

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

RUSSIAN FEDERATION



**THE SECOND NATIONAL REPORT ON PLANT GENETIC
RESOURCES FOR FOOD AND AGRICULTURE IN THE
RUSSIAN FEDERATION**

Note by FAO

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CONSOLIDATED SUMMARY



Sustainable development of the Russian Federation, improved nutrition, life and health quality for the population, as well as ensured national food and bioresources security may become possible only on the condition of agroecosystems conservation and maintenance of ecological environment. These tasks require formulation and consistent realization of public policy influencing the development of various spheres of national life. This policy must ensure implementation of principles of agrobiodiversity conservation, its comprehensive study and rational use within the national system of socioeconomic relations. Preservation and restoration of agrobiodiversity should be among key activities of the state.

Russia is playing a key role in maintaining the biosphere functioning on a global scale, since vast territories occupied by natural ecosystems are preserved within its boundaries, and a significant part of global biodiversity is represented in the country. Thanks to its huge territory, Russia is among the most important countries from the point of view of the species inhabiting it, that is 11 400 species of vascular plants, 269 mammal, 628 bird, 58 reptile, 41 amphibian species, almost 400 of coastal and 290 freshwater fish species. Out of 11 400 plant species, 1 363 species possess social or economic importance, among which 1 103 species are used in the official and folk medicine and 350 are edible ones.

The natural resource potential, as well as intellectual and economic capacity of the country determine the important role played by Russia in solving global and regional ecological and food problems.

Globally, the environment is mainly destabilized due to:

- The increasing population of the planet and the simultaneous shrinking of inhabitable territories;
- Degradation of the main biospheric components, including the decrease in and disappearance of biodiversity;
- Climate change and depletion of the ozone layer;
- The increasing ecological damage caused by natural disasters and technogenic accidents;
- The level of global community coordination in the sphere ecological and food problems solving within the globalization framework.

Russia is among the countries whose agriculture depends on climatic fluctuations and changes to the maximum extent. Improvement of agroclimatic conditions for productivity formation, a decrease in the climate-determined agricultural production risk and the growth of bioclimatic potential have been recorded for the greater part of Russia. Nevertheless, in some regions of the country an increased air temperature and the accompanying higher evaporation rates have not facilitated higher productivity. The main negative consequence of the changing climate for the Russian agriculture will be the possible repetition of droughts and an increased aridity in a number of regions. A decreased yield of cereals at the expense of the increased aridity may be expected in some regions the nearest decades. While the warming progresses, a drop in yields may exceed 20% and become critical for economy of some regions.

The balance of positive and negative consequences from the change of the environment and climate may in general be assessed as positive for the Russian agriculture. At the same time, it will be hardly possible to use these advantages unless agriculture has been adapted beforehand to the expected changes in the global environment and the maximum benefit has been derived from plant genetic resources (PGR) and their wild relatives.

The main trend in the adaptation is the raising of productivity and sustainability of agriculture in the steppe and forest-steppe zones of the country at the expense of implementing a complex of measures aimed at controlling droughts and introducing moisture-saving technologies. A complex of such measures includes a reduction of arable lands and development of grassland farming; introduction of agricultural systems widely using the most drought-tolerant crops (cultivars) in the most arid regions; shifting sowing of spring crops to earlier and of winter crops to later dates for making a better use of moisture and other resources. In those regions of the steppe (forest-steppe) zone, where a sufficient level of moisturizing is predicted, the main trend in adaptation should be optimization of the use of the increasing thermal resources by means of expanding lands under the more heat-loving crops which are of high value due to their deficiency in Russia.

Therefore, realization of a complex of measures related to collection, conservation, study and sustainable use of genetic resources of cultivated crops and their wild relatives (PGR) is obviously a priority trend in activities of the state and society. These genetic resources are the most valuable national property, and their safe conservation, thorough study and evaluation ensure food security for thenation and all humankind.

Conservation and rational use of agrobiodiversity in Russia are influenced by such negative factors as:

- The resource-consuming way of economy development, which leads to the depletion of natural resources and degradation of the environment;
- Ineffective use of genetic resources;
- Insufficient attention paid by the state to the problems of collecting, conservation and study of genetic resources of agricultural plants and animals;
- Low level of technology and management in agriculture and the high rate of farm equipment depreciation;
- Consequences of the economic crisis and the decreased funding for R&D.

Taking into account specifics of activities in this sphere, it will be necessary in the nearest future to adopt the National Program of the Russian Federation for conservation of genetic resources of crop plants and their wild relatives and their rational use for food and agriculture. This Program was developed in 2007 for a period till 2015. The Program is aimed at coordinating at the national level a range of activities undertaken by various public institutions holding genetic resources of agricultural plants and animals. The National Program of the Russian Federation is the main means and major tool for achieving the aims set in the spheres of accumulation, conservation, study and utilization of agrobiodiversity. It is the mechanism that will be used for implementing the majority of measures at the national and international levels, that is, developing legal grounds concerning agrobiodiversity, determining and working out conditions of accessing its components and equitable sharing of benefits from its use. Also, it will help to improve financing and planning of research and practical work, establish priorities in the work with and management of national PGR collections, and ensure sustainable use of accessions conserved in them.

In Russia, collections of agrobiodiversity components are concentrated in institutions belonging to different ministries and agencies. Quite often, disconcerted actions, absence of clearly-formulated aims and tasks and drawbacks in planning prevent rational collecting, safe conservation, study and efficient utilization of biodiversity. The main holders of *ex situ* collections of plant resources, which possess potential value for increasing agricultural production and ensuring food security of the country, belong to the network of the Russian Academy of Agricultural Sciences. Botanical gardens, subordinates of the Russian Academy of Sciences, also hold important plant collections.

Collecting, study and conservation of useful plants with the purpose of their use in breeding programmes or direct introduction into cultivation has been acquiring special importance in recent years due to the accelerating extinction of biological species as a result of anthropogenic activities. The loss of economically important species delivers an irrecoverable damage to the breeding capacity and undermines the possibility to solve the food problem in general. Out of over 2 000 vascular plant species growing on the territory of Russia and adjacent countries, about 1 200 are endangered species and require special protection. The latter include over 2 thousand species representing wild relatives of cultivated plants (WRCP) possessing important characters of immunity, quality, tolerance to unfavourable environmental factors, etc. In terms of WRCP availability, Russia occupies one of the leading positions in the world. Of special importance are the wild species of fruit, berry and nut-bearing plants, of numerous forages, grasses and leguminous grasses (alfalfa, sainfoin, *Psathyrostachys* spp, *Agropyron* spp, *Melilotus* spp, *Astragalus* spp.), grain legumes (*Lathyrus* spp, lentil, vetch, etc.), vegetables (onion, spinach, *Origanum*, *Allium ursinum*, etc.), as well as of valuable medicinal, ornamental and spicy plants. All WRCP still occur in Russia and their preservation within natural habitats (*in situ*) is exceptionally important. A part of these species are protected in nature reserves, on protected territories, in national parks and natural monuments. Botanical gardens contribute to monitoring and coordinating activities concerning conditions of conservation, to assessment of genetic diversity of endemic and threatened species of useful plants in the territory of Russia, and promote establishment of field genebanks for conserving the species, which seed do not store long.

Forest genetic resources are represented in the National Agrobiodiversity Program predominantly by tree species of agricultural application (food, industrial or medicinal raw material).

The function of preservation of forest biodiversity and genetic resources is performed by nature reserves, national and natural parks and other protected territories. Sustainable development of a state requires equal attention to the economic, social and ecological components and recognition of impossibility for the human society to progress under conditions of degrading nature. It means that the future strategic planning of activities in the sphere of agrobiodiversity and agroecosystems conservation should envisage the following measures:

- Prevention of negative ecological consequences of various types of economic activities;
- Refusal from economic and other projects which influence on the agroecosystems is either impossible or difficult to predict reliably;
- Participation of the indigenous and local population, including farmers, in preparation, discussion, adoption and implementation of decisions in the sphere of conservation and rational use of genetic resources;

- Provision of open access to the agrobiodiversity-related information;
- Provision of free access to genetic resources, just and equitable sharing of benefits from their utilization.

Adoption of a National Program at the governmental level is especially urgent due to the processes of globalization and international integration, rapid development of science and technology, springing up of new technologies, general worsening of the environment and genetic erosion acceleration and climate change. Addressing these global issues, including the food problem, requires joining efforts and acting in the most efficient way. The main idea of a National Program is in developing governmental and non-governmental measures for eliminating negative tendencies and creating the most optimal conditions for secure conservation of agrobiodiversity both *ex situ* and *in situ*, developing fundamental and applied research on genetic resources, eliminating duplication of efforts, increasing possibilities of introducing valuable plant material and enriching national genetic diversity by means of conducting collecting missions in Russia and foreign countries and carrying out international exchange, as well as in using bioresources efficiently and rationally, applying new technologies and scientific achievements.

International cooperation plays a key role in the range of genetic resources-related activities. Its objective is in realization of national interests of Russia by means of participating in processes aimed at solving global and regional problems of food and bioresource security. Cooperation is based on the national legislation, taking into account international obligations of the country in the sphere of agrobiodiversity. Of high priority are the following areas:

- Participation in consolidating global community efforts towards conservation and sustainable utilization of agrobiodiversity for increasing food security and reducing the level of poverty;
- Joining the IT PGRFA, participation in the development and implementation of other international agreements related to the matters of agrobiodiversity;
- Ensuring efficient coordination of the adopted international obligations realization and creating a mechanism to control these activities at the national level;
- Active participation in various international and regional networks dealing with conservations and utilization of genetic resources.



INTRODUCTION

Russia is the largest country in the world. It occupies an area of 17 million sq. km (12.5 % of the world's total land area) and stretches through 11 time zones from East to West for 7 thousand km. Climate varies from the Arctic to Moderate Subtropical. Russia encompasses 8 biogeographical and 54 ecological zones. Population of the country is 142 million people, of which about 38.2 million are rural dwellers (28%).

Though 70% of the territory of Russia is regarded as the zone of risky agriculture, agroclimatic resources of the country facilitate the development of diversified agriculture. A vast territory of Russia with the majority of the population is located within boundaries of the cold and temperate belts. The southern part of this territory, which lies in the subzone of mixed forests and forest-steppe zone, encompasses Central Russia, the south of Western Siberia and the Far East and has enough moisture and the total daily air temperatures (above +10°C) from 1 600 up to 2 200°C. The northern part of the country which includes the northern taiga in the Russian Plain and the greater part of Siberian and Far East taiga, has sufficient, or in some places excessive moisture, and the total daily air temperatures throughout the vegetation period within the 1 000-1 600°C range.

The most unfavourable agroclimatic conditions are observed in the Russian Far North, where excessive moisture is combined with the total daily air temperatures throughout the vegetation below 1 000°C. Land cultivation is possible here only in dispersed small areas where heat undemanding crops may be grown or glasshouse cultivation developed.

The warmest part of Russia are the steppe regions of the Southeastern Russian Plain and South of the West Siberian Plain, as well as the Precaucasus region. The daily air temperatures throughout the vegetation period total here 2 200-3 400°C.

The land resources available for the Russian agriculture, for land cultivation in the first place, are limited by unfavourable climatic conditions. The permafrost area covers 1 100 million ha, i.e. over 60% of the total lands. About 710 million ha may be used for agricultural purposes, however, productive agricultural lands amount just to 13% of the total lands, including arable lands, which amount to 8% of the total land resources of the country. Nevertheless, per capita land availability is sufficiently high in Russia and amounts to 0.9 ha.

Lands are unevenly distributed between regions. The area of arable land varies from 5 to 70% of the total lands in different regions. The main arable lands are located in the European part of Russia, in Southern Siberia, within the steppe and forest-steppe zones, as well as in the southern part of the forest zone. The main pastures are concentrated mainly in the southeastern regions of the Russian Plain and southern limits of the West Siberian Plain. In contrast to pastures, the most important hayfields are located in the northern parts of the European Russia, on flood meadows in the first place. Considerable areas of arable land and hayfields are concentrated in the Bon-Black Soil Belt in the European Russia to the north of forest-steppes.

The areas under woodland amount in Russia to 766.6 million ha (about 69% of the total territory), that is, account for 22% of the world's forests. All forests are subdivided into three main groups: taiga, composed of larch and spruce in higher latitudes and coniferous forests of the Altai-Sayany and Far East regions; mixed forests (coniferous and deciduous forests) in the Northeastern Russia, Caucasus and Far East, and subtropical forests along the Black Sea coast. Seven forest ecosystems in Russia are among priority territories of global importance. These are:

- Birchtree forests in the Scandinavian mountains on the Barentz Sea;
Taiga, located in three major areas, namely in the Ural Mountains which serve as a geographical feature separating the European part of Russia from the Asiatic, in the Eastern Siberia where it occupies 1/4 of Russia and represents the world's largest territory with intact wild nature, and in Kamchatka Peninsula in Northeastern Russia;
- An ecosystem that includes mixed forests, steppes and meadows in the Altai-Sayany mountains, Siberian mountains along the borders of Russia, Kazakhstan, Mongolia and China. This is one of the world's centers of diversity of species numbering over 800 species of forest plants and over 200 species of rare and endemic plants;
- Broadleaf and pine forests of the Far East in Southeastern Russia.

Steppes in Russia have underwent significant changes as a results of their plowing for subsequent crops cultivation, intensive grazing, as well as other anthropogenic activities. Dahurian steppe is one of the better-preserved ecological

regions characterized by huge biodiversity and intact meadows.

Russia features the world's richest wetlands, which include 120 thousand rivers, 2 million lakes and over 500 million ha of diverse wetland territories which are of paramount importance for biodiversity in ecosystems and traditional land utilization. Four fresh-water and three marine ecosystems in Russia are included in 200 priority territories of global importance. These are deltas of Volga and Lena, rivers and wetlands in Eastern Russia, Baikal Lake, as well as the Bering, Barentz and Okhotsk seas.

The country possesses gigantic reserves of renewable fresh water amounting to 4 312 km³. The greater part of these reserves is found in remote parts of the country and less than 2% are utilized by people. Distribution of water reserves throughout the country is uneven. 90% of terrestrial water discharge is received by the Arctic and Pacific oceans, while the basins of the Caspian and Azov seas (where 80% of the population is concentrated) receive only 8% of the total annual discharge (Tab. 1).

TABLE 1
Specific water supply in economic regions of Russia

Economic regions	Water supply (thousands of m ³ /year)	
	per 1 km ² of territory	per capita
Northern	349	90.6
Northwestern	455	11.6
Central	232	3.9
Central Black-Soil	125	2.7
Volga-Vyatka	577	18.2
Volga (Povolzhsky)	503	17.3
North Caucasus	195	4.3
Urals	157	6.6
West Siberian	241	44.7
East Siberian	273	136
Far East	290	297
Russia in general	250	28.5

According to forecasts concerning the climate change, if the average annual temperature increases by 3-5°C and rainfall by 10-20%, the increase in annual discharge is expected to be 25-40% in the basis of Volga and Dnieper and 15-20% of Yenisey. The annual discharge into the Arctic Ocean may increase by approximately 15-20%. In this relation, the risk of dangerous freshets will increase in many regions of the country. Under conditions of the changing climate, the traditional agricultural regions of Russia (North Caucasus, Lower Volga and Southern Siberia) will experience an increase in droughts, water supply worsening and additional demand in water.

Russia possesses a well-developed network of protected territories with a total area of 120 million ha (6.6 % of the country's total area). They are subdivided into 4 categories: 100 strict nature reserves (according to the IUCN classification) with a total 33.5 million ha; 35 national parks (7 million ha); 68 federal sanctuaries (12.5 million ha) and over 4 thousand natural monuments totaling 83.6 million ha.

The status of UNESCO biosphere reserve has been given to 28 Russian nature reserves and 5 national parks.

According to their purpose, all lands in Russia (1 709.8 million ha) are subdivided into 7 categories, among which agricultural lands amount to 401.6 million ha (23.5% of all lands) (Tab. 2). These are the lands which are either actually used or can be used for producing agricultural products. Agricultural grounds total 222 million ha (i.e., 13% of the total country's land reserves), among which 55.2% million t (1996) down to 76.2 million t (2006). At the same time, 14 million ha of arable lands may be additionally used to bring in 20 million t of grain.



TABLE 2
Categories of land resources in Russia (as of 01.01.2006)

Land category	Area	
	million ha	%
Lands for agricultural purposes 401.6 23.5	401.6	23.5
incl. those in the Fund of land redistribution (39.9) (2.3)	(39.9)	(2.3)
Lands in inhabited places	19.1	1.9
Industrial and special purpose lands	16.7	1.0
Lands of specially protected territories	34.2	2.0
Forest land	1 104.9	64.6
Land of water reserves	27.9	1.6
Reserve stock land	105.4	6.2
Total lands	1 709.8	100.0

Lands of agricultural purpose occupy a significant part of Russian territory and their importance for national economy, food security and cultural identity is extremely high. These lands support the existence of a rich biological diversity. Many biological species, ecosystems and even landscape types exist in Russia almost exceptionally on agricultural lands. Biodiversity in these lands directly depends on the conducted agricultural activities, and vice versa, value of grounds for agricultural utilization (soil fertility included) to a significant extent determined by both current and past biodiversity.

The structure of agricultural lands ownership is as follows: 275.8 million ha (68.7% of lands of this category) are in federal and municipal ownership and 125.8 million ha are in private ownership, including 120.7 million ha (30.1% of lands of this category) owned by private persons and 5.0 million ha (1.2%) by legal entities.

The land reform carried out in Russia in 1990 – 2007 has brought such major results as abolition of state monopoly on land ownership, provision of conditions for civil circulation of land plots; appearance of farmers as a new stratum of the society, and realization of the Unified State Land Register. Practically, grounds for a new land system in Russia have been laid down. At the same time, the reforms are inconsistent and slow. One of the weak spots of national economy is the management and protection of agricultural lands. At present, the situation concerning agricultural lands is characterized by:

- A big share of unprofitable agricultural enterprises;
- Absence of updating the legal status of land plots within agricultural enterprises;
- Incompleteness of peasant (farmer) households re-registration;
- Inadequacy of land management, absence of soil and geobotanical investigations, conservation of low-productive lands, measures aimed at protecting productive lands from degradation and pollution, and of land reclamation.

Degradation of agricultural grounds is one of the most important socioeconomic problems which poses a threat to ecological, economic and, in general, national security of Russia. The worst damage to soils is done by water and wind erosion (50 million ha), waterlogging and local overwetting (40 million ha), droughts (at times, up to 170 million ha), land salinization and alkalinization (40 million ha), contamination with radionuclides and heavy metals (3.6 million ha). All in all, protection is required for 58 % of arable lands and 95 % of pastures, and 32 % of irrigated lands need reconstruction.

Processes of soils degradation are augmented by unfavourable socioeconomic conditions in agriculture in general. Governmental support to the agroindustrial complex has been decreased 19 times and the volume of investments 7 times; rural salaries do not exceed 35% of the average salary in the industry. Such a salary disparity leads to curtailment of production. Since 1996, working places have been decreasing in number, the quality of life of the rural population has been reducing, depopulation of villages has been progressing (out of 155 000 villages 13 000 were liquidated, 35 000 have a population below 10 and 37 000 less than 50 people). 60 % of village homesteads have an average income that is below the subsistence level.

About 13 % of the country's population is engaged in agriculture. In rural areas, maximum up to 53% of all the employed work in the agricultural sector, 11% are engaged in industry, 21% are nonproductive workers, and the remaining 15% are engaged in construction, transport and procurement. In comparison with urban population, rural is still less educated and qualified. A sharp decline in the share of young, able-bodied population in rural areas is observed. Birth rate is declining in rural areas more rapidly than in urban, and these two tendencies lead to a rapid ageing of rural population.

In Russia, agricultural sector provides 12% of the gross national product and over 15% of national income, and accumulates 15.7% of capital assets (2007). This sector of economy numbers 300 large and medium-size agricultural enterprises and 267.5 thousand peasant (farmer) households (PFH). At their disposal, they have 14.9 million ha (73 ha per farmstead, on the average). Besides, the agricultural sector includes 15.9 personal subsidiary plots (PSP) totaling 7.014 thousand ha (0.44 ha per plot), kitchen gardens owned by 4.3 million families (408 thousand ha, 0.10 per garden), 1 259 thousand ha owned by amateur horticulturists (0.9 ha per plot). Also, there should be mentioned 19.3 minor agricultural enterprises employing 203 thousand workers.

Over half of all agricultural production comes from the population-owned kitchen gardens and PSP, though they occupy only 6.1% of all agricultural land. As a result of reforms, the agrarian structure has undergone substantial changes in Russia since 1998. The share of family households (PFH, households including PSP, and those in garden and horticulture associations) in the structure of gross agricultural output has increased. While in 1990 it amounted to 26.3%, by 1998 it has reached 60.8% of gross output. During these years the volume of output of large enterprises decreased 2.8 times and increased by 12.3% for private households. Specialization of farms of different type has become more obvious. Collective farms keep leading positions in growing cereal and industrial crops, while family farms specialize in producing potato, vegetables, fruits and berries.

Households are mainly aimed at self-sufficiency and market-oriented production of agricultural products. About 9.3 millions of them (58%) are engaged in unstable small-scale commodity production. At the same time, about a half of them produce the main part of products, that is, over 57% of the total agricultural output. PSP produce about 93% of potato, 85 % of vegetables, 89% of fruits and berries, 54% of meat, over 55% of milk and 27% of eggs. PFH produce about 6% of gross agricultural output (17% of grain, 10% of sugar beet, 24% of sunflower and 3% of poultry and cattle). These results have been achieved by means of increasing volumes of heavy manual non-qualified labour and limited application of agricultural appliances, feeds and fertilizers.

The share of households in gross agricultural output equals 52%, while that of agricultural enterprises is 42%. Such a structure is an evidence that Russian agriculture is sliding towards small-scale commodity production and becomes less competitive. The share of products with extremely low marketability, produced using manual labour, primitive technologies, with minimum mechanization of labour-consuming processes, keeps growing. For instance, marketability of potato is 5.4 times lower than of that produced by agricultural enterprises. Similarly, marketability of vegetables is lower 10 times, of cattle and poultry – 3, of milk – 4.4 and of eggs – 14.4 times.

A new attitude towards rural areas and agricultural activities must be formed, since these are areas where traditional occupations, knowledge and culture of many peoples in Russia are maintained and their shrinking brings a threat of destruction of sociogenetic and culture codes, which have been forming for centuries, and of irrecoverable loss of agrobiodiversity. For a vast territory of Russia, optimization of land management envisages adaptive management of natural and creation of anthropogenic landscapes, the structure of which will meet requirements of economic use of agroecosystems without disturbing the ecological balance, as well as promotion of agrobiodiversity protection, thorough study of genetic resources for agriculture and their rational utilization.

The main branches of Russian agriculture are plant growing (about 55% of gross agricultural output in the country) and husbandry. Plant growing is the basis of agriculture; the level of its development determines that of husbandry development. Plant growing encompasses cultivation of cereals (top priority), grain legumes, forages, vegetables, melon crops, potato, industrial and various perennial crops.

Cereal crops occupy almost 55% of all arable lands in the country, the main being wheat, rye, barley, oat, rice, buckwheat, millet and maize. Wheat holds the first place and accounts for 44% of the total grain production in the country. Spring wheat is sown in steppes of the Volga, Urals and Siberian regions, while winter wheat is cultivated in the Central Black Soil Belt and North Caucasus. Maize is grown in Southern Russia maize is grown for grain, and in the Non Black Soil Belt it is grown for silage. Rye is a more cold-tolerant crop and the main areas under rye are located in the Non Black Soil Belt. Barley, one of the most early crops that tolerates frosts and droughts well, is spread from the Maritime Province in the East to the Arkhangelsk Province in the North and Caucasus in the South. Spring barley is cultivated in the North Caucasus. Oat is grown in the Non Black Soil Belt and forest-steppe zones of the European Russia, as well as in Siberia and the Far East.

Grain crops (millet, buckwheat, rice) occupy a very small territory. They have different areas of distribution determined by biological differences. Millet is cultivated predominantly in the steppe zone, in the regions of the European Russia (Volga Region and Southern Urals), where soils are lighter. The area of buckwheat cultivation is vast and encompasses the Arkhangelsk Province, the North Caucasus and Black Sea Region in European Russia, as well as Siberia and the Far East. Rice is grown in Russia on flood plains of Don and Kuban rivers, in the North Caucasus, Astrakhan Province, Kalmykia and the Far East.



