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

BANGLADESH

AG-GCP/RAS/186/JPN
FIELD DOCUMENT NO.2007/05

The Second Report on Plant Genetic Resources for Food and Agriculture of Bangladesh – The State of Activities

Bangladesh Agricultural Research Council
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February 2007

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ACKNOWLEDGEMENTS

The paper is an outcome of the FAO project "Establishment of a National Information Sharing Mechanism on the Implementation of Monitoring of Global Plan of Action for Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture." The project involved participants from some 20 stakeholder organizations including the Chief Technical Adviser of the Project, Dr. N. Quat Ng of the FAO Regional Office for Asia and the Pacific, Bangkok and Dr. Paul Quek, Scientist (Documentation / Information) of the Bioversity International, Malaysia.

The organizations from within Bangladesh included the Ministry of agriculture, the Ministry of Forest and Environment, Bangladesh Agricultural Research Council, the Bangladesh Agricultural Research Institute, the Bangladesh Rice Research Institute, the Bangladesh Jute Research Institute, the Bangladesh Institute of Nuclear Agriculture, the Bangladesh Sugarcane Research Institute, Bangladesh Forest Research Institute, Bangladesh Tea Research Institute, the Cotton Development, Bangladesh National Herbarium, the Bangladesh Livestock research Institute, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Bangladesh Agricultural University, Mymensingh, the Department of Agricultural Extension, the Forest Department, the Seed Certification Agency, Coastal Development Partnership, East West Seed (Bd.) Ltd. and Bangladesh Rural Advancement Committee (BRAC). The activities of the project was coordinated by Dr. Md. Abdur Razzaque, Member Director (Crops), Bangladesh Agricultural Research Council and the National Focal Point for the Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture.

We express our thanks to the participants of the organizations from within Bangladesh for providing information on plant genetic resources on behalf of their organizations which were the bases of this report. We specially express our thanks to Dr. N. Quat Ng and Dr. Paul Quek for their caring assistance in imparting training on NISM-GPA, the software used in preparing the PGR database and the report. Mr. Abeed Hossain Chowdhury, Director of the Computer Centre of BARC, deserves our special thanks for taking constant interest in project activities, acting as the repository of the database, providing training and backstop assistance to stakeholder organizations, and in developing NISM-GPA database for Bangladesh. Finally we would like to express our thanks to FAO and the Government of Japan for financial and technical assistance in preparing this valuable report.

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ACRONYMS AND ABBREVIATIONS

ACUC	Asian Centre for Underutilized Crops
AEZ	Agro Ecological Zone
ARIs	Agricultural Research Institutes
AVRDC	Asian Vegetable Research and Development Centre
BAAG	Bangladesh Academy of Agricultural
BADC	Bangladesh Agricultural Development Corporation
BARC	Bangladesh Agricultural Research Council
BARI	Bangladesh Agricultural Research Institute
BAU	Bangladesh Agricultural University, Mymensingh
BFRI	Bangladesh Forest Research Institute
BGASA	Bangladesh Golden Agri Seed Associates Ltd.
BINA	Bangladesh Institute of Nuclear Agriculture
BJRI	Bangladesh Jute Research Institute
BNH	Bangladesh National Herbarium
BRAC	Bangladesh Rural Advancement Committee – an NGO
BRRI	Bangladesh Rice Research Institute
BSF	Bangladesh Seed Federation
BSGDMA	Bangladesh Seed Growers, Dealers and Merchants Association
BSMRAU	Bangabandhu Sheikh Mujibur Rahman Agricultural University
BSRI	Bangladesh Sugarcane Research Institute
BTRI	Bangladesh Tea Research Institute
CARD	Centre for Agriculture and Rural Development
CARE	Cooperation for Assistance and Relief Everywhere
CBD	Convention of Biological Diversity
CDB	Cotton Development Board
CDP	Coastal Development Partnership
CFC	Common Fund for Commodity
CG	Contract Grower
CGIAR	Consultative Group for International Agricultural Research
CIMMYT	International Centre for Maize and Wheat Improvement
CIP	International Potato Centre
COGENT	Coconut Genetic Coconut Genetic Resources Network
CS	Certified Seed
CTA	Chief Technical Adviser
CWR	Crop Wild Relative
DAE	Department of Agricultural Extension
DNA	Deoxy Ribonucleic Acid
DoF	Department of Forest
DUS	Distinction Uniform Stability
E&C	Exploration and Collection of germplasm
EIA	Environment Impact Assessment
FAO	Food and Agriculture Organization of the United Nations

FBSE	Farmer Based Seed Enterprise
FCD	Flood Control and Drainage
FCDI	Flood Control, Drainage and Irrigation
GATT	General Agreement on Trade and Tariff
GIS	Geographical Information System
GKF	Grameen Krishi Foundation
GoB	Government of Bangladesh
GPA	Global Plan of Action
GTZ	German Technical Assistance
HRC	Horticulture Research Centre
HYV	High Yielding Varieties
IAEA	International Atomic Energy Authority
IARC	International Agricultural Research Centre
ICARDA	International Centre for Agricultural Research in Dry Areas
ICPPGR	International Conference and Programme for Plant Genetic Resources
ICRISAT	International Crop Research Institute for the Semi Arid Tropics
ICUC	International Centre for Underutilized Crops
IJO	International Jute Organization
IJSG	International Jute Study Group
INGER	International Network for Genetic Evaluation of Rice
INIBAP	International Network for Banana and Plantation
IPGRI	International Plant Genetic Resources Institute
IPSA	Institute of Post-Graduate Studies in Agriculture
IRRI	International Rice Research Institute
ISO	International Sugar Organization
ISTA	International Seed Testing Association
IT	Information Technology
IUCN	International Union for Conservation of Natural Resources
JICA	Japan International Cooperation Agency
MAS	Molecular Aided Selection
MHAT	Moist Hot Air Treatment
MoEF	Ministry of Environment and Forest
MoU	Memorandum of Understanding
NARS	National Agricultural Research System
NBPGR	National Bureau of Plant Genetic Resources
NCPGR	National Committee on Plant Genetic Resources
NGO	Non Government Organization
NISM-GPA	National Information Sharing Mechanism – Global Plan of Action for Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture
NSB	National Seed Board
NSP	National Seed Policy
NZ	New Zealand
OECD	Organization for Economic Cooperation and Development
OP	Open Pollinated
ORC	Oilseed Research Centre
PBD	Plant Breeding Division
PGR	Plant Genetic Resources
PGRFA	Treaty on Plant Genetic Resources for Food and Agriculture

PPB	Participatory Plant Breeding
PRC	Pulses Research Centre
PRSP	Poverty Reduction Strategy Paper
PVS	Participatory Variety Selection
RAPD	Random Amplification of Polymeric DNA
SAARC	South Asian Association for Regional Cooperation
SANPGR	South Asia Network of Plant Genetic Resources
SAVERNET	South Asia Vegetable Research Network
SCA	Seed Certification Agency
SDC	Swiss Agency for Development and Cooperation
SSR	Simple Sequence Repeat
TAMNET	Tropical Asia Maize network TLS Truthfully Labelled Seed
TLS	Truthfully Labelled Seed
TRIPS	Trade Related Intellectual Property Rights
TTMU	Technical Training and Monitoring Unit
UBINIG	Policy Research for Development Alternative
UNDP	United Nations Development Program
UNFPA	United Nations Fund for Population Activities
USA	United States of America
USDA	United State Department of Agriculture
VCU	Value for Cultivation and Use
WARDA	West Africa Rice Development Authority
WCR	Wild Crop Relatives
WPF	Wild Plants for Food Production
WRC	Wheat Research Centre
WTO	World Treaty Organization

THE STATE OF ACTIVITIES

SUMMARY

Bangladesh is an abode of 5 000 species vascular plants and is the secondary centre of origin of a good number of crop plants. Evidence is mounting about the rapid wane of its genetic resources. The National Agricultural Research System (NARS) started cropping systems research as far back as in 1974 with a special focus on crop diversification.

A number of potential cropping patterns have been identified. As a result cropping system is gradually transforming from traditional practices to improved management practices with improved varieties.

There are more than 160 crops grown in Bangladesh. Among them there is a good number of major crops in Bangladesh that are beyond the list of major crops of Multilateral System of International Treaty on Plant Genetic Resources for Food and Agriculture (FAO). There are also about 100 minor crops, including fruits and vegetables that are grown in Bangladesh. With the change of subsistence crop production system to commercial agriculture, an accompanying change in the seed supply system is now noticeable in the country. Agricultural research institutes, universities and others involved in crop variety development, supply Breeder Seed to Bangladesh Agricultural Development Corporation (BADC) for production of Foundation Seed and Certified Seed. The time is ripe for the development of organized seed industry in Bangladesh.

1. The State of Plant Diversity

While the diversity of traditional varieties is decreasing fast, there is an increasing trend in the diversity of modern varieties. More than 300 wild indigenous species of plants have been identified that are relatives to the cultivated crops grown in Bangladesh. The major reasons for the loss of diversity include, among others, the use of high yielding crop varieties at the expense of traditional varieties/landraces, lack of knowledge of multiple use of species, lack of value addition as well as overexploitation of plant genetic resources. National and institutional priorities for undertaking PGR surveys should be established.

GPA Activity Area 1

Some sporadic surveys on wild PGR have been undertaken in Bangladesh and the priority areas for survey and inventory of plant genetic resources in Bangladesh have been identified. Constraints in undertaking survey and monitoring activities include, among others: insufficient financial support for PGRFA; insufficient trained staff in PGRFA and lack of awareness in conservation of plant genetic resources. Through a collaborative National Workshop on Plant Genetic Resources in 1997, involving the National Committee on Plant Genetic Resources (NCPGR), the Bangladesh Agricultural Research Council and the IPGRI, the national priorities in PGR have already been identified. The National Committee on Plant Genetic Resources is in place but it needs to be reactivated.

GPA Activity Area 2

Programmes/projects/activities on *in situ* conservation of Wild Crop Relatives and Wild Plants for Food and Agriculture have so far been poor in Bangladesh. The major limitations to on-farm conservation include, among other things, lack of incentives to farmers for on-farm conservation and improvement of PGRFA; insufficient number of staff for conservation work; inadequate staff training; insufficient supply of seed/planting material. The priority needs for supporting on-farm conservation and improvement of PGRFA are: developing markets for products originating from traditional and under-utilized varieties and crops; providing incentives, including awards, to farmers for on-farm conservations; management and improvement of PGRFA; seed enhancement and creating facilities for genetic finger printing. The National Committee for Plant Genetic Resources (NCPGR) should be revived to undertake initiatives, among other things, towards post-disaster restoration of agriculture and to identify its (NCPGR) institutional base with the proposed National Institute of Plant Genetic Resources.

GPA Activity Area 3

Bangladesh is vulnerable to natural calamities like flood, cyclones, tornadoes, tidal surges.

River bank erosion is a silent disaster. The National Committee for Plant Genetic Resources (NCPGR) should be revived or an institutional base should be identified to undertake initiatives, among other things, towards post-disaster restoration of agriculture. In the interim period, the Bangladesh Agricultural Research Council is taking care of the activities related to PGR.

GPA Activity Area 4

The Bangladesh Agricultural Research Institute has identified two *in situ* locations (for pigeon pea and jackfruit), the Bangladesh Rice Research Institute has identified five *in situ* locations for wild rice and the Bangladesh Tea Research Institute has identified 100 Tea Estates as *in situ* locations of tea germplasm. For promoting *in situ* conservation of Wild Relatives of Crops and Wild Plants for Food production, the major needs identified include: livelihood supporting species should be identified and their conservation promoted and regional approach in *in situ* conservation of PGR should be undertaken.

GPA Activity Area 5

Ex situ programmes/projects/activities have been undertaken by stakeholder organizations.

After 1996, Bangladesh Agricultural Research Institute undertook 3 exploration missions; Bangladesh Rice Research Institute undertook 6, East West Seed (Bd.) Ltd. undertook 8, Bangladesh Sugarcane Research Institute 4 missions, while Bangladesh Institute, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Cotton Development Board and Bangladesh Tea Research Institute undertook one exploration mission each. Total germplasm collections (genebank plus field genebank) in different stakeholder organizations up to 1996 were 18 000 and collections between 1996 and 2006 were about 13 000. Publications related to *ex situ* collection are mainly in hard copies of Annual Reports. Different stakeholder organizations use different information systems on collections that need to be harmonized.

The proposal for establishing the National Plant Genetic Resources Institute should be revived and implemented for coordinated and coherent activities on PGR, especially for *ex situ* collection, evaluation, characterization, and management. Regional / international collaboration should be strengthened. A regional SAARC programme on PGR vis-à-vis genebank may be developed in order to strengthen regional PGR activities. Other priorities include: Improving regeneration facilities; Regional and international collaboration; Developing facilities for molecular characterization / Developing genetic finger printing facilities; Developing documentation facilities; Improving facilities for long term conservation; Germplasm collection from remote areas; Human resources development in PGR with emphasis on germplasm conservation; Genetic finger printing facilities; and International collaboration.

GPA Activity Area 6

For regeneration of threatened species identification of threatened species should be strengthened, farmers' participation in regeneration should be promoted, exchange of germplasm among countries should be promoted and storage facilities improved.

GPA Activity Area 7

The stakeholder organizations having provision for rare and endangered species are Bangladesh Agricultural Research Institute, Bangladesh Rice Research Institute and Bangladesh Sugarcane Research Institute. Their activities in endangered/ rare species should be specifically strengthened. In the absence of any clear mandate for any organization in the country for collection and conservation of rare and endangered species, the establishment of the National Gene bank proposed by NCPGR should be revived to cater for activities, among others, of rare and endangered species.

