JAPAN:

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

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Note by FAO

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CHAPTER 1
Introduction

Japan has and will continue to give high priority to national and international efforts to conserve global plant genetic resources. Japan seeks cooperation, collaboration and good coordination at the multilateral and bilateral level to ensure that efforts to protect and sustainably use global plant genetic resources are focused, well directed and harmoniously conducted.

Progress in the molecular and environmental sciences have been remarkable over the past decade. Further technological progress is needed, perhaps in areas where different disciplines overlap, which will lead to improvements in *in situ* and *ex situ* genetic resources conservation in the future.

The Japanese government recognises that more attention to holistic conservation is required and will endeavor to fully participate and provide its own experiences to other countries on this vital global issue.

Japan consists of 3 island arcs, the Honshu, Ryukyu and Izu-Bonin arcs, spanning about 3,000 km between 46°N to 24°S. The climate ranges from sub-tropical in the south to cold temperate in the north. Most of Japan enjoys a climate found in southern temperate regions. Japan's climate is mainly controlled by the rhythmic shift of the monsoon circulation. The moderating effect of the sea is felt in coastal lowlands. Japan experiences two rainy seasons between spring and summer and in the autumn.

The land area of Japan is 378,000 km^2 but only 14% of this is of use agriculturally of which 12% is cultivated and 2% is in long term pasture. 66% of Japan is mountainous and abundantly forested. Short fast flowing rivers have been harnessed for irrigation of rice and to provide hydroelectricpower. 20% of Japan's surface is urban or under road or rail systems.

Japan has a population of 124 million which has become increasingly urban this century. The number of farm households has dropped from 6 million in 1960 to 3.7 million in 1992 (9% of total Japanese households). By the year 2000 the number of farm households is expected to decline to less than 3 million (FAO,1993).

1.1 THE JAPANESE FLORA AND ITS CONSERVATION

Japan supports a rich flora in relation to its size (Table 1). This is a consequence of Japan's earlier closer proximity to mainland Asia and its subsequent insular development with distinctive diverse geographic and climatic characteristics. Japan's flora was not greatly affected by the Pleistocene glaciation which has resulted in some relic flora's remaining in Japan.

The total flora of Japan of nearly 4,000 species includes many endemic species, particularly on the Ryukyu islands and Bonin islands. Threatened and endangered plants have been highlighted in the Red data book for Japan (Japanese Society of Plant Taxonomists, 1993).

Preservation of natural vegetation has been an important component of the Japanese governments conservation strategy. Many laws have been passed in Japan to protect the environment such as the Basic Environment Law and the Natural Environment Conservation Law. After the Second World War reafforestation was one of Japan's national priorities. In the Nature Conservation Law was passed to preserve important nature reserves.

The main laws and regulations on the preservation of vegetation in Japan are the National Parks Law (administered by the Environment Agency), the Law for the Protection of Cultural Properties (administered by the Agency for Cultural Affairs), and the Regulation of Reserve Forests (administered by the Forestry Agency) (Takahashi et al., 1975), Law for Conservation of Endangered *Species* of Wild Faune and Frola (administered by Environment Agency, Ministry of Agriculture, Forestry and Fisheries and Ministry of International Trade and Industry) and the Guidelines for Establishing Protected Forests and National Forest Management Bylaw (administered by Forestry Agency) (Takahashi et al., 1975, National Strategy of Japan on Biological Diversity).

a) Natural Parks

Japan's natural parks consist of National, Quasi-national and Prefectural Parks and each is divided by virginity, scenic or recreational value into various subdivisions: the special protection area, first, second and third class special protection areas and ordinary areas. Natural parks occupy about 13.5% of Japan's total land area.

b) Natural monuments

The conservation of plant life in Japan was first officially promoted by an act passed in 1919 to designate various plants official national monuments.

Since then scientifically important plant specimens or communities and botanical natural monuments are protected by various laws (Kato, 1995).

c) Reserve forests

The objective of preserving reserve forests is to contribute to the management of National Forests and to conserve places of scenic beauty and/or wildlife.

1.2 JAPANESE AGRICULTURE TODAY

The total area of Japan's agricultural land in 1991 was 5,204,000 ha, of which 2,825,000 ha or 54% was paddy (rice) fields. The total value of Japan's agricultural output was about US$ 127,000 million (\100=$1) in 1991. Of this output 27% represented dairy and meat, 25% rice, 24% vegetables and 10% fruit. Since 1975 agricultural land has been declining in favor of non-farm uses at an average annual rate of about 22,000 ha, most of which is taken out of paddy production (FAO, 1993).

Japanese farms are characterised by their small size per farm household. Of all commercial farms in 1991, 58% were less than 1 ha and only 13% were more than 2 ha in size. In addition to the small size of farms the land of farm households tends to be fragmented. Small home gardens around farm houses are a major reserve of agriculture crop genetic diversity in Japan.

The Japanese government has a target to increase the size of farm holdings so Japanese agriculture can become more efficient and competitive (FAO, 1993). Both the decline in farmland area and farm household number and structural changes to increase farm holdings are likely to have an adverse effect on farm crop diversity in some areas.

The Japanese government introduced a policy on sustainable agriculture in fiscal year 1992. Sustainable agriculture, as defined by MAFF (Ministry of Agriculture, Forestry and Fisheries), must meet 2 basic criteria:

A. sustainable yields and quality;

B. reduced use of chemicals and mineral fertilizer.

A number of sustainable agriculture initiatives have been taken, such as incorporating more natural pest and disease resistance into crops to reduce the use of pesticides, which are leading to beneficial environmental effects. The promotion of sustainable agricultural practices is likely to have a conserving effect on genetic diversity off the farm as, for example, run off pollution is reduced.

Japanese agriculture is currently in transition as it adjusts to major international and internal changes related to the agriculture sector. Conservation, evaluation

and sustainable use of genetic resources is one of the components to help effect this transition smoothly.

Table 1. Comparison of the Japanese flora with that of North America and New Zealand (adapted from Maekawa, 1974)

Region	*Gymnosperm (gen) spp*	*Dicotyledons (gen) spp*	*Monocoty-ledons (gen) spp*	Latitude
Japan	(17) 39	(737) 2353	(275) 1064	30-45.5°N
Eastern N.America	(10) 26	(438) 1727	(178) 974	36.5-48°N
New Zealand	(5) 20	(233) 1249	(115) 438	34-47.5°S

CHAPTER 2
Japanese Agricultural Plant Genetic Resources

Japan represents, for many *species*, a latitudinal edge where unusual diversity may be expected. Zeven and de Wit (1982) includes most of Japan with China to form a China- Japanese Center of crop diversity.

The *species* of cultivated plants which originated in Japan are shown (Table 2a) (Kihara, 1969). Most of the indigenous food crops of Japan are peculiar to Japanese cuisine, such as wasabi (*Eutrema japonica*) and mioga (*Zingiber mioga)*. Major crops which are thought to have been introduced into Japan more than 2,000 years ago are shown (Table 2b). Cultivated *species* found in Japan around the 10th century AD are shown (Table 2c). All these *species* have been selected for Japan's agroecological conditions and there is considerable diversity for these crops in Japan.

The major crops and some related wild *species* of crops in Japan are listed in Appendix 1.

The five major crops of Japan are rice, wheat, barley, potatoes and soybeans. None of these crops was domesticated in Japan. The major crops of Japan, by area and yield is shown (Table 3).

Japan is a food importing country. In 1989 the food self sufficiency of Japan on a calorie basis was only 48%. Consequently Japan imports large amounts of food from other countries. Over 80% of Japans consumption of soybeans, maize and wheat are imported (MAFF 1989).