Industrial crops are used as raw matter for some branches of industry. They occupy small areas of the total cultivated lands. Of special importance for Russia is sunflower, which is cultivated in the Central Black Soil Belt, the North Caucasus, Volga Region, the Urals and south of Western Siberia, and flax, which grows in the Northwest, Vologda, Kostroma and Yaroslavl provinces. Sugar beet cultivars are grown in the country for the production of sugar and feeds. Due to climatic conditions, industrial crops are grown in Russia on a limited territory. Cultivation of these crops implies a more efficient utilization of land in comparison with grain crops cultivation due to a much higher yield per ha in monetary terms, but these crops do not spread geographically as wide as cereals.

Of all grain legumes, cultivation of only pea and lentil is economically expedient under the conditions of Russia, however *Phaseolus* beans and soybeans are also cultivated. Even during the most productive years the total yield of grain legumes has never exceeded 5 million t in the country. To this or that extent, grain legumes are used in all economic regions of Russia in crop rotation, as they perform an important function of replenishing nitrogen in the soil. Peas are grown mostly in the Non Black Soil Belt, lentils are cultivated in the northern strip of the Central Black Soil Belt, and *Phaseolus* beans and soybeans, being crops of tropical origin, are cultivated in the parts of Russia with a more southern location. Considerable areas are occupied by soybeans in the Far East, since this is a water-loving crop.

Potato has long been a staple Russian food. Up to 90% of potato-growing areas are concentrated in the central regions of the country. Besides food purposes, potato is widely used as an animal feed (especially in pig-breeding), and for technical purposes.

Large-scale vegetable and fruit production is concentrated in southern regions of European Russia. Vegetable and melon crops production is a weak spot of Russian plant cultivation. A considerable part of vegetables consumed in the country is imported. The most widespread in Russia are cabbage, table beet, onion, cucumber, tomato, marrow and eggplant. The share of household plots (of urban population, in particular) in vegetables growing and developing hotbed and glasshouse production of these crops has sharply increased.

According to the Russian State Statistical Committee, in 2008 all categories of farms planted cereals on 47.2 million ha, sunflower on 6.2 million ha, sugar beet on 0.8 million ha, potato on 2.1 million ha and vegetables on 0.6 million ha. In comparison with the previous years, areas under cereals have increased by 2.3 million ha (5.2%), including those under wheat (2.2 million ha increment, i.e., 8.8%). The lands under sunflower have increased by 0.9 million ha (16.8%). Areas under potato and vegetables have also somewhat increased (by 1.6% and 2.2%, respectively). The areas under sugar beet cultivation have shrunk by 22.7%. The greater part of cultivated lands is still concentrated in agricultural organizations: for instance, these are the lands under cereals (76% of all lands held by all categories of farms), under sugar beet (87.9%) and sunflower (64.7%). The share of PFH in crops sown by all categories of farms amounted in 2008 to 23.0% (22.5% in 2007) for cereals, 34.9% (34.8) for sunflower and 11.0% (13.3%) for sugar beet. The current data on the main agricultural products production are compared below with those for the Soviet times (Tab. 3).

TABLE 3
Agricultural production (in million t)

	Soviet times	2007
Grain (after processing)	102	78
Sugar beet	24	21
Sunflower seed	2.9	5.5
Potato	12	36.8
Vegetables	6.5	15
Milk	33.4	30
Cattle and poultry (deadweight)	4.7	5.2

In the end of July 2008, the livestock population on-farms of all agricultural producers was 22.7 million animals (1.1% less in comparison with previous years), among which cows numbered 9.4 millions (1.0% less), pigs – 17.4 millions (1.1% less), sheep and goats – 24.1 millions (4.3% gain). The livestock population held at individual household plots totaled 48.5% of cattle, 43.2% of pigs, 50.8% of sheep and goats (in 2007–47.9%, 43.8% and 51.6%, respectively).

The upper limit of imports permissible for food security of a country is 25%, while in Russia for certain foodstuffs imports amount to 50%. Though imports of food keep growing (e.g., imports of meat already exceed 50%) and reached 21 billion USD in 2006, meat consumption per capita has decreased by 18 kg in comparison with that in 1990, of milk by 141 kg, and of fish and seafood – by 8 kg.

Russian agricultural production is subsidized from the federal, regional and local budgets. Trends in subsidizing differ significantly: the federal budget funds are used predominantly as compensation payment for the damage caused by emergency situations, for making capital investments, for supporting the breeding business and seed production, while from the regional budgets producers receive the largest subsidies for animal husbandry, raising soil fertility, etc. However the main principle of state support to the agrarian sector is not in fulfilling all financial demands of this sector of economy, but in truly reforming its economic mechanism.

Economic growth in agriculture has been observed during the last 8 years. From 1999 through 2006, the volume of agricultural production increased by 34.4%. However, a tendency towards a decline in the rates of agricultural development and falling behind those of industrial development started taking shape in 2002. While in 1999 -2001 the average annual growth rate in agricultural production was 6.8%, in 2002 -2006 it was only 2.3%. The total volume of imports of foodstuffs and agricultural raw materials (except for the textile raw materials) has increased 2.9 times in comparison with that in 2000. In the sphere of plant growing, the level of production of 1990 could be restored only in 2004, and for husbandry it has been only half restored.

The main reasons for a relatively slow development of agriculture are:

- Low rates of structural reform and technological modernization in the sector of economy, as well as of reproduction of natural and ecological resources;
- Unsatisfactory level of the market infrastructure development in this sector of economy;
- Financial instability and insufficient inflow of private investments in the sector of economy;
- Inadequate financing provided for solving a complex of problems related to conservation, study and utilization of agrobiodiversity components;
- Deficiency of qualified personnel.

Problems of the agroindustrial complex will be tackled within the framework of the State Programme of Agricultural Development and Regulation of the Markets for Agricultural Products, Raw Materials and Foodstuffs adopted for the period of 2008 -2012. The Programme describes the aims, tasks and main trends in the development of this sector of economy and regulation of the markets for agricultural products, raw materials and foodstuffs, as well as volumes of funding, mechanisms designed for realizing the envisaged measures and the indices of their efficiency.

Priority tasks in modern agrarian and socioeconomic policy of Russia are as follows: to create conditions and legal grounds for sustainable development of agriculture; conserve agroecosystems and agrobiodiversity, increase rates of agricultural production, solve social problems in rural regions, as well as promote well-being of the population and ensure food security of the country.



BIOLOGICAL RESOURCES



Grain growing is one of the main sectors of plant industry. The wide distribution of cereal crops throughout the agriculturally developed territories of Russia is determined by the significant diversity of biological peculiarities of these crops and multitude of their species and cultivars. Grain of cereal crops is of importance as a food, and also as a fodder. Over a half of all sown areas in Russia (53%) are occupied by cereals and grain legumes (2/3 are spring crops, 1/3 are winter ones). However, winter crops make a bigger contribution to the total grain produced in Russia due to their yields, which are more than two times higher than those of spring crops.

During the last decades, areas under barley have been increasing especially rapidly and the total yields of the crop kept growing. Consequently, barley has firmly occupied the second place after wheat among other cereals. Oat and rye share the third place in terms of total yields. All other cereals (maize, millet-like crops, buckwheat, grain legumes, and rice) neither occupy significant areas, nor play important role in grain production in the country.

Of industrial crops, long-fibered flax and hemp are of special economic importance. Their fiber is used in the textile and hemp-processing industries for manufacturing linen, cables, etc. Seed of these crops is used for producing linseed and hemp oils, which are used for food and by various industries. The wastes from seed processing are used as cattle fodder. Industrial crops contain fiber, oil and sugar, which are used as raw materials by different branches of light and food industries manufacturing textiles, extracting oil and sugar, etc. Industrial crops occupy only 5% of all sown areas (6 million ha), but they have high commercial value and their specific share in the total agricultural production is sufficiently big.

Wheat is the most important grain crop in Russia, which makes a great contribution to the grain stocks of the country. In recent years, wheat grain production amounts to just less than 1/2 of all grain produced in the country, and the areas under this crop exceed those under all other cereals and grain legumes put together.

Barley is the second grain crop in terms of production volume, which accounts for 1/4 of the country's total grain yield. Under conditions of Russia, this is primarily a fodder crop used as a basis for producing mixed fodders. As a food crop, it is used for beer brewing, peeled barley and concentrated foods production, etc.

Rye is a winter crop used for both food purposes and for feeding cattle. Winter rye is one of the most important food crops in Russia. At present, much less rye is cultivated and its share grain production has decreased noticeably. Nevertheless, Russia holds the first place in terms of total yields of this valuable cereal crop. Unlike wheat, rye tolerates acid soils quite well; it is more frost-resistant and requires lower temperatures for initiation of growth. It tolerates droughts better than winter wheat. The main area of rye cultivation is the Non-Black Soil Belt of Russia. Recently, winter wheat, a more valuable and high-yielding crop, is crowding rye out from the Black Soil Belt, which agroclimatically is more favourable for rye cultivation.

Oat is a forage crop, in the first place. In the past, it had been widely used as a forage for horses, but later on sowing areas under oat kept reducing along with the decreasing horse population in the country and increasing barley cultivation. The main advantage of oat is the acid soils tolerance.

Maize is high-yielding grain crop. In terms of yielding ability under conditions of Russia (3 – 3.5 t/ha), it is inferior only to rice. Maize is a valuable crop, as it can be used for both grain production and for silage and green forage for cattle. Among maize food products are flour, groats, cornflakes, and vegetable oil. Besides, starch, syrup, alcohol and many other products can be produced from maize. Some maize cultivars are early-ripening, though the most high-yielding are the late-ripening cultivars. Since maize does not tolerate summer frosts and is a short-day crop, these factors prevent its spreading northwards. The most appropriate for maize cultivation in Russia are black soils. For silage and green forage maize can be cultivated also on acid soils, provided they are limed.

Millet is a low-yielding crop (0.8 – 1 t/ha in Russia) which has not spread widely in the country. The main advantage of this crop is its drought resistance, surpassing that in other cereals, which helped millet spread into the dry areas of the country deeper than other domesticated crops.

Buckwheat is a valuable groat crop, usually a low-yielder (0.6 – 0.7 t/ha). It is very sensitive to the lack of soil moisture and hot winds, but is well-adapted to acid soils. The main sowing areas are located in the southern forest belt and northern forest-steppe zone of European Russia. Buckwheat yields increase noticeably when pollination is done by bees. However,

the main areas of buckwheat cultivation coincide with the location of the largest enterprises of chemical industry which have pernicious influence on beekeeping. Hence are the unjustified low yields of buckwheat in Russia.

Rice is a valuable food crop, the best yielding one among other cereals cultivated in Russia (up to 4 t/ha and over). However, this is the most heat-loving crop of all the cereals.

The main industrial crops in Russia are sunflower, sugarbeet and long-fiber flax.

Sunflower is the most widely spread industrial crop. Almost all sunflower oil consumed in Russia is produced locally. Sunflower is sensitive to soils; it gives high yields when cultivated on well-structured black soils, but it is less moisture demanding than sugar beet. An important condition determining high oil content in sunflower seed is the abundance of sunny days.

Sugar beet is a multipurpose crop. In Russia, it is grown both for food (for sugar) and for feed production, though the first purpose dominates. Sugar beet processing for sugar production leaves a huge volume of wastes which can be used as excellent juicy feed for cattle and pigs. Present-day Russia is not self-sufficient in sugar, in the first place due to the very limited area with agroclimatic conditions appropriate for sugar beet effective cultivation. For instance, sugar beet cultivars are quite demanding to insolation. To achieve high sugar content in tubers, abundance of sunny days is required.

Long-fiber flax is the most ancient industrial crop cultivated in Russia. Homespun linen has always been an essential product sold at national fairs and treasured in foreign countries. In comparison with previous times, the total areas under long-fiber flax have decreased six times. The main reason of that is an abrupt decrease in rural population in the main flax-producing areas (southern part of the forest belt). Long-fiber flax starts growing at comparatively low temperatures and has a short vegetation period. Thanks to these features, this crop has advanced northwards farther than other industrial crops. High-quality fiber and high yields of long-fiber flax can be obtained only in the areas with cool, rainy and cloudy summers. In the areas with dry and warm climate (in the Transvolga steppes, in Southern Urals and in the Kulundinskaya steppe) mostly crown flax is cultivated. The stem of crown flax does not grow tall, branches strongly, and is not suitable for textile fiber production. Flax of this type is grown exceptionally for the production of linseed oil, which is used for technical and medicinal purposes.

Potato is a staple food in Russia. It is called "the second bread". In addition to being a food, potato is widely used as a feed, especially for pigs, and for different technical purposes.

Vegetable and melon growing are among the weakest spots of the Russian plant industry. A considerable part of vegetables consumed in the country is imported (mainly from the former Soviet Union republics). The most popular in Russia are cabbage, table beet, carrot, onion, cucumbers, tomato, vegetable marrow and eggplant.

The character of crops distribution within the country is determined by both their biological properties which require certain environmental conditions, and by socioeconomic factors. The degree of correspondence between biological properties of different cultivated plants and different types of natural environment should be considered in close relation to modern farming systems and cost efficiency of production. This makes it possible to explain the differences between the established cultivation areas of certain and areas of their potential cultivation.

The main areas of winter wheat cultivation are located in Russia in the North Caucasus. These are the Krasnodar Territory and Rostov Province in the first place, the Central Black-Soil Belt and territories along the right bank of Volga. Spring wheat is mainly cultivated in the Volga Region, Southern Urals (Bashkiria, Chelyabinsk, Kurgan, Orenburg and some other provinces), southern parts of Western and Eastern Siberia (including Khakassia), the Far East (southern part of Khabarovsk Territory and Amur Province). The areas of spring and winter wheat cultivation represent a "wheat belt". North and south of it wheat is also cultivated, but areas are relatively insignificant.

Barley is cultivated from the Maritime Territory in the East, to the Arkhangelsk Province in the North, and the Caucasus in the South. Spring barley is sown in all economic regions of the country. Especially widely it is grown in the North Caucasus, Volga Region, Central Black Soil Belt, other regions of European Russia, as well as in Southern Siberia. Winter barley cultivation is mainly concentrated in the North Caucasus. At present, barley is cultivated as a forage crop, though it also has importance as a food crop and for beer brewing.

Oat cultivation is common in the areas of the forest belt with milder climate, often on poor sandy loam soils. In the forest-steppe and steppe zones the importance of oat is decreasing in comparison with other cereals. Besides the Non-Black Soil Region and forest-steppe zone, oat is also cultivated in Siberia and the Far East.

Maize cultivation areas are not big and concentrated mainly in the North Caucasus – the only region in Russia, the western part of which in terms of natural conditions may be compared to the Corn Belt in the midwestern USA. Maize is also cultivated in the central belt of European Russia and in southern Siberia, however, it's grown not for grain, but for silage and green fodder only.

Pea is cultivated mostly in the Non-Black Soil Belt; lentil – in the northern strip of the Central Black Soil Belt; Phaseolus bean and soybean are grown in southern parts of Russia. Soybean is a moisture-loving plant, therefore considerable areas under this crop are concentrated in the Far East (Zeya-Burea Plain and lowlands near Khanko lake).

Millet is grown predominantly in the steppe zone and in the areas with light soils in European Russia. The main cultivation areas are located in the Volga Region and southern Urals.

Unlike millet, **buckwheat** is not tolerant to droughts and demands sufficient soil moisturizing. Buckwheat yields are increasing thanks to a better crop pollination as a result of beekeeping development in the areas of buckwheat cultivation. Buckwheat is cultivated on a vast territory: from Arkhangelsk to the North Caucasus and Black Sea Area in the European Russia, throughout Siberia and in the Far East.

Rice is cultivated in Russia mainly on the overflow lands along the Don and Kuban rivers in the North Caucasus, on the Volga – Akhtubia floodlands in the Astrakhan Province, on the Sarpinskaya depression in Kalmykia, and on the lowlands near Khanko lake in the Far East.

Industrial crops cultivation means a much more intensive way of land utilization in comparison with cereals production, as per hectare yields of industrial crops have a higher value in terms of money. Nevertheless, industrial crops do not have such a wide geographical distribution as the cereals.

Industrial crops have more narrow cultivation areas (in comparison with cereals) because of the strict limitations imposed by availability of appropriate natural conditions; higher labour consumption; and specificity of their processing, which determines location of cultivation areas in proximity to processing enterprises (e.g., sugar beet sowings tend to concentrate around sugar refineries).

Climatic conditions of Russia either completely prevent or strongly limit cultivation of some industrial crops. In the first place, this is such an important multipurpose industrial crop as cotton (textile fiber, cotton oil, cellulose and raw matter for chemical industry). Sugar beet and soybean cultivation areas are also comparatively small.

Sunflower occupies about 1/2 of all the lands under industrial crops in Russia. Sunflower cultivation is mainly concentrated in the steppe and dry steppe zones; areas under this crop in the forest-steppe zone are also considerable. The North Caucasus Economic Region is the main producer of sunflower seed (over 60% of the country's total).

Large sunflower sowings beyond the North Caucasus are located in the Central Black-Soil and Volga economic regions. The lands allocated for sunflower cultivation for silage are located northwards of said regions and exceed those in said regions.

Of other oil crops cultivated in Russia soybean should be mentioned. It is cultivated predominantly in the south of the Far East (the Maritime Province and south of the Khabarovsk Province).

The highest production of sugar beet and the maximum sugar yields per hectare can be obtained in the forest-steppe zone, especially in its western part, where frequency of droughts is lower. Sugar beet cultivation is labour-consuming, therefore it can be cultivated only in the regions with adequate labour resources. About 1/2 of all sugar beet produced in the country comes from the Central Black Soil Belt and about 1/4 from the North Caucasus (the Krasnodar Territory in the first place). Beyond these main areas, sugar beet is cultivated in the forest-steppe along the Volga, in the Urals, and in very insignificant quantities – in the southeast of Western Siberia (the Altai Territory). In the steppe zone, sugar beet occupies 1.5 million ha.

The main **flax growing** area is situated in the southern part of Russian Non-Black-Soil Belt. The Central economic region in recent years has been generating about 60% of domestic gross harvest of flax fibre, the Northern and Volga-Vyatka regions producing approximately 10% each. As for all eastern territories of Russia, they yield only 5–7%. In the last decades prices and demand for natural flax fabrics have abruptly increased, and Russia, possessing favourable agri-climatic environments for this crop and substantial production experience, is able to satisfy domestic demand for flax fabrics to its fullest as well as manufacture them for export purposes. Fibre flax, with its comparatively low requirement for warm temperatures, is produced in many economic regions of the country: Central (Tver, Kostroma, Smolensk and Yaroslavl provinces), North-Western (Novgorod and Pskov provinces), Northern (Vologda province), Volga-Vyatka (Nizhny Novgorod and Kirov provinces), Ural (Udmurtia and Perm province) and West Siberia (Omsk, Tomsk and Novosibirsk provinces).

Mustard, with its high drought resistance, is widely grown in the Lower Volga Region, Stavropol province and southern Urals.

Biological properties of **potato** enable this crop to occupy vast territories. However, the best for its production are forest and forest-steppe regions, especially their westward and central areas with milder climate and appropriate moisture. 90% of potato plantings are concentrated in the European part of Russia (Central region). Potato producing enterprises are clustered round big cities and potato processing factories.



The country's network involved in testing and protecting breeding achievements is headed by the Russian State Commission which generates a unified policy of legal variety protection. One of its functions is keeping the State Register of Protected Breeding Achievements and the State Register of Breeding Achievements Approved for Utilization.

The Register of Protected Breeding Achievements lists varieties protected by patents. At present, there are 204 plant genera and species in this list. Varieties are filed with the Register either as bound to a certain region or when recommended for the whole country. Recommendations concerning selection of crop varieties for certain soil and climate conditions are developed according to the results of state-controlled regional trials.

The category of crops is assigned to cereal, leguminous, forage, oil-bearing (including volatile oil), industrial, vegetable, medicinal, flower, fruit and berry plants, plus potato, sugar beet and grapevine, used in agricultural production.

Depending on the stage of crop variety reproduction, the following categories of crop seed are established: originals, elite (seed of elite varieties) and reproductions (seed of the first and following reproductions and hybrid seed of the first generation).

The system of seed production is a network of functionally interlinked individuals and entities producing original, elite and reproduction seed. Such detailed definition helps to specify targets for conservation among the biodiversity of plant varieties cultivated in Russian agriculture.

Breeding practice has a priority status and is funded mainly from the federal budget.

The government supports national seed production by earmarking budget investments, regulating prices, granting tax exemptions, recompensing costs of original and elite seed production and offering other economic incentives.

The existing regulatory legal base of plant breeding and seed production forms the platform for solving problems that directly concern biodiversity. The system of governmental measures instituted to meet the demands of agriculture for high-quality crop cultivars has developed into four interconnected components: plant breeding, state system of variety testing, seed production and state seed and variety inspection.

The State Register of Breeding Achievements Approved for Utilization contains over five thousand varieties and hybrids (including more than 500 varieties of cereals). Only in the past five years breeders produced about 2 000 new high-yielding best-quality crop cultivars and hybrids. There are varieties of winter wheat resistant to rust, powdery mildew and ear wilt with high potential grain productivity of 10–13 MT per hectare. Spring wheat cultivars L-503, Samsar, L-505, Omskaya 29 and Omskaya 30 are also resistant to rust and high-yielding. Widely used now are promising winter varieties of durum wheat: Bezenchukskaya 182, Bezenchuksky Yantar, Zarnitsa Altaya, Krasnokutka 10 and Lyudmila. Winter rye cultivars Alfa and Valdai, spring barley cvs. BIOS 1, RAMOS, Suzdalets and others manifest high winter-hardiness, resistance to lodging and productivity of up to 6–7 MT per hectare. Barley cvs. Bastion, Kozyr and Sekret would yield 9–12 MT of grain per hectare. Introduced into production were such determinant pea cultivars as Nord, Orlovchanin 2, Orlus, Flagman 5, Flagman 7 and Samarets. On file with the State Register are 9 cultivars and 7 hybrids of sunflower yielding seed up to 4 MT/hectare, containing 50–53% of best-quality oil, resistant to broomrape, downy mildew, rots and tolerant to phomopsis. New varieties of soybean, rapeseed, oil-bearing flax, mustard, castor bean, false flax (*Camelina*), sesame, colza and groundnut have been approved for agricultural utilization. The State Register files about seventy potato varieties, most of which are high-yielding (50–60 MT/hectare), resistant to diseases and adapted to cultivation in various agroclimatic zones of Russia. There are many interesting cultivars and hybrids of vegetables and cucurbits, fruit and berry plants demonstrating winter-hardiness, disease resistance, high productivity, good commercial and consuming qualities.

One tenth of grain production in Russia is concentrated in Krasnodar Territory; a special place in grain-producing industry belongs to wheat—the country's major food crop (ca. 1.2 mln hectares). Main varieties currently in cultivation are: Yuna (26% of area under winter wheat), Soratnitsa (15%), Nika Kubani (11%), Skifyanka (9%), Rufa and Leda (12%), and only 2% are occupied by cultivars developed in other regions. For each economic zone of Krasnodar Territory, it is recommended to cultivate 10 or more varieties, with 4–5 for each farm. Such diversity is expected to secure a natural shield against unfavourable environmental impacts.

Great efforts to preserve diversity of plant varieties have been made by amateur horticulturists and florists. Sometimes united under a volunteer society, they work, for the most part, individually at their own expense. Their endeavours urged the State Commission to pay more and more attention to the varieties specially developed for private orchards and gardens, homestead plots and small farms—vegetables, of course, being the first in the list. Such varieties should have high consumer-oriented qualities.

Over 500 species of wild crop relatives occurring in Russia make part of the country's native flora. Being genetically and evolutionary close to the cultivated species, they are introduced into cultivation and used in crosses aimed at developing new varieties. These wild species include over 200 forages, about 100 fruits, around 90 small fruit species



and approximately the same number of industrial plants, over 70 vegetables, about 20 cereals, 20 nuts and a dozen small grain species. The major part of Russia belongs to one floristic region, and as a result many families and genera are present in floras of most country regions. At the same time, diversity of natural conditions has determined intraspecific type formation, while the influence of the neighbouring floristic regions had its effect on the peculiarity of specific composition in some regions of Russia.

