FAO International Technical Conference on Plant Genetic Resources

CONSERVATION AND SUSTAINABLE UTILIZATION OF PLANT GENETIC RESOURCES IN EAST ASIA

Sub-Regional Synthesis Report

Annex 1 of the Report of the
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Food
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Note by FAO

This Sub-Regional Synthesis Report was prepared for the Sub-Regional Meeting for East Asia, Beijing, China, 24-26 July 1995, preparatory to the FAO International Technical Conference on Plant Genetic Resources, Leipzig, Germany, 17-23 June 1996. The meeting considered the report was a valuable input to the preparatory process for the FAO Fourth International Technical Conference on Plant Genetic Resources and would be particularly useful to the FAO Secretariat in preparing the Report on the State of the World's Plant Genetic Resources. It constitutes Annex 1 of the Report of the Preparatory Meeting. The Report is being made widely available by FAO as requested by the International Technical Conference.

The Report was drafted by Ms. Zhou Mingde of the IPGRI Office for East Asia, and revised by Dr. Iqbal Kermali following the Sub-regional Preparatory Meeting, taking into account modifications proposed by the countries. The collaboration of many others, in reviewing Country Reports, and editing the draft is gratefully acknowledged, particularly Dr. Zhang Zhongwen.

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I. INTRODUCTION

A. The Agricultural and Forest Sector

1. The countries of the East Asia sub-region, as defined for the purposes of this report, include the People's Republic of China, the Democratic People's Republic of Korea (DPR Korea), Japan, Mongolia and the Republic of Korea. They span a range of climates from upland temperate to sub-tropical/tropical with huge diversities in population numbers and land use. A summary of the general information for the sub-region is shown in Table 1.

2. China is the largest country in Asia. It's area is more than 80% of the East Asia sub-region. Rep. of Korea has the highest population density in the sub-region followed by Japan, DPR Korea and China. Mongolia has one of the highest population growth rates in Asia, but the population density is very low. In China, Japan and the Republic of Korea, population pressures have resulted in a low ratio of forest area/capita.

3. These densely populated countries are facing major challenges emerging from:

- Socio-economic changes arising from population growth and urbanization, increasing affluence in the region, and the resulting shift in the rural farm structure.
- Market openings and international trade agreements which are considered essential to the industrial well-being of the region. Increasing emphasis on environmentally sound development, including biodiversity issues, which will eventually result in an overall social benefit in terms of both economic productivity and quality of life.
- Decentralization of government responsibilities, and decentralization of budgets to regional and local governments with increasing accountability to locally elected authorities.

4. Japan is the second most powerful economy in the world, but the contribution of agriculture to its GDP and the proportion of labour force engaged in agriculture is very low. In contrast, agriculture is the main occupation of labour force in China. Nearly 80% of Mongolia's agricultural land is used for grazing purposes.

Table 1: Basic Facts of the countries in the sub-region[1]

	Land area (x 1000 km²)	Population 1993 (million)	Population density (x km²)	Population growth rate (%)
China	9,326	1,203	129	1.04
DPR Korea	120	23	192	1.83
Japan	375	120	335	0.32
Mongolia	1,565	2	2	2.58
Rep. of Korea	98	45	464	1.04

	Land use (1992) Arable (%)	Pasture (%)	Forest/ woodland (%)	Labour in agriculture (1993) (%)	Agriculture in GDP (%)
China	10	14	14	65	30
DPR Korea	14	<1	75	31	25
Japan	11	>2	67	5	2
Mongolia	<1	80	8	28	35
Rep. of Korea	19	<1	65	20	8

[1] **Data from UN and FAO statistics**

5. The principle crops of the sub-region include rice, sorghum, wheat, barley, millet, corn, soybeans, peanuts, pulses, sugarbeets, potatoes, cotton, oilseeds, forages, rootcrops, vegetables and fruits. Japan is about 50% self-sufficient in food production and imports wheat, corn and soybeans. In Mongolia, the food supply situation is very tight due to the cessation of assistance from the former USSR, the disruption of trade and the transition to a market economy. China is basically self-sufficient in food. However, the grain supply is not sufficient and efforts are being made to increase grain production. Despite the use of improved seed varieties, expansion of irrigation and the heavy use of fertilizers, North Korea has not yet become self-sufficient in food production. It faces chronic food shortages, especially after the floods of 1995. Food self-sufficiency is also low in Republic of Korea (34% in 1993).

6. A major portion of land with agricultural potential (Table 2) in DPR Korea and Republic of Korea is sub-humid (productive rainfed land, with attainable yields greater than 40 percent of potential constraint-free yields, in zones with 180-269 growing days, with very suitable and suitable soil and terrain conditions). In China, the sub-humid, the humid (similar to sub-humid, except with more than 270 growing days) and the marginal (marginally productive rainfed land, with attainable yields of 20-40 percent of potential constraint-free yields, in zones with more than 120 growing days, with only marginally suitable soil and terrain conditions) areas occur in equal

proportions. The latter also occur in Republic of Korea. The FAO agro-ecological zones for Japan and Mongolia are not available. The country report of Mongolia describes their agroelogical regions to include Hangai-Khuvsgul region (17%), Selenge-Onon (17%), Mongolian Altai (11%), Steppe (18%) and Gobi Desert (38%).

Table 2: Agro-ecological zones ('000 ha)[1]

AT2010 ZONE[2]	China	DPR Korea	Rep. of Korea
AT1: Dry Semi-Arid	72	0	0
AT2: Moist Semi-Arid	3,779	134	0
AT3: Sub-Humid	46,587	3,405	2,287
AT4: Humid	50,234	0	110
AT5: Marginal in AT2-AT4	49,413	273	1,185
AT6: Fluvisols/Gleysols	25,089	105	313
AT7: Marginal Fluvisols/Gleysols	5,342	62	306
Total	**180,516**	**3,979**	**4,201**

[1] **FAO (1993)**
[2] **FAO (1993): Agriculture: Towards 2010.**

B. Indigenous Plant Genetic Resources

7. The sub-region has a large diversity of higher plants, ranging from 30,200 species in China to 2,272 in Mongolia (Table 3). Percentage endemism is 26% for the region. Endemism is especially high in China (56%) and Japan (37%), and approximately 1% of the total number of species in these two countries are threatened.

Table 3: Flora and endemism for higher plants in the sub-region[1]

Country	Number of species[2]	Number of endemics	% Endemism[2]	Number of threatened species
China	30,200	18,000	55.9	350
DPR Korea	2,898	107	14.0	0
Japan	4,700	2,000	37.2	41
Mongolia	2,272	229	10.1	0
Rep. of Korea	2,898	224	14.0	33

[1] **Source: World Conservation Monitoring Centre, 1992**
[2] **Combined total for DPR Korea and Rep. of Korea**

8. East Asia is one of the main centres of crop species in the world. More than 300 cultivated species originated in East Asia, including 290 in China. Many crops of global importance, such as soybean, rice, wheat, citrus, oat, barley, buckwheat, Chinese cabbage, sorghum, adzuki bean, tea, etc. have

their either primary or secondary centre of diversity in East Asia, from where they spread all over the world. Most species originating in East Asia are popularly used for food and vegetables. Some species such as rice, wheat, soybean, Chinese cabbage, etc. have played a very important role in agricultural development in East Asia. Rice has been cultivated for over 7,000 years and has become one of the major food crops in East Asia.

9. The diversity among species cultivated in the sub-region is very high. For example, six hundred kinds of crops are cultivated in China and include grains, industrial crops, fruits, vegetables, forages, green manure crops, flowers and medicinal crops (Appendix 1). In addition, the sub region is also rich in wild species and species related to the cultivated plants. There is also significant diversity in genepools of forest species like *Polulus, Salix, Paulownia, Castanea, Phyllostachys,* bamboo, *Metaseguoia* and many conifers (*Abies, Cryptomeria, Larix, Picea* and *Pinus*). Although the majority of the woody plants are used for timber, they are also an important source of fruits, fiber, resin, and medicine. For example, in Republic of Korea, wild plants are classified as pasture (19% of total taxa), medicinal (17%), edible (14%), ornamental (13%), timber (7%), fiber (1%), industrial (0.5%) and unknown (27%).

