REPUBLIC OF KOREA:

COUNTRY REPORT TO THE FAO INTERNATIONAL TECHNICAL CONFERENCE ON PLANT GENETIC RESOURCE

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Compiled by:

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Note by FAO

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CHAPTER 1
Introduction to Republic of Korea and its Agricultural Sector

1.1 BASIC INFORMATION

The Republic of Korea is a peninsular country extending southward from the northeastern part of the vast Asian Continent, which lies between 124°ll' 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). So the flora of the peninsula have 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, which are composed of the mountainous areas occupying 65% of the total land area, the plains mainly lying to the south, and the south-western archipelagoes consisting of about 3,400 islands, respectively.

Annual average temperature shows large variation from 14°C in the southern area to 5°C in the northern part and the amount of annual precipitation ranges from 1,400 mm in the southern part of the peninsula to 400 mm m 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 is assessed that the flora of the vascular plants in Korea are very diverse and specific as compared to those of surrounding countries.

Subtropical broad leaved trees, such as *Quercus myrsinaefolia* Bl., *Cinnamomum camphora* Sieb., *Camellia japonica* L., *Fagopyrum esculentum* Moench, *Pinus koraiensis* Sieb. et Zucc., and *Juglans manshurica* Maxim., are mainly distributed in the southern part of Korea. Whereas temperate and coniferous trees are mainly occurred in the middle part, such as Genus *Quercus,* Genus *Alnus, Zelkova serrata, Fraxinus mandshurica, Pinus densiflora, P. koraiensis, and P. thunbergii* Parlatore *Pinus densiflora, Abies holophylla* Maxim, *Picea jezoensis* Carr., etc. are distributed in the frigid region.

It is estimated that around 4,000 vascular plants naturally occurs in Korea which could be classified into 190 families including ferns. Around 3,700 taxa of flowering plants were reported to have been naturally grown (Chung, 1956, 1957, Lee 1980). In addition, about 407 taxa of Korean endemic species including 6 endemic genera distributed.

As shown in Annex 1, from 1966 to 1993 around 150,000 hectares of forest in Korea have been lost and transformed into other uses, 22% for industrial complexes, 18% for golf field, 16% for roads, 12% for mines, 9% for pastures and 23% for others. In the forest production, timber production decreased from 1,108,000 m^3 in 1977 to 710,000 m^3 in 1993 (Annex 2).

The population of Korea is about 44,056 thousands and the population density is very high. So the average forest area per capita is 0.15 hectare, no more than one fourth of the world average.

Arable land reaches 2,109,000 hectares occupying 21.2% of the total land area. Paddy fields occupy 1,345,000 hectares, 63% to the total arable land, and upland areas are approximately 764,000 hectares. Korea belongs to temperate monsoon climatic regions where rice has been grown as a typical staple food.

Soybean, barley, corn, wheat, other coarse grain crops and vegetables are mainly cultivated in arable upland. Most of agricultural products are consumed for domestic uses and as of 1993 the rate of the crop self-sufficiency was 34% as shown in Annex 3.

1.2 BRIEF PROFILE OF THE AGRICULTURAL SECTOR

Average cultivated acreage per farm household in Korea is around 1 hectare and most of the farm houses grow crops mainly for home-consuming use. The remainder would be sold to the market for getting more living expense. Recently, much effort has been given to increasing the scale of farm management through agricultural mechanization on a national basis.

Most of the seeds which farms grow could be obtained at the appropriate seed firms at the inception of variety release based on the seed distribution procedure (breeder's seed foundation seed registered seed release to farms). Usually, each farm harvests and uses the seeds every year till the existing cultivars are replaced with new one.

In case of vegetable seeds, most farmers purchase the seeds each year which seed companies develop for commercial purposes each year. And the amount of imported seeds for cultivation is increasing recently.

1.3 RECENT TREND IN CROP PRODUCTION

1.3.1 Estimation of the productivity of staple food crops

As to the agricultural productivity of Korea, rice production has shown to be slightly increased. The trend would be caused not by the increase of cropping area, but by the increment of rice productivity per unit area with new high-yielding cultivars widely released and so its self-sufficiency could be nearly attained. On the contrary, cultivated areas of barley, wheat, corn, soybean, and potatoes would have become drastically decreased since 1970 and it would be assumed that the production of these crops have kept decreasing. Totally, the rate of crop self-sufficiency noted 80.4% in 1970 and then has been rapidly reduced to 33.9% in 1993.

1.3.2 Diseases and pests in rice

Rice sheath blight *(Acrocylindirum oryzae)* would be the most destructive disease in rice cultivation which damaged around 555,000 hectares of rice paddy field from 1980 to 1990. Besides, rice pests like brown planthopper, white-backed planthopper and small brown planthopper, etc. have attacked 586,000 hectares of rice fields over the country in the same period. A survey on disease and pest damage showed that rice yield production was 3.8% decreased in controlled plot, but 16.4% in not-controlled one. By taking into consideration various crops, it would be noted that introduced cultivars having exotic resistant genes would be stronger to natural disasters, but crop landraces which have horizontal resistances to diseases and pests would be relatively inferior to the former.

1.3.3 Geographical classification of the flora in Korea

Lee and Yim (1978) grouped the floristic provinces of Korean Peninsula into 8 regions based on the composition of plant species as shown in Fig. 1. Provinces from 4 to 8 lie in South Korea and main tree species are as follows;

- Middle province (4): Genera *Megaeranthis, Pentactina, Abeliophyllum, and Hanabusaya* which belong to Korean endemics.

- South province (4): Genera *Cephalotaxus, Ilex, Meliosma, Camellia, Stewaria, Tracheospermus*
- South-coast province (6): Genera *Cyrtomium, Torreya, Castanopsis, Stauntonia, Raphiolepis, Aridisia*
- Cheju province (7): Genera *Psilotum, Myrica, Diapensia, Azolla, Citrus*
- Ullung province(8) :Genera *Tsuga, Fagus, Wasabia, Tiarella*

FIG 1 EIGHT FLORISTIC PROVINCES OF THE KOREAN PENINSULA.

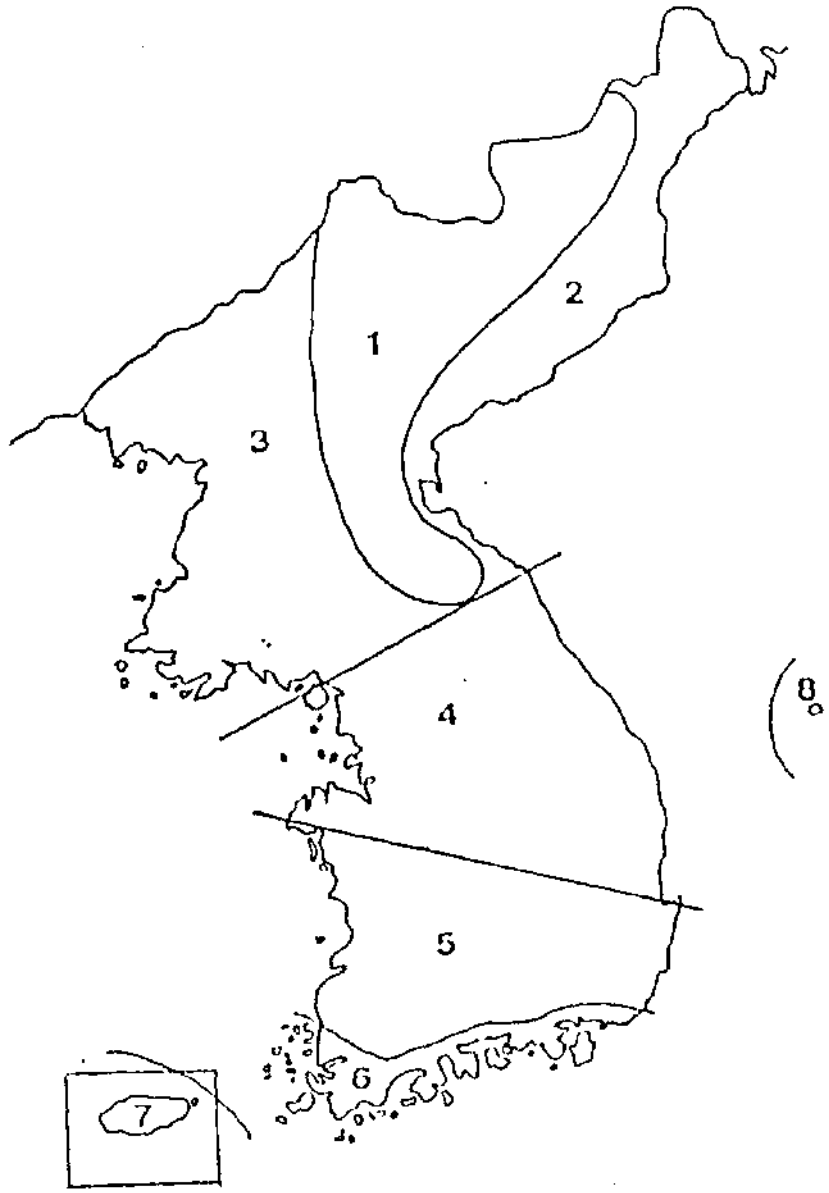


Fig 1. Eight floristic provinces of the Korean Peninsula divided by Lee and Yim (1978). ①Kabsan Prov. ②Kwanbuk Prov. ③Kwansco Prov. ④Middle Prov. ⑤South Prov. ⑥ South-coast Prov. ⑦Cheju Prov. ⑧Ullung Prov.

