conservation and effective use; to involve interested farmers into accessions regeneration, characterization and evaluation activities
- to expand existing collections of traditional varieties of cultivated plants through regeneration activities, repatriation of accessions of Armenian origin from foreign gene banks, inventorying and sampling of landraces still cultivated in local farms, rehabilitation of old collections of grape and fruits and establishment of new ones
- to expand characterization and evaluation activities of *ex situ* collections in order to facilitate wider PGRFA utilization for breeding and variety improvement.

### **3.1.6. Genetic erosion of ex-situ collections**

The threat of erosion for *ex situ* collections increases as a result of low seed germination, small seed samples, untimely and inadequate regeneration practices (agro-ecological conditions, isolation of cross-pollinated plants, etc.).

The situation of *ex situ* collections of the country is alarming. Viability in most of the *ex situ* seed collections held by the scientific institutions of Armenia is either low or null. With the absence of a proper gene bank these collections have been maintained under room temperature and humidity for years and have not been timely regenerated due to limited financial and technical means.

A decrease in the number of PGR accessions is also observed in the field collections of the scientific centers of MoA. That's a result of insufficient care, negative impact of biotic and abiotic factors, land privatization, etc.

To meet these urgent needs, a number of projects addressing regeneration of endangered *ex situ* collections have recently been implemented. Mainly vegetable crop and vegetatively propagated plant collections, and, in part, cereal collections benefited from these projects. The implementation of project “Conservation and utilization in breeding of wild relatives of cereals in Armenia (2004-2006)” helped to regenerate 164 accessions of cereals. Regeneration of 1,080 valuable accessions of wheat, *aegilops* and barley is expected to be done with support from the Crop Diversity Trust within the submitted project proposal.

A coherent and adequately funded conservation policy that ensures necessary regeneration and preserves genetic integrity of existing collections must be timely implemented in order to halt further genetic erosion of important *ex situ* collections. Institutions and capacity building in this respect is urgently needed through the strengthening existing *ex situ* facilities and training of national staff in charge of them.

## **3.2. Planned & Targeted Collecting**

### **3.2.1. Collecting Activities over the Past 10 Years**

PGRFA collecting missions have been periodically carried out by the scientific staff of the Institute of Botany of NAS, Armenian State Agrarian University and, in recent years, SC of Agrotechnology of MoA within the framework of relevant scientific, international and regional collaborative programs. The inventory of the flora of Armenia (species composition and distribution in the country) is one of the main objectives of the Institute of Botany. During 1998-2008 a large number of valuable accessions of cultivated and wild plants (cereals, grain legumes, forage grasses, fruit, fruit-berries, grapes, industrial, forest, ornamental) was collected as a result of collecting missions and field explorations. 20 collection missions were organized during the last ten years, as a result approximately 2200 accessions of about 110 species were collected. Traditional varieties and wild crop relatives make out the greater part of the collected material.

Some collection missions were carried out with the support from international organizations and with the direct participation of researchers from Russia, Australia, Great Britain, USA, Syria, Slovenia, Japan, etc.

### **3.2.2. Research needs and priorities for planned and targeted collections**

Scientific institutions while arranging expeditions usually face some constraints to their work: insufficient financing, the lack of trained staff, appropriate means of transportation, equipment and technical tools. The extension of planned and targeted collections of genetic resources focuses on the field collections and joint collection missions within the framework of regional and international projects. That enables not only to make precise identification, but also to implement evaluation activities with joint efforts to ensure the usage of the accessions.

The planning of collecting activities on the basis of national catalogue data will contribute to effective use of technical and financial means. It will be possible after the data related to *ex situ* collections accessions have been loaded into the national catalogue.

### **3.2.3. Basic shortcomings of collections of plant genetic resources (gaps, ways for their identification and elimination)**

At present the majority of *ex situ* collections accessions in scientific centers is in need of regeneration, even under the most optimal conservation conditions the vitality of samples is expected to fall in the course of time. In case of unique single samples similar losses can be irreplaceable. Consequently, monitoring of accessions vitality and periodical regeneration must remain a primary objective for *ex situ* conservation activities.

It is necessary also to improve the level of documentation in collections holder institutions, through use of computer programs, preferably of general format.

Running of national catalogue and coordination of *ex situ* collections by a national gene bank will enable precise identification of accessions subject to regeneration and implement correlated regeneration activities. To eliminate basic shortcomings in PGRFA collections there is a need for technical, methodological and training support from international organizations.

## CHAPTER 4

### THE STATE OF PGRFA USE

#### 4.1. Utilization and enhancing of use of plant genetic resources

##### 4.1.1. *Sharing of Plant Genetic Resources*

Since their establishment all existing *ex situ* collections in the Republic have always been made freely available upon request for research and breeding activities to scientific and educational institutions (scientific staff, students, post-graduate students), notwithstanding the fact that there was no regulatory mechanisms in place for exchanging plant genetic resources. With the entry into force of the International Treaty on PGRFA and its ratification by the Republic of Armenia, the exchange of the Annex 1 list of crops is now regulated under the Standard Material Transfer Agreement adopted by the Governing Body of the Treaty at its first meeting in Spain in June 2006. A regulatory mechanism for the exchange of all crops and species that are not included in the Annex 1 is still to be decided.

##### 4.1.2. *Characterization and evaluation*

To encourage national capacity it is demanded to develop national information system, which will contain characterization and evaluation data of stored accessions PGRFA. *Ex situ* collections accessions have not been fully characterized at present, which is conditioned by the absence of modern methodological, technical facilities and proper staff. Evaluation data mainly contain agronomic features; characterization data – morphological or, in some cases, cytological.

Activities on plant genetic resources evaluation and characterization are implemented in eight scientific and educational institutions of the Ministry of Agriculture, Ministry of Education and Science and National Academy of Sciences.

The research results are published in national and international journals, proceedings of scientific conferences. The majority of available information is not digitized which hampers the exchange of information among different scientific institutions and *ex situ* collections holders.

