COUNTRY REPORT ON THE STATE OF PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

REPUBLIC OF TAJIKISTAN

STATE OF PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE (PGRFA) IN THE REPUBLIC OF TAJIKISTAN

COUNTRY REPORT

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DUSHANBE 2008

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ACRONYMS AND ABBREVIATIONS

AS RT	Academy of Sciences, Republic of Tajikistan
BG	Botanical Garden
BI	Botany Institute, AS RT
Bioversity International	International Plant Genetic Resources Institute (IPGRI)
CBD	Convention on Biological Diversity
CDB	Central Data Base on *ex situ* genetic resources
CGIAR	Consultative Group on International Agricultural Research
CIMMYT	International Maize and Wheat Improvement Center
CIS	Commonwealth of Independent States
FAO	Food and Agriculture Organization
FI	Farming Institute, TAAS
f.o.b.	Free on board
GBAO	Gorno-Badakhshan Autonomous Oblast
GPA	Global Plan of Action
GTZ	German Agency for Technical Cooperation
HI	Horticulture Institute, TAAS
ICARDA	International Center for Agricultural Researches in the Dry Areas
MoA	Ministry of Agriculture
NordGen	Nordic Genetic Resource Center
Oblast	Province
OSCE	Organization for Security and Co-operation in Europe
PBI	Pamir Biology Institute, AS RT
PGR	Plant Genetic Resources
PGRFA	Plant Genetic Resources for Food and Agriculture
PP&GI	Plant Physiology and Genetics Institute, AS RT
Rayon	District
RNCGR	Republican National Center of Genetic Resources
RRS	Rayons of Republican Subordination
SCVT	State Commission for Variety Testing and Protection
Sida	Swedish International Development and Cooperation Agency
TAAS	Tajik Academy of Agriculture Sciences
TAU	Tajik Agrarian University
UN	United Nations
USDA	United States Department of Agriculture, USA
VIR	All-Russian Plant-Production Institute, Russian Federation
WSU	Washington State University (USA)

EXECUTIVE SUMMARY

Tajikistan is blessed with rich floristic diversity and recognized one of the center of origin and diversity for many crop species. There are about 5 000 plant species, including 650 endemic species and 3 000 low plant species found and described that is closely related to wide variations in geography, altitude, soil, climate and culture. In the wild flora of Tajikistan one can find various species of plant used for food and agriculture as wild or introduced crops. This is the first document that reviews the state of plant genetic resources in the country as in 1990s while developing the FAO Report on State of the World's Plant Genetic Resources for Food and Agriculture Tajikistan was not covered.

The present Country Report reviews the introduction to the country and agriculture profile, current status of Plant Genetic Resources in the country, focusing on (i) State of diversity, (ii) *In situ* management, (iii) *Ex situ* management, (iv) State of use, (v) National programs, trainings and legislation, (vi) Regional and International collaboration, (vii) Access to genetic resources, benefit sharing arising out of their use and farmers' rights, and (viii) Contribution of Plant Genetic Resources management to food security and sustainable development.

Tajikistan is the country with the most ancient history of an agricultural civilization, and up to the present days, agriculture is the main sphere of activity for the population and source of income for the economy. The share of agriculture in GDP is about 23-25%. Cotton and aluminum are the main export products. Marketing of agricultural products helps to get 30-35% income from export and 35-38% from taxes and levies. Thus, agriculture has great potential for stable economic growth, poverty alleviation and food security.

After independence, there were serious changes in the cropping patterns and production of important products. The government revised agricultural policy and oriented that to meeting people's demands in food products and reinforcing the economy. The government is concerned in increasing cotton production which brings hard currency to the national economy, and at the same time not reducing production of other food products. Private sector, including households, is firstly concerned with increasing food production which brings income. However, implementation of this strategy was complicated due to current problems in the economy of the country. Due to that only grain and potato production increased per capita, 185.3 and 207.0% respectively, but production of other food products per capita sharply reduced.

Tajikistan was described by Academician N.I.Vavilov as one of the centers of origin and diversity for many crop species. Tajikistan is the homeland for dwarf wheat, sphere grain wheat; the homeland of most legumes, like peas, lentil, chickpea, common bean, golden bean, horse bean. It is also the center of origin and diversity for rye, mustard, flax, safflower, cotton-guza, melon, pumpkin, carrot, onion, reddish, garlic. In Tajikistan huge diversity of fruit crops like pistachio, apricot, pear, apple, almond, walnut, fig and pomegranate are concentrated. From this center major fodder crops – lucerne, sainfoine, Persian clover and others originate.

There has been a huge loss in agricultural biodiversity during the last decades due to the introduction of improved varieties in major crops like wheat, rice, cotton and vegetables. Due to little varietal improvement work in minor or under utilized crops, there still exists a lot of diversity in mung bean (*Vigna radiata*), mash (*Vigna mungo*), berries, nuts and horticultural crops. The awareness created by various local, regional and international organizations about the importance of plant genetic resources has attracted the attention of policymakers, researchers and farmers for *in situ* and *ex situ* conservation and sustainable utilization of these resources. Recently the Republican National Genetic Resource Center (RNGRC) was established under the Tajik Academy of Agricultural Sciences. The RNGRC has the national mandate on conservation, evaluation and distribution of germplasm. The RNGRC has six laboratories for (i) exploration and collection, (ii) seed conservation, (iii) *in vitro* conservation, (iv) germplasm evaluation & characterization, (v) plant introduction and seed health and (vi) data management.

Significant contribution made by CGIAR centers like ICARDA and Bioversity International on development of *in situ* and *ex situ* conservation and sustainable utilization of plant genetic resources. First Genbank in Tajikistan was constructed by financial support of ICARDA. Although it was located in the temporary building constructed for the Farming Institute that buildings were destroyed by earthquake and did not have proper seed storage conditions and management system, it has been able to conserve more than 5 000 accessions of various crops. Recently started development project funded by Swedish International development and Cooperation Agency (Sida) implemented by NordGen is planning to improve the *ex situ* conservation system by constructing the modern National Genebank and training the staff from the National Plant Genetic Resources Center on use of genbank operations and database management. For *ex situ* conservation, the national program on collection, conservation and evaluation are underway but more needs to be done to fill in the gaps

in collection from various areas of the country particularly for the wild relatives of crop plants.

Regarding the utilization of these resources, a number of new varieties of cotton, wheat, maize, sorghum, fodder crops, food legumes, vegetables and horticultural crops have been developed which have contributed significantly in food security and sustainable development. Besides high yields, the introduction of these varieties has considerably supported the sustainable management of diseases like the yellow rust in wheat, virus diseases on potato, wilt on cotton, Aschochyta in chickpea.

Tajik researchers have close cooperation with ICARDA and Bioversity Int. who provide assistance in inventory, surveys, collection and conservation of PGR as well as data base development. First genbank was established by ICARDA assistance at the Farming Institute. Recently NordGen, at the financial support of Sida, initiated construction of a new genmbank with modern facilities in the Republican National Genetic Resources and training researchers in genebank management.

There are several regulations related to PGR issues adopted in recent years. However there is an urgent need in strengthening the legal base of conservation, collection and utilization of PRG. Tajikistan is signatory to Convention on Biodiversity and Cartagena Protocol and applied for a membership to the Union for the Protection of New Plant Varieties (UPOV), International Seed Testing Association (ISTA), OECD Seed Certification Schemes and International Seed Federation (ISF).

Future improvements on PGR conservation, collection and utilization require public awareness. It is important that everybody – starting from policy makers to people with any other background to understand the importance of conservation and efficient utilization of PGR. It should be understood that the PGR lost will never be reproduced. It is important that Tajikistan signs the International Treaty of PGRFA.

In the Database for GPA is collcetd information on 37 institutions working on PGR, apart that 6 difined as the main stakeholders in the monitoring of implementation of the GPA. Also information on 149 researcher, breeders and managers of institutions is collected. While preparaing the report reviwed 190 pulications of Tajik researchers (books, articles, catalogues, laws and regulations) that covers activities on PGR for the last 10 years.

legislations.

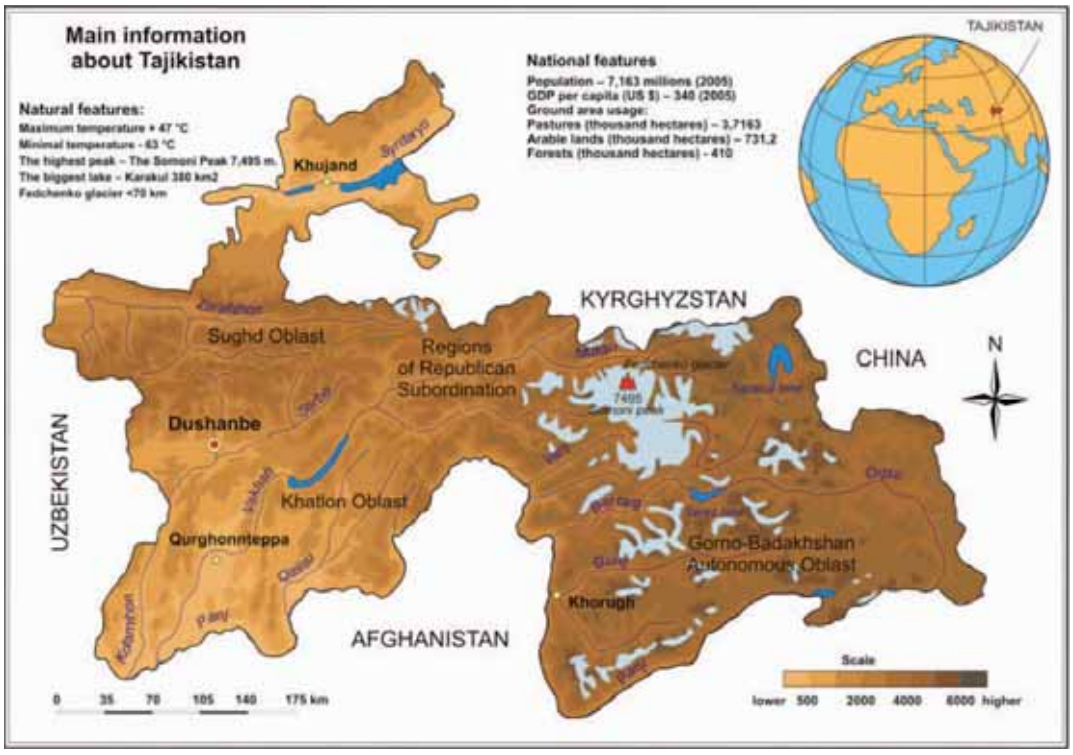
INTRODUCTION

Tajikistan is a landlocked country located in Central Asia. The total territory of the country is 143 100 sq. km (55 251 sq. mi). It is bounded by China in the east, Afghanistan to the south, and Uzbekistan and Kyrgyzstan to the west and north.

The elevation of the territory of Tajikistan above the sea level varies from 300 up to >7 400 m, which causes the wide contrast of soil-climatic conditions. 93% of the country's territory is occupied by mountains and hills. Climate of Tajikistan is sharply continental with hot summers, mild winters; semiarid to polar in Pamir mountains. Highest elevation is Qullai Ismoili Somoni 7 495 m.

FIGURE 1

Map of the Republic of Tajikistan



There is a diversity of soil type in Tajikistan, grouped in the following:

1. Grey serozem
2. Mountainous brown carbonate soils
3. High mountain meadow-steppe
4. High mountain steppe
5. High mountain desert steppe
6. High mountain desert soils
7. Nival zone.

In the valleys in the North and South Tajikistan the annual precipitation makes less then 200 mm, but in the foothills it increases up to 400-600 mm. However the precipitation is not evenly distributed and its biggest share comes during winter and early spring. The unique climatic conditions of Tajikistan mountains is expressed through decreasing the amount of precipitation by increasing the elevation above sea level. In Eastern Pamir there are high mountainous deserts with annual precipitation less then 100 mm.

Tajikistan is rich in water resources; it is ranked the ninth in the world for total availability of hydroresources and the second - on the volume of hydroresources per capita. Mountainous rivers allow to construct hydropower stations and to produce incredible amount of energy. The tallest hydropower station (HPS) in the world – Norak HPS is built in Tajikistan.

Average annual flow of surface water accumulating on the territory of the country is 64 km^3, or 55.4% from the total water resources of the Central Asian countries. Ground water, which is estimated at 18.23 km^3, is the basic source of centralized water supply in the country. There are about 8 500 glaciers covering 6% (8,6 thousand km^2) of the country. These glaciers contain about 500 km^3 of water, after melting it constitutes a considerable part of summer base flow. Besides glaciers, the country is rich in rivers and lakes.

In the wild flora of Tajikistan one can find a various species of plant that used for food and agriculture as wild or introduced crops. Especially rich flora diversity could be found in Zeravshan, Hisar, Darvaz and Badakhshan regions, where registered more then 3 000 species of high plants, when in the valleys there are only 800-900 species and in riparian forest ecosystem – 500 species. However most parts of these genetic resources are critically endangered, which requires taking preservation measures. On the result of land cultivation in 1970-80s area of riparian forest ecosystem was reduced by 3-4 times. Uncontrolled grazing of livestock caused changes in plant diversity, productivity of pastures and extinction of wild plant species.

Total area of the State Forest Fund of the Republic of Tajikistan makes 1 760 thousand ha, including 506 thousand ha of forest or 3% from the total area of the country. Juniper forest covers the main part (150 thousand ha) and located in the Northern part of the country. The area under pistachio trees makes 78 thousand ha, walnut - 10 thousand ha, tangled vegetation of saxaul (*Haloxylon*) - 12 thousand ha, poplar (*Populus* gen.) - 10 thousand ha, maple (*Acer* gen.) - 46 thousand ha and the area of other trees and shrubs makes more then 200 thousand ha.

The natural vegetation of Tajikistan annually produces over 80 million tonnes of land (31 mln.) and underground (48 mln.) phytomass, a considerable part of which forms valuable communities. The valuable communities of Tajikistan are forest, meadow, steppe, tugai, semidesert to desert, and semisavanna vegetation, a considerable part of which is relic, endemic, and endangered species. All these species are of a genetic, ecological, economical, food, and forage significance. Many species and their communities exist under extreme conditions and restricted environmental ranges in various mountainous ecosystems.

More than 70 species of valuable plant form independent flora formations. Among them the most valuable are: nuts (*Juglans regia*), apples (*Malus Sieversii*), maples (*Acer turkestanicum*), junipers (*Juniperus seravschanica*, *J. semiglobosa*, *J. turkestanica*, *J. sibirica*), birches (*Betula tianschanica*), sea buckthorns (*Hippophae rhamnoides*), populus (*Populus pruinosa*), elaeganus (*Elaeagnus angustifolia*), pistachios (*Pistacia vera*), common jujube (*Ziziphus jujuba*), figs (*Ficus carica*), hawthorns (*Crataegus pontica*), saxaul (*Haloxylon persicum*). Representatives of valuable plant associations occur almost on the whole territory of Tajikistan. A considerable part of them are high-productive pastures, hayfields, and food, medicinal, and technical resources. Grass communities are most diverse in composition and structure. They include 10 of 20 types of vegetation, 4 of them belong to subshrubs and 6 - to woody-shrubs.

Grass and subshrub associations make over 70% of arable lands (3.5 million hectares of pastures) and 90% of natural medicinal resources of vegetation origin.

The civil war (1992-1997) severely affected the already weak economic infrastructure and caused a sharp decline in industrial and agricultural production. The country is slowly recovering from the economic crisis and is trying to cope with the existing problems. GDP in 2007 was $11.82 billion that makes per capita $1 800. GDP indicator is still low and makes only 70% from the level in 1991. Real growth rate of GDP is 7.8% while the inflation rate is 13.2%. The main agriculture products are cotton, grain, fruits, grapes, vegetables; cattle, sheep, goats. The main industries of the country are aluminum, zinc, lead; chemicals and fertilizers, cement, vegetable oil, metal-cutting machine tools, refrigerators and freezers. Tajikistan is reach of such natural resources as hydropower, some petroleum, uranium, mercury, brown coal, lead, zinc, antimony, tungsten, silver and gold. The main export goods are aluminum, electricity, cotton, fruits, vegetable oil, and textiles. Total exports in 2005 reached $950 million f.o.b.

The total population of Tajikistan is calculated as 7.2 mln., more than 60% of that in the age below 16. Approximately 26 % of population inhabited in the cities and rayons and 74% - in rural areas. Total labor force is 2.1 million 67% of that involved in agriculture, 7.5% in industry and 25.3% in services. There is a tendency on increase on the population of the rural areas versus cities. The growth rate of population is very high that makes about 21 per 1 000 people. Inspite of measures taken by the Government on family planning (birth rate reduction), the nearest five years population growth in Tajikistan is not expected to reduce lower than 1.5% a year. Expected population in 2025 is about 8.7mln.

Increase of population leads to increase of demand on food that requires the measures to be taken to strengthen food security. Recent years, food consumption, especially of livestock products, per capita all over the country has

sharply reduced. Population has unbalanced food intake by other important food dimensions. At present, every citizen of Tajikistan consumes approximately 10% of the recommended physiological meat consumption rate, 19% of milk and dairy products consumption rate, 30% of sugar, 36% of fruit and berries, 56% of vegetables and melons, 68% of potato. About 90% of calories, proteins and fat is consumed by population through crop production, the most of which is bread (about 80%). WFP defined that 27 rayons in Tajikistan among 58 have "the highest" or "high" level of food insecurity (2002). People in the foothills have comparatively more access to food products than those who live in the highlands (Muminjanov, 2003). Absence of sufficient sources of income aggravates the state of food security in the households, and as the result, majority of young people have to leave agricultural sector and migrate to Russia and other CIS countries in search of a seasonal job.

Agriculture in Tajikistan is under transition to market economy and reforms are an ongoing process. The number of big farms is reducing by restructuring, land distribution and establishment of relatively small private dehkan (farmer) farms. The size of these private farms varies from 0.5 to 20-50 ha in the irrigating cropping system and 100-200 ha in the rainfed zone. Today agriculture sector covers more then 30 000 dehkan farms, 14 collective farms (kolkhozes), 18 state farms and 2 576 other kind agricultural enterprises, which make certain contribution to the development of the economy.

Both crop production and livestock husbandry are the core of Tajikistan agriculture. However crop production has bigger share in the total value of agriculture products (70-72%) then livestock husbandry (28-30%).

The Tajik farmers keep different types of livestock as cattle, sheep and goats, horses, donkeys, yaks and poultry. Due to weak control over this sector and chaotic slaughter of animals for meat during the last decade of 1990 total number of livestock sharply decreased. Reduction in poultry mainly was due to the weak veterinary control over diseases and lack of mixed fodder. Now number of livestock is slightly increasing. There are about 1 702 500 heads of cattle, including 864 300 cows, 3 798 400 sheep and goats, 78.5 thousand horses, 3 280 400 poultry, 171 300 donkeys, 15 200 thousand yaks and 118 600 families of honeybee consist livestock sector of Tajikistan. After collapse of the USSR, production of livestock products sharply reduced. Recent years annual production of meat makes 119 000 tons, milk – 583 600 tons, eggs – 111.2 mln.pcs, honey 1 975 tons.

Tajikistan has insufficient land because of geographic location and terrain, physical and mechanical soil features and difficult access to irrigated water and further expansion of agriculture areas is limited. Improper land use especially poor work of drainage networks aggravated the state of land reclamation, its degradation, raised the level water table and salinity. Soil erosion, especially water erosion causes serious problem in some rayons. Every year, about 30% of arable land is washed out and blown by the wind.

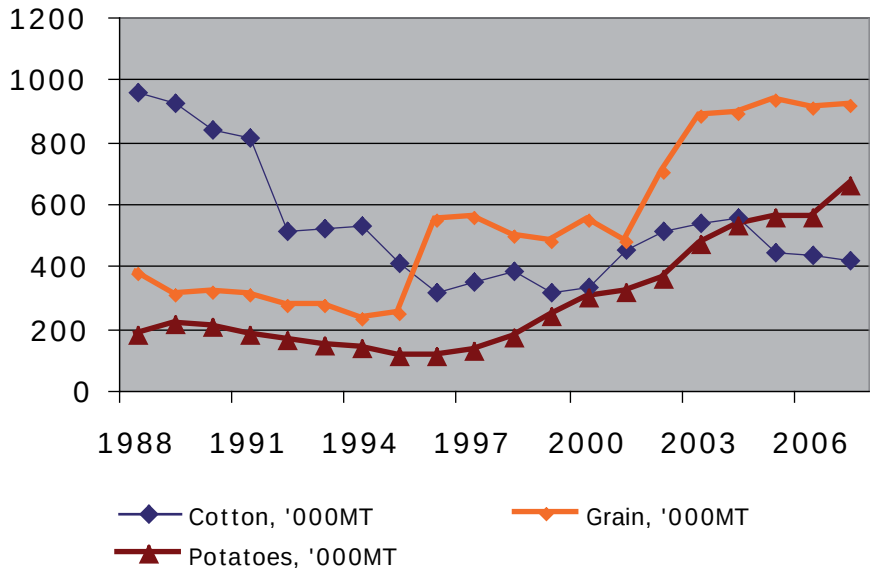
As the result,during recent years, area of agriculture land has been reduced that promoted the urbanization growth. For example, in 1998, agriculture land covered more than 4.2 million ha, but in 2007 it made about 3.9 million ha, 77% of that are pastures. Most part of pastures and hayfields is situated on the highlands and is also reducing. During 1988-2007 total pasture area has reduced to more than 200 thousand ha. In 2007, pasture area was 3,0 million ha among them – 1.5 million ha are summer and 1,1 million are winter pastures. Starting from 1988 area of arable land decreased from 856.9 thousand ha to 710.5 thousand ha in 2007.

