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

REPUBLIC OF KOREA

Second Country Report
on Plant Genetic Resources for Food and Agriculture
in Republic of Korea

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Compiled by
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CONTENTS

Executive Summary

The Republic of Korea is located in North-East Asia and lies contiguous to China and Russia, and near the Japanese archipelago. The Korean peninsula is about 1,030 km long and 175 km wide at its narrowest point. The land area covers 99,200 km^2, and it has a population of almost 49 million people. Mountains cover about 65% of land mass, making it one of most mountainous regions in the world. The mountain range that stretches the length of the east coast falls steeply into the East Sea, while along the southern and western coasts, the mountains descend gradually to the coastal plains that produce the bulk of Korea's agricultural crops, especially rice. The plains of the country are mostly arable, representing a high proportion of the total territory at 17.9%, where 60% of which are paddy fields and 40% are upland. Rice covered the largest area mainly concentrated in the paddy field followed by vegetables in the upland areas.

The cultivation areas of food crops have decreased during last four decades. Rice was cultivated in 1.23 million hectares in 1965, but decreased to 0.95 million hectares in 2007. Despite of decreasing area of cultivation, total production in 2007 increased by about 79% when compared to 1965, which indicates that development of high-yielding rice varieties and modern techniques for rice cultivation were the major contributory factors. On the other hand, cultivated areas of barley, wheat, corn, soybean, and potatoes have drastically decreased since 1970 and it would be assumed that the production of these crops might continually decrease. As a result, the rate of crop self-sufficiency was noted at 80.4% in 1970 and has drastically reduced to 27.2% in 2007.

It was estimated that around 4,884 vascular plant species naturally occurs in Korea which could be classified into 205 families and 1,145 genus including ferns. *Ex situ* conservation has been more common than *in situ* conservation for the agricultural genetic resources. Hence, there have been limited *in situ* conservation activities for wild crop or wild relatives which are classified as agricultural plant genetic resources. This was due to the lack of understanding for the importance of *in situ* conservation of agricultural genetic resources. Currently, however, the efforts to develop the conservation system suitable to the Korean situation have been made, as the *in situ* conservation for agricultural genetic resources becomes more important than ever.

The *ex situ* conservation of seed and plant genetic resources for food and agriculture in Korea is carried out by the National Agrobiodiversity Center (NAC), Rural Development Administration (RDA). The NAC is mandated to plan and implement national projects on collection, introduction, identification, documentation, multiplication, regeneration, characterization, evaluation, conservation, exchange, distribution, and infrastructure construction of plant genetic resources in the whole country. The NAC has 156,282 accessions of agricultural genetic resources including 50,203 Korean-origin (32%) and 106,079 foreign-introduced (68%) resources. Regarding the *ex situ* conservation of forestry genetic resources, three organizations, Korea Forest Seed & Variety Center (KFSVC), Korea Forest Research Institute (KFRI), and Korea National Arboretum (KNA) under Korea Forest Service (KFS), are primarily responsible.

The agricultural genetic resources have been usually used for the development of new varieties. Recently, the area of utilization is expected to expand to the fermented food and environment-friendly materials. Aside from the production of direct economic value, the resources will be used for society and ecosystem such as for the education, prevention of animal disease, reforestation, and fish stocking.

The National Management Programme for agricultural genetic resources carried out by Ministry for Food, Agriculture, Forestry & Fisheries (MIFAFF), responsible and management organizations of agricultural genetic resources. The MIFAFF (RDA and KFS) establishes '5-Year Basic Plan for the Agricultural Genetic Resources' and the 'Annual Implementation Plan'. It also appoints and operates the responsible organizations, authorizes the genetic resource transfer, surveys and collects the resources, makes the resource list, registers the conserved resources, and supervises the overseas transfer.

Recognizing the infinite value of genetic resources as the common assets of mankind, Korea has collaborated with different countries in the Eastern Europe, Central Asia, China, and the Southeast Asia, through the cooperation projects such as joint research, and collection, and exchange of genetic resource. With regards to the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) of FAO, which took effect in 2004, Korea has made national-level endeavor to implement the treaty, aiming at the sustainable conservation and utilization of agricultural genetic resource as well as the fair share of benefit. Furthermore, Korea will also continuously join in the international efforts for agricultural sustainability, food security, economic development, and poverty alleviation.

INTRODUCTION

1. General information

The Republic of Korea is a peninsular country extending southward from the northeastern part of the vast Asian Continent, which lies between 124°11' E - 131°52' E longitudinally and between 33°4' N - 43° N latitudinally. Biogeographically, the country belongs to Sino-Japanese floristic region covering South Siberia, Japan, North China, Manchuria, and some part of the Himalayas (Good, 1974). Hence, the flora of the peninsula has been much associated with those of the surrounding countries, like Japan, Manchuria, and North China. Korea, with an area of about 9.9 million hectares, shows a varied terrain of the ecosystems composed mainly of mountainous areas occupying 64% of the total land area with the plains mainly lying to the south and the south-western archipelagoes consisting of about 3,400 islands. Korea is densely populated with about 49 million inhabitants.

Korea has four seasons, with wet monsoon/summer in the middle of the year, and a cold winter from November to March. The annual average temperature shows large variation from 14°C in the southern area to 5°C in the northern part. The amount of annual precipitation ranges from 1,400 mm in the southern part of the peninsula to 400 mm in the high land of the northern region. The climatic condition is diverse from the subtropics occurring in the southern coastal area to the frigid high land zone in the northern mountains. Due to these various climatic and geographical conditions, it was assessed that the flora of the vascular plants in Korea were very diverse and specific as compared to those of surrounding countries.

Subtropical broad leaved trees, such as *Cinnamomum camphora* Sieb., *Camellia japonica* L., *Quercus myrsinaefolia* Bl., and *Mallotus japonicus* (Thunb.) Muell. Arg. are mainly distributed in the southern part of Korea. On the other hand, temperate and coniferous trees are mainly predominant in the middle part, such as *Pinus densiflora* and *P. thunbergii* Parlatore. *P. koraiensis*, *Abies holophylla* Maxim, *Picea jezoensis* Carr., *Abies nephrolepis* (Trautv.) Maxim, *Taxus cuspidata* S. et Z., etc. which are distributed in the frigid region.

It was estimated that around 4,884 vascular plant species naturally occurs in Korea which could be classified into 205 families and 1,145 genus including ferns (Korea Plant Names Index, http://www.koreaplants.go.kr:9101). In addition, about 328 taxa of Korean endemic species including six endemic genera were distributed.

Table 1. Endemic plants of the Republic of Korea

Class	Family	Genus	Species	Subspecies	Varieties
Filicineae	5	7	7		2
Gymnospermae	1	2	2		1
Angiospermae	51	151	252	2	60
Monocotyledoneae	10	27	48	1	14
Dicotyledoneae	41	124	206	1	43
Total	57	160	263	2	63

※Source : Endemic Vascular Plants in Korean Peninsula (2005, Korea National Arboretum)

The floristic provinces of Korean Peninsula can be grouped into eight regions based on the composition of plant species (Figure 1). Four to eight provinces lie in South Korea and the main tree species found are as follows;

- Middle province (4): Genera Megaeranthis, Pentactina, Abeliophyllum, and Hanabusaya which belong to Korean endemics.
- South province (5): Genera Cephalotaxus, Ilex, Meliosma, Camellia, Stewaria, Tracheospermus
- South-coast province (6): Genera Cyrtomium, Torreya, Castanopsis, Stauntonia, Raphiolepis, Aridisia
- Jeju province (7): Genera Psilotum, Myrica, Diapensia, Azolla, Citrus
- Ullung province (8) :Genera Tsuga, Fagus, Wasabia, Tiarella