To ensure effective and sustainable use of PGRFA in the Republic it is necessary

- to enter evaluation and characterization data of all *ex situ* collections accessions into the national catalogue and update it periodically
- to ensure the access of evaluation and characterization data through establishment of an appropriate mechanisms for that
- to expand the range of implemented scientific themes directed at accessions evaluation
- to involve farmers and non-governmental organizations into genetic resources evaluation activities.

##### 4.1.3. *Base collections*

*Ex situ* base collections are available at the gene bank of the SC of Agrobiotechnology. The rest of them are short-term conservation collections, constantly used for breeding and comprehensive study purposes. The problem of creation of their base collections can be gradually solved in case long-term conservation conditions are available.

#### 4.2. Improvement of use of plant genetic resources

##### 4.2.1. *Actions taken to improve the use of plant genetic resources*

Relevant studies and applied projects targeted at the use of plant genetic resources, varieties improvement and creation of new varieties are carried out in the Republic:

- 162 new varieties of 26 crops have been developed and registered by the “Seed Agency” due to the use of introduced genetic resources in breeding and varieties improvement activities in last ten years
- “Armsim” variety of soft wheat was released in 2006 as a result of the study and selection of ICARDA and CIMMYT breeding nursery lines
- 4 variety samples of durum wheat and 2 perspective varieties of barley have been selected as a result of long testing of the wheat and barley breeding lines from ICARDA and CIMMYT breeding nurseries carried out in different natural climatic conditions
- 4 varieties of chick pea “Hatzavan”, “Sisian”, “Lilit” and “Alina” have passed a state variety testing and are ready to be released in 2008
- 2 varieties of winter barley (“Utik”, “Sevan”) were released in 2007
- 3 varieties of winter wheat (“Armik”, “Van”, “Aray”), winter varieties of barley (“Alashkert”, “Vektva”), 2 varieties of soybean (“Milena”, “Menua”) are to submitted for variety testing in 2008
- in 2005-2008 176 breeding lines of vegetable crops received from the Word Vegetable Center have been evaluated in terms of adaptability to local conditions, five improved varieties of tomato (“Zhanna”, “Rubina”, “Zeytoun”, “Armine”, “Narek”) and 7 varieties of pepper (“Natali”, “Emili”, “Mili”, “Gita”, “Zspanak”, “Punj”, “Kon”) are submitted to state variety testing
- Breeding activities based on utilization of local breeding and imported varieties of grapes and fruit crops have been implemented. About 40 elite forms which are at the stage of investigation have been created.

The experience on the use of wild crop relatives in breeding is also available:

- Soft wheat variety “Voskehask” (*Aegilops tauschii* x Bezostaya 1) has passed variety testing and been released. It is cultivated now in the pre-mountain zone (Kotayk Marz) in a number of farms
- “Syunik 1” new variety of rye has been created through individual selection from rye field-weed variety. It has also passed state variety test
- “Zvartnots” emmer wheat variety has been created through crossing between durum wheat and two-grain wild wheat. It is at the stage of propagation, to be submitted for state variety test
- “Marina” new variety sample of barley has been created through crossing between wild barley (*H. bulbosum*) and multi-row barley (*H. vulgare*). It is at the stage of propagation, to be submitted for state variety test
- Two varieties of tomato “Gandzak” and “Nver” created through distant hybridization with wild species have been released.

#### **4.2.2. Constraints of the use of plant genetic resources**

A number of factors hamper full and more effective use of plant genetic resources:

- the lack of stored accessions characterization and evaluation data based on application of modern assessment methodology
- the low level of access to accessions characterization and passport data due to the absence of designed web sites and internet connection
- the lack of appropriate staff (young specialists, breeders), technical facilities and training for full scale breeding implementation
- the lack of strong collaboration links between collection holders of genetic resources and users, as well as farmers
- limited number of accessions is available in the gene bank and other collections

In recent years, with the purpose of mitigation of the above mentioned constrains, some actions, aimed at the extension of the use of plant genetic resources, have been taken.

- Within the framework of the EC/FAO project on “Designing an Integrated Strategy to for Improved Utilisation of Plant Genetic Resources for Food Security in Armenia” a joint study has been conducted by FAO, ICARDA and the Ministry of Agriculture of RA, titled “Elements of a National Strategy for Management and Use of Plant Genetic Resources in Armenia“. Some crucial recommendations on PGR conservation and use for the development of national policy have been introduced in the Study Report.

- A number of projects (e.g. participatory studies within the UNDP/GEF project on “in-situ conservation of crop wild relatives through enhanced information management and field application) which contributed to strengthening of collaboration links due to the all stakeholders involvement (collection holders, users, taxonomists) have been implemented.

- A realization of scientific theme on accessions evaluation of abiotic and biotic stress related resistance have been undertaken

- Within the framework of Agrarian technology assessment program (Rural Enterprise and Small-Scale Commercial Agriculture Development Project) underutilized crop varieties have been tested in farms (black wheat, patison, physalis) with the purpose of demonstration and introduction of new cultivation technologies.

#### **4.2.3. Recommendations**

Following actions are necessary to be undertaken to ensure effective and wider use of PGRFA:

- to extend activities on characterization and evaluation of germplasm, taking as a ground the priorities, pointed out in the «Agriculture sustainable development strategy»
- to organize training courses at regional or international level on evaluation of plant genetic resources, use of molecular and biotechnological methods in breeding
- to strengthen institutional capacities, improve technical facilities
- to extend a range of pre-breeding activities
- to strengthen the links between breeders and seed producers, to encourage farmers' and seed producers' interest to modern varieties and technologies
- to improve means of communication and information exchange
- to improve of plant varieties protection system; to create privileged and favorable conditions for breeders by developing relevant legal environment
- to organize field days with the purpose of demonstration of advantages of modern breeding varieties and marketing features of traditional ones
- to raise the level of public awareness, to incorporate PGRFA related issues into education and public awareness programmes.

#### **4.2.4. Reducing genetic weakness in Agriculture System**

As a result of privatization of land resources of agricultural significance the size of a farm plot in average is now about 1,4 ha. That hampers profitable application of intensive technologies (crop rotation, work mechanization, etc.). Cultivated land was fragmented into more than 1, 2 million land plots. New technologies, the latest scientific achievements are not applied in farms. The major part of entities doesn't have relevant education and work experience. That impedes farming systems, agro-technical rules application, which, in its turn, brings to vulnerability of agrarian systems.