The main types of agriculture raw materials used in other sectors of economy are cotton-fibre, cotton seeds, cocoon, tobacco, fruit and vegetables, meat, milk and wool. However, industry does not work in the full capacity, therefore products are partially processed.

Both species of cotton - medium staple (*Gossipiym hirsutum* L.) and fine fiber (*G.barbadenze* L.) are grown in Tajikistan. Fine fiber cotton acreage makes about 5 -10% of the total area occupied by the crop. Cotton is the main crop and most part of agricultural inputs and finances are contributed to production of this crop. However, after gaining independence, agricultural policy of the government was addressed to attainment of food security in general and grain independence in particular. At the same time, the focus is made on wheat growing since it provides approximately 60% of country with food products.

In 1980-ies, some farms had the cotton yield up to 3.5-4.0 tons/ha, and at present, this indicator does not exceed 1.6-1.7 tons/ha. In 2007, the average yield was 1.7 tons/ha, total production of raw cotton made 419.8 thousand tons. Therefore during the last decades the trend on reduction on cotton production and increase on grain and potatoes production was observed (fig. 2).

FIGURE 2
Trends on cash and food crop production, 1988-2007



Source: Agriculture Statistic Yearbooks. Dushanbe, 1988: 1999; 2007.

Tajikistan is famous for its delicious fruits - apricots, peaches, grapes, apples, pear, persimmon, pomegranates and citrus, cultivated both on large areas and on household plots. In foothill and mountain areas wild plantations of subtropical nuciferous - the pistachio, almond, walnut, as well as fig and mulberry trees.

Despite the increase of production of food products, Tajikistan still relies on import. The main imported products are grain, flour as well as meat, poultry, eggs, rice, buckwheat, confectioneries and vegetable oil. These products are imported from Kazakhstan, Uzbekistan and Russia, though some of them are produced in European countries, Iran and Turkey. In 2003, more than 3 700 tons of meat, 800 tons of milk and diary products, 2 700 thousand eggs and 32 thousand tons of vegetable oil were imported to the country. Annually about 250-300 thousand tons of grain and 130-200 thousand tons of flour is imported to the country. In addition to that there was provision on grain and flour through humanitarian organizations, but that has reduction trend.

The cropping areas with a feature of vertical zoning basically located at the elevation from 300 up to 1 500 m, and partially, regions of rainfed agriculture located at the elevation up to 3 000 m. However, experience shows that cropping in Pamir is possible up to 3 900 m, where vegetables, potato and barley can be successfully grown.

There are an irrigated and a rainfed cropping system in Tajikistan. Irrigated land is considered more effective for agriculture; however, its area is quite limited. As a whole, more than 85% from the main plant product's volume which is produced in the country is grown on the irrigated land. Due to deterioration of irrigation drainage networks and pumps, secondary soil salinity, irrigated arable area is decreasing. If in 1991, area of irrigated arable land in the country was 641.2 thousand ha, in 2007, it reduced to 593.6 thousand ha. Less than 0.07 ha of irrigated arable land is per capita.

Total area of rainfed land is 406.6 thousand ha. Most of this area is located on the zones which are less supplied and not supplied by precipitation. Rainfed agriculture is highly developed in upland agro-ecological zone. Grain cereals (wheat, barley, rye), legumes (pea, chick-pea, vetch, lentil) and oil crops (flax, sufflower), as well as fruit trees and vineyards are grown on the rainfed land.

Rainfed land of Tajikistan is divided in the following groups according to the level of precipitation:

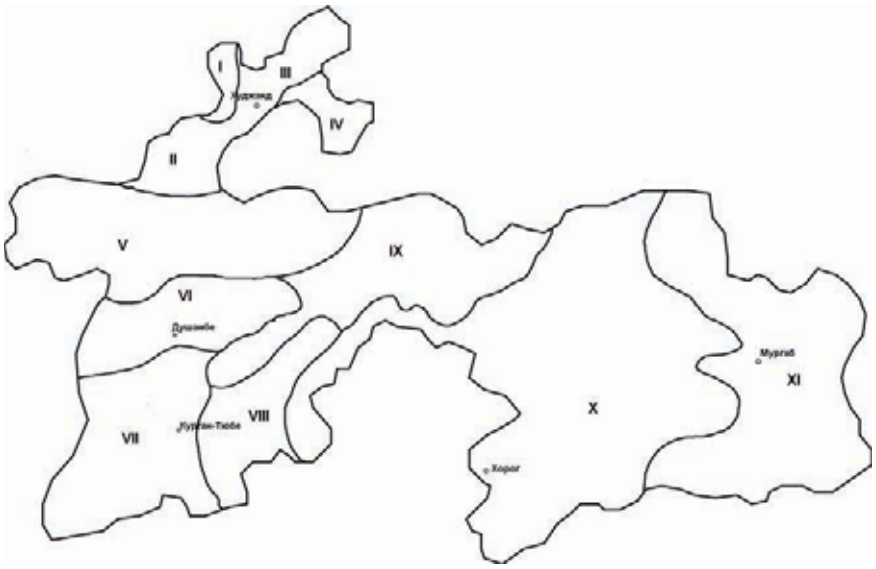
- Non-supplied – less than 250 mm precipitation per year.
- Partially–supplied – 250-350 mm.
- Supplied – 250-500 mm.
- Well supplied – more than 500 mm of precipitation per year.

In 1961, while creating scientific system of agriculture in Tajikistan, F. N. Bochkovsky and V.Ya. Kuteminsky developed zoning of the country on the base of farming perspectives and natural characteristics. Thus, the whole territory of the country was divided into 6 natural and farming rayons: I - Vakhsh (Kurghonteppa); II – Hisor; III – Kulob; IV – Leninabad (Khujand); V – Garm; VI – Pamir (GBAO).

In 1964, L. N. Babushkin, taking into account natural and orographic boundaries, which more or less affect the whole complex of weather formation, distinguished 11 agro-climatic zones: I – Dilvarzin; II – North–Turkistan; III – Kuramin; IV – Isfara; V – Zarafshon; VI – Hisor; VII – Vakhsh; VIII – Kizilsuy IX – Karotegin – Darvoz; X – West-Pamir and XI – East Pamir (Fig. 3).

FIGURE 3

Agro-climatic zones of Tajikistan by L. N. Babushkin (1964)

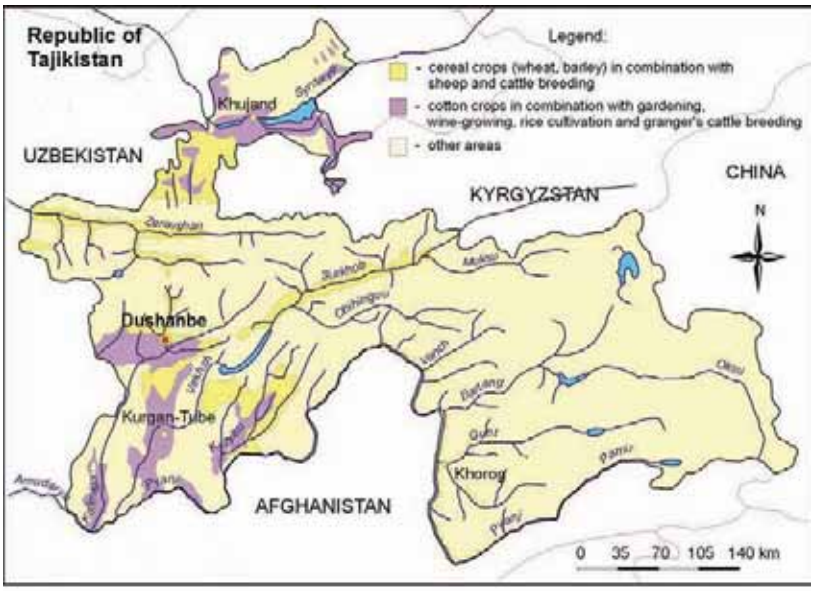


It should be noted that agro climatic zoning by L. N. Babushkin is fundamental. It is not outdated and is used by Tajik scientists at different research work till now. However, a group of consultants from ADB Project (ASAP, 2001) making an assessment of agricultural sector of Tajikistan and with the aim to group climatic zones more globally, conditionally divided the whole territory of the country into main 4 agro-climatic zones:

- Hot, dry, comparatively fertile valleys in the South;
- Hot, dry, comparatively less fertile valleys in the North;
- Cool and at some places humid zones in the foothills;
- Cold, dry, less fertile highlands in the East.

The main criterion for this work was the elevation above the sea level, although research workers took into account other climatic indicators.

FIGURE 4
Cotton and cereals growing zones



Source: Ministry of Agriculture

First agro-ecological zone

Valleys in the South – covers southern plains from 350 to 800 m. above the sea level, winter is moderate, summer is very hot, rainfalls reach 150-250 mm. Here basically cotton, rice, lucerne, wheat, vegetables and maize as well as subtropical fruit trees (lemon, orange) are grown (figure 2).

This zone covers the most part of Khatlon area, some areas of which are located in a foothill agro-ecological zone. In lowlands of west and south of oblast there are large cotton-growing farms. Irrigation systems supply more than 320 thousand hectares of lands, or 16 % from the total area of oblast. As the most part of lands of this zone is irrigated, a living standard of the population strongly depends on proper functioning of the irrigation system. The water in irrigation system comes from large rivers – Kofarnihon, Vakhsh and Panj, originating from glaciers of Hissar mountain range, mountain chains Alai and Pamirs.

The second agro-ecological zone

The valleys in the north - includes northern valleys of the country at elevation from 270 up to 800 m above the sea level, where the winter is cold, and summer is very hot; the annual amount of precipitations makes up 150-250 mm; here basically cotton, wheat, rice, lucerne, vegetables, fruit trees (mainly apricot), maize and sorghum are grown (figure 2).

This zone includes rayons of Sogd oblast, though; some of areas belong to a foothill agro-ecological zone. As in Khatlon area, here also on the most part of irrigated lands cotton is grown. The basic source of water for the northern part of the zone is the river Syrdarya, and for the western part – the river Zarafshon. In the northeast part of the country the main source of irrigated water is underground pumped water.

The third agro-ecelogical zone

A zone of foothills - covers foothill areas of Tajikistan at the elevation of 800-2 000 m above the sea level, where the winter is very cold and summer is hot; here 200-650 mm of precipitations per year fall out; mainly cereals, potatoes, fruits, vegetables, melons and gourds, lucerne and maize are grown (figure 2).

This zone does not correspond to administrative division, as it includes foothill rayons of Khatlon and Sogd oblasts as well as RRS and some rayons of GBAO. In most cases a part of one rayon enters a foothill zone, and another part - one of first two zones. Comparatively small part of lands in this zone is irrigated, and in some rayons the water pumped to the large height. Cotton is not grown in this zone; the main crop is cereals.

The fourth agro-ecological zone

A mountain zone. These are mountain rayons at the elevation over 2 000 m above the sea level, where the winter is extremely cold, the summer is warm, more than 200 mm of precipitations fall per year; basically wheat, barley, oats, potatoes and lucerne are grown. (figure 2). This zone mainly covers rayons of GBAO. The zone radically differs from valley zones, and the problem is not only in limited land, but also conciseness of the period of crop cultivation. In the USSR the main activity of population in this zone was livestock husbandry, for which the feeds were delivered, there were the largest pastures. Now feeds are not delivered any more, and opportunities for the development of agriculture are limited.

CHAPTER 1

THE STATE OF DIVERSITY

1.1 The State of Diversity of Plant Genetic Resources for Food Security

The diversity of flora and fauna of Tajikistan was the main attraction point for researchers from early days. Several expeditions were conducted by Marco Polo, German, British and Russians to explore native nature of Tajikistan. Therefore Academician N.I.Vavilov visited Tajikistan in 1916 and 1924 with scientific expeditions and included Tajikistan to the Central Asian center of crop origin (1935). Later on this center was combined with other core areas and became part of South-West Center (1987). In Pamir N.I.Vavilov discovered and fixed 37 new forms of bread and 10 forms of dwarf wheat. Comparable study of collected plant material allowed him to announce in the botanical literature on discovery within Pamir bread wheat of *Triticum* L. specie forms without ligule (6). He discovered and described 9 diversity of liguleless forms (*pamiricum, schugnanicum, horogi, oxianum, gunti, kabulicum, afganicum, tadjicorum* and sub. *gunti*), 16 forms of bread wheat with ligule (*albinflatum, lutescense, lutinflatum, alborubroinflatum, milturum, graecum, erotrospermum, erutroleucon, ferrugineum, pseudoturcicum, barbarosa, coeruleoflutumum, meridionale, pseudomeridionale, hostianum, turcicum*) and 9 diversity of liguleless forms of rye.

From this center a number of crop species have been originated. Hewe was found the huge potential of diversity of bread wheat. This center is a homeland for the main food legumes, as pea, lentil, mungbean, checkpea, golden bean, horse bean, etc. and defined as a center of origin and diversity for rye, coleseed, (*Brassica campestris*), mustard, arucola (*Eruca sativa*), linen, flax, coriander, safflower, cannabis, cotton-guza, melons, gourd, carrot, turnip, reddish, onion, garlic, spinash and basilica. Here is a concenntration of the genepools of fruit trees – pistachio, apricot, pear, almond, vine grape, apple, walnut, qween-apple, pomegranate and fig. From this center of plant diversity originate main important fodder crops – Lucerne, sainfoin, Persian clover, *vicia*, etc.

The various native crops of the region and introduction during the period of time are given in Table 1.

TABLE 1

Crop species native or introduced in Tajikistan

Native	Introduced
Grain Cereals	
Bread wheat (*Triticum vulgare Vill.*), dwarf wheat (*Triticum compactum Host*), round-grain wheat (*Triticum sphaerococcum Perc.*), rye (*Secale cereale* L.), millet (*Panicum miliaceum*) and oats (*Avena sativa* L.)	Maize (*Zea maiz* L.), rice (*Oryza sativa* L.), buckwheat (*Fagopyrum esculentum*)
Legumes	
Peas (*Pisum sativum* L.), lentil (*Lens esculenta Moench*), common beans (*Vicia faba* L.), lathyrus (*Lathyrus sativus* L.), chickpea (*Cicer arietinum* L.), golden bean (*Phaseolus aureus Roxb., P. mungo*),	Soybean (*Glycine max* L.),
Fodder crops	
Lucerne (*Medicago sativa* L.), Persian clover (*Trifolium resupinatum* L.), common vetch (*Vicia sativa* L.), sainfoin (*Onobrychis altissima Grossh.*), fodder beat (*Beta vulgaris* L.)	
Oil seed crops	
Turnip (*Brassica campestris* subsp. *Olietera Metzg.*), mustard (*Brassica juncea Czern.*), arucola (*Eruca sativa Lam.*), linen (*Linum usitatissimum* L.), sesame (*Sesamum indicum* L.), safflower (*Carthamus tinctorius* L.)	Sunflower (*Helianthus annuus* L.), oil seed rape (*Brassica napus* var. *oleifera* L.)
Fiber crops	
Cotton-guza (*Gossipium herbaceum* L.), cannabis (*Cannabis indica Lam.*)	Medium staple cotton (*G.hyrsutum* L.), fine fiber cotton (*G.barbadense* L.)
Vegetable and melon/watermelon crops	
Melon (*Cucumis melo* L.), calabash (*Lagenaria vulgaris Ser.*), carrot (*Daucus carota* L.), turnip (*Brassica campestris* L.), reddish (*Raphanus sativus* L.), onion (*Allium cepa* L.), garlic (*A.sativum* L.), spinach (*Spinacia oleracea* L.), portulaca (*Portulaca oleracea* L.)	Potatoes (*Solanum tuberosum* L.), tomato (*Lycopersicon esculentum* L.), pepper (*Capsicum annuum* L.),

Native	Introduced
Spices & condiments	
Basilic (*Ocium basilicum* L.), cumin (zira) (*Binium persica* L.)	
Fruit plants	
Pistachio (*Pistacia vera* L.), apricot (*Prunus armeniaca* L.), pear (*Pyrus communis* L.), almond (*Amygdalus communis* L.), oleaster (*Eleagnus angustifolia* L.), grapes (*Vitis vinifera* L.), walnut (*Juglans regia* L.), apple (*Malus pumila Mill.*), fig (*Ficus carica* L.), pomegranate (*Punica granatum* L.), queen-apple (*Cydonia oblonga Mill.*), plum (*Prunus divaricata Led.*), cherry (*Cerasus avium* (L.) Monch), barberry (*Berberis vulgaris* L.),	Persimmon (*Diospyros lotus* L.), lemon (*Citrus limon*), Common jujube (*Zizyphus sativa Gaertn.*), tangerine, orange

Source: Vavilov, 1935; MoA, 2007

As less then 6% of country's territory is used for crop production, the diversity of genetic resources provides the sustainable basis for food supply and security. A variety of crops like cotton, wheat, rice, maize, barley, sorghum, tobacco, chickpea, mungbean, lentil, groundnuts, sesame, onion, cucumber, tomato, garlic, melon watermelon, pumpkin and various other vegetables and fruits are cultivated in Tajikistan. The trends in area, yield and production of most of the crops for the last decades are given in Table 2.

TABLE 2

Trends on the area. Production and yield of important crops in Tajikistan,1991-2007

Crop	1991			2007		
	Area, '000 ha	Yield, t/ha	Production, '000 tons	Area, '000 ha	Yield, t/ha	Production, '000 tons
Cereals						
Wheat	143.59	1,0	153.12	307.96	2.3	649.30
Rice	9.4	2.7	25.76	10.80	3.0	52.10
Maize	15.25	3.9	60.42	11.38	4.0	130.07
Barley	45.99	1.1	50.34	51.45	1.6	71.03
Rye	1.96	1.0	2.05	0.23	1.0	0.24
Oats	3.37	0.9	3.31	3.12	1.1	3.45
Industrial Crops						
Cotton, total	298.83	2.76	814.249	254.83	1.66	419.78
Including:						
Medium Staple (*Gossypium hirsutum* L.)	235.90	2.64	623.749	240.292	1.62	391.46
Fine Fiber (*Gossypium barbadenze* L.)	62.93	3.03	190.500	14.538	1.94	28.32
Tobacco	4.23	2.62	11.077	0.374	1.47	0.51
Food Legumes, total	11.84	0.750	8.876	11.790	1.07	24.65
Including:						
Lentil	1.72	0.71	1.23	1.232	0.76	0.51
Peas	1.87	0.55	1.02	5.743	0.76	5.24
Oilseed crops, total	5.32	0.53	2.84	26.716	0.54	14.55
Including:						
Flax	3.80	0.42	1.60	18.64	0.46	8.19
Melon and watermelon	10.50	8.70	175.00	11.12	18.90	254.17
Potato	12.81	14.10	180.89	29.75	21.84	662.09
Vegetables, total	28.02	19.30	627.81	39.11	19.02	835.13
Fodder crops						
Fodder beet	2.37	34.50	82.57	0.39	16.63	6.51
Perennial grasses	110.00	67.7	25.52	38.52	14.4	47.13
Fruits	78.70	3.21	69.8	91.36	2.25	157.2
Grapes	37.10	4.45	92.60	36.22	3.56	116.9

Source: Vavilov, 1935; MoA, 2007

Besides the crops mentioned above, a number of other minor crops like buckwheat, millet, golden bean, mungbean, horse bean and various medicinal plants are being grown particularly in the Northern, Central and Eastern mountains for a very long period and rich genetic diversity is found in these crops. The main popular fruits of the country are apple, peach, plum, apricot, pomegranate, grapes, walnut, pistachio, almond, persimmon and others.