CHAPTER 2
Indigenous Plant Genetic Resources

2.1 FOREST GENETIC RESOURCES

2.1.1 Major useful woody plants in Korea

There are ca. 1,050 woody plants under 750 species in Korea of which needle leaved trees are 50 taxa and broad leaved trees are 1,000 taxa, in which some endemic species are included. Majority of them are used for timber and the others are for fruit, fiber, resin, and medicine.

2.1.2 Examples of some important woody plants

Timber plants :	Japanese Red Pine *(Pinus densiflora)*
	Black Pine *(Pinus thunbergii)*
	Oak (*Quercus spp.*)
	Needle Fir *(Abies holophylla)*
Fruit:	Chestnut *(Castanea crenata)*
	Chinese Walnut *(Juglans sinensis)*
	Jujube *(Ziziphus jujuba* var. *inermis)*
	Korean Pine *(Pinus koraiensis)*
	Sawtooth Oak *(Quercus acutissima)*
	Maidenhair Tree *(Ginkgo biloba)*
	Tung Oil Tree *(Aleurites fordii)*
	Common Camellia (*Camellia japonica*)
	Torreya *(Torreya nucifera)*
	Alpine Strawberry *(Rubus crataegifolius)*
Fiber:	Kudzu Vine (*Pueraria thunbergiana*)
	Paper Mulberry *(Broussonetia kazinoki)*
	Diptri *(Wikstroemia trichotoma)*
	Bush Clover *(Lespedeza bicolor)*
Resin:	Japanese Red Pine (*Pinus densiflora*)
	Lacquer Tree (*Rhus* spp.)

Tanin:	True Rhus *(Rhus chinensis)*
	Khaki Persimmon *(Diospyros kaki)*
Medicinal Plants:	Japanese Cornelian Cherry (*Cornus officinalis*)
	Amur Corktree *(Phellodendron amurense)*

Needle leaved tree forest, broad leaved tree forest, and mixed tree forest constitute 45%, 28%, and 27% of the total forest, respectively, and the mean forest accumulation is only 44 m^2 per 1 ha.

2.1.3 Status of natural forest and reserved forest

Pinus densiflora is the most widely distributed plant in Korea, however it suffers from various harmful insects which was introduced from foreign country. Damage is accelerating rapidly at present. Besides this, the ecosystem in Korea is gradually losing its balance because of climatic changes (acid rain, air pollution, and so on) and rapid industrialization.

The government of Republic of Korea designated 131 places of 11,052 ha. as the natural reserved forest in which 9,453 stocks of 97 species, aged of 800-900 years old, are specially protected.

The forest area of 206,967 ha. are protected for various purpose, e.g. protection of soil erosion prevention of stone falling and health landscape (Annex 4). The area of national parks and provincial parks are 383,357 ha. and 73,248 ha. in 20 places, respectively (Annex 5).

2.1.4 Status of *in situ* conserved forest

Forest Genetics Research Institute surveyed genetic variation in natural forest in Korea from 1972. As a result, a total of 2,662 ha. in 24 populations was designated as *in situ* conservation forest including valuable 10 species (Annex 6).

List of endangered woody plants in Korea

Zanthoxylum coreanum Nakai	(*Rutaceae*)
Empetum nirum var. *japonica* K. Koch	(*Empetraceae*)
Berchemia racemosa var. *magma* Makino	(*Rhamnaceae*)
Hibiscus hamabo Sieb. et Zucc.	(*Malvaceae*)
Daphne kiusiana Miq.	(*Thymeleaceae*)
Diapensia japonica var. *obovata* (Fr. Schw.) Nakai	(*Diapensiaceae*)
Arctous ruber (Rehder et Wilson) Nakai	(*Ericaceae*)
Rhododendron mucronulatum for. *albiflorum* T. Lee	(*Ericaceae*)

Ardisia crenata Sims.	(*Myrsinaceae*)
Lonicera okamotoana Ohwi	(*Caprifoliaceae*)
Taxus caespitosa Nakai	(*Taxaceae*)
Celtis edulis Nakai	(*Ulmaceae*)
Schizandra nigra Maxim.	(*Magnoliaceae*)
Albizzia coreana Nakai	(*Leguminosae*)
Echinosophora koreensis Nakai	(*Leguminosae*)
Echinopanax horridum Kom.	(*Araliaceae*)
Forsythia ovata Nakai	(*Oleaceae*)
Forsythia saxatilis Nakai	(*Oleaceae*)

2.2 OTHER WILD SPECIES AND WILD RELATIVES OF CROP PLANT

2.2.1 Endemic and endangered plants in Korea

Korean endemic plants are 407 taxa of 61 families, 172 genera, 339 species, 46 varieties and 22 formas including North Korean species (107 taxa) (Annex 7). The government of Republic of Korea appointed 126 taxa as special preservation plants which were consisted of 16 endangered taxa, 20 vulnerable taxa, 41 endemic taxa, and 49 rare taxa (Annex 8).

Wild relatives of crop plant in Korea

- *Leguminosae*: wild soybean, wild adzuki bean, mung bean, *Vigna spp.*, *Pisum sativum*
- *Poaceae*: *Avena sativa*, *Oryza sativa*, *Fagopyrum esculentum*, *Ecidnochloa crusgalli* var. *frumentacea, Setaria viridis, Panicum miliaceum*
- Fiber Crop: *Boehmeria nivea*, *Abutilon avicennae*, *Corchorus capsularis*, *Cyperus exaltatus* var. *iwasakii*, *Juncus effusus* var. *decipiens*, *Broussonetia kazinoki*
- Table Luvuries: *Thea sinensis*
- Dye Plant: *Rhus verniciflua, Persicaria tinctoria, Gardenia jasminoides*
- Fruit Tree: *Pyrus ussuriensis, Pyrus pyrifolia, Malus sieboldii, Prunus spp.*, *Morus* spp., *Diospyroslotus, Morus australis, Morus alba*
- Vegetable: *Allium* spp., *Amaranthus* spp.
- *Solanaceae*: *Solanum nignumlud*

Wild plants in Korea could be classified in following categories by means of its use : pasture (1,101 taxa, 24%), medicinal source (996 taxa, 21.7%) edible source (839 taxa, 18.3%), ornamental source (761 taxa), timber (423 taxa), fiber (30 taxa), industrial (15 taxa) and unknown (1,637 taxa, 35.6%).

Causes of extinction of indigenous plant

(1) Destruction of forest, especially, needle leaved tree, by acid rain which was brought from industrialization.

(2) Construction of recreation facilities including factory site, golf links and express way.

(3) Overhunting of wild plants such as medicinal plants and valuable ornamental sources.

The way of prevent of the indigenous plants from extinction

(1) Periodic survey of plants distribution in all over the country (Ministry of Environment).

(2) Escalate designation of national parks and take legal action to prevent overhunt.

(3) Prohibition action of collection, marketing and distribution of rare and endangered plants.

(4) Development of indigenous plant as a useful germplasm.

(5) At present, action of strength for *in situ* conservation by means of propagation and recover of endangered and rare plants is doing. However, land use policy for Prohibition of extinction of wild germplasm resources is not available yet. But, at least, the indigenous plants in national park, green belt, provincial park and natural conserved forest are conserved due to restriction law.

For more action and reasonable conservation, many specialist and researchers in field of taxonomy, ecology, physiology, forest pathology, population genetics, ethnobotany, etc., as well as training and international cooperation are most needed.

2.3 LANDRACES ('FARMERS' VARIETIES) AND OLD CULTIVARS

2.3.1 Cultivation of landraces and extinction trend

Cultivation of landraces and its conservation

Cultivation of landraces in farm households are not due to governmental policy but needs of farmers themselves. And also, nowadays, some farmers recognize the importance of landraces as useful plant germplasms by massmedia. They do not receive any compensation from the government but they conserve seeds of landraces which were passed and received from their ancestors.

Crop landraces conserved at present

- Legumes: Soybean, Red bean, Cowpea and Kidney bean which were originated from Korea
- Cereals : Maize, Millet, Sorghum, Chinese millet
- Cash Crops : Buckwheat, Sesame, Perilla, Castor-Oil plant, Pumpkin, Medicinal plants
- Vegetables Garlic, Edible wild plants, Gourd, Spinach Beet, Crown Daisy

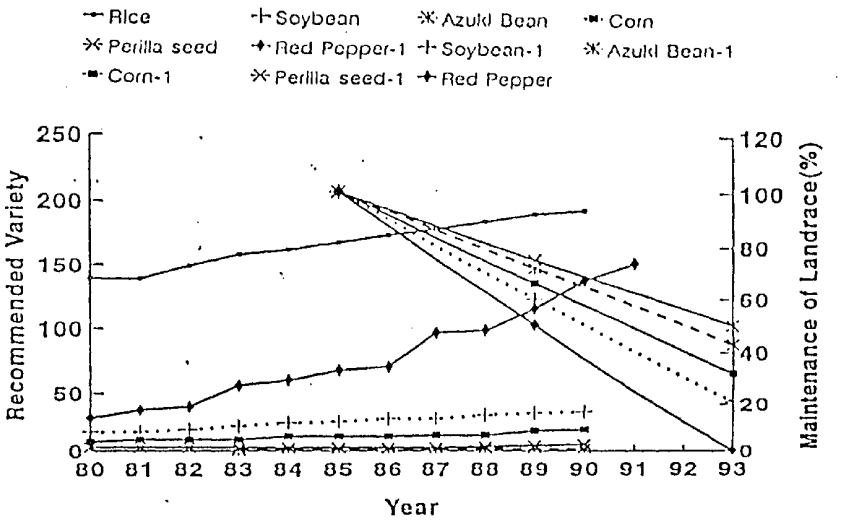
Crop landraces almost extincted

- Important crop landraces such as rice, wheat and barley were almost substituted with advanced cultivars which were bred and distributed by government.
- Vegetables : Major landraces of vegetables such as red pepper, radish, Chinese cabbage, onion, spinach, lettuce, Welsh onion, cucumber, melon, water melon, carrot, eggplant, tomato, etc., were substituted with competent cultivars which were bred and provided by seed companies.