The solution to the problem includes land consolidation, diversification of agricultural production, farm cooperatives, creation of voluntary units (associations, communities, units) and introduction of new technologies.

#### **4.2.5. Promoting desertification of crop production systems, Development and Commercialization of Under-Utilized Crops and Species**

Vertical zoning of the territory of the Republic and diversity of soil-climatic conditions are favorable for cultivation of multi-type crops, particularly fruit and vegetable plant species. At present with the purpose of extension of cultivated plants assortment the scientific institutions of MoA of RA study

and develop cultivation technologies for new crops, which are demonstrated and tested on the farms within the framework of Agrarian Technologies Assessment Project.

In scientific theme titled «Non traditional crops» was approved for the SC of vegetable and industrial crops.

#### **4.3. Seed production system and sale markets**

The establishment of profitable seed production system is of strategic significance for the country's food security.

A strong system of agricultural crops seed production existed in the Republic before 1990's. Scientific research institutes were involved in primary seed-breeding and more than 120 seed-production state farms operating in the field of agriculture dealt with seed production. These farms were liquidated after privatization and, in fact, both primary seed-breeding (super elite, elite production) and its reproduction in seed-breeding farms stopped operating in the Republic. As a result the volume of production of high productive seeds drastically went down; the succession of seed propagation and reproduction technologies was broken, which sharply cut down technological progress in the branch.

The Gyumri Breeding Station, Echmiadzin experimental farm of the SC of Agriculture and Plant Protection and CS of Vegetable and Industrial crops have taken up primary seed-breeding since 1994, producing a limited quantity of winter wheat and vegetable crops seed material. The opportunity for partly satisfaction of land users' demand in seeds has been created due to the seeds/planting material export. However the reserve and insurance foundations failed to be established; no capital investments were made.

At present the low level of meeting a demand on quality seed material (15-20% at its best) brings to low yield of cereal crops. The lack of seed fields is a major constraint for the introduction of seed-production system; great deals of seed fields are in unsatisfactory phytosanitary state. Non-application of crop-rotation, the lack of appropriate technical base also proves to be unfavorable.

The «Concept of seed-breeding development in the Republic of Armenia in 2003-2010» has been elaborated by the Ministry of Agriculture to regulate the relations between state and private seed production sectors as well as for specification. The priority is given to development of private seed-breeding farms.

With the support of the Government of Armenia the new programme «Development of seed-breeding of wheat and barley in the Republic of Armenia in 2007-2011» has started. The programme is implemented by the Gyumri Breeding Station, SC of Agriculture and Plant Production, «Seed Producers Association of Syunik», and the «Seed Producers Support Association». The subsidies provided by the State serve to promote the production and distribution of high quality seeds, since now this business is not profitable. By the end of the programme it is envisaged to produce about 3590 tones of high quality seeds (elite and super elite seeds), which will cover about 10% of the total high productive seed market for cereals, in comparison with today's 1-2%. In nearest future it is expected to extend this seed production programme to other crops types.

#### **4.4. Seed Breeding Related Legislation**

The «Law on Seeds» (2005), the «Law on Plant quarantine and Plant Protection» (2006) were developed and adopted by the Government of RA with the purpose of introduction of the system of seed material certification and quality control, what is correspondent to international standards, and of increasing of effectiveness of seed material test and control state service as well. New « Law on new plant varieties» is in the process of development.

To ensure compliance of the «Law on seeds» seven Governmental Decrees have been worked out and adopted by the Government:

- «Seeds certification procedures» - according to this document the seeds of all plants included the official list of plant varieties permitted for use must be certified
- The list of notifiable plant species, where the most important for republic's economy 10 crops (wheat, barley, maize, potato, tomato, cabbage, cucumber, watermelon and melon) are included
- Procedures of seeds import and export
- Sampling procedures and format of sampling act
- Procedures of certification of seeds field monitoring implementing person and application format for field monitoring
- Procedures of organization of the state testing on plant varieties economic profit, and of registration in the list of plant varieties permitted for use in the Republic of Armenia and getting off from the list
- Procedures of running registration books for producers, importers and exporters of certified seeds and registration book format.

In 2008 the “Law on organic agriculture” was adopted. This law regulates relations connected to production, storage, processing, sale of organic agricultural food and raw material, and wild plants storing up. The law compliance will contribute to enhancement cultivation of old traditional varieties, increase their demand in local and foreign markets and production range.

#### ***4.5. Cultivation and Distribution of Local Varieties***

Modern intensive crop varieties, especially of wheat, barley, potato, vegetable melon crops, due to their high productivity and resistance to pests and diseases, gradually displaced local varieties from the market. Local traditional varieties, which are quite adapted to local conditions and possess the best taste qualities, are still cultivated by some entities for their own needs in limited quantities. The list of old local varieties includes for example, Karmir Akfahat (Ferrugineum), Alti-Aghanj (Ferrugineum), Spitakahat (Grecum), Zarda (Hamadanicum), Galgalos (Delfi). They are less productive but certainly more adapted to local agro-ecological conditions than imported varieties.

The grain legumes, despite their food and forage significance, occupy a limited area. In local markets they are mainly presented by highly demanded local varieties. Emmer wheat also belongs to the number of crops of this type and there is also high demand for emmer wheat landraces, which belongs to the number of likely crops, due to its taste qualities.

A great deal of imported varieties and hybrids of vegetable crops has lower quality and taste than the local ones. Seed price of local varieties is also significantly cheaper. For these reasons the market's demand for local varieties of tomato and other vegetables has remained strong.

## CHAPTER 5

### THE STATE OF THE NATIONAL PROGRAMMES, TRAINING AND LEGISLATION

#### 5.1. National Programme

The PGRFA National Programme has been not developed yet in the country. Elaboration of a national PGRFA programme is considered in the republic as a stable and long-term platform for implementation of international agreements, such as the Global Plan of Action on the Conservation and Sustainable Utilization of PGRFA, as well as the relevant obligations of the CBD, Framework Convention on Climate Change and Convention to Combat Desertification. Moreover an effective and strong coordination both horizontally and vertically is needed in order to minimize duplication of efforts and functions of stakeholders dealing the PGR conservation and use.