Wild plant forms are inexhaustible reserves of genes lost in cultivated varieties in the process of evolution. Of these forms, the most valuable for breeding are plant species carrying high commercial quality traits and resistance to pests, diseases and unfavourable environmental factors.

Definitely, one of the ways to intensify crop production is searching for new utilizable plant species capable of converting various marginal lands into food producing areas. For example, a species of gen. *Salicornia* (*Clenopodiaceae* family) identified not long ago among the halophytes makes it possible to use saline soils of marshes and coastal lands in Europe and Asia for agricultural production.

According to the amount of useful information available and the level of their practical utilization wild plants may be divided into three groups: utilized, promising and potential. Utilized are the species which are presently used for practical purposes. Promising are those which proved their practical usefulness but cannot be used now because of their insufficiency or inaccessibility, underdeveloped cultivation techniques or inadequate processing technologies. Potentially useful is a plant species which reveals a certain practicable property, but remains untested for practical purposes.

Further progress of botanical and phytochemical research expands the list of useful plants and the number of utilizable species grows in the course of time. The areas of immediate concern are identification of such wild plant species, their comprehensive analysis, registration of their resources and development of sustainable approaches to their practical utilization. The latter activity is especially important since some of the useful wild plant species are now under the threat of extinction brought about by many years of exploitation, so their conservation and sustainable management are regarded as inevitable protection measures.

Populations of many wild relatives have reduced in numbers, e.g. *Rhaponticum carthamoides*, *Glycyrrhiza uralensis*, *Rheum altaicum*, *Viburnum opulus*, *Hypericum perforatum*, *Hippophae rhamnoides*, *Allium altaicum*, *A. victorialis*, *A. microbulbum* in the Altai and Siberia; some *Actinidia* species, *Schizandra chinensis*, *Pueraria lobata*, *Vitis amurensis*, *Juglans ailanthifolia*, *Malus sieboldii*, *Armeniaca sibirica*, *A. mandshurica*, *Cerasus Kurilensis*, *Rubus pseudojaponicus*, *Rubus crataegifolius*, *R. parvifolium*, *Fragaria iinumae*, *F. yezoensis*, *Corylus mandshurica* in the Far East; a series of *Berberis*, *Ribes*, *Sorbus*, *Rubus*, *Rosa*, and *Crataegus* species, *Hippophae rhamnoides*, *Cornus mas*, *Vaccinium arctostaphylos*, *Pistacia mutica*, *Raphanus maritimus*, *Beta macrocarpa*, *B. corolliflora* in the Caucasus, etc.

Shrinking of populations brings about irreversible erosion of germplasm and loss of potentially valuable genetical materials. At present, the tendency of increasing plant genetic resources erosion is visible in the country.

The uniqueness of genetic diversity of crop wild relatives in Russia is determined by a number of factors. To begin with, the greater parts of the areas of distribution of many wild relatives are located within the country.

Specificity of properties in many species is connected with their belonging to a certain floristic region. For instance, *Poaceae* and *Fabaceae* from the European Siberian floristic region, as representatives of a younger flora, are free from protective poisonous substances and thus make a far better gene pool of forage grasses if compared to those from the older floras of Eastern America and Eastern Asia.

Linaceae and *Labiatae* species, characteristic of the Eurasian North, yield wonderful drying oils in high latitudes. Some *Euphorbia* species manifest their rubber-bearing capabilities in humid and relatively warm conditions of the moderate belt in the west of Russia. Thanks to its specific nature, the Altai features some species combining plant height and earliness (e.g. *Dactylis glomerata*, *Allium schoenoprasum*). Wild relatives of cultivated plants are of interest to a contemporary breeder from two points of view. First of all, it is the use of wild forms for hybridization with the cultivated ones, since a number of existing gene pools of cultivated plants lack separate valuable characters which are present in the wild relatives.

For example, the gene pool of alfalfa, the oldest forage crop, had been missing genotypes with sufficient draught resistance. Hybridization of wild steppe forms of *Medicago falcata* with the cultivated *M. sativa* has yielded hybrid alfalfa adapted for cultivation in steppe regions. The wild *Malus baccata* from Siberia has been used for quite a long time for improving varieties of the cultivated *M. pumila*. *Ribes dikuscha*, a species from Yakutia, is involved in developing large-fruited varieties of currant. Wild growing ecotypes of meadow grasses belonging to *Festuca*, *Bromus*, *Alopecurus*, *Phleum*, *Dactylis*, and *Poa* have served as source materials for many varieties of forage crops. Secondly, direct domestication of separate wild species is of special importance. For example, *Melilotus album*, *Agropyrum sibiricum* and *A. cristatum* have been introduced into cultivation as forage grasses in the Lower Volga region. *Hippophae rhamnoides* is being introduced

into cultivation in Siberia as a vitaminous plant. *Ribes rubrum*, a wild species of red currant, has been domesticated likewise. *Vitis amurensis* has been introduced into cultivation and served as a basis for developing varieties of grape in the Far East.

The search for the forms possessing valuable characters is carried out permanently. For instance, relatively large-seeded forms of *Vicia grandiflora* have been found, and this character may facilitate germination of the covered seeds. Tall forms with a weaker stem branching in some representatives of *Apocynum*, *Abutilon*, and *Cannabis* are of interest for breeding fibre crops. Some populations of *Agropyrum* species from Yakutia are known to withstand (at tillering nodes) winter frosts down to 50°C; besides, populations of forage grasses with high protein content and unique frost and draught resistance have been found in the Altai; soybean populations from the Far East have been discovered to have high protein quality and high rate of disease immunity; some Siberian *Malus* species have been found to resist freezing out at 50°C. However, utilization of wild relatives of cultivated plants is far from completion, and the multitude of their potential uses are still not studied in detail.

Many species of crop wild relatives are very important local sources of plant production. Among them are *Allium ursinum*, *A. victorialis*, *A. altaicum* and other *Allium* species which are used by the population of the Far East, the Altai, Siberia, and the Caucasus as vegetables. In Northern regions of the forest tundra belt, berry bearing shrubs like *Rubus chamaemorus*, *R. arcticus*, *R. saxatilis*, *Oxycoccus palustris*, *Vaccinium vitis idaea*, *V. uliginosum* quite often are the major sources of plant products.

In the Russian central belt, such forest berries as *Fragaria*, *Rubus*, *Ribes* are very popular with the people for their flavour, and in the Far East the above also relates to *Lonicera* and *Actinidia* species.

North Caucasus doesn't experience any deficiency in the diversity of cultivated crops, and nevertheless, the local population follows the tradition of including in the diet wild fruit of *Malus*, *Pyrus*, *Prunus*, *Mespilus*, *Cornus*, and *Cydonia*. Many species of the *Brassicaceae* family are edible and their young plants are used in the North Caucasus as spices and salad components; for instance *Brassica campestris*, *Brassica juncea*, *Bunias orientalis*, *Camelina caucasica*, *Eruca sativa*, *Isatis tinctoria*, *Lepidium sativum*, *Raphanus raphanistrum*, *Sinapis arvensis*, etc. Many *Asteracea* species, e.g. *Cartamnus lanatus*, *Lactuca serriola*, *Sonchus arvensis*, *Cichorium intybus*, etc. are used in the national cuisine in the region.

The attitude of the local population to the existing genetic diversity is that of consumers; people view these resources as food and show no interest in their conservation. Quite often, special devices to accelerate harvesting are used when gathering cowberry, bilberry, etc., which results in tearing off of leaves and shoots, restoration of which requires many years.

Wild fruit, berries, vegetables, spices, aromatic and melliferous plants may serve as a good reserve of valuable food for local population and raw materials for food producers. This is especially true for the northern territories and the Far East where crops are not cultivated due to severe environments (very short growing period, permafrost, boggy soils, etc.), which brings about a deficit in supplies of fresh plant products to the population.

At present, most crops are depleted by ceaseless vegetative reproduction. Nearly all varieties of apple-tree suffer from scab, cherry from coccomycosis, currant from anthracnose, gooseberry from powdery milder, etc. Today's production priority is not only biochemical composition of fruit and green matter, but also resistance of varieties to abruptly changing environments that cause their weakening. Still there is a chance to find hidden recessives, new spontaneous mutations and genetic recombination in natural plant populations in order to develop utterly resistant cultivars with a complex of commercial properties.

Quite relevant in the present-day situation is the idea of adaptive approach to agricultural production when champion cultivars are gradually replaced by varieties capable of yielding moderate harvests but with lesser costs. Underexplored and underutilized wild plants may become not only donors and sources for breeding but also a part of people's diet.

For instance, the vegetation of the Russian Far East is represented by more than 4 000 species of higher plants, with only 700 currently used for food. There are 1 700 species of vascular plants in the flora of Magadan province, but only 140 of them may be regarded as wild food-producing plants. The most interesting of them are leafy vegetables and vitaminous plants (67 and 30 spp. respectively). About 1 200 higher plant species occur in Kamchatka province. Among them 122 spp. are wild plants used for food, including 31 spp. of fruits or berries and 77 of vitaminous and leafy plants. This region offers a multitude of plants promising for domestication and breeding practice: fruits and berries little known to local population (*Prinsepia* spp., *Micromeles alnifolia*, *Viburnum burejaeticum*, various wild currants, etc.), edible herbs (various species of ladybell, thyme, chickweed, etc.) and others. Currently, a comprehensive review is being prepared on wild food plants of the Far East (more than 500 species). This work will help to make new useful plants available to the region's local population.

Regretfully enough, Russia, like most of the world's countries, suffers from the ongoing process of crop diversity extinction. The main threat is still the chemistry-oriented technological approach to agricultural production development

with the following consequences:

- Agricultural ecosystems are overburdened with enormous amounts of fertilizers, modifiers and pesticides. Farming methods are unified without heed of regional or local environmental diversity.
- Only a limited number of high-yielding species, varieties and breeds are used, while indigenous varieties and breeds are being lost.
- There is a tendency to deploy and develop vast agricultural areas of one and the same type.
- Soil erosion leads to the loss of soil fertility and diversity of soil ecosystems.

Agricultural regions of the country are populated well enough (about 30% of Russia's population live there) are yield a greater share of food products. These factors predetermine principal tasks to be solved while undertaking efforts to save and revive agricultural biodiversity. These tasks are:

- to raise biocoenotic self-regulation ability in such ecosystems to its maximum and minimize management measures needed to maintain their environmental sustainability;
- provide for environmental safety;
- support productivity of agriculture; and
- shape a healthy and comfortable environment for people's life.

To solve these tasks and preserve agricultural ecosystems in rural areas the following measures should be taken:

- a strategic effort to switch agricultural development from dominating chemistry-based technologies toward evolutionary environment-friendly approaches;
- enhancement of environment-improving and resource-restoring functions of agricultural ecosystems;
- preservation and revival of environmentally balanced traditional natural and cultural systems and rural landscapes;
- registration of the diversity of regional and local environments, diversification of farming techniques, utilization of a greater assortment of varieties and breeds, and development of farmland complexity;
- conservation of diversity in animal breeds and plant varieties, each of which should be adapted to certain local environments and be an element of regional cultural heritage;
- reconstruction of historical environment-friendly centres of crop production and animal farming;
- promotion of a cautious and strictly controlled approach to GMO utilization.

It is clear from this analysis that without governmental support and understanding of biodiversity conservation problems in agriculture, without raising public awareness and involvement in solving these problems, the threat of losing the existing genetic diversity will continue its drastic growth. This is a complex challenge for the whole international community. Very important for preserving sustainable diversity of plant varieties is acknowledgement of traditional experiences and practices of crop production and animal farming. It is necessary to include aspects of agricultural biodiversity in long-term science and technology programmes and work out plans of urgent activities.

There is a no lesser need to coordinate the activities of federal executive authorities with those of the constituent regions of the Russian Federation in the development and implementation of relevant decisions aimed at protection, improvement and restoration of crop varieties for biodiversity conservation in agriculture.

Considering this need, such activities at the national and regional levels should be as follows:

- identification of major biodiversity components in agricultural production systems, monitoring and assessment of the impact of different technologies on these components;
- promotion of farming techniques that may increase productivity, slow down degradation and restore biodiversity;
- raising awareness of farmers, amateur horticulturists and animal breeders concerning their role in conservation, sustainable utilization and management of biodiversity in crop varieties and animal breeds, and aiding them in their practical work;
- development and application of management principles in monitoring genetic erosion of plant resources;
- providing access to genetic resources and equitable sharing of benefits from their utilization.



IN SITU CONSERVATION

Russia contains practically a complete range of Eurasian natural ecosystems (with exception for tropics). These are Polar deserts, tundras, forest-tundras, taiga, mixed and deciduous forests, forest-steppes, semi-deserts and subtropics. The range of different soils is extremely wide: from Arctic soils in the North up to brown semi-desert soils and subtropical zheltozems in the South. The flora of Russia includes over 12 500 species of wild vascular plants, over 2 200 of mosses and liverworts, and about 3 000 lichen species.

In terms of wild relatives of cultivated plants (WRCP), Russia holds one of the leading places in the world. In its European part alone there grow 237 species, 148 more occur in the Far East Region and 250 – in Siberia. Of special importance among them are the wild species of apple, pear, raspberry, currant, strawberry, grape, apricot, mountain ash, actinidia, various nuts, pomegranate, onion, asparagus, flax, poppy, numerous forage grasses and legumes, ornamentals and spices. All this richest plant diversity that must be preserved for the benefit of mankind, now is either strongly decreasing or is endangered.

Protection of the nature in its integrity is impossible without establishing special territories specially designed for conservation of the natural environment, where economic activities will be either limited or banned.

One of the means of biological diversity *in situ* conservation is the establishment of the specially protected natural areas and objects (SPNA). These lands were singled out in the Land Code as an individual category in 1991. This is explained by the increased socioeconomic importance of these lands, the worsened ecological situation and the necessity to strengthen protection of the environment by legal and other means. According to the Russian Legislation, the specially protected natural areas and objects are the areas of land and/or water and air space above them, which possess natural complexes and objects of special importance for conservation, scientific cultural, aesthetic, recreational and health purposes.

SPNA are a national treasure and are designated to protect typical and unique natural landscapes, animal and plant diversity, and the objects of natural and cultural heritage. Economic activities are either totally or partially banned on these specially protected areas, and zones or districts with controlled economic activities are established on the adjacent territories.

The main categories of protected areas are:

- State strict nature reserves, including biosphere ones;
- National parks;
- Nature parks;
- State nature refuges;
- Natural monuments;
- Territories of traditional nature management by the aboriginal smaller peoples of the North, Siberia and the Far East.

SPNA may be of federal, regional or local significance. The former are federal property and are managed by federal authorities. SPNA of regional significance are property of the constituents of the Russian Federation and are governed by the authorities of the constituents of the Federation. SPNA of local significance are the municipal property and are managed by the local authorities (municipalities).

The legislative system concerning SPNA is a multilevel one. At the federal level, it is governed by federal laws On the Specially Protected Natural Areas, On Environmental Protection and other statutory acts, among which are presidential decrees, governmental regulations and arrangements. Legislative acts adopted prior to the change of the political status of the Russian Federation stay valid, as they do not contradict Constitution of the Russian Federation of 1993 and the laws adopted in compliance with it. The relations concerning the use of the SPNA natural resources are also regulated by the Land Code of the Russian Federation, by the Subsoil Law, the Forest Code and the federal law On Wildlife.

According to the Land Code of Russia, one of the principles of the land laws stipulates priority of conservation of the particularly valuable lands and the SPNA lands. According to this principle, requisitioning and use for any other purpose of the particularly valuable lands for agricultural purposes, lands under forests of the first group, SPNA lands,

lands occupied by the objects of cultural heritage and other lands of special value is either limited or forbidden by federal laws.

In terms of strictness of protection, all SPNA can be subdivided into three groups.

1. **Absolute nature protection.** The regime of this kind is characteristic of strict nature reserves and natural monuments. According to it, economic activity is totally banned on the protected territory and human intervention is permitted only for research purposes, sanitary felling, fire fighting, carnivores control, etc.
2. **Relatively strict nature protection.** The regime of this kind envisages a combination of the absolute ban on economic exploitation of natural resources with its permission in limited amounts. This regime of protection is typical of the state nature refuges.
3. **Nature protection of mixed type.** This regime envisages a combination of strict nature reserves with the adjacent zones used for recreation and tourism. The regime of this kind is characteristic of natural parks.

The legal status of state biosphere nature reserves has some peculiarities. These reserves belong to the international system of biosphere reserves performing global ecological monitoring.

The State SPNA Cadastre is maintained for the evaluation of relevant resources. It contains the information about:

- Legal status and the underlying legal texts;
- Geographical location, boundaries and areas;
- Administrative and departmental subordination;
- Tasks facing particular SPNA;
- Ecological, scientific, educational, recreational, economic, historical or cultural value;
- The degree of exploredness and locations where data on qualitative and quantitative characteristics of the protected nature complexes and their components is stored;
- The owners, users and lessees of lands and other resources, methods and intensity of management;
- The degree of integrity, of adverse factors severity, and of disturbedness of nature complexes and their components due to human activities;
- The measures envisaged for the restoration and reproduction of flora and fauna;
- Funding and available material and technical resources;
- The last examination (dates, aims, etc.).

Traditionally, the main forms of nature protection in Russia are represented by the state strict nature reserves (s) and national parks (NPs).

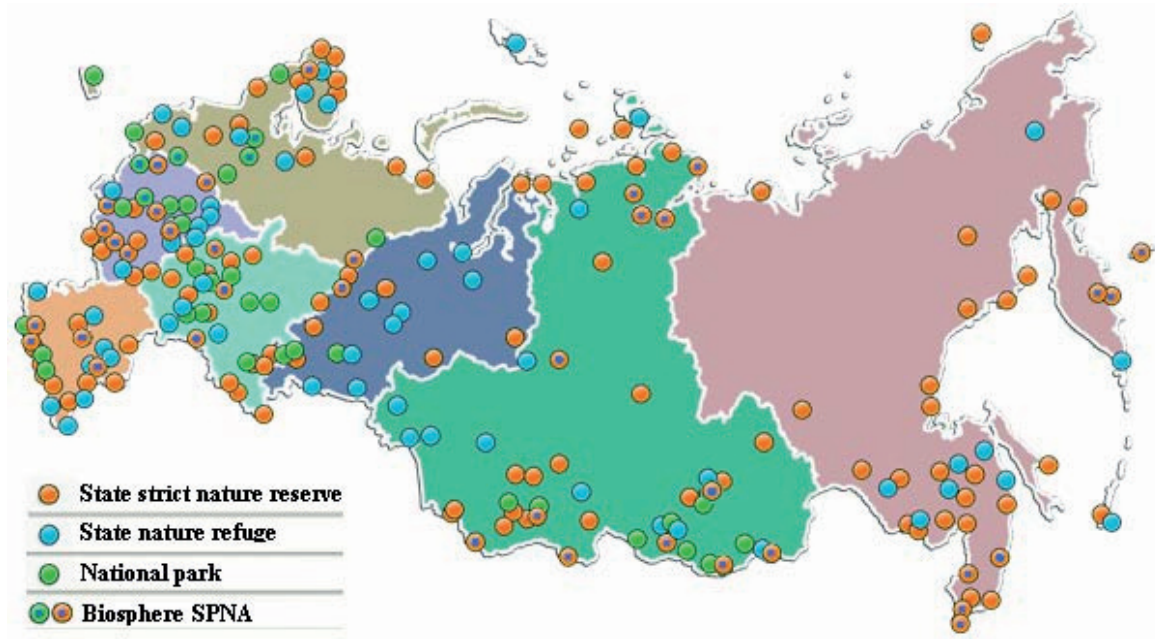
The network of SSNRs and NPs has been developing for over the last 80 years and it keeps growing. In 1997, there were 95 SSNRs in the country totaling 31 million ha, and 32 NPs with a total area of 6.7 million ha. Altogether, these areas occupied about 1.9 % of the total country's territory (1.5% SSNRs and 0.4% NPs). In 2007, the number of SSNRs was 101 and that of NPs – 36, and respective areas occupied by them were 35 and 7 million ha (2.0 and 0.5%).

The UNESCO World Heritage List contains 8 natural properties and 30 SPNA.

According to the law, **state strict nature reserves** (SSNRs) have the status of conservation, research and eco-educational institutions. They are located in on territories of 70 constituents of the Russian Federation (Fig.1).



FIGURE 1
SPNA in the Russian Federation (2007)



The SSNRs are charged with the following tasks:

- Protection of natural territories for the sake of conservation of biodiversity and maintenance of intactness of the protected natural complexes and objects;
- Organizing and conducting research activities;
- Conducting ecological monitoring within the framework of the statewide environmental monitoring system;
- Ecological education;
- Assistance in training scientific personnel and experts in the sphere of the environment protection.

Protection regime is the strictest in SSNRs, and they have a special staff to realize it. Almost all Russian SSNRs are under the jurisdiction of the Ministry of Natural Resources and Ecology. At the establishment of an SSNR, all of its territory is withdrawn from the previous land tenant and the rights are transferred to the nature reserve. SSNRs are the institutions which perform not only the nature conservation, but also research activities. Their majority would have a Scientific Department engaged in long-term investigations related to wild nature protection. Many SSNRs make their contribution to raising public awareness about ecological issues.

Unfortunately, the number of SSNRs in Russia is insufficient for nature conservation. For instance, there are just 12 reserves in the taiga belt in the European Russia. The SSNR network on this territory should be expanded considerably, but no new SSNRs are established here at present due to the reluctance of the regional authorities to lose control over a part of the territory, unwillingness of the industrialists to let potential raw material sources go, as well as due to the chronic lack of governmental funding for the conservation activities.

National parks (NPs) are the federal institutions holding the second place in terms of significance for nature conservation, ecological education and research. Their territories include natural complexes and objects possessing special ecological, historical and/or aesthetic importance.

The use of lands, waters, subsoil reserves, flora and fauna on the territory of an NP may be permitted only upon coordinating this matter with the state authority for the protection of historical and cultural monuments. Lands of other tenants and owners may be situated within NP boundaries and in such cases the NP will enjoy the exceptional right to purchase such lands at the expense of the federal budget.

The regime of NPs protection is differentiated, taking into account natural, historical, cultural and other features of these territories. Therefore, different functional zones may be established within an NP, including:

- strict nature protected zones where any economic and/or recreation activities are forbidden;
- ecotourism zones organized for educational purposes;
- recreation zones;
- economic zones for servicing various needs of the NP.



In the NPs established in the regions inhabited by aboriginal peoples, special areas may be designated for them to carry out traditional agricultural activities, practice primitive and folk arts and crafts, and use natural resources for said purposes.

In contrast to SPNA of other categories, **nature parks** are nature conservation/recreational institutions under the jurisdiction of constituents of the Russian Federation. The lands of nature parks have been provided for this purpose for an unlimited period, though they may include the lands of other tenants and/or owners. In addition to solving the task of nature conservation, nature parks are engaged in creating conditions for recreation and recreation resources preservation.

Nature parks include nature conservation, recreational agri-economic, and other functional zones. The bans and limitations on the activities which may reduce ecological, aesthetic or recreational value of a nature park are set forth legislatively in a more general form than for other SPNA.

Nature parks are a comparatively recent SPNA category. Practically, in terms of organizational principles, use of the territory, aims and tasks they are analogous to national parks, though at the regional level. Unfortunately, the procedure of nature parks establishment is has not been sufficiently elaborated in Russia due to the multitude of intricate and obscure bureaucratic complications. Nature parks are the optimal form of SPNA on densely populated and intensively exploited territories. This SPNA category may have good perspectives, provided the main bureaucratic obstacles preventing creation of nature parks have been eliminated and the establishment mechanism worked out.

The **state nature refuges** (68 federal ones with a total area of 12.5 million ha) are the territories of special importance for the conservation or restoration of natural complexes or their components, and for maintaining ecological balance. A state nature refuge can be established with or without lands requisitioning, under federal or regional jurisdiction, and may have different profiles, that is, be either

- a complex (landscape) refuge designed for conservation and/or restoration of landscapes;
- a biological (botanical and zoological) refuge intended for protection and recovery of the rare or endangered plant and/or animal species, or of the species possessing special economic, scientific or cultural importance.