Besides the variety of crops under cultivation, a large number of wild relatives to many crop species are found in Tajikistan, which is mainly distributed in mountains of Hisor, Darvoz and Badakhshan. During the expeditions conducted by Pamir Biology Institute under supervision of R.A.Udachin and F.G.Negmatulin were collected not only already fixed for Pamir area diversity, but also discovered new, unknown in botany forms. Only on *T. aestivum* L. were found 24 accessions diversity: a) with ligule – *navrozkyi* Udacz (analog var *alborubrum* by type of spike *speltiforme*); *schrederi* Udacz (analog var. *multurum* by type of spike *speltiforme*); *golbekii* (analog var. *erytholeucon* by type of spike *speltiforme*); 6) without ligule – *petropavlovskianum* Udacz (analog var. *transcaspicum*); *ischkaschimicum* Udacz et. Sch. (analog var. *heraticum* Udacz); *nicolai* Udacz.(analog var. *suberythroleuconinflatum*); *suchobrusianum* Udacz (analog var. *subperrygininflatum*); *raikoviae* Udacz (analog var. *submeridionalinflatum* Udacz); *baranovii* Udacz (analog var. *subbarbarosinflatum*); *subtadjicorum* Udacz et. Sch. *flaksbergeri* Udacz (analog var. *submeridionale*); *dorofeevii* Udacz et. Sch. (analog var. *subgostianum*); *baruschanicum* Udacz (analog var. *coesioides*); *gorbunovii* Udacz (analog var. *meridionale*); *guasibarbaroza* Udacz, *ruchsianum* Nigm (analog var. s*uberythrosperminflatum – quasimeridionalinflatum* Nigm) and *japschorvii* Nigm (analog var. *hostianum*). From T. *compactum* Host. group discovered and described 4 accessions without ligule: *nigmatullinii* Udacz et. Sch. (analog var. *erinacinflatum*); Vysoskyi Udacz et. Sch. (analog var. *erenacem*); *saresicum Nigm* (analog var. *icterinum*) *и* Nigmatullini Udacz (analog var. *echinoides*). It was mentioned that T. *spelta* L. (analog var. *tarakanovii* Udacz) without ligule also was found.

In Mountaneous Badakhshan zone in total 151 accessions of wheat, including 107 bread wheat, 33 dwarf forms were discovered and 11 forms belonging to other species, obviously were introduced. The richest diversity of wheat was discovered in the Territory of Bartang River, upper part of Vanj (Poymazor) and Shohdara River.

1.2 The State of Crop Diversity

1.2.1 Cereals

Bread in Tajikistan, as in all other Central Asian countries, is the staple food product for the population, and wheat growing is one of the most important spheres of agricultural activity for Tajiks. Grain production annually makes about 850-930 thousand tons that 2-3 times higher than amount produced in 1980s, from which 75-80% is produced by private sector. Most part of grain crops grown in Kahtlon Oblast, there 55-60% of total production in the country is produced. Contribution of Sogd Oblast to the "bread basket" of the country is 20-22%, RRS – 17-19% and GBAO – 2-4%. However, there is no difference in grain yield from region to region that is very low and is about 1.5-1.7 tons/ha. Among cereals wheat is a leading crop. Over the last 10 years wheat areas all over the country increased to almost 2,5 times. Wheat occupies 330 000 – 340 000 ha scattered over a wide range of ecological regions that makes 84% from total cereals area and 85% of total grain produced. Expansion of wheat acreage led to epiphytotic changes and fungal diseases. In comparatively humid years, when the level of precipitation is higher than usual, outbreak of yellow rust is observed, which affects all varieties grown. Presently most of the area is occupied by improved varieties, but local land races still exist in high mountains in Badakhshan region due to local preferences or non-availability of improved varieties suitable for these areas. The local land races of wheat are of great importance for quality and their tolerance to diseases, but they are not tolerant to lodging. Therefore most wheat land races are grown in mixture with the horse bean.

Rice second to wheat makes a notable contribution into the food security of the population of valleys in the country. Rice is one of introduced crops in Tajikistan, which is well adapted under climatic conditions of the country. During the last years rice acreage has sharply extended, and its production also increased. Annual production of rice with total acreage of about 11 thousand ha makes 52 thousand tons. 40-42% from the total area of rice is allocated in household plots, and they produce about half of the total production in the country. In most cases rice is cultivated as a second crop in the double cropping system and it is a huge reserve for the increase of efficiency of crop production and attaining food security.

There some other grain cereals as barley, oats and rye are grown relatively in small areas and used mainly for feeding livestock.

1.2.2 Legumes

The area under legumes is 11-12 thousand ha and it is an important group of food crops providing proteins. Among legumes, the pea, chickpea, lentil, mungbean, mash bean, cowpea, horse bean, and common bean constitute important gene pools of various legumes. Diversity occurs in plant type, days to maturity, pod size, shape, grain colour etc. Some of the germplasm has been identified to be resistant to diseases and abiotic stresses. New varieties of legumes have been developed by the Tajik breeders in 1980-s. Presently, there is a close cooperation between the Farming Institute and ICARDA on testing new germplasm and developing new varieties of chickpea, lentils, etc. Due to introduction of foreign varieties and development of new varieties erosion of various landraces / varieties of legumes could be observed. Despite efforts by International NGOs on introduction of legumes as the main source of protein for improving livelihood of the households, local people prefer to grow and to consume the landraces of mungbean and golden bean (mash). The landraces of horse bean are still grown in high mountains. The grain is used as food and the stems as firewood that makes people grow it.

1.2.3 Fodder crops

Production of different fodder crops is one of the main conditions for development of livestock husbandry and increase of its outputs. In Tajikistan mainly lucerne and maize are grown for production of green biomass and forage, sugar beet and fodder beet, and mixture of various legumes and cereal grasses cultivated as fodder crops. Sometimes, grasses and legumes are inter-cropped. Some of the wild relatives to these crops are also available in various ecologies. Beside this, hayfields and pastures were the important source of grazing animals. However, due to uncontrolled grazing the erosion of genetic diversity of pasture plants is very often observed. The dominant pasture plant species are the following: cock's foot grass (*G. dactylis glamerata* L.), foxtail grey (*G. alopecurus pratensis* L.), meadow bluegrass (*Poa pratensis* L.), fescue grass (*Festula sulcata* L.), Allay Fescue grass (*F.alaica*), sedge (*Carex stenophylloides* L.), Andaulian locoweed (*Astragalus andaulgeusis*), Olga locoweed *(A. olga*), Trigonella (*Trigonella pamirica*), Alpine Forgerons – (*Myosotus suaveoiens*), Artemisus (*Artemisus lehmaniona*), persicara (*Polygonum trifolium*), zizifora (*Zizifora pamiskaya*), senecio (*Senecio renordi*), Carnation Zeravshanica (*Dianthus serovshanicus*), Adonis (*Adonis turcestanicus*), aconite (*Aconitum seravshancum*), wild purslane (*Euphorbum serovshanica*), etc.

1.2.4 Oil seed crops

Despite the diversity of oil seed crops originated from Tajikistan, most of oil is produced from cotton seed. More then 50% of cooking oil is imported from other countries like Russia, Iran, Turkey and China. However farmers grow in marginal areas such oil seed crops as flax, safflower and sesame for extracting oil in local conditions. Indigenous crops express a wide diversity in morphological traits and response to various stresses. Introduction of sunflower and soybean in early 1980s for oil production was not successful due to socially non-acceptance and absence of processing facilities. During recent years there have been some attempts by International Community and local entrepreneurs to introduce rape seed in Tajikistan.

1.2.5 Fiber crops

Cotton-guza (*Gossipium herbaceum* L.) and cannabis (*Cannabis indica Lam.*) are the main indigenous fiber crops in Tajikistan. However cotton has a dominant position with the introduction of G. *hirsutum* and G. *barbadenze* groups. Cotton is the major cash crop, cultivated on valleys above 800masl. Therefore all cotton varieties are improved and there are local landraces being grown recently. Fine fiber cotton G. *barbadenze* that acreage makes about 5-10% of the total area occupied by the crop has higher value in terms of fiber. In 1980-ies, some farms had the cotton yield up to 3.5-4.0 tons/ha, and at present, this indicator does not exceed 1.6-1.7 tons/ha. In 2007, the average yield was 1.7 tons/ha, total production of raw cotton made 419.8 thousand tons. Therefore during the last decades the trend on reduction of cotton production was observed.

1.2.6 Horticultural crops

A wide range of fruit species like apricots, peaches, grapes, apples, pear, persimmon, pomegranates and citrus are cultivated in Tajikistan. These possess wide genetic variability in fruit size, shape, colour, maturity time and quality etc. These fruit species have been diversified through human selection over hundreds of years.

Apricot is widespread throughout Tajikistan and is grown at the altitude of 330 meters (Aivaj village, Shartuz rayon) up to 3 000 masl (Langar village, Ishkashim rayon). However the main area for industrial cultivation of apricot is located in the valleys, piedmonth and mountains with altitude up to 2 000 masl. The main zone of its cultivation is situated in the northern areas of Tajikistan, mainly in Isfara, Kanibadam, Khujand, Aini and partially Asht districts. Area of apricot orchards in Tajikistan is 24.4 thousand hectares, 93% or 22.7 thousand hectares out of them are located in Soghd Oblast. The local genepool of apricot in Tajikistan includes more than 300 varieties and forms, identified and characterized for the moment.

Persimmon is absolutely new subtropical plant for Tajikistan. By selecting the best introduced varieties and development of crop management according to climatic conditions of the region persimmon has got a status of the main subtropical crop, especially wildly grown by private sector. The first introduced varieties of persimmon were Khiakume, Zendjimaru, Gosho-gaki, etc. and this assortment was enhanced by the new varieties developed by Tajik breeders like Vostok, Gissarskiy, Vakhsh and Tajikskiy. Another introduced plant is common jujube (*Zizyphus sativa Gaertn.*). The first introduced varieties were Tayan-Czao and Uzyn-khun, which have Chinese origin. Later on new varieties as Gissarskiy, Yujanin, Burnim, Pervenec, etc. were bred by Tajik breeders.

Wild plantations of subtropical nuciferous - pistachio, almond, walnut, as well as fig and mulberry are grown in foothill and mountain areas. The population stores up these fruits for winter, and prepares various sweets from berries. Over the last 15 years due to the shortage of agriculture inputs and funds, the state of orchards and vineyards became very poor. For a long time such prophylactic and crop management measures as pruning, application of pesticides and insecticides to control weeds, pests and diseases on large areas are not conducted. Infestation of dangerous diseases of fruit trees, such as tetters and various moulds, appearance of such pests as mulberry pickleworm, whitefly, Turkistan brown-tail moth, fruit worm etc., is also connected to it. The average production of fruits and berries in recent years makes 150-160 thousand tons and grapes 100-116 thousand tons.

The grapes grown in Tajikistan include land races of *Vitis vinifer*a, V. *hissarica* and V. *darvazica*. Anti-alcoholic campaign taken place in former USSR late 1980s severely affected grapes diversity in Tajikistan. Hundreds of hectares of grape plantations were destroyed in a short time that resulted in genetic erosion of crop diversity.

More than 30 species of vegetables are grown in Tajikistan. Due to importing new varieties and hybrids and lack of seeds of local varieties, the rate of genetic erosion has been very high in major vegetables like cucumbers, tomatoes, onions, cabbage, carrots, radish, black raddish and turnips etc. Local cucumber variety Benazir, tomato variety Faizabad and onion Dusti, which are widely grown in Tajikistan in recent years, are slowly disappearing. The indigenous diversity is still found in cucurbits, bitter gourd, spinach, *Brassica* spp., etc.

Potato is an introduced crop that became one of the basic food sources in Tajikistan. It is truly named "additional bread" and it satisfies 7 % of population's needs in basic food products. The basic potato-growing zones of Central Asia, including Tajikistan are considered mountains and foothills, the soil-climatic conditions of which are suitable for potato production. However, the yield of all crops remains very low. Lack of certified seed of improved varieties, mineral fertilizers, chemicals, fuels and machinery, are the main constraints for increasing yield. The crisis that stroke the economy and agriculture of Tajikistan after getting independence, also strongly affected the potato production of the country. Several International Donor Organizations were involved in importation of seed potato of different varieties. Annual production of potatoes in recent years makes about 600-650 thousand tons that in average makes about 90 kg per capita.

1.3 State of Diversity of Wild Crop Relatives

The main characteristic of the Tajik mountains is the wide growth of wild plantations. In many cases there is no exact demarcation between wild and cultivated plants. Among 276 species of Pamir-Alay dendroflora, the share of wild fruit trees makes 74 species, including species *Rosa* L., berries and nuts. Most cultivated forms and varieties of fruit trees derived from about 30% of these species. Wallnut (*Juglans regia* L.) and pistachio *(Pictacia vera* L.) have been cultivated after using their wild forms for a long time, after selecting the best forms in the wild populations. The breeding of modern varieties of walnut and pistachio is based in these species. In some part of Pamir, where it is most suitable climatic condition for growing seedcrop fruit trees, the main plantations of wild apple *Malus silversii* (Lebed.) could be found. A number of

local varieties bred just by domestication and future selection of the best forms and cultivation in better conditions for a long period of time. There is also a wide diversity of pears like *Pyrus tadshikistanica* Zapr., P. cajon Zanp., P. *korshinskii* Litv (=P.*bucharica* Litv.), as well as the local varieties with stong branches and long life Tanamrud, Safedamrud, Taramrud, Nor, Vay-vay, Nospoti, Amrud have been discovered in the mountain regions of Tajikistan. In Rushan Rayon one can find cultivated form of pear Shulvi that has panicle type of flowering and fruit formation. Discovered and described forms of pear in Pamir regions without further selection could be grown in the small farms and house yards. On the result of selection conducted for many years in the forests and gardens from forms *Prunus cerasifera* Ehrh. (P. *sogdiana* Vass.), P. *darvasic*a Temberg, P. *tadshikistanica* Zapr. a new form P. *cerasifera* (alicha) was developed.

1.4 Wild Plants for Food Production

In 12 books "Flora of Tajik SSR" (1957-1991) a number of useful wild plants are described, however, most of them are not cultivated, plus colletion and utilization is limited in the natural conditions. In the forest of Tajikistan a wide range of wild plantation are grown for food production like walnut (*Juglans regia* L.), pistachio (*Pictasia vera* L.), fruits of wild apple, pear, hawthorn, grape, barberry, seabackthorn, wild onion (anzur), rhubarb, the seeds of *Binium persica* (zira). The following species are used as the medicinal plants: great nettle (*Urtica dioica*);, John's wort (*Hyperiaim*);, old-mans-pepper (*Achillea millefolium*), marjoram (*Origanum*), beggar-ticks (*Bidens*), balm (*Melissa*). The roots of nardus (*Inula*), licorice (*Glycyrrhiza*), the flowers of tansy (*Tanacetum*), the leaves of plantain (*Plantago*), bull's-foot (*Tussilago farfara*), fruits of roseberry and jujube collected to be used as a medicine. The plants of *Ungernia Victorii* ephedra also collected for that purpose. Due to intensive collection of wild plants there is a risk of loosing the genetic resources of such species as *Binuim persicum* (Boiss.) B. Fedtsch, *Rheim maximoviczii* Losinsk., *Ferula violacea* Korov., *Allium fedtchencoanum* Regel, A. *oschaninii* O.Fedtsch., A. *cepa* L., A. *satuvim* L., *Prunus nachichevanica* S. Kudr., etc.

1.5 Diversity of Modern Selection Varieties

Crop varieties grown in Tajikistan are presented by wide genetic diversity. The main part of the crop varieties grown in Tajikistan are breeding varieties and described with the best value for cultivation and use. Cultivated varieties have high yield potential, adopted to environmental conditions, tolerant to abiotic factors and resistant to diseases and pests. According to the legislation of the Republic of Tajikistan a new variety needs to be officially tested for VCU during 3 years. The best varieties, which are superior to the existing standard one are registered in the Catalogue of commercial varieties and are released. In the catalogue, published in 2008 only 310 varieties of 65 crops registered, out of which 190 varieties are foreign and 120 bred by local breeders (table 3).

TABLE 3
Number of Crop Varieties Released in Tajikistan

Crops	Total	Foreign		Local	
		Number	%	Number	%
Industrial crops	26	8	30.77	18	69.23
Grain cereals	30	11	36.67	19	63.33
Fodder crops	16	3	18.75	13	81.25
Legumes	15	4	26.67	11	73.33
Oil seed crops	6	2	33.33	4	66.67
Vegetables	64	55	85.94	9	14.06
Melon/Watermelon crops	15	10	66.67	5	33.33
Pome fruit crops	31	30	96.77	1	3.23
Stone fruit crops	47	30	63.83	17	36.17
Berries	26	16	61.54	10	38.46
Citrus crops	4	4	100.00	0	0.00
Subtropical crops	16	11	73.33	5	33.33
Nuts	12	6	50.00	6	50.00

Crops	Total	Foreign		Local	
		Number	%	Number	%
Bushes	1	0	0.00	1	100.00
Total	**310**	**190**		**120**	

Farming and Horticulture Institutes released more than 90% of the varieties released in Tajikistan by breeding centers from 1980 up to present. Cotton occupies the first place among the other crops in terms of the number of released varieties, which is equal to 17. It is followed by vegetables and fruits with 15 varieties being released during the assessed period. About 8 and 6 varieties have been released for wheat and others small grain crops, respectively. Potato varieties, used in commercial production, are mostly imported from abroad (western countries) or released before the assessed period. No varieties have been released by the local breeding centers for rice during the assessed period. In addition, utilization of locally selected varieties by large farmer holdings was observed to be declining since introduced varieties of a number of crops started to occupy large area. Hence, some locally selected varieties have disappeared completely due to inappropriate conservation facilities of *ex situ* collections in the past. Locally selected variety of barley like Javi bapust is an example.

In the monitoring of GPA implementation database there is data regarding 479 varieties being cultivated, their genealogy and origin, among which 304 are released and are eligible for protection. Research has shown, that only 30-35% of them are in wide use in the agricultural system of Tajikistan. Apart from the released varieties there is a number of those, cultivation of which is permitted in Tajiksitan. Those are wheat varieties Jagger, Sultan-95, Atai-85, Umanka, Krasnodarskaya-99, Basribey-97, etc., barley varieties - Dobrynia-3, Khutorok, Fedor, Kondrat, tomatoes – Titan, Finish, Volgogradec, Santyago, etc., potatoes – Sante, Kondor, Kosmos, Picasso, etc. as well as a number of varieties of sweet pepper, cucumber, eggplant, carrot, bulb onion, raddish, etc.

Apart from the mentioned varieties the variety of bread wheat is widely cultivated in Tajikistan named Jagger, which was tested within the framework of the GTZ-CYMMIT «Regional network of wheat variety promotion and seed production», and further on seeds in high volumes were imported at the support of the World Bank. This variety is predominantly sown since 2001.

Research work with vine was oriented to breed new varieties, appropriate for cultivation, under rainfed conditions in the Central and South-Wested part of Tajikistan. As a result of the research 9 varieties of vine have been bred, 3 of which were released – very early maturing table variey Gissarski early maturing and Zarif, as well as table-rasin medium to late maturing vatiety Anzob.

As a result of breeding work and collective study of of vegetable crops and potato, new cabbage varieties have been bred and released – Dushanbinskaya late maturing, of carrot – Mshaki red, cucumbers – for pickling Gissarski, Tajikski early maturing 18, to be consumed fresh Benazir, onion Peshpazak, Dusti, garlic – Dushanbinski 2, melon – Bukhori 33, Sari Kaun 31, water melon – Vakhshski temnokori, pumpkin – Leninabadskaya perekhvatka, potato – Zarina.

During USSR all imported foreign germplasm of cotton had to be tested in the quarantine nursery in Uzbekistan then distributed to other Soviet Republics. As the threat of curve virus was increasing, in 1995 the Government of Tajikistan adopted a Decree prohibiting importation of foreign varieties. Therefore until recent years all varieties grown were local or Uzbek, Kyrgyz or Turkmen. In 2007 first time since Tajikistan became independent 17 foreign cotton varieties from USA, Australia, Turkey, Brazil, India and Bulgaria were tested in 3 agro-ecological zones. Improving plant quarantine and plant variety protection legislation and adoption of seed policy are the basis for further enhancement of cotton genetic resources in Tajikistan.

1.6 Diversity of landraces/farmers' varieties

National breeding in Tajikistan which has been lasting for many centuries contributed to breeding of a number of valued landraces of crops. Among crops cultivated in the country most of the landraces can be observed in the assortment of cereals, apricot, apples, mulberry and walnut (Annex 1).

The National Database references show 981 old varieties and landraces, including: cereals - 660, legumes - 209, fodder crops – 42, oil seed crops – 40, tobacco – 1, pasture plants – 4, fruits and berries – 20.

Russian scientists, who conducted expeditions in the 1800 noted that in Darvaz, Vanj, Rushan, Ishkashim and Vakhan mainly local wheat varieties are cultivated out of cereals – Safedak, Rushtak, as well as Bezosti Kilak. As well as that such landraces of wheat are well-known as Sabzak, Shukhak, Lailak Bakhori, which have a high productivity, resistance to diseases and good bread-making quality of grain.