The main challenges of PGRFA *in situ* conservation, *ex situ* maintenance and sustainable utilization are reflected in relevant strategies and national programmes:

- “Agriculture Sustainable Development Strategy”
- “State Strategy and National Action Plan for Development of Nature Protected Areas in Armenia”
- “Food Safety Policy of the Republic of Armenia”
- Forest National Policy and Strategy
- Forest National Programme
- Sustainable development programme
- Biodiversity Strategy and Action Plan
- “Strategic Program of Poverty Reduction National Action Plan to Combat Desertification in Armenia”
- “Action Plan for Armenian National Capacity Self-assessment for Global Environmental Management”
- “Complex and annual programs of the Lake Sevan ecosystem rehabilitation, conservation, reproduction and use”

In 2007 the elements of a national strategy for management and use of PGR in Armenia were developed within frames of FAO Project on «Designing an Integrated Strategy to for Improved Utilisation of Plant Genetic Resources for Food Security in Armenia». The proposed key recommendations targeted on improvement of the national integrated system will serve as a basis for elaboration of National PGRFA programme.

#### 5.2. Networks

Country's network or PGRFA incorporates the Ministries (MoA, MoNP, MoES), research institutions, universities, seed breeding and seed producing private companies, extension services, NGOs.

The inter-ministerial Commission on PGRFA was established by the initiative of the Ministry of Agriculture at the beginning of 2005 with the purpose of better coordination of PGRFA conservation, study and usage activities, elaboration of national programmes and strategies, linking the various components of the existing PGR network.

#### 5.3. Education and Training

The challenges of improvement of the level of ecological education are highlighted as priorities and envisaged in the «National Biodiversity Strategy and Action Plan». That particularly related to

training of teachers, lecturers and the improvement of educational system aimed at biodiversity conservation at the level of schools and higher educational institutions.

The training of the appropriate staff through organization and conducting of seminars, workshops and experience exchange is underlined as a strategic direction in the «Strategy on the development of Natural Specially Protected Areas in Armenia» and Action Plan».

In 2001 the Law of RA “On population ecological education and upbringing” was adopted. According to this law the ecological education is implemented at pre-school, secondary, secondary-vocational, high, post-graduate levels, also involving wide levels of society.

PGRF related education is carried out mainly by specialized chairs of Armenian State Agrarian University and Yerevan State University.

Some short-term training courses organized by international organizations (Bioversity International, ICARDA, SIMMYT, AWWC, CIP NUFFIC, etc.) play an essential role in training specialists on PGRFA conservation methodology, accessories documentation, data base operation, running a gene bank, in-vitro conservation of plant material.

In the Republic there is a necessity in organization of trainings at local, regional and international levels. That refers to application of modern molecular and biotechnological methods for evaluation of genetic material, cryo-conservation, use of geographical information, application of new methods and modern approaches applied in adaptive breeding, accessions phytosanitary control.

#### **5.4. Legislation**

According to Article 10 of the Constitution of the Republic of Armenia the environmental control, its rehabilitation and effective use of natural resources are guaranteed by the state.

The country’s legislation which more or less relates to the issues of effective management of PGRFA has significantly been improved during the last 10 years (*Annex 3*).

- new regulations to eliminate gaps in legislation regulating the use of plant genetic resources has been elaborated – the Law of RA “On environmental control” (2005), “On seeds” (2005)
- to develop market economy, to sign new international agreements, to harmonize the national legislation with EU legislation the following regulations have been elaborated: the Law of RA “On nature specially protected areas” (2006), Forest Code (2005), the Law of RA “On plant quarantine and plant protection” (2006)
- the Law on “On new plant varieties” is at the stage of development.

A number of secondary legislation act and decrees related to PGRFA conservation and sustainable usage have been developed and adopted by the Government to ensure laws compliance.

Though PGRFA conservation and use related legislation has been significantly improved, yet there are challenges which can not be regulated by present legislation:

- development of encouragement mechanisms for the author of a breeding variety
- farmers’ rights precise determination
- development of criteria of PGR monitoring in special protected areas and cadastre running mechanisms
- establishment of control on penetrating of invasive species, which are potentially dangerous for PGR
- regulation of access to plant genetic resources and sharing of benefit resulted from their use.

#### **5.5. Information Systems**

It is difficult to ensure the effective use and conservation of plant genetic resources without centralized informational system. That enables farmers to get proper information on varieties and more effective use. Regularly updated database helps to find out accessions of prior importance in terms of PGRFA conservation, to organize collection missions and for users, to acquire accessions with required features.

In this respect some actions are taken in the Republic to register ex-situ collections accessions, to load information into computer database, to ensure their data availability in international catalogues. Yet, there are some issues to be solved:

- Up-to-date databases linked with a national inventory are not in place, which makes the access to seed collections difficult for breeders and farmers.
- No intranet structure to accommodate such linkages is available.
- In spite of availability of qualified and dedicated staff, additional staff is needed to carry out various tasks: develop and maintain information systems, perform regeneration activities, evaluations and monitoring of the population status in protected areas.

## **5.6. Public Awareness**

Armenia has a signatory of Aarhus Convention since 2001. By assistance of OSCE four Public Environmental Information Centers have been established in 4 marzes to meet the obligations of the Convention. Centers are furnished with appropriate equipment, computers, and library and actively involve representatives of local communities into decision-making in the field of biodiversity conservation and sustainable use as well as planning and implementation of relevant activities.

The issues concerning public involvement in decision making in the field of bioresources protection and management plans development process are defined in a separate Chapter (Chapter VII) of the Law of RA “On nature specially protected areas”, where public rights to be informed on NSPAs related activities are highlighted.

The national reports on biodiversity prepared by RA Ministry of Nature Protection and information on plant resource collections, import and export permissions can be found on [www.mnp.am](http://www.mnp.am) Internet website, which is available for all layers of population.