GPA Activity Area 8

Expanding *ex situ* conservation activities, covering vegetatively propagated materials and recalcitrant seeds, needs special attention in Bangladesh. Promotion of community genebanks and linking them up with the proposed National Plant Genetic Resources Institute has a high potential for expanding both *in situ* and ex situ conservation of germplasm.

2. The State of Use of Plant Genetic Resources

GPA Activity Area 9

Characterization and evaluation work is still in preliminary phases in Bangladesh. Studies on core collections are yet to take off. However, the number of germplasm used for breeding, seed enhancement and supply by the Bangladesh Agricultural Research Institute was 590 accessions, Bangladesh Rice Research Institute about 20 000 accessions, Bangladesh Tea Research Institute about 30, Cotton Development Board 130, Bangladesh Sugarcane Research Institute 229, Bangladesh Jute Research Institute 2 915, East West Seed (Bd.) Limited Bangladesh 5 263 and Bangabandhu Sheikh Mujiubur Rahman Agricultural University used 547. Research on establishment of methodologies for core collection should be initiated. Also networking projects to share knowledge, experience, and facilitation in the exchange of expertise should be promoted.

GPA Activity Area 10

The major needs for increasing genetic enhancement and base broadening are: Strong staff training programme, and Germplasm exchange with regional / international organizations.

GPA Activity Area 11

Since the introduction of green revolution technologies, monoculture of modern crop varieties with narrow genetic bases has intensified. Constraints in diversifying crop production and broadening diversity are: marketing/commercial obstacles for diversity-rich products; no incentive programme for diversified crop production processing or marketing. Breeding programmes with the objectives of crop diversification should be promoted; market niches for diversified crops should be created and promotional activities undertaken; marketing incentives should be introduced for diversified crops. Regional / international programmes for food security should be undertaken through crop diversification. Molecular lab facilities for research and development of diversified crops should be created.

GPA Activity Area 12

Regional/international programmes should be undertaken for development and commercialization of under-utilized crops and species. Such regional/international programmes would help promote national activities on under-utilized crops.

GPA Activity Area 13

The Agricultural Research Institutes (ARIs) supply the breeder seed while the Bangladesh Agricultural Development Corporation (BADC) is responsible for production and distribution of Foundation and Certified Seeds in the public sector. One private company, East West Seed (Bangladesh), has nonetheless established itself as quality seed supplier for vegetable crops. The agency responsible for variety registration is the Seed Wing of the Ministry of Agriculture

There is no regulatory framework in place for developing and expanding local seed systems for crops or crop varieties important to small-scale farmers and no realistic programme for quality seed production in the country. There is no incentive for seed production of local varieties / under-utilized crops. No formal mechanism exists for developing seed growers' association. However, with donor support two seed growers' association, the Bangladesh Golden Agri seed Associates Ltd, (BGASA) and Bangladesh Seed Federation (BSF) have come into existence, the latter is yet to get formal recognition by the Ministry of Commerce. The umbrella organization, Bangladesh Seed Growers, Dealers and Merchants' Association (BSGDMA) appears to be more oriented towards seed trading rather than seed growing. Major constraints in making seeds of new varieties include: decreasing availability of seeds of local varieties and lack of incentive for seed production of local varieties. The needs are: awareness creation of the loss of traditional/ local varieties; development of national programmes for seed purification; seed production and supply of traditional/local varieties; creation of incentives for production of traditional/local varieties; market promotion of traditional/local varieties; promotion of Seed Growers' Association, identification of crops/varieties that have large-scale consumption and industrial use potential.

GPA Activity Area 14

Numerous locally adapted traditional crop varieties have been replaced by modern varieties.

The major constraints to increasing markets for local varieties and diversity rich products are: lack of awareness about the intrinsic value of local varieties and diversity rich products; low yield of local / traditional varieties; and lack of incentives for local varieties and "diversity-rich" products in the country. Priorities for developing new markets for local

varieties and diversity rich products are: a national programme for value addition and processing of traditional varieties; exploring overseas markets for local varieties and 'diversity-rich' products; decentralization of the seed production and distribution system; studies on developing new markets for local varieties/diversity-rich' products; market promotion for local varieties and introduction of an incentive system for production of local varieties and 'diversity- rich' products.

3. The State of National Programmes and Training Needs

GPA Activity Area 15

Bangladesh was the first in South Asia to establish the National Committee on Plant Genetic Resources (NCPGR). With the initiatives of the Committee priority needs in PGRFA were identified and draft Acts, Biodiversity and Community Knowledge Protection Act of Bangladesh; and Plant Variety and Farmers' Rights Act of Bangladesh were prepared. The two Acts provided the legal framework for the national strategy of PGRFA. The Acts are under consideration of the government. The Bangladesh national Herbarium published the first volume of the Red Data Book of Vascular Plants of Bangladesh.

The priority needs for building the national programme in PGRFA are: Establishment of a national coordination body (such as the dormant NCPGR) to follow up international agreements vis-à-vis all other activities related to PGR; clear identification of focal points with defined responsibilities and accountability; and adequate fund allocation to PGR activities.

GPA Activity Area 16

Bangladesh is a signatory of a number of PGRFA networks and has benefited from these networks through increased stakeholder participation in PGR activities, participation in several training programmes for national programme scientists and increased awareness of PGRFA.

GPA Activity Area 17

Needs for constructing a comprehensive information system for PGRFA are: Awareness creation on PGR; staff training; and appropriate software for data management and information system for PGR

GPA Activity Area 18

There is no formal mechanism in the country for assessing genetic erosion. The need for assessing genetic erosion and staff training is strongly felt in the country.

GPA Activity Area 19

In view of the weak curricula in universities and other educational institutions on PGR related subjects, the national strategy for education and training on PGRFA should be developed with a sense of urgency.

GPA Activity Area 20

The needs for promoting public awareness of the value of PGRFA conservation include:

Training, publications and telecasting on PGRFA; institutional capacity building for conservation and use of PGRFA; development of relevant course curricula in educational institutions; and external support.

4. Priority Activity Areas for Bangladesh

- Establishment of a national genebank for conservation, use and enhancement of biodiversity - National Centre for PGRFA
- An assessment of genetic diversity and the extent of PGR erosion
- Development of national framework for PGRFA
- Strengthening of coordination among different stakeholders
- Human resources development and capacity building in PGR activities
- Biochemical and molecular characterization of germplasm
- Introduction of course curricula on PGR in universities and other relevant educational institutions

- Revision of the plant quarantine regulations
- Formalization of Biodiversity Act and Plant Variety and Farmers' Rights Protection Act
- Training on: *in situ* methodologies, regeneration of conservation, marker aided characterization, information technology for database management and information sharing on conservation and sustainable utilization of PGR, genebank management.
- Development of an early warning system on genetic erosion
- Entrepreneurship development and marketing skills with regard to PGR resources.

PROLOGUE

The Fourth International Technical Conference of the Food and Agricultural Organization (FAO) of the United Nations held in Leipzig, Germany in 1996 adopted twenty priority areas in the Global Plan of Action (GPA) for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture (PGRFA). The Conference also adopted the Leipzig Declaration, which focuses attention on the importance of plant genetic resources for the world food security, and commits countries to implementing the plan. This paper, along with a perspective of plant genetic resources of Bangladesh and its agriculture, provides the state of activities with regard to the GPA.

CHAPTER 1

BACKGROUND

Bangladesh constitutes a large part of the South Asian Mega Centre of genetic diversity, sharing with India. The landscape of Bangladesh is the abode of some 5 000 species of vascular plants[1]. There are more than 500 species of medicinal plants, 130 species of fibre resources (both wild and cultivated), 18 species of bamboo. It is the secondary centre of origin of major crops like rice, a number of vegetables like eggplant, the cucurbits, beans, fruits like jackfruit, banana, mango and citrus, spices like chilli, ginger and turmeric, root crops like taros and yams, etc[2,3]. In this delta once grew the legendary fibre crop, "the muslin cotton", believed to be a cultivar of *Gossypium arboreum*, which is now extinct. Isolated studies revealed that some 45 species of angiosperms and at least two species of pteridophytes are on the verge of extinction and of these 9 species were identified as endemic to Bangladesh[4]. The first volume of the Red Data Book (2001)[5] identified 106 species of vascular plants that are threatened and some of which are no longer traceable.

There are some 10 000 to 80 000 edible plants on Earth, but only 29 species account for 90% of our food products[6]. Considering its rich reserve of plant genetic resources, Bangladesh is no better off in the use plant genetic resources, if not worse off. The country needs to give an urgent attention towards conserving its reserve of genetic resources, which are on a rapid wane, not only for posterity but also for their immediate use in crop improvement, for use as fuel and fibre, for nutrition and medicare. What is a wild plant today can turn out to be an important plant tomorrow with our new knowledge about its intrinsic value in food and nutrition, in medicare, its new use through new processing technology; the contributions that plant genetic resources make in keeping a sound environment and in sustaining the ecosystem notwithstanding.

[1] Khan, M. S. 1991. Towards Sustainable Development: Genetic Resources of Bangladesh. Conservation Strataegy of Bangladesh. International Union for Conservation of Natural Resources, IUCN / Bangladesh Agricultural Research Council (BARC)
[2] Ibid.
[3] Huq, M. F. and Banik, R. L. 1992. Country Report – Bangladesh. Proc. Regional Workshop on Tree Breeding and Propagation, held in Bangkok, Thailand, July 10-14, 1990. Field Document No. 2 (RAS/88/025). Pp. 19-48.
[4] BARC. 1995. Bangladesh Country Paper for International Conference and Propgramme for Plant Genetic Resources (ICPPGR) (the First Report on PGR). BARC/IPGRI/FAO.
[5] Khan, M. S. et al. (Eds.). 2001. Red Data Book of Vascular Plants of Bangladesh. Bangladesh Agricultural Research Council/Bangladesh National Herbariumm Dhaka.
[6] Sasson, A. 1990. Conservation and Utilization of Plant Genetic Resources.In: Feeding Tomorrow'World. UNESCO, Paris.

CHAPTER 2

THE LANDSCAPE OF BANGLADESH AND ITS FLORA

Some 2 500 years ago the landscape of what now constitutes Bangladesh was in the Indian Ocean and was known as the Bay of Assam. A number of major rivers: the Ganges, the Jamuna, the Brahmaputra, the Surma and their tributaries flowed from upstream Himalayan regions towards the Bay Assam. The rivers brought huge quantities of silts and sediments downstream. As the rivers approached the sea, their flow slowed down and the silts and sediments started depositing near the mouths of the rivers, forming new land[7]. Once above the water level, the newly formed land had hardly any chance of sediment deposit. The vast plain of the Bengal delta was thus formed with alluvial deposits. And no wonder, the delta is low lying and so uniquely a flat landscape.

The new land formed was initially colonized by plants from the surrounding regions: the Tarai region of Nepal in the north, Assam and Tripura (India) on the northeast and east, Myanmar on the southeast, Orissa on the southwest, Bihar (India) on the west and regions beyond[8]. The sea on the south of the flat landscape came to be known as the Bay of Bengal. The mild, sub-tropical climate with fertile silt soils favoured the growth of numerous flora. The delta became thick jungles of tropical and sub-tropical plant species[9]. The fertile soil with mild climate was suitable for growing crops with minimal efforts. This attracted human settlements from neighbouring regions as well as other parts of the world. There were many invaders to Bengal and many of them settled down in the delta following invasions. The settlers cleared the jungles to build houses and to grow crops. Many settlers brought with them species of plants from other parts of the world, some of which became established along with the local flora. The present plant biodiversity is a composite of more than 5 000 angiosperm species[10], about twice as much in number as in the Western Europe.

[7] Hossain, M. G. 2001. Biodiversity of Bangladesh – Extant, Endangered and Extinct. In:Mian M. A. W. et al. 2001. Agricultural Research in Bangladesh in the 20th Century. Bangladesh Agricultural Research Council & Bangladesh Academy of Agriculture. Pp.19-35.
[8] Ibid.
[9] Ibid.
[10] Khan, M. S. 1977. Flora of Bangladesh No.4. Commelinaceae. Bangladesh National Herbarium, Bangldesh Agricultural Research Council, Dhaka. Pp.2.

CHAPTER 3

BANGLADESH AGRICULTURE

Since the time the British colonial rulers (1757-1947) started promoting the expansion of capital oriented cash crops (e.g. indigo, cotton, jute, tea, etc.) that were exported to the metropolis of the colonizers, instead of growing food crops, the bounty of Bengal agriculture started eroding, food deficits started appearing and it soon turned into a land of famines. Bengal faced successive famines in 1892-93, 1898-99, the great depression 1928-35 and the great famine of 1943 and 1974.

However, contributions from agricultural research coupled with the toils of some 14 million farm households, mostly small and marginal, brought in sight the country's long cherished dream of "food self sufficiency". The dream virtually turned into a reality in late 1990s. "Bangladesh today is definitively out of the shadow of famine."[11] The challenges the country faces now are sustaining and further increasing land and labour productivity to feed its growing population of 140 million (growing presently at 1.6%), from a cultivated land area of only 8.20 million hectares, reduced from 9.09 million hectares a decade ago. Conservation of the rapidly declining natural resource bases: the agricultural land and its fertility, the forest resources and the biodiversity, the water and the energy resources, has become an urgent task.

Bangladesh agriculture has traditionally been subsistence in nature. Farmers, in order to supplement cash requirement, have often pursued off-farm activities. Marginal and small farm households, together with landless households, constitute more than 70% of the farm families[12]. Most farmers pursue raising field crops, homestead vegetables, trees (for fuel, fruits and timber), rear cattle and poultry, and undertake aquaculture in many cases.

However, two noticeable changes have been discernible these days: one is the lesser use of animals as draft power that are being replaced by mechanical power (power tillers), and the other is the gradual transformation of subsistence farming into commercial agriculture. Nonetheless, intensive use of land for production of a large array crops all through the year, multiple farm components (livestock, poultry, fish) and various on-farm and off-farm activities pursued by farmers make farming systems in Bangladesh highly diverse.