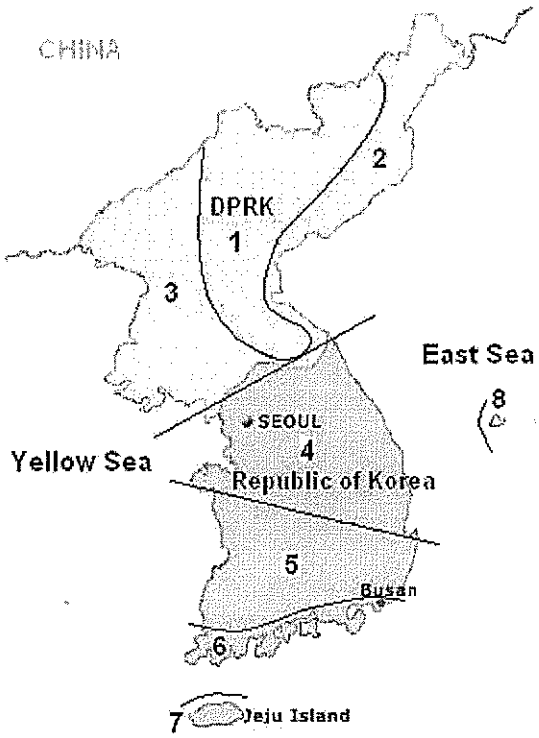


Figure 1. Eight floristic provinces of the Korean peninsula (Lee and Yim, 1978).
①Kabsan Prov. ②Kwanbuk Prov. ③Kwanseo Prov. ④Middle Prov. ⑤South Prov. ⑥South-cost Prov. ⑦Jeju Prov. ⑧Ullung Prov. * DPRK : Democratic People's Republic of Korea

About 66% of the Korean soil was formed in the Cenozoic Era and 70% of the bedrock is granite and gneiss. The soil is very susceptible to erosion due to the severe changes in climate and downpours in summer. The varying climate also caused the regional differences in soil. Brown forest soil covers half of the total land. The red soil and yellow soil are another notable soil types mostly distributed in the southwest coastal area. Dark red soil and greyish brown soil are found in southeast area while volcanic ash makes up most of Jeju and Ullung islands.

2. Brief Profile of the Agricultural Sector

In 2007, there were about 1,231 farm households representing a population of 3,274 which was almost 7% of the entire population. The proportion of agricultural lands was 17.9% (1,782,000 ha) of the entire national territory of 9,972,000 ha of which 60% (1,070,000 ha) were paddy fields, and 40% (712,000 ha) were farms. Korea's agricultural

land area has been decreasing steadily, with a mean annual reduction of 14,558 ha between the years 2000 and 2007. In particular, the reduction of paddy fields, which represent 70% of agricultural land and the habitat of numerous aquatic organisms, has been significant.

The decreasing area in paddy fields can be attributed mainly to the conversion of rice fields into farms, followed in order by the construction of public facilities, building construction, unused land, and other factors. Although new agricultural lands are established every year, the ratio is relatively lower than the proportion of agricultural land that is converted for other purposes. Most newly-created agricultural land is formed by filling-up, while about 8% is formed through reclamation by drainage. This suggests that natural green areas, which provide ecologically excellent life habitats, tidal flats of coastal wetlands, or inland wetlands have been formed into agricultural land.

Large reductions of agricultural land area have been due mainly to the construction of buildings and public facilities as a result of urbanization and industrialization (60%), as well as due to the conversion of farmlands into unused land (22%), which is much more likely to be utilized for industrial purposes or city construction rather than converting back as agricultural land. This encroachment on farmland may lead to a domino effect of encroachment on natural green areas or wetlands.

3. Crop Production

Regarding the agricultural productivity of Korea, rice production has slightly increased. Such trend can be primarily be attributed to the increment of rice productivity per unit area with new high-yielding cultivars widely released, hence, self-sufficiency could nearly be attained. On the other hand, cultivated areas of barley, wheat, corn, soybean, and potatoes have drastically decreased since 1970 and it would be assumed that the production of these crops might continually decrease. In total, the rate of crop self-sufficiency was noted at 80.4% in 1970 and has drastically reduced to 27.2% in 2007.

CHAPTER 1 The State of Diversity

1.1 General characteristics of biodiversity in Korea

The Republic of Korea's terrain is mostly mountainous, with the Baekdudaegan mountain range as the spine of the Korean Peninsula, and has a wide range of vegetative habitats, from the warm temperate to the cold climate zones. In addition, the country's unique terrain, topography, and climate conditions, with its forest ecosystem linked to marine life, have made it possible for the country to possess a relatively large variety of flora and fauna compared to other temperate regions given the country's small area (99,200 km^2), with over 30,000 species, including forest and marine resources.

Korea's endogenous life forms consist of animals (64%), plants (12%), fungi and lichen (6%), protists (14%), and prokaryote (4%), with a high proportion of endemic species. These characteristics of the plant and animal life of Korea are affected by a variety of habitat and environmental factors, such as the well-formed coastlines, the four distinct seasons influenced by the East Asian monsoon, the thousands of islets, the historic background of steady contact with the continents, volcano eruptions, and the overflowing rivers and typhoons during the summer season.

By the end of 2007, the total forest area of the country covered 6,382,000 ha, accounting for the 64% of the total land area (9,972,000ha). Of the entire forest area, the national forests represent 24% (1,509,000 ha), public forests at 7% (489,000ha), and private forests about 69% (4,384,000 ha). In the inland territory, due to the geographical conditions, large river water flows west and south slowly, while the rivers flowing to the east are frequently characterized by short and swift currents. Throughout the year precipitation tends to be low, except during the summer rainy season when there is a high concentration of rain. Korea's inland wetlands, with a total area of 3,541 km^2, are broadly distributed throughout the country, of which the wetland conservation areas covers 107.1 km^2, with high light intensity, making them appropriate for wild plants and animals to inhabit and breed.

With regard to coastal regions, the total length of the coastline is about 12,682 km, 78% of which is natural coast, while 22% is artificial. The coastal wetlands occupy 2.5% of the entire territory, 83% of which are concentrated in the western coast. The ocean currents

affecting the country include the Yellow Sea Warm Current, the East Korean Warm Current, the branch currents of the Kuroshio Current that begins off the east coast of Taiwan, and the North Korean Cold Current (a tributary of the Liman Current that originates in the Sea of Okhotsk). Naturally formed coastal sand dunes act as buffers to ocean energies (such as wind energy, tidal energy, and wave energy) that also function as reservoirs of coastal sand and ground water, habitats, and sources of natural scenic beauty.

Korea's estuarine ecosystems form various habitat environments, under the conditions of fresh water, nutrient salt, organic and various polluted matters carried in from terrestrial runoff as an ecotone, with a particularly large variety of organisms inhabiting, including freshwater, brackish, and marine life.

1.2 The main values of plant genetic resources

The plains of the country are mostly arable, representing a high proportion of the total territory at 17.9% (1,782,000 ha), where 60% of which are paddy fields and 40% are upland. Table 1.1 presents the hectarage devoted in the cultivation of major commodities such as rice, barley, beans, potato, vegetable, and orchard. There are classified as paddy field and upland. Rice covered the largest area mainly concentrated in the paddy field followed by vegetables in the upland areas.

Table 1.1. Cultivation area of major crops in Republic of Korea (1,000 ha)

Crops	Total	Paddy field	Upland
Rice	950	933	17
Barley	56	48	8
Soybean	88	8	80
Vegetables	223	31	192
Orchard	149	3	146
Potato	40	3	37

The cultivation areas of major food crops have decreased from 2.95 million hectares in 1965 to 1.16 million hectares in 2007, during last four decades. Rice was cultivated 1.23 million hectares in 1965, but decreased to 0.95 million hectares in 2007. Despite of

decreasing area of cultivation, total production in 2007 increased about 79% when compared to 1965, indicating development of high-yielding rice varieties, japonica or indica/japonica, and modern techniques for rice cultivation were the major contributory factors.

The area of production in minor crops sharply decreased during 1965-2007 due to the scarcity of labor and low income. For instance, the area of barley production has decreased from 827,000 hectares in 1965 to 56,000 hectares in 2007. Soybean also showed similar trend and it was reduced from 308,000 hectares in 1965 to 88, 000 hectares in 2007.