Nature refuges represent an important component of the SPNA system. When appropriate control of conditions in nature refuges and their protection will be ensured, they, as protected areas which may be created without considerable organizational and financial inputs, and where local population will have a legal right for traditional low-intensity nature utilization, will make the ecological backbone of most forest regions in Russia.

Nature refuges may be created for an unlimited period, or for a definite period (10, 20 years, etc.). In some regions there exist only permanent nature refuges, in others – both permanent and temporary ones. Proprietors and owners of land plots located within the boundaries of a nature refuge enjoy land tax allowances. According to the law, the use of nature resources in a special way is permitted only to representatives of ethnic communities living their traditional ways of life.

It should be noted that nature refuges are the most common, though the least protected SPNA. The forest management bodies traditionally ignore nature refuges in forest regulations, or when planning forest utilization and agricultural activities. For instance, quite often felling intensity in nature refuges is as high as on the adjacent territories. In most cases, no special guarding of nature refuges is foreseen. Sometimes the existence of an officially established nature refuge which is mentioned in nature protection reports and accounts of all kinds is absolutely unknown at the regional level by either authorities, or forestry managers, or forest organizations. Sometimes exact boundaries of a nature refuge are vague due to the incorrect paper work done during its establishment.

Natural monuments (4 000, total area of 83.6 million ha) are unique, irreplaceable natural complexes and natural or artificial objects of ecological, scientific, cultural and aesthetic value. They may be of federal, or regional, or local importance. Proprietors, owners or users of land plots on which natural monuments are located accept obligations concerning introduction of the special protection regime for these objects. The expenses related to ensuring special protection of natural monuments by proprietors, owners or users of said land plots are compensated from the federal budget and off-budget sources.

The above-said shows that a SPNA system has been created in Russia and is actively used. Since 2002, it has become a component of the National Strategy for Biodiversity Conservation in Russia. However, it should be stressed that the problem of PGRFA *in situ* conservation is paid inadequate attention due to departmental isolation, almost total absence of efforts coordination in the sphere of agrobiodiversity conservation, incompleteness of socioeconomic reforms in the agrarian sector and imperfection of the legislative and regulatory framework. Therefore, there exists an urgent necessity in uniting efforts of all stakeholders, those engaged in plant industry and breeding in the first place, in order to discover and make an inventory of the areas with the maximum concentration of WRCP, especially those located within the Vavilov's Centers of Origin of Cultivated Plants and their Wild Relatives, in order to organize their duplicate conservation in genebanks.

Despite the efforts undertaken by the state within the recent 10 years, the process of biodiversity disappearance continues in the country. Negative ecological processes become one of the main reasons of the agricultural grounds shrinking. Lands become totally degraded due to their irrational utilization and because of the negative phenomena which occur and spread due to a sharp decrease in activities aimed at protecting valuable grounds from water and wind erosion, waterlogging, overgrazing, swamping, etc.

Urgent and decisive measures should be undertaken to ensure *in situ* conservation and protection of agrobiodiversity with the aim of sustainable management and rational use of its components. Different techniques of genetic resources conservation should be applied and accompanied by collecting plant diversity in the nature for organizing its safe conservation in *ex situ* collections. Besides, the Russian legislation at the federal, regional and local levels requires further development and harmonization, when necessary, with various international acts in the sphere of environment protection.

At present, more and more nature protection and management experts come to understanding the fact that neither single SPNA, nor dozens or even hundreds of them scatter across this or that region are possible to provide the adequate level of agrobiodiversity safety. This task can be solved by introducing rational exploitation of agroecosystems, raising public awareness about the role of genetic resources in the economic development of the country, and by providing economic incentives for the *in situ* conservation of landrace varieties and WRCP.

Unfortunately, the problem of the on-farm (on homestead plots, in peasant (farmer) households [PFH], local communities) genetic diversity conservation in Russia is paid insignificant attention. As it has been already mentioned, SPNA contain extremely rich diversity of plant species and it is only reasonable to use the existing national SPNA system for conserving plant resources for agricultural use (Tab. 4).

Investigations performed by Russian scientists have shown that 91 SSNRs out of 101 harbour 1147 WRCP species (i.e., 71.2% of the total number) belonging to 39 families. At the same time, 29% of the total number of WRCP (463 species) does not grow in any SSNR in Russia (at least, they have not been found there, so far).

TABLE 4

WRCP species in state strict nature reserves (SSNRs) of Russia

SSNR	SWRCP/(Total species)	SSNR	WRCP/(Total species)
Kavkazsky	246 (1 439)	Bolshekhokhtsyrsky	175 (944)
Altaisky	237 (1 357)	Ilmensky	173 (936)
Khopersky	231 (1 159)	Sikhote-Alinsky	172 (1 064)
Lazovsky	230 (1 272)	Privolzhskaya Lesostep	171 (824)
Tsentralno-Chernozemnyi	228 (1 036)	Sokhondinsky	169 (988)
Zhigulevsky	202 (1 030)	Khingansky	169 (972)
Belogorye	202 (958)	Ussuriysky	162 (815)
Teberdinsky	196 (1 120)	Kedrovaya Pad	160 (909)
Voronezhsky	195 (978)	Sayano-Shushensky	159 (967)
Galichya Gora	190 (885)	Prioksko-Terrasnyi	157 (888)
Kabardino-Balkarsky	175 (1 043)		

The richness of perennial legumes and grasses of the Urals Region is well represented in the Ilmensky and Denezhkin Kamen SSNRs. Several regions characterized by a higher specific diversity of wild relatives of forage and other agricultural crops may be singled out. The North Caucasus contains two foci of specific diversity of perennial alfalfa, melilot, xero- and mesophytic grasses which are well represented in the protected areas. In the protected areas of Transbaikalia there grow valuable forms of Siberian apple (*Malus baccata* Borkh.), sea buckthorn (*Hippophae rhamnoides* L.), Siberian apricot (*Armeniaca sibirica* (L.) Lam.), hawthorn (*Crataegus sanguinea* Pall.). Also, there occur perennial forages, some of which are spread across Eurasia, (*Dactylis glomerata*, *Bromopsis inermis*, *Medicago falcata*, *Elymus* spp, *Agropyron cristatum*, etc.), while some – in Siberia only. Of special interest is the Muiskeya Kettle which is characterized by a climate that is warmer than that on the surrounding territories. This area is an old agricultural center featuring a large number of local forms of cultivated plants (vegetable and melon crops).

The places of WRCP accumulation outside SSNRs can be regarded as territories on which microreserves may be established or used for organization of new or broadening the existing protected territories. The main protected objects

on these additionally provided territories will be the species of WRCP. The species which do not occur within any SSNR of the country have been identified. For instance, For example, wild persimmon *Diospirus lotus* and wild pomegranate *Punica granatum* are among them.

It should also be noted that conservation of plant diversity is facilitated by registering the most valuable or endangered species into the Red Data Book. For instance, 18 species of WRCP were included in the Red Data Book of Russia and 6 species were included in the International Red List of Threatened Species: *Allium altaicum* Pall., *Allium pumilum* Vved., *Elytrigia stipifolia* (Czern. ex Nevski) Nevski, *Secale kuprijanovii* Grossh., *Medicago cancellata* Bieb., and *Staphylea colchica* Stev. (Tab. 5).

TABLE 5
WRCP species included in the Red Data Book of the RF

<i>Allium altaicum</i> Pall.	<i>Lathyrus litvinovii</i> Iljin
<i>Allium pumilum</i> Vved.	<i>Lespedeza tomentosa</i> (Thunb.) Maxim.
<i>Armeniaca mandshurica</i> (Maxim.) Skvortsov	<i>Medicago cancellata</i> Bieb.
<i>Asparagus brachyphyllus</i> Turcz.	<i>Poa radula</i> Franch. et Savat.
<i>Corylus colurna</i> L.	<i>Prinsepia sinensis</i> (Oliv.) Bean
<i>Elytrigia stipifolia</i> (Czern. ex Nevski) Nevski	<i>Rheum altaicum</i> Losinsk.
<i>Festuca sommieri</i> Litard.	<i>Secale kuprijanovii</i> Grossh.
<i>Ficus carica</i> L.	<i>Staphylea colchica</i> Stev.
<i>Juglans ailanthifolia</i> Carr.	<i>Viburnum wrightii</i> Miq.

At present, the work is underway to present WRCP as objects for conservation to experts of SSNRs and to compile lists of priority species of WRCP to be protected in particular SPNA. Said experts will be provided also with the information about biological, geographic and ecological peculiarities of these species, and appropriate documents and materials prepared to justify the necessity of including WRCP in priority lists as the objects of primary importance for *in situ* conservation.

Biodiversity monitoring plays an essential role in ensuring *in situ* conservation of the maximum plant genetic diversity for agriculture and selecting appropriate conservation methods. In Russia, there has formed a departmental system of information gathering about the status of bioresources utilized in agriculture, forestry, pisciculture, hunting industry, water industry, sanitary-and-epidemiologic service, state land cadastre service and the SPNA service. However, departmental systems of bioresources registration do not encompass the entire biodiversity, they are isolated and use different parameters and methods of information gathering.

Monitoring should provide authorities, scientific and public organizations, business structures and the population with information about the status of biodiversity and trends in its change. On-line information relating to biodiversity condition should allow timely correction of control actions directly aimed at influencing biosystems, or aimed at socioeconomic processes having effect on the biosystems. The national reporting should comprise the most general biodiversity data on the condition of the environment.

Due to the diversity and complexity of the objects for monitoring, vastness of the country and differences of conditions in its regions, the monitoring system cannot be created in Russia using one and the same model. An efficient Unified State System of Biodiversity Monitoring (it being a subsystem of the Unified State System of Ecological Monitoring) should be created by establishing a common information space and developing a distributed structure of relatively independent regional, departmental, etc. information structures.

The system of biodiversity monitoring will include the following interrelated components:

- The Federal Information and Analytical Center for Biodiversity acting as the coordinator of activities on data collecting, storing and analyzing. It will be aimed at performing managerial functions at the federal level and observing the fulfillment by Russia of international commitments related to biodiversity conservation;
- Regional systems of biodiversity monitoring working on the basis of regional monitoring centers, with obligatory participation of SSNRs and biostations. These systems were designed to provide information support to managerial activities at the regional level, as well as to gather and process data requested by the Federal Monitoring Center;
- Departmental systems of bioresources monitoring in agriculture, forestry, pisciculture, hunting industry, water industry, sanitary-and-epidemiologic service, state land cadastre service and the SPNA service;
- A genetic resources information system;



- A data analysis system for assessing lands and soils condition.
- A data analysis system for assessing condition of abiotic components of the environment from the point of view of biodiversity conservation;
- A system for analyzing the remote sensing data;
- A system for analyzing general state statistical data (to register human impact on the wildlife) and of public opinion data (to find out the attitude of different social groups towards biodiversity).

Therefore, the state system of biodiversity monitoring will make it possible to a considerable degree to manage bioresources in different sectors of economy, keep their account, predict risks of their extinction, safely conserve *in situ* and duplicate, when necessary, in *ex situ* collections. The given system will make it possible:

- To identify all the agricultural regions the importance of which is high due to biodiversity they contain. These regions also include wetlands, semi-natural grass ecosystems, mountainous habitats, etc;
- To strengthen viability of agricultural production in agroecosystems through funding well-developed and precisely aimed agroecological programmes, which will be coordinated with other measures designed for strengthening the rural areas and with market instruments;
- To promote in rural areas administration and management practices, which take into account the problems of agrobiodiversity and landscape;
- To identify on agricultural grounds habitats of currently low-potential and low-value plants, the importance of which may rise considerably in future, for instance, due to their improvement;
- To secure transfer, maintenance and utilization of viable GMOs produced biotechnologically in the forms which correspond to directions of the Cartagena Protocol on Biosafety and relevant national legislation;
- To promote application of technologies reducing various risks to biodiversity, including acceptable combinations of modern and traditional techniques;
- Stimulate the use of traditional, extensive and mixed agricultural practices promoting conservation and sustainable use of agrobiodiversity.

EX SITU CONSERVATION



PGR conservation under controlled artificial conditions in *ex situ* collections is a governmental strategic task aimed at safeguarding the country against natural disasters and ensuring the future harvests' insurance fund. The measures aimed at *ex situ* conservation of plant and animal biodiversity are complementary to the *in situ* conservation activities.

From practical point of view, *ex situ* conservation at present has definite advantages for the efficient utilization of crop plants genetic resources:

- Centralized management of different PGR collections, creation of unified databases for the conserved accessions (mainly passport data), possibility of qualified processing and control of movement;
- Relatively safe conservation under regulated conditions and duplication of accessions for further complex investigation;
- Concentration of plant diversity accessions representing a source of initial material for solving tactical breeding tasks;
- Availability of the thoroughly studied and evaluated material, its accessibility, as well as of the accompanying information;
- Operational accessibility of a particular set of accessions required for achieving concrete aims;
- Rapid receipt of collection accessions and purposeful utilization of germplasm thanks to easy access.

Efficiency of plant diversity *ex situ* conservation sharply increases when materials are preserved in genebanks at low temperatures.

A world-famous Russian scientist N.I. Vavilov was one of those who initially developed national and global strategies of collection, preservation and rational utilization of genetic resources of cultivated plants and their wild relatives.

Ex situ conservation of biodiversity components (genetic resources of wild and domesticated species of plants and animals) is carried out in Russia using different methods. Among these are the creation and management of collections of various agricultural crops and their wild relatives, microorganisms, tissue cultures of plants and animals. These materials are conserved in different seed stores and genebanks at low and ultra-low temperatures (cryoconservation), as well as in field genebanks (special gardens and nurseries), and in DNA banks.

The term "genetic resources collection" implies the collected, systematized and documented biodiversity components, which have actual or potential value and are conserved under controlled *ex situ* conditions by different institutions or their specialized structural subdivisions to keep these materials viable and available for further study and rational utilization.

Holders of national collections are the organizations or their structural subdivisions which, by virtue of their bylaws or a special permit from the superior bodies, are entitled to collecting, preserving and studying samples of genetic diversity with the aim of their guaranteed long- or medium term conservation, investigation and further use in a variety of research, educational or breeding programmes.

Russian *ex situ* collections of genetic resources of cultivated plants and their wild relatives are subdivided into 5 categories according to their purpose, functions, crop mandate and priority in conservation and study. The first category is composed of **national PGR collections**. These contain global plant diversity, which constitutes representative, systematized and documented (in accordance with the accepted international standards) assemblage of accessions of different species of cultivated plants and their wild relatives. Such collections are formed to ensure safe long-term conservation of global and national plant resources for solving different present-day tasks and problems of future generations, as well as to ensure bioresource and food security of the country by means of efficient study and rational utilization of the conserved genetic diversity.

The second category includes **PGR collections for research and breeding**, which contain samples of different genetic material and are formed for solving particular research, educational or breeding tasks. Some collections in this category or their parts, which contain unique valuable accessions (of one or several crops) of global, regional or national importance may seek eligibility for the status of national collections, provided they are completely documented, their safe long-term conservation complies with international standards, and they are managed by qualified scientific and technical staff.

Special commercial PGR collections belong to the third category. They are created by different organizations – PGR holders and users – for commercial use of the genetic material itself and the results of its research. Such collections are formed at the initiative of holders of *ex situ* collections, or on the basis of special agreements with individual organizations seeking creation of a bioproduct or a solution to specific problems faced by different branches of industry or agriculture.

Temporary research PGR collections are collections in the fourth category. They are formed of plant resources requested from holders of collections of category I and II by different user organizations or research units for utilizing in their research and breeding programmes carried out as part of grant and R&D activities. Upon completion of short-term research works, or finding solution to concrete breeding tasks, genetic materials from these collections, or complete collections, may be either handed over to the holders of collections of categories I and II, or discarded on the basis of mutual agreement.

The fifth category includes **International PGR collections** which contain plant accessions received from international organizations, foreign national collections or genebanks for responsible storage (backup collections) on the basis of intergovernmental or interdepartmental agreements. As a rule, responsibility for safe keeping of such collections is taken by a national collection holder, whose status allows, inter alia, concluding agreements about duplicate storage and/or joint research on accessions from international collections or their parts. Activities concerning these collections, as well as conditions of storage and access to accessions, are stipulated by special bilateral or multilateral agreements.

All collections of genetic resources of cultivated plants and their wild relatives should be supplied with at least minimum information about the accessions in accordance with accepted norms of work with genetic materials. A PGR collection databank of the holder organization should include characterization, evaluation and any other available information about each accession conserved in the collection. This information is subdivided into several categories:

1. **Passport data:** basic information about the basic parameters of an accession;
2. **Characterization data:** phenotypic description (inherited, easily visually registered characters insensitive to the environment);
3. **Evaluation data:** all data obtained in the course of a comprehensive study of an accession;
4. **Local traditional knowledge:** information about plant resources used in traditional agroecosystems obtained from local population in the course of collecting missions.

Information from any of these categories may be either widely accessible to users, or be under restricted access in accordance with legislation of the Russian Federation and/or special provisions concerning information support of PGR collections.

The main holder and keeper of national collections of genetic resources of cultivated plants and their wild relatives in the country is the State Scientific Center of the Russian Federation – the N.I. Vavilov Research Institute of Plant Industry (the most common abbreviation is VIR), which has been dealing with the problems of collecting, conserving, studying and using these resources rationally for about 115 years. The main activities of VIR are:

- Systematic collecting of GR of cultivated plants and their wild relatives of economic importance for Russia.
- Long-term conservation of plant diversity and improvement of conservation methods and techniques.
- Fundamental and applied research in the fields of genetics, physiology, biochemistry, immunology, botany, molecular biology, biotechnology, evolution, phylogeny, and taxonomy aimed at obtaining new data on global PGR.
- Comprehensive study of agricultural crop GR, identification of new initial material for efficient plant production and adaptive plant breeding.
- Creation of genetic collections and donors of economically important traits and properties.
- Development of theoretical grounds, technologies and methods of plant breeding; creation of cultivars and hybrids of main agricultural crops.

At present, VIR keeps collections of cultivated plants and their wild relatives, which rate among the largest in the world and among the richest in terms of botanical diversity. As of 31 December 2007, the total global PGR collection conserved at the institute, its branches and experiment stations numbered 322 238 accessions belonging to 64 botanical families, 376 genera and 2 169 species, over 30% of which are already extinct (Tab. 1. Dynamics of the VIR collection).

This PGR collection is a strong strategic resource for ensuring food, bioresource and ecological security of the country (see: Appendix 1. Composition of the global collection of cultivated plants and their wild relatives for 31 December 2007).

The below-listed departments and other structural units of the institute are charged with the tasks of collecting, conserving and performing initial study of plant diversity:

Departments of:

- Wheat;
- Oat, rye and barley;
- Maize and groat crops;
- Grain legume crops;
- Perennial forage crops;
- Oil and fiber crops;
- Tuber crops;
- Vegetable and melon crops;
- Fruit crops;
- Agrobotany and *in situ* PGR conservation;
- Plant introduction group;

Seed storage:

- Long-term low-temperature conservation complex (including cryostorage);
- Biotechnology laboratory (*in vitro* conservation);
- Laboratory of PGR long-term conservation and seed science.

TABLE 6

Composition of the PGR collections at VIR (2007)

Collection	Accessions number
Wheat and <i>Aegilops</i>	52 037
Rye, barley and oats	36 922
Maize, rice, sorghum, buckwheat, etc.	48 218
Industrial crops	27 266
Forage crops	29 851
Leguminous	45 898
Tuber crops	8 818
Vegetables	49 738
Fruit, berries, subtropical plants and grapes	23 490
TOTAL ca.	322 238

The institute also includes methodological departments and laboratories dealing with in-depth study and evaluation of the conserved plant diversity. These are departments of Genetics (including Immunity laboratory); Biochemistry and molecular biology; Plant physiology; and the Laboratory of ecological genetics.

The VIR global collection encompasses accessions of the following PGR categories:

- Wild and weedy species – relatives of cultivated plants;
- Local varieties used in traditional agroecosystems;
- Cultivars (cultivated currently, or discarded ones, or those not included in national catalogues of recommended cultivars);
- Elite breeding lines;
- Nucleic acid samples (DNA and RNA) as the main carriers of genetic information preserved in the collection in the high-molecular genomic and/or cloned forms
- Donors and genetic sources of economically important traits identified as the result of studying intraspecific and varietal diversity and/or obtained experimentally.



The VIR global collection is subdivided into several types:

- **National base collection** include germplasm accessions listed in the Permanent Catalogue of VIR and placed for long-term storage in the national genebank/specialized storage equipped for safe long-term conservation of said materials, as well as accessions of perennial plants maintained in long-term field genebanks.
- **Working (active) collections** contain germplasm accessions listed in the Provisional Catalogue of VIR and from the collections under medium-term storage. These materials are intended for exchange, supplying different users with seed and other genetic materials for research, breeding and educational purposes, etc.
- **Duplicate collections** are composed of germplasm accessions from working collections, which had been either handed over to users in different institutions (international genebanks included) for duplicate storage, study and consequent use, or those placed in other genebanks under “black box storage” for safe duplication as insurance against unforeseen events or natural disasters.
- **Genetic collections** include germplasm accessions representing forms of a species, obtained through selection or produced experimentally, which manifest inherited differences for one or several traits.
- **Core collections** contain germplasm accessions, the minimum number of which is capable of representing the main genetic diversity of a particular species.
- **Herbarium collections** are composed of herbarium specimens of wild and cultivated plants which serve as a key tool for investigating biological diversity of the plant world.
- **DNA and RNA collections** are composed of the main carriers of genetic information – nu acid samples (DNA and RNA) of plant and/or other biological origin, which conform to certain physicochemical characteristics. DNA and RNA samples may be preserved in the collection in the high-molecular genomic and/or cloned forms.

Seed collections of global genetic resources are conserved under long-term conditions in freezers of the Kuban State Seed Storage (+4°C, -10°C) constructed near Krasnodar city in 1976 on the territory of the Kuban Experiment Station of VIR. In 2000 it was modernized and equipped with new refrigeration compressors and heat-insulating panels. Accessions of the global collection are also safely duplicated at VIR HQ in St.Petersburg in specialized low-temperature chambers (-10°C), the assembly of which was completed in 2001.

Russian collections of cultivated plants and their wild relatives which seek eligibility for long-term conservation as national base collections should:

- Be the state property;
- Include objects of high socioeconomic importance and nutritional significance of global, regional and national level;
- Contain wild relatives of cultivated plants, endemics and rare genotypes, including the endangered species or those under threat of extinction;
- Be safely duplicated entirely or in part in other institutions;
- Include genetic resource accessions possessing specific properties/qualities and growing in specific ecological conditions;
- Be composed of accessions with wide ecogeographic coverage of plant diversity;
- Maintain efficient relations with users by providing free access to collection accessions and accompanying information in compliance with legislation of the Russian Federation and international legal provisions;
- Store accessions in strict compliance with quarantine safety requirements;
- Keep passport data on collection accessions and other relevant information;
- Contain accessions of the crops included in Appendix I to the FAO International Treaty on Plant Genetic Resources for Food and Agriculture.

The base collection conserved at the VIR Headquarters at -10°C contains 33 984 accessions and the operational collection holds 78 521 accessions; the medium-term collection preserved at +4°C numbers 182 025 accessions. All in all, 216 009 accessions of various agricultural crops and their wild relatives are duplicated at the VIR HQ.

The base collection preserved at the Kuban Storage at -10°C numbers 3 085 accessions, and the operational one – 2 272 accessions. The base collection stored there at +4°C consists of 239 213 accessions. The total accessions from the collections of VIR amount to 455 222 accessions.

A small part of the VIR collections is duplicated in different foreign genebanks and CGIAR International Centers. For instance, about 600 accessions of different agricultural crops originating from Central Asia have been placed as a the backup collection in the USA (cotton, Southern cucurbits and small-seeded vegetable crops); the filed genebank of the Institute for Breeding Research on Horticultural and Fruit Crops (Germany) maintains 50 apple accessions; ICARDA keeps



duplicates of parts of the VIR collections of wheat, barley and some legumes. About 1 000 duplicates of cereals, legume and industrial crops were sent in 2008 to the Svalbard Global Seed Vault (Norway). The work on preparing other duplicate collections to be placed in this Storage will continue in the nearest future.

Accessions from the base collection of vegetatively propagated crops are maintained either in field collections, or in the long-term cryostorage at -196°C .