3.1 Farming systems

The National Agricultural Research System (NARS) started cropping systems research, a component of farming systems research, as far back as in 1974. It was soon recognized that since other components like livestock, aquaculture, homestead forestry are, in practice, inseparable from farming practices followed by the farmers, the farming systems research should address the "holistic farming systems", rather than cropping systems only.

While farming system research and development aimed at total farm production, special focus was given to crop diversification against the predominant rice monoculture. A number of potential cropping patterns have been identified. As a result cropping system is gradually transforming from traditional practices to improved management practices with improved varieties. In an era of globalisation and free trade that we are in, there is the need for intensified farming systems research and development efforts in the country to help the small producers survive, do better and to become competitive.

[11] Planning Commission. 2004. Unlocking the Potential, General Economic Division, Planning Commission, GoB (PRSP, December 2004).
[12] Hossain, M.G. 2005. Bangladesh Agriculture: A Critique on Performances and the Challenges of Tomorrow. Jatiya Shahitya Prakashoni, Purana Paltan, Dhaka.

3.2 Crops/plant products

There are more than 160 crops grown in Bangladesh[13]. Rice, wheat, sugarcane, pulses, oilseeds, potato and vegetables are the main food crops. The other major crops are sugarcane, jute and tea. With a rapid increase in vegetable production in recent years, some vegetables are now exported to a number of countries in the Middle East and the European Union. The country is grossly deficient in timber production.

Recent studies demonstrated that Bangladesh has comparative advantage in the production of a number of crops, e.g. some vegetable crops (eggplant, radish, cucumber, yard long bean, taro, tomato and cabbage), and rice in so far as import substitution is concerned[14]. However, high risks of marketing and the difficulties in producing rice as well as non-rice crops in the same service unit stand as obstacles to the exploitation of this potential. The main problem lies in the high cost of crop production as compared to other Asian countries (mainly because of high input costs) and the wide "yield gaps" between the farmers' yields and the yields obtained in experiment stations.

3.3 The state of food security

Despite a significant progress in domestic food grain production in recent decades (from 11.0 million tons in 1971 to about 27.0 million tons at present), widespread poverty and food insecurity prevails in the country. The long-term strategy calls for redressing the poverty problem from at least two fronts: (a) a steady supply of food at a price affordable to the general mass of the people, and (b) increasing and diversifying income opportunities for the poor that would ensure their purchasing power[15]. In meeting these pre-conditions, the government aims to ensure increased food production through (i) improved efficiency in production, (ii) an increased efficiency in the food distribution system and (iii) increased trade and commerce.

3.4 Agriculture – a changing scenario

Bangladesh agriculture, as we indicated above, is gradually transforming from the subsistence production system to commercial agriculture. Under the traditional subsistence farming practices, the farmers produced crops mainly for household consumption and the surplus, if any, was sold in the market. The importance of traditional cash crops (jute, sugarcane, tobacco, etc.) of Bangladeshi farmers has diminished with time. Of necessity, farmers are now turning towards food crops like rice, wheat, fruits and vegetables for commercial production and for cash earning. This trend of commercialization of agriculture is clearly visible nowadays in the production systems being followed by the farmers of the country.

3.5 The seed supply system

With the change of subsistence crop production system to commercial agriculture, an accompanying change in the seed supply system is now noticeable. Farmers now look for quality seeds in the market, instead of the traditional practice of saving seeds for growing in the next season. The private seed entrepreneurship in Bangladesh started in early 1970s accelerated during 1990s and exhibited a sustained growth well into 2000s[16].

Up until 1990s, the officially recognised seed production and distribution agency was the Bangladesh Agricultural Development Corporation (BADC), a public sector organisation. Agricultural research institutes, universities and others involved in crop variety development, supply Breeder Seed to BADC for production of Foundation Seed and Certified Seed. The National Seed Policy (NSP) declared in 1993 made provisions for private sector to play a role in seed production and distribution.

[13] Mondal, M. H. 1990. Plant Genetic Resources Activities in Bangladesh. Proc.South Asia National Coordinators Meeting. March 21-24, 1990. held at IBPGR Regional Office for South Asia, NBPGR Campus, Pusa, New Delhi 110 012, India.
[14] Shahabuddin, Q. and Paul Dorosh. 2002. Comparative Advantage in Bangladesh Crop Production. International Food Policy Researchy Institute (IFRI), Washington, DC. October 2002.
[15] GoB. 2004. Unlocking the Potential (PRSP), General Economic Division, the Planning Commission, Government of Bangladesh.
[16] Hossain, M. G. and Shaikh, M. A. Q. 2007. Vegetable Seed Market Research (Draft), KATALYST-Swisscontact,Dhaka.

Since then private sector participation has come into focus and the supply of quality seeds has been increasing steadily[17].

However, in the absence of organised seed producing enterprises within the country, many seed traders appeared in the market. These traders supply quality seed in small quantities and mostly through import. Multinational companies are also making easy inroads to the seed market of the country mostly through importation. The time is ripe for the development of organized seed industry in Bangladesh.

[17] Hussain. M. M. 2005. Seed Production Storage and Marketing Technology. Publisher Hussain , M. Imteaz. & Hussain M. Iftekhar, Pirerbag, Mirpur, Dhaka. Pp. 11-13

CHAPTER 4

THE STATE OF PLANT DIVERSITY

4.1 Major crops and their state of diversity

The Major Crops of Bangladesh within and beyond the List of Multilateral System: The major crops of Bangladesh, as enlisted in the list of crops included in the Multilateral System of the International Treaty (FAO), on Plant Genetic Resources for Food and Agriculture (PGRFA), are shown in Table 1

In addition, there is also a large number major crops of Bangladesh that are beyond the list. These include, among others, jute, tea, sugarcane and a number of vegetable crops (see Table 2).

The diversity of most of the major crops is enormous. For examples, there were 12 000 rice germplasm[18]. Some 1 090 landraces of Dehsi jute (*Corchorus capsularis*) and 519 of Tossa jute (*Corchorus olitorius*) were reported to be scattered throughout Bangladesh[19], and there are 700 tea germplasm[20], 300 varieties of sugarcane[21], and so on. While the diversity of traditional varieties is decreasing fast, there is an increasing trend in the diversity of modern varieties. Data on the diversity of most other crops are not available but there is a decreasing trend for all traditional varieties.

4.2 Minor crops and their state of diversity

A good number of minor and under-utilized crops are grown in the country (Table 3). The state of diversity of minor and underutilized crops has hardly been monitored. Many of these are important for food security, especially for the rural people and the poorer sections of the population. Due to intensive agriculture with modern varieties, conversion of previously fallow land for crop cultivation and clearance of forestland, the diversity of minor crops and under-utilized species, many of which grew in the wild, is decreasing fast.

4.3 Wild plants related to cultivated crops

More than 300 wild indigenous species of plants have been identified that are relatives to the cultivated crops grown in Bangladesh[22] (Appendix Table 1). But in recent times these have been seriously threatened due to intensive agriculture, clearing of fallow land and conversion of agricultural land to non-agricultural uses and abuses.

4.4 Changing relative importance of crops

The relative importance of a number of crops has changed over the years. There was very little *Boro* (winter) rice cultivation in the past but currently *Boro* contributes about 50% of the rice produced. This led to a significant reduction in the cultivation of *Aus* rice, pulses and oilseed crops. Similarly the area under jute, a major cash crop, has also reduced drastically. Of late, vegetable production has been increasing due mainly to the commercialisation trend in agriculture and the better access to markets through improvement of rural roads and transport facilities. In recent years maize cultivation has also been increasing fast.

[18] Source: BRII, : Answers to Question 7.1 of 'Indicators and Reporting Format for Monitoring the Implementation of Global Plan for Conservation and Utilization of PGRFA. Bangladesh Agricultural research Institute (2005)
[19] Husain, et al. 1988. Cited in Bangladesh Country Report (1995). International Conference and Programme for Plant Genetic Resources. Bangladesh Agricultural Research Council/FAO.
[20] Source: Bangladesh Tea Research Institute (BTRI). 2005
[21] Source: Banfladesh Sugarcane Research Institute (BSRI). 2005
[22] BARC. 1995. Bangladesh Country Report, International Conference AND Programme for Plant Genetic Resources (ICPPGR).

TABLE 1

The major crops of Bangladesh within the list of Multilateral System of the International Treaty on Plant Genetic Resources for Food and Agriculture and their state of diversity

Crop	Scientific name	State of diversity	
		Present state of diversity	Diversity trend
Cereals			
Rice	*Oryza sativa*	About 12 000 local germplasm[25] were identified through surveys thatare all threatened. The causes of threats identified were: replacementof these varieties by modern varieties; disturbances of natural habitatsby construction of coastal and flood control embankments; drainageand water logging problems resulting from development projects; lackof development of value chain and business development fortraditional varieties (e.g. fine grain and aromatic rice); declining soilquality especially due to lack of organic matter and micro-nutrients	While the diversity of traditional varieties is decreasing, there is, however, an increasing trend in the diversity of modern varieties through release of new varieties from research institutes. (For example, BRRI has released 45 new modern varieties since its establishment in 1970).
Wheat	*Triticum aestivum*	Some 556 accessions of wheat are being maintained in BARI gene bank (*ex situ* collection)[26]. Of these 140 cultivars were mentioned.[27]	Increasing with new introductions
Pulses (Grain legumes)		A total of 854 species under 98 genera represent the Legume flora of Bangladesh. Out of these, 21 species are used food (vegetables or pulses) and 722 species were recorded as medicinal plants[28]. A total number of 9342 accessions are recorded to be in BARI gene bank but their species/variety wise data were not available.	Decreasing
Chickpea	*Cicero retinue*	752 accessions available	Decreasing
Grass pea	*Lathers datives*	Some 1 845 accessions available. Closely related species available include *Lathers apace* and L. *odoratum*	Decreasing
Lentil	*Lens culinaris*	422 accessions available	Decreasing
Mungbean	*Vigna radiata*	41 accessions available. Closely related species available include *Vigna aconitifolia. V. adenantha, V. luteola, V. mungo, V. pilosa, V. umbellate, V. mungo, V. unguiculata, V. diphylla.*	Decreasing
Oilseeds			
Coconut	*Cocos nucifera*	Data on diversity not available. However, two cultivars were mentioned.	Decreasing
Mustard	*Brassica* spp.	154 accessions available. However, 344 oil-producing *Brassica* species were mentioned.[29]	Decreasing
Vegetables			
Radish	*Raphanus sativus*	Data on diversity not available. However, 19 cultivars were mentioned.[30]	Increasing with the release of new varieties, but traditional varieties decreasing.
Arum	*Colocasia esculenta*	Data on crop diversity not available. However, a total of 53 species under 20 genera represent the family *Araceae* in Bangladesh. Of these, 10 species are used as vegetables and 15 species are of medicinal value. Some 16 species were found endemic which were not found during the survey.[31]	Not known

[23] BRRI. 2005. Answers to Question 7.1 of 'Indicators and Reporting Format for Monitoring the Implementation of Global Plan for Conservation and Utilization of PGRFA

[24] BARI: Answers to Question 7.1 of 'Indicators and Reporting Format for Monitoring the Implementation of Global Plan for Conservation and Utilization of PGRFA. Bangladesh Agricultural research Institute (2005)

[25] Khan, M. S. & F. Ahmed. A tentative List of Plant Genetic Resources (Wild and Cultivated). Mimeo. Bangladesh Agricultural Research Council /Bangladesh Academy of Agriculture(2001)

[26] BARI: Answers to Question 7.1 of 'Indicators and Reporting Format for Monitoring the Implementation of Global Plan for Conservation and Utilization of PGRFA. Bangladesh Agricultural research Institute (2005)

[27] Ibid.

Crop	Scientific name	State of diversity	
		Present state of diversity	Diversity trend
Brinjal (Eggplant)	*Solanum melongena*	Some 248 cultivars were mentioned.[32] Closely related species available include *S. torvum, S. erianthum, S. nigrum, S. barbisetum, S. trilobatum, S. sysmbrifolium. S. capsicoides, S. virginianum S.*	Increasing with the release of new varieties, but traditional varieties decreasing.
Potato	*Solanum tuberosum*	A total of 23 cultivars were mentioned.[33]	Increasing with new introduction
Sweet potato	*Ipomoea batatas*	Some 14 wild species available i.e. I. *imolucrata, I. learii, I. nil, I. purpurea, I. rubens, I. aspera, I. longiflora, I. illustris, I. peniculata, I. pescaprae, I. reptans, I. salicifolia, I. obscura, I. sepinria*, etc.	Not known
Fruits			
Banana	*Musa sapientum, M. paradisica.*	Some 10 varieties were mentioned.[34] One wild species, *M. ornate*, occurs in Bangladesh	Decreasing
Sugar crops			
Sugarcane	*Saccharum officinarum*	About 900 cultivars were mentioned. At least three wild species occurs in Bangladesh i.e. *S. arundinaceum, S. fuscum* and *S. sponteneum.*	Increasing with the release of new varieties, but traditional varieties decreasing.
Beverage crop			
Tea	*Camellia sinensis*	About 500 germplasm have been collected.	Increasing with the release of new varieties and collection.
Fibre crops			
Jute	*Corchorus* sp.	Data on diversity not available. However, 14 species under the genus *Corchorus* were mentioned.	Not known
Cotton	*Gossypium hirsutum*	Some 430 accessions are being maintained in Cotton Research Farms, Mahiganj in Rangpur District, and Sripur in Gazipur District and Saidrpur in Dinajour District.	Increasing g with new introduction
	Gossypium arboreum	Some 30 accession at Balaghata Farm in Bandarban District	Decreasing

[28] Ibid.
[29] Source: Bangladesh National Herbarium (Taxonomic Study of the Family Araceae).
[30] Source: Khan, M. S. and F. Ahmed. A Tentative List of Plant Genetic Resources (Wild and Cultivated). Mimeo. Bangladesh Agricultural Research Council /Bangladesh Academy of Agriculture(2001)
[31] Ibid.
[32] Ibid.