Decreasing trends of landraces in Korea

In Korea, an industrializing country, decreasing trends of landraces are very fast and serious. For example, as you can see in Annex 9 and Fig. 2, a 74% of landraces were lost on average during 1985-1993 in 147 farm households at 3 locations (Ahn, 1994).

Fig. 2. Estimation of crop landraces maintained



CHAPTER 3
National Conservation Activities

3.1 *IN SITU* CONSERVATION ACTIVITIES

3.1.1 Planning

Ministry of Environment and Forest Genetic Research Institute, the Forestry Administration are responsible for the *in situ* conservation activities of plant genetic resources.

Ministry of Environment carries out plans on habitats conservation by survey of ecosystem and the Forestry Administration is responsible for *in situ* conservation by analyzing of genetic variation.

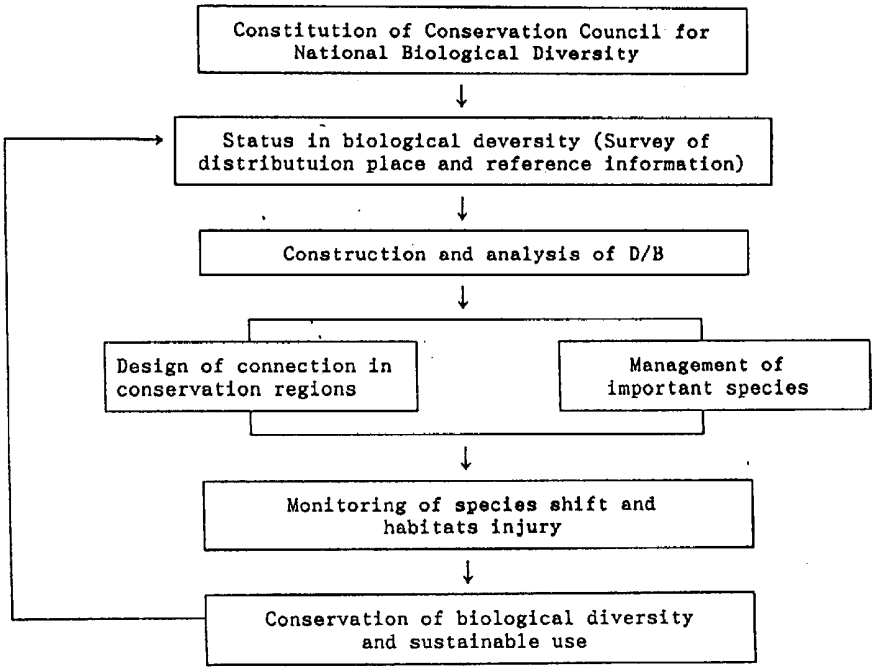
National plan for conservation of biological diversity is as follows.
First of all, ecosystems and habitats for the ideal conservation of species diversity are surveyed.

In addition, a study of genetic diversity and structure of natural populations (especially forest tree species) is carried out employing genetic markers. Secondly, a continuous monitoring of the ecological characteristics (demography, environment etc.) and genetic variation is carried out.

Thirdly, appointment of the protecting areas for the preservation of threatened species, ecosystem, which have high species diversity and natural populations containing large genetic variation are selected.

Fourthly, recovery of destroyed habitats, conservation, and sustainable management of plant genetic resources are carried out (Fig. 3).

Fig 3 Flow chart of national plan for conservation of biological diversity



In situ conservation sites are managed by technical experts, members of Ministry of Environment and Forestry Administration. Ministry of Environment has roles of basic planning of conservation, investigation of the natural environment, the designation of natural ecosystem region for conservation and protected area for special plant, and so on according to the law of natural environment conservation. Forestry Administration is carrying out the designation of natural protection forestry based on law of forestry.

3.1.2 Monitoring

Korean Natural Conservation Association (KNCA), which is composed of professors, researchers and farmers, investigates plant distribution and ecosystem in annually and regionally. KNCA has finished a survey of the 33 forest species and 178 population at 11,582 ha area of natural forestry (Annex 10). Genetic variation and structure analysis of natural population in forestry was studied by several universities and Forest Genetics Research Institute.

3.1.3 Conservation status

In situ conservation status in forestry, 2,662 ha. were selected as conservation forestry area, and most of the species are black pine, big cone pine, fir tree and Korean fir (Annex 6).

3.2 *EX SITU* CONSERVATION

3.2.1 Genebank System and Collections

Ex situ conservation of genetic resources in Korea is largely carried out by two national research institutes e.g., seed by RDA genebank and forestry by Forest Genetics Research Institute (FGRI), Forestry Administration (Annex 11,13). RDA genebank preserves a total number of 120,000 accessions and FGRI has 4,540 accessions in the field. Long-term storage facility for forestry is negligible.

RDA genebank is a national institute supported by Korean government and was built in 1988 according to IPGRI recommended standards. It can store as many as 200,000 accession. Annually, RDA genebank spends 400,000 US$ excluding researcher's salary. It is responsible for collection, evaluation and preservation of genetic resources which are carried out by members; four senior researchers, thirteen junior researchers and three technicians.

3.2.2 Preservation of genetic resources

RDA genebank has 95,000 cereal crops, 9,000 vegetables, and 12,000 industrial and medicinal plants germplasm. Of the 120,000 accessions, 22,000 are landraces and the others include introduced varieties and inbred lines. Like other countries, rice germplasm is the major collections in Korea with the number of landraces and introductions being 3,200 and 17,800, respectively.

3.2.3 Utilization of genetic resources

Every year about 4,000 accessions, 3% of the collected resources are utilized by breeding institutes, universities and private seed production companies. This number includes the number of germplasm exchanged with research institutes of the foreign countries. The number of incoming foreign country is larger than that of outgoing to other country. The major sources of introduction are from the international agricultural agencies under CGIAR.

3.2.4 Landraces

About 22,000 accessions which are 18% of the germplasm at RDA genebank are national collections among which 10,000 accessions are landraces. Germplasms at RDA are not enough to represent the genetic diversity of the landraces in Korea. Landraces of rice, barley and wheat are almost extinct but legumes coarse crops, industrial and medicinal plants and some vegetables still can be collected

extensively. Random sampling technique has been employed to collect the landrace before they were extinct. The researcher working at nationally distributed extension offices under RDA is the major contributor to collect the landraces. They collect from farm to farm base. Researcher working at RDA genebank generally collect by given information but this practice is not extensively employed due to financial constraint.

3.2.5 Storage facilities

Only RDA genebank has seed storage rooms not only for long-term storage but also for short-term storage. However, a few national or private research institutes have short-term storage wherein temperature is controlled at 5°C to 12°C. Seed storage facilities of RDA genebank was built in 1988 following the guideline of the International Standards.

The eighty eight square meter long-term storage room maintains controlled temperature of -18±1°C and is maintained at frost free condition. The one hundred and seventy six square meter short-term storage room has 4±1°C temperature with 40% relative humidity. Seed storage room is maintained 15±3°C temperature with 15% relative humidity. Seeds are dried until their moisture content are 3% to 8%. Packing room is controlled at temperature of 20±3°C with 30% relative humidity (Annex 12).

Seeds for long-term storage are packed into aluminum foil to avoid getting moisturized and kept into the -18°C storage room. On the other hand, seeds for short-term storage are packed into PET bottle with suicagel and kept into 4°C storage room.

RDA was designated as one of Sesame World Base Collection in 1991 by IPGRI. They are stored in RDA genebank. A small scale of genebank will be constructed in Youngnam area for duplication of accessions.

3.2.6 Seed Storage Process

Upon receiving seeds the passport data of the seeds are input in genebank system at RDA, and then good quality of seeds are selected through selection process such as germination test.

Selected seeds are dried and wrapped by the above way depending on the storage periods. This process generally takes about two months or more depending on the availability of manpower.

3.2.7 Availability of consignment storage from other countries

RDA genebank is able to preserve a total of 200,000 accession but as of 1995 it stores only 120,000 accession. RDA genebank can also store seeds of the foreign country once the viability test can be carried out at RDA genebank.

3.2.8 Seed Bank and Botanical gardens

The history of botanical garden in Korea started in 1967 although the experimental forestry belonging to university was installed in the early 1900, but it has still limited numbers. Seedbank of the botanical resources was officially established in 1991 and it has 115,000 accessions of clonal repository resources which are stored in four national and public forestry. National and public botanical gardens maintain the number of 10,900 accessions which is generally consist of ornamental trees, introduced varieties and landraces (Annex 13). Private botanical gardens also collect but they are interested in foreign species for their economic purpose. Many of the accessions of national and private botanical gardens are duplicated.