10. Due to a long cultivation history and diversified ecogeographical environments in East Asia, a considerable amount of landraces or primary cultivars are available. In remote areas of China and Mongolia, in particular, landraces adapted to particular environments are still used by farmers. The main reasons for growing these local varieties are: **(1)** lack of improved varieties, **(2)** improved varieties are not adopted to diversified ecosystems, such as those with dry climate, poor (acidic, dry, waterlogged, acidic, or alkaline) soils,
(3) their special characteristics such as disease resistance, high quality and adaptability to adverse environments. In many parts, especially in Japan, the crops introduced thousands of years ago, together with the indigenous species, form an important component of their traditional cuisine.

11. The landraces of several crop species have disappeared or are disappearing in the more developed areas. These landraces are being replaced by modern cultivars, which are usually much more uniform and have a narrow basis in terms of genetic diversity. Thus crop diversity used in production has decreased dramatically. For example, a study of 147 farms at three locations in the Republic of Korea showed that an average of 74% varieties was lost during the period from 1985 to 1993. Major crops such as wheat, rice and maize have increased their acreage, and minor crops such as millets, buckwheat, barley and oat have decreased.

12. East Asia has many wild relatives of crop species such as *Glycine soja, Oryza rufipogon, Oryza meyeriana, Oryza officinalis, etc*. These species are usually distributed in natural environments. They are very important genetic resources for crop improvement. Some wild relatives of wheat possess valuable disease-resistant genes which can be transferred to wheat cultivars. Collecting and conserving wild relatives is a major component of plant genetic conservation work. The wild species are more difficult to manage and are threatened by loss of suitable ecological environment due to climate change and overgrazing.

13. Erosion of genetic diversity within and among forest species in natural habitats is occurring in spite of the protection measures undertaken. Deforestation has been particularly high in China over the past 10 years. The reasons include increased demand, forest clearing for more farmland, cutting trees for fuel, natural disasters such as fire, flood, disease and pests, etc. Deforestation has resulted in severe flooding in China, DPR Korea and Republic of Korea. In Republic of Korea, erosion of indigenous species is caused by acid rain, construction of recreation facilities, buildings, golf links, and roads, and by overhunting of wild plants. Introduced insects pests are causing serious damage to the most widely distributed *Pinus densiflora.*

II. ASSESSMENT OF PGR PROGRAMMES AND ACTIVITIES

A. National Programme, Policies and Legislation

14. Most countries started plant genetic resources (PGR) programmes in the 1950s as the role of germplasm in crop improvement was recognized. The governments of the East Asia countries pay great attention to PGR work, have relevant policies and have issued laws to provide legal status for PGR activities. They have also allocated a considerable amount of funding for the necessary activities in their national programmes.

15. Although the level and scope of the national programmes vary from country to country, every country in the region has established a national PGR system involving governmental agencies, research institutes and universities at central and local levels. Public awareness on the importance of germplasm for human survival has greatly increased among policy makers, public organizations and individuals. Japan, Mongolia and the Republic of Korea have set up advisory bodies responsible for developing proposals on long-term planning, and providing recommendations to governments for financial and other resources allocation.

16. For crops, the national programmes have focused genetic resources activities on the important species. Agricultural research in the sub-region, especially in China, Japan, DPR Korea and the Republic of Korea have been related to intensified cropping systems, especially for small farms. Linkages to the International Rice Research Institute (IRRI) fostered this, and other international centres such as the Asian Vegetable Research and Development Centre (AVRDC), the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), the International Centre for Agricultural Research in the Dry Areas (ICARDA), and International Potato Centre (CIP) are also involved. As well as intensified cropping, China, in particular, has pioneered research in farm forestry and community forestry. Mongolia has a major interest in rangelands. However, insufficient attention has been given to dry-land, rainfed and upland farming.

17. Scientific and political interests related to *ex situ* conservation, documentation, evaluation and use, limited *ex situ* stands and reserves for tree conservation need to be looked into. Collections of crop germplasm emphasize landraces and a limited number of wild relatives. Wild relatives are proposed for *in situ* attention for rice, soybean, tea, *Amphicaipaea* bean, some wheat grasses, mulberry, leek and buckwheat. Despite the large potential benefits, interest does not yet extend to on-farm conservation of landraces, due firstly to a degree of scientific skepticism and to lack of tried methodologies and, secondly, to the huge task still required to make the *ex situ* systems more comprehensive. An integrated approach to conservation might be beneficial, encompassing *in situ* conservation as complementary to *ex situ* conservation.

18. Japan, the Republic of Korea and China have established very strong national programmes on plant genetic resources conservation and use, while DPR Korea and Mongolia have relatively weak national programmes in terms of scope and level. Usually, each country has one or several national programmes for crop plants, medical plants and forests, respectively, supported by relevant ministries or departments. The crop genetic resources programme is given high priority in funding and human resource investment in the five countries of the sub-region.

19. The Convention on Biological Diversity (CBD) signed by over 150 countries in 1992, and ratified by all five countries of the region, has an important influence on national policies in providing the legal framework for conservation of biological diversity. Following the Convention, the countries in East Asia have initiated a series of actions on assessing the status and planning activities for the national programme. In 1994 China published "Biodiversity Conservation Action Plan", the Chinese White Paper, which acts as a long-term plan for conservation and sustainable use of biodiversity

in China. The Republic of Korea published the "Korean Biological Diversity 2000". Other countries also have similar activities in planning a long-term conservation programme on biological diversity. Table 4 shows the major indicators of national programmes on PGR in the sub-region.

Table 4: The major indicators of national programmes on PGR in East Asia

Indicators	China	DPR Korea	Japan	Mongolia	Rep. of Korea
National program	yes		yes	?	yes
Advisory body			yes	yes	yes
FAO Commission on GRFA	yes	yes	yes		yes
FAO International Undertaking		yes			yes
Convention of Biodiversity	yes	yes	yes	yes	yes
Quarantine Regulation	yes	yes	yes		yes
Plant Breeder's Rights			yes		yes
Seed Law	yes	yes	yes		yes
Environment Protection Law	yes	yes	yes		yes
Germplasm Exchange Policy	yes	yes	yes		

(a) China

20. The crop genetic resources programme is executed by the Ministry of Agriculture and is undertaken by the Institute of Crop Germplasm Resources of the Chinese Academy of Agricultural Sciences (CAAS). The forest genetic resources programme is executed by the Ministry of Forestry and is undertaken by the Institute of Forestry Research of the Chinese Academy of Forestry. China also has a small programme for medicinal plants implemented by the Institute of Medicinal Plant Genetic Resources of the Chinese Academy of Medicinal Sciences. China has not established any advisory body on genetic resources. The decision on genetic resources activities are made by the Ministry of Agriculture, for crop species; the Ministry of Forestry, for forest species; and the Bureau of the Chinese Medicine Administration, for medicinal plants; in consultation with other relevant ministries such as the State Planning Commission, the State Science and the Technology Commission, etc. Consultation meetings involving relevant experts make recommendations for government decision.

21. The national PGR programmes involve more than 400 research institutes and over 2,000 specialists in plant species, 23 research institutes and over 70 scientists in forest species. Despite the considerable amount of funding by the central and local governments, the needs for PGR activities can not be met because of the large number of germplasm collections in the country.

22. The Chinese Government has promulgated a series of laws and regulations on environment protection and biodiversity conservation. The Seed Law recognizes the breeders' right and the contribution of genetic resources workers, and encourages conservation and use of genetic resources. The Quarantine Law regulates the activities on germplasm exchange.

(b) Democratic Peoples' Republic of Korea

23. The Pyongyang Crop Genetic Resources Institute (PCGRI) is responsible for organizing the national conservation activities on PGR, with participation of other related research institutes and universities. The policy is set by the central government, which also provides the funding. Planning is done by the Agriculture Commission.