TABLE 2

Some major crops[33] of Bangladesh beyond the list of crops under the Multilateral System of the International Treaty on Plant Genetic Resources, their uses, relative importance and regional difference

Crop	Scientific name	Uses/products	Relative importance	Regional difference in importance
Fibre crops				
Jute	*Corchorus* spp.	The major fibre crop of Bangladesh	Economic (a major export crop)	Important all over the country
Vegetables				
Ash gourd	*Benincasa hispida*	Extensively used vegetable crop	Food security	Important all over the country
Bitter gourd	*Momordica charantia*	Extensively used vegetable crop	Food security	Important all over the country
Bottle gourd	*Lagenaria siceraia*	Extensively used vegetable crop	Food security	Important all over the country
Hyacinth bean	*Lablab purpureus*	Extensively used vegetable crop	Food security	Important all over the country
Cucumber	*Cucumis sativus*	Extensively used vegetable crop	Food security	Important all over the country
Okra	*Abelmoschus esculentus*	Extensively used vegetable crop	Food security	Important all over the country
Papaya	*Carica papaya*	Extensively used vegetable crop	Food security	Important all over the country
Pumpkin	*Cucurbita moschata*	Extensively used vegetable crop	Food security	Important all over the country
Ribbed gourd	*Luffa acutungula*	Extensively used vegetable crop	Food security	Important all over the country
Snake gourd	*Trichosanthes anguina*	Extensively used vegetable crop	Food security	Important all over the country
Tomato	*Lycopersicon esculentum*	Extensively used vegetable crop	Food security	Important all over the country
Oilseeds				
Groundnut	*Arachis hypogea*	Widely grown oilseed crop	Food security	Important all over the country
Spices				
Chilli	*Capsicum annum frutescens*	Extensively used spice crop	Food security	Important all over the country
Garlic	*Allium sativum*	Extensively used spice crop	Food security	Important all over the country
Ginger	*Zingiber officinale*	Extensively used spice crop	Food security	Important all over the country but grown especially in hilly / forest areas
Onion	*Allium cepa*	Extensively used spice crop	Food security	Important all over the country
Turmeric	*Curcuma domestica/ longa*	Extensively used spice crop	Food security	Important all over the country, but especially in hilly / forest areas
Fruits				
Guava	*Psidium guajava*	Widely grown fruit tree	Food security	Important all over the country
Jackfruit	*Artocarpus heterophyllus*	Widely grown fruit tree	Food security	Important all over the country, but grown especially in central districts
Litchi	*Litchi chinensis*	Widely grown fruit tree	Food security	Important all over the country, but grown especially in northern districts (Rajshahi, Dinajpur, Natore, Naogaon, etc.)
Mango	*Mangifera indica*	Widely grown fruit tree	Food security and economic (cash crop)	Important all over the country but grown especially in northern districts.
Papaya	*Carica papaya*	Widely grown fruit tree	Food security	Important all over the country
Watermelon	*Citrullus lanatus*	Widely grown fruit crop	Food security	Important all over the country
Sugar crops				
Sugarcane	Saccharum officinarum	Widely grown sugar crop	Food security and economic (cash crop)	Important all over the country, but grown especially in northern districts
Beverage				
Tea	*Camellia sinensis*	A major export crop	Economic (a major export crop)	A major export crop grown especially in hilly areas of Sylhet and Chittagong districts

[33] Ibid.

TABLE 3
Minor and underutilized crops of Bangladesh and their state of diversity

Crop	Scientific Name	Diversity	
		Present state of diversity	Diversity trend
Cereals			
Barley	*Hordeum vulgare*	Some 30 geermplasm in BARI genebank	Decreasing
Foxtail Millet	*Setaria italica*	More than 500 germplasm in BARI genebank	Decreasing
Maize	*Zea mays*	More than 100 germplasm are reported to be maintained at BAU and 69 in gene bank at BARI	Increasing with introduction of new varieties
Pearl Millet	*Panicum milliaceum*	Only two germplasm in BARI genebank	Not known
Triticale	*Triticosecale*	Five germplasm in BARI gene bank	Remaining the same
Pulses			
Black gram	*Vigna mungo*	89 accessions in BARI genebank	Not known
Pigeon pea	*Cajanus cajan*	84 accessions in BARI genebank	Not known
Oilseeds			
Linseed	*Linum usitatissimum*	Not known	Not known
Niger	*Guizotica abyssinica*	2 accessions in BARI genebank	Not known
Safflower	*Carthamus tinctorius*	Not known	Not known
Sesame	*Sesamum indicum*	83 accessions in BARI genebank	Not known
Vegetables			
Amaranth	*Amaranthus* spp.	Data on diversity not available. However, 620 accessions in BARI genebank.[36]	Not known
Bathua	*Chenopodium album*	One accessions in BARI genebank	Not known
Carrot	*Daucas carota*	Data on diversity not available. However, two varieties were mentioned.[37]	Not known
Cheena shak	*Brassica* spp.	10 accessions in BARI genebank	Not known
Drumstick	*Moringa oleifera*	10 accessions in BARI genebank	Not known
French bean	*Phaseolus vulgaris*	10 accessions in BARI genebank	Not known
Indian spinach	*Basella alba*	34 accessions in BARI genebank	Not known
Kalmia shak	*Ipomoea aquatica/ reptans)*	Data on diversity not available. However, five varieties were mentioned.[38]	Not known
Lima bean	*Phaseolus lunatus*	Not known	Not known
Marfa, Phuti	*Cucumis melo*	Not known	Not known
Spinach	*Spinacea oleracea*	Data on diversity not available. However, three varieties were mentioned.[39]	Not known
Sponge gourd	*Luffa cylindrica*	Not known	Not known
Squash	*Cucurbita moschata /pepo*	Not known	Not known
Teasle gourd	*Momordica dioica/cochinchinesis*	Data on diversity not available. However, two varieties were mentioned.[40]	Not known
Winged bean	*Psophocarpus tetragonolobus*	One accession in BARI genebank	Not known
Yam	*Dioscorea* spp.	62 accessions in BARI genebank	Not known
Yam bean (Shak alu)	*Pachyrrrhizus tuberosus*	3 accessions in BARI genebank	Not known
Yard Long Bean	*Vigna unguiculata*	147 accessions in BARI genebank	Not known
Spices			Not known
Black cumin	*Nigella sativa*	6 accessions in BARI genebank	Not known

[34] Source: Khan, M. S. & F. Ahmed. (Undated). A Tentative List of Plant Genetic Resources (Wild and Cultivated). Mimeo. Bangladesh Agricultural Research Council.
[35] Ibid.
[36] Ibid.
[37] Ibid.
[38] Ibid.

Crop	Scientific Name	Diversity	
		Present state of diversity	Diversity trend
Black pepper	*Piper nigrum*	Not known	Not known
Coriander	*Coriandrum sativum*	18 accessions in BARI genebank	Not known
Cumin seed (Jeera)	*Cuminum cyminum*	Not known	Not known
Fenugreek (Methi)	*Trigonella foenum-graceum*	Four accessions in BARI genebank	Not known
Join	*Carom capsicum*	One accessions in BARI genebank	Not known
Fruits			Not known
Amloki	*Phyllanthus emblica*	10 accessions mentioned	Not known
Amra	*Spondias dulcis*	10 accessions mentioned	Not known
Arboroi	*Cicca acida*	10 accessions mentioned	Not known
Bel	*Aegle marmelos*	Data on diversity not available. However, 15 varieties were mentioned.[41]	Not known
Carambola (Kamranga)	*Averrhoa carambola*	Not known	Not known
Cashew nut	*Anacardium occidentale*	Not known	Not known
Chalta	*Dillenia indica*	Not known	Not known
Custard Apple (Sharifa)	*Annona squamosa*	Not known	Not known
Dewa	*Artocarpus lacucha*	Not known	Not known
Jalpai	*Elaecarpus floribundus*	Not known	Not known
Jamrul	*Syzygium samarangense*	Not known	Not known
Kalajam	*Syzygium cumini*	Not known	Not known
Kath badam	*Terminalia catappa*	Not known	Not known
Kothbel	*Feronia limonia*	Not known	Not known
Kul	*Zizyphus jujube/maurutiana*	Data on diversity not available, However, five varieties were mentioned.	Not known
Latkan	*Bixa orellana*	Not known	Not known
Lemon	*Citrus limon*	Not known	Not known
Lime	*Citrus aurantifolia*	Not known	Not known
Mandarin	*Citrus reticulata*	Not known	Not known
Nona	*Annona reticulata*	Not known	Not known
Pomegranate	*Punica granatum*	Not known	Not known
Pummelo	*Citrus grandis*	25 varieties were mentioned.[42]	Not known
Rose apple (Golapjam)	*Syzygium jambos*	Not known	Not known
Safeda	*Achras sapota*	Not known	Not known
Sweet orange (Malta)	*Citrus sinensis*	Not known	Not known
Tamarind	*Tamarindus indica*	Not known	Not known
Fibre crops			
Cotton	*Gossipier* spp.	Not known	Not known
Mesta and Kenaf	*Hibiscus* spp.	Data not available	Not known
Sun hemp	*Crotalaria juncea*	Not known	Not known
Sugar crops			
Date palm	*Phoenix sylvestris*	Not known	Not known
Palm	*Borassus flabellifer*		Not known
Narcotics			
Tobacco	*Nicotiana tabacum,/ rustica*	Not known	Not known
Betel nut	*Areca catechu*	Not known	Not known
Green-maturing crops			Not known
Sun hemp (Shon pat)	*Crotalaria jounce*	Not known	Not known
Sesbania (Dhaincha)	*Sesbania canabina*	Not known	Not known

Modified after[1] Mondal, M. H. 1990. Plant Genetic Resources Activities in Bangladesh. Proc.South Asia National Coordinators Meeting. March 21-24, 1990. held at IBPGR Regional Office for South Asia, NBPGR Campus, Pusa, New Delhi 110 012, India.

[39] Ibid.
[40] Ibid.

4.5 Threats of genetic vulnerability and causes of genetic erosion in Bangladesh

Recognizable threats of genetic vulnerability include, among other things, replacement of traditional varieties/land races by modern varieties, forest clearance and forest encroachment and disappearance of homestead backyard forests. The first volume of Red Data Book (2001)[41], as mentioned earlier, identified 106 species of vascular plants that are threatened and some of which are no longer traceable. The diversity of land races/farmers' varieties has decreased significantly over the years. The factors responsible for genetic erosion in Bangladesh are many and each of these plays a part in the erosion of genetic resources. These are listed below:

- Unplanned conversion of agricultural land to non-agricultural uses.
- Urbanisation and human population growth.
- Use of high yielding crop varieties at the expense of traditional varieties/landraces.
- Riverbank erosion, leading not only to the direct loss of land and homesteads along with biodiversities but also to driving the affected peoples out to areas previously used for agriculture or left for wild /forest flora.
- Disappearance of backyard forests due to scarcity of land.
- Construction of flood control embankments leading to habitat destruction.
- Water logging and drainage problems arising from Flood Control and Drainage (FCD) Projects and/or Flood Control Drainage and Irrigation (FCDI) Projects.
- Shrimp monoculture in coastal areas leading to salinity increase that practically drove out crop culture and/or the growth of wild flora in these fragile ecosystems.
- Unscrupulous forest clearance and overexploitation of forest species.
- Settling plain land farmers in forest areas who attempt plain land cultivation practices there. Forest dwelling people previously used to manage these forests with their traditional knowledge.
- Felling of trees in village groves to meet the demands for timber and fuel.
- Hill cutting.
- Flood.
- Construction of barrage (e.g. Farakka Barrage upstream in India) leading to water stress downstream affecting biodiversity.
- Environmental effects – cyclones, tidal surges, environmental pollution, and sea level rise, and salinity increase in coastal areas as mentioned above.
- Introduction of invasive alien species (especially Acacia and Eucalyptus)
- Plant diseases (especially red rot disease in sugarcane has been identified as a major cause of loss of sugarcane diversity).
- Lack of knowledge of multiple use of species, lack of value addition as well as overexploitation of plant genetic resources.
- Loss of soil fertility and the desertification process ensued in northern parts of Bangladesh.

4.6 Improving the understanding of the state of diversity

The following issues need to be given attention for improving the understanding of the state of diversity:

- National and institutional priorities for undertaking PGR surveys should be established.
- For capacity building, especially for assessing genetic erosion and improving responses to genetic erosion, staffs have to be trained and adequate trained staffs have to be deployed.
- Strategic direction for biodiversity conservation with appropriate policy should be in place along with research and management facilities.
- Logistic supports to be made available for awareness creation on biodiversity and their conservation.
- Regional and international cooperation and support should be sought.
- Evaluation and characterization of genetic material have to be strengthened.
- Genetic finger printing facilities should be made available for assessing diversity.
- Preservation facilities (*in situ*, on-farm, *ex situ*, field genebank, *in vitro*, cryo-preservation) for genetic material need to be developed and strengthened.
- Necessary financial supports need to be provided.

[41] Khan, M. S. et al. (Eds.). 2001. Red Data Book of Vascular Plants of Bangladesh. Bangladesh Agricultural Research Council / Bangladesh National Herbarium, Dhaka,

CHAPTER 5

THE STATE OF *IN SITU* MANAGEMENT

5.1 GPA Activity Area 1: Surveying and Inventorying of Plant Genetic Resources for Food and Agriculture

Some sporadic surveys on wild PGR have been undertaken in Bangladesh and the priority areas for survey and inventory of plant genetic resources in Bangladesh have been identified (Table 4).