In the framework of “Assessment of Priority Capacity Needs for Biodiversity Conservation and Establishment of CHM Structures” project, “Armenian biodiversity” website was designed and launched in 2002 ([www.biodiv.am](http://www.biodiv.am)).

In the framework of “UNEP/GEF *In situ* conservation of crop wild relatives through enhanced information management and field application” project a national site ([www.cwr.am](http://www.cwr.am)) has been created to ensure CWR related information exchange and access.

As an output of the “Ecological information, education and public awareness raising” project funded by TACIS, the draft “Regulations on ecological information collection and dissemination” was developed.

Activities on public awareness raising and information dissemination are actively implemented at local level in forms of organization of public hearings, round tables, establishment of regional environmental information centers, dissemination of booklets/brochures on relevant themes, conduction of lectures, etc. Many regional and international projects related to PGR conservation and use include the public awareness component, within frames of which booklets, video films, meetings with local communities and farmers, field days are organized. A great number of projects related to biodiversity conservation and public awareness are implemented by more than 10 NGOs.

## CHAPTER 6.

### THE STATE OF REGIONAL AND INTERNATIONAL COLLABORATION

#### **6.1. General Situation on International Collaboration**

During the last years the collaboration of the Republic with regional and international organizations related to PGRFA conservation and usage (FAO, Biodiversity International, ICARDA, CIMMYT, CIP, ACIAR, Asian Center on Vegetable breeding development and research, World Vegetable Center, etc.) as well as other countries' gene banks, research institutions (Russia, Slovakia, Japan, USA, etc.) has significantly expanded.

The Ministry of Agriculture has signed collaboration agreement with ICARDA covering germplasm exchange, information and related methodology sharing, visits of scientists. Within the frames of this agreement some Armenian specialists have been trained by ICARDA on documentation and databases.

The SC of agriculture and Plant Protection of MoA have a joint programme of activities targeted on potato virus free mini-tubs production.

The cooperation agreement between USDA/MAP and Armenia covered germplasm exchange, training on GRIN system, collections missions on the territory of the Republic.

The organization of collection missions, through collaboration agreements, English language and data base operating trainings, specialized courses has significantly benefited (contributed) to the improvement of qualification of the involved staff and public awareness. Along with that seed collections has been enriched and national gene bank has been established.

In 2004 together with other Caucasus Republics Armenia has been included into EU "European Neighborhood Policy" (ENP). Taking into consideration the country's priority issues related to environment protection and biodiversity Armenia has submitted its recommendations to be included into Armenia-EU Action Plan, where Armenian environmental cooperation with European countries in this given sphere has to be reinforced.

#### **6.2. International Networks**

Being a member of ECPGR since 2002 Armenia is represented in working groups of its coordination network.

Republic of Armenia is full member of the Regional Network – Central Asia and Trans-Caucasus Network and took part in many projects implemented in the framework of this network.

Armenia is a part of WIEWS (Global Network of the World Information and Early Warning System on PGR), 18 institutions have been registered in the system, including state, private organizations and NGOs.

#### **6.3. International Programs and Agreements**

At present the Republic of Armenia is a party to 15 environmental conventions and 3 protocols, including:

- ♦ Convention on Biodiversity (1993)
  - Cartagena Protocol on Biosafety (2004)
- ♦ UN Framework Convention on Climate Change (1993)
  - Kyoto protocol (2002)
- ♦ The Ramsar Convention on Wetlands (1993)
- ♦ Convention to Combat Desertification (1997)
- ♦ The European Landscape Convention (2004)

- ◆ International Convention on Plant Protection (2006)
- ◆ International Treaty on PGRFA (2007)
- ◆ The Convention on the Conservation of European Wildlife and Natural Habitats (2008).

The Global Plan of Actions for conservation of plant genetic resources for food and agriculture on PGRFA were adopted by Armenia in 1996.

Armenia has also been a member of European Cooperative Program on PGR since 2000.

Armenia is a party of Pan-European Strategy on Biological and Landscape Diversity and participants to the processes held within that strategy.

Armenia is included into UNDP, UNEP and OSCE “Environment and Security” regional initiative’s “Risk transformation cooperation” project implementation. The development of a legal document (“Caucasus Convention”) addressed needs in conservation of Caucasus mountainous ecosystems is envisaged.

It is essential to note that international price growth of food products is a serious challenge, which is possible to overcome only with joints efforts of international societies and states, particularly focusing on the expansion of regional collaboration in this field and implementation of joint projects.

## CHAPTER 7.

### ACCESS TO PGRFA AND BENEFIT SHARING RESULTING FROM THEIR USE, AND FARMERS' RIGHTS

#### **7.1. Access to Plant Genetic Resources**

Through ratification of the Convention on Biological Diversity in 1993 the Republic of Armenia committed to the fulfillment of obligations on PGR conservation and sustainable use along with responsibilities on access to genetic resources and equitable sharing of benefit arising out of their use.

On March 20, 2007 the country joined the International Treaty for Plant Genetic Resources for Food and Agriculture. Being a member of this international treaty, Armenia, like other member countries of the Treaty, has to meet commitments to enhance the access to plant genetic resources covered by Annex 1 of the Treaty (*Annex 4.*) and equitable sharing of benefits resulting from their use.

At present Armenia has not developed any special legislation regulating access to genetic resources. Available *ex situ* collections accessions in Armenia, acquiring the appropriate certificate from of the Plant Quarantine State Inspectorate of the ministry of Agriculture of RA are provided to other countries' gene banks, scientific institutions for their research work, accessions exchange upon request.

#### **7.2. Fair and Equitable Sharing of the Benefits of the Use of PGR**

The provisions on equitable sharing of benefits of the use of PGR, which are defined by the Convention on Biological Diversity, are in an urgent need of improvement of regulations in Armenia. The first step in this area were undertaken in 2002, when within the framework of UNDP/GEF "Self-assessment of the national capacities for the global environmental management" project the draft national strategy on access to genetic resources and was developed. It was based on the Bonn Guidelines on Access to Genetic Resources and Fair and Equitable Sharing of the Benefits Arising out of their Utilization. The activities directed at the revision of the national strategy along with development of conception and law on access and benefit-sharing are implemented in the framework of the project "In-situ conservation of crop wild relatives through enhanced information management and field application".