24. Although the national programme on PGR is not extensively organized and planned, the activities on collecting, conservation, characterization and evaluation are all being carried out in coordination with PCGRI. Funding is only sufficient for regeneration and characterization of newly collected germplasm which is conserved in the active genebank. Funding is not sufficient for germplasm evaluation and for long-term storage.

25. DPR Korea has a Quarantine Law regulating activities on germplasm exchange, and the Environment Protection Law for conservation of forestry and land resources.

(c) Japan

26. The Agriculture, Forestry and Fisheries Research Council of the Ministry of Agriculture, Forestry and Fisheries (MAFF) initiated a nation-wide coordination of PGR in 1965. The National Institute of Agrobiological Resources (NIAR), Tsukuba, is the leading research institute on conservation and use of plant and micro-organisms, while the Forestry Research Institute, Kanto, is responsible for forest species. The Agrobiological Genetic Resources Council was established as an advisory body on plant and forest genetic resources activities.

27. Japan has given great attention to the conservation and use of plant and forest genetic resources and sustainable funding is provided by the Government. The Agriculture section of the Japanese Academy of Sciences has

a genetic resources committee which oversees genetic resources activities in Japan. The NIAR project is coordinated by an official who plays a major role in decision-making. A curator has been assigned for crop species to be responsible for managing relevant activities including research. The project involves about fifteen central and local research institutes and number a of experts. Several universities and the private sector participate in the activities of the project.

(d) Mongolia

28. Mongolia depends heavily on animal husbandry and is rich in forage plant genetic resources. Therefore, conservation of forage species is as important as food crop species. The Ministry of Agriculture and the Ministry of Science and Technology play a role in making policies, planning and funding activities on plant genetic resources. The Mongolian National Agricultural University and its related research institutes are mainly involved in the research work on PGR. The National Board for Plant Genetic Resources (NBPGR) is an advisory committee for activities on plant genetic resources. The Board also organizes national workshops and training courses in the area of PGR.

29. Mongolia started PGR conservation activities in cooperation with the former Soviet Union, especially in collecting. In 1991, a five year plan was started by the NBPGR to introduce, conserve, and document accessions of plant genetic resources, including forage species. The programme involved five research institutes of the Mongolian National University. The Plant Science and Agricultural Research Institute in Darkhan has been designated as a national base collection for both crop and forage species and takes the lead role in collaboration with other research institutes. The Institute of Animal Husbandry is the leading institute in collecting, characterization, evaluation and documentation of forage genetic resources in the country. Mongolia has been facing economic difficulties for the last ten years and has not been able to provide adequate resources for the PGR activities, especially on conservation and characterization.

(e) Republic of Korea

30. The Rural Development Administration (RDA) and the Forestry Administration are responsible for policy matters on plant and forest genetic resources including ecosystem conservation through vegetation and species monitoring, management of protected areas, and the maintenance of genetic diversity. The Genetic Resources Council (GRC) and the Germplasm Advisory Committee (GAC) advise on developing the national plan for germplasm activities, decision-making for priority collecting missions, and for cooperative actions on characterization, evaluation and use of genetic resources. A national genebank for base collections was established several

years ago but funding is needed for characterization and evaluation. Funding is allocated annually according to the plan made by the relevant institutes.

31. The Ministry of Environment and the Forest Genetic Resources Institute are responsible for the *in situ* conservation activities on plant genetic resources. The Ministry of Environment carries out plans on habitat conservation by survey of the ecosystem and the Forestry Administration is responsible for *in situ* conservation. The government has designated 131 sites totaling 11,052 ha. as the natural reserved forests in which 97 species are preserved.

32. The Republic of Korea has national legislation on plant quarantine, nature conservation and Environment protection, and seed law dealing with seed multiplication procedure, seed testing, and seed trading.

B. Sub-Regional Programme and Networks and International Collaboration

33. The countries in the sub-region share many common interests related to the conservation and use of PGR. There is a good opportunity for these countries to work together and share financial, personnel and germplasm resources. As mentioned earlier, all five countries have ratified the Convention on Biological Diversity. Only one country has signed the International Undertaking. However, with the recent accession of China, four countries are members of the Commission on Genetic Resources for Food and Agriculture (CGRFA) of the Food and Agriculture Organization of the United Nations (FAO) (including DPR Korea, Japan and the Republic of Korea).

34. There are no agreements among countries of the sub-region which affect PGR conservation and use. However, a bilateral technical cooperative agreement has been developed between Japan and Mongolia with the aim of building the capacity of the Mongolian National Agricultural University. The cooperative project on rice improvement between China and Japan involves germplasm exchange. China has frequent contacts with DPR Korea and the Republic of Korea, and efforts have been made to enhance cooperation with these countries.

35. The East Asia Coordinators Meeting on Plant Genetic Resources, organized by the International Plant Genetic Resources Institute (IPGRI) in September 1994, recommended the formation of a Regional Network on Conservation and Utilization of Plant Genetic Resources for East Asia (EA-PGR) for the five countries.

36. The aims of the network will be to:

(i) promote a documentation system for the national plant genetic resources programmes;

(ii) share PGR and information on PGR among member countries;

(iii) strengthen the national programmes on plant genetic resources;

(iv) coordinate research activities and avoid duplication of efforts;

(v) implement a cooperative programme with common interests; and

(vi) improve conservation and use of plant genetic resources in the region.

37. Earlier, in April 1991, IPGRI organized the Less-utilized Crop Genetic Resources Symposium in Beijing, which brought together national coordinators to exchange information and experiences and identify opportunities for cooperation in this area.

38. Some countries of East Asia have been involved in crop networks which are coordinated by IPGRI to promote conservation and use of particular crop genepools in the region or in the world. China has participated in activities of the networks of bamboo, coconut, sweet potato, and tropical fruit trees. Japan has supported the bamboo network and participated in the tropical fruit tree network. At this stage, the activities of crop networks are mainly on information exchange among the countries, no substantial regional research activities are carried out.

39. At present, the United Nations Development Programme (UNDP) has two regional and sub-regional programmes involving East Asian countries. The first programme is related to the application of biotechnology in agricultural development in the Pacific region, in which China is involved. The second programme is concentrated in three countries in Northeast Asia; namely, China, DPR Korea and Mongolia. The programme includes four major activities on food crops, fruit trees, vegetable and animal husbandry with the aim of promoting cooperation among and support to national programmes, developing advanced technologies for production, processing and breeding, and fostering technology transfer. Crop germplasm exchange among these countries will be facilitated.

40. FAO also has some technical cooperation projects in individual countries in East Asia. Table 5 lists some projects recently executed by FAO.

Table 5: PGR related projects recently executed by FAO in the sub-region

Project Code	Project title
UNDP/CPR/85/040	Strengthening Soybean Research
UNDP/CPR/91/130	Seed Breeding Programme
UNDP/DRK/86/002	Vegetable Research and Development
GCP/RAS/103/DEN	Improved Seed Production
UNDP/RAS/89/040	Regional Cooperative Programme for Improvement of Food Legumes and Coarse Grains in Asia
UNDP/RAS/89/036	Strengthening Jute and Kenaf Seed Programmes
UNDP/RAS/89/041	Research and Development of Vegetable Crop
UNDP/ROK/87/018	Support to Microbial Cell Bank: Korean Collection of Type Culture
UNDP/ROK/87/006	Strengthening of RDA's Plant Genetic Resources
UNDP/CPR/86/016	Development of Coffee Planting and Processing in Yunan Province
TCP/DRK/2354/A	Hazel Nut Production
UNDP/DRK/86/002	Vegetable Research and Development
UNDP/DRK/86/008	Rice Crop Production
UNDP/RAS/93/067	People-centered Sustainable Development
UNDP/RAS/93/066	Biotechnology and Biodiversity
UNDP/RAS/93/065	Integrated Pest Management
GCP/RAS/145/NET	Intercountry Programme for the Development and Application of Integrated Pest Control(IPM)
GCP/RAS/146/AUS	Intercountry Programme for the Development and Application of Integrated Pest Control(IPM)
GCP/RAS/147/SWI	Intercountry Programme for the Development and Application of Integrated Pest Control(IPM)
TCP/DRK/0051/A	Assistance to Improve Crop Production on the Paekm Plateau