In Fergana valley scientists identified more than 30 local varieties of apricot, including wide diversity of its forms: Khurmoi, Isfarak, Boboi, Kandak, Mirsanjali, Tajiboi, Mullo gadoi, Uchma, Mahtobi, Javpazak, Daravshak, Kali zafari, Bibi Nigori, Shirpaivand and others. The Zarafshan Sub-Group of apricot varieties represents significant group of white peel fruit varieties (lyuchak), beautifully painted (gulyunghi), more resistant to fungus diseases. These varieties are Gurdi-gov, Samsherak, Safedak, Shohi, Tulyaki, Hojiboy, Lyuchaki, Voruhi Urmetani, etc. In the Central Tajikistan seedlings of local and introduced apricot varieties are mainly cultivated. During their seed duplication, various forms with different size, quality, colour of fruits, terms of ripening, flowering, etc., came.

Such varieties as Falgari, Kukoni, Lafka, Surkhak, Mokhtobi, Safedak, and Kandak are well known. In the Southern Tajikistan local varieties namely Kandak and Toshkurgani with various terms of ripening and high quality of the pulp, suitable for drying and processing, as well as Bodomi and Gulyunghi forms, are identified. Seedlings of Shalah and Nosiri forms were also found there. Diversity of apricot varieties in the Mountain Badakhshan is quite wide.

All its range is mainly introduced from outside Mountain Badakhshan, and on the basis of this material enormous number of local apricot varieties have been developed, selected and conserved. Rakhmatuloi, Labkajak, Mahmuri, Kanduzak, Daragi, Ravshan-Ali, Mashpak, Khudruyak, Safedak, Sabznulak, Hirimon, Kokanay, Gurai-Balkh, etc. are the main among them.

Most of the above varieties are populations and types, differing by the period of ripening, size, chemical and mechanical composition of fruits, their shape, colour, taste and other morphological features. For instance, Isfarak variety range includes following forms: Ak-isfarak, Kzil-isfarak, Kata-isfarak, Bodom-isfarak, Maida-isfarak, etc.; Kadu - khurmoi, Kzil-khurmoi, Ak-khurmoi, Khurmoi kandak, Khurmoi #2, etc.; Mirsanjali variety range includes Kzil Mirsanjali, Kadu Mirsanjali; Babai variety range contains Ak-Babai, Kzil-babai; Lyuchaki - Lyuchaki paivandi, Lyuchaki safed, Lyuchaki zard, etc.

However, when new varieties are released the local landraces started to gradually disappear. The threat of disappearance of local landraces is still there.

1.7 Danger of genetic weakness

Early 1970s the scientific community raised the alarm about genetic erosion. J.Harlan (1975) used this term to describe a potentially disastrous narrowing of the germplasm. A dramatic decrease in diversity in a cultivated crop could bring serious consequences, since genetically uniform cultivars grown over vast areas are susceptible to devastating epidemics.

Releasing of modern varieties by SCVT as well as illegal importation of modern improved crop varieties and hybrids have great impact to germplasm enhancement, but at the same time it has a danger to genetic weakness. Every year the number of marketed crop varieties is increasing. It is especially related to wheat, vegetable and potato varieties as there is a huge germplasm imported by Donor Agencies and farmers/entrepreneurs in recent years. Some of the seed farms have established close cooperation with Russian Research Institutes for testing and marketing new varieties in Tajikistan. These farms grow about 25 to 30 varieties of wheat, 10-12 varieties of barley and wide diversity of tomato, legumes, pumpkins and leaf vegetables. One may see at the market new varieties of persimmon, apple, peaches, plums and lemon. In opposite to that the old varieties of onion, cucumber, pumpkin, melon and watermelon are disappearing from the market. Well known Tajik melons are very seldom seen in the market.

During recent years the Government of Tajikistan has imported a number of new varieties of apples, pear, cherry and pistachio from Iran and China to establish modern gardens. This action is positive towards germplasm enhancement, but has a danger to local genetic resources weakness.

There is a threat to loose such valued genetic resources in different soil-clamatic zones depending on the influence of bio-climatic factors, such as solar radiation, rich in UV rays, a sharp change of positive and negative temperatures, the mineral content of soil and other. The threat of erosion of the genetic resources is presented in reduced volume of populations of the local landraces of cereals and grain legume crops, intensive disappearance of the existing forms, folk-bred varieties, on the other hand – deplacement of local varieties by other imported varieties, , which were widely used in production. Therefore a threat has come up that valued varieties for the national economy are disappearing, and particularly for crop production, of many wild forms of crops and ensuring a generative population from the seed sown, to breed new varieties, which have such qualities and characters, which would enable to continue growing the crop and thus which would substantially increase the potential of its productivity. Considering that a sharp necessity rises to collect, study, multiply and preserve the germplasm of local varieties.

With the expansion of borders of the cultivated areas high up in the mountains, at present the endemic liguleless forms of soft wheat have mostly preserved in small patches in natural boundaries of the Pyandj valley (Barushono-Rushan group, height 2 000-2 400 masl), in Bartanga valley (Siponjo-Dazhomskaya group, height 2 500-2 700 m and Yapshorvo-

Roshorvskaya group, height 2 800-3 200m) and in Shokhdara (Roshtkalino-Barzovskaya group, height 2 200-2 700 m and Sindevo-Sendskaya group, height 2 800-3 200 m). The detailed description of the forms of wheat have preserved only in Yapshorvo-Roshorvski and Bartangski group at the height of 2 800-3 200 masl.

1.8 Factors influencing to state of the plant genetic diversity

Preservation and rational utilisation of genetic resources requires an analysis of factors leading to genetic erosion and to a gradual disappearance of the specie, as well as the size and the character of the exposed risk. The study of this issue is one of the main tasks for a strategic planning of the given support to preserve and utilise genetic resources. The conducted research and analysis show that factors causing genetic erosion of different plant have an integrated character. The main factor which influences the increase of risk of genetic erosion is a sharp increase of the population. In order to meet the increasing demand of the population in food measures are being taken to increase their production. Such measures include breeding new varieties of intensive crop varieties, expansion of territory, expansion of cultivated land, uncontrolled clearance of forest and collecting of plants, as well as excessive grazing, which are the direct causes of disappearance of genetic resources of plants. With population growth comes the development of road contruction, construction of dwelling houses and other institutions. On the other hand environmental factors are the cause to the erosion, such as earth quakes, which often occur in this region, avalanching, mud flow, as well as stress factors such as drought, dry hot wind, and extreme frosts. The plants at the frithes are often washed away by Spring floods. Under the influence of anthropogenic influence the lower border of the forest in Pamir-Alai is gradually increasing, and the upper is decreasing, as if sliding down, which is also the cause of complex mountain formation processes.

The processes of the genetic erosion have much accelerated in the period of the Civil War 1992-1997 and this process is increasingly continuing up to now. After the collapse of the USSR and the conflict in the Republic, part of the population from the Khatlon oblast and rayons in the Gissar valley were forced to buy their own populated areas and to move to safer areas, firstly to mountain territories. In safe mountain areas, where a substantial part of the population migrated out from the conflict zone, accelerated processes are observed of soil degradation and of plant cover.

Clearance of forest imposes a special threat to the disappearance of plants. The forests of Tajikistan belong to category I, i.e. all of them deal with environmentall protection and protection of soil and their clearance is strictly forbidden. It is only allowed to clear under sanitary measures and annually about 7 000 m^3 of firewood. However during recent years because of lack of fuel we observe a total clearence of forests, which lays a negative impact on the preservation of genetic resources. Clearence of even single trees in dense juniper forests leads to intensive development of erosion, accompanied by destruction of plants. Observations carried out on high-density stand nut and juniper forests, have shown that as a result of intensive grazing the grass plants have almost completely been destroyed. The clearance brings most harm to pistachio zone. Here the local population highly destroys the trees in a radius of 10-20 km around inhabited areas. In spite of the fact that around the inhabited area the pistachio and other small-leaf forests have long been destroyed, the population systematically continues to destroy rare and unique pistachio trees. Currently small-leaf forests are actively cut down for construction purposes and partially for firewood.

However in recent years it is not only forests, but all that can be deployed for fuel is being destroyed. Lack of fuel, a deficit of electric power and low income force the population to tackle life problems through utilising the surrounding wild environment. As a result, only in Shaartuz rayon a number of thousand hectares of haloxylon dessert are destroyed. The same is observed in all forest zones of Leninabad, Khatlon oblasts and Rayons under the Republican Subbordination. Best forests are being destroyed, which perform water protecting and soil protecting function. The development rate for clearance of forests in those zones exceeds the processes of self-restauration of those forests many times. Bottomland forest formations, which protect bank zones of mountain rivers in Vakhsh, Kofarnigon in the lower stream, up to the reserve "Tigrovaya balka" , Zarafshon, Syr Darya for the recent years are almost destroyed.

Natural pastures and hay making of Tajikistan occupy over 3.5 mln. ha and are the most important source of full-value and diverse forage for livestock production. The stock of forage on pastures according to the estimates of specialists makes over 1.6 mln. tonns of dry matter a year. Pasture livestock production is profitable – gives the cheapest product, the net cost of which is much lover than that of the products, which is received under in-house maintenance of livestock during winter. The modern condition of pastures of the Republic is characterised by a progressive decrease in foreage productivity cause by anthropogenic factors.

As a result of excessive grazing and grought the whole territory of low grass pastures in near-mountainous plainland and low hills of Southern Tajikistan, is highly degraded. The desertification process has so strongly influenced the condition of plant biodiversity, that on the territory of South Tajikistan in the mountain areas of Aktay, Khodja and Kazian,

Rongontau juniper stands are completely destroyed. Their existence in the past can be witnessed through only some bushes or grass plants, which came before the juniper. In the Sukhrob River and Carategin the juniper and maple forests, especially nearby inhabited areas. As a result of intensive rain storms, intensive melting of snow throughout South-West, Central and East Tajikistan rain storms occur, mud slides, floods, surges of graciers, as a result of which they bring an irreversible harm to the economy and the plant population of the country. According to data available, almost 80 % of force majors, happen in central and Northern-Easterm parts of Tajikistan.

At the beginning of exploring of the valley of the Republic in the whole of Kulyab zone, Vakhsh valley and in Leninabad oblast at the banks of Syrdarya hundreds of thousands of hectares of highly productive riparian woodland forests were destroyed. Only in the Vakhsh valley over 300 thousand riparian woodland have been destroyed. The decrease of water level, as welll as reduction of the level of ground water have laid a great influence on the soil and plant cover in the delta of the rivers Yakhsu, Vakhsh, Pyandj and Kofarnigan. Here, together with riparian woodlands reed started to die out, and the area was instead covered with saline soil.

Grubbing of old orchards with apricot, apple, pear, sweet cherry, mulberry, as well as vine trees, bred through many centuries of folk selection have lead to a significant loss of genetic resources of fruit crops. Because of that IPGRI is implementing an International project on *In situ*/on-farm preservation of further erosion of species of fruit crops and their wild species and their conservation together with TAAS and HI in the Central Asia. The project is designed for 2006-2010 and is funded by the Global Evironment Fund (GEF).

Salination of soil has a huge impact on the variation of genetic diversity of plants. In the Republic more than 110 thousand ha of soil with different level of salination is registered. 74 thousand ha out of them are exposed to postprimary salination. After investigating the Central part of Beshkent valley out of 12 thousand ha of land 8,5 thousand ha were exposed to postprimary salination because of increase of the level of ground water. At present only 3.5 thousand ha of land is used in the agricultural turnover.

A certain danger of destruction of plant resources is caused by pests. For recent years grasshopper attack is observed, especially in boderpoints with Afghanistan and Uzbekistan in spring time. This is a pantophagous pest and destroys yield in large areas, and thus brings an irreversible harm to agriculture and the natural environment.

To conserve the plant diversity certain measures are being taken by the Government. In 2000 a National action plant was adopted to combat desertification in Tajikistan. Considering the importance of conservation and effective utilisation of genetic resources to strengthen food security of the population, in 2007 a National Republican Genetic Resources Centre at the Academy of Agricultural Sciences of Tajikistan was established. The regulatory framework which governs the protection and efficient use of genetic resources is being improved. New large-scale and small-scale hydro-power generating stations are being constructed. On the Vakhsh river the Sangtuda HPS is being constructed and is gradually being launched. Quarying and marketing of stone coal is expading so as to avoid clearance of forests for fuel.

With support of a SIDA funded project the contruction of a gene bank has started. At the same time it is important to maintain the collection according to international standards, to enlarge and regenerate it. It is also necessary to accelerate the work on inventory and conservation of the collections *in situ*. In this regard, National Centres need help from regional and international organisations, as resources allocated from the State budget will not be sufficient, and the protected plant resources represent a global public good.

1.9 Future needs and priorities

Tajikistan has limited land resources, but is blessed with diversity of plant species. It has suitable soil and climatic conditions for growing almost all plant species. Crop production increase, first of all, should aim to enrich local markets and meet the needs of local population for food and subsequently to expand international trade and diversify crop species and varieties' production.

The Government of Tajikistan is keen to improve the conservation of germplasm and minimize its genetic erosion. The National Republican Genetic Resource Center is presently delivering two research programs funded by the State Budget on the preservation of the genetic resources of industrial, legume, grain, fodder, oil seed crops and their wild relatives as well as on the preservation and multiplication of genetic resources of fruit and vegetables for breeding purposes. More efforts are needed to expand germplasm collections, crop improvement, appropriate production technologies, open marginal lands for cultivation and diversify present cropping patterns.

Many of the local crop breeding programs have limited access to plant genetic resources and therefore rely on a narrow breeding stock and produce narrowly adapted varieties. Conservation of the genetic resources is a strategic priority of the Tajik government. However, the national genebank of Tajikistan has not yet been established. It is important to

emphasize that conservation in itself is not enough for improved access of breeding programs to genetic resources. Development of a comprehensive information database and regular plant material characterization and multiplication activities will be necessary to be carried out. Plant breeders are interested in having information on the conserved genetic resources to identify and acquire germplasm of genotypes that possess traits needed for their crop improvement programs. Characterization of the core collections can encourage greater and more efficient use of the genetic resources. Such information and germplasm must be available not only for the local breeders, but also worldwide as it can be useful in other environments, or can facilitate development of the varieties that can be useful in the country. Analogously, the local breeding programs must be supported to provide them with adequate access to the international and foreign germplasm banks and germplasm exchange networks.

CHAPTER 2

THE STATE OF *IN SITU* MANAGEMENT

2.1 Reserves and environment protection zones

Plant genetic resources require a careful protection so that in the future humanity could use them but also for conservation of nature and the ecosystems. We know that most of the plant genetic resources are valuable, and they can be used in breeding programs to produce improved varieties. One of the most important ways of preserving plant genetic resources is through the protection of territories, on which certain plant species grow wild, the so called *in situ* conservation. To conserve wild species of crops it is important to create reserves and environment protection zones. On the territory of Tajikistan there are 19 specially protected environment protection territories, 4 of which are reserves, 2 national parks and 13 wildlife reserves. The most popular of them are the Tiger reserve, Ramit, Dashtijum and Zorkul with a total are of 100 thousand ha. The plant diversity of the Tiger reserve is represented by riparian forests with dense crown layer of Russian olive (*Elaeagnus angustifolia* L.), on the edges it has different grass. In the mountain reserve of Romit there are tree formations: maple forest (*Acereta*), nut (*Juglandeta*), white poplar (*Albae poluleta*), populus laurifolia (*Laurifoliae populeta*), juniper stands (*Junipereta*), almonds (*Amygdaleta*) and bush plants of rosary (*Rosarieta*), willow-shrubs (*Saliceta*), jujube (*Ziziphuseta*) and other. In addition there are 13 wildlife reserves, which cover almost all natural landscape zones of the country. However in those reserves and environment protection zones there is also a degradation and disappearance of valued species of plant genetic resources caused by social and economic processes.

2.2 Inventories, surveys & priority setting

First efforts of inventory registration and description of plant genetic resources in Tajikistan were carried out by scientific expeditions, organised by AS USSR in 1920, and later by staff of the Botany Institute of AH of Tajik USSR. As a result of that research a series of publication titled «Flora of Tajikistan», with detailed description of the flora in the country were made available. Subsequently other researches had been carried out to study plant genetic resources of specific crops (e.g., study of diversity of cereals and grain legumes by the staff of Pamir Biology Institute). Unfortunately, systematic studies to inventory plant genetic resources were not carried out. Because of that with the participation of all the 8 Central Asian and Transcaucasian countries, with support from Bioversity International and ICARDA, the Central Asian Caucasus network for plant genetic resources had been established (CACN-PGR). Within that framework, an inventory of Tajikistan flora started by ICARDA in early 2000. Computers and an information system were supplied to document all existing collections of plant genetic resources, and one staff member was trained to work with the documents. As part of the network activities, with the participation of research worker from TAAS, materials from the most important crops were collected, characterized for valuable breeding traits, and placed on either *in vitro* or long term storage. As a result much was done on inventory registration and documentation of landraces of local varieties and folk-bred varieties, which allowed to colled 5 589 samples, including 1 240 – landraces of local traditional varieties, which are not in mid term conservation.

ICARDA in cooperation with TAAS organized four collecting expeditions. The first one was carried out in Sogd oblast (northern Tajikistan) in 2000. During this expedition 112 accessions were collected, among them 34 varieties of wheat, 28 of barley, 10 of chick pea, 8 of rye, 6 of pea, 7 of vetch, 4 of forage beans, 4 of haricot, 3 of flax, 2 of chin, 2 of safflower, 2 of lentil and 2 of triticale. The second expedition with scientists from VIR and the Uzbek Institute of Botany, was conducted in the Rasht valley and Western Pamirs in 2003. 112 accessions of cereals, 83 of wheat, 19 of barley, 20 of rye, 105 of legumes, 98 of forage, 89 wild relatives were collected. Unique endemic varieties of rye without ligule were collected, as well as dwarf wheat and its wild relatives. In 2004 another expedition covered agricultural areas of Khatlon oblast. About 428 accessions were collected, 111 of cereals, 109 of beans, 21 of forage crops and 11 of oil seed plants, including 75 varieties of wheat, 30 of barley, 7 of pea, 23 of haricot, 43 of chick pea and 15 of lentil. Some unique and endemic varieties of wheat Sabzak (in Romit gorge), Shuhak and Lailak Bahori (in Khovaling valleys) were found. These varieties

are characterized by high productivity and early maturity. In 2006 during an expedition to Sogd oblast with scientists from Armenia, Russia and Australia, 317 accessions of cereals, legumes and forage crops were collected. All these genetic resources are conserved in the gene bank of the National centre for genetic resources of Tajikistan, and duplicated in the gene bank of ICARDA. Seed germination and vigour tests are conducted annually.

Support in documentation of collected samples of fruit crops was provided by Bioversity International, within the collaborative efforts of the network of National Agricultural Centres of Central Asia. This Centre established a centralized regional data base, based at the Horticulture Institute. This data base comprised information on 140 varieties of *Prunus armeniaca*; 61 P. *persica*; 15 P. *domestica* and P. *cerasifera*; 29 P. *avium*, 18 *Cerasus* sp.; 104 *Malus domestica*, M. *siversii*, M. *silvestris*, M. *caucasica*, M. nedsvetsky from Kazakhstan, Kyrgyzstan, Turkmenistan, Tajikistan and Uzbekistan.

In 2000 Bioversity International jointly with "TajikLes" (Tajik Forest Enterprise) conducted a research expedition on genetic resources of *Pistacia vera* L. with the aim of defining the eco-geographic distribution and agro-morphological variations and use of pistachio in Central Asia. During the expedition natural forests of *Pistacia vera* in Dangara, Dahana Kiyika and Kurgan Tyube were studied.

In 2007, 6 expeditions were organized to study the fruit crops, their relatives, and their morphological description and definition of variety characteristics of apple (*Malus* Mill.), pear (*Pyrus communis* L.), apricot (*Prunus armeniaca*), peach (*Prunus persica* L.), plum (*Prunus* Mill.), cherries (*Gerasus* Juss.), walnut (*Juglans regia* L.), almond (*Amigdalus* L.), pistachio (*Pistacia vera* L.), mulberries (*Morus*), sea-buckthorn (*Hippophae rhamnoides* L.) and grapes (*Vitis vinifera* L.) in Central Tajiksitan, Kulyab zone, Badakhshan and Sogd.

Surveying and inventorying genetic resources requires skilled personnel and funds. Due to lack of funds these activities are not conducted regularly in the country. ICARDA and Bioversity provide assistance to national research institutions in this issue. So far it has not been possible to conduct surveys and monitoring of PGR without their assistance. Monitoring and inventory of grain crops, leguminous plants, fodder crops, vegetable, fruit and berry plants is considered to be a priority trend. The database of crops which was initiated with the assistance of Bioversity Int. and ICARDA, is located at the National Republican Centre for Genetic Resources (NRCGR) and at the Horticulture Institute. It is essential to update this database and harmonize it according to international standards. Besides fund shortage, there is a lack of experienced and qualified specialists. To overcome this constraint it is necessary to involve botanist-scientists from other Research Centers of Tajikistan, International Centers and other countries. Currently there is no close cooperation between the Research Institute of Academy of Sciences and the Academy of Agricultural Sciences and there is a need to train national staff. It is essential to strengthen both the financial and technical capacity of NRCGR. This organization should play a leading role in all PGR surveys. It is necessary to develop an integrated strategy for *in situ* and *ex situ* conservation in order to prevent genetic erosion.