#### **7.3. Implementation of Farmers' Rights**

The rights of peasant farms are regulated in Armenia by Civil Code (2001). The Government of RA also regulates economic activities of farms, individual farmers through tax policy, Water and Land Codes, Law «On breeding achievements protection», Law «On water users and associations of water users», and secondary legislation. With the purpose of protection of farmers concern and increase effectiveness of agricultural systems Government of RA has a successive approach in the implementation of the state programmes addressed to the development of irrigation system, land improvement, pastures watering, agricultural crops pest control.

"The Strategy of sustainable development of agriculture" project envisages improving tax and crediting system in agriculture through development and introduction of subsidizing mechanisms.

## CHAPTER 8.

### CONTRIBUTION OF PGRFA MANAGEMENT TO FOOD SECURITY AND SUSTAINABLE DEVELOPMENT

The challenge of raising the level of food security is one of priorities of the country's economy. At present this challenge is considered in the terms of international price growth for food products, taking into account the Republic's dependence on import of a number of food products of vital importance.

The rise of the level of physical and economic availability of food products is implemented in compliance with the requirements of the RA Law of the Republic of Armenia on "Food Security" (2002) within the framework of Food Security policy of RA and Sustainable Development Programme (2008).

Activities targeted at the rise of the level of physical and economic availability of food products contribute to the increase of the level of self-sufficiency for main food products.

In 2005-2007 the average data for the level of self-sufficiency for wheat was 37,3%, grain legumes crops - 53,2%, vegetable oil - 5,6%. In this respect the replacement of import food products by locally produced food products is getting very important, which, in its place, is conditioned by profitable management of plant genetic resources used for food production and agriculture.

A series of measures are undertaken to raise the level of availability of food products. The implementation of these measures will enhance the increase of production of agricultural products and foster the rise of the level of main food products self-sufficiency. Activities envisaged by strategic documents include objectives related to the PGRFA profitable management:

- stimulation of the local production of food products of vital importance, especially bread, vegetable oil, sugar
- introduction of new technologies for cultivation of more profitable forage crops (maize, fodder beet, Jerusalem artichoke, non-traditional crops, etc.)
- introduction of new technologies for cultivation of new crop varieties
- introduction of crops ensuring high value added value and satisfying market requirements.

The National Programme on «Agriculture development and increase of the level of self-sufficiency for main food products for 2008-2010» is in the stage of development at the moment. It is in the range of activities targeted at the raise the level of self-sufficiency of agricultural food products of vital importance, to create favorable conditions for agricultural entities, to enhance sub-sectors of relative advantages and by proper using agricultural resource potential.