3.3 DOCUMENTATION

3.3.1 Computer system with H/W & S/W

So far, we are not equipped with network system with other genebanks and research institutions to exchange data on a regional or a crop basis. Each research institutions used personal computer for data management, while computer system network and geographic information system will be set up in 1997-2004. Software system is used in genebank management in each research institute. Therefore development of integrated networking system is required for information management system of plant genetic resources in Korea.

3.3.2 Documentation

When crop landraces and wild species are collected following information such as, local name, utilization, donor name and acquisition data are recorded. Incoming accessions are registered with their passport information for database system. In the collection of germplasm, many of the preserved landraces in genebank were collected not by professional collectors but by regional extension officers, so they have not specified passport data. Wild species not collected systematically and passport data are very poor.

3.3.3 Exchange of information between genebanks

Korea genebank has not networking system with foreign genebank to exchange information. Printing matter or letters were used for information exchange among the genebanks. Internet system to exchange data and information will be set up as soon as possible.

3.3.4 Documentation on *in situ* collections

Ministry of Environment are responsible for the documentation of *in situ* collections. Informations on demography, stochasticity and analysis of genetic variation are important parameters in conservation of plant genetic resources, are inadequate condition. In tree, analysis of basic genetic variation is carried out on natural population of forestry such as a pine, black pine, big cone pine and oak.

Documentation and registration of plant genetic resources in Korea is not completely accomplished due to lack of professional scientists like taxonomist, ecologist and genetist, and poor research activities and budget.

3.3.5 Evaluation and Characterization

Characterization and evaluation of the stored germplasm samples are carried out by scientists working in genebank of RDA and experiment stations for various crops under RDA. It is done by using partially modified IBPGR/IPGRI descriptors for international network. Farmers are not involved in the evaluation of collection, but support the passport data. About 40% of the stored germplasms by RDA genebank has gone through the primary evaluation which may include biochemical test, physiological responses, microbiological test, disease and pest susceptibility, and yield productivity, and so on. Evaluation by genetic fingerprinting is done by limited extent, if any, and improved software for documentation is needed.

RDA genebank have been published books including characterization and evaluation data of the major crops such as rice, wheat, barley and maize. This publication was provided to institutes, seed companies, researchers and farmers. The data from evaluations carried out by researchers, professors and seed companies and data returned to the genebank. These data input into database system for data management. Data evaluation data help improve collecting and conservation strategies.

3.3.6 International Collaboration for Evaluation

The evaluation of genetic resources will be cost-effective and practical when each country collaborates with international research institutes under CGIAR which take the leading role. But, there are difficulties in that all countries must open their stored germplasms and evaluation work for some international research institutes.

Base collection was evaluated and duplicated at Base Collection Center under the supervision of CGIAR and everybody will use collections.

3.3.7 Regeneration

Seed viability test is done whenever seeds are 5 to 10 years old in the short-medium term storage and 10 to 20 years old in the long term storage. Seeds having less than 80% germinability are sent to National Crop Experiment Station for multiplication.

RDA genebank was satisfied that regeneration procedures are adequate to maintain the genetic character of the original sample collected in Korea and similar meteorological ecology zone, while germplasm collected at different meteorological ecology needs special treatment for flowering and multiplication.

Evaluation and multiplication of stored germplasm have been carried out in coordination with genebank researcher and RDA affiliated research institutes. RDA genebank has not enough land, facilities and labour to work against natural mutation and contamination.

Especially, in case of out-pollinating crops and forest tree, genetic drift and inbreeding due to small size of regeneration samples are unavoidable.

RDA genebank maintained more than one generation of the same accession. After multiplication, fresh materials are changed with old materials. If they were the same accessions, they would be preserved using each envelope within the same bottle. But new samples would be discarded in case of different between old and fresh materials.

3.3.8 Forest Genetic Resources

Characteristics and natural distribution of habitats in major forest tree are investigated by professors and researchers. Investigation on threatened species is unsatisfactory due to different opinions postulated by other scientists in evaluation parameters.

Especially, study on characteristics of habitats and distribution in large scale is not yet carried out. Forest Genetics Research Institute has plans about basic investigation for the evaluation parameters and application. In based on the results of actual place investigation, it will prepare demonstration field following the law of *in situ* conservation for the highly threatened species. In case of special and isolated population in habitat characteristics, it will preserve native area, and if need any restoration, it will be repaired (Annex 6, 11, 14, 15).

Pine tree and economic forest species are preserved 10 species and 24 population at 2,662 ha as *in situ* conservation of forestry. For the use of breeding materials in forest genetic resources, they are preserved as *in situ* conservation forest of next generation gene and clone bank (Annex 6,11,14,15). Forestry Administration is carrying out field test, next generation test, analysis of genetic variation in major forest tree.

Forestry Administration has plan about established GIS program for grasp of distribution in habitats. Also Forest Genetics Research Institute will be set up database system for management of forest genetic resources.

CHAPTER 4
In-Country Uses of Plant Genetic Resources

4.1 USE OF PGR COLLECTIONS (1991-1994)

- Degree of germplasm utilization: crop germplasm used recently, from 1991 to 1994, was as followed.
- Rice (20,758) wheat (1,604) Barley (1,122) Soybean (996) Corn (928) Pepper(626) Onion (623) Chinese cabbage (468) Green perilla (459) Sesame (224)
- 13.5% of the whole accessions of the germplasm have been used by 300 researchers.
- Distributed to country abroad : Russia (102), Japan (77), India (22), Zimbabwe, Poland, USA, China etc.
- Germplasm distributed to the seed companies are almost vegetables such as pepper, Chinese cabbage, pumpkin and cucumber
- 92,800 accessions of germplasm have never been used, but the utilization frequency may be increased after detailed evaluation in the near future
- Farmers can not utilize germplasm of the gene bank by direct distribution but indirectly through extension agencies or experiment organizations.

4.2 CROP IMPROVEMENT PROGRAMMES AND SEED DISTRIBUTION

- Function of national plant breeding programme : improvement of landraces or cross breeding of disease and/or insect-resistant cultivars
- Final object : raising the rate of self-sufficiency through improvement of high-yielding cultivars of the crops
- Degree of fullfilment for national demand of breeding : generally submitted to national demand, but there are some problems e.g. deficiency of germplasm suitable for breeding purpose

- The main body of plant breeding research: all food crops except vegetables which executed by seed companies have been bred by national organizations
- Distribution methods of novel cultivars to farmers food crops multiplied by seed supply system, e.g. breeder's seed - foundation seed - registered seed and distributed to farmers. In vegetables, farmers, purchase the seeds which were supplied by seed company.
- Methods by which farmers could participate in breeding : farmers doesn't directly take part in breeding but they assess the good lines in regional adaptation test.

4.3 USE OF FOREST GENETIC RESOURCES

National programme for seed production and supply of forest trees is carried out by Forest Genetics Research Institute (FGRI), Forestry Research Institute, etc. Seeds bred or collected by FGRI were propagated at seed orchard estimated at 725.5 ha and provided to farmers for cultivation (Annex 14).

Superior seeds were produced from superior trees, 28 species, 2,724 trees including fine trees, among them 1,560 clones are being conserved by grafting method (Annex 15,16).

4.4 BENEFITS DERIVED FROM THE USE OF PLANT GENETIC RESOURCES

None of the germplasm was conserved only for users abroad. Benefits of the use of landrace germplasm lie in breeding of cultivars which are adaptable to Korean climate and environment, are resistant to disease and have superior quality suitable to consumers' tastes. On occasion, it is advantageous to study jointly with researchers abroad.

If a good cultivar is bred from overseas germplasm, ownership of existing germplasm should admitted and the benefits from the germplasm which was introduced after execution of bio-diversity agreement have to be distributed by international contract.

4.5 IMPROVING PGR UTILIZATION

The goal of germplasm research lies in augmentation of degree of self-sufficiency of food through breeding of novel cultivars and increase of farmers' earnings.

To use the germplasm effectively, a lot of research power and budget should be investigated and then breeders can use the data of characterized and evaluated. Detailed evaluation (physiological, ecological, genetic and quantitative) and documentation should be carried out through training of researchers. It is essential to obtain the analytical instruments and tools for detailed and higher degree of evaluation.

CHAPTER 5
National Goals, Policies, Programmes and Legislation

5.1 NATIONAL PROGRAMMES

5.1.1 The national organization for plant genetic resources (PGR)

The PGR activities are performed by "The Basic Conservation Programme for Nature and Environment (1994-2003)" under the ministry of environment (M.E.)

Conservation of Nature and Environment (Ministry of Environment)					
Conservation of nature ecosystem	**Protection of nature landscape**	**Protection of wild animal/plants**	**Nature Conservation**	**Utilization & Management of land**	**Sustainable use of biological resources (Rural Development Administration and Forestry Administration)**
Protect area of nature ecosystem (Ministry of environment)	National Park (Ministry of Domestic Affairs)	Endemic wild animals and plant (Ministry of Environment)	Public awareness (Ministry of Domestic Affairs)	Nature conservation area and green belt (Ministry of Construction and Traffics)	Exploration, collection and conservation of biological Resources
Natural monument protected area (Ministry of Culture/Gymnastics)	Urban Park (Ministry of Construction and Traffic)	Natural monument [wild animal and plant] (Ministry of Culture and Gymnastics)			Identification, characterization and evaluation of biological resources
Natural protected area of forest (Ministry of Culture/Gymnastic)	Scenic beauthy (Ministry of Culture and Gymnastics)	Wild birds and mamnals (Forestery administration)			Data mangement
Acquatic protected area (Fishery Administartion)					
Conservation of biological diversity and making national inventory (Ministry of Environment)					
Physiology and Ecology study on Agricultural pest and diseas (Rural Development Administation)					

5.1.2 Conservation Programme for Plant Genetic Resources (PGR)

In case *in situ* conservation activities on PGR will be organized into the Ministry of Environment (M.E.) and the Forest Genetic Research Institute (FGRI). The protection of habitat by ecosystem monitorings will be carried out by M.E. and *in situ* conservation for the important tree species population with genetic variation analysis will be carried out by FGRI.