PGR related projects recently executed by FAO in the sub-region (continued)

Project Code	Country	Dates	Title	PGR Element
GCP/RAS/103/DEN	Regional		Improved seed production	Small
GCP/RAS/145/NET GCP/RAS/145/AUL GCP/RAS/145/SWi	Regional	01.94-12.97	Intercountry programme for the development and application of integrated pest control	Small
TCP/DRK/0051/A	DPR Korea		Assistance to Improve Crop Production on the Paekm Plateau	Small
TCP/DRK/2354/A	DPR Korea		Hazel Nut Production	Small
UNDP/CPR/85/040	China		Strengthening Soybean Research	Small
UNDP/CPR/86/016	China		Developing of Coffee Planting and Processing in Yunan Province	Small
UNDP/CPR/91/130	China	03.93-12.97	Seed breeding programme	Large
UNDP/DRK/86/002	DPR Korea	05.88-12.93	Vegetable research and development	Medium
UNDP/DRK/86/008	DPR Korea		Rice Crop Production	Small
UNDP/RAS/89/036	Regional	02.91-12.94	Strengthening jute and kenaf seed programmes	Small
UNDP/RAS/89/040	Regional	01.90-12.95	Regional cooperative programme for improvement of food legumes and coarse grains in Asia	Medium
UNDP/RAS/89/041	Regional	04.91-12.94	Research and development of vegetable crops	Medium
UNDP/RAS/92/078	Regional		Farm-centered Agriculture Resource Management Programme	Medium
UNDP/RAS/93/064	Regional		Agroforestry Network	
UNDP/RAS/93/065	Regional	10.93-12.98	Integrated pest management	Medium
UNDP/RAS/93/066	Regional	10.93-12.97	Biotechnology and biodiversity	Large
UNDP/RAS/93/067	Regional		People-centered Sustainable Development	Small
UNDP/ROK/87/006	Rep. of Korea		Strengthening of RDA's Plant Genetic Resources	Large
UNDP/ROK/87/018	Rep. of Korea	07.88-03.94	Support to microbial cell bank: Korean Collection for Type Cultures	Large

Further details of some FAO projects recently executed by FAO in the sub-region[1] (continued)

The regional FAO/UNDP Farm Project, UNDP/RAS/92/078, "Farm-Centred Agriculture Resource Management Programme", contains three sub-projects relevant to plant genetic resources: RAS/93/066, "Asian Biotechnology and Biodiversity", RAS/93/064, "Agroforestry Network" and RAS/93/065, "Integrated Pest Management". A further sub-programme, RAS/93/067, "People-centred Sustainable Development", aims at developing farmers' capabilities for participation in the improved management, conservation and utilization of natural resources.
Sub-project RAS/93/066 includes a specific component on conservation, in addition to an extensive component on utilization, through biotechnology. One of the objectives of the sub-project is the assessment of the potential of new biotechnologies to contribute to the characterization and conservation, by farming communities, of biodiversity. A "rational farming system" will be studied, because of its relevance to natural resources management. Workshops on biodiversity assessment will be held, and there will be extensive networking.
Sub-project RAS/93/065 aims to develop national capabilities for training in community-based organization-building for IPM, in lowland and upland farming systems in Asia and to establish community-based field laboratories for IPM research, including for the assessment of new developments in biodiversity and bio-technology.

41. The international agricultural research centres (CGIAR centres) and other regional international centres play an important role in promoting the development of the national programme in East Asia. These activities include cooperative research projects, training, information exchange, etc.

42. IPGRI established a regional office for East Asia in Beijing in 1988 for coordinating activities in the region, including collecting, characterization and documentation, research on seed storage, training and workshops, etc. The IPGRI Office for East Asia maintains strong contacts with national programmes through national coordinators identified by each country.

[1] From information provided to the FAO Commission on Plant Genetic Resources, CPGR/6/95/5.1, May 1995.

43. CIP established a liaison office in China to manage the cooperative activities on germplasm and other researches, including breeding in the country. CIP also has activities in DPR Korea and in the Republic of Korea.

44. IRRI has an office in Japan, responsible for the cooperative activities between Japan and IRRI. China has been involved in IRRI germplasm and training programmes, ICRISAT sorghum and legume and peanut programmes, and CIMMYT training and breeding programmes. Other centres, such as ICARDA, also have some activities related to germplasm exchange and training. The Republic of Korea has been involved in IRRI and AVRDC activities. AVRDC also has good cooperation with China in the vegetable and mungbean programme. Table 6 illustrates some of the interactions among East Asia countries and the Centres of the Consultative Group on International Agricultural Research (CGIAR) and other agricultural research centres.

Table 6: Interaction among East Asia Centres of the Consultative Group on International Agricultural Research (CGIAR) and other agricultural research centres

Centres	Countries involved in activities of regional and international centers				
	China	DPR Korea	Japan	Mongolia	Rep. of Korea
IPGRI	yes	yes	yes	yes	yes
CIP	yes	yes			yes
IRRI	yes		yes		yes
ICRISAT	yes				
CIMMYT	yes				yes
ICARDA	yes				
IITA	yes				
AVRDC[1]	yes				yes

[1] **Non-CG centre**

C. Conservation Activities

45. Conservation programmes involve a series of activities on germplasm collecting, characterization and documentation, and storage.

(a) Collecting

46. The countries in East Asia have paid great attention to collecting plant genetic resources, especially crop species. They usually collect germplasm either through organizing specific collecting missions, or through local institutes and agricultural extension agencies. Table 7 shows crop diversity collected and maintained by each country in the sub-region.

Table 7: Crop diversity collected and maintained in the sub-region

Crop	Accesions[1]				
	China	DPR Korea	Japan	Mongolia[2]	Rep. of Korea
Cereals	200,000	26,320	83,300	15,380	67,670
Legumes	10,000	3,530	14,900	460	23,900
Industrial crops	60,000	3,460	10,000	160	11,000
Vegetables	25,000	8,150	21,400	1,980	8,600
Fruit trees	10,000		8,000	100	280
Forage	3,000	580	42,200	1,500	3,380
Root and tuber crops	1,000		5,800	520	70
Others	10,000		11,400		700
Total	**319,000**	**42,040**	**197,000**	**20,100**	**115,600**

[1] **Includes collections from both within and outside the country**
[2] **The collections of Mongolia do not include those maintained in the Vavilov Center**

47. Generally, the activities on germplasm collecting and utilization are focused on major crops such as rice, wheat, maize, etc. However, some minor crops or underutilized crops have great potential in sustainable food supply. Minor crops, including buckwheat, millets, safflower, various beans, etc., are playing an important role in food security in remote areas, mountainous areas, and dry areas in different countries in the region. These crops are characterized by high nutrition, short growth period, resistance to disease and stresses, and multiple uses. The loss of genetic diversity in minor crops is occurring in the region due to less attention being given to their collection and conservation.

48. In China, The Ministry of Agriculture organized a nation-wide collecting activity in the 1950s. As local research institutes and agricultural extension agencies were involved, the collecting activity covered most of the counties in each province, and most of the crop species existing in the country. Since the 1980s, the Institute of Crop Germplasm Resources of CAAS has organized a series of collecting missions to the regions of diversity centres in Yunnan, Tibet, Sichuan, Guizhou, Hainan, Hubei, etc.

49. Japan started collecting activities before World War II. But nation-wide exploration and collection was only systematically conducted for rice in 1962-1965, and for maize in 1953-1968. After starting the MAFF Genebank Project in 1982, the collecting has focused on minor crop species and wild relatives of small grain, vegetables, fruit trees, tea and mulberry. Currently, 6-8 domestic missions are organized annually to collect germplasm in collaboration with prefectural institutes. In addition, Japan also organizes 5-6 international missions annually, and has collected a large number of crop germplasm from about 40 countries in the world.