TABLE 4
Surveys and inventories undertaken and priority areas identified in Bangladesh

Stakeholder	Title of survey/ inventory	Area surveyed/ inventoried	Area priority ranking for *in situ* conservation	Survey details	Surveying methods	Threatened species	Causes of threat	Major findings
Bangladesh Agricultural Research Institute	Ethno botanical survey on Taro and Yam	Different districts of Bangladesh	Medium	Indigenous knowledge used; identification of threatened / endangered species	-	-	Lack of knowledge on multiple use and value addition	-
Bangladesh National Herbarium	Biosystematic studies of *Cucurbitaceae*	Bangladesh	Not set/ known	Indigenous knowledge used	Field survey, literature survey and examination of herbarium specimens	*Trichosanthes himalensis*	Habitat destruction	A total of 45 species were identified under the family *Cucurbitaceae* of which 15 species are vegetables.
Bangladesh National Herbarium	Exploration of the wild plant genetic resources of Kaptai National Park	Kaptai National Park, Rangamati	High	Indigenous knowledge used; identification of threatened / endangered species, threat to genetic diversity	Field survey, literature survey and herbarium specimens. Ethnobotanical data collected.	Of 423 species recorded threatened species recorded were 25.	Over exploitation and deforestation .	A total 423 species under 292 genera in 93 families recorded.
Bangladesh National Herbarium	Taxonomic studies of *Araceae* from Bangladesh	Bangladesh	Not set /known	Indigenous knowledge used; identification of threatened / endangered species, threat to genetic diversity	Field survey, literature survey and herbarium specimens. Data collected from 30 AEZs	At least 7 species have been identified as threatened	Habitat destruction, over exploitation	A total of 53 species under 20 genera in Bangladesh. Some 10 species used as vegetables and 16 species were endemic and endangered. Five species were recorded only once but not found during the study.
Bangladesh National Herbarium	Inventory of threatened plants to publish Red Data Book	Bangladesh	High	Indigenous knowledge used; identification of threatened / endangered species, threat to genetic diversity	Field survey, literature survey and herbarium specimens.	The names of 106 threatened vascular plants identified.	Habitat destruction, over-exploitation, climatic changes	A total 0f 106 species were listed in the first volume of the "Red Data Book of Vascular Plants of Bangladesh". Species categorised according to IUCN Red List Categories.
Bangladesh National Herbarium	Legume Flora of Bangladesh	Bangladesh	Not set / known	Indigenous knowledge used; identification of threatened / endangered species, threat to genetic diversity	Mainly based on literature survey and herbarium collections. Field studied done in a few cases.	About 50 species are threatened.	Habitat destruction and over-exploitation	A total of 332 species under 98 genera identified. A total of 21 species recorded that were used as vegetables/pulses and 23 species recorded to be used as medicinal plants.

Stakeholder	Title of survey/ inventory	Area surveyed/ inventoried	Area priority ranking for *in situ* conservation	Survey details	Surveying methods	Threatened species	Causes of threat	Major findings
Bangladesh National Herbarium	Survey of Plant Diversity of Bangladesh to publish the series of "Flora of Bangladesh" (*Annonaceae, Solanaceae, Combretaceae, Cuscutaceae, Malvaceae and s*)	Bangladesh	Not set / known	Indigenous knowledge used; identification of threatened/ endangered species, threat to genetic diversity	Field survey, literature survey and examination of herbarium specimens.	Some 23 species *Annonaceae*, 5 species of *Solanaceae*, 4 species of *Cuscutaceae*, 6 species of *Menispermaceae* and 2 species of *Malvaceae* have been identified as threatened.	Habitat destruction, climatic changes, over-exploitation	A total of 42 species under15 genera of the Family *Annonaceae* identified. Of these 3 species were fruit yielding and widely cultivated. A total of 35 species under 13 genera of the Family *Solanaceae* identified, 5 species were vegetable syielding, two Nicotiana species, 4 species used as medicinal plants, and two species cultivated a sornamental plants. A total of 21 species under 6 genera of the family *Combretaceae* identified. Of these, 5 species are used as medicinal plants. A total of 6 species under the family *Cuscutaceae* have been identified, of which one species is used a medicinal plant. A total of 19 species under the family *Menispermaceaehave* been identified ofwhich one is a fibre yielding plant and one is a poisonous plant. A total of 49 species under19 genera of the family *Malvaceae* have been identified of which 3 species are used as vegetables, 21are fibre yielding and 6 species are medicinal plants.
Bangladesh National Herbarium	Survey of Pteridophytic Flora of Bangladesh	Bangladesh	Not set / known	Indigenous knowledge used; identification of threatened/ endangered species	Field survey, literature survey and herbarium specimens.	About 25 species identified as threatened.	Habitat destruction and over-exploitation	A total of 165 species under 56 genera of 28 families identified. Of these 12 species were used as vegetables and 40 as medicinal plants.
Coastal Development Partner-ship(CDP)	Rice Diversity and Production in the Southwest of Bangladesh	Southwest Costal Region	High	Indigenous knowledge used; identification of threatened/ endangered species, threat to genetic diversity.	Samples of indigenous rice varieties and anthropological information collected through FGD.	About 30 indigenous rice varieties were threatened.	Coastal Embankment Project, increased salinity and water logging and aggression of modern varieties.	Some 116 varieties werec ollected through resource poor farmers in 20 villages in 4 districts of the south west region of Bangladesh.
Cotton Development Board	Baseline Survey on Potentiality of Cotton Production in Bangladesh	63 Upazilas of the 19 cotton growing district (10 cotton growing zones)	Low	Indigenous knowledge used; identification of threatened/ endangered species, data entered in GIS	To know farmers' capability through questionnaire, GIS system	*Gossypium arboreum*, indigenous species of cotton was threatened.	Monoculture of modern varieties	Middlemen purchase immature cotton, mixed varieties led to genetical deterioration.

Stakeholder	Title of survey/ inventory	Area surveyed/ inventoried	Area priority ranking for *in situ* conservation	Survey details	Surveying methods	Threatened species	Causes of threat	Major findings
Bangladesh Rice Research institute	Collection and Registration of RiceVarieties	Bangladesh	Medium - High	Indigenous knowledge used; identification of threatened/ endangered species, threat to genetic diversity.	Questionnaire, Passport Data, etc.	Wild rice (*Oryza rufipogon, O. officinalis, O. nivara*) are threatened.	Monoculture of modern rice, disturbances of natural habitats	About 12 000 local rice germplasm identified as new germplasm. Many local varieties have already been lost from farmers' fields
Bangladesh Rice Research institute	Characterization of Rice Germplasm	BRRI HQ, Gazipur	Low - Medium	Indigenous knowledge used; identification of threatened/ endangered species, threat to genetic diversity. Data entered into GIS	Data recording	Local rice cultivars	Monoculture of modernrice, disturbances of natural habitats	About 12 000 local rice germplasm identified as new germplasm. Many localvarieties have already been lost from farmers' fields.
Bangabandhu Sheikh Mujibur Rahman Agricultural University	Survey and Collection of Local Rice Germplasm	Netrokona and Kishoreganj District	Medium - High	Indigenous knowledge used; threat to genetic diversity.	-	-	Competition from modern high yielding varieties	-
Bangladesh Agricultural Research Institute	Ethnobotanic-alsurvey on Taro andYam	Different districts of Bangladesh	Medium	Indigenous knowledge used; identification of threatened/ endangered species	-	-	Lack of knowledge on multiple use and value addition	-
Bangladesh National Herbarium	Biosystematic Studies of *Cucurbitaceae*	Bangladesh	Not set/known	Indigenous knowledge used	Field survey, literature survey and studies on herbarium specimens	*Trochosanthes himalensis*	Habitat destruction	-
Bangladesh National Herbarium	Exploration of the Wild Plant Genetic Resources of Kaptai National Park	Kaptai National Park, Rangamati, Hill Tracts of Bangladesh	High	Indigenous knowledge used; identification of threatened/ endangered species, threat to genetic diversity	Field survey, literature survey and studies on herbarium specimens. Ethno-botanical data collected.	A total 423 species under 292 genera in 93 families recorded. Number of threatened species recorded was 25.	Over exploitation and deforestation.	-
Bangladesh National Herbarium	Taxonomic Studies	Bangladesh	Not set /known	Indigenous knowledge used; identification of threatened/ endangered species, threat to genetic diversity	Field survey, literature survey and studies on herbarium specimens.Data collected from 30 Agro Ecological Zones of Bangladesh	A total of 53 species under 20 genera in Bangladesh. Some 10 species used as vegetables and 16 spp. were endemic and endangered. Five spp. were recorded only once but not found during the study.	Habitat destruction	-

Stakeholder	Title of survey/ inventory	Area surveyed/ inventoried	Area priority ranking for *in situ* conservation	Survey details	Surveying methods	Threatened species	Causes of threat	Major findings
Bangladesh National Herbarium	Inventory ofThreatened Plantsto Publish RedData Book	Bangladesh	High	Indigenous knowledge used; identification of threatened/ endangered species, threat to genetic diversity	Field survey, literature survey and herbarium specimens.	The names of 106 threatened vascular plants identified.	-	A total 0f 106 species were listed in the first volume of the "Red Data Book ofVascular Plants of Bangladesh' (2001). Species categorised according to IUCN Red List Categories.
Bangladesh National Herbarium	Legume Flora of Bangladesh	Bangladesh	Not set / known	Indigenous knowledge used; identification of threatened / endangered species, threat to genetic diversity	Mainly based on literature survey and herbarium collections. Field studies done in a few cases.	About 50 spp. were threatened.	Habitat destruction and over-exploitation	A total of 332 spp. under 98 genera identified. A total of 21 spp. recorded that were used as vegetables/pulses and 23 spp. recorded to be used as medicinal plants.
Bangladesh National Herbarium	Survey of Plant Diversity of Bangladesh (to publish the series of "Flora of Bangladesh"-- *Annonaceae, Solanaceae, Combret-aceae*	Bangladesh	Not set / known	Indigenous knowledge used; identification of threatened/ endangered species, threat to genetic diversity	Field survey, literature survey and herbarium specimens.	Some 16 species *Annonaceae*, 4 species of *Solanaceae*, 3 species of *Combretaceae* identified as threatened.	Habitat destruction	A total of 42 species under 15 genera of the Family *Annonaceae* identified. Of these 3 species were fruit yielding and widely cultivated. A total of 35 species under 13 genera of the Family *Solanaceae* identified, 5 species were vegetable yielding, two *Nicotiana* species, 4 species used as medicinal plants, and two species cultivated as ornamental plants. A total of 21 species under 6 genera of the family *Combretaceae* identified. Of, 5 species used as medicinal plants.
Bangladesh National Herbarium	Survey of Pteridophytic Flora of Bangladesh	Bangladesh	Not set / known	Indigenous knowledge used; identification of threatened / endangered species	Field survey, literature survey and herbarium specimens.	About 25 species identified as threatened.	Habitat destruction and over-exploitation	A total of 165 species under 56 genera of 28 families identified. Of these 12 species were used as vegetables and 40 as medicinal plants.
Coastal Development Partner-ship	Rice Diversity and Production in the Southwest of Bangladesh	Southwest Costal Region	High	Indigenous knowledge used; identification of threatened / endangered species, threat to genetic diversity.	Samples of indigenous rice varieties and anthropological information collected through FGD.	About 30 indigenous rice varieties were threatened.	Coastal Embankment Project, increased salinity and water logging and aggression of modern varieties.	Some 116 varieties were collected through resource poor farmers in 20 villages in 4 districts of the southwest region of Bangladesh.
Cotton Development Board	Baseline Survey on Potentiality of Cotton Production in Bangladesh	63 Upazilas of the 19 cotton growing district (10 cotton growing zones)	Low	Indigenous knowledge used; identification of threatened / endangered species, data entered in GIS	To know farmers' capability through questionnaire, GIS system	*Gossypium arboreum*, indigenous species of cotton was threatened.	Monoculture of modern varieties	Middlemen purchase immature cotton, mixed varieties led to genetical deterioration.

Stakeholder	Title of survey/ inventory	Area surveyed/ inventoried	Area priority ranking for *in situ* conservation	Survey details	Surveying methods	Threatened species	Causes of threat	Major findings
Bangladesh Rice Research Institute	Collection and Registration of Rice Varieties	Bangladesh	Medium - High	Indigenous knowledge used; identification of threatened / endangered species, threat to genetic diversity.	Questionnaire, Passport Data, etc.	Wild rice (*Oryza rufipogon, O. officinalis, O. nivara*) are threatened.	Monoculture of modern rice, disturbances of natural habitat disturbances	About 12 000 local rice germ plasm identified as new germ plasm. Many local varieties have already been lost from
Bangladesh Rice Research Institute	Characterization of Rice Germplasm	BRRI HQ, Gazipur	Low - Medium	Indigenous knowledge used; identification of threatened/ endangered species, threat to genetic diversity. Data entered into GIS	Data recording	Local rice cultivars	Monoculture of modern rice, disturbances of natural habitat disturbances	About 12 000 local rice germ plasm identified as new germ plasm. Many local varieties have already been lost from farmers' fields.
Bangabandhu Sheikh Mujibur Rahman Agricultural University	Survey and Collection of Local Rice Germplasm	Netrokona and Kishoreganj District	Medium - High	Indigenous knowledge used; threat to genetic diversity.	-	-	Competition from modern high yielding varieties	-

Sources: PRSP, December 2004. Unlocking the Potential (PRSP). Planning Commission, Government of Bangladesh. Pp. 7.