Up to now the plant species of International Treaty which are available in Tajikistan flora are not yet defined. Therefore there is a need for developing a project proposal and defining these plant species.

In order to conserve PGR, it is necessary to establish a system of regular observation, monitoring, inventory and warning system informing on loss of PGR. All these activities are interrelated, as only when regular observations are conducted it is possible to detect the threat of PGR extinction. While conducting research on wild relatives of cultivated plants in the environment, it is important to correlate the percentage of plant species to the change in their distribution. It is evident that Tajikistan is a mountainous country with complex relief, and it is thus impossible to cover all districts by observation. Therefore the aero-cosmic survey of areas difficult for access is required. As for landraces and cultivated crop varieties, it is important to regularly observe the trend in correlation of crops cultivated by farmers. For instance, due to the introduction of hybrids and new crops of cucumbers, there is a risk around the Benazir variety bred by the FI. How to conserve this variety so that it is not extinct, the specialists should be concerned about, especially breeders and specialists of PGR. As the farmers are no longer interested in this variety, they will not cultivate it. However this variety was bred since years, as it had valuable characteristics, such as resistance to biotic and abiotic factors. Therefore it is important to conserve the seeds of this variety, the seeds might be used in breeding programmes. Another example, although there have been delivered and bred over 20 varieties of wheat in recent years farmers still demand for Siette-Cerros 66 that is one of the firstlings of CIMMYT. Unfortunately this variety has almost disappeared and its acreage is being reduced year by year.

Experienced specialists with proven botanic education are needed for conducting surveys. However there is lack of such specialists, and therefore there is need in assistance and support in education and retraining of personnel.

It is well known that activities addressed to conserve PGR could not be limited just by conducting surveys and determining PGR vanishing risk levels. PGR conservation and rehabilitation measures require involvement of funds and competent specialists.

2.3 On-farm management and improvement of the PGRFA

On-farm preservation of plant genetic resources is one of the approaches mainly used to preserve landraces and old local varieties of crop. On-farm preservation is mostly suitable for perinnual crops intensive introduction of new varieties of annual and biannual crops squeeze out landraces and local varieties from farmers' field, which caused genetic erosion. Very often it is very difficult to preserve on-farm the annual and biannual crop species due to different factors as well. For instance in 1971 in Pamir Biology Institute established unique collection of local population and varieties of grain cereals and legumes. However due to having place social and economic difficulties it was impossible to preserve this collection of genetic resources.

The considerable work in this issue is implemented by Bioversity Int., HI and other organizations, including farms and private individuals participating in the "*In situ*/On-farm preservation and use of agri-biodiversity of fruit plants in the Central Asia" project. On the basis of this project's experience it is necessary to develop measures and project proposals on stable assistance to on-farm management and improvement of PGRFA. Land reforming and farms restructuring are still in progress in Tajikistan that resulted in reducing number of large farms, and instead there are being established farms interested first of all in higher production output and increase of income. Experience shows that farmers are not interested in establishment of collections and on-farm preservation of PGR. Therefore there is a need in assistance of the regional and international centers for sustainable existence of the established of farm collections. The project mentioned above mainly establishes collection nurseries of fruit crops and their wild relatives; however it is necessary to provide assistance in the establishment of such collections for grain crops, leguminous plants, and vegetable and fodder crops. At present the major limitation is the non-availability of trained manpower and resources.

2.4 Restoring agricultural systems after disasters

Experience shows that environmental and social and economic factors can be the reason behind a sharp reduction of the number of plant genetic resources. Considering these factors a system shall be put in place to alarm the threats of restaruation of genetic resources in agriculture and food. In Tajikistan the extreme factors causing genetic erosion are the hot dry summer climate, accompanied by dry wind (especially in the South), as well as extreme frosts, avalanching, eqrth quakes, rainstorms and floods. The Government of Tajikistan is taking measures to prevent threats and ways of eliminating extreme stresses in the nature, but the country's economy does not allow resolving all the problems independently. For the past 10-15 years for various reasons (lack of funds for mechanisation and the high level of obsoletion, price increase for lubricants, mineral fertilisers, chemicals and so on.) under new conditions of the market economy farmers would come across with a number of difficulties. A part of orchards and vineyards, especially under rainfed conditions, because of weak maintenance have highly degraded. As a result the total area of orchards and vineyards is reducing annually, and so does the yield. The best part of orchards and vineyards was under bad conditions, high level of dyewood trees of fruit species and shrubs of vine. The same process is observed with tree plants in households. A high deficit of energy (electricity, coal, natural gas) has contributed to a massive clearance of trees in orchards of different category of farms and wild species of fruit crops and vine. All of that has lead to destruction of a part of unique forms and arieties of fruit crops. Early-imported varieties of fruit crops because of weakening of maintenance have lost their varietal characters and have degraded. The Government will try to import new forms and varieties of fruit crops from China, Iran, the USA and other countries in large quantities. But for a sustained repeated introduction of germplasm a close collaboration between international and national centres is necessary, which will allow on the basis of scientific approach to study the germplasm, collect and store varieties according to the agro-climatic zones of the country. Newly introduced varieties can also be used in breeding programes with local forms, wild species and landraces to breed adapted forms and varieties, with valued characters for cultivation and use.

The assistance from International and regional centres in this terms is to conduct events on the repeated introduction of germplasm and their inclusion in breeding programs.

Strict measures on the restauration of orchards and vineyards are being taken by the Government of the Republic of Tajikistan.

The Siette-Cerros 66 was the most widespread wheat variety in Tajikistan in 1980's that was characterized by high adaptability and better economically valuable characteristics. Due to the accrued economic problems and the civil war in 1990s this variety was about to disappear and there was exigency of wheat seeds of best varieties in the country. Therefore with assistance of GTZ- CIMMYT "Regional network for promotion of wheat varieties and seed production" project new wheat varieties and lines were delivered, among which the best adaptability was shown by variety Steklovidnaya 24 and

Jagger. This is an illustrative example of the reintroduction of germplasm. CIMMYT and ICARDA are providing significant assistance in enrichment of gene pool of grain crops and leguminous plants. On the basis of selection from the improved lines provided by these international centers a number of new wheat, barley, chick-pea and scarlet grosbeak varieties ware selected. 3 varieties of wheat having origin from CIMMYT and ICARDA have been released. AVRDC provides assistance in reintroduction of vegetable crops germplasm (onion, tomato, eggplant, cabbage, food legumes).

Due to the above mentioned economic and social problems the condition of gardens and vineyards has worsened as well. The imported varieties of fruit crops in the past had lost their grading factors and degraded due to bad care. The Government of the country tries to import new kinds and varieties of fruit crops from China, Iran, the USA and other countries in bulk. But for the sustainable reintroduction of germplasm it is necessary to have close cooperation of International centers with National ones and it will allow to conduct science-based germplasm evaluation, breeding and distribution of varieties to the agroclimatic zones of the country. Newly imported varieties can be used as well in the breeding programs together with local forms, wild relatives and ancient varieties for breeding of adaptive forms and varieties possessed valuable economical indicators. The assistance of International and regional centers in this case consists of support of activities on reintroduction of germplasm and their inclusion into the selection programs. The same situation is observed with forage crops.

The "Seed Law" makes provision for the establishment of Governmental Seed Fund, which is intended for regions, where seed production is not implemented or possibilities of its production are limited, as well as for rendering assistance in case of natural disasters or the other emergencies to physical and legal bodies, seed and dekhan farms, dealing with the production of agricultural products. At the present the specialists of MOA are implementing the regulations on order of establishment and utilization of Governmental Seed Fund. The establishment of seed fund of basic varieties of main agricultural crops will make possible to provide farmers when germplasm is lost during disasters. Tajikistan went through a civil war and economic crisis, and gained enough experience on variety preservation and recruitment of the lost germplasms.

The same was for forage crops. Therefore at the support of the Sida funded «Support to Seed Sector Development in the Republic of Tajikistan» breeding of forage crops is restored – Lucerne and esparcet by way of germplasm introduction from Canada, France, the USA and Sweden. Reintroduced forms of germplasm are used for crossing with local varieties and forms.

Since 1995 introduction of cotton seed from abroad was forbidden because of the threat of a virus of leaf roll disease, highly spread in Pakistan and other Asian countries. This measure was temporary and was taken because of a weak function of material and technical facilities of the plant quarantine system. From 2007 on in parallel with improving the regulatory framework for plant quarantine and attracting foreign investment the introduction of new varieties was reactivated for new varieties of cotton, both for official testing and for inclusion in breeding programs. At the support of Sida and TIKA new collaboration between breeders of Tajikistan and Turkey has been started to breed new varieties. For that reason 16 cotton varieties had been introduced from the Turkish CRI of cotton production and crosses have been made between them and local forms and varieties. However the work can be terminated due to lack of funds, provided by Sida, because according to the dicision of the Government of Sweden it is phasing out support to Tajikistan until end of 2010 r. Because of that it is necessary that International and regional Centres rendered support to Tajik breeders in a sustainable collaboration with colleagues from other countries with regards of germplasm exchange. Assistance will also be needed to draft project proposals to seek for new donors.

2.5 Wild crop relatives and wild plants for food production

In situ conservation of wild crop relatives and other wild plants used for various purposes is considered one of important priorities in National Programs on Biodiversity and Biosafety. The programs contain recommendations and plans related to expansion of protected areas for conservation of these valuable biodiversity, elimination of threats of extinction through increased public awareness, involvement of threatened species in *ex situ* conservation and reintroduction into nature etc, and other measures to be taken and on-going activities.

However, for the present there are serious problems in this field. Increased public awareness, involvement of local people and farmers in *in situ* conservation activities are as important as implementation of laws adopted and decisions made by the government toward solution of these problems.

It is necessary to take political measures for the improvement of *in situ* conservation of wild relatives of cultivated plants i.e. enhancement of legislative base for the genetic resources protection. Introduction of endangered species into the Red Book is not giving positive results without taking specific measures in specific cases. Therefore conditions

contributing to extinction of valuable wild relatives of cultivated plants should be combated with. It is clear that due to deterioration of socio-economic conditions, population started to cut trees, shrubs and gather plants for food. Thus measures should be taken to promote the use of alternative sources of fuel and food. The Government of Tajikistan takes measures to increase production of coal that exists in a sufficient amount in the country. There are being constructed and put into operation big and small hydro power stations. Assistance is being provided through provision seed materials of wheat and potato in order to increase farmers' interest in food production improvement.

Collection of wild relatives of the cultivated plants is also conducted to get economic profit. For example, population harvest rhubarb in the mountains in spring time and wild onion anzur in autumn in order sale them and get income. It is quite obvious that with taking economic measures addressed to improve well-being of population such practice will be reduced. In recent years ferula became widely popular among the pursuers of easy profit and due to the relaxation of control population of this plant was significantly damaged. It was developed that pitch of ferula has healing features and is valued highly. People started to collect pitch of the ferula plant for export that resulted in its termination and had a risk of its total extinction. Taking into account the situation accrued the President of Tajikistan E.Rahmon issued a Decree "On categorical prohibition of harvest and export of ferula pitch" dated 19 September, 2008. The Decree also makes provisions on considering the issues of expansion of area under cultivation for growing ferula plant in the corresponding regions of the country.

There is a need for development of large- scale projects on collection, multiplication of threatened species and their reintroduction, as well as for support of international and regional organizations on staff training.

The development of agriculture is possible only if new intensive crops are bred and cultivation technologies enhanced. However the diversity of local crops and plants growing in nature is also important. To enlarge the market for these crops, activities should be carried out to enable rehabilitation and reproduction. The Government should motivate and support the initiative of farmers to grow local crops. On the other hand, some varieties, especially fruits, are grown only in specific zones. The Government should support the development of infrastructure, construction of plants on processing fruits and berries of local varieties. The development of infrastructure, especially construction of roads, is going on in Tajikistan. It will enable the farmers from distant districts to provide the urban markets with valuable fruits and berries of local varieties: Murud and Amrud pears, Khuboni, Husni Yusuf apples, Husaini and Chillagi grapes, as well as figs, pistachio, walnuts, etc. The free economic zones and local markets are to be opened in districts bordering with Afghanistan, where the population on both sides of the Panj river will benefit from trade. It is probable that the local varieties and diversity of crops will be sold at these markets too.

2.6 Improvement of *in situ* management, priorities and needs

In recent years the Government support in the conservation of genetic resources *in situ* is mainly through improvement of the regulatory framework, attraction of projects on development, as well as establishment of new environment protection zones. As a result of degradation of the surrounding environment it is necessary to adopt a Law of the Republic of Tajikistan «on specially protected environmental terrirories» so as to conserve unique ecosystems, rare and extincting species of flora, as well as implementation of research work. To maintain and govern relations in specially protected environmetal territories under the decree of the Government of the Republic of Tajikistan as of March 1, 2004 №70 «Issues of the State Committee for environmental protection and forestry of the Republic of Tajikistan», a State Institution has been established «Tajik National Park». However outside environmentally protected territories conservation of genetic resources is almost not observed. Therefore necessity arises to closely involve the Government members, education insitutions, public and communities in a campaign to conserve genetic resources. With this aim it is important to conduct promotions to raise awareness among public using means for massive agitation.

National research centres closely collaborating with CGIAR ICARDA Centres, Bioversity Int., but it is necessary to draft new projects to create collections and conserve genetic resources *in situ* so as to efficiently apply the experience and in doing so to attract international and regional organisations.

CHAPTER 3

THE STATE OF *EX SITU* MANAGEMENT

3.1 The state of *ex situ* collections

At present the collected genetic material of crops and landraces, as well as wild species is conserved *ex situ* in the Farming Institute and in Pamir Biological Institute. The total amount of conserved samples *ex situ* is 5 317, out of which 981 are local and landraces and 1 775 breeding samples. The systematic collection and conservation of grasses and wild relatives of wheat started in 1992 by Plant Physiology and Genetics Institute. Collection includes a number of accessions. Some of these are included in a living herbarium and in some cases the accessions are connected to GPS data. These collections are generally regenerated every 3 year. The collection includes around 3 000 *Aegilops taushii* which they through electrophoresis have divided into 13 biotypes. The collection also included number cultivated wheat's or landraces from the Pamir region, wild relatives, *Secale cereale* and *Hordeum*.

There are 1 500 plant species in the Botanical garden of which around 750 are endemic to Central Asia. However, this number has lately been reduced as 20 years ago they had more than 2 500 species in the Botanical garden. These species have been lost mainly to lack of maintenance but also to cutting of trees during the civil war. With Germany (Gatesleben) they have a project on wild onions—have a collection of more than 100 wild onion accessions. The National Herbarium contains more than 200 000 samples and all species of Tajikistan (around 4 500) are represented. All data is only in written form —- not computerized. No Seed collection exists of National *Herbarium*. That is why assistance is needed in the creation of herbarium database.

Ex situ collection of cereals in Pamir Biological Institute contains 80% wheat and 20% barley. This collection includes around 60 wheat landraces originating from Pamir. Since they have no storing facilities they regenerate collection every 3 year. There is also a collection of root crops (all are introduced) and landraces of horsebean which is endemic to Pamir.

There are *in vitro* collections of potato varieties, clons and lines received from CIP in the Research Institute of Biotechnology, Tajik Agrarian University and RI of Plant Physiology and Genetics

3.2 National Gene Bank

In the past in Tajikistan there was no gene bank for conservation of genetic material of wild and cultivated plant species as this material was kept in the main gene bank of All-Union (now All-Russian) Institute for plant cultivation (VIR) named after N.I.Vavilov and other research instititutes of Soviet republics. In these centers genetic material originated from Tajikistan was exchanged with other gene banks of International centers and of other countries. In 2000 on ICARDA's initiative the first gene bank was built in Farming Institute, where collected samples are kept nowadays. ICARDA has also provided assistance in training of the personnel to work in the gene bank. However, germplasm storage conditions in present gene bank do not meet the requirements. In this connection, with the financial assistance Swedish International Development and Cooperation Agency, Sida and technical support of NordGen specialists the construction of a modern gene bank was started under the Republican National Center for Genetic Resources.

It is planned to conduct intensive trainings for the staff of RNCGR in NordGen in 2009-2010. With the support of Sida a gene bank is constructed in Kyrgyzstan as well, that is why it is planned to create a network database exchange between these two neighboring countries. However there are some problems and limitations and to solve them is necessary for the effective conservation of genetic resources in gene banks and for database exchange. The matter is that the database system created with the support of ICARDA is different from another one which NordGen is going to introduce. It is necessary to make a correct decision on the question of the same database and information exchange system usage in the region. On the other hand the Government of Sweden made a decision to reduce the number of countries which are rendered assistance in the development, thus the CAC are withdrawn from the number of countries which are assisted and supported by Sweden. In this connection there is a threat in the stable activity of the constructed gene bank and its cooperation on regional and international level. For solving this problem it is necessary for donors and International

centers to make a decision to continue providing support to the gene bank of Tajikistan till it will be sustainable. Government of Tajikistan pays attention to the development of the gene bank, but assigned means from the budget are not enough for gene bank to function.

Local germplasm collection, conservation and data base maintenance for all locally grown crops is of high priority and has to be carried out within a national genetic resource bank. Its establishment is a matter of emergency and must be supported through the government funding.

3.3 Field Collections and Botanical Gardens

The horticulture Institute created collections of best introduced varieties of apple, pear, plum, cherry, sweet cherry and cherry plum, which include more than 200 varieties. Local and wild growing species have been studied as well as spontaneous hybrids, species and genes of subfamiliy of plum in order to test and select weakly growing rootstocks for intensive stone fruit orchards. In Faizabad variety testing station of the HI are conducted to research, select and multiply best local and introduced varieties of fruit crops, berries and nuts. At present the conserved valuable gene pool consists of: local apple varieties 54, walnut – 90, buckthorn– 18 introduced varieties, mulberry – 20, gooseberry – 16, currant – 12. As well as that valued forms of almond, pistachio, pecan hickory and walnut.

In the South of Tajikistan in 1940 I. S. Kolybzev initiated the growing of subtropical crops in ground trenches with a cover during winter. Vaksh zonal station was formed here for subtropical crops, where a rich collection was formed of introduced varieties. Collection study of vine varieties was conducted in Hissar and Vakhsh valleys, also in Istaravshan and Muminabad base points of the HI. Field collection of the plant genetic resources in Tajikistan is grown in Varzob mountain botanical station, Dushanbe, Pamir, Khujand and Kulob botanical gardens.

Varzob mountain botanical station is in the Southern slope of Hissar mountain range, in Kondara gorge, in the Varzob river pool. Its lower border crosses at the altitude of 1050 m, and the upper – 2 400 m. The total area makes about 1 000 ha. On that station research is conducted to study forest flora of Tajikistan and Pamir-Alai, identification of species content of dendroflora, morphological and biological characters of trees and shrubs, development of methods to create highly productive fruit, forest and different kinds of anti-erosion plants in the mountains. The Kondara Botanical Garden is situated in the mountains, about 30 kilometers north of Dushanbe. The area contains many local and endemic plants, but exotic material has also been introduced, so the station now functions both as a nature reserve and a botanical garden. The station, a small hut beside a mountain trail, is unmanned during winter months. A little further down the trail there is a gate and a guard's cottage. At the station there are three-four rooms, including a small conference room. The rooms are filled with botanic demonstation material, tree logs, maps and photographs. The Kondara station belongs to the Dushanbe Botanical Garden. There is no power or no telecommunications connections at the station.

The botanical garden in Dushanbe was established in 1933, is located in the Centre of Dushanbe at the altitude of 800-840 m. Its total area is 34 ha, most part of it is occupied with dendrologic collections. 2190 species of trees and shrubs are grown there. The biggest are (10 ha) the part with flora of ancient mediterranian, where Tajikistan's dendroflora is represented, all the Central Asian, Crimea, Caucasus, West Asia and Mediterranian sea area with 639 trees and shrubs species. Second in size (7 ha) is the botanical-geografic area of flora of East Asia with 837 species. Third area (5.3 ha) is with dendroflora of America with a collection of 488 trees and shrubs species. The forth area has 3 ha with 226 species with featuring Central Europe and Siberia. In the collection rosarium under an area of 1.2 ha 552 rose flower varieties are kept, and lilac 119 varieties. In greenhouses there are over 2 700 species of tropical and subtropical plants, such as palm trees, cactus family, peppery, begonian and other. However, most part of these plants have died out with severe frosts and the absence of heating system.