Table 1.2. Crop cultivation area, production, and rate of self-sufficiency in Korea

Crops	2007			1965	
	Area (103 ha)	Production (103 MT)	Self-sufficiency(%)	Area (103 ha)	Production (103 MT)
Rice	950	4,407	95.8	1,228	3,501
Barley	56	176	48.3	827	1,459
Wheat	2	8	0.2	93	184
Soybean	88	128	11.1	308	174
Corn	17	84	0.7	49	40
Root	21	224	98.4	213	1,045
Tuber	20	-	-	232	121
Others	8	7	9.8		
Total	1,161	5,034	27.2	2,950	6,524

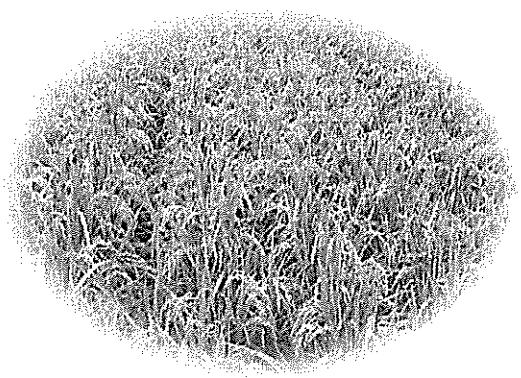


Table 1.3. Changes in the area of agricultural land by year

Year	Total agricultural land area (103 ha)	Paddy field (103 ha)	Farm (103 ha)	Reduction of agricultural land (ha/yr)
1990	2,109	1,345	764	△17,909
1995	1,985	1,206	779	△47,449
2000	1,889	1,149	740	△10,160
2001	1,876	1,146	730	△12,623
2002	1,863	1,138	724	△13,520
2003	1,846	1,127	719	△16,628
2004	1,836	1,115	721	△10,360
2005	1,824	1,105	719	△11,595
2006	1,800	1,084	716	△23,569
2007	1,782	1,070	712	△18,891

1.3 Change of biodiversity

Ruderal vegetation of the agricultural ecosystems consists of 527 species, with their biotopes constituting 8 classes, 8 orders, 8 alliances, 7 associations, 2 sub-associations, and 32 communities, for a total of 41 biotopes. The freshwater invertebrate fauna that have appeared in the rice field ecosystems are 5 divisions, 7 classes, and 222 species.

The progress of climate change in Korea is faster than the global average, which has led to a rapid reduction in national biodiversity. Climate change has emerged as a factor threatening the forests, as it increases the risk of natural disasters such as wildfire or heavy rains that disturbs ecosystems. Also, there is a recognizable threat of genetic vulnerability due to the development and adoption of new varieties with pest and disease resistance. Many agricultural institutes have been researching on varieties for improvement of production and food security. Farmers are now hesitant to cultivate landraces because the productivity is comparatively low than using new breeds.

The Republic of Korea used the changed numbers of crop landraces cultivated farm as a indicators of genetic erosion by time sequence at the same farms(Table 1.4).

Table 1.4. Decreasing ratio of crop landraces cultivated farms in the Republic of Korea

Crops	Mountain area			Urban area			Plain area			
	1885	1993	Ratio (%)	1885	1993	Ratio (%)	1885	1993	Ratio (%)	Average (%)
Soybean	23	5	23	11	3	27	48	9	19	21
Adzuki bean	8	4	50	5	2	40	22	9	41	43
Mung bean	3	0	0	2	0	0	4	2	50	22
Kidney bean	3	0	0	6	2	33	4	2	50	31
Cowpea				2	0	0	6	1	17	13
Maize	9	2	22	4	2	50	6	2	33	32
Sorghum	1	0	0	3	0	0	3	1	33	14
Millet				3	0	0				0
Italian millet	2	0	0	4	2	50				33
Perilla	6	3	50	1	1	100	5	2	40	50
Sesame							3	1	33	33
Red pepper				2	0	0	6	0	0	0
Pumpkin							4	1	25	25
Buck wheat	1	0	0				3	1	33	25
Others	1			8	0	0				0
Total	57	14	25	51	12	24	114	31	27	26

A total of 221 species in Korea are rated and controlled as Critically Endangered (CE) and Endangered (EN) under the Protection of Wild Fauna and Flora Act, Ministry of Environment(Table 1.5). The species can be divided into 156 animal species (71%) and 65 plant species (29%). The animal group includes 22 mammal species, 61 bird species, 6 reptile and amphibian species, 18 fish species, 20 insect species, 29 invertebrate species, 64 terrestrial plant species, and 1 aquatic plant species.

The Korea National Arboretum of KFS assessed and classified the rare plant species on the Korean peninsula in 2008(Table 1.6). The result shows that there are 389 species falling in the conservation category of IUCN including 4 EWs (Extinct in the wild), 144 CRs (Critically endangered), 122 ENs (Endangered), and 119 VUs (Vulnerable).

Table 1.5. Changes of designation of protected species

Dates	Designation status of endangered species
'89. 3. 10	92 wild animal and plant species designated
'93. 1. 18	179 wild animal and plant species designated
'98. 2. 19	194 wild animal and plant species designated as threatened and protected
'05. 2. 10	221 wild animal and plant species designated as threatened (Critically Endangered (CE) or Endangered (EN))

※ Source : Ministry of Environment

Table 1.6. Classification of rare plant species in Korea

Class	Pteridophyta	Gymnosperm	Angiosperms		Total
			Dicotyledoneae	Monocotyledoneae	
Extinct in wild	2		1	1	4
Critically endangered	20	2	80	42	144
Endangered	15	1	82	24	122
Vulnerable	16	4	79	20	119
Subtotal	53	7	242	87	389
Others	Least concerned 70, Data deficient 112				182
Total					571

※ Source : Korea Red Data Book (2008, Korea National Arboretum)

1.4 Current issues and future plan

The biotechnological and molecular biological researches on these resources are needed for the conservation and evaluation of biodiversity of plant genetic resources. It is necessary to understand deeply genetic erosion and to strengthen the evaluation capacity for monitoring and response. The national-level comprehensive research system and informatization are needed. Infrastructure and PR on the biodiversity are also required.

The 1st National Biodiversity Strategy(NBS) was determined in 1997 following the deliberation of a national cabinet meeting, and its English edition was submitted to the 4th COP in 1998. In October 2008, the country established a National Working Group to formulate the 2nd NBS and produce a national report. The Working Group launched the 2nd

NBS, and held a workshop in December to prepare national strategies. On May 2009, the 2nd NBS was formulated and determined.

Table 1.7. National Strategies on major areas of the Convention on Biological Diversity (CBD)

CBD Focal Areas	National Strategies (2009-2013)
Protect the components of biodiversity	1. Effective conservation of major ecosystems and habitats (1) Protect the biodiversity of major ecosystems and habitats Forest / freshwater/ coast and marine/ islands/urban ecosystems (2) Expand and conserve protected areas
	2. Conserve species diversity (1) Pursue strategy for global plant conservation (2) Research the status of threatened species and restoration
	3. Conserve genetic diversity
Promote sustainable use	4. Promote sustainable use and consumption (1) Apply ecosystem approach (2) Implement CITES
Address threats to biodiversity	5. Research and manage invasive alien species
	6. Manage Living Modified Organisms (LMO)
	7. Establish countermeasures to climate change
Maintain biodiversity for human well-being	8. Maintain capacity of the ecosystem to deliver goods and services (1) Eco Tourism (2) Use of positive incentives
Protect traditional knowledge, innovations, and practices	9. Protect traditional knowledge, innovations and practices (1) Protect traditional knowledge (2) Maintain socio-cultural diversity of indigenous and local communities
Ensure the fair and equitable sharing of benefits arising from the use of genetic resources	10. Ensure access to genetic resources and benefit sharing
Ensure provision of financial, human, and technological capacity	11. Transfer technology and provide adequate resources (1) Technology transfer (2) Financial resources and system
	12. Facilitate international collaboration and involvement of stakeholders
	13. Perform communication, education and public awareness (1) Communication and publicity work (2) Education (3) Information Sharing System
Monitoring and Assessment	14. Perform monitoring and Assessment (1) Monitoring and Research (2) Global Taxonomy Initiative

CHAPTER 2 The State of *In situ* Management

2.1 *In situ* conservation of wild plant genetic resources

Korea has 205 family, 1,145 genus and 4,884 species of native plants. *In situ* conservation is under the responsibility of the Ministry of Environment and Korea Forestry Service (KFS) and the *in situ* conservation of agricultural genetic resource is still in the preparation phase. The Ministry of Environment has set the conservation area for the plants on the verge of extinction and monitors the changes. KFS manages the trees and designated the large natural forests of diverse or unique genetic resources that are worthy of conservation, as the protected forest for the *in situ* conservation. The Protected Areas for Forest Genetic Resources Conservation, designated by the KFS, have been on the steady rise to 251 areas (90,254 ha) in 2007. The KFS has broken down the purpose of Protected Areas to preserve the diversity of ecosystem for the sustainable forest management as well as to conserve the genetic resource and the habitat of rare plant species. Specifically, it has designated the large natural forests of high conservation value as *'In situ* Protected Forest for Genetic Resources Conservation'. As of 2007, 14 tree species of 39 groups in 2,683 ha were designated.