Mondal, M. H. 1990. Plant Genetic Resources Activities in Bangladesh. Proc. South Asia National Coordinators' Meeting, 21-24 March, 1990 held at IBPGR Regional Office for South Asia, NBPGR Campus, Pusa, New Delhi – 110 012,

India. BARC. 1995. Country Report – Bangladesh for the International Conference and Programme for Plant Genetic Resources (The First Bangladesh Report on PGR)

Constraints in surveying and monitoring

- The Plant Variety and Farmers' Rights Protection Act of Bangladesh and the Biodiversity and the Community Knowledge Protection Act of Bangladesh have been drafted and these are under process at the government level.
- The government needs to be persuaded to implement the proposal submitted for establishing the National Institute for Plant Genetic Resources. The proposed institute was expected to organize PGRFA activities including surveying and monitoring. The proposal was submitted in 1999.

In addition, the following constraints are to be addressed with urgency:

- National priorities on biodiversity vis-à-vis PGRFA identified in the National Workshop in 1997[42] need to be revisited and new set of priorities, as deemed necessary with the passage of time, be established and action initiated.
- Insufficient financial support for PGRFA.
- Insufficient staff in PGRFA.
- Existing staffs do not have sufficient skills.

Needs and priorities for surveying and monitoring

- Awareness campaigns on conservation of plant genetic resources should be strengthened and widened. (Bioversity and FAO can be of assistance).
- Organisational responsibilities for carrying out PGR activities should be clarified and coordinated. At the moment the responsibility is diffused with a number of institutes but none with a comprehensive responsibility.
- Surveying and monitoring of PGRFA should be taken up with urgency. (Bioversity and FAO can be of assistance).
- Adequate staff for carrying out PGRFA should be deployed.
- Training needs in PGRFA, especially in surveying and monitoring, should be properly assessed and training provided. Where necessary, training of existing staff to upgrade skills should be organised. (Bioversity and FAO can be of assistance).
- Adequate funds for carrying out activities related to PGRFA, including surveying and monitoring, should be made available.
- Collaboration and sharing of information on PGR with countries of the region and international organisations/ institutions should be strengthened. (Bioversity and FAO can be of assistance).
- Priority areas for survey and monitoring have been identified. Such surveys and monitoring activities need to be organised and implemented. (Bioversity and FAO can be of assistance in taking initiatives).

Opportunities

- Bangladesh is a signatory to the CBD (1992) and the government is committed to the implementation of the Global Plan of Action (GPA) for Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture.
- Through a collaborative National Workshop on Plant Genetic Resources in 1997, involving the National Committee on Plant Genetic Resources (NCPGR), the Bangladesh Agricultural Research Council and the IPGRI, the national priorities in PGR have already been identified. These need be revisited and if necessary, a new set of priorities should be established.
- The National Committee on Plant Genetic Resources is in place but it needs to be reactivated.
- The Acts related to PGR have been drafted. These need to be formalised and operationalised.
- Priority ranks for surveys have already been identified.
- Some survey and inventory work have already been undertaken by stakeholder institutions/ organisations. Support is needed for strengthening and for widening survey and inventory work.

[42] Ibid.

5.2 GPA Activity Area 2: Supporting On-Farm Management and Improvement of Plant Genetic Resources for Food and Agriculture

Programmes/projects/activities on *in situ* conservation of Wild Crop Relatives and Wild Plants for Food and Agriculture (WCR/WPF) have so far been poor in Bangladesh. The major limitations to on-farm conservation and improvement of PGRFA are as follows:

- On-farm management and improvement of PGRFA are yet to be regarded as a national priority.
- Lack of incentives to farmers for on-farm conservation and improvement of PGRFA.
- Insufficient number of staff for conservation work.
- Insufficient skills of staff.
- Inadequate staff training.
- Lack of financial support.
- Insufficient seed / planting material.
- A small minority of landowners, who are usually absentee landlords, owns a major portion of the cropland, especially in southern coastal region. They could care less for on-farm conservation of PGR.
- Increasing population and scarcity of land warrant more crop production from the same limited land area.
- Traditional varieties with lower yield have a low premium to the mass of farmers.

Priority needs

For promoting on-farm management and improvement of PGRFA, the following should be given attention to:

- Awareness building on indigenous PGRFA, their extent and significance, their erosion, and their potentials for improvement, through seminars, publication of booklets and biodiversity fairs.
- Awareness building on the causes of changes / erosion of PGRFA.
- Promoting the uses of traditional varieties in identified pocket areas (rain-fed areas and marginal lands) where farmers still depend on them. These farmers should be given incentives for conservation and for promotion of traditional varieties.
- Developing markets for products originating from traditional and under-utilized varieties and crops.
- There have been initiatives from the private sector[43] for developing, at the local level, small-scale seed production enterprises. Such initiatives should be supported.
- Providing incentives, including awards, to farmers for on-farm conservations, management and improvement of PGRFA.
- Providing training on on-farm management and improvement of PGRFA with special emphasis on:
  - Seed enhancement.
  - Preservation.
  - Processing and packaging.
  - Consumption.
- Organising visits to successful models of on-farm management.
- Creating facilities for genetic finger printing.

[43] For example, Bangladesh Golden Agri Seed Associates (BGASA), with about 40 small-scale farmer based seed enterprises (FBSEs)as members and spread throughout the country, have been producing quality seeds with assistance from GTZ and BADC. The number of companies has been steadily increasing with time and these FBSEs are contributing to the seed requirement at the local level. The enterprises have benefited from credit support from a National Commercial Bank against security money provided by GTZ but for a limited time. Such credit facilitation needs to be continued and widened to encourage local level quality seed production, skill development, enterprise and income generation in rural areas.

5.3 GPA Activity Area 3: Assisting Farmers in Disaster Situation to Restore Agricultural Systems

Bangladesh is vulnerable to natural disasters like floods, cyclones, tornadoes, tidal surges and occasional droughts. River bank erosion is a silent disaster. Unfortunately, till today this disaster has hardly featured in government documents as an important threat to people, their livelihood, for that matter to plant genetic resources. A national plan to assist farmers, to recover and preserve PGRFA following disasters, is yet to be developed so that the genetic resources lost as a result of natural disasters could be restored. Awareness campaigns on the loss of genetic resources should be undertaken with a sense of urgency.

Community genebanks are yet to be promoted and identification of appropriate germplasm for re-introduction, following a disaster, has not been given attention to in the past. Pre-disaster information on PGRFA has not usually been maintained. The National Committee for Plant Genetic Resources (NCPGR) should be revived to undertake initiatives, among other things, towards post-disaster restoration of agriculture and to identify its (NCPGR) institutional base with the proposed National Institute of Plant Genetic Resources.

5.4 GPA Activity Area 4: Promoting *In Situ* Conservation of Wild Crop Relatives and Wild Plants for Food Production

Bangladesh has not yet been able to develop a plan for *in situ* conservation though some sporadic attempts have been made by some stakeholder organizations. For examples, The Bangladesh Agricultural Research Institute has identified two *in situ* locations for each of pigeon pea and year round jackfruit. The Bangladesh Rice Research Institute has identified five *in situ* locations for wild rice and the Bangladesh Tea Research Institute has identified 100 Tea Estates as *in situ* locations of tea germplasm.

Up till now, no organised programme/project/activity to raise public awareness of the value of crop wild relatives and wild plants for food (CWR/WPF) in food security and plant breeding has been undertaken. The draft Biodiversity and Community Knowledge Protection Act proposes policy/regulatory changes that could have a positive impact on conservation of wild crop relatives and wild food plants.

For promoting *in situ* conservation of Wild Relatives of Crops and Wild Plants for Food (CWR/WPF) production, the following needs were iden tified:

- The draft Biodiversity and Community Knowledge Protection Act should be formalized and implemented without any further delay.
- R&D activities on *in situ* conservation of CWR/WFP should be promoted and strengthened.
- Model testing of *in situ* methodology, especially in marginal land, should be initiated.
- Homestead forestry, agroforestry and fodder raising programmes should be strengthened.
- Livelihood supporting species should be identified and their conservation promoted.
- Concerted efforts should be made to preserve traditional knowledge related to PGR, with special reference to CWR/WPF.
- Regional approach in *in situ* conservation of PGR should be undertaken.
- Regional and international collaboration and support should be sought for promoting *in situ* conservation of CWR/WPF.

CHAPTER 6

THE STATE OF *EX SITU* MANAGEMENT

6.1 GPA Activity Area 5: Sustaining *Ex Situ* Collections

Ex situ Programmes/Projects/ Activities have been undertaken by stakeholder organizations (Table 5). Some the important species covered include *Triticum aestivum, Hordeum vulgare, Sorghum bicolour, Lathyrus sativus, Lens culinaris, Brassica campestris, Brassica oleracea, Lablab purpureus, Luffa cylindrical, Musa* sp., *Aegle marmelos, Mangifera indica, Zea mays, Oryza sativa, Gossypium arboreum, Gossypium hirsutum, Corchorus capsularis, Corchorus olitorius, Camelia* spp. etc. But the capacity and storage conditions of stakeholders vary.

TABLE 5[44]

***Ex situ* programmes/projects/activities undertaken and species covered by different stakeholders**

Stakeholder	*Ex situ* programmes/ projects/activities	Type of activity	Species covered [46]
Bangladesh Agricultural Research Institute (BARI)	Conservation of germplasm	Collection, long and medium term conservation ingene bank storage, and also conservation infield genebank	Cereals: T*riticum aestivum, Setaria italica, Panic miliaceum, Sorghum bicolor, Zea mays,Hordeun vulgare, Fagopyrum esculentum, Triticale cereale, Pennisatum americanum, Eragrostisabyssinica, Avena* sp. Pulses: *Lathyrus sativus, Lens culinaris, Cicer arietinum m, Vigna mungo, Cajanus cajan, Vignaradiata, Macrotyloma uniflorum, Vigna unguiculata, Pisum sativum, Phaseolus vulgaris, Canavaliagladiata, Psophocarpus tetragonolobus, including some wild legumes like 'Bazari', 'Hinta' etc.* Oilseeds: *Brassica campestris sub*-sp. *campestris, Arachis hypogea, Sesamum indicum, Glycinemax, Ricinus communis, Linum usitatisimum, Guizotica abyssinica* Vegetables: *Lablab purpureans, Brassica oleracea, B. oleracea* var. *botrytis, Raphanus sativus, Amaranrhus* spp., *Cucurbita moschata, Solanum melongena, Lagenaria vulgaris, Hibiscusabelmoschus, Benincosa hispida, Luffa cylindrica, Vigna sinensis subsp sesquipedalis, Luffaacutangula, Trichosanthes anguina, Momordica charantia, Lycopersicum esculentum, Basellaalba, Spinacea oleracea, Faba vulgaris, Phaseolus vulgaris, Hibiscus subdariffa, Canavaliagladiata, Ipomoea aquatica, Psophocarpus tetragonolobus, Cucumis melo, Trochosanthes dioica,Dioscorea* spp. *Emblica officinalis, Moringa oliefera, , Ficus carica, Citrus sinensis,Amorphophalus campanulatus, Ficus carica, Momordica coccichinensis (wild)* Fruits: *Persia americana, Musa* spp. *Aegle marmalos, Averrhoa bilimbi, Syzygium cumini,Annona reticulata, Madhuca indica, Baccaurea sapida, Averrhoa carambula, Carrissa carandus,Prunus avium, Cowa mangostrin, Annona squamosa, Phoenix sylvestris, Dillenia indica,Flacourtia jangomas, Crescentia cujete, Spondalis mangifera, S. heterophyllus , Ziziphusmauritania, Citrus sinensis, Nephelium longana, Flacourtia indica, Mangifera indica, Artocarpuslakoocha, Citrus sinensis, Passiflora edulis, Punica granatum, Nephelium lappacheum, Diospyrosperegrina, Tamarindus indica, Antidesma ghaesembilla, Diospyros discolor, Syzigiumsamarangens, Artocarpus champeden, Mangifera sylvetica, Feronia elephantum, Vitis vinifera,Psidium guajava, Loea* spp. *Citrus grandis.* Root and Tuber Crops: Aroids, Potato, Yams and Sweet Potato. Others: Some ornamental and medicinal plants as well as some under-utilized PGRFA.

[46]Species names given under stakeholders are not essentially exhaustive.

Stakeholder	*Ex situ* programmes/ projects/activities	Type of activity	Species covered [46]
Bangladesh Agricultural Development Corporation (BADC)	Seed Processing and Storage	Seed processing and short-termstoring (including fieldgene bank)	Seeds of cereals, jute, vegetables, pulses, oilseeds and potato
Bangladesh Rural Advancement Committee (BRAC)	Storing Maize Germplasm	Short-term storing (including field gene bank)	*Zea mays*
Coastal Development Partnership (CDP)	Rice Diversity and Production in Southwest Bangladesh	Short-term storing (including field genebank)and on-farm conservation	*Oryza sativa*

After 1996, Bangladesh Agricultural Research Institute undertook 3 exploration missions; Bangladesh Rice Research Institute undertook 6, East West Seed (Bd.) Ltd. Undertook 8, Bangladesh Sugarcane Research Institute 4 missions, while Bangladesh Institute, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Cotton Development Board and Bangladesh Tea Research Institute undertook one exploration mission each.

Data on germplasm collection prior to 1996 and between 1996 and 2006 are given in Table 6. Total germplasm collections (genebank plus field genebank) in different stakeholder organizations up to 1996 were 18 000 and collections between 1996 and 2006 were about 13 000 (Table 6). Publications related to *ex situ* collection are mainly in hard copies of Annual Reports. Different stakeholder organizations use different information systems on collections.