Table 2. Plant species long cultivated in Japan (Source:Kihara,1969)

a. Originating in Japan

Allium ledebourianum (asatsuki)
Aralia cordata (udo)
Brasenia schreberi (junsai)
Cryptotaenia japonica (mitsuba)
Equisetum arvense (tsukushi)
Lilium auratum (yama-yuri)

Lilium lancifolium (oni-yuri)
Lilium maximowiczii (ko-oni-yuri)
Oenanthe stolonifera (seri)
Petasites japonicus (fuki)
Phellopterus littoralis (hama-bohu)
Polygonum hydropiperi (tade)
Pteridium quilinum (warabi)
Salsola komarovi (oka-hijiki)
Suaeda glauca (matsuna)
Tetragonia expansa (tsuruna)
Wasabi japonica (wasabi)
Zanthoxylum piperitum (sansho)
Zingiber mioga (myoga)

b. *Species* introduced into Japan more than 2,000 years ago

Cannabis sativa
Colocassia esculenta
Cucumis melo
Fagopyrum esculentum
Glycine max
Gossypium herbaceum
Hordeum vulgare
Oryza sativa
Panicum crus-galli
Panicum miliaceum
Phaseolus chrysanthos
Raphanus sativus
Setaria italica
Triticum vulgare

c. *Species* introduced into Japan prior to 1,000 years ago

Allium fistulosum
Arctium lappa
Benincasa hispida
Brassica juncea
Brassica rapa
Cucumis sativus
Dioscorea batatas
Pisum sativum
Sesamum indicum
Solanum melongena

Table 3 Major crops of Japan - production and area (MAFF,1994)

	Production (tons)	Area (ha)
Rice 1	7,834,000	2,139
Wheat1	637,000	184,000
Barley1	271,000	74,000
Potato1	3,493,000	111,000
Sweetpotato1	1,033,000	53,000
Soyabean1	100,600	87,000
Azuki bean1	45,000	52,000
Radish 2	2,346,000	59,000
Mikan (Citrus) 2	1,683,000	69,000
Apple 2	1,039,000	49,000
Japan pear 2	418,000	18,000
Plum (eating) 2	33,000	4,000
Plum (pickling) 2	82,000	16,000
Persimmon 2	307,000	26,000

[1] Figures for 1993
[2] Figures for 1992

CHAPTER 3
The Japanese Plant Genetic Resources System

The Japanese Academy of Sciences Agriculture section has a genetic resources committee which oversees genetic resources activities in Japan. Three Ministries have major activities related to the conservation of plant genetic resources these are the Ministry of Agriculture, Forestry and Fisheries, the Ministry of Health and Welfare and the Ministry of Education (Fig.1) (Suzuki and Watanabe 1987). Conservation of plant genetic resources as a nationally coordinated activity was initiated by the Agriculture, Forestry and Fisheries Research Council of the Ministry of Agriculture Forestry and Fisheries (MAFF) in 1965.

Nationwide efforts to conserve traditional varieties of various crops was undertaken (e.g. rice collections in the 1960's are described by Omura,1970). By the 1980's a more comprehensive national structure for conservation was developed within MAFF. This consists of central institutes for research on conservation of crop (National Institute of Agrobiological Resources-NIAR) and forest (National Forest Tree Breeding Center) genetic resources (Nakagahra, 1994; Ohba, 1994). These two institutes also have the national crop and forest genebanks.

3.1 MAFF GENEBANK PROJECT FOR AGRICULTURAL CROPS

Structure: The MAFF Genebank for plants consists of a National Center (NIAR) and sub-banks located throughout Japan. Sub-banks are located in 15 national institutions (Table 4). They are assigned specific crops, and share research activities on collecting, evaluation and preservation for vegetatively propagated plants, multiplication, and development/use of the germplasm for new breeding materials. 43 research units in prefectural institutes are connected to the network of the project with special assignments from MAFF.

The project has divided agricultural crops into 12 groups i.e. 1. rice, 2. wheat and barley, 3. tuber crops, 4. legumes, 5. small grains and industrial crops, 6. forage crops, 7. fruit trees, 8. vegetables, 9. ornamental plants, 10. tea, 11. mulberry, 12. tropical crops. A curator is appointed for each plant group. These curators make

annual plans, long term schemes for evaluation, documentation and collecting as well as proposing appropriate budgeting and allocation of human resources needs.

Collection: Domestic exploration in recent years has been intensive with between 7 and 8 missions being undertaken annually (Table 5). These missions now target the most remote locations and small islands. Foreign scientists have participated in some of these missions in Japan. International collaboration on collecting is covered in chapter 6.

Preservation: In 1988 a new generation of preservation facilities was built to house the increasingly large collection of germplasm conserved in Japan (Table 6). The storage facility has a complete robotic storage facility. The active collection is maintained at -1°C, 30% RH and the base collection at -10°C, 30% RH.

Vegetatively propagated plants are maintained either in field genebanks or cellbanks. The Center Bank and specific sub-banks are assigned to preserve these crops. Cryopreservation techniques, using ultra low temperature, are being applied to preservation of plant *species*, for which this process is appropriate, at the Center Bank.

Data management: Initially information on conserved plant genetic resources was published as catalogues (e.g. NIAR, 1990). Early laboratory based computerization has now evolved into a national computer network. The national network permits research stations across Japan to use the central germplasm database. This system is being expanded with the development of a DNA database. These databases which function within the MAFF communications network has linkages to INTERNET so that the Japanese system is part of the global system. The Japanese government is placing high priority on improvements in a national information network and international linkages (Umehara, 1993).

Distribution: The number of accessions distributed in recent years from the MAFF genebank project is shown (Table 7). The foreign countries (economies) which have received germplasm from Japan via the MAFF genebank project are shown (Table 8).

3.2 CONSERVATION OF GENETIC RESOURCES BY THE MINISTRY OF EDUCATION

A number of institutes of the Ministry of Education conserve large collections of genetic resources. The University of Kyoto has historically important collections of cereals (Sakamoto, 1993, 1994). Important collections of the *Oryza* are conserved

at the National Institute of Genetics (Oka, 1988). Many other collections are held by other institutes of the Ministry of Education and these are listed in Appendix 2. Some of the genetic resources conserved within the Ministry of Education are duplicated in the genebank system of the Ministry of Agriculture. Some of the collections, such as the *Oryza* collection, are duplicated in CGIAR genebanks.

3.3 *IN SITU* CONSERVATION

Research on issues related to *in situ* conservation are being conducted in various laboratories in Japan. Much of this work focuses on wild relatives of crops. However the institutional framework for effective *in situ* conservation of farmland ecosystems is still lacking in Japan. As Japan's farming population ages, since young people are not choosing farming for a career, the prospect of increasing genetic erosion and loss of indigenous knowledge is a real threat (Shirata and Vaughan, 1994).

Table 4 Plant genetic resources system in MAFF

Academy of Sciences Agriculture section -section 6			
Committee on Genetic Resources			
Governament Ministry	Ministry of Health and Wwelfare	Ministry of Education	Ministry of Agriculture Forestry and Fisheries
Principal Genetic Reasources Conserved	Medicinal Plants	Crop genetic Resources	Crop genetic Resources