Table 2.1. *In situ* conservation of forestry resources (2006)

Classification	Tree species	Group	Area(ha)
Total	14 species	39	2,683
Needle-leaf tree	*Pinus densiflora* Siebold & Zucc.	5	2,015
	Pinus koraiensis Siebold & Zucc.	2	33
	Abies holophylla Maxim.	1	30
	Pinus thunbergii Parl.	1	14
	Abies koreana Wilson	2	32
	Pinus pumila (Pall.) Regel	1	2
	Picea abies (L.) H.Karst.	3	9
	Taxus cuspidata Siebold & Zucc.	4	110
	Abies nephrolepis (Trautv.) Maxim.	2	28
Broad-leaved tree	*Quercus mongolica* Fisch. ex Ledeb.	9	354
	Quercus variabilis Blume	4	31
	Cornus controversa Hemsl. ex Prain	2	16
	Populus maximowiczii A.Henry	1	5
	Stewartia koreana	2	4

Ex situ conservation has been more common than *in situ* conservation for the agricultural genetic resources. Hence, there have been limited *in situ* conservation activities for wild crop or wild relatives which are classified as agricultural plant genetic resources. This was due to the lack of understanding for the importance of *in situ* conservation of agricultural genetic resources. Currently, however, the efforts to develop the conservation system suitable to the Korean situation have been made, as the *in situ* conservation for agricultural genetic resources becomes more important than ever. As a result of current research on the wild crops and its relatives, it was found that there were about 220 species of crop wild relatives excluding wild vegetables and ornamental plants, and the number would increase up to 400 species if the scope of crops is expanded.

For more systematic *in situ* conservation, it was envisioned to make a detailed conservation list and to conduct research on the geographical distribution and ecosystem. The resource recovery technology will be developed for conserving biodiversity, and conservation area will be designated for monitoring the changes in ecosystem. It was also planned to make research guideline and to build national and international network for the *In situ* conservation of agricultural biological resource.

2.2 On-farm management and improvement of plant genetic resources for food and agriculture

Only some interested farmers have been conserving the landraces by themselves. For the crop landraces, *ex situ* conservation has been done mainly at the government-level. Table 2.2 shows the magnitude of landraces conserved by the government in 2007.

Table 2.2. Crop land races conserved by government (2007)

Crops	Total conserved resources (accessions)	Domestic landraces (accessions)	Landraces ratio(%)
Food crop	117,275	23,257	20.0
Horticulture	14,984	2,380	16.0
Special use	18,617	5,231	28.0
Others	3,819	361	9.0
Total	154,695	31,229	20.0

However, dissemination of new and improved varieties has led the decrease of farmers raising the crop landraces, and some are already lost or on the risk of being lost. Because the natural evolution and differentiation of species was stopped under the *ex situ* conservation, the necessity of on-farm conservation is ever growing. The NAC has conducted surveys on the on-farm conservation of landraces since 2005 and Table 2.3 shows the results of the surveys.

Table 2.3. On farm activities in Korea (2005~2007)

Year	Stakeholders	Projects
2005	-Shinlim Agricultural Cooperatives	·Effect of *in situ* conservation of native cereal in demonstration fields ·Establishment of supply base & practice field of native cereals ·Constant PR and development on conservation and usability of cereals
2006	-Group: Shinlim Agricultural Cooperatives -Local government: Youngju City Agricultural Technology Center -Incorporation: Seung-Dang Processing & Farming Union -Individual: Jung-sun Sunrising Farm	·Connecting conservation and marketing of native species
2007	-Group: Shinlim Agricultural Cooperatives (Native cereal) -Local government: Youngju City Agricultural Technology Center (Native soybean) -Incorporation: Seung-Dang Processing & Farming Union (Native cereal) -Individual: Jung-sun County Sunrising Farm (Native soybean) -Gyeongbuk Seed Production Center (Native crops) -Gyeongnam Agricultural Resources Center (Native crops)	·Awareness on the importance of constant native species conservation ·Connecting seed production & distribution with processing/sale ·Development of 'Buseok-kong' a native soybean and local cereal varieties ·Production and sale of 'Jinunee-kong (*Rhynchosia volubilis*)' ·Demonstration field for native crop and seed bank establishment

So far, the policy and financial support for the on-farm conservation has not been sufficient due to lack of awareness on the importance of land races. In the future, efforts will be made to survey on the current state of on-farm conservation and to provide financial support to the farmers holding landraces of high conservation value. Together with the on-farm conservation, the *ex situ* conservation will be continued to provide for the loss by disaster.

CHAPTER 3 The State of *Ex situ* Management

3.1 *Ex situ* Management of Plant Genetic Resources

The *ex situ* conservation of seed and plant genetic resources for food and agriculture in Korea is carried out by the National Agrobiodiversity Center (NAC), Rural Development Administration (RDA). The Korean National Genebank changes its name to the National Agrobiodiversity Center (NAC) in November, 2006 after the completion of the new genebank facilities with a holding capacity of around 500,000 accessions for both medium and long term storage. The NAC is mandated to plan and implement national projects on collection, introduction, identification, documentation, multiplication, regeneration, characterization, evaluation, conservation, exchange, distribution, and infrastructure construction of plant genetic resources in the whole country. NAC has the 'Integrated Plant Genetic Resources Management System (IPGRMS)'. The system includes 31 provincial and regional plant genetic resources centers.

The IPGRMS includes Academies/Institutes of Agricultural Sciences at provincial and regional levels and agricultural universities concerned. They mainly participate in certain specific activities of collection, regeneration, evaluation and conservation on plant genetic resources for food and agriculture. The total of plant genetic resources for food and agriculture in Korea is about 230,661 accessions (Table 3.1). They are conserved by the IPGRMS.

Table 3.1. Status of *Ex situ* Conservation of Plant Genetic Resources for food and agriculture in Korea

Integrated Plant Genetic Resources Management System	No. of accessions		
	Seed	Clone	Total
National Agrobiodiversity Center	156,282	990	157,272
Provincial and regional PGR Center	46,241	27,148	73,389
Total	202,523	28,138	230,661

Regarding the *ex situ* conservation of forestry genetic resources, three organizations, Korea Forest Seed & Variety Center, Korea Forest Research Institute, and Korea National Arboretum under Korea Forest Service, are primarily responsible. The *ex situ* conservation of forestry can be divided into two categories; 1) *ex situ* gene conservation forest area such as clone conservation forest or cultivar conservation forest, and 2) seed bank which preserve seed and culture collection by low temperature/mid-term storage. Korea Forest Seed & Variety Center manages the *ex situ* conservation of genetic resources for seed orchard and newly registered varieties by the Seed Industry Act. Korea Forest Research Institute manages the conservation of native species, endemic species, and rare & endangered species growing in natural forest in Korea. Forest Environment Research Institutes and public & private arboretums in each city and province perform as a local genetic resource management agencies.

3.2 The State of Collection

The NAC preserves 156,282 accessions of seed germplasm belonging to nearly 1,777 species at seedbank (Table 3.2) and 990 accessions of clonal germplams at cryobank. Of the total 156,282 accessions of seed germplasm, 31,229 are domestic landraces and the others include introduced varieties and inbred lines. Like other Asian countries, rice germplasm is the major collections in Korea with almost 27,976 accessions.

The KFS's *ex situ* conservation of tree genetic resources includes Seed Orchard, Clone Conservation Forest, Cultivar Conservation Forest, Experiment forest and Genetic resources conservation forest, covering 731 tree species planted in 319.2 hectares.

Table 3.2. Seed germplasm accessions conserved in the National Agrobiodiversity Center of RDA (as of December 31, 2008)

Crops	No. of species	No. of accessions	No. of domestic landrace accessions
Cereal crops	414	118,405	23,257 (19.6%)
Vegetables & fruit trees	462	15,523	2,380 (15.3%)
Industrial & medicinal plants	258	18,533	5,231 (28.2%)
Forage crops & others	643	3,821	361 (9.5%)
Total	1,777	156,282	31,229 (20%)

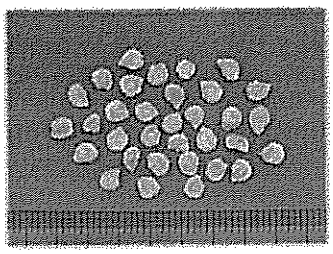
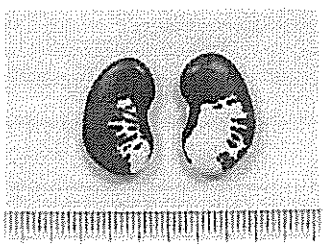
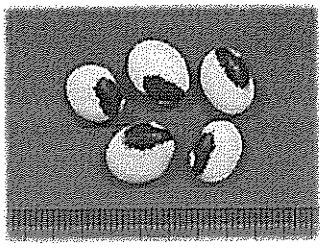
Table 3.3. Germplasm accessions conserved in provincial and regional plant genetic resources centers (as of December 31, 2008)

Integrated Plant Genetic Resources Management System	No. of accession		
	Seed	Clone	Total
Cereal crops	33,839	1,905	35,744
Vegetables & fruit trees	10,059	15,490	25,549
Industrial & medicinal plants	2,343	8,085	10,428
Forage crops & others		1,668	1,668
Total	46,241	27,148	73,389

The forest genetic resources under management of three agencies under KFS are as follow; 1) 1,678 species of plant (21,833 samples) and 127 species of fungus (960 samples) in seed bank for mid and short-term conservation, 2) 747 ha of *ex situ* conservation forest such as seed orchard or clone bank after asexual reproduction of vegetative individuals from 85 forest plant species, 3) 104 ha of arboretums preserving 3,344 species of forest genetic resources (Table 3.4).