In case *ex situ* conservation activities on PGR will be conducted by the Rural Development Administration (RDA) and FGRI. And also the M.E. will establish and manage the National Bio-resources Conservation Center.

5.1.3 The goals and objectives of national PGR programme

Goals

The first goal is ecosystem conservation through vegetation and species monitoring and efficient management of the protected area. The second goal is the maintenance of genetic diversity through exploration, collection, preservation and evaluation of PGR.

Implementation of convention on biological diversity

Survey of vegetation of ecosystem, stress analysis and regeneration of rare species by continuous monitoring and research would make it possible to maintain biological diversity. Government will make a active role through the related international cooperation.

5.1.4 National committee for maintaining biodiversity

National committee for biodiversity will be composed of biologists, agricultural scientists, forest scientists, lawyers and related governmental officers. Under the committee subcommittee could be organized by specialists in the local area basis. Main responsibility of the committee is to give advice for making a strategy, making legal regulation, monitoring and making inventory for conservation of biological diversity.

5.1.5 Research organization for PGR

Forest genetic resources

The curator for *in situ and ex situ* conservation is Director, Forest Genetic Research Institute, Forestry Administration. And the other curator for *ex situ* field conservation of forest is Director, Arboretum Interior Breeding Station, Forestry Research Institute. The security of position is quite unstable at present.

Agricultural genetic resources

The curator for *ex situ* conservation is Director, Genetic Resources Division, Department of Bio-Resources, National Agricultural Science and Technology Institute, under Rural Development Administration. The security of position depends on the decision of the Administrator of RDA and the duration of position continue several years until ten years.

Annual programme and Budget

Programmes are annually approved by Director General of the institute and budgets are allocated continuously every year.

Collection of plant genetic resources

Regulations when collecting and carrying out samples in the protected area should be approved by the related Minister of government as follows; natural monument from Ministry of Culture and Gymnastics, controlled area from a mayor and a county head, endemic wild animal and plant from the Minister of Environment, National and Province Park from the related governor.

It is needed to loosen legal regulation for national organization to collect freely in the national park and protected area in order to conserve biodiversity at the gene bank for the purpose of sustainable use.

5.1.6 Training

Trained staff

There are few specialists on the conservation and utilization of PGR. In case of RDA Gene Bank there are 18 staffs. Among them only 4 personnels were (short term) trained in the well developed foreign gene bank. Therefore theological and practical background on PGR are in the quite poor status.

Needed training fields

- Population genetics, plant taxonomy and ecology for genetic diversity
- Plant taxonomy, ethnobotany, ecology, seed science, geography, data management population genetics, plant breeding for gene bank management
- Plant pathology, entomology and plant inspection for plant quarantine service

Available training programme in host country

There are some possibility to offer course such as agronomic evaluation from RDA genebank, plant breeding from institutions and practical identification of plants from Arboretum. The administrator's understanding on PGR activities is getting better, however the importance of conservation on PGR is underestimated and not receive a high priority.

Training of ethnic group

The country lovers' society are not included in programme on PGR, however public awareness on PGR often is broadcasted with documentary series on TV programme.

Research continuity of trained staff

Normally they manage and study on PGR, however in case of promotion they should move into another position dealing with different work.

5.2 NATIONAL LEGISLATION

5.2.1 Plant Quarantine Laws

Quarantine inspection and release

Phytosanitary certificate will be issued by quarantine inspector if not contaminated with pests and diseases.

Prohibited plants

The entry of the prohibited plants should be with permit by the Minister of Ministry of Agriculture, Forestry and Fisheries.

In vitro plants

In case *in vitro* plants, they are little bit easy to pass quarantine.

Loss of materials

In case of vegetative plants or prohibited plants they are sometimes lost by unproper management during quarantine procedure.

Promulgation of Enforcement Regulation of Plant Protection Act

It is needed to enforce plant protection act and to shorten the periods of procedure of import plant quarantine.

Isolated cultivation of import plant

Plants to be subject to postentry quarantine should be inspected according to the procedure described in notification on isolated cultivation.

5.2.2 Incentives to farmers for the conservation of landraces

There are no regulations about incentives to encourage cultivate local and traditional agricultural plants

5.2.3 Nature conservation and Environment protection law

The objectives of this law are to protect nature and environment from artificial damage and to conserve a diverse natural ecosystem, and to carry on pleasant life with healthy public welfare. It consists of 7 chapters and 41 articles, and covers as follows;

Article 1: Preamble

Article 2: Basic planning for nature conservation and environment protection, and monitoring for nature and environment

Article 3: Protected area for nature conservation

Article 4: Conservation on biological diversity

Article 5: Nomination of the controlled area

Article 6: Subsidiary regulation

Article 7: Penal regulation

This law also deals with national responsibility and international cooperation for conservation of biological diversity and for sustainable utilization, and its components are such as:

- Monitoring the components of biological diversity.
- Regulation for conservation on biological diversity.
- International trade of the endangered animal and plant species.
- Protection of endemic plant and animal.
- Foreigner's use on host biological resources.
- Import regulation of animals and plants for natural ecosystem conservation.

5.2.4 Seed law

This regulation deals with seed multiplication procedure, seed testing, seed trading and seed import and export. In case of export and import of seeds it is needed to have a permit by the minister of M.A.F.F.

Restriction of import, export, and domestic circulation of seeds are as follows;

- when the Genetically Modified Organisms (GMO) could stress ecosystem,
- when the foreign pest and parasite will be prevalent,
- when the biochemical products by imported seed would be harmful to public health,
- when the injudicious import of seeds will affect seriously on the conservation of domestic plant genetic resources.

Seed multiplication procedure

Seed multiplication procedures are different according to species, as follows;

- cereals are performed in the RDA

  Breeder's seed.

  Basic seed.

  Foundation seed.

  Certified seed.
- Vegetables and ornamental plant are dealt with in the private seed company.
- Trees are performed in the Forestry Administration.

Intellectual property right

Intellectual property right is on the way to establishment.

Access to PGR

The germplasm exchange with foreign country are recommended on government basis. Director General of research institute is in charge of above matters, however curator of Gene Bank decides practically. Factors influencing decision of matters are as follows:

- Availability of materials.
- Agreement with other countries.
- Marketing competition on major resources.
- Prohibition regulation on the distribution of new crop varieties within 3 years.

Overseas collecting missions were never performed until now because of limited fund and administrator's poor understanding on PGR, however there are some possibility afterwards, even though each host country has their own policies.

5.2.5 Other policies

The M.A.F.F. assists the certified cereal seed production farm by purchasing the seeds with higher price than at the market.

5.2.6 Trade, Commercial and other International Agreements

The Republic of Korea became a member of the WTO (1994), CITES and the Convention on Biological Diversity.

CHAPTER 6
International Collaboration

6.1 UNITED NATIONS INITIATIVES

6.1.1 UNCED

In Korea, more than 150 scientists gathered and proposed a "Korea biological diversity 2000", suited to purpose of Agenda 21, for conservation and sustainable use of biological diversity, on national basis, but its budget is not reflect in national budget.

- Status of biological diversity in Korea.
- Strategies for conservation of biological diversity in Korea.
    - Legislation and system.
    - Economical, social and cultural strategies.
    - Conservation of genetic resources *(ex situ* and *in situ* conservation).
    - Research and education.
    - Conservation of biological diversity and international collaboration.

The ministry of Environment established the law of nature protection, Forestry Administration (Forestry genetics and research institute) manages *in situ* conservation of Korea, and *ex situ* conservation is managed by RDA gene bank, Forestry Research Institute, Forestry Genetics and Research Institute, Arboretum of University.

At the lst conference of parties convention on biological diversity agreement, Korea promised to donate the assignment of financial support every year from 1995.

As the purpose of the commission of FAO is conservation and free, sustainable use of agricultural plant genetic resources, it is thought as a part of conference of biological diversity. The conference of biological diversity emphasize *in situ* conservation of biological diversity, but the commission of FAO put emphasis on in *ex situ* conservation.

6.1.2 FAO global system

The commission on PGR is a one with the goal of developing world agriculture by conservation and free exchange of plant genetic resources between the nations, worldwide which are not origin of genetic resources of crop plant introduced insect resistant and disease tolerant plants from origin countries longtime ago and used them to breed new cultivars to increase productivity.

Direct benefits of the commission is still to exchange of information about genetic resources. From now on we anticipate intermediate role of free exchange of crop plant genetic resources between donor country and recipient country. So it would be possible to *in situ* conserve and continuous use genetic resources, and contribute to coexistence of the world. Korea attended the commission in order to contribute to coexistence of world with free exchange of genetic resources by global system.

If CPGR or International Undertaking is set up as a global system and international fund is established, Korea will be a donor of fund, and will be a beneficiary of researcher program and international collection.