50. The Republic of Korea has a long-term plan for germplasm collecting activities. RDA has made an effort to collect landraces of major crops such as rice, wheat, barley, sorghum, maize and millet since the 1980s. Collecting wild relatives such as wild soybean and wild rice and endangered crop species has also been given high priority. In recent years, missions have been organized to collect legumes, sesame, forage species, etc. In the total collection, about 66% was collected by scientists through research programmes and about 23% by agricultural extension officers throughout the country. Some agricultural universities have been involved in the collecting activities. The total accessions have reached more than 110,000.

51. DPR Korea started collecting activities in 1950. The relevant research institute of the Academy of Agricultural Sciences collected and conserved mandated crops. The valuable economic species were collected and conserved in the Botanical garden. Systematic collecting work on a national scale started in the 1970s after the PCGRI was established. About 70,000 accessions of various crop germplasm have been collected in the country and abroad. The majority of germplasm is exotic and only 6,000 accessions were collected in the country. Further collecting is needed. There is a seed storage at -10°C installed in the PCGRI. However, it is too small (4 x 5 x 2m) to conserve all collected germplasm for the country. The majority of the germplasm users are breeders from the Academy of Agricultural Sciences. Annually around 1,500 accessions are used in breeding programmes and other research areas.

52. Mongolia collected its plant germplasm in cooperation with Russia in the early 1920s when the Vavilov Institute sent an exploration team to Mongolia. During 1931-1990, nine collecting missions were organized to collect local plant species in Mongolia. High priority was given to collecting barley genetic resources as barley is an important food crop for the Mongolian people. Attention was also given to collect local millet varieties. In 1993-1994, collecting missions for crop and forage plant species were conducted in the South and East parts of Mongolia under the support of IPGRI. There is need to collect PGR resources in the South and Southeast parts of the country.

53. For forests, most of the activities in East Asia are surveying the ecogeographic distribution and identifying species diversity as well as gathering the information of ecosystem diversity. It is estimated that the region possesses great diversity in forest species.

(b) Storage

54. The base collections in China, Japan, the Republic of Korea and DPR Korea are maintained at optimum conditions. About 90% of the total germplasm collections in the region has been stored in base collections. These collections are only maintained for the safety of germplasm accessions and are not available for distribution. The active collections are usually maintained in the provincial medium-term genebanks, research institutes, universities and experimental stations with conditions varied from room temperature to -18°C. These genebanks/institutions are responsible for germplasm regeneration, characterization, distribution and utilization.

55. For seed collections, after regeneration or multiplication, they are usually stored in genebanks for long-term and medium-term conservation. Japan, China, and the Republic of Korea have established long-term storage facilities. DPR Korea has a movable cold storage for medium to long-term storage for some of their collections. Mongolia only has normal room-temperature storage. Table 8 shows the conditions and number of accessions in base and active collections in the sub-region.

Table 8: Conditions and number of accessions in base and active collections in East Asia

Country	Base collection		Active collection	
	Conditions	Accessions	Conditions	Accessions
China	-18°C, 57% RH	280,000	-18°C - 25°C	350,000
DPR Korea	-5°C	10,000	ambient	30,000
Japan	-18°C, 30% RH	143,000	-1°C - 5°C	81,000
Mongolia			ambient	20,000
Rep. of Korea	-18°C, 40% RH	120,000	5°C - 12°C	110,000

56. For vegetatively propagated crop and perennials, field genebanks are used to conserve the collections. There are 23 such field genebanks in China, 15 in Japan, 7 in the Republic of Korea and some in DPR Korea and Mongolia. The crop species conserved in field genebanks are listed in Table 9. For conserving collected tree germplasm, China has established 7 field genepools covering 29 important tree species in different regions from Heilongjiang in the Northeast to Guangxi in the South of China.

Table 9: Crop species conserved in filed genebank in East Asia

Crops	Accessions maintained in field genebanks established in East Asia				
	China	DPR Korea	Japan	Mongolia	Rep. of Korea
Fruit trees	10,000		8,012		
Root and tuber crops	2,854		5,168		
Tea	2,011		5,647		
Mulberry	1,660		1,911		
Rice	1,000		245		
Forage crops			8,438		
Vegetables	1,313		1,401		
Tropical and sub-tropical crops	12,900		116		
Ornamental plants			3,614		
Fiber crops	1,251				

57. In the national genebank of China, there are 52 species of grain and cash crop seeds, and more than 80 species of vegetable germplasm in conservation for long-term storage. By the end of 1994 the germplasm in the genebank had reached over 300,000 accessions. About 90% of the accessions are landraces or primary cultivars. In addition, more than 21,190 accessions of perennial and vegetatively propagated crop plants or their wild relatives are conserved in 23 national depositories. However, operating funds for the national genebank and local mid-term storage and depositories is seriously inadequate, one-third of the mid-term genebanks is non-functional. If this trend continues, the preserved accessions will disappear.

58. In Mongolia, about 20,000 accessions of cereals, food legumes, vegetables, fruits and forage crops are stored in the Plant Science and Agriculture Research Institute at room-temperature conditions. Although IPGRI (ex-IBPGR) has provided some funding for purchasing two deep-freezers for conserving some germplasm, further improvement is needed in the conservation facilities.

59. Japan has modern conservation facilities for plant genetic resources. A genebank with a completely automated system in the storage rooms has been functioning for many years. The collections in the MAFF Genebank system are classified into three collections: base, active and working. Up to now, a total of 197,538 accessions of various crops are preserved in these genebanks (including field genebanks), of which 143,131 accessions are in the base

collection for long-term storage, accounting for 72.5 percent of the total preserved accessions. Some MAFF germplasm is used in breeding programmes. Biotechnology has been used in gene transfer and DNA recombinant and is expected to promote the use of plant genetic resources.

(c) Regeneration

60. Regeneration of germplasm is a critical step for maintaining genetic diversity and genetic integrity of the materials. Ideally, regeneration is carried out in case either viability of materials is decreased to a certain level, for example below 85% in base collection, or the amount of seed stock is lower than the minimum requirement in active collection. For China, Japan, DPR Korea and the Republic of Korea, the germplasm is regenerated at local experimental stations and research institutes or appropriate locations. For each crop, there is a working group responsible for providing advice on the methods used for regeneration in order to maintain genetic diversity and integrity.

61. Regeneration is still a bottleneck among PGR activities, because it requires a large amount of labour and financial resources which now are not sufficient. Mongolia has a large number of accessions urgently needing regeneration. Some barley and wheat accessions have already been stored for over 30 years, and the viability of these materials is decreasing. Another problem is lack of appropriate regeneration methods in terms of the size of the population used for covering the whole genetic diversity and pollination control methods used for maintaining genetic stability and integrity.

(d) Characterization and documentation

62. Characterization and documentation are usually major components of the national conservation programme. Accurate data recorded on germplasm accessions which are documented in a computerized information system will greatly improve the access to the materials by breeders and other researchers.

63. In China, the Institute of Crop Germplasm Resources of CAAS has organized characterization activities since early 1980, in cooperation with relevant research institutes and universities. The germplasm was characterized locally and data was recorded according to the descriptor lists developed for each crop in consultation with IPGRI-published descriptor lists. By the end of 1994, about 300,000 accessions of various crop germplasm collections had been characterized for 25-70 characters. The data have been compiled into catalogues for most of crops. A computerized documentation system has been established in the Institute of Crop Germplasm Resources of CAAS on a 486 Personal Computer. The system contains all passport data and characterization data of 300,000 accessions. The system can provide services on information retrieval, statistical analysis, etc., as requested.

64. Japan has characterized its germplasm collections under the MAFF genebank project. In 1991, Japan developed a manual on standard methods for characterization and evaluation as well as a descriptor list for each crop. Morphological characters are considered essential for characterization. Several research institutes have been involved in the activities. An information database called the Genebank Database Management System (GMs) was developed at the National Institute of Agro-biological Resources. The system is composed of three parts: passport data, conservation and distribution management data, and characterization and evaluation data. The local institutes can access the database through the MAFF information network. Catalogues are also available for most of crops.