TABLE 6

Germplasm collections of some important crops up to 1996 and between 1996 and 2006

Stakeholder	Crop group	No. of accessions collected up to		
		1996	1996-2006	Total
Bangladesh Agricultural Research Institute	Cereals other than rice	1 191	386	1 577
	Pulses	3 174	159	3 333
	Oilseeds	182	699	781
	Vegetables	768	2 748	3 516
	Spices	50	106	156
	Fruits	5	84	89
	Field Genebank			
	Fruits and Vegetables	61	136	197
	Sub-Total	**5 431**	**4 218**	**9 649**
Bangladesh Rice Research institute	Rice (Cultivated and Wild)	4 926	1 333	6 259
Bangladesh Sugarcane Research Institute	Sugarcane (Wild and Cultivated)	999	363	1 362
Cotton Development Board	Cotton	386	104	490
Bangladesh Jute Research institute	Jute (Cultivated and Wild)	5 539	54	5 593
Bangladesh Tea Research institute	Tea (Cultivated and Wild)	320	155	475
Banglabandhu Sheikh Mujibur Rahman Agricultural university	Various Crops	152	612	764
East West Seed (Bd) Ltd.	Vegetables	204	6 239	6 443
Total		**17 957**	**13 018**	**31 035**

Needs Priorities in sustaining *ex situ* collections

The needs and priorities identified were as follows:

- Support to existing genebanks should be strengthened, with particular reference to their modernization.
- The proposal for establishing the National Plant Genetic Resources Institute should be revived and implemented for coordinated and coherent activities on PGR, especially for *ex situ* collection, evaluation, characterization, and management.
- Regeneration activities should be improved for maintaining the germplasm collected and safeguarding against their losses and degeneration.
- Arrangements should be strengthened for staff training in stakeholder organizations and retaining them so that

the PGR system becomes stronger in the future. It is rather weak at present.

- Continuous support should be ensured in terms of trained staff and finance, particularly for active collections, to prevent their losses.
- Participatory *ex situ* conservation system should be developed with the involvement of local farmers/peoples so that collection of indigenous germplasm can be strengthened, information on local knowledge and practices, as well as information on the uses of indigenous PGR can be gathered, documented and preserved. For this, establishment Community Genebanks and their networks would be an opportune approach.
- Contingency plans for and buffer stock of indigenous PGR should be developed to support farming systems following disasters.
- Regional / international collaboration should be strengthened. Bangladesh has fallen behind in attracting regional/ international collaboration in comparison to neighbouring countries. A regional SAARC programme on PGR *vis-à-vis* genebank may be developed in order to strengthen regional PGR activities.
- Arrangements should be made for maintenance of duplicate germplasm samples with other national genebanks as well as with regional/international genebanks (i.e. IRRI, CIMMYT, AVRDC, etc.)
- Botanical gardens / National Parks should be brought under the purview of PGR conservation.
- Fairs of biodiversity may be arranged to stimulate public interest in PGR.

There are instances of attempts for collections and conservation of gemplasm by community organizations.

These indicate community interests in conservation which, if properly nurtured, can lead to the establishment of community genebanks.

6.2 GPA Activity Area 6: Regenerating Threatened *Ex Situ* Accessions

Regeneration of *ex situ* accessions is weak, even though some stakeholder organizations have had regeneration projects. The needs for *ex situ* regeneration are:

- Availability of adequate fund
- Improving regeneration facilities
- Regional and international collaboration
- Continuous dialogue and free flow of information between concerned organizations
- Technical assistance
- Developing facilities for molecular characterization / Developing genetic finger printing facilities
- Developing documentation facilities
- Improving facilities for long term conservation
- Germplasm collection from remote areas
- Developing *in vitro* and cryo-preservation facilities
- Human resources development in PGR with emphasis on germplasm conservation

The priorities are, however, the following:

- Human resource development
- Technical assistance
- Free flow of information
- Documentation
- Genetic finger printing facilities
- International collaboration
- Financial and logistic support

In particular, work on identification of threatened species needs to be strengthened; site specific facilities for regeneration of threatened species/accessions should be developed with farmers' participation; exchange of germplasm between countries of the region should be promoted; and storage facilities (short-, medium- and longterm) should be improved.

6.3 GPA Activity Area 7: Supporting Planned and Targeted Collecting of Plant Genetic Resources

Collecting missions have been undertaken by different stakeholder organizations but these were, in the main, ad hoc attempts and there are many gaps in collection. Gaps detected were: incomplete coverage of targeted taxa, incomplete geographical coverage, missing historical/known cultivars/landraces.

The stakeholder organizations having provision for rare and endangered species are Bangladesh Agricultural Research Institute, Bangladesh Rice Research Institute and Bangladesh Sugarcane Research Institute.

Collection and exploration needs to be strengthened in all stakeholder organizations; periodic surveys of germplasm should be undertaken to assess changes with time; and virtually all stakeholder organizations need support in skill development, in characterization and evaluation as well as in identification of gaps in collections. The establishment of the proposed National Plant Genetic Resources Institute with specific mandate to look into the needs in PGR collection, conservation and their management, and promotion of community genebanks, would help overcoming most of these technical constraints.

6.4 GPA Activity Area 8: Expanding *Ex situ* Conservation Activities

Expanding *ex situ* conservation activities, covering vegetatively propagated materials and recalcitrant seeds, needs special attention in Bangladesh. Research on management of PGR, for that matter on conservation methodology is extremely weak, if not non-existent and, therefore, needs strengthening. Promotion of community genebanks and linking them up with the proposed National Plant Genetic Resources Institute has a high potential for expanding both *in situ* and *ex situ* conservation of germplasm. This would also warrant not only training of staff but also training of farmers involved in community genebank and entrepreneurship development. In general, there is the need for capacity building for *ex situ* conservation virtually in each of the stakeholder organizations and for a focused national attention on *ex situ* conservation of PGR.

CHAPTER 7

THE STATE OF USE OF PLANT GENETIC RESOURCES

7.1 GPA Activity Area 9: Expanding the Characterization, Evaluation and Number of Core Collections to Facilitate Use

Characterization and evaluation work is still in preliminary phases in Bangladesh. Studies on core collections are yet to take off. Studies on core collections are yet to take off.

However, the number of germplasm used for breeding, seed enhancement and supply by the Bangladesh Agricultural Research Institute was 590 accessions, Bangladesh Rice Research Institute about 20 000 accessions, Bangladesh Tea Research Institute about 30, Cotton Development Board 130, Bangladesh Sugarcane Research Institute 229, Bangladesh Jute Research Institute 2 915, East West Seed (Bd) Limited Bangladesh 5 263 and Bangabandhu Sheikh Mujubur Rahman Agricultural University used 547 (Table 7).

Obstacles to establishing core collections include:

- Widespread lacking in the understanding of the concept of core collection
- Limited number of trained personnel
- The need for core collection is yet to be recognized
- Methodology not known/available.

Research on establishment of methodologies for core collection should be initiated with backstopping support from regional and international organizations. Also networking projects to share knowledge, experience, and facilitation in the exchange of expertise should be developed and implemented.

TABLE 7

Status of the use of plant genetic resources by different stakeholder organizations

Stakeholder	Name of crop	Total no. of accessions	Type of use			No. of accessions used
			Breeding	Seed enhancement	Supply to others	
Bangladesh Agricultural Research Institute	Foxtail Millet	200	√	-	-	200
	Proso Millet	185	√	-	-	185
	Chickpea	100	√	-	√	100
	Okra	31	√	-	-	31
	Sweet Gourd	7	√	-	√	7
	Ash Gourd	5	-	-	√	5
	Bitter Gourd	5	-	-	√	5
	Bottle Gourd	5	√	-		5
	Snake Gourd	5	-	-	√	5
	Sweet Gourd	5	-	-	√	5
	Hyacinth Bean	5	-	-	√	5
	Wheat	2	√	-	-	2
	Stem Amaranth	11	√	-	-	11
	Leaf Amaranth	10	√	-	-	10
	Brinjal	9	√	-	-	9
	Chilli	5	√	-	-	5
	Total	**590**				**590**
Bangladesh Rice Research Institute	Rice	6 259	√	√	√	Around 20 000 samples
Bangladesh Tea Research Institute	Tea	475	√	-	-	30
Cotton Development Board	Cotton	490	√	√	√	130
Bangladesh Sugarcane Research Institute	Sugarcane	902	√	√	√	229
Bangladesh Jute Researc hInstitute	Jute (*Corchorus capsularis*)	2 368	√	√	√	2 915 accessions are reported to have been used
	Jute (C.olitorius)	1 465	√	√	√	
	Wild Corchorus	278	-	√	√	
	Kenaf	698	-	√	√	
	Mesta	453	-	√	√	
	Wild Hibiscus	369	-	√	√	
	Allied genera	346	-	√	√	
	Total	**5 977**				
Bangladesh Institute of Nuclear Agriculture	Rice	300	√	-	-	-
	Mung bean	100	√	√	√	-
	Mustard	35	√	√	√	-
	Groundut	42	√	√	√	-
	Lentil	150	√	√	√	-
	Total	**627**				

Stakeholder	Name of crop	Total no. of accessions	Type of use			No. of accessions used
			Breeding	Seed enhancement	Supply to others	
East West Seed (Bd) Ltd	Bitter Gourd	800	√	√	-	720
	Bottle Gourd	730	√	√	-	450
	Ridge Gourd	150	√	√	-	120
	Watermelon	34	√	√	-	34
	Pumpkin	842	√	√	-	612
	Snake Gourd	112	√	√	-	110
	Cucumber	200	√	√	-	200
	Ash Gourd	631	√	√	-	600
	Tomato	1 200	√	√	-	1 200
	Chilli	200	√	√	-	120
	Brinjal	800	√	√	-	600
	Onion	112	√	√	-	80
	Radish	120	√	√	-	120
	Cauliflower	60	√	√	-	53
	Yard Long Bean	26	√	√	-	25
	Okra	123	√	√	-	120
	Hyacinth Bean	16	√	√	-	16
	Stem Amaranth	6	√	√	-	6
	Papaya	29	√	√	-	29
	Leaf Amaranth	8	√	√	-	8
	Spinach	14	√	√	-	14
	Indian Spinach	8	√	√	-	8
	Kangkong	6	√	√	-	6
	Coriander	12	√	√	-	12
	Total	**6 239**	**-**	**-**		**5 263**
Bangabandhu Sheikh Mujibur Rahman Agricultural University	Rice	95	√	√	-	95
	Pea	88	√	√	-	88
	Radish	20	√	√	-	20
	Mung bean	100	√	√	-	100
	Black gram	50	√	√	-	50
	Chick pea	25	√	√	-	25
	Snake Gourd	27	√	√	-	27
	Rapeseed	22	√	√	-	22
	Pumpkin	28	√	√	-	28
	Ginger	19	√	√	-	19
	Onion	38	√	√	-	38
	Brinjal	84	√	√	-	84
	Ash Gourd	46	√	√	-	46
	Total	**642**				**642**

7.2 GPA Activity Area 10: Increasing Genetic Enhancement and Base-broadening Efforts

Of the two broad approaches for genetic enhancement / pre –breeding, 'Introgression' and 'Base-broadening', some introgression programmes have been undertaken by some stakeholder organizations but for base-broadening, there is hardly any attempt as yet.

Constraints in increasing Genetic Enhancement and Base Broadening are: Insufficient trained and skilled staff and lack of knowledge of appropriate germplasm

- Inadequacy of fund
- Lack of incentives for good work

The needs for increasing genetic enhancement and base broadening are:

- Strong staff training programme
- Strengthening breeding programmes, with special reference to enhancing genetic base including molecular techniques
- Strengthening germplasm collection, characterization, evaluation and documentation for easy flow of information
- Germplasm exchange with regional / international organizations
- Fund for improving research and facilities for genetic enhancement and base-broadening.
- Inter-institutional linkages should be strengthened.

7.3 GPA Activity Area 11: Promoting Sustainable Agriculture through Diversification of Crop Production and Broader Diversity in Crops

Since the introduction of green revolution technologies, monoculture of modern crop varieties with narrow genetic bases has intensified. This has posed threats of genetic vulnerability vis-à-vis reduced diversity. Therefore, an assessment and improvement of genetic diversity has become an impending need. But the programmes undertaken are scanty in relation to the diversity of crop species, especially in fruit trees and forest species.

Constraints in diversifying crop production and broadening diversity are as follows:

- Marketing/commercial obstacles for diversity-rich products.
- There is no incentive programme for diversified crop production, processing or marketing.
- Breeding programmes are, in general, weak especially for diversification of crop production.
- Broadening diversification in crops for improvement is limited.
- Reporting references are poor.

The needs are:

- Breeding programmes with the objectives of crop diversification should be promoted.
- Incentives for researchers, producers and processors of diversified crops should be introduced.
- Market niches for diversified crops should be created and promotional activities undertaken.
- Marketing incentives should be introduced for diversified crops.
- Regional / international programmes for food security should be undertaken through crop diversification. Under
- such programmes, innovative breeding programmes should be encouraged and trials of breeding lines, fixed lines and finished varieties through exchange programmes may be undertaken.
- IARCs (ICRISAT, IRRI, CIMMYT, IPGRI, and ACU/ICUC) should be encouraged to support national programmes on crop diversification.
- Molecular lab facilities for research and development of diversified crops should be created.

The priorities in diversifying crop production and broader diversity of crops are:

- Breeding programmes with the objectives of crop diversification.
- Regional/international programmes for food security through crop diversification.
- Incentives for researchers, producers, processors of diversified crops.
- Development of market niches and promotional activities for diversified crops.
- MoUs with IARCs on programmes of crop diversification.
- Development of molecular lab facilities.

7.4 GPA Activity Area 12: Promoting Development and Commercialization of Under-utilized Crops and Species

There are nearly 100 under-utilized crops grown in Bangladesh (Table 8) and most of these are important for food security, economic activities and/or medicinal uses, especially of rural poor people. Development efforts for these crops are scanty, and programme/ project/activity related to commercialization of under-utilized crops is practically non-existent. Policy/legal framework needs to be developed to promote development of under-utilized crops and their commercialisation in view of their large number, their market potentials and their value in nutrition and food security.