An integral part of botanical research on introduction of plants, carried out by Dushanbe botanical garden. Monography «Plants for decorative horticulture of Tajiksitan» (1986), written by the team of the garden under the supervision of correspondent member of AS RT V.I. Zapriagaeva, which serves a practical manual for specialists of decorative horticulture, forestries and architects of the amenity planting. Correspondent member of AS RT M.I. Ismailov concluded the introduction of trees and shrubs of the Northern part of Dushanbe botanical garden for 65 years.

The Khudjand botanical garden was formed in 1955, and is located at the Syrdarya riven bank, in Khudjand at an altitude of 350 m. The total area of the garden is 22 ha. The point of interest of the garden is the area of natural riparian from *Populus pruinosa* and *Elaeagnus angustifolia*. The flora of the riparian is higly destroyed by man and requires high costs for restoration. There is a tree nursery with 260 trees and shrubs species, a collection site of decorative grass and soild covering pants, where introductions and endems are places from the North of Tajikistan.

The Pamir botanical garden is situated in Khorog at an altitude of 2 320 masl where rivers Gunt and Shakhdara merge into a flow. This is the most high mountain situated botanical garden in the CIS. The garden was established in 1940. On the territory of the garden there is a number of soil categories, which are observed in Western Pamir – rocks, steepy and sandy areaas, gravel, slides, stormy cone of detritus, mountain slopes. The flora fund of the garden makes about 4 thousand species, presented in botanical collections and the aboriginal flora of the reserve territory. In the colletions there are about 3 thousand species, forms and varieties of trees and grass plants. The exchange of seed in the garden is practised with 170 recipients in former Soviet Republics and about 200 partners from 40 other countries abroad.

The Pamir botanical garden has tested in its nurseries and collections 30 thousand species, forms and varieties of plants. At present the Pamir botanical garden has an area of 624 ha, over 100 ha of them are irrigated land. At the base of the wild growing grass plants collection in 1979 a collection compilation was started for medicinal plants, and now it has more than 50 species. Studies are being conducted on wild and disappearing plants of the GBAO flora. To that end a nursery is established, in which about 30 species of rare plants and those almost extinct are collected. The researve territory of the garden occupies over 50 ha. The flora fund of the reserve of the botanical garden includes over 800 plant species.

The gene pool of wild growing and crop of fruit species is studied of the Gorno Badakhshan at an altitude of 1 000 up to 3 050 masl. It demonstrates that such fruit species as apple, apricot, peach, walnut, pomegranate, white silk, vine and buffalo berry in West Pamir and Darvaz have a high leven of polymorphy. Some promising forms have been suggested of fruit crops, which do not require further selection: 15 forms of apricot, 12 - apple, 10 - pear, 6 - peach, 6 - walnut, 5 – white silk, 2 – sweet cherry, 1 - vine and others.

3.4 Priority setting

To enlarge activities on *ex situ* conservation the establishment of modern gene bank is required. Some work is conducted in this area by the Government of Tajikistan and international organizations. But the establishment of a modern gene bank will not solve all issues related to conservation of gene resources. Therefore it is necessary to strengthen the national gene bank and facilitate its sustainable development. In this regard, the Government or international organizations acting alone cannot achieve the targets set. The governmental, international and regional centers should cooperate closely to strengthen the technical basis and enhance the skills and expertise of gene bank staff.

To strengthen the activities on *ex situ* conservation the regional and international database systems should be established. There is an agreement among the countries of the region on exchange of genetic resources, but MTA Agreement should be signed as well.

As it was stated above, currently the Tajik scientists use the database and characterization system and collection evaluation system of ICARDA, but NordGen intends to introduce the system and programs utilized in the Scandinavian countries. The support will be needed to set up a comprehensive use of the characterization and collection evaluation systems. It is necessary to use the applied descriptors on description of existing PGR forms and varieties. However there is limited knowledge on descriptors among local scientists and specialists, therefore there is a need in training staff to enable the establishment of such descriptors.

The genetic collections should be kept in a centralized way, therefore a modern gene bank should be constructed. The gene bank of RNCGR contains PGR collections collected during expeditions. The Pamir Institute on Biology also has a certain PGR collection, but requires assistance in characterization and evaluation. The assistance is needed to conduct evaluation of PGR on the basis of molecular markers with the use of relevant devices and equipment, and trained specialists.

The descriptors of IPGRI should be utilized for characterization and evaluation of different varieties. Almost all institutions working on PGR have possibilities to evaluate genetic resources according to morphological, agronomic, biochemical characteristics, as well as according to resistance level for biotic and abiotic factors. However, only IPP&G has a possibility to evaluate the PGR on the basis of molecular markers.

The main collections of perennial fruit crops are established in HI sub-organizations, but they should be supported and complemented by new varieties, wild relatives of cultivated crops and landraces.

An important issue is multiplication and recruitment of genetic material, stored in gene bank. This activity requires not only financial means, but experienced specialists whose skills and knowledge allow conserving genetic indications of wild relatives, landraces and cultivated species at multiplication. Presently specialists of NRCGR with purpose of updating annually multiple seeds of about 50-60 endangered landraces. But support and assistance is needed from the side of regional and international centers in systematic and appropriate multiplication of seed samples conserved in gene bank.

Training and retraining of the personnel should be the important component of developed projects on recruitment of samples under threat.

It is important for the personnel of NRCGR to realize that their mission is to collect, protect and multiply genetic resources in order these resources served people, but not be kept as a museum exhibit. They should be ready to free exchange of genetic resources with other genetic centers, breeders and gene banks. That is why it is necessary to introduce a system of centralized conservation and free exchange with the observance of all norms and rules. Unfortunately it is not observed nowadays. Conserved samples are available in moderate size and it is not always possible to get them. Probably, in the time of the construction of the new gene bank and transfer of genetic resources from the present gene bank it will be revealed that some part of collections had already lost their sowing qualities. The seed material of these species should be rehabilitated. Such outcomes are quite probable, taking into account the conditions of conservation which do not correspond to the requirements, and the RNCGR staff should be ready for it. The staff should be trained and the system of reproduction and rehabilitation of species under the threat of extinction should be established.

In order to rehabilitate lost gene resources, it is necessary that regional and international centers support RNCGR to obtain species from collections and gene banks of other countries and centers of CGIAR, as some specimens of gene resources were taken out earlier, or were exchanged from VIR. For example, the seed of Lucerne bred by Tajik breeders obtained from the gene bank of Washington State University (USA).

In accordance with scientific information, and based on the data of expeditions and research conducted during these last years in Tajikistan, a great diversity of wild relatives of different plant varieties grow in mountainous areas and foothills, such as grain crops, legumes, forage crops, fruits, nuts, etc. It is known that expeditions on collection of genetic resources were carried out in cooperation with ICARDA and Bioversity Int. However one time expeditions cannot cover all districts and it is impossible to conduct a comprehensive collection of genetic material in this way. To study this diversity in a more detailed way, and facilitate the collection of genetic materials, it is necessary to have a national plan or programme of expeditions. The RNCGR should take a leading role in these expeditions. However this center should have knowledgeable specialists on plants and botany, able to locate, differentiate and describe plant species. At the initial stage of expeditions specialists in botany from the Institute of Botany of the Academy of Sciences of the Republic of Tajikistan and universities should be attracted. Specialists with a solid experience on particular species should participate in expeditions. Currently there is a lack of cooperation between the scientists of Tajikistan on the issues of preservation and efficient use of genetic resources. Each institute and organization wishes to conduct expeditions on collection and description of genetic resources and have its own collection. Apart from research institutions, even some NGOs and projects intend to work on collection and preservation of PGR. There is a need, therefore, in consolidation of efforts and cooperation. The international and regional organizations should facilitate understanding of the importance of cooperation among local research institutions.

CHAPTER 4

THE STATE OF USE

4.1 Distribution of plant genetic resources

Plant breeders working at the research institutes in Tajikistan have an active germplasm collection. However there is a need for enrichment of these collections by germpalsm introduction and exchange. There is only one active center for *ex situ* conservation of genetic resources of improved varieties, landraces and wild relatives of cultivated crops, but there is no mechanism and legal base for distribution of plant genetic resources. Limiting resources does not fully allow multiplication and maintenance of genetic resources stored in the genbank, Therefore there is not sufficient seed of all varieties available for germplasm exchange within the country and in the international level that limits access of plant breeders to the germplasm to be used for breeding purposes. Despite limiting resources and lack of experience in the NRGRC the mechanism of recording the distribution of samples of *ex situ* conserved plant genetic resources to breeding programs has been established. Introduction of new accessions is carried out through NRGRC. Hopefully building up a new modern genebank and introduction of short-term and long term storage facilities at the NRGRC will make the germplasm are available to breeding programs upon request.

4.2 Utilization and enhancing the use of plant genetic resources

Crop breeding in Tajikistan mainly carried out by two major research agricultural organizations – Farming Institute (FI) and Horticulture Institutes (HI) that are supervised by the Tajik Academy of Agrarian Sciences, Ministry of Agriculture. Research activities in the FI are targeted to field crops, while HI is specialized on perennials, vegetables and potato. Both FI and HI has also the research branches and Experimental stations which are situated in other provinces and involved in testing of improved materials and maintaining germplasm collections. Breeding activities of the FI are largely complemented by Khatlon Branch, which is located in the South in Vakhsh Valley of Tajikistan. Both carry out breeding of cotton, grain cereals, grain legumes and fodder crops. FI is specialized on breeding of medium staple cotton and wheat, while Vakhsh Branch breeds for fine-fiber cotton. Besides, these research centers, crop breeding is also carried by RI of Plant Physiology and Genetics, Tajik Agrarian University and Pamir Biological Institute, which were not involved in crop breeding initially, but got involved in breeding research in late sixties and early seventies.

Despite the relatively small area occupied by different field crops, breeding of the same field crops is often carried out by several organizations independently in Tajikistan. Cotton, which is the most important commercial crop in Tajikistan, is bred by five research organizations: FI, its Khatlon and Sughd Branches, RI of Plant Physiology and Genetics, and Tajik Agrarian University. All five centers allocate major portions of their resources for it (up to 60%). Wheat, which is the most important staple crop of Tajikistan, is bred by five research organizations: FI, Khatlon Branch, RI of Plant Physiology and Genetics, Tajik Agrarian University and Pamir Biological Institute. In terms of resource allocation, wheat takes often less than cotton (up to 25-30% in general, but there is an exception - 70% at Pamir Biology Institute). The same institutions breed for small grain crops but allocate less resource with exception of Khatlon Branch, which allocates more than half of its recourses for small grain crops. Several research entities belonging to the FI take care of rice, maize, sorghum, oilseed, forage and grain legume breeding in the country but allocate very little resources for them.

In contrast, potato breeding and virus-free seed production seems to be more optimized through cooperation of the research organization: RI of Biotechnology of Tajik Agrarian University, which is responsible for production of micro-tubers through tissue culture, HI, which multiplies the planting material in the field and RI of Plant Physiology and Genetics providing scientific support to biotechnology research.

At the Pamir Biological Institute they collect landraces, multiply them and distribute to farmers. For breeding activities they believe that crosses should be made between introduced cultivars and some of the local landraces. A limited number of crosses are made every year. They have also tested 80 varieties of wild potatoes from VIR.

All breeding centers mentioned importance of germplasm exchange among the former Soviet Union countries, which had taken place before the disintegration of USSR. Tajikistan had not established a national germplasm conservation system by the year of 2005 and, therefore, "local germplasm bank" is indicated as the source of all germplasm obtained from locally maintained collections. Local germplasm bank is the only or almost the only source of germplasm for rice, sorghum, cotton and tobacco. Participation in the international evaluation networks has become an important source of improved germplasm for wheat, other small grain and grain legume breeding programs, but still, local collections are important for them as well as for other crops. A large portion of potato germplasm comes to Tajikistan from western public organizations and CIP. For the perennial and vegetable crop breeding programs, local germplasm bank provide more than half of utilized germplasm, while the rest is sourced from private sector and farmer materials.

Allocation of the resources to strengthen plant breeding capacity can be different by crop and activity. There are crops in Tajikistan that do not require a full-scale breeding program due to low area and/or availability of highly adapted germplasm from international centers or other countries. The results of the evaluation of imported wheat, barely, grain legume, vegetable and potato germplasm as well as the fact that majority of the cultivars are foreign or derived from imported germplasm suggest that many of these crop breeding programs could focus on adaptation breeding to evaluate and select varieties from imported germplasm (at least during the next 10-20 years).

Although all breeding research is clearly divided among FI and HI, which are specialized on field and fruit/vegetable crops, respectively, low coordination was observed among the institutes, branches and experimental stations uniting under the umbrella of each of the Research Institutes. Often, the institute and the branch of Research Institutes carry out breeding research of the same crop independently from each other explaining it by regional specialization and/or different breeding objectives. Taking into account diversity of the agricultural areas and total area of arable land in Tajikistan, not more than one breeding program should be retained for most of the crops. These programs will better utilize possibilities of regional trials provided by a pretty large network of the branches, experiment stations and farms in the country to promote wider adaptation and address environmental diversity of Tajikistan.

Base broadening contributes to reducing genetic vulnerability to abiotic and biotic stresses and therefore increases efficiency of the breeding programs. To exploit full potential of the genetic resources, greater emphasis must be made on germplasm enhancement, through identification of useful traits and their introgression to locally adapted elite germplasm. Nearly all local breeding programs need to broaden the base of their breeding material. However, base-broadening is an expensive and long-term investment that Tajikistan may not be able to afford for many crops. In many cases, participation in international and regional cooperation networks can be more efficient way of broadening genetic base of the local breeding programs.

International and regional cooperation is very important for success of the breeding programs. The cooperative networks can be good sources of new germplasm, while the international centers can assist in or do more cost-efficiently molecular characterization of germplasm, crosses and evaluating segregating populations for the local breeding programs. On the other hand, regional cooperation among the Central Asian breeding centers and extension systems, if it is supported by the governments, can facilitate evaluation of the advanced lines and accelerate their release and promotion and save considerable resources for each of the participating country.

In longer term, one of the strategies of countries like Tajikistan (rich in genetic diversity but with too little area of the crops to justify full-scale breeding programs) can be greater emphasis on research of genetic resources and line evaluation. The genetic resources should be studied with the purpose of not only conservation but also sharing them with the global community and getting ready lines instead, followed by evaluation and release.

Although Tajikistan possesses a great diversity of plant resources, however its distribution is limited to a number of areas, therefore there is no need for each separate institution or organization to collect and conserve PGR in such a small country. There should be one united gene bank for the whole country, and its collection should be complemented by research institutions and organizations. That is why it is necessary to concentrate all available collections of local gene fund into one institution. To enlarge the PGR collection and capture all new taxons, varieties and populations, regular expeditions for PGR collection and description are required. The gene bank requires constant PGR renewal, for which a constant search of new germplasm is required. Besides, the system of germplasm exchange should be established, both at regional and international levels.

The support from international and regional centers is required for this purpose, in order to train and re-train staff, strengthen material and technical base of gene bank, enlarging and complementing the PGR collection. It is important that this support is not one-time activity, but is rendered until the Tajik gene bank start functioning in a sustainable way.

4.3 Utilization of genetic resources in breeding programs

Many of the local crop breeding programs have limited access to plant genetic resources and therefore rely on a narrow breeding stock and produce narrowly adapted varieties. Conservation of the genetic resources is a strategic priority of the Tajik government. It is important to emphasize only conservation is not enough for improved access of breeding programs to genetic resources. Development of a comprehensive information database and regular plant material characterization and multiplication activities will be necessary to carry out. Plant breeders are interested in having information on the conserved genetic resources to identify and acquire germplasm of genotypes that possess traits needed for their crop improvement programs. Characterization of the core collections can encourage greater and more efficient use of the genetic resources. Such information and germplasm must be available not only for the local breeders but also worldwide as it can be useful in other environments, or can facilitate development of the varieties that can be useful in the country. Analogously, the local breeding programs must be supported to provide them with adequate access to the international and foreign germplasm banks and germplasm exchange networks.

More then 40 programs, projects and activities on plant breeding, crop improvement and on genetic enrichment have been implemented last years by the research institutions of the National and Agricultural Sciences. Now there are more then 30 scientific programs and collaboration project are implemented by the Research Institutes, most of which relates to plant breeding activities.

Genetic improvement activities on various crops have been implemented by relevant institutes, including main activities on cotton, wheat, legumes and fodder crops. In addition, a series of projects on plant breeding, variety distribution and variety improvement have been implemented in collaboration with ICARDA, CIMMYT, Sida, GTZ, German Agroaction, Agha Khan Foundation, Oklahoma State University and other international organizations. Since 1998 Tajikistan joined CGIAR "Collaboration Programs for Sustainable Development of Agriculture in Central Asia and Southern Caucasian countries". The program involves 9 CGIAR centers and 8 countries in the region. In the framework of International Winter Wheat Improvement Program (IWWIP, CIMMYT – ICARDA-Turkey), research works are carried out on evaluation and the study of selection materials at local condition and utilization breeding activities. Institute of Horticulture carries out research works on testing and breeding of vegetables and potatoes in collaboration with International Vegetable Center (AVRDC) and International Potato Center (CIP), Cotton breeders established joint breeding program with Nazilli Cotton research Institute (Turkey). Collaboration of Tajik Lucerne breeders with colleagues from France and Sweden has been established with support of Sida. There is close cooperation on wheat breeding between Tajik Agrarian University and Oklahoma State University where the segregated material of wheat arrives to Tajikistan for further testing and selection.

Sida project "Support to Seed Industry Development in Tajikistan" is providing technical assistance on strengthening of capacity of the national institutions on variety testing and registration, phytosanitary and plant quarantine, also seed certification and quality control. Despite that there are seeds of different crop varieties illegally imported to the country. Therefore, the main obstacle in enhancing these activities includes introduction of unknown varieties. Seeds of such crop varieties with unknown quality are sold at a low price in local markets both as food and seed as food and seed. Because of this reason and due to lack of information on quality seeds of local varieties along with high production cost of seeds impede wide dissemination of them and stimulation of breeding activities. Significant progress on crop genetic improvement can be made through strengthening scientific supervision over the process by research institutes and through farmer participatory research activities undertaken by relevant institutes. Research works supporting breeding programmes have been carrying out intensively.

New varieties are created through classical selection methods (interspecific, intraspecific – distant hybridization). Accessions introduced from international centers and tested in local condition successfully may also be registered as new variety.

The studies on biotechnology, gene engineering, photosynthesis, molecular biology carried out at the Plant Physiology and Genetics, Academy of Sciences, Republic of Tajikistan and the Research Institute of Biotechnology, Tajik Agrarian University also contributes to crop breeding & improvement. There is a need of support by international and local donor organizations to strengthen facilities and capacity building.

The main objectives and priorities of crop breeding Programs include development of high-yielding varieties tolerant to biotic and abiotic stresses, especially drought tolerant and resistant to diseases and pests through systematic utilization of genetic resources, and by this way improving food security. In this respect, the PGRFA could play very important role. The opinion of farmers is taken into consideration in priorities settings. Market related obstacles and farmers' interest on growing mainly food crops and cash crops also were indicated main constraints in crop diversification by farmers and experts on relevant disciplines.

4.4 Reducing genetic weakness in agriculture system

One of the primary measures taken by the Government of Tajikistan after independence was agricultural reforms and strengthening the role of private sector. Due to farm privatization and land reform the big farms were restructured. As the result the number of large farms has reduced, but the number of small farms increased. Consequently the size of the farms also reduced that does not allow full application of cropping system and resulted in genetic weakness and escape to the wild by plants. The development of complete and commercially sustainable seed industry is the best way against genetic weakness. It is difficult to control this system as the final stage of seed production is implemented by farmers. The farmers are reluctant to sign license agreement on this activity with the breeders.

The resistant to diseases and pests as well as tolerance to abiotic stresses like drought, salinity and hot weather are of special importance in crop improvement activities. In the breeding programs of the main crops there is cooperation of plant breeders with agronomists and plant pathologists. There is close cooperation with ICARDA, CIMMYT and IWWIP (CIMMYT-ICARDA-Turkey) on cereals and legumes breeding. Sida assisted in establishment of cooperation with Turkish Cotton research Institute in cotton breeding, as well as for Lucerne and sainfoin breeding with a number of private and public breeding and seed companies from USA, Canada, France, Sweden.

Cotton is a strategic crop in Tajikistan. This crop has been profitable during the Soviet period with a developed infrastructure. However after independence is established, due to delivery constraints (fuel, spare parts, fertilizers, plant protection means, etc.) and introduction of free pricing for cotton its cultivation turned unprofitable. Introduction of future contracts was aimed for developing of cotton cultivation; however the total debt of cotton growing farms today constitutes 500 mln. USD. Therefore, diversification of economically important crops which could serve as an alternative to cotton is needed. Thus the ground for diversification idea is laid in Tajikistan. Rapeseed and sunflower can serve as alternatives, since oil production is an important area for food production industry, and most of oil is imported from other countries. Diversification is important taking into account a growing need in forage. Saffron can be grown which is of great value at the world market. However introduction of alternative crops requires certain changes in land use practice, and development of infrastructure, e.g. construction of plants producing vegetable oil. It is clear that with development of market relations and free choice of farmers on crops to be cultivated, it is possible to diversify crops.