## List of principal crop wild relatives of Armenia

Crop name	Species name	Crop name	Species name
<b>CEREALS</b>		<b>LEGUMES</b>	
Wheat	<i>Triticum araraticum</i> Jakubz.	Lentil	<i>Lens orientalis</i> (Boiss.) Schmalh.
	<i>T. boeoticum</i> Boiss.		<i>L. ervoides</i> (Brign.) Grande
	<i>T. urartu</i> Thum.ex Gandil.	Liquorice	<i>Glycyrrhiza glabra</i> L.
Aegilops	<i>Aegilops crassa</i> Boiss.		<i>G. echinata</i> L.
	<i>A. tauschii</i> Cosson	Pea	<i>P. sativum</i> L. subsp. <i>humile</i> (Holmb.) Greut., Matthäs & Risse
	<i>A. umbellulata</i> Zhuk.		<i>P. elatius</i> M. Bieb.
	<i>A. cylindrica</i> Host		<i>Vavilovia formosa</i> (Steven) Fed.
	<i>A. triuncialis</i> L.	Grass pea	<i>Latirus cicera</i> L.
	<i>A. biuncialis</i> Vis.	Bitter vetch	<i>Vicia ervilia</i> (L.) Willd.
	<i>A. triaristata</i> Willd.	<b>OIL and/or FIBER CROPS</b>	
	<i>A. columnaris</i> Zhuk.	Safflower	<i>Carthamus oxyacanthus</i> M. Bieb.
<i>A. mutica</i> (Boiss.) Eig.		<i>C. gypsicola</i> Iljin	
Rye	<i>Secale vavilovii</i> Grossh.	Turnip	<i>Brassica rapa</i> L.
Barley	<i>S. montanum</i> Guss.	Rape	<i>Brassica napus</i> L.
	<i>Hordeum spontaneum</i> C.Koch	Flax	<i>Linum bienne</i> Mill.
	<i>H. glaucum</i> Steud.	Gold of pleasure	<i>Camelina sativa</i> L.
	<i>H. murinum</i> L.	Hemp	<i>Cannabis sativa</i> L.
	<i>H. geniculatum</i> All.	<b>CONDIMENTS</b>	
	<i>H. marinum</i> Huds.	Thyme	<i>Thymus kotschyanus</i> Boiss. & Hohen
	<i>H. violaceum</i> Boiss. et Huet	Summer savory	<i>Satureja hortensis</i> L.
	<i>H. bulbosum</i> L.	Tarragon	<i>Artemisia dracunculus</i> L.
<i>H. hrasdanicum</i> Gandil.	Sumac	<i>Rhus coriaria</i> L.	
<b>FRUITS CROPS</b>		Wormwood	<i>Artemisia absinthium</i> L.
Mountain ash	<i>Sorbus aucuparia</i> L.	Lemon balm	<i>Melissa officinalis</i> L.
	<i>S. haiastana</i> Gabr.	Caraway	<i>Carum carvi</i> L.
	<i>S. takhtadjanii</i> Gabr.	Oregano	<i>Origanum vulgare</i> L.
	<i>S. subfusca</i> (Ledeb) Boiss.	Brown mustard	<i>Brassica juncea</i> (L.) Czern.
Crataegus	<i>Crataegus orientalis</i> Pallas ex M.Bieb.	Hop	<i>Humulus lupulus</i> L.
	<i>C. pontica</i> C.Koch	Coriander	<i>Coriandrum sativum</i> L.
Apple	<i>Malus orientalis</i> Uglitzk.	Mints	<i>Mentha longifolia</i> (L.) L.
Grape vine	<i>Vitis sylvestris</i> C.C.Gmelin		<i>M. pulegium</i> L.
Currants	<i>Ribes biebersteinii</i> Berland. ex DC.		<i>M. arvensis</i> L.
	<i>R. armenum</i> Pojark.	<b>VEGETABLES</b>	
Diospyros	<i>Diospyros lotus</i> L.	Spinach	<i>Spinacia tetrandra</i> Steven ex M. Bieb.
Plum	<i>Prunus domestica</i> L.	Beet	<i>Beta vulgaris</i> subsp. <i>maritima</i> (L.) Arcang
	<i>P. divaricata</i> Ledeb.		<i>B. lomatogona</i> Fisch. et C.A.Mey
	<i>P. spinosa</i> L.		<i>B. macrorrhiza</i> Steven
Pear	<i>Pyrus caucasica</i> Fed.		<i>B. corolliflora</i> Zoss. ex Battler
	<i>P. syriaca</i> Boiss.	Carrot	<i>Daucus carota</i> L.
	<i>P. takhtadzhianii</i> Fed.	Asparagus	<i>Asparagus officinalis</i> L.
	<i>P. medvedevii</i> Rubtzov		<i>A. verticillatus</i> L.
Medlar	<i>Mespilus germanica</i> L.		<i>A. persicus</i> Baker
Cornelian cherry	<i>Cornus mas</i> L.	Garden cress	<i>Lepidium sativum</i> L.
Pomegranate	<i>Punica granatum</i> L.	Chicory	<i>Cichorium intybus</i> L.
Silver berries	<i>Elaeagnus angustifolia</i> L.	Leek	<i>Allium ampeloprasum</i> L.
	<i>E. orientalis</i> L.	Purslane	<i>Portulaca oleracea</i> L.
Fig	<i>Ficus carica</i> L.	Sorrel	<i>Rumex acetosa</i> L.
Wood strawberry	<i>Fragaria vesca</i> L.		<i>R. crispus</i> L.
Raspberry	<i>Rubus idaeus</i> L.	Watermelon	<i>Citrullus colocynthis</i> (L.) Schrad.
Quince	<i>Cydonia oblonga</i> Mill.	Melon	<i>Cucumis melo</i> L. subsp. <i>agrestis</i> (Naud.) Pangalo
Apricot	<i>Armeniaca vulgaris</i> Lam.	Radish	<i>Raphanus raphanistrum</i> L.
Sea buckthorn	<i>Hippophaë rhamnoides</i> L.	<b>NUT CROPS</b>	
Jujube	<i>Ziziphus jujuba</i> Mill.	Almond	<i>Amygdalus nairica</i> Fed.&Takht.
Rosa	<i>Rosa hemispherica</i> J. Herrm.		<i>A. fenzliana</i> (Fritsch) Lipsky.
Sweet cherry	<i>Cerasus avium</i> (L.) Moench	Hazel	<i>Corylus avellana</i> L.
Sour cherry	<i>Cerasus vulgaris</i> Mill.	Walnut	<i>Juglans regia</i> L.
Bird cherry	<i>Padus racemosa</i> (Lam.) Gilib.		
Gooseberry	<i>Grossularia reclinata</i> (L.) Mill.		

## STATE PROTECTED AREAS OF ARMENIA

N	Name	Year of establishment	Territory (ha)	Location	Protected objects
1	2	3	4	5	6
1	“Arjatkhlēni” Hazelnut	1958	40	Northern slopes of Ijevan Mountainous Range, Khaghaghaghbyur River Basin, 1500-1800m above sea level	Relict groves of yew and hazel-nut
2	Ijevan	1971	7800	Slopes of Ijevan Mountainous Ranges, River Aghstev Basin, 900-2100m above sea level	Rare and valuable animal species (brown bear, roe-deer, black grouse)
3	Gandzakar (Upper Aghdan)	1971	6800	Ijevan Mountainous Ranges, River Paytajur Basin, right tributary of River Aghstev	Mountainous forests, rare and valuable animal species (brown bear, roe-deer, black grouse)
4	Akhnabat Yew Grove	1958	25	Polaz River Basin, south-eastern slopes of Miapor Mountainous Range, near the village Akhnavank, 1400-1700m above sea level	Unique relict yew grove with 300-400 year old trees
5	Her-Her Open Woodland	1958	6139	Right tributary of River Arpa, Her-Her River Basin, 1400-2000m above sea level	Relict yew open woodland and remnant orchards of pear, tragacanth milk vetch
6	Jermuk	1958	3865	Arpa River Basin, 1100-2800 m above sea level	Rare animals, Armenian mouflon, Bezoar goat, brown bear, Caucasian leopard, mountainous forests
7	Yeghegis	1971	4200	Right tributary of River Arpa, River Yeghegis Basin, 1200-2800m above sea level	Rare and valuable animal species – bezoar goat, Armenian mouflon, Caucasian leopard, rich diversity of wild wheat
8	Jermuk hydrological	1981	18000	Upper course of River Arpa	Mineral water Jermuk
9	Caucasian Rosebay	1959	1000	Northern slopes of Pambak and Tsakhkunyats Mountainous Ranges, 1900-2200m above sea level	Caucasian rose-bay
10	Margahovit State protected area	1959	5000	Northern Slopes of Pambak Mountainous Range, 1900-2200m above sea level	Forest animals – roe-deer, brown bear, red deer, Caucasian black grouse
11	Goris	1971	1900	Basins of River Vorotan and its tributary Vararakn, 1400-2800m above sea level	Forest ecosystems typical for the region, threatened species of flora and fauna
12	Boghakarn	1989	2728	Slopes of Southern Zangezur Mountainous Range, 1400-2100m above sea level	Typical species of Armenian flora and fauna
13	Sev Lich	2001	240	Near the crater of the Mount Mets Ishkhanasar (Syunik volcanic plateau), 2658m above sea level	High mountainous volcanic reservoir and adjacent areas with plant and animal associations, 102 species of vascular plants, alpine meadows