From 1991, the RDA Gene Bank was designated as the world a collection center of sesame in cooperation with FAO and IBPGR (IPGRI), and 1600 samples of sesame world collection are under evaluation and conservation process.

6.2 INTERNATIONAL AGRICULTURAL RESEARCH CENTER

6.2.1 The CGIAR

Contribution of CGIAR Center to genetic resources program of Korea, was not noteworthy compared with that of research institutes such as IRRI, CIMMYT and so on that distribute rice, wheat, barley, corn, miscellaneous cereals and sesame.

The way of cooperation which CGIAR Center provides to gene bank of each countries is (1) Training young researcher and continue good relationship enable to exchange the information more quickly (2) Increase utilization and ability of researcher by cooperating evaluation of genetic resources (3) Distribution of genetic resources and advanced materials which CGIAR possesses.

Developed and developing countries should donate more money to CGIAR in order to collect genetic resources and conduct evaluation and enhancement of genetic resources.

IPGRI should control relationship between CGIAR and gene bank of each countries or NARS in order to more freely exchange genetic resources.

6.2.2 Regional Research Centers

AVRDC and RDA keep good relationship.

Regional research center is more convenient place in the area of to technical aspect and exchange of genetic resources and breeding aspect of crops. Korea has formal agreement with AVRDC. It is good chance to interconnect national plan and based on this, it would be possible that formal agreement get better result in relation to other international institutes.

6.2.3 Regional Intergovernmental Initiatives

No collaborative actions has been made so far, but much expectations from regional initiatives could be made for national programs (NARS).

Establishment and maintenance of cooperative relationship in regional country would be beneficial to use genetic resources and develop in that area.

To hold cooperation symposium, workshop and exchange information is more desirable.

6.2.4 Bilateral Intergovernmental Initiatives

They keep general agreement between VIR in Russia and RDA Korea, Agricultural Science and Technology Institute of Korea and China, Agriculture and Fishing Technical Cooperation, Korea and Japan, RDA KOREA and USDA/ARS of USA. It would be possible to enhance understanding each other by collaborating research, visiting each other and exchanging or utilizing genetic resources. And the planned budget donation at government base is indispensable.

CHAPTER 7
National Needs and Opportunities

Even though Korea is placed in temperate monsoon zone with small area and distinct 4 seasons, relative ecology of plants are various because 65% of Korea territory is mountainous areas. Different kinds of plants are distributed according to temperature and position of areas such as forest of subtropic zone, forest of temperature zone and forest of arctic region.

Among the 4,165 species of plants which are distributed in Korea, 126 species of plants are endangered or rare species. Among the 4,165 species, 2,568 species of plants are utilized as medicine, edible plant, grasses and industrial purpose. Korea is fast industrialized country over the last 20 years, and some plants were about to extinct by pollution, wide range of development and excessive collecting, so it is necessary to conserve the resources.

This is situation of plant diversity and related problems of Korea.

1. Little understandings of people and nation scale about biological diversity or plant genetic resources.
2. Research about flora of Korea is restricted. e.g. fragmentary survey of flora and little information is available.
3. There is no natural history museum or biological diversity institute to carry out research about biological diversity, so it is very difficult to research and manage resources.
4. Establishment of the data base about biological diversity is urgent.
5. According to the fast industrialization of Korea and surrounding countries, fast extinction of ecology and quick erosion of landrace.
6. Little inspection of plant distribution, lack of *in situ* and *ex situ* conservation technique.
7. Lack of professional researchers to inspect ecology of plants, search and collect plant genetic resources, analyze genetic constitution, and classify, evaluate, and use germplasm.
8. To conserve plant genetic resources and sustainable use, the activity list below is needed.

The activities listed below are urgently needed at international base.

1. Professional researcher at professional institute to recognize present biological diversity and *in situ* or *ex situ* conservation of biological diversity.
2. National or international collaboration to promote *ex situ* conservation of genetic resources.

Each step of biological diversity program for national activity plan

Section	Program
1st step (Short Term) (1955-2000)	1. Recognition of situation and data establishment of domestic biological diversity 2. Establish the index of environmental effect and adaptation of Korea 3. Estimation of natural resources of the country.(Excavation and utilization of useful biological resources) 4. Conservation and Technical development of domestic biological diversity (gene, species, habitat/in situ, ex situ conservation) 5. Understanding status and establishment of related counterplan of imported foreign species. 6. Reinforcement of related legislation of biological diversity consolidation of organization. 7. Complete change of institute and secure of professional researcher for conserve biological diversity. 8. Public information, education and NGO support 9. Reinforcement of related Program for domestic and international program (exchange of resources, professional researcher, technical information and for education) 10. Secure suitable and stable budget
2nd step (Mid Term) (2001-2005)	1. Continuous monitoring of domestic biological diversity.(ecological, genetical) 2. Establishment and adaptation of systematic environmental effect evaluation system 3. Development of techniques for sustainable use of biological diversity. 4. Technical development for in situ and ex situ long term conservation 5. Technical development for restoration of ruin ecosystem by imported species. 6. Reinforcement of related legislation, system, organization and
3rd step (Long Term) (2006-2015)	1. Monitor (ecological, genetical) domestic and international biological diversity 2. Technical development for use of biological diversity 3. Excavation, use and globalization of typical biological diversity in Korea. 4. Technical development for restoration of ruin ecosystem. 5. Operation of synthetic monitoring system of ecology. 6. Development of management technical of in situ and ex situ protection area.

CHAPTER 8
Proposals for a Global Plan of Action (GPA)

8.1 KOREA WISHES TO PROPOSE FOR INCLUSION IN THE GPA

- Training program of researcher for investigation of plant ecosystem, classification and evaluation.
- Training program of research for analysis and evaluation of genetic variation between and within population in plant species.
- A survey of information on the plant distribution, classification, habitats and genetic variation in Korea.
- Development of database system on the plant ecosystem of Korea.

8.2 KOREA WISHES TO PROPOSE TO PUT PRIORITIES AT THE INTERNATIONAL LEVEL FOR THE GPA

- Regular proportion of collected fund for GPA should be donated from developed countries.
- Authorization of farmer's right and compensation during the certain periods to the country of origin, which has GNP less than certain levels, for the freely access to plant genetic resources and sustainable use.
- Construction of database system for international plant genetic resources through Internet or CGNET. Establish a center for the conservation and use of plant genetic resources due to extension of IPGRI organization.
- A strategy to conservation and sustainable use in each countries such as law, organization, institute, researcher and budgets.
- A wide scope and continuous publicity work on the importance of plant genetic resources in related to life of mankind.

8.3 PROPOSALS OF KOREA PLAN WILL CONTRIBUTE TO GPA

- Support of improving cultivars and breeding technique in major food crops and forestry tree.
- Conservation of world collection and participation of collect mission of plant genetic resources.

ANNEX 1

Forest land utilization in the Republic of Korea

Year	Forest					Others	
	Total	Stocked forest land	Unstocked forest land	Unsurveyed	%	Area	%
1966	6,612,496	5,438,707	1,173,789	-	67	942,163.7	10
1967	6,640,157	5,655,174	942,567	42,416	67	895,669.7	9
1968	6,630,876	5,709,154	878,919	42,803	67	898,097.0	9
1969	6,627,378	5,745,118	835,101	47,159	67	909,200.5	10
1970	6,611,474	5,700,673	859,651	51,150	67	938,758.1	10
1971	6,611,544	5,738,615	825,649	47,280	67	964,896.7	10
1972	6,596,728	5,731,658	821,845	43,225	67	1,009,391.6	10
1973	6,586,185	5,741,531	799,405	45,249	67	1,048,333.2	10
1974	6,640,839	5,930,423	702,633	7,783	67	996,498.1	10
1975	6,635,352	5,980,693	646,876	7,783	67	1,004,863.5	10
1976	6,613,455	6,017,099	588,573	7,783	67	1,028,234	10
1977	6,593,069	6,057,494	572,792	7,783	67	1,061,586	10
1978	6,578,322	6,092,111	478,428	7,783	66	1,095,970	12
1979	6,570,663	6,117,165	445,715	7,783	66	1,118,890	12
1980	6,567,772	6,301,716	241,262	24,794	66	1,135,640	12
1981	6,562,885	6,292,366	245,725	24,794	66	1,150,446	12
1982	6,553,713	6,283,817	245,265	24,631	66	1,168,447	12
1983	6,546,829	6,282,598	239,600	24,631	66	1,188,392	12
1984	6,539,558	6,278,564	241,857	19,137	66	1,217,191	12
1985	6,531,102	6,267,562	44,403	19,137	66	1,238,814	12
1986	6,523,966	6,287,750	217,079	19,137	66	1,294,365	12
1987	6,499,082	6,295,564	184,381	19,137	66	1,279,665	12
1988	6,491,494	6,287,976	184,381	19,137	65	1,294,217	13
1989	6,484,704	6,279,100	186,467	19,137	65	1,314,338	13
1990	6,476,030	6,285,756	174,438	15,836	65	1,342,527	14
1991	6,467,665	6,283,713	168,116	15,836	65	1,371,438	14
1992	6,463,764	6,297,454	166,310	-	65	1,397,669	14
1993	6,459,834	6,289,120	170,714	-	65	1,354,610	14

(Unite: ha)