The VIR collections of vegetatively propagated crops are maintained in live stands in specialized orchards, nurseries, clonal field genebanks at experiment stations in the network of the institute. As of 2007, the total accessions of fruit, berry and ornamental crops amounted to 29 276.

Two approaches are taken to set up cryogenic collections:

1. to use samples taken directly from field collections (techniques have been proved for a few species), and
2. to use explants from *in vitro* collections for cryoconservation. In the latter case, an IVBG (*in vitro* base genebank) is established.

An advantage of the IVBG is in the possibility of long-term conservation of healthy explants. Active collections of vegetatively propagated plants include both field and *in vitro* collections – IVAG (*in vitro* active genebank). IVAGs are maintained at low positive temperatures accepted for medium-term storage of collections.

Along with field collections, *in vitro* collections are created as part of active and duplicate collections. When forming an *in vitro* collection, priority is given to aboriginal and landrace varieties, wild relatives of crops of importance for breeding, unique accessions, as well as to phytopathogen-infected accessions from field collections.

A modern conservation strategy for vegetatively propagated crops preserved under controlled conditions has been developed at VIR. It includes the following stages:

- Plants sanitation, transfer into *in vitro* culture;
- Microplants examination for phytopathogens presence;
- Micropropagation;
- Plant accessions genotyping;
- Medium-term conservation of active *in vitro* collections;
- Accessions transfer to long-term cryogenic storage.

In recent years, the process of transferring Russian accessions with different geographic and ecological background into *in vitro* has been quite active. The VIR ***in vitro* collection** includes the following genera: *Solanum* (~350 accessions), *Rubus* (~120), *Cerasus* (65), *Ribes* (~50), *Fragaria* (35), *Lonicera* (~30), *Sorbus* (10 accessions) totaling about 700 accessions.

Field collection accessions and *in vitro* clones are checked for the presence of virus infections characteristic of each crop (by methods of IEA) and of bacterial endophytes (by standard microbiological methods). Maintenance and conservation of accessions in the VIR *in vitro* collection employ standard techniques accepted in plant genebanks, taking into account modifications developed at VIR.

Plant material from the VIR collections is also preserved in liquid nitrogen in the biological cryogenic complex completed by early 2002. This complex consist of 8 cryogenic tanks and 2 laboratories. So far, 372 accessions have been placed in the tanks for storage at ultra-low temperatures (-196°C).

In addition to live plant collections, the institute stores a unique herbarium collection which numbers 332 538 herbarium sheets.

A key aspect of the work with plant diversity accessions conserved in *ex situ* collections is their regeneration to maintain germinating ability. Germplasm regeneration is performed by specialists and collection curators according to the following principles:

- Critically low seed germination (50% of the initial) is the main criterion for seed regeneration;
- Selection of appropriate geographic location and agroecological conditions for regeneration;
- The use of isolation and control of pollination regime for cross-pollinated crops;
- Manual harvesting of fresh seed;
- Preliminary seed drying in field conditions;
- Additional seed drying in the drying chamber to bring seed moisture content to the level appropriate for medium- and long-term storage;
- Phytosanitary control and seed viability testing;
- Packets filling, sealing and placing in cold chambers.

Many genebanks experience serious problems with regeneration of the stored plant diversity, especially those engaged in this business for a long time. Seed regeneration is a very labour-consuming and responsible work requiring knowledge and experience. From 2002 through 2007, the efforts of VIR staff resulted in regeneration of the total of 40 933 accessions (including 8 104 of cereals, 795 of maize and groat crops, 5 634 of forages, 6 293 of grain legumes, 6 284 of oil and fiber crops, 7 684 of vegetables, 4 585 of tuber crops, etc.) and propagation of 12 473 accessions for distribution to breeding centers and placing in long-term storage.

VIR researchers have devised new original methods and guidelines for safe conservation of global plant diversity and improved long-term PGR conservation techniques, which make it possible to considerably reduce labour and financial resources required for maintaining viable collections in comparison with the traditional method of periodical regeneration of accessions. For instance, the modified method of vegetable seed preparation for long- and medium-term low-temperature conservation allows minimization of consumption of valuable seeds for germination and moisture content tests. Standards for low-temperature wheat conservation ensuring long duration of storage and maintenance of high germinating ability have been developed; cryoconservation techniques for blue honeysuckle vegetative shoots and red currant seeds designed; the method of potato *in vitro* apical shoot-tips cryoconservation improved; conditions for explants precultivation optimized; genetic stability of raspberry, blackberry and potato regenerated plants studied, and a method of *Taraxacum kok-saghyz* efficient regeneration devised.

The VIR global PGR collections are permanently enriched with new materials which are brought by collecting missions, obtained through germplasm exchange with different foreign genebanks, received from foreign and national breeding institutions and various organizations holding PGR collections. At the same time, VIR supplies various users with germplasm for research, breeding or educational purposes. During the period from 1999 through 2008, VIR received 26 000 accessions of different crops and distributed about 65 000 accessions to various users (Tab. 7).

TABLE 7
Germplasm receipt and distribution, 1999 – 2008

Year	Accessions received at VIR			Accessions sent from VIR	
	From foreign countries	From CIS countries	From Russia	To foreign countries	To CIS countries
1999	1 944	209	531	3 522	657
2000	1 822	211	949	7 218	1 107
2001	1 100	630	480	2 978	1 972
2002	1 536	244	780	3 454	1 423
2003	1 174	664	461	6 003	1 927
2004	2 413	636	316	6 311	2 646
2005	1 658	849	338	5 249	1 427
2006	964	234	577	3 660	1 299
2007	1 196	627	557	4 058	2 683
2008	317	1 119	1 276	5 227	1 672
Total	14 124	5 423	6 265	47 680	16 813

During the same period, the herbarium collection has gained over 3 thousand sheets.

An important aspect of the institute's work is organization of collecting missions for collecting plant diversity in the nature for enriching collections with new accessions. Since 2002, VIR scientists have participated in 41 collecting missions in various parts of Russia (Altai Territory; Sakhalin Island and the Far East; the North Caucasus; Leningrad, Pskov, Novgorod, Amur Provinces), as well in foreign countries: in Turkmenistan, Kazakhstan, Romania, Republic of Korea, Portugal, Canada, Armenia, Tajikistan (including the Pamirs), China (Heilongjiang Province and Inner Mongolia). A part of these collecting missions was carried out in close cooperation with foreign colleagues. As the result of these explorations, over 8 000 accessions of cereals, grain legumes, vegetables, forages, fruit crops and their wild relatives have been collected (Tab. 8).

TABLE 8
VIR collecting missions (2002 – 2008)

Year	Number of collecting missions	Collected	
		Accessions Herbarium	specimens
2002	10	1 971	42
2003	4	941	↔
2004	4	1 113	437
2005	7	1 197	252
2006	8	1 275	171
2007	3	770	↔
2008	5	1 017	22
Total	41	8 284	914

The long-term results of genetic resources collecting have been processed at the Department of Agrobotany and electronic maps of Russia and republics of the former USSR with the mapped data produced. This work has been done to improve the PGR search methodology and add systematism and purposefulness to collecting of genetic resources of crops and their wild relatives. The performed work served as a basis for developing a strategy of PGR collecting for a period till 2012.

The institute's network includes 10 experiment stations (ES) and 3 branches located in different geographic zones of Russia. Also, it includes 7 base stations established at some research institutions and breeding centers (Tabs 9 & 10).

TABLE 9
Experiment stations and branches in the VIR PGR network

No.	Name	Crops
Experiment stations (ES) of VIR		
1.	Adler ES	Soya, fiber, vegetable, cucurbits
2.	Astrakhan ES	Legume, rice, fiber, vegetable, cucurbit
3.	Volgograd ES	Barley, maize, forage, vegetable, fruit
4.	Dagestan ES	Cereal, vegetable, grape
5.	Far East ES	Soya, vegetable, oil, fruit, grape
6.	Yekaterinino ES	Cereal, legume, millet, forage, fiber, vegetable
7.	Kuban ES	Cereal, maize, fiber, oil, forage, cucurbit
8.	Maikop ES	Cereal, vegetable, forage, fruit
9.	Pavlovsk ES	Forage, fiber
10.	Zeya ES	No
Experiment stations of other research institutions		
11.	Moscow ES	Cereal, legume, forage, vegetable, potato
12.	Krymsk ES	Legume, vegetable, fruit, grape
Branches of VIR		
13.	Pushkin	Cereal, legume, fiber, vegetable, potato, fruit
14.	"Polar ES"	Forage, vegetable, potato
15.	Kuban branch of seed genebank	Long-term conservation of seed collections



TABLE 10
Base stations of VIR

No	Base station	Research institution	Employees	Activities
1.	Volgograd	Lower Volga Agricultural Research Institute	3	Maintenance and study of collections of barley and durum wheat
2.	Tyumen	Tyumen State University	2	Maintenance and study of collections of wheat, barley, oat and pea
3.	Kinel	Volga Region Agricultural Research Institute	2	Maintenance and study of collections of flax, crucifers, legumes
4.	Budenovsk	Prikumskaya ES	2	Maintenance of the cotton collection
5.	Torzhok	Flax Research Institute	2	Maintenance of the flax collection
6.	Near-Caspian	Near-Caspian Research Institute of Arid Agriculture	2	Maintenance and study of collections of cotton and crucifers
7.	Moldavian	Tiraspol Agricultural Research Institute	-	Study of collections of sunflower, legumes and wheat

Besides, agreements have been concluded about maintenance and ecogeographic study of live collections of vegetable, grain legume, forage, cereal and fruit crops at the Krymsk Experiment and Breeding Station of the North Caucasus Zonal Research Institute of Horticulture and Viticulture and at the Moscow Experiment Station of the All-Russian Breeding and Technological Institute of Horticulture and Nursery Management.

In 2008, 955 accessions of grain legume, industrial, groat crops and potato were additionally sent to the newly established base stations for maintenance and research. In the nearest future, broadening of ecogeographic studies within the VIR network is expected thanks to starting 5 new base stations at breeding centers (Tab. 11).

The main trends of research activities of branches, experiment stations and base stations stem from the main scientific objectives of the institute, that is, PGR collection, conservation, study and utilization.

Organization of research at experiment stations, branches and base stations is based on three documents, which are:

- the Scientific and Technical Task for the maintenance and study of collection accessions;
- the Subject Plan and
- the Agreement for Performance of Research Work, which mentions the amount of funding for research activities.

Maintenance and study of collection accessions are carried out in accordance with methodological guidelines developed and approved at the institute. Acceptance of field tests is done by special committees set up at the branches and experiment stations, in which sometimes representatives of the institute participate. The results of observations and assessments are recorded in workbooks the structure of which had been approved at VIR.

In the end of each year, branches, experiment stations and base stations of the institute submit Annual Reports, Test Acceptance Statements and Handing Over-Acceptance Certificates for the scientific products. Reports of experiment stations, branches and base stations for the current year and subject plans for the next year are considered and approved at meetings of the Scientific Council of VIR.

TABLE 11
Institutes to host new base stations of VIR

No.	Institute name	Crops	Base station curator at VIR
1.	Siberian Research Institute of Plant Industry and Breeding	Wheat, barley, oat, rye, <i>Phaseolus</i> bean, vetch, pea, vegetable and perennial forage crops	Department of Grain Legume Crops
2.	Kabardino-Balkarian Agricultural Research Institute	Wheat, barley, maize, millet	Department of maize and groat crops
3.	Chuvash Production Engineering Institute of Hop Production	Hop	Department of industrial crops
4.	Chechen Agricultural Research Institute	Barley, winter wheat, maize, soya, vegetable crops, potato, apple	Department of vegetable and melon crops
5.	Yakutian Agricultural Research Institute	Spring wheat, triticale, potato, perennial grasses	Department of tuber crops

An important aspect of scientific activities at experiment stations and branches is the maintenance of viable collection accessions. Volumes of this work per crop at different stations and branches are summarized in Tab. 12. It is obvious from the table that the number of germplasm accessions maintained annually at the VIR experiment stations and branches equals 89 345. Out of these, seed accessions amount to 56 257 and the vegetatively propagated ones – to 33 088 (fruit crops and grape – 25 288, potato and Jerusalem artichoke – 7 800 accessions).

The ranges of crops and numbers of accessions maintained at different stations differ. The largest amounts are maintained and regenerated at the Kuban and Maikop experiment stations and at the Pushkin Branch of VIR (from 10 600 to 17 700 accessions). An average cost of one accession maintenance varied greatly depending on the type of crop and location (the highest costs were recorded for the Adler and Far East experiment stations and the Polar Branch of VIR).

In 2005, the Global Crop Diversity Trust provided a special grant to VIR for Regeneration of Food Legume and Forage Crops originating from the Transcaucasus and Central Asia. As the result, 12 000 germplasm accessions of said crops will be additionally regenerated by 2009. In 2008 a new grant was provided to support regeneration of cereals, grain legumes and potato.



TABLE 12
Maintenance of viable collections at experiment stations and branches of VIR

Crop	Experiment station (ES)/Branch (Br.)													Total
	Adler ES	Astrakhan ES	Volgograd ES	Dagestan ES	Far East ES	Yekaterinino ES	Kuban ES	Maikop ES	Pavlovsk ES	Polar Br.	Pushkin Br.	Krymsk ES	Moscow Br.	
Wheat	-	-	-	4 440	-	620	2 400	-	-	-	1 000	-	1 200	9 660
Triticale	-	-	-	700	-	-	-	-	-	-	450	-	-	1 150
Aegilops	-	-	-	600	-	-	-	-	-	-	860	-	-	1 460
Barley	-	-	600	500	-	600	600	300	-	-	1 680	-	500	4 780
Oat	-	-	-	200	-	500	500	200	-	-	780	-	500	2 680
Rye	-	-	-	-	-	-	-	-	-	-	920	-	-	920
Grain legumes	-	1 440	32	-	-	2 470	660	100	-	-	354	990	550	6 596
Soya	400	-	-	-	1 050	-	1 300	50	-	-	140	-	-	2 940
Maize	-	-	250	-	-	-	850	350	-	-	-	-	-	1 450
Rice	-	300	-	-	-	-	-	-	-	-	-	-	-	300
Millet, buckwheat	-	-	-	-	-	735	250	90	-	-	-	-	30	1 105
Sorghum	-	-	-	-	-	-	1 000	-	-	-	-	-	-	1 000
Forage	-	-	300	-	-	2 000	900	600	3 800	200	-	-	300	8 100
Fiber	100	330	-	-	-	250	800	-	5	-	50	-	-	1 535
Oil	-	-	150	-	74	450	2 000	150	-	-	40	-	-	2 864
Vegetable and melon	223	880	1 061	340	165	330	390	3470	-	2	1 345	735	776	9 717
Subtotal	723	2 950	2 393	6 780	1 289	7 955	11 650	5 310	3 805	202	7 619	1 725	3 856	56 257
Fruit	-	-	2 490	-	1 320	-	-	4 731	-	503	5 764	6 735	209	21 752
Grape	-	-	-	365	291	-	-	-	-	-	-	2 880	-	3 536
Potato	-	-	-	-	-	30	-	570	-	2 500	4 400	-	300	7 800
Jerusalem artichoke	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Subtotal-vegetatively propagated	-	-	2 490	365	1 611	30	-	5 301	-	3 003	10 164	9 615	509	33 088
Total	723	2 950	4 883	7 145	2 900	7 985	11 650	10 611	3 805	3 205	17 783	11 340	4 365	89 345

PGR collections totaling about 80 000 accessions are held in some organizations belonging to different ministries and offices, for example in research institutions and breeding centers of the Russian Academy of Agricultural Sciences (RAAS), institutes of the Academy of Sciences, higher education institutions, botanical gardens, private breeding and seed producing companies. These collections differ in terms of size, structure, diversity, amount of available data and degree of utilization in breeding programmes. In some cases, these collections cannot help the holders solve the required aims completely, as conditions for long-term storage of genetic materials cannot be provided and acquisition of new accessions is made from time to time and unsystematically, as a rule.

From 2001 through 2008, VIR has been conducting an inventory of crop genetic resources held by research institutions within the RAAS network. Requests had been forwarded to 150 potential respondents, 91 of which reported their data, 15 ignored repeated requests, 40 could not contribute to the inventory due to the absence of collections and 2 institutions failed to report their data within the inventory period.

An analysis of the received data allow concluding that most accessions originate from Russia and CIS countries, only a small portion comes from foreign countries and the smallest amount is comprised of breeding material from different research institutions. However, this ratio differs depending on the crop. According to the data analysis, the greater part of seed collections (22 672 accessions, i.e., 45%) had been initially received from VIR on the basis of cooperation agreements with these institutions.

The number of entries in the common database is quite big, but it should be noted that some refer to duplicates stored in different institutions. Such accessions may be simultaneously preserved in two, three, four, five, six, or even seven research institutions within the RAAS network. Therefore, the total number of original accessions held by research institutions is considerably smaller.

TABLE 13

Results of the All-Russian Inventory of PGR collections

No.	Crop, groups of crops	Number of received entries	Among these:			
			VIR accessions	VIR accessions, %	Accessions worth adding to the VIR collections	Accessions with unknown status
1.	Wheat	4 660	3 172	68	321	1 168
2.	Rye, barley and oat	4 076	3 552	91	81	443
3.	Grain legume	4 918	2 679	57	536	1 701
4.	Tuber	1 431	355	31	82	994
5.	Groat	3 994	1 842	46	505	1 647
6.	Industrial	9 773	6 170	63	1 010	2 593
7.	Forage	2 147	1 140	54	804	203
8.	Vegetable	1 141	210	18	77	854
9.	Fruit	18 735	3 551	19	3 311	11 873
	Total entries in Database	5 0875	22 672	45	6 727	21 476



According to the received data, some institutions hold about 7 000 accessions which may be missing in the VIR collections. This information requires additional analysis and accessions identification. Upon the receipt of information about their origin, these accessions may be handed over to VIR on the basis of agreements with the current holders, and value of said accessions determined in course of their study.

During the inventory, some institutes provided data on several crops which used to be part of the VIR collections, but at present are conserved elsewhere. For example, it is the tobacco collection preserved at the Tobacco Research Institute, hop collection at the Chuvash Production Engineering Institute of Hop Production, etc. Besides, information has been received about a great number of rare crops and wild species maintained in the Stavropol Botanical Gardens, the Research Institute of Sylvicultural Reclamation, and the Research Institute of Floriculture and Subtropical Crops. Plant resources held by these institutions are beyond the range of genetic resources for food and agriculture.

There are 26 institutes of different categories in Russia, which hold collections of fruit crops maintained in orchards and nurseries. Mostly, these are institutions engaged in breeding these crops; the total number of fruit crop accessions in their collections amounts to 7 596, while the collections of VIR maintained at its experiment stations and branches number 23 490 accessions of 14 crops (apple, sour cherry, pear, peach, sweet cherry, currant, raspberry, strawberry, etc.). The analysis of data on various fruit collections in the country has shown that 2 732 accessions represent hybrid and anonymous materials, which lack information necessary for including them in the national collection of fruit crops, and 4 240 genotypes are available in the VIR collections. Therefore, a conclusion can be made that 87.2% of the total *ex situ* fruit tree germplasm diversity in Russia is concentrated in the VIR collections.

Among other research institutions it is necessary to mention the All-Russian Research Institute of Flax which presented a database on 6 156 accessions, 89% of which are registered in the VIR collection. Another breeding center holding significant collections of a wide range of crops totaling 2 435 accessions is the North-East Research Institute of Agriculture with its Falenskaya Breeding Station (Tab. 14).

As is known, standards of PGR safe conservation envisage availability of information about the accessions that should be stored in a database and is essential for potential users. However, majority of said institutions do not keep any passport or other databases, it making identification of accessions problematic. Breeding institutions should keep and use initial material for breeding their mandate crops, since conservation of large and diverse collections requires additional knowledge, experience, techniques, specialized equipment, efforts and funding. In most cases, these requirements can hardly be met under the present conditions of socioeconomic development of the country.

The All-Russian Inventory of genetic resources of cultivated plants has shown that almost half of the collections held in different research institutions within the RAAS network are composed of duplicates from the VIR collections, and the greater part of the preserved material is represented by hybrids and breeding lines. Besides, germplasm held in breeding centers without duplication at VIR is inadequately documented. It hampers identification of accessions and may lead to the loss of their value due to anonymity.

For over 114 years of its existence, VIR has accumulated huge volumes of information required for rational storage and use of the global collections. The first computerized passport databases for the conserved collections of crop plants and their wild relatives have been created by mid-1990s. Modern conditions of work on genetic resources require permanent improvement of information and development of existing retrieval systems, as well as integration with other holders of PGR collections, including those in foreign countries.

TABLE 14

**The largest collections held by research institutions within the RAAS network.
All-Russian Inventory data**

No.	Crop, groups of crops	Number of received entries	Among these:			
			VIR accessions	VIR accessions, %	Accessions worth adding to the VIR collections	Accessions with unknown status
1.	All-Russian Research Institute of Flax	6 156	5 481	89	173	502
2.	All-Russian Research Institute of Horticulture	2 790	717	26	826	1247
3.	All-Russian Research Institute of Genetics and Breeding of Fruit Crops	2 693	688	26	812	1 193
4.	All-Russian Research Institute of sorghum-type crops breeding and seed production	2 565	1 410	55	122	1 033
5.	North-East Research Institute of Agriculture and Falenskaya Breeding Station	2 435	1 937	80	201	297
6.	Narymskaya State Breeding Station	1 975	1 405	71	287	283
7.	Oil Crops Research Institute	1 932	465	25	848	619
8.	All-Russian Research Institute of Genetics and Breeding of Fruit Crops	1 919	669	35	805	445
9.	Siberian Research Institute of Horticulture	1 436	176	13	29	1 231
10.	Rice Research Institute	1 309	394	30	74	841
11.	Leningrad Agricultural Research Institute	1 093	939	86	21	133

For the sake of effective management of accumulation, conservation and study of plant resources, as well as electronic data analysis and exchange, creation of passport and evaluation databases for collections of the main crops using modern software has been continued.

Since the year 2000, passport and evaluation databases of the global plant diversity in the VIR collections have been created and upgraded: 30 401 entries have been added to the passport databases and 5 157 – to the evaluation ones. A concept of pooling, storing and processing information available in different departments has been developed. For its implementation, free LINUX operating system, the object-relational database management system PostgreSQL and a widely-used general-purpose PHP programming language have been chosen. The existing web edition of the information retrieval system contains 11 fields (the main part of the passport database) and allows data fetching from 9 fields for displaying them on the monitor.

Passport databases for the collections of wheats, *Aegilops* and triticale (37 694 entries, 31 fields) have been edited, uploaded to the EURISCO Catalogue and added to the European Wheat Database. All in all, information about 217 206 accessions from the VIR collections has been made accessible via the EURISCO Catalogue.

Databases have also been created for the collection of adventive weedy plants (734 species representing 56 families), as well as for genetic, trait and core collections of vegetable crops and potato.



A nomenclature taxonomic database including information about 3 213 cultivated plant species and WRCP belonging to 493 genera and 94 families (3 000 entries, 7 fields) has been created, and a nomenclature taxonomic reference book containing data on about 808 genera of 121 families registered in the herbarium database compiled.

The work on compiling databases and updating them with new valuable data is carried out in close cooperation with the ECPGR Documentation and Information Network. In 2003, VIR compiled the ECPGR Soybean Database and maintains it.

Besides *ex situ* conservation of PGRFA, much attention in the country is paid to the establishment, maintenance and study of botanical collections which serve mainly general educational purposes. In Russia, there are 76 botanical gardens and other introduction centers, which activities are coordinated by the Council of the Botanical Gardens of Russia. Their main objective is the conservation of a wide range of plant species with special attention to the rare, endangered and vulnerable species.