4.5 Seed production system and sale markets

The use of improved varieties and high quality seeds play a major role in increasing the productivity. Therefore providing farms with certified seed of high yielding well-adapted varieties is a priority task in agricultural development and to improve the wellbeing of Tajikistan's population. To achieve this task requires a series of integrated measures, which make up the 'Seed Chain'. The key links in this chain are:- breeding of new high-yielding varieties, an efficient variety testing and registration system, maintaining the registered varieties to preserve their genetic features, large-scale production, processing and marketing of seeds, and a quality assurance system to certify these seeds.

The favourable climate of Tajikistan should enable the production of sufficient seed, not only for the domestic market, but also for export. In the past, plant breeding and seed production were dominated by public organisations but as a result of the many economic in the country, state funding has sharply decreased, leading to serious problems in seed supply.

Seed system and preparation of planting material as the base for developing the crop production attracted the donors' interest which rendered the essential help through various projects. For instance, joint GTZ-CIMMYT project «Regional Network on wheat variety promotion and seed production» has allowed to introduce a number of new wheat varieties, and to select among them the highly productive, pest and disease resistant, and adapted to local conditions. As the result, for the last three years the wheat variety Steklovidnaya-24 has been released and the areas under this wheat have been noticeably extended. And moreover, selection and system of primary wheat seed-growing have been renewed, Farming Institute has provided with a tractor and other necessary technical equipment to its field offices and a number of seed-growing farms, the manufacture of grain threshing machines in Tajikistan is improved, scientific employees underwent training on problems of wheat breeding and seed-production in the CIS countries and in Mexico. Now the new varieties are annually tested for productivity and resistance to biotic and abiotic stresses in 8 locations.

Other organizations deal with importing the seed material as well. For instance, GAA and CARE in 1999 delivered 15 varieties of potato to the country from Holland in total amount of 1 500 tones, with the purpose to conduct tests and multiplication in the mountain areas in future - Mountais of Maschoh and Karategin valley. Besides, GAA for 1997-1999 delivered more than 10 thousand tones of wheat seeds from Kazakhstan and together with fertilizers distributed to the

dehkan farms in RRS, Khatlon and Sugd oblasts. With the purpose of further multiplication, the Aga Khan Foundation deliveres wheat seeds and seed potato to dehkan farms in GBAO. ACTED also supplies with wheat seeds and seed potato to the dehkan farms in Khatlon and Sugd oblasts. FAO Project was engaged in distribution of vegetable seeds and fertilizers to the poor families.

Many international organizations enumerated above provided with seed material on credit basis until the next cropping season, the interest rate of a credit was from 100 up to 200 %. The delivery and distribution of seed material has played a big role in yield and production increase, especially, for the dehkan farms. Meanwhile it has as well the negative influence as usually the conditions of seed cultivation in the dehkan farms do not always correspond to the requirements and quality of refunded seeds as it is obviously low. Distribution of such production to other farms as seed material, naturally, leads to yield decrease. Therefore these organizations distributed in most cases refunded production to the population in the form of food aid.

FAO initiative on rehabilitation of seed potato system in Tajikistan deserves the special attention and support. FAO realized that it is impossible to solve the seed problem, especially seed potato by delivery of seed material. Therefore in 2004-2007 the project on organization of seed potato production on the improved basis was implemented.

The seed system in Tajikistan, similar to other countries of the Soviet Union, was under control of the state. The seeds were produced by specialized farms. After independence, with the start of reforms and restructuring, private sector gained a bigger stake in seed farming. The Law on "Seed sector" was adopted in Tajikistan in 2002, enabling the private sector to grow seeds as well. In 2008 the same law was updated with a bigger focus on introduction of seed certification system aiming at development of international trade. With the aim to implement the law the Ministry of Agriculture is developing the National programme on development of plant breeding and seed production, including the chain started from plant breeding to production and marketing of certified seeds. By this law the roles of the state and private sector are clearly defined within the seed system. The state facilitates variety testing trials and seed certification in commercial seed industry and private sector facilitates seed production, processing and marketing. The implementation of this programme requires financial support. Therefore it is necessary that other donors render assistance in development of commercial seed farming in Tajikistan. The government of Tajikistan allocates around 3 to 6 mln. Somoni (around 1-3 mln. USD) from the state budget for purchase of seeds. The donors also assist through provision of seeds. It is obvious that this practice is of temporary character, and should be stopped so that the farmers do not acquire dependant's behavior. To shift to market relationship and to develop commercial seed industry it is necessary that the farmers understand the price and cost of seeds and are ready to pay for good seeds. This practice is not adopted yet, and so far seeds are distributed free of charge or on credit basis annually.

The climatic conditions in Tajikistan facilitate seed production for foreign seed companies with the aim of sale abroad. However it is necessary that foreign breeding companies feel that their rights are protected in Tajikistan. The law on "On breeding achievements of crops" was adopted in 1995 aiming to protect the plant varieties and breeders' rights. Currently the law is being revised, enabling Tajikistan to become a member of the Union for Protection of New Plant Varieties (UPOV). It is also necessary that the system of seed certification is operational in Tajikistan and the national standards are developed and set up. The central seed laboratory of the Republican seed inspection service of Tajikistan has been renovated and starting from 2009 it will become the member of the International Seed Testing Association (ISTA). The next step will be the membership in seed certification system of the OECD, enabling the free international seed trade.

To protect the rights of seed farmers, the Seed Association of Tajikistan was established. This organization is very young and is a member of the Central Asian Seed Association with contacts with the Seed Associations of Turkey, Egypt, Asian and Pacific Seed Association (APSA). However, the support from international and regional organizations is required for this non-governmental organization to enable it to protect the interests of its members.

With the aim to provide the farmers with high-quality seed and planting material it is necessary to develop the seed production of the main agricultural crops. The donor countries till now deliver wheat seeds and seeds of other crops from abroad whereas it is possible to adapt effectively local production of the seed in the country. Adjustment of own seed system also stimulates local producers. Thus it is necessary to support cooperation with the International Research Centers and joint donors projects (GTZ, Sida, ADB) with CIMMYT, ICARDA, IPIGRI, IRRI, and CIP can serve as an example. Foothill and mountain zones represent the big prospects for the development of seed potato production. In valleys it is possible to grow the irrigated wheat, rice and other crops. Creation of seed production of fodder crops is essential.

In general the seed sector now functions in a disorganised way and does not meet modern standards. Because of the lack of early-generation seed (super-elite and elite), farm requirements for high quality seed are not being met and seeds are simply multiplied for many generations without control. The use of poor quality seed leads to a decrease of yield, due to the loss of genetic characters and increased incidence of pests, diseases and weeds. The physical infrastructure

of the seed farms, is also severely degraded. There is a lack of equipment both for field operations and for cleaning and processing of seed. State funding to this sector has been greatly reduced, and although the private sector is developing, it does not yet have enough resources to invest in plant breeding or commercial seed production. Besides these many problems of the physical resources, there is an urgent need to train a new generation of young specialists in the key disciplines of research, production and marketing. A private seed sector is emerging slowly but to accelerate this process there is now an urgent need for government to design and implement a coordinated National Plant Breeding and Seed Industry Development Program in a concerted way to address these constraints.

CHAPTER 5

THE STATE OF NATIONAL PROGRAMMES, TRAINING AND LEGISLATION

5.1 National Programme

There is no specific National program for conservation and utilisation of PGR. However some work is being carried out intensively. In 2003 the National Biodiversity and Biosafety Center (NBBC) was established that coordinates activities on implementation of the National Biodiversity Strategy and Action Plan for Republic of Tajikistan (NBSAP) within the UN Convention on Biodiversity, and other environmental and sustainable development activities.

5.2 Networks

The network was established within the project "Central Asian and Transcaucasian Network on Plant Genetic Resources" and Tajikistan is part of it. Apart from this network Tajikistan does not participate in other networks. Initially, NordGen planned to establish a network comprised of the Central Asian countries, however due to limited resources provided by Sida, it was decided to include only Tajikistan and Kyrgyzstan into this network. It is known that only sustainable network and information exchange enable the specialists of Tajikistan to get more detailed and accessible information on availability of any genetic plant resources and their location. Therefore it is important for Tajikistan to access other international networks, information and exchange between databases.

5.3 Education & training

Tajikistan does not prepare PGR specialists or gene bank personnel. Scientists and specialists working in the PGR projects and programs have basic agronomic or biologic education and have sufficient work experience as breeders and surveyors - plant growers. Average age of the specialists exceeds 50 years old, and youth have low level of interest towards science. Youth whose knowledge level needs to be improved goes only to those projects where they can earn more money, learn English and undergo trainings abroad. Therefore there is an acute lack of the competent specialists. Thus there is a need to train staff in basics of botany and plants systematic, work on computer and foreign languages. The international and regional centers can support in training and re-profiling of staff, however it is also necessary that the interest of young specialists towards science is boosted by the state.

Bioversity Int. established a training center in Khujand where educational courses on conservation of genetic resources of apricot and other fruit crops are conducted. The NordGen intends to set up courses in Sweden for RNCGR staff. It is also necessary to conduct ad-hoc courses on different issues, because PGR collection, description, conservation, distribution and exchange, as well as management of genetic bank – are new areas for Tajikistan.

The regional and international centers should support capacity building of educational institutions, training centers, preparation and publication of curricula.

The scientific research institutions of the Republic of Tajikistan have the capacity on morphological description of genetic resources, lacking, however, appropriate knowledge and special equipment necessary to conduct marker and genetic analysis.

Training of future plant specialists who work closely with plant genetic resources in Tajikistan is undertaken at the Tajik Agrarian University, National University and Pedagogical University. Post graduate courses are available at these educational institutions and research institutes of the National Academy of Sciences and Tajik Academy of Agricultural Sciences. Short-term courses organized by international and regional organizations play an important

role in development of personnel engaged in collection, conservation and utilization of plant genetic resources and in knowledge acquisition.

Such courses are mostly attended research staff from research institutes of the National and Agricultural Academies. The TAAS has received great support for these activities from ICARDA, IPGRI, CIMMYT, and AVRDC and from other regional and international organization. Post graduate students and specialists of the National Republican Genetic Resource Center attended the trainings organized by Bioversity Int., CIMMYT and other organizations. Researchers from the Tajik Agrarian University and RI of Plant Physiology and Genetics have attended the advance training courses on Plant Genetic Resources and Intellectual Property Right and on Plant Breeding and Seed Production organized by Sida in Sweden.

In 2003 Bioversity International established a training center on genetic resources of apricot, which is located in Soghd Branch of FI. Short term training cources on evaluation of dissemination of apricot diversity and cultivated varieties for the researchers of the Central Asian countries have been conducted in the training center. Regular training courses for employees are one of the most reliable tools to enhance activities related to genetic resources. Therefore NordGen is planning to arrange intensive training courses in Sweden for the researchers from NRGRC. Establishment of short-term courses and regular trainings on various fields related to conservation and utilization of genetic resources would be advisable. It is impossible to realize this plan without support of international and regional organizations. There is a need for local, regional and international training courses on survey and inventory of PGRFA, development of Detailed Information Systems, gene bank management, on-farm management, seed treatment, molecular studies, plant breeding, seed production, cultivation technology, and resistance to diseases and pests and on product processing. However the limiting factor for attending the international courses is fluency in English or other foreign language. Therefore there is also a need for intensive English courses. One of such courses for plant breeders, seed specialists and researchers from the NRGRC has recently started.

5.4 State legislation

During recent years, a number of laws, decrees, legal and normative acts have been adopted in the Republic of Tajikistan related to environment protection, especially protected areas, protection of breeders' achievements, seed industry, plant quarantine, and protection of plant world, agricultural systems and land utilization (Table 4).

TABLE 4

The main laws and regulations of the Republic of Tajikistan on PGR

Constitution of the Republic of Tajikistan, November 4, 1994
Forest Code of the Republic of Tajikistan, June 24, 1993, #769
Law of the Republic of Tajikistan "On crop breeding achievements", November 4, 1995, #118
Law of the Republic of Tajikistan "On Seed Sector", Janury 5, 2008, #355
Law of the Republic of Tajikistan "On Plant Quarantine", May 12, 1995, #25
Law of the Republic of Tajikistan "On especial protected nature territories", December 13, 1996, #328
Law of the Republic of Tajikistan "On environment protection", December 27, 1993, #905
Law of the Republic of Tajikistan "On protection and use of plant world", May 17, 2004, #31
Law of the Republic of Tajikistan "On Grain", July 28, 2006, #200
Law of the Republic of Tajikistan "On responsibility for damage by cattle the crop fields and damages of crops, mulberry and other plantation and bushes", March 5, 2007, #240
Law of the Republic of Tajikistan "On dehkan (farmer) farm", May 10, 2002, #48
Law of the Republic of Tajikistan "On biological security", March 1, 2005, #88
Decree of the Government of the Republic of Tajikistan "On confirming the State Programe on development of especially protected nature territories", March 4, 2005, #79
National Action Plan of protection of environment of the Republic of Tajikistan, adopted by the Decree of the Government of the Republic of Tajikistan, May 3, 2006, #191
The Program on rehabilitation and further development of horticulture and grape vine production in the Republic of Tajikistan, adopted by the Decree of the Government of the Republic of Tajikistan, December 31, 2004, #499
The Program on protection of gardens and grape vineyards from diseases and pests in the Republic of Tajikistan, adopted by the Decree of the Government of the Republic of Tajikistan, July 4, 2006, #290

Targeted State Program on development of horticulture and grape production, increasing of fruit and grape production, growing the seedlings of fruit trees and evergreens in the Republic of Tajikistan for the period of 2007-2010, adopted by the Decree of the Government of the Republic of Tajikistan, April 6, 2007, #194
State Program on growing, collecting, processing of herbs and production of drugs from them for the period of 2005-2014, adopted by the Decree of the Government of the Republic of Tajikistan, May 10, 2005, #170
National Program of actions against deforestation in Tajikistan, Dushanbe 2000
Program on economic development of the Republic of Tajikistan for the period to 2015, adopted by the Decree of the Government of the Republic of Tajikistan, March 1, 2004, #86
Decree of the Government of the Republic of Tajikistan "On confirming the State Programe on forestry development in the Republic of Tajikistan", October 31, 2005, #396
On joining to the Agreement between the Governments of the Republic of Kazakhstan, Governments of the Kyrgyz Republic, Governments of the Republic of Uzbekistan on environment protection and efficient use of nature", adopted by the Decree of the Government of the Republic of Tajikistan, November 20, 1998, #444
Agreement between the CIS countries (Republic of Azerbaijan, Republic of Armenia, Republic of Belorus, Georgia, Republic of Kazakhstan, Kyrgyz Republic, Republic of Moldova, Russian Federation, Republic of Uzbekistan, Ukraine) on information cooperation on ecology and environment protection, September 11, 1998
Order of the President of the Republic of Tajikistan " On categorical forbidden of collection and export of ferula pitch", September 19, 2008, #545
Decree of the Government of the Republic of Tajikistan "On zones and special seed farms for crop seed production", June 1, 2007, #314

Among these laws and regulations there is much importance on genetic resource conservation the Law of the Republic "On protection and use of plant world", which strengthen the principles of State policy related on environment protection and efficient use of plant world, defines legal, economic and social bases in these area, and aimed to preservation and reproduction of resources of the plant world. The law was adopted in 2004, but the regulations and other legal documents assisting in implementation of the law were not developed and adopted. Surely this does not allow fulfillment of the law. The most legal acts, regulated and protected wild relatives of crops in the Republic of Tajikistan do not define protection of certain crop species. The regulations mainly aimed on such areas as e.g. land use, and plants covered because they grow in that territory, but are not covered directly by regulations.

After gaining independence, Tajikistan started to work on the issues of PGR collection and description in collaboration with ICARDA and other programmes. The law "On protected territories" defining and enlarging the list of categories of protected areas, namely natural and dendrologic parks, botanical gardens, spas and resorts. To implement this law, "The state programme on protected areas for 2005-2015" was developed. The main purpose of this programme is the enhancement of operational status of the protected areas of Tajikistan. However up to date there is no state programme on PGR. It is required, therefore, to develop, adopt and implement such a programme. It is necessary that Tajikistan signs the International Treaty on PRGFA. It will facilitate the close collaboration with FAO on development and implementation of the PGR national programme. Only a clearly defined programme will facilitate activities on collection, description, inventory, conservation and efficient use of PGR. To develop such programme, support from regional and international centers is required. Taking into account then medical importance and wide use of wild plants in modern medicine and food industry the "State program on growing, collection, processing mecicinal plants and and production of drugs for the preiof of 2005-2014» was developed and adopted by the Decree of the Government of Tajikistan # 170, from May 10, 2005. The program aimed to support succesfull implementation of the Laws of the Republic of Tajikistan «On protection and use of plant world" amd "On medicinal plans and pharmacevtic activities".

In 1993 the Forest Code of the Republic of Tajikistan was adopted, which regulates use of forest and defines in the forests the protected areas with limied use. As our society can not reject using the forest, modern forest regulation should based on the principles of sustainable forestry, wich is lacking. There is a need for development of legal acts that defines norms on cutting forest for public and private needs, but now in many cases cutting the forest depends on subjective factors, nether legal acts. Tajikistan participates in a number of international agreements and processes in the area of plant genetic resources protection. The most important international documents signed by the Government of Tajikistan are Convention on Protection of World Cultural Heritage (1992) and Convention on Biodiversity (1997). Besides, joint actions are planned to be taken in the framework of bilateral cooperation implemented by the Republic of Tajikistan together with neighboring and other countries. However, rules of law, regulating and protecting wild relatives of cultivated plants in Tajikistan are not marked out into separate in legal acts. There are no distinguished limits between regulation and protection of any crop, moreover the legislation of the Republic of Tajikistan is directed to the regulation of such areas as land use, and plants in their turn are grown on the land and are not direct object for regulation. In this connection there is a necessity to improve legislative base related to conservation and efficient utilization of plant genetic resources.

Law of the Republic of Tajikistan on "Protection and use of plant world" was passed in 2004. It strengthens principles of state policy in the area of protection and rational use of flora, defines legal, economic and social basics in this area and directed to the conservation and reproduction of flora resources. Execution of the law requires development of by-laws – normative and regulatory documents. However they are not developed and this fact complicates execution of the law.

Although Tajik legislation declares conservation of biological diversity and Tajikistan is assignee to the Convention of Biological Diversity, the system of practical measures to be taken towards protection and rare and disappearing species of plants and animals is lacking. The forestry organizations do not have a program on inventory and preservation of genetic resources. There is lack of compenent specialists to be able to evaluate negative impact of farming activities in genetic resources.

5.5 Information systems

The information exchange is an important issue in conservation and efficient utilization of PGR. Therefore the information on the number of collections, material collected by crops, wild relatives and landraces should be nationally owned and all interested people should have an access to it. This practice is widely applied all around the world and all genetic banks have the information system with necessary information on PGR being conserved. However this practice is not introduced in Tajikistan, it is very difficult to obtain the concrete information on collections, not mentioning the exchange of PGR. Therefore it is important for the specialists and scientists involved into collecting and conserving PGR to understand the significance of their activities for mankind. They should understand that the information on collected material should be prepared and made available to public. In order to establish a comprehensive information system the trainings among staff should be conducted and technical base of RNCGR strengthened. In order for this network to be sustainable, the resources for its establishment and knowledgeable staff are required.

5.6 Public awareness

The principal condition for PGR conservation is public awareness raising among general public on value of PGR, significance of its conservation for the next generation. Much more effort on propaganda and advocacy is required in order to get people understand that it is prohibited to cut down forests, pistachio and walnut, cut down medicinal and food plants, prevent overgrazing on pastures. Awareness raising on PGR conservation should be conducted at community level. All civic and private organizations, schools and colleges should be involved into awareness raising activities. The population should be educated on careful attitude towards PGR from the level of kindergarten and up to community leaders. Workshops, meetings, radio and TV programmes on PGR values, and the need in their conservation, should be employed. The Bioversity Int. project organized agro-theatres, which talked on the necessity to conserve the PGR. Advocacy publications should also be prepared, such as posters and booklets. Some work on this is conducted in protected areas, however it is necessary to conserve PGR not only in protected areas and parks, but also wherever PGR grow and wherever their habitat extends to. The support and assistance of regional and international centers are required; and advocacy campaigns can be conducted by local NGOs.

It is important that everyone – from decision-makers to ordinary people – understands the importance of conservation and efficient use of genetic resources. It is necessary to inform general public that, genetic resources, once lost, cannot be restored.