Fig. 1 Japan-Plant Genetic Resources

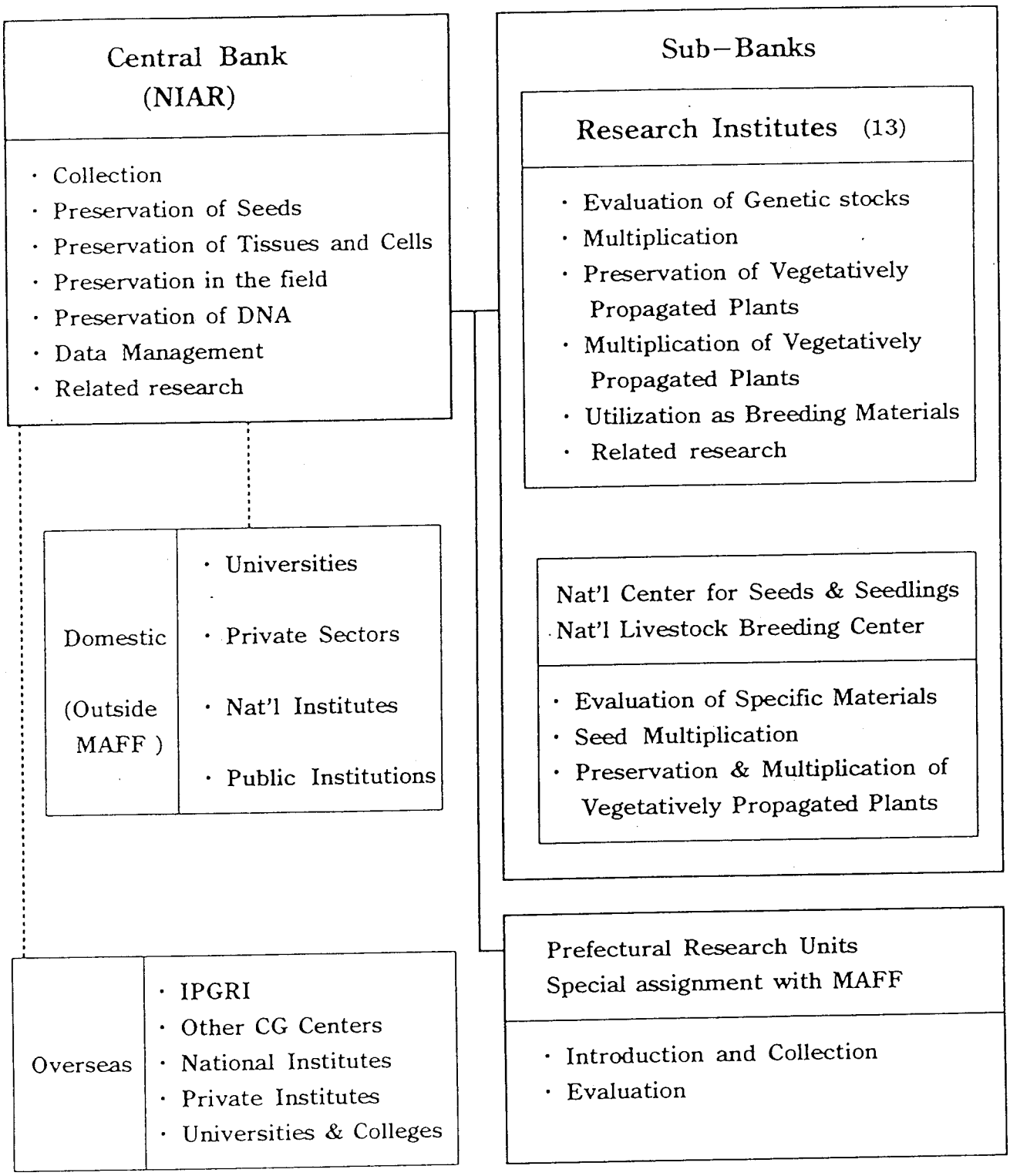

Table 5 Collecting missions within Japan for plant genetic resources carried out under the MAFF genebank project 1990-1994

Year	Region	Crop/Genus
1990	Nagano	Food legumes, millets
	Yonaguni	Wild *Vigna*
	Iwate, Yamagata	Food legumes, millets
	Iwate, Amori	*Perilla, Sesamum*
	Miyagi,Iwate,Aomori,Akita	*Rosa rugosa*
	Miyako and Yaeyama islands	Sub-tropical plants
	Gifu, Tochigi, Hokkaido	Fragaria
	Fukuoka, Oita	Soybean
1991	Okinawa	Food legumes, millets, *Sesamum*
	Akita, Yamagata	Food legumes
	Nationwide	Zoysia
	Hokkaido	Wild mulberry
	Niigata, Akita, Iwate	Tea
	Western Japan	Wild Castanea
	Shikoku, Kyushu	*Dendrobium*
1992	Nationwide	*Cucumis*
	Kyushu	Wheat and barley
	Miyako and Yaeyama islands	Sub-tropical crops
	Setouchi	*Juncus*
	Tohoku	Food legumes and millets
	Shikoku	Millets etc.
	Okinawa	*Vigna spp.*
1993	Kochi	Food legumes and millet
	Tanega, Yaku islands	Food legumes
	Shikoku	Sweet potato
	Nationwide	Perennial ryegrass
	Okayama	Wild peach
	Ryukyu islands	*Camellia*
	Tohoku	Wild soybean
	Hokuriku	*Leymus, Elymus*
1994	Aomori	Food legumes, millets
	Tsushima islands	Food legumes
	Goto islands	Food legumes

Year	Region	Crop/Genus
	Khushu	Chikusichloa
	Okinawa	*Momordica, Luffa*
	Hokuriku	Buckwheat
	Amami, Koshiki	Mulberry
	Shikoku	Sugarcane

Table 6 Present status of preservation of Plant Genetic Resources in MAFF(1994)

Crop Group	No. Of Accessions			
	Total	Base	Active	Vegetative
Rice	28,450	23,823	17,395	257
Wheat and Barley	56,968	53,386	24,140	417
Food legumes	15,126	12,687	8,824	0
Root and Tuber crops	5,762	4,862	3,866	5,120
Millet/ Industrial crops	10,186	8,523	6,414	2,649
Forage plants	42,330	16,652	11,020	8,545
Fruit trees	8,082	5,666	3,941	8,081
Vegetables	22,545	12,531	5,844	1,419
Orrnamentals	4,448	1,693	288	4,395
Tea	5,712	4,783	851	5,712
Mulberry	2,084	1,593	213	2,084
Tropical crops	888	162	161	218

Table 7 Records of accessions distributed from the Central genebank of MAFF based in Tsukuba, 1990-94

Year	No. of accessions distributed				
	Institute	University	Private Comp.	Abroad	Total
1990	5,651	896	482	373	7,402
1991	5,394	850	380	691	7,315
1992	7,235	505	172	452	8,374
1993	3,997	444	283	1034	5,758
1994	5,496	372	206	692	6,729

Table 8 Accessions distributed abroad from the Center Bank in recent years

Crop group									
Country Region Economy	Rice	Wheat Barley	Legume	Tuber crop	Small grains	Forage crop	Fruit tree	Vegetables	Total
Albania						22		38	60
Brazil		42	13					12	67
Bulgaria	79	695			83			287	1144
Canada					211			62	273
Czechos- lovakia		13			20		6	61	100
China	16	11	5	44	67	4	23	25	195
France	13	17	48		61	78		61	278
Germany		192	15		97	37		133	474
Greeke								98	98
Hungary		73		8	11	2			94
India	383	21		4	20	15		87	530
Israel					12			40	52
Italy	20	10		8		20		19	77
Rep.of Korea	28	212	18		43	6	33	28	368
Nepal	239								239
Nigeria			24			40			64
Paraguay			78		3				81
Philippines	34					100		178	312
Poland			1			69		31	101
Russia	89	146	2	9	80	105		39	470
South Africa						70			70
Taiwan (Chinese Taipai)					103	7		38	148
Turkey	11	26			19	45		21	122
UK	243	29	4		7			26	309
USA	64	4	272		124	24		135	623
Others	41	66	96	32	24	43	26	110	438

CHAPTER 4
The Evaluation and Use of Genetic Resources in Japan

Characterisation and evaluation of genetic resources has been conducted systematically as a part of the MAFF genebank project. In this section the characteristics of the Japanese evaluation system are discussed and outstanding examples of useful traits found from evaluation in the crop groups designated within the MAFF genebank project are given.

4.1 CHARACTERISTICS OF JAPAN'S EVALUATION SYSTEM

The MAFF genebank project designates three levels of evaluation for each crop species, primary, secondary and specific special characters. Specific special characters depend on the importance of the trait for users and how difficult it is to measure (Table 9). The descriptors for primary evaluation (Level 1) are limited in number to about ten essential characters.

The secondary characters (Level 2) include resistance to pests and diseases, detailed agronomic traits, such as some quantitative characters and stress tolerance. Specific characters (Level 3) are, for example, amylase content of cereal endosperm, enzyme activities/electrophoretic zymogram patterns, some results of DNA analysis, grain quality, productivity or yield. In recent years about 20,000 accessions annually have been evaluated at the primary level (Nakagahra,1993).