Table 3.4. *Ex situ* conservation of tree genetic resources (2008)

Classification	No. of accessions	Area	Agency
Seed Orchard	58	702ha	Korea Forest Seed & Variety Center
Selection Clone Bank	13 species 3,050 clones	28ha (12,133 trees)	Korea Forest Seed & Variety Center
Cultivar(Clone) Conservation Garden	27 species 1,805 varieties	17ha	Korea Forest Research Institute
Arboretum	3,344 species	102ha	Korea National Arboretum
Useful plant ex situ conservation forest	1,350 species	2ha	Korea National Arboretum

3.3 Collecting

For the last five years, the collection of domestic genetic resources has been concentrated on crops whose improved varieties have not been actively developed, especially local landraces, wild soybean and vigna species, of which second place of origin is assumed to be Korea, and native cabbages in the wild. A total of 5,573 cultivated plants and wild relatives have been collected (Table 3.5).

Table 3.5. Overview of collection activities of NAC between 2004 - 2008

Year	No. of accessions		
	Cultivated crops	Crop wild relatives	Total
2004	136	931	1,067
2005	240	1,257	1,497
2006	1,292	666	1,958
2007	40	251	291
2008	658	102	760
Total	2,366	3,207	5,573

3.4 Types of collections

The NAC of RDA has 156,282 accessions of agricultural genetic resources including 50,203 Korean-origin (32%) and 106,079 foreign-introduced (68%) resources. As shown in Table 3.5. the rice and soybean had 27,976 and 18,793 accessions, respectively, taking the largest number of collections. The Table 3.6 shows the status of seed germplasm accessions at NAC. The unidentified resources will be clearly classified through the constant information collection. The vegetatively propagated crops are packing-preserved in the responsible organization, under the national management system for genetic resources. The NAC has cryopreserved the 990 accessions of vegetatively propagated crops including garlic and potato in the liquid nitrogen.

Table 3.6. Composition of seed collections at NAC according to major crops (as of December 31, 2008)

Crops	No. of accessions	Crops	No. of accessions	Crops	No. of accessions
Rice	27,976	Peanut	2,618	Tomato	1,181
Soybean	18,793	Rape	2,313	Onion	936
Barley	18,203	Pepper	2,180	Pumpkin	936
Wheat	16,574	Mung-bean	1,615	Cowpea	784
Oat	9,315	Melon	1,489	Proso millet	765
Sesame	8,094	Perilla	1,413	Italian millet	695
Maize	7,187	Rye	1,372	Watermelon	682
Adzuki-bean	3,205	Radish	1,278	Pea	678
Bean	2,872	Triticale	1,273	Cucumber	656
Sorghum	2,691	Chinese cabbage	1,251	Sunflower	622
				Others	16,545
				Total	156,282

Table 3.7. Status of seed germplasm accessions at NAC

Classification	No. of accessions
Landrace	35,214
Wild relative	2,806
Weedy	2,032
Breeders' line	10,255
Genetic stock	215
Advanced cultivar	2,640
Unidentified	103,120
Total	156,282

Table 3.8. Composition of clone collections under the Integrated Plant Genetic Resources Management System (as of December 31, 2008)

Crops	No. of accessions	Crops	No. of accessions
Fruit and nut	8,417	Fiber plant	151
Ornamental plant	3,682	Tuber	1,905
Vegetable	3,391	Forage	1,033
Medicinal plant	7,934	Others	635
Total			27,148

3.5 Storage facilities

The NAC of RDA has three types of storage facilities - seed genebank, cryogenebank and DNA bank (Table 3.9). The seed genebank was first established in 1980 and expanded in 1988. In 2006, the third seed genebank was established and presently has two long-term storages that are kept at 18°C. Also, there are three medium term storages maintained at 4°C. In addition to seed conservation, other *ex situ* conservation methods, such as cryopreservation has been employed to conserve species, predominantly having non-orthodox seeds and vegetatively propagated species. The cryobank comprises six extra-large capacity (756 liter) cryo-tanks that store samples in the vapour phase or in liquid nitrogen (-160 to -196°C).

There are two Seed Banks for forest genetic resources in KFS preserving 21,833 seed lots collected from 1,678 species of forest plant. They are consist of mid/short-term conservation (-18°C) and short-term conservation (4°C) storage. However there is no cryobank facility so that forest genetic resources which are under short/mid-term conservation are replaced by newly collected seed genetic resources through vitality test every 5 years.

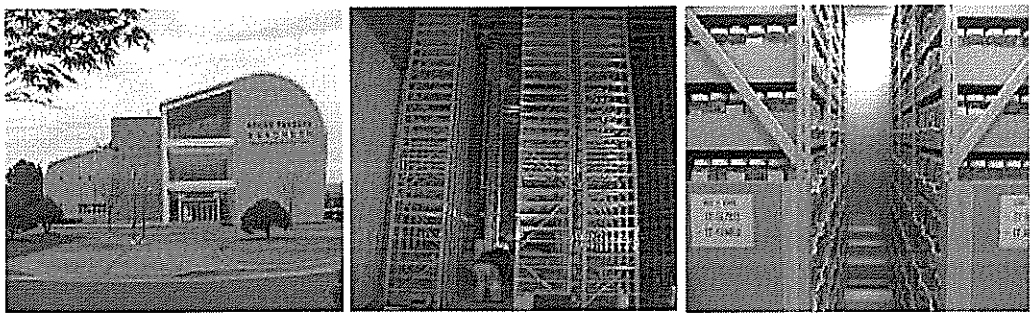


Figure 3.1. National Agrobiodiversity Center of RDA

Table 3.9. Storage facilities of the National Agrobiodiversity Center of RDA

Room designation	Capabilities	Area (m^2)	Temperature (°C)	Humidity (%RH)
Storage Facilities				
Long-term	500,000 samples	264	-18±1	40
Mid-term	500,000 samples	795	4±1	30
Cryogenebank	300,000 samples		-196	
DNA bank	60,000 samples		-70	
Seed Drying Room	3~6% seed moisture content	54	15±3	10±5
Packing Room	Reducing infiltration of moisture	98	20±3	30±5
Laboratories & Others	Monitoring seed viability, machinery & database, management	8,296	Air-conditioned	Ambient conditions

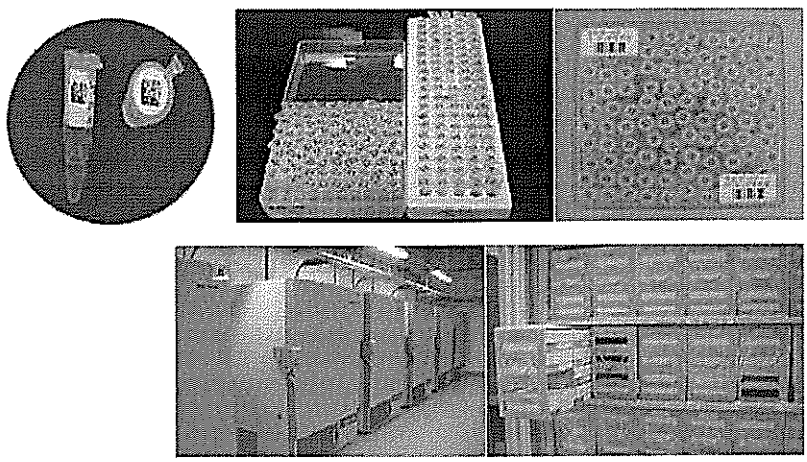


Figure 3.2. DNA bank for major plant genetic resources

3.6 Security of stored material

The NAC is conducting vitality monitoring periodically for the safe and permanent conservation of genetic resources in mid- and long-term storage. The changes in the amount of seeds due to the entry or delivery are immediately checked and the score results are computerized into the Agricultural PGR Management System on a real-time basis. Based on the monitoring result and the score, the resources are updated in order to conserve the genetic resources of high vitality.