1	2	3	4	5	6
14	Juniper Open Woodlands of Sevan (Gyuney)	1958	3312	Slopes of Areguney and Sevan Mountainous Ranges surrounding Lake Sevan	Unique relict juniper and oak open woodlands with typical fauna and flora
15	Getik	1971	6000	River Getik Basin, right tributary of River Aghstev, 1500-2700m above sea level	Rare and valuable animal species – roe-deer, brown bear, wild boar, black grouse
16	Pine of Banx	1958	4	Marmarik River Basin, northern slopes of Tsakhkunyats Mountainous Range, 1800-2000m above sea level	Unique planted stands of pine of Banx
17	Plane Grove	1958	64,2	Southern Armenia, Tsav and Shikahogh River Banks, 700-800m above sea level	The only natural plane grove in the Caucasus
18	Arzakan and Megradzor	1971	14500	Marmarik and Dalarik River basins, 1600-2100m above sea level	Rare and valuable animal species – roe-deer, brown bear and other forest species
19	Hankavan hydrological	1981	9350	Upper course of River Marmarik	Mineral water Hankavan
20	Gyulagarak Pine	1958	2576	Northern slopes of Bazum Mountainous Range surrounding Lori depression, 1400-1900m above sea level	Relict pine forests
21	Ararat Vordan Karmir	1987	204	Semi-desert areas of Ararat Valley, 850-1000m above sea level	Ararat cochineal and typical semi-desert vegetation, unique plant association
22	Goravan Sands	1958	95,99	Inclined flat areas of Ararat valley, on the southern outskirts of the town Vedi, nearby the village Pokr Vedi, near village Goravan, 1100-1200m above sea level	Remnant sands with unique species of plants and animals
23	Aragats Alpine	1959	300	“Kare” Lake with adjacent alpine meadows, 3200-3350m above sea level	“Kare” (Stone) Lake and surrounding alpine flora
24	Khor Virap	2007	50,28	Central Armenia, Ararat Marz, in the administrative boundaries of Pokr Vedi village community, left side bank of Araks River, nearby the monastery complex Khor Virap, adjacent to Artashat ancient capital, 820m above sea level	Wetland ecosystems of international significance: flora and fauna, especially swimming birds, rare species of flora and its habitat
25	Gilan	2007	118	Pre-mountain zone of South-western part of Geghama Mountainous Range, 1330-1400m above sea level – “Khosrov Forest” State Reserve on the base of “Bayburd” site	Semi-forest and pre-mountain ecosystems, flora and fauna and historical-cultural values

## List of laws related to PGR conservation and use

<b><i>Law of the Republic of Armenia</i></b>	<b><i>Year</i></b>
Law of the Republic of Armenia on Environmental Impact Assessment	1995
Law of the Republic of Armenia on Environmental Payments	1998
Law of the Republic of Armenia the Republic of Armenia on Flora	1999
Law of the Republic of Armenia on Breeding Achievements Protection	1999
Law on Environmental and Natural Resources Use Fees	1999
Law of the Republic of Armenia on Lake Sevan	2001
Law of the Republic of Armenia on Environmental Control	2005
Law of the Republic of Armenia on Tariffs for Compensation of Harm Causes to Flora and Fauna due to Environmental Legislation Violations	2005
Forest code of the Republic of Armenia	2005
Law of the Republic of Armenia on seeds	2005
Law of the Republic of Armenia on Plant Quarantine and Plant Protection	2006
Law of the Republic of Armenia on Nature Especial Protected Areas	2006

## List of plant species covered by Annex 1 of the Treaty available in the flora of Armenia

Major food Plants	Number of species available in Armenian flora	Leguminous forage plants	Number of species available in Armenian flora	Grass forage plants	Number of species available in Armenian flora
Asparagus	3	Astragalus	128	Andropogon	2
Avena	3	A.cicer	yes	Agropyron	7
Beta	4	Hedysarum	8	A.cristatum	yes
Brassica	4	Lathyrus	24	Agrostis	11
Brassica napus	yes	L.cicera	yes	A.stolonifera	yes
Brassica repa	yes	L.hirsutus	yes	Alopecurus	8
Armoracia	1	L.odoratus	yes	Arrenatherum	2
Barbarea	1	L.sativus	yes	A.elatius	yes
Camelina	1	Coronila varia	yes	Dactylis	1
Crambe	4	Lotus	4	D.glomerata	yes
Diplotaxis	1	L.corniculatus	yes	Festuca	15
Eruca	1	Lupinus	2	F.arundinacea	yes
Isatis	13	L.albus	yes	F.pratensis	yes
Lepidium	13	L.andustifolius	yes	F.rubra	yes
Raphanus	1	Medicago	12	F.ovina	yes
Rorippa	2	M.falcata	yes	F.gigantea	yes
Sinapis	1	M.sativa	yes	Lolium	3
Cicer	2	M.rigidula	yes	L.perenne	yes
Daucus	1	Melilotus	5	L.rigidum	yes
Fragaria	3	M.albus	yes	L.hybridum	yes
Helianthus	2	M.officinalis	yes	Phalaris	2
Hordeum	11	Onobrychis	21	Ph.arundinacea	yes
Ipomoea	1	O.vicifolia	yes	Phleum	12
Lens	2	Ornithopus	1	Ph.pratense	yes
Malus	2	Trifolium	29	Poa	16
Pennisetum	1	T.alpestre	yes	P.alpina	yes
Phaseolus	5	T.ambigum	yes	P.annua	yes
Pisum	3	T.angustifolium	yes	P.pratensis	yes
Secale	3	T.arvense	yes		
Solanum	4	T.hybridum	yes		
S.melongena	yes	T.pratense	yes		
S.tuberosum	yes	T.repens	yes		
Sorghum	2				
Triticosecale	1				
Triticum	13				
Vicia	30				
Vigna	1				
Zea	1				

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