4.2 EXAMPLES OF USEFUL GERMPLASM FOUND DURING SYSTEMATIC EVALUATION

Rice: Jukkoku, a native variety from Kyushu island has been the principal semi-dwarf gene source for rice in Japan. Exotic varieties of rice have mainly been used in Japan to breed for pest and disease resistance such as Modan, a Pakistan variety, which furnished resistance to rice stripe virus. Breeding to adapt rice to mecha-

nised production has been very effective in Japan. Today most operations in rice production are mechanized.

Food legumes: The Japanese soybean variety Keburi has an altered protein content and a wild soybean from Kumamoto prefecture was found to be a group A acetyl saponin defficient mutant. These varieties have been used to study soybean chemical composition so that soybeans with improved quality can be produced (Kitamura,1991; Tsukamoto et al., 1992). A wild accession of *Phaseolus vulgaris* from the CIAT genebank was found to be resistant to Mexican bean weevil (*Zabrotes subfaciatus*) and is being used in breeding(Ishimoto and Kitamura, 1993)

Wheat and barley: A search among 1,700 conserved wheat accessions for wheat which lacked waxy proteins led to finding the variety Baihou which lacks the WxB1 protein. This could lead to the development of glutinous wheat. The wheat variety Nobeokabozu has polygenic resistance to scab (*Gibberella zeae*(Schw.)Petch.) This variety has been used as a parent in breeding (Yamada, 1993). The barley variety, Mokusekko 3 from China, has two resistance genes to barley yellow mosaic disease (Ym, Ym(t)). This variety is being used to breed for resistance to this disease (Yamada, 1993).

Tuber crops: The Japanese local sweet potato variety Hichi-fuku, which is resistant to black and stem rot and has excellent storability, has been used in breeding many varieties including the popular variety Hi-Starch (Shiotani,1995) An accession of the wild relative of sweet potato (*Ipomea trifida*), from Mexico, has been used to increase starch production. This wild *species* also has resistance to root knot nematode and root lesion nematodes. These traits have been transferred to improved varieties (Komaki, 1995).

Forage crops/lawn grasses: Japanese accessions of the lawn grass *Zoysia japonica* have been found which stay green longer in autumn. The commercial use of this germplasm is being exploited. Apomictic Guinea grass (*Panicum maximum*) from Africa has been used to develop a new variety of Guinea grass forage called "Natsukaze".

Small grains/industrial crops: Native buckwheat, *Fagopyron esculentum*, varieties have been found with high rutin content. The sesame cultivar H65 from China has higher antioxidation activity than Japanese cultivars and is being used as a parent in breeding.

Fruit: Japanese pear (*Pyrus pyrifolia*) is not resistant to scab disease (*Venturia nashicola* Tanaka et Yamamoto). However, resistant clones have been found in *Pyrus aromatica* Kichuchi et Nakai. This resistance is being analysed to determine its value in breeding.

Vegetables: Late bolting Chinese cabbage, *Brassica campestris*, has been an objective of breeders in Japan. The Japanese local variety, Oosakashirona, has been a source of this trait (Ishiuchi,1993). *Cucumis aculeatus* introduced from Russia has been used as a source of genes to suppress side branching in melon.

Tea: One Japanese accession (MAK ZAI 17-1) has been used to produce lower caffeine type tea and an Indian accession (MAK IND 113) has beeen a source of high caffeine.

Over a long period Japan has closely incorporated conservation of genetic resources with its plant breeding network. The examples given above illustrate the diverse types of traits that Japanese breeders are looking for in conserved germplasm and the value of both indigenous germplasm and germplasm from other countries that furnish needed traits. Bulletins on the evaluation of germplasm in Japan have been regularly published (e.g. NIAR, 1990) in addition to being incorporated into the national germplasm database.

4.3 JAPAN'S CONTRIBUTION TO WORLD AGRICULTURE

Japanese plant genetic resources have played a major role in improving agriculture in other countries. Norin 10, a Japanese breed semi-dwarf wheat variety became one of the parents of the varieties that played such an important role in the wheat green revolution (Suzui and Nakagahra, 1993). One of the most widely grown rice varieties of all time is Mashuri. The original cross was made in India and then in later generations selected in Malaysia. Mashuri traces part of its ancestor to two old Japanese varieties - Shinriki and Kamenoo (Kawakami and Fujii 1981). Mashuri is popular because of its good taste and ability to grow in adverse environments.

The Japanese clone 821 of *Malus floribunda* has been internationally important as a source of resistance to apple scab (*Venturia inaequalis* (Cooke) Winter). Many apple varieties of the U.S. and other countries, such as Prima and Priscilla, have clone 821 in their parentage.

These examples indicate how Japan, despite being a recipient of germplasm, has also contributed useful germplasm to the world community.

Table 9 Weighted characters for evaluation

Number of characters required									
Crop group	Num. of Crops	An Example crop	Level 1 Rqd	Level 1 Optl	Level 2 Rqd	Level 2 Optl	Level 3 Rqd	Level 3 Optl	Total
01) Rice	1	Rice	13	18	12	8	8	5	64
02) Wheat & Barley, etc.	2	Wheat	9	19	10	9	7	12	66
03) Legume	3	Soybean	12	5	3	9	3	6	38
04) Tuber crops	2	Sweet potato	15	14	15	12	12	14	72
05) Millet & Indust. crops	18	Foxtail millet	11	13	3	2	4	1	34
06) Forage crops	18	Italian rye	9	8	4	11	6	6	44
07) Fruit tree	22	Apple	10	2	13	14	10	5	54
08) Vegetables	29	Melon	12	44	8	16	10	24	114
09)Ornamental plants	10	Rose	12	35	4	10	3	2	66
10) Tea	1	Tea	11	16	8	5	11	7	58
11) Mulberry	1	Mulberry	9	37	6	12	5	1	70
12) Tropical planta	3	Pineapple	7	15	2	2	4	4	34

Level 1: Characteristics essential for identifying strain, i.e. characters to be primarily evaluated

Level 2: Important characters for user's such as resistance for pest and disease, tolerance for stress, and traits specified.

Level 3: Chemically analyzed characters such as amylose, protein, isoenzyme, DNA, and productivity of strains.

Rpd: Number of characters required by the project.
Optl: Number of characters of second priority.

CHAPTER 5
National Perspectives on Conservation of Plant Genetic Resources

1. The plant genetic resources are essential for the well-being of present and future generations. These genetic resources are of importance, at least, in two respects. First they constitute the basic materials for agricultural research and plant breeding. Secondly, genetic diversity *in situ* provides for ecosystem stability and sustainability. Bearing these two perspectives in mind, Japan considers it necessary to consider the complementarity of plant genetic resources conservation and use.

2. For the conservation of plant genetic resources we are beginning to see the emergence of an enhanced, internationally agreed, global system. This global system includes both the FAO and IPGRI working in a complementary and synergistic way. Japan looks forward to this global system serving the international community to smoothly coordinate and assist in establishing linkages and mechanisms for improved conservation of genetic resources. Japan looks forward to a clearly defined and well managed system which enhances global cooperation on conservation of plant genetic resources. Japan expects to be a full participant in this emerging global system. Japan seeks to continue active collaboration with the international community on conservation of plant genetic resources.

3. National prioritization is essential in cost effectively undertaking conservation of genetic resources. Resources for all countries are limited and prioritization is essential in terms of what is to be conserved and what proportion of resources are allocated to conservation and evaluation and use of genetic resources. Similarly at an international level prioritization with respect to allocation of resources with the rationale for prioritization is necessary.

4. On-farm conservation. Japan strives towards sustainable and ecologically sound agriculture. The opportunity exists to promote the use of diverse genetic resources. On-farm conservation usually refers to conservation of what already exists on-farm. However we can also consider useful diversity currently in genebanks being packaged in a way that farmers want to use this material. For example multilines or mixed varieties are means by which genetic diversity can be reinstated on farms.