To provide for the loss caused by disaster, the NAC operates a seed vault for the safety back-up of genetic resource in the southeastern part of Korea. Currently, 13% of resources at the NAC are conserved as safety back-up. NAC also sent the 13,185 accessions of resources from 30 Korea-origin crops such as barley, sesame and soybean to the Global Seed Vault in Svalbard, Norway for the safety back conservation. The NAC established the World Seed Vault for the conservation of genetic resource from local and international origin, pursuant to the MOU signed between RDA and FAO/GCDT on August 14, 2008.

For the safe conservation and management of forest genetic resources, KFS established the plan to get synergy effect after consideration of each characteristic of three agencies, National Arboretum, National Forest Research Institute and Korea Forest Seed & Variety Center. The first step of conservation is research and investigation on the distribution, natural habitat and environment of domestic forest genetic resources before collection of wild species, and it is done by National Arboretum. At this stage, the samples for the specimens and seed /vegetative individual of rare & endangered species are obtained and preserved in the seed bank or *ex situ* conservation forest. In the second step, National Forest Research Institute investigates the genetic and ecological diversity and designates it as *in situ* conservation area under the management of regional forest services. They also manages *ex situ* conservation of superior individuals for the development of good varieties.
In the third step for multiplication and stable conservation, Korea Forest Seed & Variety Center develops and manages the *ex situ* conservation areas for the collected genetic resources. They are also planned to establish the low temperature gene bank for the long-term conservation of forest genetic resources.

3.7 Documentation and characterization

With the Agricultural Plant Genetic Resources Information Management System jointly developed by NAC and a Korean IT company, the NAC has computerized all the data from the process from acquisition of new genetic resources, passport data, seed quantity, viability-test, multiplication, characterization, storage, distribution, and monitoring. The characterization and preliminary evaluation are conducted when multiplication or renewal happens at the early stage. The characterization is conducted by the organizations and universities belonging to the IPGRMS as well as the NAC. For more precise characterization, the evaluation on disease tolerance and resistance to disasters comes first after securing the sufficient amount of seed through multiplication. Recently, the NAC is trying to analyze the material to extract new material from the resource.

For the last five years, the average input of resource management data is as follows.

- Passport data : 9,500
- Initial introduction/multiplication, seed amount check: 50,000 accessions
- Vitality test: 25,000 accessions
- Characterization : 5,000 accessions

3.8 Distribution

The NAC has distributed its genetic resources to breeding institutes, universities, schools and breeder, upon request, for research and educational purposes. About 77% of the resources distributed for the last 10 years were sent to the research institutes, 16% to the agricultural colleges, 3% to seeds companies and breeder, and 4% to the others.

3.9 Botanical gardens

The 44 arboretum & botanic gardens have been formed or under formation as of 2008 for the *ex-situ* conservation of plant genetic resources. According to the second Framework Plan on Arboretum Development and Promotion, they are 1 national, 24 public, 12 private, and 6 school arboretums.

CHAPTER 4 The State of Use

4.1 Use of Plant Genetic Resources for Food and Agriculture

Plant Genetic Resources for Food and Agriculture (PGRFA) are vital to the development and welfare of human society. They contribute enormously towards achieving the global objectives of food security and poverty alleviation, environment protection, and sustainable development. Characterization and evaluation of germplasm is required to know its worth or usefulness. Likewise, the availability of information on characterization and evaluation of conserved genetic resources is the key to utilization.

Plant breeding provides many examples on the use of genetic resources for the improvement of the varieties of crop plants. These ranged from highly specific improvement to one major factor such as susceptibility to a pest or disease to all round improvement in yield, agronomical traits, disease resistance and to changes in the form and structure of the plant type.

The agricultural genetic resources of Korea have been usually used for the development of new varieties. Recently, the area of utilization is expected to expand to the fermented food and environment-friendly materials. As a result of new variety development, 2,512 agricultural varieties, 36 forest varieties and 80 marine varieties have been developed. The microorganism industry of Korea is expected to grow from 385 billion Won in 2006 to 6,800 billion Won in 2016. Aside from the production of direct economic value, the resources will be used for society and ecosystem such as for the education, prevention of animal disease, forestation, and fish stocking.

Plant genetic resources under the custody of NAC were distributed to research institutes, universities, seed companies, and overseas organization for basic research, characterization/ evaluation, regeneration, and exchanges.

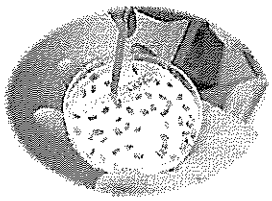


Table 4.1. Number of samples of PGR distributed over the last 10 years

Year	No. of accessions
1998	4,376
1999	7,835
2000	2,694
2001	1,875
2002	1,401
2003	2,481
2004	7,254
2005	2,598
2006	3,079
2007	3,673
2008	5,136
Total	42,402

4.2 Factors Affecting the Use of Plant Genetic Resources

There are five factors limiting the use of genetic resources. First, the lack of native resource and insufficient diversity of conserved genetic resources. The horticultural crops are not so diversed. The agriculture PGR has been concentrated on food crops (65%). The genetic resource of native species accounts for only 20%.

Second, the amount of conserved resources and their vitality are low, causing the difficulties in seed distribution. The 37% of the resources or 57,000 accessions require the multiplication for the distribution, as the amount of conserved resources are not enough or the sprouting ratio is too low. Considering the newly collected resources, the accumulated amount requiring multiplication reaches to 100,000 accessions. However, as the actual amount of annual multiplication is only around 7,000 accessions, requiring more investment.

Third, the characterization is insufficient. The characterization on basic characters remains at 76% and the evaluation on genetic trait is only 27%. The characterization and the database are urgently needed to help users easily search and use the resources.

Fourth, the informatization level on the conserved genetic resources is low, and the information search system is inadequate, resulting in the low utilization of the resource. Fifth, the stable budget is needed for the conservation and management of resources.

Table 4.2. The percentages of evaluated accessions

	2007	2008	2009
Primary evaluation	74%	75%	76%
Secondary evaluation	15%	21%	27%

* Primary evaluation : leaf, stem, root, flower and so on

* Secondary evaluation : anti-abiotic, functional, microbiological test, disease and pest susceptibility, molecular and so on

Table 4.3. The number of germplasms required regeneration according to small seed amount or low germination rate.

Classification	Conserved germplasm		
	No. of small seed amount acc.	No. of low germination rate acc.	Total
Food crop	9,310	33,705	43,015
Rice	296	6,009	6,305
Barely	3,363	15,189	18,552
Legume	4,307	9,743	14,050
Cereal	1,344	2,661	4,005
Industrial Crop	2,653	3,931	6,584
Fiber	259	516	775
Medicinal	242	595	837
Oil	2,091	2,562	4,653
Aromatic	22	148	170
etc.	39	110	149
Horticultural Crop	2,794	4,820	7,614
Fruit Vegetables	1,941	2,717	4,658
Leaf Vegetables	353	923	1,276
Root Vegetables	311	251	562
Scale	184	576	760
Fruits		114	114
Flowers	5	239	244
Forages and etc.	39	2,253	2,292
Forages	22	1,583	1,605
Native Plants	16	266	282
etc.	1	404	405
Total	14,796	44,606	59,402

* standard of regeneration needed

: seed amounts are below 400 grains or seed germination rate is below 60%.

CHAPTER 5 The State of National Programmes, Training Need and Legislation

5.1 National management of plant genetic resources

5.1.1 Mission of organizations

The National Management Programme for agricultural genetic resources carried out by MIFAFF, responsible and management organizations of agricultural genetic resources.

The MIFAFF (RDA and KFS) establishes 5-Year Basic Plan for the agricultural genetic resources and the Annual Implementation Plan. It also appoints and operates the responsible organizations, authorizes the genetic resource transfer, surveys and collects the resources, makes the resource list, registers the conserved resources, and supervises the overseas transfer.