65. The Republic of Korea has made efforts to characterize landraces of various crop species by involving RDA-affiliated research institutes. Descriptor lists for more than 50 crop species have been developed in discussions with the Germplasm Advisory Committee. An effort also was made to characterize world sesame collection, about 3,000 accessions from the Republic of Korea, USA, Turkey, India, Mexico, etc. At present, about 40% of the stored germplasm in the RDA genebank has been characterized. Primarily, efforts were made to carry out biochemical tests, physiological responses, microbiological tests, disease and pest susceptibility, and yield. The highly technical evaluation such as genetic fingerprinting is carried out by some experts on a small scale. The data obtained by different institutions on passport and characterization data have been sent to the RDA genebank and computerized by the Germplasm Information Database Programme (GIDP). The database programme is operated on a personal computer. It is planned that a computer network will be established in 1997-2004. The RDA genebank has published catalogues containing characterization and evaluation data for major crops such as rice, wheat, maize and barley. These catalogues are available to institutes, universities, seed companies and other researchers and farmers.

66. In DPR Korea, the Pyongyang Crop Genetic Resources Institute is responsible for characterizing germplasm collected both at home and a broad. The data will be recorded for each crop according to the descriptor lists published by IPGRI. The Institute has a computerized database. But data on only 10,000 accessions of germplasm conserved in the national genebank have been computerized.

67. Mongolia started to characterize their germplasm collections in 1992. More than 4,000 accessions of cereal, vegetables, fruits and industrial crops have been observed for agronomic characters according to descriptors developed by Russian scientists. A computerized documentation system is under development.

68. For forest species, some countries such as China and the Republic of Korea have made efforts to investigate the characteristics and natural distribution of habitats for major tree species. Although the characterization and evaluation are not systematically carried out for forest genetic resources, the activities evaluating particular characters directly related to use are being carried out in China.

(e) *In situ* conservation

69. Conservation of forest genetic diversity is mainly *in situ* through setting up protected areas, which is perhaps the most effective method for the conservation of forest species. According to the size and purposes, the protected areas in the region can be classified into three categories: **(1)** protected ecosystem, **(2)** protected flora and **(3)** protected forest species. There are 335 reserves for forest and 12 for grassland in China. And there are about 111 botanical gardens, where about 23,000 wild plant species are cultivated, of which 16,000-18,000 species are native flora. Continued destruction and deterioration of the ecosystem has now become one of the most serious environmental problems in China. Forests are the ecosystem type most widely distributed in terrestrial areas and with the greatest biomass and biodiversity. For a long time, China's forest resources suffered damage from random felling, destruction of forest for farming, forest fire, and plant disease and pests. This has resulted in a drastic loss of forest area, especially of natural forests. Steppes account for about one-third of China's total area. Now all grassland areas face serious decline. Threatened by grassland deterioration and intensified by wind-blown sand, desertification in the north has already accelerated and the desert area is expanding.

70. In China, on-farm conservation of plant species is only considered practical for forage species in grazing land and for some wild relatives of crop species such as wild rice and wild soybean in natural environments. On-farm conservation of crop species has the advantage of maintaining continued evolution and direct use under natural and artificial selection, but it is affected by social, biological and economic factors in the communities. China is a traditionally agricultural country and still has large areas maintaining the traditional farming system, and would be particularly interested in activities on on-farm conservation of crop species.

71. In DPR Korea most of the forest germplasm is *in-situ* conservation in flora protection areas in 200 locations and other plant protection areas and botanical gardens. More than 1,100 forest species are conserved at botanical gardens, 6 environmental protection areas; specified plant protection areas and flora protection areas located in 50 places have been set up by the government.

72. Across the region, synergies between PGR work and nature conservation have been relatively weak, except in Japan, until recently. Action on ecosystem conservation has been accelerated following the coming into force of the Convention on Biological Diversity. Forest ecosystems received the earliest attention, as far back as the 1950s in parts of the region, but specific action for grasslands and deserts only came after major international promotions, such as wetlands, had been considered. Management of nature reserves is weak. Management of genetic conservation of target species is virtually non-existent, nor are links between *ex situ* crop conservation and use of germplasm rationalized in place. Botanic gardens, arboreta and bambusetums, which are particularly important for education, could play an important role in conserving threatened species, but as yet are not significant in conserving intraspecific diversity.

D. Use of Plant Genetic Resources in the Sub-Region

73. There is great potential for use of plant genetic resources to contribute to the economic development in the East Asia countries. All East Asia countries have made efforts to evaluate, improve and use their germplasm collections in cooperation with plant breeders, pathologists and other relevant researchers.

74. Farmers are the direct users of germplasm. They have cultivated landraces for a long history along with improving plant genetic resources through natural and farmers' selection. The farmers in remote or mountainous areas have more opportunities of using landraces than those in developed areas where the landraces are rarely seen in the field. There is probably a great potential for enhancement of landraces, to improve production in marginal areas, but this has not been carried out.

75. Regarding the capacity of using plant genetic resources in national programmes, Japan, the Republic of Korea and China are more advanced in terms of technology and personnel, and funding and facilities. Each of these countries has some very good institutes engaged in crop breeding and improvement at central and provincial levels. Also some universities participate in the activities of plant breeding and related research.

76. DPR Korea has several research institutes under the Academy of Agricultural Sciences and universities engaged in breeding or crop improvement, such as the Institute of Maize, the Institute of Rice, the Institute of Vegetables, etc. In Mongolia, the Crop Science and Agricultural Research Institute and the Animal Husbandry Institute are engaged in crop and forage improvement. These institutes have adequate experimental fields, but laboratory facilities and research capability need to be improved.

77. In China, germplasm has been used in three ways: **(1)** as breeding materials, **(2)** as varieties directly used in production, and **(3)** as genetic materials for biotechnological research. Since 1949, by using local varieties, China has developed large numbers of improved cultivars for different crops including wheat, rice, maize, sorghum, millet, soybean, peanut, vegetables and fruits. Earlier, the breeding activities were mainly concentrated on variety or population improvement for high yield with germplasm collections. At present, China has a very systematic nation-wide breeding programme on major crops. It involves a large number of scientists from central and local research institutes and universities. The major objectives of the breeding programme are to develop modern cultivars with characteristics of high yielding, high quality and high resistance to diseases and pests and environmental stresses. One of the significant achievements is the success in developing hybrids, especially hybrid rice derived from a cross involving wild relatives.

78. To meet the needs of the breeding programme, germplasm evaluation activities on disease and pest resistance and stress tolerance, quality analysis, and productivity have been carried out since 1986. At the same time, germplasm enhancement and improvement through crossing with wild relatives, line and population selections have achieved significant progress in some crops such as rice, wheat, maize, etc. The desirable materials will undergo tests before being provided to breeders. However, some very good varieties are released earlier to farmers for production. The products of these kinds of varieties are considered as health food and favored by people. Seed production and distribution for released cultivars are usually strictly controlled by seed companies run by governments at central, provincial and county levels. However, breeders from research institutes and universities now also have the right to deal with the seed production and distribution.

79. In Japan, since systematic breeding efforts started in the 1920s, emphasis has been given to improving agronomic characters such as resistance to pest and disease and cold stresses, and grain and eating quality, by using genetic variation in local germplasm collections, including wild species. Recently, high technology, such as gene transfer and recombination of DNA, is being considered for using germplasm in breeding programmes. To promote the use of germplasm, Japan has carried out evaluation activities since the start of the MAFF project in 1982. The emphasis is focused on evaluating resistance to diseases and pests, stress tolerance, and agronomic traits such as grain quality and yield. Efforts are also made to assess specific characters such as starch content of cereal endosperm, enzyme zymogram pattern and DNA analysis. NIAR has established a DNA bank to conserve the DNA sequence obtained from various gnome projects. NIAR has published catalogues on genetic resources for distribution. The available collections can be provided on request from researchers.