6. Plant genetic resources as the basic ingredients of plant breeding are vital to human welfare. The promotion of plant breeding research and education should be a common concern of mankind. To promote plant breeding, plant genetic resources should be readily accessible. Free access to plant genetic resources is of vital importance to all countries. It is the policy of Japan to freely exchange plant genetic resources. Japan considers that, since all countries are dependent on one another for genetic resources, barriers which impend exchange of germplasm should not exist. Scientific research and the welfare of humans will be affected if barriers to exchange of germplasm are raised. Japan wants to work with all countries to ensure this does not happen.

7. Plant breeding in Japan has been practiced in Japan for more than 100 years. The research system for conservation of plant genetic resources and plant breeding have, in more recent years, developed with very close linkages. This system has resulted in many new varieties, which have increased and stabilized agricultural production (Table 10)

This system was strengthened in 1985 when the first phase of the MAFF genebank project was started. The second phase of this project started in 1993 and continues to the year 2,000. The MAFF genebank project goals include developing a full and effective national germplasm system with enhanced international linkages, and to develop a total management system for conserved genetic resources and their use. The objectives of this project are provided in Appendix 3.

In 1993, MAFF established a "Basic Program for the Promotion of Plant Breeding Activities". This programme clearly defines collection, preservation and evaluation of genetic resources as the basis of plant breeding.

Table 10 Released varieties of various crops in Japan by the Ministry of Agriculture, Forestry and Fisheries (up to March, 1995)

Species	Common name English(Japanese)	Released varieties
Oryza sativa	paddy rice	368
Oryza sativa	upland rice	58
Triticum aestivum	wheat (komugi)	143
Hordeum vulgare	hulled barley	33
Hordeum nudum	naked barley	31
Hordeum sativum	2-row barley	16
Avena sativa	oats	7
Coix lachryma-jobi	Jobs tears(hato mugi)	1
Ipomea batatas	sweet potato	46
Solanum tuberosum	potato	38
Glycine max	soybean	99
Vigna mungo	azuki bean	10
Arachis hypogaea	peanut/groundnut	12
Fagopyrum esculentum	buckwheat	2
Brassica campestris	rape(natane)	47
Mentha arvensis	mint	11
Helianthus annuus	sunflower	1
Chrysanthemum spp.	(jyochuukiku)	1
Juncus alatus	(igusa)	6
Linum usitatissimum	flax/linseed	4
Boehmeria nivea	ramie(chyoma)	2
Gossypium hirsutum	cotton(wata)	9
Amorphophallus konjac	(konyaku)	2
Beta vulgaris	sugar beat(tensai)	20
Saccarhum officinalis	sugar cane	10
Camellia sinensis	tea	44
Morus sp.	Mulberry	17
Fragaria ananassa	strawberry	18
Lycopersicon esculentum	tomato	25
Capsicum sp.	(piman)	2
Solanum melongena	eggplant(nasu)	2
Capsicum sp.	chili pepper	3

Species	Common name English(Japanese)	Released varieties
Cucumis sp.	Cucumber	5
Cucumis/Citrullus spp.	Melon	5
Lagenaria siceraria	(yuugao)	1
Brassica campestris	(hakusai)	2
Canarium album	(kanran)	2
Brassica juncea	(takana)	1
Brassica napus	(nabana)	1
Allium satium	(tamanegi)	5
Pisum sativum	peas(endou)	8
Phosocarpus tetragonolobus	winged bean(shikaku mame)	1
Citrus reticulata	(mikan)	10
Citrus hybrids	(tango-ru)	5
Citrus grandis	(buntan)	4
Malus spp	apple(ringo)	8
Prunus persica	peach(momo)	21
Pyrus spp.	pear(nashi)	16
Diospyros kaki	persimmon(kaki)	7
Castanea spp.	chestnut(kuri)	6
Vitis sp.	grapes(budou)	13
Eriobotrya japonica	(biwa)	1
Prunus sp.	plum(sumomo)	1
Tulipa spp.	Tulip	19
Rhododendron spp.	azalea(tsutsuji)	3
Lilium spp.	lily(yuri)	6
Chrysanthemum spp.	chrysanthemum(kiku)	7
Lolium multiflorum	Italian rye grass	15
Dactylis glomerata	Orchard grass	7
Phleum pratense	Timothy	6
Festuca arundinacea	Tall fescue	3
Festuca pratense	Meadow fescue	1
Lolium perenne	Perennial rye grass	1
Bromus inermie	Smooth brome grass	4
Paspalum notatum	Bahia grass	1
Papalum dilatatum	Dallis grass	1
Chloris gayana	Rhoades grass	1

Species	Common name English(Japanese)	Released varieties
Panicum maximum	Guinea grass	2
Panicum maximum	Colored Guinea Grass	2
Trifolium pratense	red clover	4
Trifolium repens	white clover	5
Medicago sativa	alfalfa	5
Zea mays	maize(tomorokoshi)	41
Sorghum bicolor	sorghum	9
Brassica campestris	turnip(kabu)	3
Total		**1,368**

CHAPTER 6
International Collaboration

6.1 JAPAN'S ROLE IN THE INTERNATIONAL PLANT GENETIC RESOURCES SYSTEM

Japan has played an active role in international genetic resources activities. Japan has accepted the Convention on Biological Diversity and is a member of the FAO Commission on Plant Genetic Resources and its working group.

Japan contributes about 13% of FAO's budget. Japan is currently the biggest donor country to the Consultative Group for International Agriculture Research (CGIAR), which holds some of the worlds major germplasm collections, contributing about US$ 30 million annually. Funding from the Japanese Government has enabled germplasm centers, such as the Rice Genebank of the International Rice Research Institute, to be built (MAFF, 1993).

Japan has developed strong bilateral relationships on plant genetic resources. The Japan International Cooperation Agency (JICA) and Japan International Research Center for Agricultural Sciences (JIRCAS) have been in the forefront of these activities. For example, collaborative relationships with Pakistan has led to the development of the Pakistan Genetic Resources Preservation and Research Laboratories and an active scientist exchange program (for example see Okuno et al., 1995). Other countries where Japan has assisted in establishment of genebanks includes Bangladesh, Chile, Myanmar, Sri Lanka and Thailand.

Japan has been active in training plant genetic resources scientists from other countries. This training is of two types. One type involves individual senior scientists visit Japan to undertake specific collaborative research in a particular field. A group training course, held annually since 1982, has trained 126 scientists from 29 countries.

This training course combines classroom teaching with hands on research in different laboratories. In addition, JICA has assisted in training courses in other countries, such as the International Plant Genetic Resources Exploration and Collection course held in Chile in 1994. JICA and MAFF staff assisted Chilean staff in teaching during this course.

Japanese scientists have been active in collaborative international collecting of genetic resources (Okuno, 1994). A summary of recent international missions undertaken by MAFF scientists is presented (Table 11).

Japan has recently held a series of workshops on conservation of plant genetic resources (NIAR-MAFF, 1993; JIRCAS-MAFF 1994; MAFF, 1995). These international workshops have enabled technical exchange of ideas and promoted increased collaboration between countries.

Table 11 Collaborative international collecting activities involving MAFF personnel 1990- 1994

Year	Country	Target species
1990	Morocco, Spain	*Wild Beta*
	Finland, Sweden	Forage plants
	Thailand	Rice
	Malaysia	Food legumes
	Cote d'Ivoire,Tanzania, Kenya	Forage crops
	Indonesia, Thailand	Tropical fruits
1991	USSR	Forage plants
	Poland	Vegetables
	Sri Lanka, Thailand	Millets
	Uruguay, Chile	Root crops
	Pakistan Cereals,	legumes and millets
1992	Brazil	Pineapple
	Mexico	Mulberry
	India	*Sesamum*
	Madagascar	Rice
	Indonesia	Fruit trees
	Russia,neighbouring republics	Fruits, forages
1993	Indonesia	Sugarcane
	Russia,neighbouring republics	Wheat and barley
	Russia,neighbouring republics	Legumes,vegetables
	Ghana	Cowpea, eggplant
	Vietnam	Rice, legumes
	Equador, Bolivia	Root crops
1994	Russia,neighbouring republics	Wheat and wild relatives
	Kazakstan, Uzbekistan	*Allium, Tulipa*
	Philippines	Sweet potato
	Vietnam	Taro
	Vietnam	Rice

CHAPTER 7
National Needs and Opportunities

1. Japan has comprehensively collected the major crops within the country but some minor crops and wild relatives of crops are less well collected and conserved. Further efforts are needed to collect these materials, particularly from remote locations.