The list of the largest botanical gardens of Russia making special contributions towards saving the endangered plants in *ex situ* collections is given below:

- The Main Botanical Garden of the Russian Academy of Sciences (RAS). Total area: 361 ha. Maintains collections of natural and cultivated flora numbering over 21 000 entries (over 11 000 species, forms and varieties and about 10 000 garden forms and cultivars). The collection of rare and endangered plants numbers 320 species (Moscow).
- Botanical Garden of the Komarov Botanical Institute of RAS. Total area: 22.6 ha. The collections number 11 664 taxa, including over 300 rare and endangered species from Russia and neighbouring countries (St.Petersburg).
- Botanical Garden of the Scientific-Production Association "Niva Stavropolya" of RAAS. Total area: 207 ha. The collections encompass over 5 000 taxa. The number of rare and endangered species in the collections is 291. (Stavropol).
- Botanical Garden of the Moscow State University. Total area: 36 ha. The collection contains 6 500 plant species and cultivars, including 74 rare and endangered species from the Russian flora (Moscow).
- Botanical Garden of the Urals Branch of RAS. Total area: 50 ha. Its collections number about 3 000 taxa including 130 rare species from the Urals (Yekaterinburg).
- Botanical Garden of the Far East Branch of RAS. Total area: 170 ha. The collections contain over 4 000 taxa; the number of rare and endangered species is 120, among which 100 originate from the local flora (Vladivostok).
- Polar-Alpine Botanical Garden of RAS. Total area: 350 ha. The number of species in the collections is over 2 000 including 120 rare and endangered species. (Kirovsk).
- The Central Siberian Botanical Gardens of the Siberian Branch of RAS. Total area: 1 062 ha. Botanical collections contain about 5 000 taxa. The number of rare and endangered species is 92 (Novosibirsk).

Unfortunately, relations between genebanks and botanical gardens is not as productive as they should be. Collaborative joint activities involve a very limited number of these institutions. First of all, it is explained by their belonging to different ministries and offices, lack of funds for joint research activities and difference in their priorities. In future, coordination of activities in the sphere of collecting and conserving plant diversity and closer cooperation of VIR and Russian botanical gardens are very much required.

In 2006, the Russian Federation joined the FAO, became a member of the Commission on GRFA, and currently accession to the IT on PGRFA and Multilateral System of the IT is considered at the governmental level. Russia, represented by VIR, is actively participating in all ECPGR working groups and cooperates with other international organizations and genebanks of the world (including CGIAR) on various aspects of *ex situ* plant diversity. Special attention is paid to the new initiative on establishing a European Genebank Integrated System, and Russia is involved in the development of its policy, strategy and normative documents.

The main strategic task in the sphere of *ex situ* conservation is the search for and collection of genetic resources of crop plants and their wild relatives still missing in national collections, as well as safe conservation of the collected and stored plant materials. Documentation and evaluation of the preserved germplasm also remain important tasks.

Unfortunately, along with the progress made in recent years, problems affecting quality and reducing the level of the performed works should be noticed. Solving of the problems in the sphere of PGR collection and conservation, which have accumulated during the years of economic recess, require much more significant financial resources than those currently provided by the state.

The negative trends observed at present are the national property erosion – gradual loss of plant germplasm accessions accumulated and conserved by previous generations, decline of the national school of PGR studies, as well as the decreasing share of young PGR scientists.

Among urgent necessities is the upgrading and modernization of laboratory equipment, storage facilities for preserving germplasm under controlled conditions, as well as of the small-size agricultural machinery used for germplasm regeneration, perennial plantations treatment, etc.

Adequate measures should be taken to ensure reliable protection of collections of perennial field, fruit and berry crops from the irrecoverable loss of valuable germplasm resulting from plunder.

One of the key aspects of governmental activities is the development of legal regulations determining the status of genetic resource collections, plant germplasm ownership rights, conditions of access to PGR, their exchange, and equitable sharing of benefits from their use.

Unless decisive and timely measures aimed at solving said problems have been taken, the negative tendencies in PGR collections conservation will become irreversible, affect different aspects of economic, social and cultural life, and, in the first place, undermine food and ecological security of Russia.



STUDYING AND UTILIZATION OF PGR

The legal base for production, purveying, processing, storage, sales, transportation and utilization of crop and forest plant seeds as well as for organization and implementation of variety and seed control is provided by the Seed Production Law of the Russian Federation (1997). According to its provisions, seed control is understood as the measures determining a variety's integrity and identifying crop plants and seeds as belonging to a certain variety.

On the whole, Russia's national system of planned government measures providing the needs of agriculture for high-quality crop varieties and variety seeds was moulded into four interrelated links, each with clearly set specific functions: variety production (breeding), national variety testing network, seed production proper, and national seed and variety control.

The National Programme of Agricultural Development and Control of Rural Markets for 2008–2012 support elite seed production by allocating additional subsidies from the federal budget. The Programme's section dedicated to the development of top-priority agricultural subsectors expressly identifies and names the measures aimed at elite seed production development: "Specific proportion of the acreage under elite seed plantings shall be expanded up to 15% of the country's entire arable lands, i.e. raised to the scientifically justified standards". Although seed quality has indeed slightly improved, its level is not yet high enough. Current percentage of off-grade seeds in plantings is 20%, which means considerable losses in harvests.

In recent years, despite the government's efforts to improve the situation with the seed market, investors were reluctant to support the development of crop breeding and seed production with their money. One of the main obstacles to such investments is the imperfection of the existing legal base and its inability to protect such intellectual property as a crop variety.

Besides, the new act amending the Seed Production Law (2008) should envisage a provision on crop variety testing for economic usefulness, facilitate the procedure of phytosanitary control over seed batches shipped from one constituent of the Russian Federation to another, and prohibit any market transactions with seeds of varieties unregistered in the State Register of Plant Varieties Approved for Utilization (State Register).

It is also necessary to vest more powers in determining varietal and planting qualities of seeds with seed producers, plant breeders and other physical or legal entities. However, it seems expedient to retain government control over identification of such seed qualities in agricultural crops with the assistance of accredited individuals and legal entities.

The most important role in increasing gross harvests is known to be assigned to the crop variety. However, its contribution to the crop yield is far from being equivalent in different soil and climate zones and depends of the level of land management technologies. In the present-day situation, when application of organic and mineral fertilizers, chemicals and intensive technologies decreases every year, achievements of breeding practice are the only efficient reserve for yield increase.

Many generations of Russian scientists managed to breed crop varieties with a potential for high yield and other parameters that was considered unrivalled until very recently. One of the major factors that helped them to achieve such success was studying and utilizing the plant diversity concentrated in the country's *ex situ* collections.

In Russia, the problem of all-round study and effective use of global genetic resources has traditionally been regarded as very important. The role of VIR's global PGR collections has always been crucial in creating new varieties. For example, more than 360 wheat cultivars of the former USSR were bred on its basis. A majority of 144 wheat varieties submitted in 1991–1996 for variety trials were obtained using germplasm stored in the global collection.

Employment of the collection as reference material is a very promising tool of solving various problems of plant genetics, but its role is particularly important for breeders who use the stored germplasm as breeding sources. Broad assortment of accessions genetically identified for the presence of a certain trait valuable for breeding makes the choice of parent plants for crosses and selection in splitting hybrid generation more knowledge-based. It helps to accelerate the breeding process and enhance its efficiency.



It may be illustrated by the role of VIR's collection in the national maize breeding programme deployed at many institutions situated all over the country, from east to west. This programme's aim was to advance this crop farther to the northern and eastern regions of Russia where its cultivation had been restricted by the temperature factor. Analysis of the existing genetic diversity of maize helped to breed early-ripening hybrids which could grow and develop under low soil temperature conditions in spring and produce good yields of green plant matter and mature seed within a short frost-free period. This joint project resulted in expanding the areas under maize for more than 500 km northwards.

Earlier it was already mentioned that the majority of Russia's breeding centres maintain their own live working collections of various crops. These collections vary in number, structure, diversity, degree of knowledge about them and level of utilization in breeding programmes. There are, however, cases when they cannot fully satisfy breeders' needs, because their stock is replenished only sporadically and, as a rule, without any system-based approach. That is why the global PGR collections maintained at VIR serve as a principal source of new germplasm materials for modern domestic breeding practice.

The term "source material" in breeding practice usually means cultivated and wild plant forms used for breeding new crop varieties. Cultivated forms are represented by local or breeding varieties, self-pollinated lines, clones, mutants or polyploids, etc. It is the genetic stock that is preserved in the VIR's collections.

Breeders deal with hundreds and thousands of different plant forms. However, greater part of them is discarded in the process of their work, while only a handful will be submitted for the state trials when their compliance with protectability criteria has been verified. Some of the forms that failed to acquire the status of a commercial variety are sent to VIR for storage and research purposes. Later such materials together with additional evaluation data and other information obtained by collection curators during their studies will be sent back to breeders to be once again used in the breeding process. Collection accessions almost always demonstrate worse yield, quality and other parameters than the best cultivars, so they cannot be protected as a breeder's variety, but still their scientific and practical value is high enough.

Crop wild relatives maintained and studied at VIR are also valuable as source materials and often included in breeding programmes, being an inexhaustible depository of traits (genes) lost in the process of crop evolution. Of special breeding value are those species which carry such properties as high quality and resistance to pests, diseases and unfavourable environments. Thus, using the germplasm of wild potato species already extinct in nature but preserved by VIR made it possible to save this crop from later blight and other diseases.

Transferring such characters from wild forms is an extremely laborious and time-consuming process. That is why breeders rarely employ them in their breeding efforts. It is not by chance that practically all cultivars of spring and winter wheat, barley, winter rye and other cereals that are already commercialized or undergo state trials do not contain new genes (characters), unusual for these biological species, only demonstrating new combinations of the known genes. Such situation is fraught with serious risks for agriculture. Utilizing a limited number of genetic sources possessing, say, resistance to pathogens in breeding practice may trigger outbreaks of diseases and cause devastating damage to production.

At the same time, complex studies of accessions from the global PGR collection enabled VIR's experts to find out that mildew resistance in *Triticum dicoccum* is controlled in various accessions either by one or two dominant genes or by one recessive gene; resistance of somaclonal barley lines to spot blotch is controlled by a polygene system with additive interaction between genes; two types of sorghum resistance to common greenbug (antixenosis and antibiosis) are controlled by one genetic system and represent pleiotropic effects of the same resistance genes. They identified 6 dominant oligogenes determining resistance of rye to brown rust and 2 to stem rust as well as effective resistance genes in cereals against spot blotch, root rot, powdery mildew and common greenbug. Such research activities with genetic diversity clear the way for efficient crop breeding targeted at yield increase by diminishing the risks of pest and disease incidence in crops.

By studying thoroughly the global collection for the past seven years (2000– 2007), the Institute's scientists worked out scientific theories of research on the most burning issues pertaining to genetic diversity of cultivated plants and their wild relatives. Those of the highest priority are:

- Theoretical principles of breeding for earliness on the basis of new knowledge of morphophysiological regularities in spring wheat development and production.
- New theory on plant ontogenesis based on experimental and mathematical models.
- Theory of genetic determination of Gramineae resistance to obligate and facultative fungi, sucking insects and edaphic environmental factors.
- Theory of genetic determination of short stalk character in tetraploid wheats and sunflower.
- Theory of genetic control of maize meiosis.
- Development of the theory of molecular marking of genotypes and genetic systems for identification and

registration of genetic diversity of crops and their relatives.

- Development of the theory of origin and evolution, definition of phylogeny and systematics in the most important genera (oat, pea, vetch, rye, beet and plum) using modern molecular methods.

Besides, 28 new methods of screening and studying source and breeding materials have been developed, as well as new fundamental and applied research techniques, including:

- Rapid methods of identifying genes controlling resistance to fungal diseases and sucking insects;
- Identification of previously unknown efficient genes of cereal crop resistance to brown and stem rust, spot blotch, root rot, powdery mildew and common greenbug;
- Molecular genetic approach to genotypic structure research in cultivated plants and their wild relatives for identifying and cloning genes determining plant quality and resistance to unfavourable environmental factors;
- Ecogenetic approach to the development of global PGR collections on the basis of geoinformation technologies;
- A set of methods disclosing the structure of plant genetic diversity in *ex situ* collections and its optimization with the purpose of broadening the base of source material for breeding;
- Genealogical analysis of wheat and potato in order to determine relationships and expand the pool of valuable genes for breeding.

Twenty genetic core collections have been established for wheat (400 identified genes), barley (100 genes), oat (225 genes), soybean (200 genes), tomato (106 genes), etc. Meiotic maize mutants and marked sunflower lines have been created for scientific research and breeding practice.

Specializing in the field of agricultural production complex (agriculture and plant production), VIR participates in the development of research projects and innovative technologies based on science-intensive products.

An effective technology was worked out for breeding winter rye cultivars with long-run group resistance to leaf and stem diseases. It helped to develop polyresistant populations and new cultivars combining high yield and a set of other valuable traits with resistance to brown and stem rust and powdery mildew. Such winter cultivars resist two or three widespread diseases of rye, each of which is capable of reducing grain harvest by 40–80%. Utilization of disease resistant varieties guarantees high yields without extra expenses for chemical protection. Now the cultivars bred on the basis of this technology are grown on 700 000 hectares.

In 2000–2006, as a result of intensive all-round analysis of the genetic diversity preserved in its collections, VIR distributed to Russian breeding centres 589 donors and 11 467 sources of economically important plant characters, 6 241 new accessions and 45 903 germplasm samples from trait-targeted collections of various crops developed specifically for solving vital problems of yield increase and resistance to diseases and pests. Only in the past five years domestic plant breeders released about two thousand new high-yielding crop cultivars and hybrids. Among them were such outstanding winter wheat cultivars as Gorlitsa, Ophelia, Polovchanka (Krasnodar Research Institute of Agriculture), Kolos Dona, Novinka 4 (Donskoy Breeding Centre), Malakhit and Zhneya (Samara Research Institute of Agriculture). They combine resistance to rust, mildew and ear blight with high potential productivity (10–13 MT of grain per 1 hectare).

A considerable achievement of wheat breeding was recording in the State Register of rust resistant high-yielding winter cultivars L-503, Samsar, L-505 (South-East Research Institute of Agriculture), Omskaya 29, Omskaya 30 (Siberian Research Institute of Agriculture); and winter durum wheat cultivars Bezenchukskaya 182, Bezenchuksky Yantar (Samara Research Institute of Agriculture), Zarnitsa Altaya (Altai Research Institute of Agriculture), Krasnokutka 10 and Lyudmila (South-East Research Institute of Agriculture).

The Research Institute of Agriculture for the Central Non-Black-Soil Areas release winter rye cultivars Alfa and Valdai, and spring barley cultivars BIOS 1, RAMOS, Suzdalets and others, with high winter hardiness, resistance to lodging and yield up to 6–7 MT/ha. Excellent properties demonstrate barley cultivars Bastion, Kozyr and Sekret yielding 9–12 MT of grain per hectare.

Determinant pea cultivars resistant to lodging and shedding are now being introduced into production practice: Nord, Orlovchanin 2, Orlus (All-Russian Research Institute of Grain Legumes), Flagman 5, Flagman 7 and Samarets (Samara Research Institute of Agriculture).

The All-Russian Research Institute of Oil-Bearing Crops produced and recorded in the State Register 9 cultivars and 7 hybrids of sunflower yielding 4 MT of grain per hectare, containing 50–53% of high-quality oil, resistant to broomrape, downy mildew and rots and tolerant to phomopsis. New cultivars of soybean, rapeseed and flax have been approved for agricultural production.

VIR's researchers themselves have bred 139 cultivars of economically important crops and filed them with the State Register, obtaining 93 patents and 169 authorship certificates for their breeding attainments.



The network of VIR's experiment stations regularly conducts ecogeographic studies of germplasm accessions. Only in 2007, 21 248 accessions of various crops were analyzed both in the fields and the Institute's laboratories. A complex of economic properties was evaluated in 7 277 accessions. As a result of such ecogeographic study, 1 436 breeding sources were identified, including 180 accessions with resistance to biotic stresses, 167 with resistance to abiotic stresses, 168 sources of earliness, 310 of productivity, etc. The Institute's staff members produced 3 new donors of plant characters important for breeding and released 13 new cultivars included in the State Register. Ten years of studying genetic diversity in different ecogeographic zones helped to identify or obtain more than 20 000 genetic sources and over 1 000 donors of valuable traits to be used in breeding new crop varieties and hybrids with complex resistance to stresses, high productivity and quality.

Since 2003, 80 552 accessions have undergone field evaluation. Among these, 36 474 accessions were involved in complex research. As a result, 5 142 promising breeding sources have been identified, including 1 434 of cereal crops, 832 of maize and small grains, 917 of grain legumes, 186 of perennial forage plants, 644 of potato, 230 of vegetables, 268 of oil and fibre crops and 631 of fruit-bearing plants. Only in 2006 the Institute disclosed 916 sources of resistance to biotic stresses (136 accessions) and abiotic stresses (69), earliness (153), high productivity (303) and other qualities, including sources of valuable traits in wheat (120), oat, rye and barley (84), maize and small grains (110), grain legumes (220), oil and fibre crops (90), potato (59), vegetables (88), fruit-bearing and ornamental plants (116) and forage crops (29). Also identified were 196 high-protein accessions of winter rye, barley, oat, millet, grain legumes; accessions of barley, oat and millet with high starch content; oat, millet, grain millet and oil-bearing crops with high oil content; fruit and vegetable accessions with high sugars, ascorbic acid, high or low acidity. Released into production were 7 donors of winter rye (Snezhana 3), fibre flax (VIR-16, VIR-17, VIR-18), sunflower (VIR-771 and VIR-772) and oat (RAPEN); cold-hardy hybrids of maize and *Tripsacum* with fixed heterosis and a new set of valuable traits; a source of virtually new CMS type in sunflower.

Using infested backgrounds and artificial contamination techniques made in possible to study disease and pest resistance in 8 545 crop accessions and identify 306 breeding sources in spring bread wheat to loose smut and common bunt, ear blight and a complex of diseases; in barley to loose and stinking smut and leaf scald; in common beans to bacteriosis; in pea to *Fusarium* wilt; in lupin to anthracnose; in beet to storage rot; in tomato to a complex of diseases; in black currant to bud mite, lettuce and gooseberry aphids; in red currant to bud mite and currant aphid; in honeysuckle and plum to aphids; in sorghum to common greenbug.

VIR's scientists pay special attention to the following innovative projects aimed at obtaining:

- Renewable energy sources utilizing plant resources;
- New plant form, precultivars, donors of edaphic resistance for breeding new cultivars restoring and preserving deteriorated lands and landscapes;
- High-quality domestic initial feeds for poultry and swine farming on the basis of cereal, small grain and forage genetic diversity stored at VIR;
- Domestic resource base for glucose-fructose sugar production by identifying sources with higher glucose and fructose content in sorghum stem sap;
- Domestic resource base for natural rubber production for industry by applying biotechnological methods of cell culture from natural populations of *Taraxacum kok-saghyz* and *Scorzonera tausaghyz* with increased content of rubber latex;
- Technologies of two-component yarn and blended fabric production on the basis of hemp fibre cottonization processes optimized by screening hemp and cotton accessions;
- Technology of domestic food production for patients suffering from gluten enteropathy (celiac disease) on the basis of plant diversity represented in VIR's cereal germplasm collections.

In order to secure ceaseless inflow of missing accessions with resistance to unfavourable environmental factors into *ex situ* collections VIR developed a theory and methodology for targeted introduction of worldwide genetic resources on the basis of geoinformation technologies enabling mapping of collecting sites for crops most important for plant breeding both within Russia and in other countries. Conjugate analysis of computerized maps with areas of wild plant species and crop wild relatives and those environmental factors that limit distribution of such species led to identifying promising territories for collecting plant germplasm in the Russian Federating, including the North-West, South-western Altai and North Caucasus, as well as in Transcaucasus and Northwestern Kazakhstan.

VIR's experts reviewed taxonomic systems and analyzed evolution of species within the genera *Allium* L. (onion), *Aegilops* L., *Avena* L. and *Melilotus* Mill. Recommendations were worked out for *in situ* conservation of *Prunus* L. spp. within Russia. Development of scientific principles for plant systematics associated with the problems of applied botany,

plant introduction, breeding and crop production will help to accumulate new valuable germplasm of cultivated plants and their wild relatives in the global collection of VIR and utilize it as source materials in breeding programmes aimed at producing virtually new crop cultivars.

In order to enhance conservation and study of plant generic diversity and facilitate data analysis and exchange by documenting accessions in electronic databases, a unique local computer network was set up at VIR with an external optical fibre line and a website was opened. Currently 90% of accessions are furnished with computerized passport data and 60% with evaluation data.

For example, the databases of adventive weeds established and maintained at the Institute harbour information on 734 species from 56 botanical families as well as evaluation data on winter-hardiness of wheat; drought resistance of spring bread wheat varieties from Central Asia; disease resistance of *Aegilops* species; storage rot resistance in beet; ability of soybean to reach maturity in the environments of Northwestern Russia; flower colour and shape and weight of 1 000 seeds for the collection of flax germplasm; biochemical composition of VIR's germplasm accessions; late blight resistance of potato; loose smut resistance of barley; spot blotch resistance of wheat; donors of efficient alleles from the genes of *T. aestivum* L. determining resistance to orange, leaf and stem rust, etc.

Triticum, *Aegilops* and Triticale passport data base (37 694 entries, 31 fields) has been updated and its version was submitted to EURISCO. A European search catalogue of passport information has been introduced with quick access to the data of 882 037 accessions from 39 countries.

Development of brand-new breeding and agricultural technologies and rapid progress of biotechnology and gene engineering have raised the value and role of *ex situ* germplasm collections ever higher and enhanced the significance of their research and utilization as source materials for producing new adaptive, environmentally safe and economically justified cultivars and hybrids.

As far as major trends of breeding and seed production work are concerned, there are plans to study more thoroughly the issues associated with justifying and working out appropriate techniques of rational selection among parental pairs for crosses, especially among remote ecogeographic forms in order to increase the outcome of positive transgressions and recombinations of practical value. Significant breeding potential is known to be hidden in remote hybridization. Also envisaged are studies of its genetic and cytological regularities with the purpose of synthesizing new forms, species and varieties of cultivated plants and development of new methods capable of overcoming the barriers of interspecific and intergeneric incompatibility preventing production of remote hybrids. Of great importance for agriculture was wide-scale introduction into practice of highly heterotic hybrids, specifically of maize, sunflower, vegetables and other crops. However, opportunities offered by heterosis are still considerably underutilized.

Due to the limitations in financial resources and low bioclimatic potential in most of Russia's agricultural areas, the efforts of collection curators and plant breeders in the field of PGR research and management should be aimed at the development of cultivars with broad adaptive prospects, capable of making the best use of meagre natural resources, by employing the possibilities of step-by-step hybridization and evolutionary breeding.

With this in view, the following needs must be met:

- Enhancement of the genetic base of major crops using biodiversity to reduce genetic susceptibility of varieties;
- Enlarging genetic diversity of parental plant forms distributed to breeders;
- Capacity building for breeding work on the production of new crop varieties adapted to local environments;
- Studying underutilized crops and promoting their practical application;
- Compiling registers of information on the status of crops genetic resources and measures to ensure their conservation and sustainable utilization;
- Shifting from unsustainable agricultural practice to sustainable production methods adjusted to local biotic and abiotic conditions in accordance with ecosystem principle or complex approach to land management.

Thus, one of the decisive factors in raising the efficiency of agricultural production and accelerating breeding progress in Russia is targeted replenishment, complex studying and sustainable utilization of the global genetic diversity of cultivated plants and their wild relatives.

To increase the efficiency of genetic diversity utilization in Russian plant breeding, it is crucially important to develop a clear pattern of VIR's interaction with breeding centres. A scientific and management base is required to perform continuous monitoring of new plant breeding needs and search for sustainable ways of their solution, timely acquisition of specifically valuable source materials by breeding centres and rationalization of *ex situ* conservation. This will facilitate balanced search, rapid identification and utilization of the most promising parental forms for crosses, raise breeders' awareness of new accessions added to VIR's collection and world's tendencies in enrichment and utilization of genetic diversity. Such challenge may be met through adopting Russia's National Programme on Crop Generic Resources that

will envisage stable governmental funding of a series of measures to reinforce these strategically important resources.

CHAPTER 5

NATIONAL PROGRAMME ON CROP GENETIC RESOURCES

Climate change, decline and disappearance of biodiversity, accelerated speed of urbanization and migration, demographic problems and notable threat of food and agricultural production shortages, each country's growing need for food security and new renewable energy sources—all these factors made the problem of collecting, conservation, study and sustainable utilization of PGR ever more critical.

Exceptional importance in this context is attached to such measures as active integration into the world's community, strengthening of collaboration, cooperation and coordination of activities in the PGR sphere, and distribution of responsibilities combined with indispensable protection of national interests, since the countries of the world cannot be self-sufficient with their own bioresources and find themselves more and more interdependent.