The responsible organization appoints and operates the management organization. It researches and collects the agricultural genetic resources, and establishes as well as implements the management plan. Its work also covers collection, classification, characterization, evaluation, conservation, distribution, technological R&D, coordination and supervision over management organization, and information management.

The management organization collects, short-term conserves, characterizes, and multiplies the genetic resources. It also manages the works such as research on securing and utilizing biodiversity, and resource informatization.

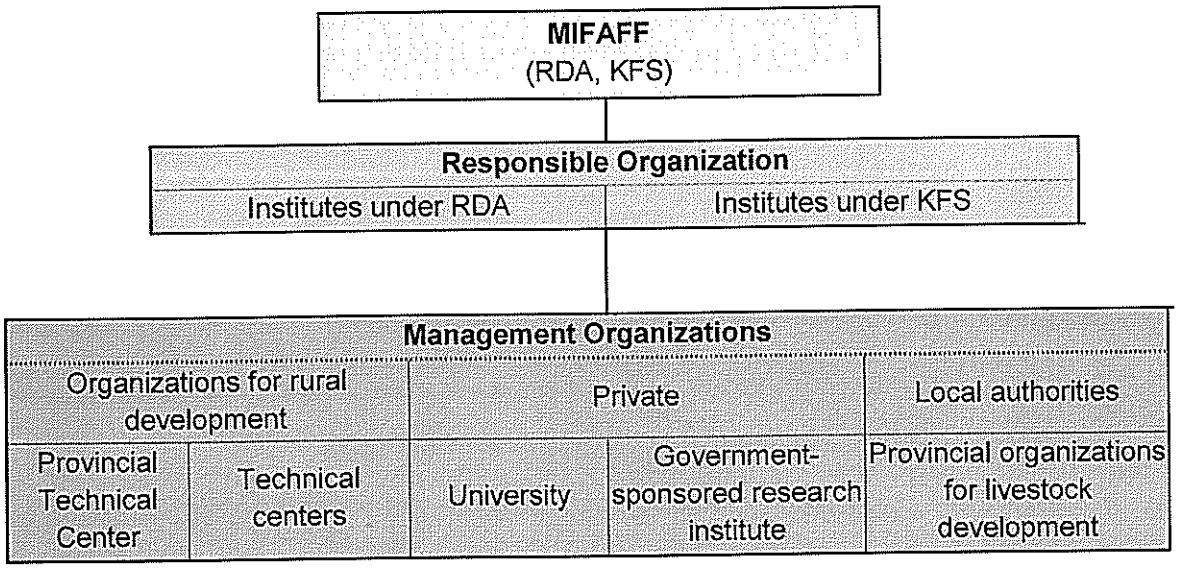


Figure 5.1. National Program System for Agricultural Genetic Resources

For the National Program, Science & Technology Policy Division of MIFAFF is in charge. The Agro-materials Management Division of RDA is responsible for the agricultural genetic resources and Forest Resource Division of KFS manages the forest resources of agricultural genetic resources. (According to the Korean National Law, the forest resources are classified as the agricultural genetic resources.)

Currently, RDA designates its four institutes as the management organizations, and KFS also appoints its three institutions.

Table 5.1. Management Organizations

MIFAFF	
RDA (4)	**KFS** (3)
National Academy of Agricultural Science	Korea Forest Research Institute
National Institute of Crop Science	Korea National Arboretum
National Institute of Animal Science	Korea Forest Seed & Variety Center
National Institute of Horticulture & Herbal Science	

There are 92 management organizations designated by the responsible organizations including 69 plant genetic resource management organizations, 12 micro-

organism management organizations and 11 livestock genetic resource management organizations. Only RDA can designate and operate the management organizations for agricultural genetic resources. Total genetic resources of these management organizations are 71,000 accessions. (Plant : 56,000, Microorganism : 9,000, Livestock : 6,000)

5.1.2 Basic and Implementation Plan

○ Basic Plan on Conservation and Management of Agricultural Genetic Resources

- The Minister of Food, Agriculture, Forestry & Fishery establishes the Basic Plan on the Conservation, Management and Utilization of Agricultural Genetic Resources at every 5 year. The Basic Plan includes the matters as follows:

· Collection, evaluation and registration of agricultural genetic resources

· Efficient conservation and management of agricultural genetic resources

· Distribution and utilization

· Biodiversity Increase

○ Implementation Plan

- According to the Basic Plan, the RDA and KFS establish the Implementation Plan every year, which includes detailed plan on collection, conservation, management, evaluation and utilization of the genetic resources.

5.2 Training on Genetic Resource Management

○ The MIFAFF (RDA, KFS) has trained the experts on the conservation, management and utilization of agricultural genetic resources. The details are as follows.

- Training Organization : Animal Genetic Resource Station (RDA), Korea Forest Seed & Variety Center (KFS), Korea National Arboretum (KFS), Korea National Forest Research Institute (KFS)
- Training Contents : Collection, Conservation, Management and Utilization of Agricultural Genetic Resources, Characterization and Evaluation Technology

○ The NAC of RDA signed the MOU with Bioversity International to establish 「Plant Genetic Resources Management Program」 on March 27, 2009. The education for the experts from 11 Asian countries will be provided at the NAC. The participating countries are Malaysia, Cambodia, Thailand, Indonesia, Vietnam, Laos, Myanmar, Philippine, Fiji, Mongolia, and Uzbekistan. The training program consists of the theory part (Agro-biodiversity, International conventions on genetic resources, Intellectual property,

Conservation technologies, Multiplication Renewal, Information management, Molecular marking, etc.) and practicum (Selection, Drying, Purity test, Vitality test, Information search, etc.).

The RDA wishes to contribute to the global society and to strengthen the international cooperation through the training program. It will further increase the investment in building the infrastructure and facilities for the training.)

5.3 National Law

5.3.1. Law on Conservation, Management and Use of Agricultural Genetic Resources

- The law was established to preserve the agricultural biodiversity and strengthen the agricultural biotechnology through the safe conservation and sustainable use of agricultural genetic resources.
- It was enacted in July 2007 and was enforced in 4th August 2008.
- It consist of General Provisions (Article 1), Conservation, Management and Use of Agricultural Genetic Resources (Article 2), Operation of committee, Appointment of management and responsible organizations (Article 3), etc.
- The MIFAFF has put forward the amendment of the Law on Conservation, Management and Use of Agricultural Genetic Resources as Korea became the member of FAO ITPGRFA.

  - New provision, 'The central government and the local authorities should endeavor after Access and Benefit Sharing(ABS) of agricultural/fishery genetic resources to harmonize with the international law for biodiversity conservation and sustainable use of agricultural and fishery genetic resources', will be established.
  - It will be established to follow the international convention or treaty in the distribution of agricultural/fishery genetic resources which are stated in the international convention or treaty.

5.3.2 Plant Quarantine Act

- The Act stipulates the matters regarding the quarantine on imported/exported and domestic plants and disease prevention for plant and animal.

- It was enacted on 30 December, 1961 and consists of General Rules (Article 1), Quarantine on Imported/exported Plants (Article 2) and Quarantine on Domestic Plant and Disease Prevention (Article 3 & 4).

5.3.3 Seed Industry Act

- The Act stipulates the right protection of breeder, the quality control over major crops, the production, certification and circulation of seeds.
- It was enacted on 16 December, 1995 and consists of 176 articles and supplementary rules. The General Rules (Article 1) defines the terminologies including the seed industry, crop, breeder, protected variety, seed manager. seed business and agricultural genetic resources. The Article 2 mentions on the right protection of breeder.

5.3.4 Wild Animal & Plant Protection Act

- The Act was established to protect wild animal and plant protection and their habitats to prevent their extinction and keep the balance of ecosystem.
- In 9 February, 2004, the separately enacted acts-Natural Environment Protection Act, Wildlife Protection Law and Game Law- were combined into this Act.
- It contains General Rules, Wild Animal & Plant Protection, Biological Resources Conservation. It classifies wild animals and plants into first class and second class depending on the degree of their extinction risk.
- It stipulates that the Ministry of Environment establishes the Basic Plan on the Wild Animal and Plant Protection at every five years, and the mayors of Province and City make the Implementation Plan.

CHAPTER 6 The State of Regional and International Collaboration

6.1 Regional Collaboration

Recognizing the infinite value of genetic resources as the common assets of mankind, Korea has collaborated with different countries in the Eastern Europe, Central Asia, China and the Southeast Asia, through the cooperation projects such as joint research, and collection, and exchange of genetic resource.