2. Prior to the introduction of computers information on conserved plant genetic resources was written in books and on cards. Putting this earlier data into the computer system is a priority.

3. Ways to more cost effectively and efficiently conserve vegetatively propagated crops are needed. Japan is conducting research on technologies to improve conservation of such materials.

4. With the rapid structural changes taking place in rural Japan there is an increasing need to reassess genetic erosion and loss of cultural information on genetic resources. The relevance and value of conserving specific agroecosystems needs to be assessed.

5. New technologies are providing valuable new opportunities to evaluate and use germplasm. Improving the efficiency and reducing the costs of these technologies are important tasks. Japan feels that strategic investment in basic science can lead to high returns on the investment. The ability of rice breeders now to accumulate polygenes systematically into breeding lines, from conserved germplasm, is possible due to basic research on the rice genome. The information Japan has obtained from rice genome research is now published and available to scientists worldwide (e.g. Kurata et al., 1994).

CHAPTER 8
Proposals for Global Action Plan

8.1 PERSPECTIVES ON FUTURE DIRECTIONS

1. Providing a sound scientific basis to global conservation of plant genetic resources. It is hoped that the global plan of action will provide us with comprehensive guidance for future plant genetic resources activities. Consequently, Japan hopes the global action plan is carefully prepared on a sound scientific basis, bearing in mind all international efforts of the past and projecting forward to the needs of humanity in the next century.

2. Cooperation, collaboration and improved coordinating mechanisms

a) Japan seeks to promote increased interaction and cooperation on technical aspects of conserving and evaluating genetic resources. At the same time improved cooperation and collaboration can lead to greater exchange both of information and germplasm. To exchange information, Japan annually holds an international workshop on genetic resources.

b) We see the enormous effort of preparing for the 1996 FAO International Conference and Programme for Plant Genetic Resources with the best of intentions of making the process participatory. Future reviews we expect to be incorporated into the coordinated global system on plant genetic resources. While some countries have large and well established genetic resources systems others are embryonic. It is often quite difficult both to digest the voluminous preparatory documents and participate effectively in large international meetings. With this in mind we hope that mechanisms can be put in place which fully take account of the differences among nations. For example, in East Asia we have a regional PGR group which meets periodically. We believe Southeast Asia and other regions have similar regional groups. Liaison within and among these regional groups could help improve inter-country and inter-regional understanding.

c) Scientific opinion is providing sometimes conflicting information on important issues related to the conservation of plant genetic resources. For example, scientists in different laboratories have different views on whether seed moisture content and temperature exert independent effects on seeds.

To clarify conflicting opinions and to assist in highlighting new and relevant techniques for genebanks, analyses of information, to provide unbiased information to the global genetic resources community is necessary.

3. The need for technological advances. Genebank workers are aware of the deficiencies of *ex situ* conservation. Materials accumulate faster than they can be adequately evaluated and maintained. The backlog of material in genebanks which have not been basically evaluated is very large. We would like to highlight four areas where future research is urgently needed.

a. DNA/gene banking and processes associated with gene insertion into plants.

b. Maintaining the long term genetic integrity of germplasm.

c. Ecological monitoring and protection systems.

d. Enhanced screening and evaluation procedures which increase sample through-put. We look to improvements in molecular technologies to help here.

Japan has scholarships available for scientists to work with Japanese scientist on some of these problems.

4. Compatibility of information systems and enhanced information exchange. Our information age challenges the genetic resources community to use the information systems available to maximum advantage for all. This requires that genebanks worldwide act in harmony to enable access and exchange of information on genetic resources. However, Japan sees that in the future information on genetic resources will become increasingly complex. For example, Japan and other countries have embarked on ambitious genome projects. The information systems required to facilitate these projects are complex, however the information this provides scientists now and in the future will be invaluable to improve crops efficiently. For many crops much useful but detailed information is becoming available.

We envisage information on germplasm in the future to span from the farmers field to the biotechnology laboratory. Japan urges partnership on information systems and enhanced data exchange to prevent duplication and wasting of resources. Japan has an open policy on information obtained on conserved germplasm. Japan hopes all countries will embrace an open sharing policy on germplasm information.

5. The need for cost efficiency. Increasingly, to cope with challenges of the future, cooperation and collaboration is needed, this may be multilateral or bilateral in nature. Cooperation should lead to more effective, cost efficient results, since duplication of efforts can be avoided.

6. Prioritization.Prioritization of activities and research is needed with the intention of improving the cost performance of conserving plant genetic resources. Our first task is to be sure that the major crops that feed mankind are ad-

equately conserved and evaluated, so that the foundation of global food production is not threatened. Among the 30 major crops (Harlan, 1976) more than half are not mandated crops of the CGIAR system. The conservation of these 30 major crops should be the prime focus of concern. Other crops should be prioritized based on a series of well defined agreed criteria for action.

7. Use of genetic resources The primary objective of conserving and evaluating genetic resources is that germplasm is available now and in the future for use by mankind. The task of our generation is to handover to the next generation a safe genetic foundation for crops which has been well evaluated and is able to meet all the challenges the next and future generations face.

APPENDIX 1

Major crops and some related wild species occurring in Japan

Crop Group

Common name	Genus	species
Rice		
	Chikusichloa	*aquatica*
Cutgrass	*Leersia*	*oryzoides*
	Leersia	*sayanuka*
	Leersia	*japonica*
	Oryza	*sativa*
	Zizania	*latifolia*
Wheat and Barley		
Barley	*Hordeum*	*vulgare*
	Hordeum	*coeleste*
	Hordeum	*murinum*
	Hordeum	*nudum*
Wheat	*Triticum*	*aestivum*
Food legumes		
Soybean	*Glycine*	*max*
Wild soybean	*Glycine*	*soja*
	Glycine	*tabacina*
Azuki bean	*Vigna*	*angularis*
Wild azuki bean	*Vigna*	*angularis var nipponensis*
Weedy azuki bean	*Vigna*	*nakashimae*
	Vigna	*minima var. minor*
Tubers		
Wild taro	*Colcassia*	*esculenta var aquatilis*
Sweet potato	*Ipomea*	*batatas*
Forage		
Chinese milk vetch	*Astragalus*	*sinicus*
	Astragalus	*adsurgens*
	Astragalus	*frigidus*

Common name	Genus	species
Forage		
	Astragalus	*membranaceus*
	Astragalus	*reflexistipulus*
	Astragalus	*shinanensis*
	Astragalus	*shiroumensis*
	Astragalus	*sinicus*
Japanese lawn grass	*Zoysia*	*japonica*
	Zoysia	*macrostachya*
	Zoysia	*matrella*
	Zoysia	*tenuifolia*
Small millets and industrial crops		
Barnyard millet	*Panicum*	*crus-galli var. frumentaceum*
	Brassica	*campestris*
Buckwheat	*Fagopyrum*	*esculentum*
Finger millet	*Eleusine*	*coracana*
Italian millet	*Setaria*	*italica*
Jerusalem artichoke	*Helianthus*	*tuberosus*
Job's tears	*Coix*	*lacryma-jobi var. flumentacea*
Konjak	*Amorphophallus*	*konjak*
Mat rush	*Juncus*	*effusus var. decipiens*
Millet	*Panicum*	*miliaceum*
	Perilla	*frutescens var. citriodora*
Perilla	*Perilla*	*frutescens*
Rape	*Brassica*	*napus*
Sesame	*Sesamum*	*indicum*
Sorghum	*Sorghum*	*bicolor*
Stevia	*Stevia*	*rebaudiana*
sugar beet	*Beta*	*vulgaris*
Sugar cane	*Saccharum*	*sinensis*
Sunflower	*Helianthus*	*annuus*
yacon	*Polymunia*	*sonsonchifolia*
Cuphea	*Cuphea*	*leptopoda*
Fruit		