ANNEX 2

Production of forest products in the Republic of Korea

Year	Total Value	Timber (mq)		Bamboo (bundle)	
		Quantity	Value	Quantity	Value
1977	213,721,575	1,107	28,645,864	118,722	724,885
1978	276,655,770	1,064,191	30,764,764	85,367	608,606
1979	309,443,831	918,152	30,185,145	98,992	697,251
1980	429,511,853	933,191	35,042,003	75,540	785,712
1981	537,946,958	975,550	43,534,278	74,237	871,745
1982	585,345,693	976,114	47,398,318	65,786	727,091
1983	710,949,304	877,611	50,109,107	165,534	2,128,327
1984	751,741,797	853,700	53,222,551	136,288	1,241,657
1985	706,179,245	780,755	46,014,610	138,955	1,326,146
1986	682,844,280	801,183	47,652,928	80,499	753,114
1987	692,096,333	740,667	45,506,385	34,788	322,708
1988	740,322,809	893,414	56,688,746	24,731	257,228
1989	743,737,757	997,102	67,252,799	16,397	170,137
1990	731,433,309	923,126	63,091,641	92,151	1,020,915
1991	743,003,692	680,090	48,929,724	20,494	259,579
1992	825,154,256	673,552	48,659,533	30,897	428,194
1993	898,519,624	710,692	60,915,932	25,486	388,298

(Unit: 100 won)

ANNEX 3

Prtoduction of Food Crops in the Republic of Korea

Year	Rice	Barley	Wheat	Corn	Soy Bean	Potato & Sweet Potato	Average Self-Sufficiency Ratio
1970	3,935	1,820	218	68	232	2,741	(80.4)
1980	3,551	906	92	154	216	1,549	(56.0)
1990	5,612	417	89	120	233	802	(43.0)
1993	4,748	321	148	82	170	905	(33.9)
1993 Cultivated Area (1,000 ha)	1,203	117	0.547	12	12	41	_
Self Sufficiency (%)	96.8	77.2	0.03	1.4	13.8	99.6	_

(Unite: 1,000 M/T)

ANNEX 4

Kinds and area of reserved forest

Kinds of reserved forest	Area (ha)
Prevention of soil erosion and run-off	8,968
Prevention of shifting sandune	1,059
Prevention of stone falling	178
Ist class water shed conservation	140,631
2nd class water shed conservation	20,003
Providing fish habitat	6,027
Health	34
Landscape	30,047
Total	206,947

ANNEX 5

Location and area of national and provincial parks

National Park		Provincial Park	
Location	Area (ha)	Location	Area (ha)
Chirisan	44,048.5	Kumosan	3,791
Kyongju	13,816	Namhansansung	3,644
Kyeryongsan	6,114	Moaksan	4,222
Hallyohaesang	16,556	Mudungsan	3,023
Soraksan	7,300	Toksan	2,104
Songnisan	28,340	Chilgapsan	3,254
Hallasan	14,900	Taedunsan	3,810
Naejangsan	7,603.2	Naksan	910
Kayasan	8,016.3	Maisan	1,690
Tokyusan	21,900	Kajisan	10,607
Odaesan	29,850	Chogyesan	2,738
Chungangsan	10,588.2	Turyunsan	3,464
Taeanhaean	3,869	Sonunsan	4,370
Tadohaesang	34,043	Palgongsan	12,208
Pukansan	7,845	Teadunsan	2,454
Chiaksan	18,209	Mungyungsaejae	530
Walaksan	28,450	Kyungpo	937
Sobaeksan	32,050	Chongyansan	4,876
Pyonsanbando	15,700	Yonhwasan	2,871.7
Wolchulsan	4,188	Taebaeksan	1,744
Total	383,386.2		73,247.7

ANNEX 6

Status of the designated forest stands for *in situ* conserrvatio of genetic resources in forest tree species.

Tree species	No. of population	Owner	Area (ha)	Altitude above sea level (m)
Pinus densiflora	4	National	2,123	680/1300
	1	Provincial	15	800
Pinus koraiensis	3	National	55	850/1,150
Abies holophylla	3	National	43	650/1,150
Pinus thunbergii	2	National	21	300/950
Abies koreana	2	National	32	1,550/1,600
Pinus pumila	1	National	2	1,750
Populus maximowiczii	1	National	5	250
Quercus mongolica	5	National	346	1,200
Cornus controversa	1	National	11	850
Picea abies	1	National	9	900

ANNEX 7

Endemic plants of the Republic of Korea

Class	Family	Genus	Species	Varieties	Forma
Filicineae	4	5	11	-	-
Gymnospermae	3	5	3	6	7
Angiospermae	54	142	325	40	15
Monocotyledoneae	8	4	45	7	-
Dicotyledoneae	46	138	280	33	15
Total	61	172	339	46	22

Based on “Classification of Endemic taxa in Korea”, reported by Lee, 1982.

ANNEX 8

List of the endangered, vulnerable, endemic and rare nativeplants in Korea

Category	Scientific name
Endangered	*Lilium hansonii* Leichtl., *Bulbophyllion inconspicum* Maxim., *Neofinetia falcata* (Thunb.) Hu, *Aerides japonicum* Reichb. FiI., *Phytolacca insularis* Nakai, *Brusenia schreberi* J.F. Gem., *Euryale ferox* Salisb., *Aconiturn koreanum* R. Raymond, *Epimedium koreanum* NaKai, *Jeffersonia dubia* Benth., *Empetum nigrum var. japonicum* K. Koch, *Bupleurum latissimum* Nakai, *Ardisia crenata* Sims, *Lathraea japonica* Miq., *Orobanche coerulescens* Steph., *Lonicera okomtoana* Ohwi. (Total: 16 species)
Vulnerable	*Dryopteris crassirhizoma* Nakai, *Hydrocharis* dubia (Bl.) Backer, *Liliumn callosum* S. et Z., *Polygonatum stenophyllun* Maxim., *Gastrodia elata* Blume, *Habenaria radiata* Spreng, *Calathe discolor* Lindl. var *bicolor* (Lindl.) Makino, *Cymbidium goeringii* Reichb. fiL, *Silene fasciculata* Nakai, *Thalictrum coreanum* Lev., *Drosera rotundifolia* Linne, *Drosera peltata* var. *nipponica* (Masam) Ohwi, *Rodgersia podophylla* A. Gray, *Tiarella polyphylla* D. Don, *Rhododendron brachy-carpum* var. roseum Koidz. *Menyanthes trifoliata* L., *Utricularia bifrda* L., *Utricularia racemosa* Wall., *Pedicularis manshurica* Maxim. *Utricularia japonica* Makino. (Total: 20 species)

Category	Scientific name
Endemic	*Taxus caespitosa* Nakai, *Arisaema takesimense* Nakai, *Disporum ovale* Ohwi, *Toleldia fauriei* Lev. et Vnt. *Hemerocallis micrantha* Nakai, *Aletris fauriei* Lev. *Polygonatwn robustwn* Nakai, *Smilacina bicolor* Nakai, *Lycoris koreana* Nakai, *Iris odaesanensis* Y. Lee, *Calathe coreana* Nakai, *Celtis edulis* NakaL, *Asarum maculatum* Nakai, *Aconitum chiisanese* Nakai *Megaleranthis saniculifolia* Ohwi, *Aconitum trilobom* I. Yang *Corydalis grandicalyx* B. Oh et Y. Kim, *Corydalis humilis* B. Oh et Y. Kim, *Wasabia koreana* Nakai, *Cardamine koreana* Nakai, *Kirengeshoma koreana* Nakai, *Albizzia coreana* Nakai, *Echinosophora koreensis* Nakai, *Euphorbia fauriei* Lev. et Vnt, *Viola diamemantica* Nakai, *Echinopanax horridum* (Non Decne) Kom., *Saussurea polylepis* Nakai, *Bupleurum eupharbioides* Nakai *Gentiana pseudo-aquatica* Kusnezoff *Primula modesta var.* fiuriae Takedo, *Forsythia saxatilis* Nakai *Androsace cortusaefolia* Nakai, *Forsythia ovata* Nakai, *Ajuga spectabilis* Nakai, *Scrophularia takesimensis* Nakai, *Hanabusaya asiatica* Nakal, *Adenophora grandiflora* Nakai, *Leontopodium coreanum* Nakai, *Ligularia taquetii* Nakai, *Senecio koreanus* Kom., *Saussurea seoulensis Nakai,*

(Total: 41 *species*)

Category	Scientific name
Rare	*Psilotium* nudum (L.) Griseb.,
	Crypsinus hastatus (Thunb.) Copel,
	Carex chordortiza Ehrh.,
	Arisaema negishii Maldno,
	Trillium tschonoskii Maxim,
	Lilium tenuifolium Fish.,
	Lycoris aurea Herbert,
	Sisyrinchium angustifolium for *album* J. Sim et Y. Kim,
	Iris rossii var. album Y. Lee,
	Iris dichotoma Pallas,
	Iris setosa Pallas,
	Iris uniflora var. carinata Kitagawa,
	Vexillabium yakusimense (Yamamoto) F. Maekawa,
	Goodyera sctdechtendalkm Reichb. fil.,
	Calanthe reflexa Maxim,
	Calanthe discolor Lindley,
	Calanthe striata R. Brown,
	Cremastra appendiculata Makino
	Cypripecdium japonicum Thunberg,
	Orchis cyclocidla Maxim.,
	Galeola septentrionalis Reichb. fil.,
	Lecanorchis japonica BI.,
	dendrobium monilifome (L.) Sw.,
	Cymbidium niponicum Malkino,
	Saururus chinensis Baifl,
	Pilea taquetii Nakai,
	Ranunculus kazusensis Makino,
	Isopyrum mandshurica Komarov,
	Leontice microrhyncha S. Moore,
	Schizandra nigra Maxim.,
	Desmodium caudatum DC.,
	Zanthoxylurn coreanum Nakai,
	Berchemia racemosa var. Magna Makino,
	Hibiscus hamabo Sieb. et Zucc.,
	Viola websteri Hemsl.,
	Daphne kiusiana Miq.,
	diapensia obovata (Fr. Schm.) Nakai,
	Monotropa hypopithys L.,
	Arctous ruber (Rehder et Wilson)Nakai,
	Rhododendron mucronulatwn for. *albiflorum* T. Lee,
	Trientalis europaea L. var. *arctica* (Fischer) Ladeb.,
	Gentiana jamesii Hemsl.,

Category	Scientific name
	Anagallidium dichotomum (L.) Griseb., *Scopolia japonica* Maxim., *Peicularis verticillata* Linne, *Cacalia pseudo-taimingasa* Nakai (Total : 49 species)

ANNEX 9

Crop land-race collections at the same farms at different locations in both 1985 and 1993.