80. In the Republic of Korea, use of PGR is promoted by distribution of good germplasm to breeders. From 1991 to 1994, about 14% of the total collection was provided to and used by over 300 local researchers. The breeding programme is focused on improvement of landraces, and disease and pest resistance through pure line selection or crossing. A number of new cultivars with good quality, high yield, and regional adaptation have been bred for soybean, sesame, adzuki bean, maize, perilla, mungbean and barley. In order to promote the use of collected germplasm, it is essential to obtain the analytical instruments and tools for detailed evaluation.

81. DPR Korea evaluates the germplasm after materials are collected at home or abroad. This is the responsibility of the Pyongyang Crop Genetic Resources Institute. The evaluation is based on the descriptors published by IPGRI. DPR Korea's breeding programme uses various crop germplasm and has developed a large number of new advanced varieties for rice, maize, soybean, sorghum, wheat, barley and for vegetable crops. The current breeding objectives are set to increase yield and quality. Germplasm is mainly used as foundation material to transfer useful genes to new varieties.

82. Mongolia has been carrying out activities on evaluation of germplasm collection for three years. About 4,000 accessions have been evaluated for agronomic characters, quality, disease and drought resistance. More than 100 elite germplasm have been provided to the breeding programme and used effectively in production.

83. For forest species, use of germplasm to improve economic trees is carried out in China. The evaluation for disease resistance and other economic characters is underway. The Republic of Korea has programmes for seed production and supply of forest trees implemented by the Forest Genetic Research Institute, the Forestry Research Institute, etc.

E. PGR Exchange

84. Sharing germplasm is expected by all countries in East Asia. Within a country, germplasm is usually shared among research institutes or groups with common interests or involved in the same programme. Materials are freely provided and the results are shared with each other. But the contribution of germplasm providers is not always recognized in breeding programmes or other research activities in some countries such as China. For some countries such as Japan, the Republic of Korea, etc., users from public and private organizations and universities can send requests to the national active genebank. Mongolia and DPR Korea have also provided a large number of germplasm to breeding programmes or other research activities. There are activities related to germplasm exchange in the region, such as the rice

cooperative project between China and Japan involving rice germplasm exchange. However, it is necessary to promote exchange of germplasm and related information. In this respect, Japan has previously expressed an interest in placing designated germplasm in the international network of *ex situ* collections under the auspices of FAO, and Japan, China and the Republic of Korea are participating in the renegotiation of the International Undertaking on Plant Genetic Resources.

III. NEEDS, OPPORTUNITIES AND CONSTRAINTS AND PRIORITIES FOR THE GLOBAL PLAN

A. Needs and Constraints for the Sub-region related to Policy Decisions and Institutional and Technical Constraints

National programme

85. Some needs and constraints are common to all national programmes and include:

(a) Genetic resources conservation activities are strongly sectoralized due to different government structures,. For instance crops, forestry, non-timber products and medicinal plants are compartmentalized under different Ministries (except for Japan), and integration across Ministries are not usually easily facilitated.

(b) The institutional bases and technical expertise are planned, supported and executed on the basis of sectional interests following the political and policy divisions. Constraints vary between sectors and countries, and sub-regional generalizations are not possible except for noting:

(i) Crop genetic resources work tends to be more advanced than for other plant resources and most emphasis is on major crops for which there is a plant breeding programme. Maybe the weakest aspect of crop genetic resources relates to the distribution, conservation and wider use of wild relatives of crop genepools. Another major gap relates to minor crop species, especially underutilized species, even though some are known to have potential in rural development: the constraints are understandable when it is realized that the crop genetic resources work is largely focused on current agricultural development and expansion. Also there is insufficient attention to PGR of dryland and other marginalized environment, or to the direct use and enhancement of landraces for these environments.

(ii) Medicinal plant research varies from country to country: Some are much more technically advanced than others and this tends to parallel the use of materials in local systems of medicine. Despite basic legislation for protection of resources, as for instance in China, the patterns of distribution of diversity are poorly known. Considerable resources, both financial and human, are required to overcome these constraints.

Sub-regional collaboration

86. Collaboration is based on three aspects: **(1)** the policy decisions and technical wishes of individual countries; **(2)** the promotion by IPGRI, FAO, and other international organizations of sub-regional collaboration largely through fostering planning meetings, sharing information and promoting joint activities, and **(3)** Japan, as a developed country, providing a degree of technical assistance and, especially, training.

87. Much would be gained by all national programmes if germplasm were to be much more freely available. There are policy problems here, including problems of understanding and degrees of competitiveness among a number of specific crop development programmes among countries which need to work out solutions for the benefit of all, with the support of international organizations such as FAO and IPGRI, where requested.

88. The biggest constraint to collaboration relates to information exchange and availability. Language barriers represent one constraint. This has been misinterpreted somewhat as the need to exchange data on samples but in effect relates to knowing who is doing what and where and providing publications and reports. A regional plant resources information centre might be considered.

Research, training and capacity building

89. Research support by governments is likely to remain strongly related to strategic production needs. In parallel, governments will develop major plans in response to the Convention on Biological Diversity. Research on crops of low immediate value, e.g. on underutilized crops, or minor forest products with little export potential or crop diversification, including plants related to indigenous cultures, require more attention.

90. Capacity building is needed at all levels for the national programmes in Mongolia and DPR Korea; China needs more training and running funds for its medium-term collections, and the Republic of Korea requires a widening of crops covered by the programme. Surveys of plant breeding interests and tree improvement interests need to be reviewed within nations and the sub-

region and a degree of strategic planning included in future recommendations.

Adequate conservation

91. Across the sub-region it is expected that at least for the most important crops, fruits and forages, and hopefully for a range of tree genepools, *ex situ* conservation will be adequate within 5-10 years - especially for those linked to activities of IARCs. However, this will not include the vast majority of domesticated species which fall outside the governments' agreed priorities for commercial production. For instance, China has documented 20 grain crops, 44 vegetables and flavorings, 52 fruits, 10 fibers, 25 industrial/cash crops, 41 major medicinal, and 30 major bamboos and rattans - all indigenous, plus 15 crops introduced before 1 AD, 71 introduced Old World plants after 1 AD and 27 species from the Americas. Compared to this vast diversity, the existing CAAS Genebank and clonal collections have a capacity for only about 130 crops. A comprehensive programme is required to deal with these marginalized species.

92. On-farm conservation is little understood in the region and further strategizing is necessary.

Adequate use

93. Better use will relate to the continued interests of plant breeders, and forage and tree improvement specialists. DPR Korea, the Republic of Korea, China and Japan have well established linkages between crop plant breeders and conservation but evaluation is not yet adequate for most breeders' needs.

94. Further information is requested concerning pasture plants and forest genetic resources.

B. Opportunities and Comparative Advantages of the Sub-Region

95. There are huge opportunities for PGR work including joint research and networking across the region. However, experience has shown that this does not often happen. One networking example concerns rice in collaboration with IRRI. Several other PGR networks have been proposed but have not come to fruition for three reasons: **(1)** lack of sufficient funding; **(2)** lack of experience on bilaterally agreed research programmes, and **(3)** political differences. Whilst successful inter-country cooperation has been developed in relation to training and in some cases in relation to capacity building, there are few examples in relation to research. Specific proposals for research on conservation and use of some priority species should be developed.

96. A number of proposals for enhanced cooperation have been agreed as follows (however, the constraints mentioned in the previous paragraph will need to be overcome before these become a reality):

- Joint multilocational evaluation of selected germplasm;
- Joint germplasm collecting missions;
- Joint research activities on *in vitro* conservation and seed conservation (leading to more secure conservation and better use of tropical and temperate fruit species);
- Identification of minimum essential descriptors for evaluation, in order to develop a common format for documentation;
- Development of strategies of programmes for in *situ* conservation.