A specific role in implementing such measures is assigned to joint efforts of specialized national centres, various institutes and international organizations dealing with PGR. However, in order to establish efficient inter-country collaboration in this sphere it is necessary, first of all, to solve the issues of nation-wide coordination and stimulate involvement of all domestic stakeholders in plant diversity conservation and utilization, regardless of the branch of economy they may represent.

Fulfilment of the above-mentioned tasks will be possible if a series of strategic decisions are taken at the government level. The highest priority among these decisions is given to the adoption of the National Programme on Crop Genetic Resources and the Plan of Actions. This will be followed by the establishment of the National PGR Coordination Committee and appointment of the coordinating institution and focal points responsible for working out mechanisms of implementing the Plan of Actions, which should be based on all fundamental international principles of operation and envisage the measures approved by the international community.

The principal idea of the National Programme and the Plan of Actions is to identify and carry out measures aimed at the following objectives: securing the most optimal conditions for safe *ex situ* and *in situ* conservation of PGR; promoting fundamental and applied research on agricultural biodiversity; eliminating duplication of activities in this sphere; capacity building for PGR management and enlarging the national reserve of genetic diversity by means of collecting missions in Russia and abroad and through international germplasm exchange; and effective and sustainable utilization of bioresources by employing novel technologies and achievements of science.

Among its other tasks, the National Programme will provide for efficient PGR-related coordination activities in the country and establishment of partnerships between different public and private institutions and organizations that maintain PGR *ex situ* collections.

In 2002, meeting the provisions of the CBD, Russia developed and adopted the National Biodiversity Conservation Strategy and the Plan of Actions up to 2010. The purpose of these documents was to fulfil the requirements set forth in the CBD and undertake a series of measures towards conservation and sustainable utilization of bioresources.

By now, many countries of the world, acknowledging strategic importance of crop genetic resources, have developed and launched national programmes on conservation and utilization of this category of biodiversity. Most of these programmes, although adjusted to national legislative systems, are shaped on the basis of the international documents worked out by joint efforts of the international community.

Despite the fact that Russia has many decades of experience with genetic resources and possesses one of the largest crop germplasm collections in the world, the process of globalization and socio-economic changes demands radical revision of the government policy regulating conservation and utilization of genetic resources of cultivated plants and their wild relatives. The accent is now shifted to the statutory and legislative base which determines the status of national *ex situ* genetic resources collections, ownership rights to plant germplasm, terms of access to and exchange of PGR, and equitable sharing of benefits from their utilization, as well as to the nation-wide coordination of actions.



In the present-day Russia the situation in this sphere is as follows:

- Notwithstanding the existing awareness of the fact the collecting, conservation, studying and sustainable utilization of PGR are strategically important tasks, the country has neither coordination mechanisms in this sphere at the national level, nor any strategy of integration in the global international network.
- A majority of Russian *ex situ* PGR collections have no clear legal status.
- The absence of a national strategy and priorities for PGR monitoring, collecting and conservation generates the risk of their unsustainable utilization and leads to genetic erosion and irreversible losses of plant diversity.
- The country has neither a unified data search system nor a databank for PGR preserved *ex situ* and *in situ*, both regarded as important tools of efficient and sustainable utilization of the national genetic diversity and its safe conservation.
- Public awareness of the need to conserve and sustainably utilize bioresources for food and agriculture is low, while there is a burning demand for qualified personnel specially trained for successful research on the national plant heritage and its long-term conservation.
- The funding of the measures aimed at collecting, conservation and study of plant diversity is provided to no more than 60% of the required amount.

All the above-mentioned dictates the urgent need to pose before the government the question of the National Programme and its urgency and strategic importance for Russia.

In 2006, VIR took the initiative to develop the National Programme on Conservation and Sustainable Utilization of Genetic Resources of Cultivated Plants and Their Wild Relatives. The theoretical foundation of the Programme was N.I. Vavilov's concept of PGR collecting, conservation, studying and utilization, while its major mechanism of implementation was based on all fundamental international principles of work in this sphere and measures worked out and adopted by the international community.

The developed National Programme has the following objectives:

- To lift the problems of collecting, safe conservation and sustainable utilization of PGR to the government level, draw attention of stakeholders in legislative and executive political circles to these problems, and furnish them with a national priority status;
- To coordinate activities in this sphere between all interested and related ministries, public institutions of different affiliation and commercial structures in the agricultural sector;
- To mobilize financial, scientific and technical resources and provide appropriate capacities for successful and efficient activities in conservation and sustainable utilization of crop genetic diversity;
- To develop and improve the legislative and regulatory base together with management, administrative, financial and economic mechanisms of PGR conservation, studying, utilization and accessibility;
- To promote further development of international collaboration and encourage Russia to join the most important international agreements and initiatives on PGR.

The strategic aim of the Programme is safe conservation, enrichment, studying and careful utilization of PGR diversity in order to enhance food, bioresource and environmental security of the country, meet the population's demands for quality food products in a stable manner, promote sustainable development of environment-friendly agriculture, reinforce the animal feed base and produce new types of raw materials for the national industry.

In the light of the above-mentioned the National Programme is expected to solve the following major tasks:

- To improve the legal and regulatory base determining the status of *ex situ* collections, regulating PGR conservation and study activities, access to these resources and equitable sharing of benefits from their utilization;
- To work out legal, regulatory and methodological documentation concerning PGR-related activities and make it applicable;
- To set up an organizational and coordination structure and mechanisms of PGR management at the government level;
- To develop and implement a financial mechanism of funding a series of measures targeted at PGR management and safe conservation;
- To monitor and inventory Russia's genetic diversity of cultivated plants and their wild relatives;
- To develop and implement the national strategy and policy of *ex situ* and *in situ* conservation of cultivated plants

and their wild relatives as a fundamental base of human sustenance and cultural heritage of the society;

- To promote fundamental and applied research on PGR collecting, conservation and sustainable utilization;
- To develop a universal flexible analytical PGR-related information system, easily accessible, open for all types of users and possessing broad communication possibilities;
- To direct PGR management and optimal utilization towards setting a secure national food and resource base;
- To coordinate PGR-related activities of Russian research institutions in order to optimize the works in this sphere at the national level;
- To train qualified PGR experts;
- To shape public opinion and raise public awareness concerning strategic, cultural and social role of PGR;
- To carry out wide-scale international collaboration, cooperation and coordination in the sphere of PGR collecting, conservation, study and utilization.

The National Programme is a long-term venture (until 2015) and incorporates the following 7 basic activities/projects:

Project 1. Monitoring of the conserved *ex situ* and *in situ* diversity of plant genetic resources in Russia.

Strategic objective: organization of research activities in Russia aimed at long-term control over the situation with genetic diversity of cultivated plants and their wild relatives maintained *ex situ* and *in situ*, evaluation and prognostication of its dynamics, identification of its optimal structure and limits of allowable variation.

Main tasks:

- Ecogeographic analysis of the status of plant species promising for cultivation and/or improvement of existing varieties and evaluation of polymorphism in local plant populations representing these species.
- Study of the structure of intraspecific genetic diversity in staple crops and development of methods to evaluate its dynamics and assess the degree of genetic erosion and genetic vulnerability of cultivated plants.
- Analysis of the distribution of the taxa prioritized for conservation within their natural plant communities in different regions of the country in order to develop a unified national strategy of *in situ* conservation.
- Establishment of the all-Russian reference and information databank of cultivated plants and their wild relatives promising for breeding practice.
- Modernization of the PGR-related data search system.

Project 2. Accumulation of PGR with the purpose to enrich the Russian national *ex situ* genetic diversity.

Strategic objective: enlargement and replenishment of the Russian national genebank with new genetic diversity of cultivated plants in order to provide for national food and bioresource security.

Main tasks:

- Development and implementation of a science-based strategy of PGR accumulation to enrich the Russian national genebank.
- Provision of legal, social, economic, financial and technical capacities for PGR accumulation.
- Development of a system of scientific, methodological and information support for the process of targeted search for genotypes with prescribed properties and their collecting.
- Identification of the genetic diversity in major crops essential for adding to the germplasm collections, definition of the territories where it should be collected and search for the sites of foreign and international *ex situ* collections where it may be stored.
- Development of the richest crop genetic diversity germplasm collection as a foundation of food and bioresource security at national, regional and global levels.



Project 3. Safe conservation of PGR at ecosystemic, populational, specific and organismal levels as well as at the level of plant organs and parts, genomic DNA, individual genes and their parts, regulatory factors of gene expression under *ex situ* and *in situ* conditions.

Strategic objective: conservation of world-wide genetic resources of cultivated plants and their wild relatives as a reserve for development of plant breeding and plant production with the purpose of supplying population with food and supporting sustainable agriculture.

Main tests:

- Development of a general conservation strategy for *ex situ* collections and *in vitro* repositories of vegetatively propagated plant varieties to ensure safe preservation of viability in plants and, if necessary, their restoration in natural environments.
- Development of a conservation strategy for genetic diversity of cultivated plants and their wild relatives within their natural plant communities where they were formed in the process of evolution (*in situ*).
- Inventorying and monitoring of Russia's crop genetic resources, including crop wild relatives, taking into account priority criteria.
- Modernization of the database of Russian genetic diversity of cultivated plants and their wild relatives conserved *ex situ* and *in situ*.
- Development of unified regulatory and methodological documentation for safe long-term conservation of PGR.
- Modernization of scientific and technical capacities providing for long-term conservation of Russian *ex situ* collections.

Project 4. Studying and sustainable utilization of PGR.

Strategic objective: Disclosure and enrichment of botanical and genetic potential of cultivated plants and their wild relatives in order to solve the problems of plant evolution, phylogenesis, systematics and genetics and identification of valuable source material for breeding and plant production.

Main tasks:

- Development of researches on evolution, phylogenesis and systematics of cultivated plants and their wild relatives.
- Assessment of adaptive and economic potential in staple crops, analysis of their hereditary variation, identification and development of sources and donors of valuable traits.
- Broadening hereditary variability of cultivated plants using modern methods and technologies in order to reduce environmental and genetic vulnerability of crop varieties.
- Establishment of specialized, genetic and trait-targeted collections of plant genetic diversity for solving priority tasks of plant breeding in different regions of the country.
- Domestication of new plant species, utilization of underutilized crops and revival of forgotten ones.
- Development of methodological principles for forming genetic diversity in adaptive agrocoenoses and optimal accommodation of cultivated species over natural and economic zones.

Project 5. Development of the all-Russian unified PGR databank and data search system for effective management of databases and *ex situ* collections.

Strategic objective: modernization of the unified database and data search system (DSS) for database management in the process of work with PGR *ex situ* collections.

Main tasks:

- Modernization of the unified database for all crops and their wild relatives.
- Development of a DSS for database management in the process of complex work with accessions from PGR *ex situ* collections.

Project 6. Staffing the PGR sphere with scientific and technical experts.

Strategic objective: staffing of institutions and organizations involved in PGR activities with qualified scientific and technical personnel.

Main tasks:

- Development of a system of specialized education providing training and retraining services for PGR personnel.
- Development of the scientific and methodological base for qualified training of PGR personnel.
- Integration of higher education colleges and research institutions which provide training for PGR specialists.
- Staffing of institutions working in the field of PGR collecting, conservation, studying and sustainable utilization with qualified experts.

Project 7. Coordination of activities at the national level and international collaboration.

Strategic objective: setting up an efficient coordination structure for optimization of works in the sphere of collecting, conservation, study and sustainable utilization of cultivated plants and their wild relatives.

Main tasks:

- Joining efforts and optimal distribution of responsibilities between all holders of PGR *ex situ* collections and organizations participating in collecting, conservation and study of genetic diversity of cultivated plants and their wild relatives with the purpose of their efficient utilization.
- Harmonization of PGR-related legal and methodological platforms at regional and international levels.
- Building a single information space in the sphere of PGR accumulation, conservation and research.
- Training of qualified personnel and staffing of the PGR-related infrastructure.
- Integration and distribution of responsibilities in the field of PGR conservation and research at regional and global levels with various organizations, genebanks and international centres.

The National Programme on Conservation and Sustainable Utilization of Genetic Resources of Cultivated Plants and Their Wild Relatives is the main resource and principal mechanism for finding solutions in the sphere of collecting, conservation and sustainable utilization of agricultural biodiversity. It will play a leading role in almost all PGR-related activities at national and international levels. The National Programme is an element of the National Biodiversity Conservation Strategy in Russia.

The draft of the National Programme worked out by VIR was discussed and approved at the sessions of the Presidium of the Russian Agricultural Academy and the Committee for Agricultural and Food Policies of the Russian Federation. The latter adopted a resolution (No. 26/7 of 25/12/06) recommending adoption of the draft by the Government of the Russian Federation. Hopefully, it may be adopted by the end of this year or in the beginning of the next one.

Major structural subdivisions responsible for implementing the programme and the plan of actions

National PGR Coordination Committee:

The National Coordination Committee (NCC) is being established in under the Russian Ministry of Agriculture. Membership in the NCC may also be delegated to representatives of other interested ministries and agencies as well as to coordinating institutes and focal points responsible for conservation of the national collections of agricultural plants, animals and microorganisms.

Primary responsibilities of the Committee (level I):

- Development of a national strategy and policy in the sphere of agricultural biodiversity;
- Drawing up proposals for the Government of the Russian Federation concerning the legislation and legal base in the sphere of agricultural biodiversity;
- Interministerial coordination activities at the national level on the problems of PGR conservation and sustainable utilization;
- International coordination;
- Identification and appointment of coordinating institutes for main activities and focal points among the holders of *ex situ* collections;
- Adoption of prioritized scientific programmes and selection of funding sources for these programmes;
- Adoption of long-term activity plans



Major functions of a coordinating institute and a focal point – holder of an *ex situ* genetic resources collection (level II):

- Monitoring and assessment of the status of genetic diversity within the given category of bioresources (degree of genetic erosion, amount and quality of *ex situ* and *in situ* conservation, conservation priorities, etc.);
- Identification and adoption of top scientific research priorities at the national level;
- Inventorying and setting up unified computerized databases for the given category of bioresources;
- Conservation, management and studying of the national base *ex situ* collections;
- Working out priorities and plans for genetic resources collecting;
- Coordinating activities of the working groups;
- Drawing up proposals for the NCC concerning legal and regulatory documents on conservation and sustainable utilization of agricultural biodiversity;
- international coordination and cooperation within the given sphere of responsibility;
- appointment of leaders for priority activities of the scientific programmes
- and approval of the working group membership;
- other activities on implementation of the Global Plan of Action.
- Each coordinating institute will nominate a Scientific and Technical Council (STC) to lead and supervise the above-mentioned activities.

Main functions and tasks of the working groups (level III):

In some cases, to ensure normal functioning of the National Programme's components and efficiency of the coordinating institute, so that the scope of all works with PGR could be covered in its entirety, special working groups will be organized. These working groups should include representatives of all stakeholders (institutes, breeders, experiment stations, etc.) who will jointly work out proposals for coordinating institutes pointing out bottlenecks in the process of solving the tasks of the National Programme and Plan of Actions and recommending appropriate remedies.

1. Definition and assessment of the status of genetic resources within the given category of biodiversity:
 - What is conserved *in situ* and *ex situ* (amount and conservation quality);
 - What is the degree of the threat of extinction and genetic erosion;
 - How much of the given biodiversity has been studied (presence/absence of data);
 - To what extent it may be interesting for users (breeders, ecologists, specialists in agricultural biodiversity, etc.)
2. Identification and adoption of top-priority activities with genetic diversity collections for further decision-making and practical measures (exploration of agricultural ecosystems, collecting, recommendations concerning the need for new natural reserves, protected areas, genetic reserves, *in situ* or *ex situ* conservation, etc.).
3. Nominating working group members and recommending them to the coordinating institute.
4. Assessing the extent of economic, social, cultural and other importance of genetic diversity at the national level and the necessity of its conservation and utilization.
5. Other functions assigned to them by the coordinating institute.

In Russia, the attempts to raise public awareness of the importance of PGR conservation and irreversible consequences of their extinction are both insufficient and inefficient. The need to keep everyone informed that PGR conservation is a national priority is beyond any doubt. In order to shape public opinion and raise public awareness of PGR-related problems it is necessary to solve the following tasks:

- Carry out a wide propaganda campaign via mass media and other popular information means promoting the need of PGR conservation and careful sustainable utilization;
- Make public awareness of the importance of PGR conservation one of the mandatory elements of public education;
- Organize a system of projects, measures and publications launching discussions on PGR conservation problems among wide scientific and public circles.

In the long run, coordination in the framework of the National Programme and fulfilment of the Plan of Actions in the sphere of PGR by all its parties form the keystone for safe conservation and sustainable utilization of biodiversity in Russia.

Such activities performed on the national level, in their turn, will enable Russia to take active part in the development and adoption of new international agreements, regulations and recommendations for cooperative activities, work out regional and global measures and receive its share of benefits from plant diversity utilization.



Formal adoption of the National Programme and the Plan of Actions will close one of the gravest gaps in the nation's functioning. However, along with the process of adopting these initiatives, special attention should be paid to the legal aspects of biodiversity, particularly to the laws and regulations pertaining to conservation and sustainable utilization of crop genetic resources.

Current Russian legislation in this sphere is based upon the provisions of the Constitution of the Russian Federation and the Civil Code. It is an extensively developed system of legal institutions, norms and directives securing biodiversity conservation. Of basic significance is the Law on Protection of Natural Environments (2002). Also important for biodiversity conservation are the Laws on Animal World (1995/2007), on Natural Territories under Special Protection (1995/2008), on Phytosanitary, Veterinary and Quarantine Control (2000), on Underground Resources, and Water (2006) and Forestry (2006) Codes.

The use of modified (by gene engineering) live organisms is regulated in Russia by the provisions of the Law on State Regulation of Gene Engineering Activities (2000) and the Cartagena Protocol on Biosafety (2000) regulating transgenic transfers of genetically modified organisms (GMO).

There are also decrees of the President of the Russian Federation, enactments of the Russian Government and other statutory acts pertaining to conservation and utilization of natural resources and environmental protection. Integral part of the national legal system are international conventions on conservation of biodiversity, safeguarding and sustainable utilization of its components, protection of water and air environments as well as the UPOV Convention, all of which were joined by Russia after 1996.

The existing legislation in the sphere of conservation and utilization of biodiversity is basically developed well enough. However, it still refers predominantly to natural resources, while many laws are of framework nature and require for their implementation separate statutory acts. These circumstances create various gaps and contradictions that bring about the need to undertake further efforts not only to amend and supplement the existing laws but also to carry out targeted activities to open new fields for law-making policy set forth in the CBD.

One of the most crucial tasks is systemic registration of biodiversity conservation requirements in the process of reforming and developing the entire Russian legislation, as biodiversity is among the most important strategic resources of the country.

Basic measures to be undertaken by the state in the nearest years in the sphere of development and modernization of its legislation:

- Systematization and modernization of the existing legislation in the sphere of genetic resources and supplementing the existing laws with new provision required for conservation of biodiversity and inexhaustible utilization of its components.
- Adoption of an amended version of the basic Law on Protection of Natural Environments reflecting the present-day socio-economic realities and biodiversity conservation tasks.
- Adoption of a full-fledged Land Code providing for biodiversity conservation in the process of real estate transactions and land management.
- Correction of the Water and Forestry Codes towards more universality by working out an updated system of governmental control regulating land management operations undertaken by owners and users of land and water areas from the viewpoint of environmental protection on the whole and biodiversity conservation in particular.
- Inclusion of biodiversity conservation requirements in the procedure of ecological assessments.
- Correction of the legislation concerning administrative offence with introduction of more severe penalties for offence committed in the sphere of biodiversity conservation.
- Further development of the traditional law-making domain. Adoption of laws governing such spheres as plant realm, hunting and huntsmanship, fisheries and soil protection; regulating transactions with specimens of rare and threatened species of animals, plants and other organisms; assigning a special protective status to indigenous forests and to water and bog resources of international significance.
- Development of the legislation in the context of ecosystemic approach and biological principles of biodiversity protection.
- Development of the legislation in the part regulating access to genetic resources and benefits from their utilization.
- Development of the legislation providing for protection of natural systems and traditional protective nature management techniques in the areas inhabited by small indigenous communities.

INTERNATIONAL COOPERATION

Presence of vast and economically underutilized territories is the feature that positions Russia in the international processes as the largest region on the globe where biodiversity of Northern Eurasia is maintained. This is the reason why Russia's contribution to the world's resistance against global environmental threats should find adequate support with the worldwide community and be taken into account in the development of international economic and financial mechanisms.

The system of international cooperation in the sphere of PGR conservation consists of numerous global, regional and bilateral conventions, agreements programmes and organizations as well as information networks and databases.

Russia carries out international cooperation under multilateral conventions and agreements pertaining to the problem of biodiversity conservation, the Pan-European strategy on biological and landscape diversity, bilateral agreements on environmental problems, etc. The country collaborates with a number of governmental agencies and non-governmental organizations in biodiversity conservation and participates in quite a few international programmes.

The main objective of Russia's international collaboration in the field of biodiversity is to enhance international biodiversity conservation activities with an emphasis on the measures of national priority.

Development of international cooperation in biodiversity conservation and management goes on through the following basic activities:

- Implementation of international obligations ensuing from the country's membership in international agreements and its participation in international organizations working in the sphere of PGR conservation and their sustainable utilization;
- Efficient interdisciplinary coordination of the work toward implementation of international obligations at the national level;
- Development and harmonization of legal issues pertaining to PGR problems;
- Establishment of a facilitation mechanism inter alia for raising awareness of national stakeholders, support of decisions taken and their promotion;
- Development and implementation of working plans under the existing international agreements in the sphere of PGR conservation;
- Active participation in regional and global PGR networks with the purpose of distributing responsibilities for conservation of *ex situ* collection accessions, their regeneration and cooperative studying;
- Interaction with international development agencies and financial organizations to employ international experience and resources;
- Utilization of opportunities and financial resources of international donors to provide for priority measures;
- Utilization of opportunities provided by joint implementation of PGR-related projects with CGIAR international centres.

Transparent, mutually beneficial and close cooperation between national genebanks in the framework of regional and global networks brings about the following advantages:

- Considerable reduction of frequency and quantity of germplasm duplications thanks to coordinated activities of genebanks;
- Distribution of responsibilities between genebanks for maintenance of *ex situ* collections of regional importance;
- possibility of free acquisition of missing accessions from *ex situ* collections of cooperating countries;
- Joint study and identification of promising accessions for future utilization in national regional breeding programmes;
- Development of common unified databases of genebank accessions and supplementing them with evaluation Data in order to facilitate their utilization;
- Launching joint collecting missions in search of new genetic resources;
- Exchange of best experience, knowledge and technologies;
- Facilitation of access to genebank accessions on the basis of a common mechanism of PGR accessibility and sharing of benefits from their utilization.



In the long run, these advantages may help to establish sustainable *ex situ* collections in each country. They will also contribute to saving great financial and human resources at national and regional levels, building a foundation for the regional and global system of PGR *ex situ* conservation capable of operational responses to climate change, and food and bioresource security of the country, the region and the world.

According to the international standards, each accession preserved under low temperature long-term storage conditions must be represented by a limited number of seeds, while distribution of such accessions is usually provided from working duplicate collections that often do not have sufficient seed reproductions to satisfy all users.

The problem of the *ex situ* germplasm regeneration still remains one of the most challenging for many countries, and the national collection of Russia is not an exception. Regional and international collaboration helps to solve this task. In the case with VIR, this kind of activity with PGR is greatly supported by the Global Crop Diversity Trust (GCDT).

For example, the negotiations of the GCDT representatives with the Russian Minister of Agriculture in 2006 led to signing an agreement, according to which VIR received a special grant of 230 000 U.S. dollars to reproduce 11 000 accessions of grain legumes and perennial forage grasses from the Russian collection until 2009. In 2008, a new agreement was signed to support regeneration of more than 10 000 cereal, grain legume and potato accessions. The access to regenerated germplasm will be granted on the terms of the International Treaty on PGRFA in accordance with the provisions of the bilateral agreement between VIR and the Global Trust.