Crops	Sangjoo Kum			Geumneung Kum			Gochang Kum			Average maintenance Ratio (%)
	1985	1993	Ratio of maintenance (%)	1985	1993	Ratio of maintenance (%)	1985	1993	Ratio of maintenanc-e (%)	
Soybean	23	5	23	11	3	27	48	9	19	21
Adzuki bean	8	4	50	5	2	40	22	9	41	43
Mungbean	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 / Ave.	57	14	25	51	12	24	114	31	27	26

No. of farms investigated: 147 (Sangjoo 44, Geumneubg 38, Gochang 65)

ANNEX 10

Tree species of main natural forest stands and the number of populations conserved in situ in Korea.

Tree Species	Population	Area (ha)
Needle leaved trees (13)	93	9,891
Pinus koraiensis Sieb. et Zucc.	19	212
Pinus densiflora Sieb. et Zucc	28	9,005
Abies holophylla Maxim	14	147
Pinus thunbergii Parlatore	12	159
Abies Koreana Wilson	9	125
Pinus pumila (Pall.) Regel	1	2
Taxus cuspidata Sieb. et Zucc.	1	5
Abies nephrolepis Maxim.	4	26
Picea abies (L.) Krsten	4	10
Picea iezoensis (Sieb. et Zucc.) Carr.	3	53
Juniperus chinensis L. var. *sargentii* Henry.	1	12
Torreya nucifera (L.) Sieb. et Zucc.	1	20
Empetum nigrum L. var. *japonicum* K. Koch	1	15
Board-leaf treee (20)	80	1,791
Quercus variabilis Bl.	4	392
Betula schimidtii Regel	4	20
Fraxinus rhynchophylld Hance	7	56
Cornus controversa Hemsley ex Prain	6	33
Tilia amurensis Rupr.	6	29
Betula costata Trautvetter	7	41
Fraxinus mandshurica Rupr.	4	31
Juglans mandshurica Carr.	2	4
Quercus acutissima Carr 1	7	
Acer truncatum Bunge	1	9
Betula ermanii Chamisso	1	3
Acanthopanax senticosus (Rupr. et Maxim.) Harms	1	1
Sterwartia pseudocamellia Maxim.	1	2
Rhododendron schlippenbachii Maxim.	1	4
Quercus serrata Thunb. ex Murray	4	127
Betula davurica Pall.	1	4
Populus maximowiczii Henry	1	5
Ulmus davidiana Planchon ex DC. var. *japonica* (Rehder) Nakai	1	4
Carpinus laxiflora (Sieb. et Zucc) Bl.	4	43
Quercus mongolica Fisch. ex Ledeb.	23	976
Total (33 species)	178	11,582

(Forest Genetics Research Institute, 1994)

ANNEX 11

Status of ex situ conservation in forest tree species

Type of Preservation	Treee *species*	No. of Clones	No. of Cultivar	No. of Plants	No. of samples	Area
Seed production	*Pinus 20 densiflora*, etc.	1,492		254,366		725.5
Clone bank	*Cryptomeria 20 japonica*, etc.	2,069		33,227		68.3
Cultivar maintenance	*Castanea 53 crenata*, etc.		1,536	11,114		21.3
Display garden	*juglans 229 manshurica*			1,904		7.0
Experimental Forest	*Populus 14 davidiana*, etc.			54,206		29.9
Progeny test Forest	*Abies 14 holophylla*, etc.			114,165		55.1
Introduced *species*	*Pinus 99 taeda*, etc.			102,017		76.9
Ex situ conservation	*Pinus densiflora*			6,000		3.0
Tissue culture seedling	*Populus nigra* 13 var. italica, etc.			6,872		1.5
Seed preservation	*Pinus 149 koraiensis* etc.				946	
(Total)	611	3,561	1,536	583,871	946	988.5

ANNEX 12

Surface area, Dimension and capacities of RDA Genebank

Items	Capabilities & Activities	Area (m^2)	Temp. (°C)	Humidity (%RH)
Long-term Storage	200,000 samples	44 x 2	-18±1	Frost free
Duplication facility *	200,000 samples		-10±1	Frost free
Short-term Storage	200,000	44 x 4	4±1	40
Seed Drying Room	Drying of seed moisture content up to 3-8%	15	15±3	15
Packing Room	Reducing the infiltration of moisture	50	20±3	30
Laboratory & Others	Monitoring the seed viability & their management	1,000	Air conditioning	

* Yeungnam Agri. Exp. Station Located at Milyang, Korea
An International Standard recommended by IBPGR
To withstand earthquake damage
To maximize storage spaces by using Mobile Rack System

ANNEX 13

Status of ex situ conservation on plant genetic resources in Korea

Items	N.o of organization	Year of estabilishment	Reproductive types	No. of Staff (Persons)	Area (ha)	No. of accession	No. of *species*
Genebank	1	1991	Seed	18	0.15	115,639	
National (Botanic garden)	4	1967 1992	Trees	40	2,043	6,266	3,000 *species*
Private (Botanic)	1	1985	Ornamental shrubs & Trees	14	1	1,088	
Private (garden)	4	1969 1987	Ornamental shrubs & Trees	123	253	11,277	7
Arboretum			native plants	8	53	1,258	900 *species*

ANNEX 14

The current status of seed orchards and seed supply for the planting programme in the Republic of Korea

Species	Seed orchards established	Status of seed supply
Pinus densiflora	109	sufficient
P. thunbergii	22	sufficient
P. rigida	50	sufficient
P. rigida X P. taeda	80	sufficient
P. koraiensis	91	insufficient
Abies holophylla	10	insufficient
Cryptomeria japonica	30	sufficient
Chamaecyparis obtusa	40	sufficient
Larix leptolepis	270	insufficient
Quercus acutissima	3.6	insufficient
Q. variabilis	2.0	insufficient
Q. serrata	2.0	insufficient
Betulla costata	2.7	insufficient
Fraxinus mandshurica	4.0	insufficient
F. rhynchophylla	2.0	insufficient
Zelkova serrata	1.0	insufficient
Juglans mandshurica	2.9	insufficient
Genus Alus	3.1	sufficient
Genus Tilia	0.2	insufficient
Total	725.5 ha	

ANNEX 15

The current status of selected plus trees and their clone banks in the Republic of Korea

Species	No. of trees selected	No. of clones conserved
Pinus densiflora	425	422
P. thunbergii	151	151
P. rigida	87	87
P. rigida X P. taeda F 1	150	149
P. taeda	13	13
P. koraiensis	300	299
Larix leptolepis	145	145
L. gmelini	4	1
Cryptomeria japonica	93	90
Chamaecyparis obtusa	114	102
Abies holophylla	100	99
Quercus acutissima	207	70
Q. serrata	110	48
Q. variabilis	110	50
Q. mongolica	110	20
Fraxinus mandshurica	100	99
F. rhynchophylla	104	90
Juglans mandshurica	102	19
Zelkova serrata	102	94
Betulla costata	48	-
B. schmidtii	50	-
Genus Alus	34	12
Tilia mandshurica	25	-
T. amurensis	18	2
Populus davidiana	10	-
P. koreana	2	-
P. maximowiczii	4	-
Carpinus laxiflora	6	-

Total	2,724	2,062

ANNEX 16

Applications of different clonal propagation methods for the estabilishment in the Republic of Korea

Species	Method	Status	Remarks
Pinus densiflora	grafting	very good	
P. thunbergii	grafting	very good	
P. rigida	grafting	very good	
P. rigida X P. taeda	grafting	very good	
P. koraiensis	grafting	good	
Abies holophylla	grafting	very good	
Cryptomeria japonica	cutting	very good	high rootability
Chamaecyparis obtusa	cutting	very good	high rootability
Larix leptolepis	grafting	very good	
Quercus acutissima	grafting	not so good	by rejuvenation
Q. variabilis	grafting	not so good	by rejuvenation
Q. serrata	grafting	not so good	by rejuvenation
Betulla costata	tissue culture	good	
Fraxinus mandshurica	grafting	not so good	low survival
F. rhynchophylla	grafting	not so good	low survival
Zelkova serrata	grafting	not so good	low survival
Genus Tilia	grafting	not so good	low survival