Common name	Genus	species
Small millets and industrial crops		
Bayberry	*Myrica*	*rubra*
Ginko	*Ginko*	*biloba*
Honeysuckle	*Lonicera*	*caerulea*
Iyo	*Citrus*	*iyo*
Japanese walnut	*Juglans*	*sieboldiana*
	Castanea	*crenata*
	Juglans	*subcordiformis*
Loquot	*Eriobotrya*	*japonica*
Mume	*Prunus*	*mume*
Natsudaidai	*Citrus*	*natsudaidai*
Persimmon	*Diospyros*	*kaki*
Satsuma mandarin	*Citrus*	*unshiu*
Japanese pear	*Pyrus*	*pyrifolia*
Vegetables		
Bracken	*Pteridium*	*aquilinum*
Wakegi	*Allium*	*X wageki*
Tiger lily	*Lilium*	*lancifolium*
Maximowicz's lily	*Lilium*	*leichtlinii*
Goldband lily	*Lilium*	*auratum*
Wasabi	*Eutrema*	*wasabi*
Hakuran	*Brassica*	*X napus*
Burdock	*Arctium*	*lappa*
Japanese butterbur	*Petasites*	*japonicus*
Mitsuba	*Crytotaenia*	*japonica*
Mioga	*Zingiber*	*mioga*
	Osmunda	*japonica*
Horsetail	*Equisetum*	*arvense*
	Eleocharis	*kuroguwai*
	Allium	*victorialis*
	Cirsium	*dipsacolepis*
	Elatostema umbellatum	*var. majus*
Angelica tree	*Aralia*	*elata*
	Cacalia	*delphiniifolia*
Knotweed	*Polygonum*	*hydropiper*
Japanese pepper	*Zanthoxylum*	*piperitum*
	Phellopterus	*littoralis*

Common name	Genus	species
Vegetables		
	Oenanthe	*javanica*
	Farfugium	*japonicum*
Udo	*Aradia*	*cordata*
Water shield	*Brasenia*	*schreberi*
Oriental melon	*Cucumis*	*melo var. makuwa*
Pickling melon	*Cucumis*	*melo var. conomon*
Pumpkin	*Cucurbita*	*moschata*
Eggplant	*Solanum*	*melongena*
Taro	*Colocassia*	*esculenta*
Broad bean	*Vicia*	*faba*
Asparagus bean	*Vigna*	*sesquipedalis*
Perilla	*Perilla*	*ocymoides*
Onion	*Allium*	*fistulosum*
Yaguranegi	*Allium*	*fistulosum var. viviparum*
Chive	*Allium*	*schoenoprasum var. foliosum*
Garlic	*Allium*	*chinense*
Salt green	*Brassica*	*campestris*
Leaf mustard	*Brassica*	*juncea*
Radish	*Raphanus*	*sativus*
Turnip	*Brassica*	*campestris*
	Dioscorea	*japonica*
Ginger	*Zingiber*	*officinale*
Lotus	*Nelumbo*	*nucifera*
Ornimental		
Chrysanthemum	*Dendranthema*	*grandiflorum*
	Dendranthema	*boreale*
	Dendranthema	*indicum*
	Dendranthema	*ccidentalijaponense*
	Dendranthema	*Zawadskii var. latilobum*
	Dendranthema	*Zawadskii*
	Dendranthema	*Yoshinaganthum*
	Dendranthema	*japonicum*
	Dendranthema	*weyrichii*

Common name	Genus	species
Ornimental		
	Dendranthema	*articum subsp. Maekawanum*
	Dendranthema	*pacificum*
	Dendranthema	*Shiwogiku*
	Dendranthema	*Aphrodite*
	Dendranthema	*ornatum*
	Dendranthema	*crassum*
Nippon daisy	*Nipponanthemum nipponicum*	
	Dianthus	*superbus var. longicarycinus*
	Dianthus	*superbus var. superbus*
	Dianthus	*shinanensis*
	Dianthus	*japonicus*
	Dianthus	*kiusianus*
	Rosa	*acicularis var. nipponensis*
	Rosa	*hirta*
Polyantha Rose	*Rosa*	*multiflora*
Memorial Rose	*Rosa*	*wichuraiana*
Rugosa Rose	*Rosa*	*rugosa*
Common Camellia	*Camellia*	*japonica var. japonica*
	Camellia	*japonicus var decumbens*
Sasanqua	*Camellia*	*sasanqua*
	Camellia	*lutchuensis*
	Rhododendron	*kiusianum*
Luchu azalea	*Rhododendron*	*scabrum*
	Rhododendron	*amanoi*
Torch azalea	*Rhododendron*	*kaempferi*
	Rhododendron	*macrosepalum*
	Rhododendron	*ripense*
	Rhododendron	*sataense*
	Rhododendron	*eriocarpum*
Wild thyme azalea	*Rhododendron*	*serpyllifolium*
	Rhododendron	*tosaense*
	Rhododendron	*indicum*

Common name	Genus	species
Ornimental		
	Rhododendron	*tashiroi*
	Rhododendron	*weyrichii*
	Rhododendron	*latoucheae*
	Rhododendron	*mucronulatum*
	Rhododendron	*pentaphyllum*
	Rhododendron	*yakushimanum*
Japanese azalea	*Rhododendron*	*japonicum*
Snow azalea	*Rhododendron*	*mucronatum*
	Rhododendron	*oomurasaki*
	Rhododendron	*dilatatum*
	Rhododendron	*reticulatum*
Easter lily	*Lilium*	*longiflorum*
Sasa lily	*Lilium*	*japonicum*
Rose lily	*Lilium*	*rubellum*
Show lily	*Lilium*	*speciosum*
Gold lily	*Lilium*	*auratum*
	Lilium	*auratum var. platyphyllum*
Tiger lily	*Lilium*	*lancifolium*
Leichtlin's lily	*Lilium*	*leichtlinii var. maximowiczii*
Wheel lily	*Lilium*	*medeoloides*
Upright lily	*Lilium*	*alexandrae*
	Lilium	*nobilissimum*
	Lilium	*maculatum*
Candlestick lily	*Lilium*	*dauricum*
Star lily	*Lilium*	*concolor*
	Dendrobium	*moniliforme*
Tea		
Tea	*Camellia*	*sinensis*
Camellia	*Camellia*	*japonica*
Sasanqua	*Camellia*	*sasanqua*
Mulberry		
	Morus	*bombysis*
	Morus	*alba*
	Morus	*lhou (latifolia)*

Common name	Genus	species
Tea		
	Morus	*acidosa*
	Morus	*kagayamae*
	Morus	*boninensis*
	Morus	*yoshimurai*
	Morus	*tiliaefolia*
Tropical crops		
Sugarcane	*Saccharum*	*officinarum*
	Saccharum	*sinese*

APPENDIX 2

Genetic Resources conserved in Universities and Colleges of the Ministry of Education (1989) For locations see map 2

Spp.	Univ.	(no. of acc.)
Rice	Hokkaido	(1352)
	Yamagata	(140)
	Tsukuba	(120)
	Gifu	(111)
	Nagoya	(24)
	Kyoto	(2122)
	Kyoto Fudai	(978)
	Kobe	(33)
	Okayama	(293)
	Kyushu	(4454)
	Saga	(15)
	Kagoshima	(150)
	Ryukyu	(1732)
	Nat. Inst. Genet.	(10,000)
Wheat	Tsukuba	(80)
	Chiba	(93)
	Yokohama Municipal	(453)
	Gifu	(76)
	Kyoto	(8205)
	Kyoto Fudai	(38)
	Osaka Ed.	(132)
	Kobe	(201)
	Tottori	(511)
	Okayama	(686)
	Kochi	(385)
	Miyazaki	(12)
	Nat. Inst. Genet.	(146)
Barley	Chiba	(74)
	Yokohama Municipal	(7)
	Kyoto	(569)