The role of such activities is exceptionally important in the context of repatriating collection accessions to the genebanks of the countries striving to establish their national collections. Some countries that do not have sufficient experience in PGR conservation and management build their national collections in the current phase with materials obtained from the collections already established in other countries. Such kind of activity is called repatriation and requires primarily the germplasm of landraces, traditional varieties and crop wild relatives.

VIR frequently receives requests from the national genebanks of the ex-USSR countries for repatriation of their national germplasm. This tendency is quite explicable. In the Soviet period, VIR was the main supplier of breeding source materials to all Union republics, because it was the only institution holding global crop diversity. In the period from 2000 through 2007, VIR repatriated more than 1 500 accessions to the Baltic republics (Estonia, Latvia and Lithuania). All this material has been duplicated and stored at NordGen, Sweden.

According to the world's rating list, VIR is currently the fourth in terms of the stored amount of accessions, but its collection is unmatched in terms of its unique nature. It harbours 21% of the world's preserved diversity of flax, 13% of wheat, 10% of tomato and sunflower, 9% of lentil, 8% of potato, 7% of sugar beet, etc. In Europe, the Institute's collection is the richest and largest in most crops. This is the reason why requests for repatriation become more and more numerous and rather challenging for VIR's staff both from physical and financial points of view.

Repatriation in itself or, to be more exact, PGR reintroduction is a necessary and rightful mission. In addition to many advantages, repatriation offers a possibility to regenerate and study plant germplasm accessions in natural growing environments. What are the aims of repatriation? PGR are an important element of cultural and historic heritage of any nation. Together with traditional knowledge and experience in their utilization, these resources have great social and economic value for the whole nation and for smaller peoples, and taken in their worldwide entirety represent global heritage of humankind. Their cultural significance is realized in passing from one generation to another and sharing the traditions which shape people's lifestyle and custom, handicraft and science, social environments and mentality. Moreover, repatriation of genetic resources is an essential factor helping to restore agricultural ecosystems after natural calamities or local ethnic conflicts and may also contribute to the development of traditional medicine, revival of religious rites and culinary customs and any other features that distinguish and enrich a nation or nationality.

The country seeking repatriation, if necessary or when requested by the genebank holding the desired germplasm accession, must prove that it is indeed the country of its origin, guarantee the possibilities of its consequent long-term conservation and regeneration as well as free access to this accession and accompanying information.

Thus, repatriation of genetic resources may be regarded as not only political but also a scientific endeavour delegating specific rights and obligations to both countries — the donor of the preserved priceless heritage and the recipient of the repatriated seed. It means that when national genebanks initiate the process of repatriation they need to make phase-by-phase plans of their operations and observe certain procedural regulations. The first phase consists of database search in different foreign *ex situ* collections, selection and registration of PGR accessions having the required origin, and synchronization of their data with the information available in the existing national catalogues, registers and other archival documents. The second phase includes identification of the accessions by modern scientific methods and confirmation of their presence and availability with the prospective holder. In the third phase a special PGR material transfer agreement is drawn up between the two genebanks regulating the recipient's guarantees concerning long-term conservation, distribution of rights and responsibilities, joint research and possible sharing of benefits from future utilization of the repatriated germplasm.

It is also worth mentioning that there may be two types of repatriation: “physical”, when the requested genetic material is physically transferred as duplicate germplasm accessions together with relevant information, and “legal” (intangible), confirming “ownership rights to a germplasm accession”. In the latter case, the duplicated germplasm together with the original accession may be left in the holder’s keeping, while all information about it, including evaluation data, if these are not confidential, is sent to the country of origin and included in the recipient’s general catalogue of the national *ex situ* collection.

The country repatriating plant germplasm is obliged to retain the accession’s primary catalogue number and register the source of germplasm. Notwithstanding the type of repatriation, both national genebanks have equal rights to utilize genetic material received before the CBD effectuation date. The terms regulating utilization of germplasm materials received after 1994 are stipulated in the agreements signed by the holder and the recipient at the time of repatriation/transfer.

In the context of regional cooperation, many problems with PHR collecting, conservation and study may be solved automatically, as the mechanism is usually set forth by a special joint decision of several governments and hence prescribes the rules of conduct to national genebanks. With such type of international cooperation, it is important to have common areas of interests and mutual trust between the partners, work out a coordinated strategy and working plan, and integrate into such collaboration various interested parties, such as community organizations, private enterprises and farmers.

One of the examples of beneficial regional cooperation is the collaborative programme on PGR undertaken by the CIS countries. After the disintegration of the USSR, its former republics suffered abrupt decline of scientific research, experienced grave deficit of research-oriented human and financial resources, while their existing capacities could not satisfy the requirements of modern science. All these circumstances had adverse effect on the capabilities of the region’s countries to solve the task of sustainable PGR management in agriculture. So it became obvious that the efforts and potentials of these countries should be united with those of the international organizations and focused on the crucial areas of agricultural biodiversity research, thus building capacities for breeding high-yielding cultivars with resistance to biotic and abiotic stresses using stored plant germplasm as source material.

In 1996, the countries of the Central Asian Region (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan) convened their first meeting under the aegis of the CGIAR, with VIR’s representative present. The meeting outlined the phases of joint networking, appointed administrative bodies of the network and set up working groups in the main areas of collaboration. ICARDA became the network coordinator. In 1999, this network was joined by the countries from the Caucasus (Armenia, Azerbaijan and Georgia). Thus, the CAC Net came to existence with the following priorities:

- *In situ/on-farm* PGR conservation.
- Capacity building and further development of safe conservation measures for *ex situ* collections of cultivated plants and their wild relatives.
- Efficient studying and rational utilization of the genetic potential of plant diversity.
- Enhancement of technical possibilities and enhancement of scientific potential for PGR conservation and sustainable utilization.

VIR participated in the regional network of the Central Asia and the Caucasus (CAC Net) as an observer. In 2007, at the GCDT’s initiative, a group of expert with direct participation of VIR worked out the Regional Strategy of Conservation, Replenishment and Utilization of PGR for Food and Agriculture in the Central Asia and the Caucasus for the period until 2015. This strategy was adopted by the CAC Net. Its objective is to develop and introduce an efficient coordination system for safe PGR conservation, collecting, studying and rational utilization. The strategy is aimed at reducing poverty rate, raising common wealth and promoting environment-friendly and sustainable agricultural practices.

The Regional Strategy is based on efficient cooperation beneficial for all participating countries, goodwill partnership and smooth coordination of activities between the partners. Collaboration under this Strategy has many forms, depending on the problem of PGR management to be solved. For safe conservation of prioritized *ex situ* collections in the CAC countries leading institutes/organizations have been chosen and agencies charged with specific services have been identified.

Basic terms of such partnership include: unity on aims; complete trust between collection holders and other participating organizations; readiness for collaboration within the region and beyond its boundaries; adequate financial resources; and compliance with the international standards of PGR conservation and management. This partnership also envisages that selected national genebanks may be entitled with regional responsibility for conservation of certain plant species or groups of crops and be in charge of relevant regional databases. Selection of such countries/institutions will depend on their comparative advantages, availability of adequate capacities, qualifications of their staff, consistent

interest to such activities, and ability to perform this kind of work on a long-term basis. During the next Coordination Meeting in 2007, the regional network council invited VIR to enter the CAC Net as a full-scale partner. This question may be solved in 2009.

Collaboration and networking within the CAC Net may be conducted both in multilateral and bilateral form and encompass all areas of PGR-related activities, including documenting, regeneration, safe duplication, quarantine testing, studying, evaluation, characterization, germplasm distribution, collecting, participation in various research projects, database development, harmonization of legal issues and laws in the PGR sphere. In addition to its involvement in the CAC Net, VIR maintains bilateral cooperation on some aspects of PGR activities with Armenia, Azerbaijan, Kazakhstan, Tajikistan and Uzbekistan.

The Institute continues its mutually useful research collaboration with the International Centre for Agricultural Research in the Dry Areas (ICARDA). Their joint activities aimed at collecting and studying plant diversity in the Western and Central Asia have been performed in the framework of a cooperation agreement signed in 2000. In addition to the development of joint specialized evaluation databases of wheat, barley, chickpea and other crops, in July 2007 the partners launched a trilateral collecting mission in Kazakhstan following an invitation of the Kazakh Academy of Agricultural Sciences.

In 2007, VIR signed an agreement with the Kazakhstan Centre of Agricultural Biodiversity concerning training of national scientific experts in long-term conservation of bioresources, and with their National Office of UNEP on scientific and methodological assistance in the area of *in situ* conservation of fruit plants. In September 2007, VIR's researchers attended a conference organized by the Kazakhstan Ministry of Agriculture jointly with UNEP where the national strategy of local plant diversity conservation was worked out.

It should be mentioned, however, that a crucial hindrance to both multilateral and bilateral cooperation is the absence of financial resources to support joint endeavours and collaborative research projects, despite the fact that in 1999 an Agreement on PGR was signed by the governments of the CIS countries in Minsk, Belarus.

Nevertheless, there are palpable achievements in this sphere. Joint efforts of the countries involved helped to develop compatible national passport databases, launch joint PGR collecting missions and conduct training courses in various PGR-related areas. In 2002, several representatives of the leading CAC institutions attended a two-week training course at VIR dedicated to database management (Georgia, Kazakhstan, Uzbekistan, etc.) and a one-month field workshop on the problems of PGR study and evaluation at the Kuban Experiment Station of VIR (Georgia, Kazakhstan, Tajikistan, Turkmenistan and Uzbekistan).

In the period from 1996 through 2006, VIR shipped to the CAC countries 6 633 accessions of cereal (1 679), small grain (1 299), industrial (1 142), vegetable, fruit-bearing, forage and other crops, including 772 to Armenia, 526 to Azerbaijan, 177 to Georgia, 2 388 to Kazakhstan, 409 to Tajikistan, 68 to Turkmenistan and 2 293 to Uzbekistan.

During the same period VIR received from the CAC countries 2,694 accessions of cereals (618), forages (905), grain legumes (512) and other crops, including 593 from Armenia, 190 from Azerbaijan, 156 from Georgia, 690 from Kazakhstan, 132 from Kyrgyzstan, 734 from Tajikistan, 43 from Turkmenistan and 166 from Uzbekistan. Dozens of collecting missions explored the territories of Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan.

Modern PRG-related legislations in the CAC countries is founded on their Constitutions and represent systems of legal institutions, norms and regulations targeted at safe biodiversity conservation. The laws are supported by a number of relevant presidential and governmental decrees, resolutions and statutory acts. However, the existing legal mechanisms regulating PGR conservation and utilization have a lot of drawbacks and gaps. So, there is an important task to continue development of national legal platforms on such issues as intellectual property rights, access to genetic resources and equitable benefit sharing.

Taking into account the importance of such law-making activities in the sphere of PGR, the Inter-Parliamentary Assembly of the CIS countries in 2008 charged VIR with the mission to work out the model law *Concerning Conservation of Crop Genetic Resources and Their Sustainable Utilization*. This law was given its first reading and is scheduled to be adopted in March 2009.

The law will establish a legal platform for governmental policies in the sphere of collecting, conservation and study of crop genetic resources and their wild relatives; sustainable utilization of these resources for food and agriculture; research, breeding and educational activities in this sphere; and safeguarding of this social, cultural and historical heritage for the sake of the present and future generations.

The law will also secure a common approach to the problems of collecting, conservation, studying and sustainable use of agricultural biodiversity and regulate practical activities in this sphere.

Beside the CAC countries, VIR has bilateral collaborative agreements on PGR with the Ukraine, Belarus and Moldova. During the past six years (2002–2008) these countries received from VIR 5 300 accessions of various crops (883 to Belarus,



4 097 to the Ukraine, and 320 to Moldova) and shipped to VIR 1 786 accessions (1 338 received from the Ukraine, 184 from Moldova, and 264 from Belarus).

A crucial role in VIR's integration into European international cooperation was played by IPGRI (former IBPGR, now Bioversity International). In 1990, the first Memorandum between the two institutions was signed to make VIR an official member of the ECPGR (European Cooperative Programme for Plant Genetic Resources). Rapid socio-economic and political changes in Europe dictated the need of signing a new Memorandum of Understanding, this time between VIR and IPGRI (April 2001). This agreement is still valid. Its Article 4, dedicated to VIR's participation in Phase VI ECPGR, stipulates that "...pending the formal participation of the Russian Federation to ECP/GR, interim arrangements will be agreed and appended to this Memorandum...".

The relevant interim agreement views Russia as an associated member country of the ECPGR, while VIR acts as a focal point of the Russian Federation. According to Clause 3 of this interim agreement, VIR will act as national focal point for ECP/GR in RF. This entails regular liaison with ECP\GR Secretariat, with the Chairpersons of individual networks, WG, crop coordinating groups, task forces and National Coordinators from participating countries etc." This undertaking enabled VIR to participate in almost all ECPGR Working Groups, including the WG on information and databases. In 2003, the Institute organized jointly with the ECPGR Secretariat a meeting of the Steering Committee in St. Petersburg.

A recent initiative of the ECPGR Steering Committee in the sphere of regional cooperation, European Genebank Integrated System (AEGIS), was intended to provide unhindered access to the unique germplasm of crops and their wild relatives preserved in more than 500 European genebanks, enhance safety of European PGR and promote their sustainable utilization and management. With this aim, AEGIS will carry out the following tasks:

- enhance coordination, cooperation and collaboration in the PGR sphere among European countries in new integrated Europe;
- conduct efficient and resource-saving activities to preserve European plant diversity;
- raise standards of PGR management in the region to a new quality level and guarantee safe long-term conservation of PGR;
- carry out efficient and sustainable regeneration of accessions important for the region from socio-economic, cultural and historical points of view;
- promote facilitated access to germplasm accessions and relevant information for the member countries;
- improve interlinks between *in situ* and *ex situ* conservation;
- promote exchange of knowledge, information and novel technologies.

Implementation of the AEGIS initiative was started not long ago, but judging from the previous three-year pilot project on four crops (VIR was involved in the *Avena* working group) finalized in 2006, such cooperative effort has very positive prospects for all ECPGR members. Meanwhile, the possibility for Russia to join Phase VIII of the ECPGR as a full member country is being decided by the government.

In fact, the country's participation in this regional programme is vitally important both for Russia and for Europe. Such coordinated efforts and cooperative activities, as in the case of AEGIS, between states and networks may provide an extremely positive impact on the progress with PGR conservation and management.

Despite all difficulties that VIR is facing in the situation of general crisis with governmental funding of science and research in Russia, the Institute continues to fulfil its major function entrusted to VIR by its founder Nikolai Vavilov. In the past 5 years VIR supplied to all categories of users in the ECPGR member countries 4 389 germplasm accessions and received 1 449 accessions. The Institute maintains Europe's largest *ex situ* collections of tomato (ca. 7 000 accessions), wheat (ca. 44 000), cucurbits (ca. 14 000), cabbage, soybean, etc. VIR de facto plays the role of a national coordinating centre in the sphere of PGRFA within the Russian Federation; therefore its full-scale participation in the ECPGR activities is an important political and strategic issue not only for Russia, but for the whole European community.

On the basis of bilateral agreements VIR participates in ongoing international collaboration with various national programmes of European (Bulgaria, Czech Republic, France, Germany, Slovakia, etc.) and other countries (Canada, China, Republic of Korea, etc.) as well as with private companies of the Netherlands, Japan, Spain and the United States. Besides, close contacts in various PGR-related areas are established with the network of the Baltic countries and NordGen.

The Institute's first agreement with the Nordic Genetic Resource Centre and the Baltic states (Latvia, Lithuania and Estonia) was signed in 2002. This document envisaged establishment of national *ex situ* collections in the three republics of the former Soviet Union, identification, regeneration and repatriation of the regional germplasm diversity to these countries, organization of workshops and lectures on major PGR-related problems (legal aspects of PGR, cryoconservation, databases, etc.) and PGR collecting activities.



In the beginning of the 2000s, screening for accessions of Nordic crops in VIR database and hand-written catalogues was carried out. There are a large number of accessions of Nordic crop material in VIR. The material present at VIR was collected in the beginning of the last century and represents historical Nordic material. The duplicate screening and repatriation of materials addressed only barley and oats. The rest of crops still should be analyzed, duplicates identified and unique accessions included in the NordGen collection.

Screening of duplicates would ensure including in the collections only unique accessions, avoiding unnecessary expenses of maintaining several copies of one accession. The gained PGR evaluation information will stimulate utilization of the material of Nordic origin and contribute to sustainable development of agriculture. The information and material is valuable for new Nordic Food development. These accessions have also potential value as source of genes for crop adaptation to climate changes.

For a number of species the most efficient way of preservation is *in situ* and on-farm conservation. There is a large number of crop species common for the Nordic countries and the North-West of Russia, so the region could benefit from common approaches on species conservation techniques. Preservation of plant material *in situ* is vulnerable to climate changes, and this aspect will also be considered in the recommendation development. It will create a platform for cross-sector collaboration—agriculture, horticulture and environment. The guidelines developed in such collaboration will have strong impact on securing genetic resources for the future and influence international development in this area of work.

Utilization of genetic resources in order to broaden genetic base and improve adaptation ability of crops to the changing environment (emerging diseases, abiotic stress) are important for sustainable development of agriculture and food security in the future. Since the North-West of Russia and Nordic countries are located in northern Europe, having same crops, similarities in day-length conditions and temperatures, the possibility of collaboration in this field should be explored for the benefit of the whole region. Of great importance is to select and develop plant materials useful for breeding for changing climate. Field trials under extreme climate conditions, testing/evaluation of disease resistance, and stability in crop performance (genotype/environment interaction) will be evaluated and suitable material selected.

The common efforts on PGR education will contribute not only to better understanding of the subject, but also enhance the collaboration in this field in the future. NordGen has started a project on collaboration with Nordic Universities and Institutes in education concerning PGR. Common courses/seminars between Nordic and Russian experts on plant genetic diversity will strengthen the PGR initiatives in the region, facilitate networking and stimulate the mobility of Nordic and Russian experts working on PGR.

In 2006 Russia became a member of FAO. In 2007 the country joined the FAO Commission on Plant Genetic Resources. The Russian Government is discussing the issue of joining the International Treaty on Plant Genetic Resources for Food and Agriculture. Unfortunately, these discussions have been underway for three years already, and the time of final decision is yet unknown.

Summarizing the country's international collaboration during the past decade, it is easy to conclude with certainty that VIR still remains the key Russian partner for the majority of foreign national and international organizations in the sphere PGR collecting, conservation, research and utilization. However, international cooperation may be considerably improved and enhanced both at global and regional levels.

For this purpose, the following measures should be undertaken:

- Decision of the Government concerning joining the International Treaty of Plant Genetic Resources for Food and Agriculture;
- Decision of the Ministry of Agriculture concerning full membership in the ECPGR;
- Adoption of the National Programme on Plant Genetic Resources;
- Decision on adequate governmental funding of the PGR problem;
- Training of qualified professional personnel for all kind of works with PGR;
- Closer collaboration with the CGIAR International Centres.

COMPOSITION OF THE GLOBAL COLLECTION OF CULTIVATED PLANTS AND THEIR WILD RELATIVES FOR 31ST DECEMBER 2007

No.	Crop	Number of accessions
	Wheat, triticale & Aegilops	-
1	Winter bread wheat	16 044
2	Spring bread wheat	16 211
3	Durum wheat	6 328
4	Rare species	3 887
5	Triticale	4 100
6	<i>Aegilops</i>	5 467
	Subtotal:	52 037
	Rye, barley & oats	-
1	Rye	3 264
2	Barley	20 921
3	Oat	12 737
	Subtotal:	36 922
	Maize & other small grains	-
1	Maize	14 490
2	Millet	8 990
3	Rice	5 856
4	Buckwheat	2 232
5	Sorghum	9 776
6	Sudan grass	487
7	Finger millet	203
8	Japanese millet (barnyard)	108
9	Mohar millet (<i>Setaria italica</i> ssp. <i>moharica</i>)	351
10	Foxtail millet (<i>Setaria italica</i> ssp. <i>maxima</i>)	4 393
11	Pennisetum	480
12	Genetic collection	852
	Subtotal:	48 218
	Forage crops	-
1	Alfalfa & other perennial <i>Medicago</i> species	4 427
2	Hop clover & other annual <i>Medicago</i> species	535
3	Red clover	4 150
4	White clover	1 360
5	Alsike clover	451

No.	Crop	Number of accessions
6	Other <i>Trifolium</i> spp.	1 327
7	Bird's-foot trefoil (<i>Lotus</i> spp.)	573
8	Serradella (<i>Ornithopus</i> spp.)	75
9	Melilot	1 114
10	Sainfoin	993
11	Timothy grass	1 729
12	Reed canary grass	438
13	Meadow fescue	1 196
14	Tall fescue	441
15	Cock's-foot	1 423
16	Meadow foxtail & other <i>Alopecurus</i> spp.	413
17	<i>Bromus</i> , <i>Elymus</i> , <i>Arrhenatherum</i> , <i>Agropyron</i> spp.	1 474
18	Meadow grass (<i>Poa</i> spp.)	1 890
19	Common ryegrass & other <i>Lolium</i> spp.	1 435
20	Bent grass (<i>Agrostis</i> spp.)	717
21	Red fescue	668
22	Milk vetch	148
23	Other leguminous plants	786
24	New silage crops	321
25	<i>Elytrigia</i> , <i>Psathyrostachys</i> spp.	1 726
26	<i>Kochia</i> , winterfat	41
	Subtotal:	29 851
	Grain legumes or pulses	-
1	Pea	8,411
2	Soybean	7 030
3	Vetch	4 180
4	Lupin	3 296
5	Phaseolus beans	8 166
6	Chickpea	3 035
7	Horse beans	1 911
8	<i>Lathyrus</i> spp.	1 705
9	Lentil	3 478
10	Cowpea	4 363
11	New pulse crops	323
	Subtotal:	45 898
	Industrial crops	-
1	Sunflower	2 788
2	Flax	5 983
3	Peanut, sesame, safflower	3 776
4	Rapeseed & field mustard	1 415
5	Mustard	1 516
6	Cotton	6 475
7	Poppy	1 842
8	Castor oil plant	1 176
9	Hemp, jute, kenaf, etc.	1 584
10	Other oil-bearing plants	582
11	Rubber plants	128
12	New industrial crops	1



No.	Crop	Number of accessions
	Subtotal:	27 266
	Tuber crops	-
1	Breeding cultivars (<i>Solanum tuberosum</i> , ssp. <i>tuberosum</i>)	2 100
2	Indigenous Chilean varieties (<i>Solanum tuberosum</i> , ssp. <i>chiloense</i>)	130
3	Cultivated sp. <i>Solanum andigenum</i> Juz. et Buk.	2 650
4	Cultivated primitive species	546
5	Wild species	2 705
6	Dihaploids	324
7	Interspecific hybrids	360
8	Other tuberiferous crops	3
	Subtotal:	8 818
	Vegetables and cucurbits	
1	Cabbage	3 192
2	Tomato	7 380
3	Cucumber	4 099
4	Onion & garlic	3 016
5	Pepper & eggplant	2 580
6	Carrot, etc.	6 771
7	Beet	2 947
8	Swede & turnip	871
9	Lettuce & dill	3 041
10	Watermelon	3 099
11	Rare <i>Cucurbitaceae</i> species	655
12	Melon	4 115
13	Pumpkin & marrow squash	2 483
14	Minor crops	5 489
	Subtotal:	49 738
	Fruit plants	-
1	Apple	4 343
2	Pear	1 837
3	Quince	335
4	Rowan (<i>Sorbus</i> spp.)	43
5	Serviceberry (<i>Amelanchier</i> spp.)	19
6	Other pome fruits	-
7	Plum	4 174
8	Apricot	614
9	Peach	438
10	Sour cherry	1 067
11	Sweet cherry	491
12	<i>Microcerasus</i>	275
13	Bird cherry	201
14	Almond	128
15	Remote hybrids	-
16	Hazelnut	108
17	Walnut	78
18	Black currant	1 360
19	Red currant	394
20	Gooseberry	262

No.	Crop	Number of accessions
21	Raspberry	231
22	Blackberry	83
23	Strawberry	1 512
24	Honeysuckle	420
25	<i>Actinidia</i> spp.	323
26	<i>Magnolia</i> vine	79
27	<i>Viburnum</i> spp.	37
28	Other berries	-
29	Ornamental plants	1 587
30	Grapevine	3 051
	Subtotal:	23 490
	Total:	322 238