APPENDIX I
INVENTORY OF CHINESE CULTIVATED PLANTS
(Excluding Forages, Less Important Plants and Trees)[1]

Part 1: Pre-historic crop plants

I. Grain crops

Clycine max
Colocasia esculenta
Colocasia tonoimo
Dioscorea batatas
Echinochloa crusgalli
Eleusine coracana
Euryale ferox
Fagopyrum esculentum
Fagopyrum tartaricum
Hordeum vulgare
Hydrosme konjac
Oryza sativa
P. milliaceum var glutinosa
Panicum milliaceum
Setaria italica
Stizolobium hassjoo
Triticum aestivum
Vena nuda
Vigna angularis

II. Vegetables and flavourings

Agastache rugosus
Allium bakeri
Allium odorum
Benincasa hispida
Brasenia schreberi
Brassica alboglabra
Brassica campestris
Brassica chinensis
Brassica juncea
Brassica napiformis
Brassica narinosa
Brassica parachinensis
Brassica pekinensis
Brassica rapa
Bursa bursa - pastoris

[1] Most of these plants are also cultivated in other countries of the sub-region

Vegetables and flavourings (continued)
Chrysanthemum coronarium
Cinnamomum cassia
Cucumis conomon
Cucurbita moschata
Eleocharis tuberosa
Fagara chinifolia
Glehnia littoralis
Hemerocallis flava
Illicium verum
Ipomoea aguatica
Lagenaria siceraria
Lagenaria vulgaris
Lillum brownii
Lillum tigrinum
Malva verticillata
Nelumbo nucifera
Oenanthe slolenifera
Perilla nankinensis
Perilla ocymoides
Raphanus sativus
Sagittaria sagittifolia
Solanum melongena
Stachys sieboldii
Toona sinensis
Trapa bicornis
Vigna sinensis
Zanthoxylum bungeanum
Zingiber mioga
Zingiber officinale
Zizania caduciflora

III. Fruit tree
Actinidia chinensis
Actinidia eriantha
Canarium album
Canarium nigrum
Carya cathayensis
Castanea mollissima
Citrus aurantium
Citrus grandis
Citrus hobitis
Citrus junos
Citrus medica
Citrus reticulata

Fruit tree (continued)

Citrus sinensis
Clausena lansium
Corylus chinensis
Crataegus pinnatifida
Diospyros kaki
Diospyros lotus
Elaeagnus angustifoflia
Eriobotrya japonica
Fortunella crassifolia
Fortunella hindsii
Fortunella japonica
Fortunella margarita
Fortunella obovala
Ginkgo biloba
Hovenia dulcis
Juglans sinensis
Litchi chinensis
Malus asiatica
Malus micromalus
Malus prunifolia
Myrica rubra
Oimocarpus longan
Pinus densiflora
Poncirus trifoliata
Prunus armeniaca
Prunus japonica
Prunus mume
Prunus persica
Prunus pseudocerasus
Prunus salicina
Prunus tometosa
Pyrus betulaefolia
Pyrus bretschneideri
Pyrus pyrifolia
Pyrus ussuriensis
Rhodo-myrtus tomentosa
Torreya grandis
Ziziphus jujuba
Ziziphus jujuba var. spinosa

IV. Fibre crops

Abutilon theophrasti
Achnatherum splendens
Apocynum venetum
Boehmeria nivea
Broussonetia papyrifera
Cannabis sativa
Gossampinus malobarica
Phragmites communis
Pueraria thunbergiana
Sesbania cannabina
Trachycarpus fortunei

V. Economic crops

Aleurites cordata
Aquilaria sinensis
Astragalus sinicus
Camellia oleifera
Camellia sinensis
Chaenomeles sinensis
Cinnamomum camphora
Fraxinus chinensis
Gleditsia sinensis
Gymnocladus chinensis
Hodgsonia macrocarpa
Indigofera tinctoria
Intigofera anil
Lespedeza bicolor
Lithospermum erythrorhizon
Livistona chinensis
Melilotus suaveolwna
Morus alba
Polygonum tinctorium
Quercus acutissima
Rubia cordifolia
Saccharum sinensis
Toxicodendron verniciflnum
Tripterygium wilfordii
Typha latifolia
Xanthoceras sorbifolia

VI. Medicinal plants

Acacia catechu
Achyranthes bidentata
Aconitum carmichaeli
Adenophora stricta
Angelica dahurica
Angelica sinensis
Anemarrhena asphodeloides
Arctinum lappa
Asparagus co-chinchinensis
Atractylodes macrocephala
Campsis grandiflora
Cassia tora
Codonopsis pilosula
Cornus officinalis
Cyathula officinalis
Eucommia ulmoides
Fritillaria thunbergii
Gastrodia elata
Glycyrrhiza uralensis
Gunura segetum
Leonurus artemisia
Ligusticum wallichii
Lonicera japonica
Lycium chinensis
Magnolia officinalis
Mentha haplocalyx
Momordica grosvenori
Ophiopogon japonicus
Panax ginseng
Panax pscudo-ginseng
Pinellia ternata
Platycodon grandiflorus
Rauvolfia verticillata
Rehmannia glutinosa
Rheum officinale
Salvia miltiorrhiza
Schisandra chinesis
Scrophularia ningpoensis
Talinum paniculatum
Tetrapanax papyriferus
Trichosanthes kirilowii
Tussilago farfara

VII. Floscopa

Arundinaria simonii
Bambusa multiplex
Bambusa sinospinosa
Bambusa spinosa
Bambusa texitilis
Bambusa vulgaris
Calamus rhabdocladus
Calamus tetradactylus
Chimnobambusa utilis
Daemonorops margaritae
Indocalamus latifolius
Phyllostachys pubescens
Sinarundinaria nitida
Sinocalamus beecheyanus
Sinocalamus oldhami

VIII. Other important plants

Camellia japonica
Chimonanthus praecox
Chrysanthemum morifolium
Cymbidium ensifolium
Daphne odora
Gardenia jasminoides
Hibiscus mutabilis
Jasminum sambac
Magnolia liliflora
Michelia figo
Osmanthus fragrans
Paeonia lactiflora
Paeonia suffruticosa
Rhododendron simsii
Rosa Chinensis
Rosa rugosa
Ruta graveolens
Syringa obtata
Wisteria sinensis

Part 2: Examples of introduced old world crops showing secondary diversity

Allium cepa
Allium fistulosum
Allium porrum
Allium sativum
Apium graveolen
Artocarpus heterophyllus
Avena sativa
Beta vulgaris
Brassica caulorapa
Brassica napus
B. oleracea var. botrytis
B. oleracea var. capitata
Canavalia gladiata
Carthamus tinctorius
Citrullus vulgaris
Citrus limon
Coix lacryma jobi
Coriandrum sativum
Cucumis melo
Cydonia oblonga
Cymbopogon citratus
Daucus carota
Dioscorea alata
Dioscorea hispida
Dolichos lablab
Ficus carica
Foeniculum vulgare
Gossypium arboreum
Gossypium herbaceum
Hibiscus cannabinus
Humulus lupulus
Juglans regia
Lactuca sativa
Linum usitatissimum
Luffa cylindrica
Mangifera indica
Medicago sativa
Petroselinum crispum
Phaseolus calcaratus
Phaseolus radiatus
Pisum salivum
Prunus avium

Part 2 (continued)

Punica granatum
Pyrus communis
Ricinus communis
Saccharum officinarum
Secale cereale
Sesamum orientale
Sorghum bicolor
Spinacia oleracea
Styrax japonica
Trichosanthes anguina
Triticum durum
Vicia faba
Vigna mungo
Vigna unguiculata
Vitis vinifera

Part 3: Examples of Crops from the Americas showing secondary diversity

Arachis hypogaca
Canna edulis
Capsicum annuum
Carica papaya
Cucurbita pepo
Gossypium barbadense
Gossypium hirsutum
Helianthus annuus
Helianthus tuberosus
Ipomoea batatas
Lycopersicum esculentum
Manihot esculenta
Nicotiana tabacum
Persea americana
Phaseolus vulgaris
Solanum tuberosum
Zea mays