Spp.	Univ.	(no. of acc.)
Barley	Kyoto Fudai	(38)
	Okoyama	(6235)
	Kochi	(30)
Rye	Kyoto	(121)
	Tottori	(168)
	Okayama	(3)
Oats	Tsukuba	(56)
	Kyoto	(380)
	Osaka Ed.	(40)
	Miyazaki	(21)
Triticale	Kyoto	(63)
	Tottori	(267)
Soybean	Hokkaido	(36)
	Iwate	(440)
	Yamagata	(111)
	Chiba	(80)
	Nagoya	(68)
	Kyoto	(3)
	Tottori	(297)
	Kyushu	(671)
Phaseolus vulgaris	Hirosaki	(149)
	Yamagata	(7)
	Chiba	(112)
	Kyoto	(200)
Vigna unigulata	Tokyo Agr. Tech.	(38)
	Chiba	(31)
	Kyoto	(3)
Dolichos lablab	Chiba	(3)
Pisum sativum	Chiba	(3)
Phaseolus lunatus	Tsukuba	(3)
	Kagawa	(513)
Peanuts	Kyoto	(197)
	Kochi	(250)
Lentils	Chiba	(6)

Spp.	Univ.	(no. of acc.)
Winged bean	Kyoto	(2)
	Kagoshima	(16)
Corn	Chiba	(74)
	Kyoto	(70)
Setaria italica	Tsukuba	(873)
	Chiba	(27)
	Gifu	(15)
	Kyoto	(813)
	Ehime	(9)
	Kagoshima	(550)
Panicum miliaceum	Tsukuba	(105)
	Gifu	(15)
	Kyoto	(206)
	Ehime	(25)
Echinochloa frumentacea	Tsukuba	(173)
	Chiba	(17)
	Gifu	(10)
	Kyoto	(114)
	Ehime	(9)
Sorghum	Tsukuba	(90)
	Chiba	(11)
	Gifu	(12)
	Kyoto	(270)
	Ehime	(19)
Eleusine coracana	Tsukuba	(126)
	Chiba	(81)
	Gifu	(6)
	Kyoto	(83)
Coix	Kyoto	(20)
	Kyoto Fudai	(32)
Buckwheat	Tsukuba	(225)
	Chiba	(76)
	Kyoto	(4)
	Kyoto Fudai	(2)
	Miyazaki	(29)

Spp.	Univ.	(no. of acc.)
Amaranthus	Tsukuba	(198)
	Chiba	(71)
	Miyazaki	(9)
Cotton	Tsukuba	(21)
	Tokyo Agric.Tech.	(6)
	Shinshu	(18)
	Shiga	(14)
	Kyoto	(58)
Seni (fibre)	Tsukuba	(6)
	Shinshu	(13)
	Shizuoka	(3)
	Shiga	(4)
	Osaka Fudai	(3)
	Tottori	(18)
	Miyazaki	(8)
Safflower	Hokkaido	(10)
	Yamagata	(7)
	Tsukuba	(4)
Perilla frutescens	Kyoto Fudai	(116)
Sesame	Toyama	(200)
	Tsukuba	(17)
	Chiba	(9)
Sunflower	Tsukuba	(1)
	Shizuoka	(2)
Mint	Okayama	(126)
Beet	Hokkaido	(83)
Sweetpotato	Mie	(544)
	Okayama	(72)
Gabi	Okayama	(200)
Apple	Hokkaido	(40)
	Hirosaki	(129)
	Yamagata	(7)
	Chiba	(17)
	Kyushu	(5)

Spp.	Univ.	(no. of acc.)
Pear	Kyushu	(1)
Persimmon	Gifu	(22)
	Kyoto	(150)
	Kyoto Fudai	(35)
	Kyushu	(89)
Peach	Kyoto Fudai	(18)
Prunus salicina	Yamagata	(12)
	Kyushu	(25)
Yellow Peach	Yamagata	(12)
Plum	Tsukuba	(19)
	Kyoto	(8)
Fig	Osaka Fudai	(18)
	Kyushu	(15)
Citrus	Kinki	(228)
	Kyoto	(88)
	Okayama	(67)
	Saga	(460)
Passiflora caerulea	Kagoshima	(9)
Morus bombycis	Hokkaido	(28)
	Tokyo Agric. Tech.	(46)
	Shinsu	(427)
	Kyoto Tech.	(168)
Tomato	Yamagata	(19)
	Chiba	(6)
	Osaka Fudai	(16)
Eggplant	Chiba	(8)
	Kyoto	(60)
	Okayama	(7)
Capsicum	Chiba	(16)
	Kyoto	(832)
	Kyoto Fudai	(6)
Cucumis melo var.makuwauri	Fukui Jun. College	(33)
	Chiba	(19)
	Kyoto	(35)

Spp.	Univ.	(no. of acc.)
Cucumis melo var.makuwauri	Kyoto Fudai	(300)
Melons	Fukui Jun. College	(99)
	Osaka Fudai	(1600)
Cucumis melo var.conomon	Fukui Jun. College	(10)
	Osaka Fudai	(100)
Cucumber	Kyoto Fudai	(50)
Bitter gourd	Chiba	(11)
Pumpkin	Fukui Jun. College	(72)
Allium grayi	Miyazaki	(9)
Allium chinensis	Miyazaki	(10)
Garlic	Yamagata	(16)
	Kinki	(14)
Allium fistulosum	Chiba	(7)
	Kyoto	(10)
	Kobe	(19)
Garlic chive	Miyazaki	(7)
Brassica campestris/B.napus	Tohoku	(850)
	Tsukuba	(427)
	Utsunomiya	(30)
	Chiba	(79)
	Osaka Fudai	(19)
Perilla crispa	Kyoto Fudai	(106)
Portulaca oleracea	Miyazaki	(20)
Lotus	Tokyo	(54)
Willow	Tohoku	(157)
Orchid	Tsukuba (171)	
	Chiba (319)	
Tradescantia sp.	Saitama	(21)
Amaranthus inamoenus	Chiba	(27)
Paeonia suffruticosa	Tottori	(10)

Spp.	Univ.	(no. of acc.)
Paeonia lactiflora	Tottori	(11)
Roses	Kyoto Fudai	(58)
Plum blossom	Tsukuba	(174)
	Chiba	(69)
	Kyushu	(30)
Cherry blossom	Tsukuba	(158)
	Nat. Inst. Genet.	(250)
Chaenomeles lagenaria	Tottori	(10)
Mapel	Chiba	(100)
Camellia lagenaria	Tsukuba	(210)
	Tokyo Agric.Tech.	(26)
	Chiba	(80)
	Kyushu Tokai	(1020)
	Nat. Inst. Genet.	(60)
Camellia	Tokyo Agric. Tech.	(100)
Morning glory	Ibaraki	(80)
	Tokyo	(8)
	Shizuoka	(298)
	Nat. Inst. Genet.	(552)
Salvia spp.	Chiba	(21)
Aromatic plants	Tsukuba	(58)
Cosmos	Tamagawa	(10)
Bamboo	Meyo	(87)
Daffodils	Tottori	(95)
Licorice	Tottori	(14)
Iris	Yamagata	(128)
	Miyazaki	(87)
Gladiollus	Tottori	(55)

APPENDIX 3
The main objectives of the second phase of the Ministry of Agriculture, Forestry and Fisheries Genebank Project

1. To increase conserved holdings to 250,000 accessions.
2. To give increased attention to the conservation of wild *species*.
3. Characterisation and evaluation of already conserved germplasm will be intensified, with emphasis on active collections.
4. The information system will be improved so that the national system is fully integrated and this fully integrated system will have enhanced linkages with the international system.
5. Technologies to improve conservation will be tested and incorporated into the national system.

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