It is necessary to improve public awareness that requires external assistance from the part of regional and international organizations. People, first of all villagers, should understand that they are the owners of the wild relatives of the cultivated plants growing on the areas where they live. Only acquisition of sense of owner will enable them to understand that they should take care of preservation of genetic plant resources and these resources should be transferred from generation to generation. Therefore it is necessary to strengthen the outreach work. Such an approach is also required for preservation of pasture plants that in a large degree consist of wild relatives of the cultivated plants. This issue needs assistance from the part of regional and international organizations in development and implementation of genetic resources preservation development projects. As an example there is a project on rehabilitation of pastures and pasture rotation implemented by FAO.

The matter is that donors are assisting in solving food issues by provision food staff and seed material for free, imported from abroad. But with the purpose to develop agriculture it is necessary for donors to direct their support to the increase of local producers' interest. Donors should keep in mind that Tajikistan owns unique examples of wild relatives of cultivated plants and their preservation is needed not only for Tajikistan but for the whole mankind.

CHAPTER 6

THE STATE OF REGIONAL AND INTERNATIONAL COLLABORATION

6.1 General situation of international relations

Close collaboration was established with international and regional organizations (FAO, ICARDA, Bioversity International, USDA, CIMMYT, International Trust Fund for PGR, AVRDC, etc) and science centers, gene banks and botanical gardens of USA, Scandinavian countries (NordGen), Russia, Japan, Italy, Australia, Great Britain, Germany, Turkey, India, France, Mexico, Caucasus, Central Asia and other countries, agreements were signed and joint activities are on-going.

6.2 International networks, programs and agreements

It is obvious that national, regional and international networks avoids duplications of activities and provides significant support in technology transfer, duplication of germplasm, information and germplasm enhancement and exchange, technical expertise exchange, training of researchers, access to advanced research outputs, general characterization and evaluation of germplasm and in strengthening information provision on PGRFA. Insufficient financial sources are main limitations in development of networks. Tajikistan is actively participating in the Central Asian and Transcaucasian Network on Plant Genetic Resources and has participated in most projects implemented in the last 4 years including "Regional Gene Banks supporting project", "Establishment of Regional Network" and "Completion of the Inventory of *ex situ* collections". Apart from this network Tajiksitan is not part of any other network. Initially Nord Gen was aiming to create a network, which would include Central Asian coutnries, however because of the limited support such a network can work only between Tajikistan and Kyrgystan. It is clear that only a well established network and information exchange allow the Tajik specialists have a more detailed information on availability of any PRG and their location. Therefore it is very important for Tajiksitan to have access to international networks and information and that it could also share its data base.

In order to prove that Tajikistan is one of the centers of origin and diversity of a number of agricultural crops, it is necessary to regularly collect PGR, conserve, efficiently use, and establish databases, to participate in the international networks of PGR, and exchanger information with colleagues from other countries.

Tajikistan is signatory to a number of international conventions and agreements including International Convention on Biodiversity (Rio-de Janeiro, 1992), Kartahen Protocol on Bio-security (Montreal, Canada, 2000), Convention for the protection of the world cultural and natural heritage (Paris, France, 1992.) etc. Apart from that, within the bilateral cooperation between the Republic of Tajiksitan and neighboring countries in environmental protection joint actions are foreseen.

Tajikistan has applied for a membership to the Union for Protection of New Varieties (UPOV), International Seed Testing Association and OECD Seed Certification Schemes. Seed Association of Tajikistan is an observer member for the International Seed Federation (ISF). The International Trust Fund has provided technical assistance in improvement of National Gene Bank through regional project. Tajikistan is collaborating with Bioversity Int. on development of PGR Database. Tajikistan intends to join International Treaty on PGR.

CHAPTER 7

ACCESS TO PGRFA, BENEFIT SHARING ARISING OUT OF THEIR USE & FARMERS' RIGHTS

7.1 Access to plant genetic resources

The policy of the Government of the Republic of Tajikistan has officially accepted the principles related to facilitation and improvement of access to PGR adopted on international standards. Significant progress was made in this area after 1997 when Tajikistan became a signatory to the "Convention on Biological Diversity". Started close cooperation with ICARDA and Bioversity Int. on conducting surveys, inventory, collection and preservation of PGR allowed to share the PGR with the International Centers of CGIAR and other countries. For instance, the accessions collected during the expeditions arranged by ICARDA initiative are conserved in the gene bank of the National centre for genetic resources of Tajikistan, and reserve copies – in the gene bank of ICARDA and Australia.

Tajik researchers have good access to the PGR from CGIAR centers and other genebanks. Taking into account the construction of modern genebank Tajik researchers are indenting to collect the PRG, which have Tajik origin and shared with other genebanks via VIR and share the accessions collected and conserved in Tajikistan. However as it was mentioned above, within the country the germplasm exchange is done with difficulties. Due to limited fundings researchers of the RNCGR conduct surveys, collect the germplasm and multiply them, therefore they are to always keen to share the germplasm. It this regards there is a need for support from international and regional organizations to support the expeditions on inventory, surveys, collection and conservation of PGR. As the genetic erosion is taking place such kind of initiatives could be taken soonest possible to be able to preserve the disappearing germplasm.

There is also a need for harmonization of documentations on PGR sharing mechanism internationally accepted, including sharing the germpalsm by signing MTA.

7.2 Fair and equitable sharing of the benefits of the use of PGR and implementation of Farmers' Rights

One of the main principles of PGR use is the access and benefit sharing. The main political document regulating the benefit sharing is the law of the Republic of Tajikistan "On crop breeding achievements" that was adopted in 1995. The law is aimed to protect the breeder's right on obtaining a royalty for varieties bred. However the implementation of the law was not fulfilled, because the regulations inforsing the law were not developed and developed. From another hand, the transition from planned economy to market driven is going very slowly. At the beginning the Government was motivating the breeders paying from the State budget one time gonorarum for new variety bred. Now it is no longer practiced and the system of collecting royalties is still not in place. Therefore now the breeder's right is not protected that somehow stops introduction of new foreign varieties and gives more flexibility to the farmers on growing all kind of varieties – protected and non-protected without paying any royalty. There is a law of the Republic of Tajikistan "On dehkan (farmer) farm", from May 10, 2002, which defines the legal bases of estanblishment and activities on dehkan farms. Hovewer the law does not cover the issues related to use of variety and farmer's priviladge.

Tajikistan has applyied for UPOV membership In 2006 the Second UPOV Workshop for CWANA Region was held in Dushanbe. Now the process of improving the law on plant variety protection (PVP) is going on. The new draft of the law on PVP which conforms with the UPOV Convention 1991 has been developed and now it is in the Parliament. Adoption of the law will enable Tajikistan to become a member of UPOV and will also support the progress towards WTO membership.

The next step for achieving the equitable sharing of the benefit of the use of PGR is a functional variety testing system, consisting of DUS (to enable protection and royalty income for the breeder) and VCU (to distinguish new superior varieties and protect the farmer from inferior seed) must be established. Seed certification must be introduced with a well-functioning system for field inspection of certified seed crops and laboratory testing of seed lots. Certified seed crops should be produced under licence from the breeder and a system for royalty collection on certified seed sales should be organized. It is proposed to form a Plant Royalty Bureau within the Seed Association of Tajikistan (SAT), as the responsible organization. Seed producers must respect these licence agreements and pay royalties on the quantities of certified seed produced/sold of the licensed varieties. A functional extension service must be established, informing farmers on modern crop management including how new varieties should be cultivated. Applied Plant breeding should be the responsibility of the Tajik Academy of Agricultural Sciences and private plant breeding enterprises, while basic research in plant breeding should be the responsibility of the Tajik Agrarian University and the Tajik Academy of Sciences. However, cooperation on common research projects of interest for plant breeders should be supported. Within the Tajik Academy of Agricultural Sciences a restructuring is needed to assure a more efficient utilization of the Government funded activities. This includes identification of priority crops and consolidation of breeding activities on fewer breeding stations.

Plant breeding activities should focus on high priority crops identified, i.e. cotton, wheat and lucerne. Other crops may also be subject to plant breeding provided that royalties on certified seed will make the breeding profitable. Breeding institutes should have specially allocated facilities, and funds, to undertake variety maintenance and the production of 'super-elite seed'. This seed should be sold to the multiplication farms to initiate the seed chain.

CHAPTER 8

CONTRIBUTION OF PGRFA MANAGEMENT TO FOOD SECURITY AND SUSTAINABLE DEVELOPMENT

Food security – is an officially accepted term all over the world, which is used to define the state of food market and economy of the country as a whole. In the first part of 1990-ies, population in Tajikistan was supplied with food which was stable and above minimum requirements. From the mid 1990-ies, situation was worse. Starting from 1997, food was insufficient for supplying minimum requirements in calories, proteins and fat, and this deficit is growing every year. It should be noted that about 90% of calories, proteins and fat is consumed by population through crop production, the most of which is bread (about 80%). That is why, it should be mentioned that population has unbalanced food intake by other important food dimensions.

After independence, there were serious changes in the structure of crop areas and production of important products. The government revised agricultural policy and oriented it to meeting people's demands in food products and reinforcing the economy. The government is concerned in increasing cotton production which brings hard currency to the national economy, and at the same time not reducing production of other food products. Private sector, including households is firstly concerned in increasing food production which brings income. However, implementation of this strategy was complicated due to current problems in the economy of the country.

If we analyze data on crop production per capita, we can reveal changes that have occurred in the sector and its contribution to the food security of the population. According to table 5, after independence, production of food products has been reducing, but recent years there is a tendency on increase of production. Especially, grain, potato, vegetables production increased per capita, which is achieved by introduction of modern varieties as well as expanding the acreage.

TABLE 5
Livestock and crop production per capita, kg

Product	1988	1991	1999	2003	2007
Grain	74.5	54.3	79.0	138.1	131.1
Potato	35.7	32.3	39.2	73.9	93.2
Vegetables	108.7	112.1	63.0	91.1	117.6
Melons and pumpkins	33.7	31.2	13.7	21.6	35.8
Fruit and berries	42.1	31.6	12.7	13.8	22.1
Grapes	34.9	21.6	8.8	4.4	16.5
Milk, kg	13.0	13.4	4.9	6.7	8.2
Eggs, pieces	164.0	104.9	49.5	69.2	157.1

Source: Statistic Yearbooks, Dushanbe, 1999; 2003; 2007

The Government of the Republic of Tajikistan took a number of measures in economic reforms and development. The objective of Economic Development Programme of the Republic of Tajikistan with the term up to 2015 is to focus all efforts in creating bases for market economy, developing its infrastructure, establishing economic mechanism and enhancing labour interest. It also aimed to increasing of production and economic measures in agriculture. To meet people's demand in wheat and strengthen food security of the country, it is planned in this stage to increase the wheat yield. The government finances breeding program to achieve food security. In addition, official strategies are also available for crop improvement by using advanced methods and technologies. State program in poverty reduction and development of the regions can be cited as an example.

Though situation in food security is getting better year by year, it is still not possible to stop import of food products. The main imported products are grain, flour as well as meat, poultry, eggs, rice, buckwheat, confectioneries and vegetable oil. These products are imported from Kazakhstan, Uzbekistan and Russia, though some of them are produced in European countries, Iran and Turkey. Despite the import Tajikistan exports products to Russia, Kazakhstan and other CIS countries and about 70% of the volume of exported goods goes to European countries. The main components for export are cotton and aluminium. Besides cotton, fruits and vegetables are also exported to Northen districts of Kazakhstan and Russia. Onion, potato, grapes, apples, apricots, tomatoes, sweet-cherry, tobacco, leather and wool are exported in large volumes.

The agriculture policy towards research programs aimed for wide utilization of PGRFA, broadening *in situ* and *ex situ* conservation, efficient utilization of genetic resources as food, wear and in crop improvement activities will continue and lead to elimination of poverty and contribute to welfare of people. Contributions of PGRFA in the country's economic development and in poverty reduction are multi-brunched. It is mainly related to germplasm enhancements by utilization of genetic resources by the national breeding programs and developing improved crop varieties. Introduction of modern crop varieties from commercial breeding companies as well as receiving advance lines from International Centers play significant role on yield increase, improvement of livelihood and food security.

Commercialization of unpopular crops requires some external support and assistance, since arable land is very limited in Tajikistan and farmers are interested in production of highly profitable crops, or in production of those crops which would provide food security for the household. Therefore a complex approach should be applied enabling both conservation of valuable crops and profit. Cultivation of Lucerne and Esparcet could be interesting for farmers from the point of view of development of animal husbandry and production of meat and milk products. Another approach is the development of international trade. For example, western companies are interested in cheap production of millet and safflower. These crops are cultivated in Tajikistan on rainfed lands. Such contacts facilitate development of business and commercialization of unpopular crops.

APPENDIX 1

LOCAL NAMES OF OLD VARIETIES AND LANDRACES

Apricot (*Prunus armeniaca* L.)		
1	Khurmoi	Хурмои
2	Isfarak	Исфарак
3	Boboi	Бобои
4	Kandak,	Кандак
5	Mirsanjali,	Мирсанджали
6	Tajiboi	Таджибои
7	Mullo gadoi	Мулло гадои
8	Uchma	Учма
9	Mahtobi	Махтобак
10	Javpazak	Джавпазак
11	Daravshak	Даравшак
12	Kali zafari	Кали зафари
13	Bibi Nigori	Биби нигори
14	Shirpaivand	Ширпайванд
15	Lychak	Лучак
16	Gulyunghi	Гулюнги
17	Gurdi-gov	Гурди гов
18	Samsherak	Шамшерак
19	Safedak	Сафедак
20	Shohi	Шохи
21	Tulyaki	Туляки
22	Hojiboy	Ходжибои
23	Voruhi	Ворухи
24	Urmetani	Урметани
25	Falgari	Фалгари
26	Kukoni	Кукани
27	Surkhak	Сурхак
28	Mokhtobi	Мохтоби
29	Bodomi	Бодоми
30	Cherai Badakhshi	Чераи Бадахши
31	Rakhmatuloi	Рахматуллои
32	Labkajak	Лабкаджак
33	Mahmuri	Махмури
34	Kanduzak	Кандузак
35	Daragi	Дараги
36	Ravshan-Ali	Равшанали
37	Mashpak	Машпак
38	Khudruyak	Худруяк
39	Safedak	Сафедак
40	Sabznulak	Сабзнулак
41	Hiromon	Хиромон
42	Kokanay	Коканай
43	Gurai-Balkh	Гураи Балх

Wheat (*Triticum aestivum* L.)		
44	Sabzak	Сабзак
45	Shukhak	Шухак
46	Laylak Bahori	Лайлак Бахори
47	Surkhak	Сурхак
48	Safedak mestniy	Сафедак местный
49	Bobilo	Бобило
50	Safedak Ishkashimskiy	Сафедак Ишкашимский
51	Kilak Bartangskiy	Килак Бартангский
Grape vine (*Vitis vinifera* L.)		
52	Chillagi	Чиллаги
53	Husayni	Хусайни
54	Toifi	Тоифи
55	Shibirgoni	Шибиргони
56	Kishmish	Кишмиш
57	Basarga	Басарга
58	Sultoni	Султони
59	Sohibi	Сохиби
60	Surkhak	Сурхак
61	Tagobi	Тагоби
62	Javs	Джавс
63	Anguri kalon	Ангури калон
Apple (*Malus domestica* L.)		
64	Pakhta seb	Пахта себ
65	Husni Yusuf	Хусни Юсуф
66	Sebi joydori	Себи джойдори
67	Sebi sariboy	Себи сарибой
68	Sebi safed	Себи сафед
69	Sangseb	Сангсеб
70	Gulamadi	Гуламади
71	Kulchamani	Кулчамани
72	Saidshoi	Саидшои
73	Sebrakht	Себрахт
74	Shulmun	Шулмун
75	Choymavi	Чоймави
76	Kulchaseb	Кулчасебак
77	Chushchak	Чушчак
78	Kilomovn	Киломовн
79	Chomovn	Чомовн
80	Shirinak	Ширинак
81	Tiramohi surkh	Тирамохи сурх
82	Raufi	Рауфи
83	Malik Shohi	Малик Шохи
84	Kanoati	Каноати
85	Karsak seb	Карсак себ
Pear (*Pyrus communis* L.)		
86	Amrud	Амруд
87	Nashputi	Нашпути
88	Murud	Муруд
89	Noki kabud	Ноки кабуд
90	Noki kulula	Ноки кулула
91	Kumnok	Кумнок

Pear (*Pyrus communis* L.)		
92	Dilafruzi daroz	Дилафрузи дароз
93	Shaking	Шакинг
Mulbery (*Morus alba* L.)		
94	Balkhi	Балхи
95	Revishtin	Ревиштин
96	Rabaraz	Рабараз
97	Nayzabek	Найзабек
98	Muzafari	Музафари
99	Sohtut	Шохтут
100	Aslitut	Аслитут
101	Bedona	Бедона
102	Muzafari	Музафари
103	Javtut	Джавтут
104	Rakhshak	Рахшак
105	Suyohtut	Сиёхтут
106	Kabudtut	Кабудтут
107	Maskagi	Маскаги
108	Gultut	Гултут
Walnut (*Juglans regia* L.)		
108	Bepustak	Бепустак
109	Qogati	Когати

APPENDIX 2

STAKEHOLDERS AND THEIR COLLECTIONS

Stakeholders	Name of collections	Number of accessions	Number of accessions distributed at least once
Farming Institute	Genepool of FI	757	23
Institute of Plant Physiology and Genetics	Collection of potato varieties and hybrids	115	7
	Plant Collection of IPPhG	98	3
	Collection of fine-fiber and medium staple cotton varieties	130	8
Pamir Biology Institute	Genepool of PBI	372	27
Republican National Genetic Resource Center	National Genebank	1 905	105
Horticulture Institute	Genepool of Fruit and fruit-berry crops	182	63

APPENDIX 3

STAKEHOLDERS PARTICIPATING IN THE ESTABLISHMENT OF THE NATIONAL INFORMATION SHARING MECHANISM ON GPA IMPLEMENTATION

Name of organization	Farming Institute (FI)
Subordination	Tajik Academy of Agricultural Sciences
Address	Sharora setllement, Hisor district, Dushanbe
Tel	(992 37) 2217005
Fax	
E-mail	
Web	
Field of activity	Breeder;Seed producer;Seed supplier;Research;Extensionist;Genebank (short term collections)
Priority plants	wheat, barley, triticale, maize, tobacco, leguminous plants
Number of accessions in the collection	757
Name of organization	Horticulture Institute (HI)
Subordination	Tajik Academy of Agricultural Sciences
Address	Rudaki, 21A, 734025, Dushanbe
Tel	(992 37) 2270801
Fax	
E-mail	bogparvar@mail.ru
Web	
Field of activity	Breeder; Seed producer; Seed supplier; Research; Extensionist;Genebank (short term collections)
Priority plants	Fruit, fruit-berry plants, grapevine, vegetables
Number of accessions in the collection	182
Name of organization	Institute of Plant Physiology and Genetics (IPPhG)
Subordination	Academy of Sciences of the Tajikistan Republic
Address	299/2 Aini str., 734063, Dushanbe
Tel	(992 37) 2258083
Fax	(992 37) 2244719
E-mail	asrtkarimov@mail.ru
Web	www.ippg.tj
Field of activity	Breeder; Research; Laboratory; Genebank (short term collections)
Priority plants	Cereals, potato, cotton
Number of accessions in the collection	343

Name of organization	Pamir Biology Institute (PBI)
Subordination	Academy of Sciences of the Republic of Tajikistan
Address	1, Kholdorov str., 736002, Khorog
Tel	(992 93) 5808693
Fax	
E-mail	ogonazar@mail.ru
Web	
Field of activity	Botanical garden;Research;Extensionist;Genebank (short term collections)
Priority plants	Cereals, legumes, forage crops
Number of accessions in the collection	372

Name of organization	Republican National Genetic Resource Center (RNGRC)
Subordination	Tajik Academy of Agricultural Sciences
Address	Rudaki Rayon, Sarikishti Village
Tel	(992 37) 446 7676
Fax	
E-mail	genresurs@mail.ru
Web	
Field of activity	Research;Laboratory;Genebank (medium term collections);Genebank (short term collections)
Priority plants	All PGRFA which are priority for Tajikistan, including: Agricultural crops, their wild relatives, medicinal, aromatic and oil-bearing plants
Number of accessions in the collection	1 905

Name of organization	Tajik Agrarian University (TAU)
Subordination	Ministry of Agriculture
Address	Rudaki, 146, 734017, Dushanbe
Tel	(992 37) 2247207
Fax	(992 37) 2247207
E-mail	rectortau@mail.ru
Web	www.tajagro.tj
Field of activity	Educational;Research;Laboratory
Priority plants	Cereals and legumes
Number of accessions in the collection	