The first collaboration in the genetic resource was made between RDA and Russia for the collection and exchange of the agricultural genetic resource and experts. Since the RDA signed the MOU on Technical Cooperation with Vavilov Research Institute of Plant Industry of Russia in 1993, the exploration and collection of agricultural genetic resource has earnestly progressed. The MOU signed between RDA and Uzbek Research Institute of Plant Industry (UzRIPI) has facilitated the research collaboration in discovery, multiplication, and characterization of genetic resource. The NAC of RDA has also worked with Yunnan Province and Genetic Resource Research Institute of Bulgaria through the joint researches.

RDA also concluded the bilateral agreement with Agricultural Research Service of the U.S.A and National Institute of Agrobiological Sciences of Japan. In 2007, under the agreement between RDA and ARS, 1,600 accessions of Korean-origin genetic resources of 34 crops, which had been sent to the America in the early 1900s, were returned to RDA, and in 2008, the Japan Seed Bank restored the 1,500 accessions of 32 crops including barley and cabbage to Korea, recording as exemplary case of genetic resource restoration through the bilateral cooperation.

6.2 International Collaboration

In Korea, the Ministry of Environment is responsible of meeting the three goals of Convention on Biological Diversity (CBD), and the MIFAFF and RDA manage the agricultural genetic resource, mainly seed management, and ITPGRFA-related tasks.

Since Korea joined in CBD in October 1994, it has strived to implement the three goals of the convention: 1) to conserve biological diversity, 2) to use biological diversity in a sustainable fashion, and 3) to share the benefits of biological diversity fairly and equitably. Specifically, Korean has been actively participating in the international negotiation regime to efficiently implement 'Access to genetic resources and Benefit Sharing (ABS)'.

With regards to the ITPGRFA of FAO, which was effective in 2004, Korea has made national-level endeavor to implement the treaty, aiming at the sustainable conservation and utilization of agricultural genetic resource as well as the fair share of benefit. In particular, *ex-situ* conservation, one of the core agenda of Global Plan of Action recommended by FAO IT (International Treaty), has been the area where Korea has concentrated its efforts.

As a part of these efforts, Korea, established a fully-automated seed bank with a holding capacity of 500,000 accessions for short- and mid-term conservation in November, 2006. Also RDA has deposited 13,000 accessions of Korean native and improved breeds to Svalbard Global Seed Vault of Global Crop Diversity Trust (GCDT), joining in the FAO's efforts to permanently conserve seeds on the globe.

On March of 2009, RDA signed the MOU with Bioversty International to jointly operate the international training center for genetic resources experts. The 16 experts from 12 Asian countries including Malaysia and Cambodia will come to Korea to have the training. The training scale will be expanded gradually. As such, Korea has been putting its utmost efforts to implement the Global Plan of Action of FAO IT.

CHAPTER 7 Access to PGRFA, Benefits Sharing and Farmers' Right

7.1 International and National Legislation on Plant Genetic Resources

The Republic of Korea has participated in the international framework related to access and benefit sharing of plant genetic resources. It is a member country of CBD and the International Union for the Protection of New Varieties of Plants (UPOV). It ratified the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) in April 2009.

The Korean government developed a domestic law for the conservation, management and utilization of agricultural genetic resources in 2007. The legislation includes some provisions on rules and procedures of access to genetic resources for both domestic and international use. But, there are no articles on implementation of benefit sharing. It requests the government for appropriate measures and polices, especially in investigation, collection and documentation of landraces. The government shall support activities on conservation, management and utilization of landraces. Due to the re-organization of the government, the legislation is supposed to amend to cover forestry and fishery genetic resources for food agriculture as well as plant, microbial and animal genetic resources.

7.2 The State of Access to Genetic Resources

Access to genetic resources of foreign countries is restricted after the CBD, like many other countries, though Korea relies on plant genetic resources which originated from foreign countries for its food security and agricultural production. The RDA has exchanged germplasm with foreign countries, including Russia, Uzbekistan, Bulgaria by international collaboration in collection and exchange of plant genetic resources. RDA also re-introduced landraces native to Korea from USA and Japan in 2007 and 2008, respectively. The standard material transfer agreement (SMTA) of ITPGRFA is used in national germplasm management system for all crops.

7.3 Implementation of Farmers' Right

Currently, Korea has not established legal system on farmers' right. The domestic law on conservation, management and utilization of agricultural genetic resources includes relevant provisions that government can support farmers' activities, including conservation of landraces in their farm. As a member of ITPGRFA and CBD, Korea seeks appropriate measures and regulations for implementing farmers' right as well as facilitated access and fair and equitable sharing of benefit arising from utilization of germplasm.

CHAPTER 8 Contribution of PGRFA Management to Food Security and Sustainable Development

8.1 Food Security and Agricultural Technology

The RDA has utilized the foreign and domestic genes to develop about 2,000 new varieties including food crops (high-yielding and good quality rice, barley, soy bean, potato) and horticulture crops (pepper, garlic, water melon, grapes, tangerine) and to disseminate them to farmers, contributing to the national food security. The high-yielding Tong-il rice was developed as a result of RDA's several-years of research and investment in 1972, which liberated Korea from the Spring famine. The success of the Tong-il rice has led to the development of new and diverse varieties, ushering the era of Green Revolution, the self-sufficiency of rice to Korea. In 1977, the rice yield per hectare of Korea was 4.94 ton/ha, which was the world highest record. The know-how acquired from Tong-il rice development has been the corner stone for the development of other crops' varieties and cultivation technologies and the relevant industry such as agricultural machinery and plastic (vinyl). Specifically, the technology of plastic rice seedbed had been the starting point of 'White Revolution', a year-round cropping of fruits and vegetables.

Since the late 2007, the grain exporters including Russia, India, and Brazil have halted or limited export for stabilizing their food supply, which caused the surge of international grain price. In Haiti, the food crisis triggered the collapse of its government, and about 30 countries around the world including Philippines, the major rice producer, faced riots and demonstration caused by food shortage. In case of Korea, the self-sufficiency of rice, starting from the Tong-il rice, has greatly contributed to overcoming economic crisis and stabilizing the society. For the development of Tong-il rice, over 40 RDA's researchers studied 4,500 accessions of native and introduced varieties. Through the artificial crossing, the selection of superior line of next generation and the generation advancement at IRRI for the 7 years from 1965, the Tong-il rice came to be developed and disseminated to farmers in 1972. At the background of the development, the genetic resources of thousands of species have been used for the development of new variety, which had underscored the value and importance of plant genetic resources.

8.2 Conservation of Major Plant Genetic Resources

Though many Asian countries have the diverse and abundant genetic resources, their conservation facilities for the genetic resources are poor and vulnerable to natural disasters such as typhoon, earthquake, and flood. For the prevention of the resource loss caused by the disaster and safe conservation, the concerted efforts of international society become more important than ever. Under the recognition that the best way to prevent the loss is the duplicate safety back-up conservation, the RDA signed the MOU with GCDT for the sustainable use and conservation of PGR on August, 2008. Under this MOU, Korea have shown its strong will to contribute to the world food security by providing the long-term conservation facility at the NAC free of charge to the international society. For the first time among the Asian countries, the Department of Agricultural Research of Myanmar expressed its intention to send 1,000 accessions of its native rice varieties and deposited the initial 200 accessions. On the other hand, the Asian Vegetable Research & Development Center (AVRDC) located in Taiwan deposited its 5,000 vegetable seeds to the NAC for the long-term conservation.

The NAC of RDA will continue to faithfully meet its obligation as the member of the CBD with its conservation of genetic resource from other countries and international research institutes. Furthermore, Korea will also continuously join in the international efforts for agricultural sustainability, food security, economic development, and poverty alleviation.

List of Abbreviations

ABS Access and Benefit Sharing

ARS Agricultural Research Service

AVRDC Asian Vegetable Research and Development Center

BI Bioversity International

CBD Convention on Biological Diversity

COP Conference of the Party

FAO Food and Agriculture Organization

GCDT Global Crop Diversity Trust

ITPGRFA International Treaty on Plant Genetic Resources for Food and Agriculture

IUCN International Union for Conservation of Nature

KFS Korea Forest Service

KNA Korea National Arboretum

MIFAFF Ministry for Food, Agriculture, Forestry & Fisheries

NAC National Agrobiodiversity Center

PGRFA Plant Genetic Resources for Food and Agriculture

RDA Rural Development Administration

SMTA Standard Material Transfer Agreement

UPOV Union for the Protection of New Varieties of Plants

UzRIPI Uzbek Research Institute of Plant Industry

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