TABLE 8

Under-utilized crops of Bangladesh with their relative importance, regional differences, and progress achieved in their development and commercialization

Crop	Scientific Name	Uses/Products	Relative importance	Regional difference in importance	Progress achieved
Cereals					
Barley	*Hordeum vulgare*	Widely used food grain	Food security	All over the country, especially in marginal land	-
Fox Tail Millet	*Setaria italica*	Widely used food grain	Food security	All over the country, especially in marginal land	One variety released (BARI)*
Maize	*Zea mays*	Widely used fish feed and food grain	Food security	All over the country	Four varieties released (BARI*
Pearl Millet	*Panicum milliaceum*	Widely used food grain	Food security	All over the country, especially in marginal land	One variety released (BARI)*
Pulses (Grain legumes)					
Black gram	*Vigna mungo*	Widely used protein crop	Food security, Nutrition	All over the country	Two variety released, one each by BARI and BINA
Pigeon pea	*Cajanus cajan*	Widely used protein crop	Food security	All over the country	-
Oilseeds					
Linseed	*Linum usitatissimum*	Widely used oilseed	Food security	All over the country	Two variety released, one each by BARI and BINA
Niger	*Guizotia abyssinica*	Widely used oilseed	Food security	All over the country	-
Safflower	*Carthamus tinctorius*	Widely used oil seed	Food security	All over the country	-
Sesame	*Sesamum indicum*	Widely used oil seed	Food security	All over the country	One variety released (BARI)*
Soybean	*Glycin max*	Widely used oil seed, as a pulse crop and as a poultry feed.	Food security	All over Bangladesh	One variety released (BARI)*
Vegetables					
Amaranth	*Amaranthus spp/ gangeticus*	Widely used vegetable	Food security	All over the country	One variety released (BARI)**
Bathua	*Chenopodium album*	Widely used vegetable	Food security, Nutrition	All over the country	-
Carrot	*Daucas carota*	Widely used vegetable	Food security, Nutrition	All over the country	-
Cheena sak	*Brassica spp*	Widely used vegetable	Food security, Nutrition	All over the country	One variety released (BARI)**
Drumstick	*Moringa oleifera*	Widely used vegetable	Food security, Nutrition	All over the country	-
French bean	*Phaseolus vulgaris*	Widely used vegetable	Food security, Nutrition ity	All over the country	-
Indian spinach	*Basella alba*	Widely used vegetable	Food security	All over the country	-
Kalmi sak	*Ipomea aquatica/ reptans)*	Widely used vegetable	Food security, Nutrition	All over the country	One variety released (BARI)**
Lima bean	*Phaseolus lunatus*	Widely used vegetable	Food security	All over the country	-
Marfa, Phuti	*Cucumis melo*	Widely used vegetable	Food security	All over the country	-
Spinach	*Spinacea oleracea*	Widely used vegetable	Food security	All over the country	-

Crop	Scientific Name	Uses/Products	Relative importance	Regional difference in importance	Progress achieved
Sponge gourd	*Luffa cylindrica*	Widely used vegetable	Food security	All over the country	-
Squash	*Cucurbita moschata / pepo*	Widely used vegetable	Food security	All over the country	-
Teasle gourd	*Momordica dioica*	Widely used vegetable	Food security	All over the country	-
Winged bean	*Psophocarpus tetragonolobus*	Widely used vegetable	Food security, Nutrition	All over the country	-
Yam	*Dioscorea* spp.	Widely used vegetable	Food security	All over the country, especially in hillyareas	-
Yam bean (Shakalu)	*Pachyrrhizustuberosus*	Widely used vegetable	Food security	All over the country	-
Yard Long Bean	*Vigna unguiculata*	Widely used vegetable	Food security	All over the country	One varietyreleased (BARI)**
Spices					
Black cumin	*Nigella sativa*	Widely used spice	Food security,medicinal value	All over the country	-
Black pepper	*Piper nigrum*	Widely used spice	Food security,medicinal value	All over the country	One varietyreleased (BARI)**
Coriander	*Coriandrumsativum*	Widely used spice	Food security,Nutrition	All over the country	-
Cumin seed (Jeera)	*Cuminum cyminum*	Widely used spice	Food security	All over the country	-
Fenugreek (Methi)	*Trigonella foenum-graceum*	Widely used spice	Food security,medicinal value	All over the country	-
Join	*Carum copticum*	Widely used spice	Food security,medicinal value	All over the country	-
Fruits					
Amloki	*Phyllanthusembelica*	Widely used fruit	Food security,medicinal value	All over the country	-
Amra	*Spondias dulcis*	Widely used fruit	Food security	Grown in southern districts, especially inBarisal Division	-
Arboroi	*Cicca acida*	Widely used fruit	Food security	All over the country	-
Bel	*Aegle marmelos*	Widely used fruit	Food security	All over the country	-
Carambola(Kamranga)	*Averrhoacarambola*	Widely used fruit	Food security,medicinal value	All over the country	-
Cashew nut	*Anacardiumoccidentale*	Widely used fruit	Food security,medicinal value	All over the country	-
Chalta	*Dillenia indica*	Widely used fruit	Food security,medicinal value	All over the country	-
Custard Apple(Sharifa)	*Annona squamosa*	Widely used fruit	Food security	All over the country	-
Dewa	*Artocarpus lacucha*	Widely used fruit	Food security	All over the country	-
Jalpai	*Elaecarpusfloribundus*	Widely used fruit	Food security	All over the country	-
Jamrul	*Syzygiumsamarangense*	Widely used fruit	Food security	All over the country	-
Kalajam	*Syzygium cumini*	Widely used fruit	Food security	All over the country	-
Kath badam	*Terminalia catappa*	Widely used fruit	Food security	All over the country	-
Kothbel	*Feronia limonia*	Widely used fruit	Food security	All over the country	-
Kul	*Zizyphus jujube*	Widely used fruit	Food security	All over the country	-
Latkan	*Bixa orellana*	Widely used fruit	Food security	All over the country	
Lemon	*Citrus limon*	Widely used fruit	Foodsecurity/ medicinal	All over the country, especially in SylhetDivision	-
Lime	*Citrus aurantifolia*	Widely used fruit	Food security/ medicinal	All over the country, especially in SylhetDivision	-
Mandarin	*Citrus reticulata*	Widely used fruit	Food security	All over the country, especially in SylhetDivision	-

Crop	Scientific Name	Uses/Products	Relative importance	Regional difference in importance	Progress achieved
Nona	*Annona reticulata*	Widely used fruit	Food security	All over the country	-
Pomegranate	*Punica granatum*	Widely used fruit	Food security	All over the country	-
Pommelo	*Citrus grandis*	Widely used fruit	Food security	All over the country	
Rose apple(Golapjam)	*Syzygium jambos*	Widely used fruit	Food security	All over the country	-
Safeda	*Achras sapota*	Widely used fruit	Food security	All over the country	-
Sweet orange(Malta)	*Citrus sinensis*	Widely used fruit	Food security	All over the country	-
Tamarind	*Tamarindus indica*	Widely used fruit	Food security	All over the country	-
Fibre crops					
Cotton	*Gossypium* spp.	Fibre	Economic	All over the country, especially in Hillyareas and northern districts	Two varietiesreleased (BARI)*and 12 varietiesreleased byCDB***
Mesta	*Hibiscus sabdariffa*	Leaf, calyx and bark	Vegetables,sauces jelly andfibre	High land and hilly areas of Bangladesh	-
Sun hemp	*Crotalaria juncea*	Fibre	Economic	All over the country	-
Sugar crops				All over the country	-
Date palm	*Phoenix sylvestris*	Widely used for 'gur'making	Food security	All over the country, especially southwestern districts	-
Palmyra palm	*Borassus flabellifer*	Widely used for gurmaking and fruits	Food security	All over the country	-
Narcotics					
Tobacco	*Nicotianatabacum,/ rustica*	Narcotic	Economic	All over the country, especially innorthern districts	One varietyreleased (BARI)*
Betel nut	*Areca catechu*	Narcotic	Economic	All over the country, especially insouthern districts	-
Green-manuring crops					
Sun hemp (Shunpat)	*Crotalaria juuncea*	Soil amelioration	Economic	All over the country, especially inmarginal land	-
Sesbania(Dhaincha)	*Sesbania canabina*	Soil amelioration	Economic	All over the country, especially inmarginal land	-

Modified after Mondal, M. H. 1990. Plant Genetic Resources Activities in Bangladesh. Proc. South Asia National Coordinators Meeting, March 21 - 24, 1990.
*Source: Characteristics of Crop Varieties Released by the National Seed Board (No.2), 1992.
**Source: AVRDC-USAID-BARI-BARC Project Consultancy Report 'Technology Transfer of Vegetable Crops in Bangladesh', 1999.
*** Source: Cotton Development Board.

In order to promote the development of commercialization of under-utilized crops and species, development of national programmes for under-utilized crops should be promoted, with especial emphasis on their identification for large-scale consumption/industrial use, through market development. Improving the seed supply system and processing/ storage of under-utilized crops and species need to be given attention to. Regional / international programmes should be undertaken for development and commercialization of under-utilized crops and species. Such regional/international programmes would help promote national activities on under-utilized crops. IARCs like ACU, ICU, AVRDC, and ICRISAT may take initiatives in developing regional/ international programmes. Incentives to researchers, producers, processors should be created. Marketing of under-utilized crops/species needs to be promoted at the same time.

7.5 GPA Activity Area 13: Supporting Seed Production and Distribution

The Agricultural Research Institutes (ARIs) supply the breeder seed while the Bangladesh Agricultural Development Corporation (BADC) is responsible for production and distribution of foundation and certified seeds (in the public sector). However, currently the private sector is playing a significant role in seed production and distribution. But quality of such seeds is not always up to the mark. One private company, East West Seed (Bangladesh), has nonetheless established itself as quality seed supplier for vegetable crops. Similar initiatives should be supported.

The agency responsible for variety registration is the Seed Wing of the Ministry of Agriculture with assistance from the National Seed Board (NSB). The ARIs, Department of Agricultural Extension and the Seed Certification Agency, and NGO, private entrepreneurs and farmers' representatives are the members of NSB. For seed-quality standards, the ISTA rules are generally followed along with nationally defined rules (e.g. rules for notified crops – rice, wheat, jute, sugarcane and potato).

The Constraints in making seed of new varieties available in the market are as follows:

- Delay in the availability of basic/foundation seed through the public sector seed distribution system.
- Insufficient availability of commercial seeds.
- Inadequate / poor seed production, processing and storage facilities.
- Adulteration, inadequate availability and high cost of inputs for seed production.
- Low physical purity of seed.
- Poor germination.
- Long distances to seed supplier.
- Seed price is often too high compared to commodity price. This, however, does not seem to deter farmers in procuring quality seed with high cost, provided farmers are convinced of a good harvest.

Cultivated varieties

Cultivated varieties are numerous. However, a list of recommended varieties is available. The proportions of areas sown to modern crop varieties range from 20% for oilseed crops to 100% for maize, with the proportions of Boro and Aman rice about 80% and 65% respectively. In recent times, the use of modern varieties of vegetables appears to be increasing fast mainly through the private sector.

There is no regulatory framework in place for developing and expanding local seed systems for crops and crop varieties important to small-scale farmers and no realistic programme has so far been developed for quality seed production in the country (except the seeds of modern varieties produced by BADC), let alone local varieties and/or under-utilized crops. As such there is no incentive for seed production of local varieties / under-utilized crops.

Seed growers' organization

There is no legal barrier for organization of local seed growers' association, but no formal mechanism exists for developing seed growers' organization. However, with donor project support, two seed growers' associations of small-scale seed producers, the Bangladesh Golden Agri Seed Associates (BGASA) and the Bangladesh Seed Federation (BSF) have come into existence. The latter is yet to get a formal recognition of the Ministry of Commerce. BGASA is, however, thriving on its own. Apart from this, the Bangladesh Seed Growers, Dealers and Merchants Association (BSGDMA) exists but its activities are more oriented towards seed trading rather than seed growing.

Constraints in making seeds of new varieties include:

- Lack of awareness of the intrinsic value and importance of local varieties.
- Decreasing availability of seeds of local varieties.
- Lack of incentive for seed production of local varieties.
- Absence of market promotion efforts of local varieties.
- Absence of policy/regulatory framework and programmes for traditional/local varieties.
- Very low production and availability of quality seeds.
- Availability of quality seeds and planting materials to farmers is constrained by the poor seed distribution system.
- Local varieties are still grown in many parts of the country but there is no organized system for their seed supply.

The needs are:

- Awareness creation of the loss of traditional/ local varieties.
- Development of national programmes for purification, seed production and supply of traditional/local varieties.
- Creation of incentives for production of traditional/local varieties.
- Market promotion of traditional/local varieties.
- Promotion of Seed Growers' Association.
- Identification of crops/varieties that have large-scale consumption and industrial use potential.
- Regional/international programmes for seed production of traditional varieties should be undertaken
- Contingency stock of seeds of traditional varieties by the public sector to meet demands in emergencies (e.g. crop failures following floods or droughts, disease epidemics, etc) should be developed.

Opportunities that exist for promoting local traditional varieties are:

- A significant percentage of crops grown belong to traditional/local varieties.
- Some seed growers that produce local popular varieties are coming up in the private sector.
- Some seed growers' association(s), with small-scale seed enterprises at the local level, has of late come into existence (e.g. BGASA and Seed Federation) that deserve support.
- The private sector is now thriving with seed production of improved as well as traditional varieties.
- Tissue cultured materials for potato and banana are gaining popularity.
- Nursery owners are now investing in the production and supply of seeds and saplings.

7.6 GPA Activity Area 14: Developing New Markets for Local Varieties and "Diversity-Rich" Products

Numerous locally adapted traditional varieties of crop plants have been replaced by modern varieties. Consequently, informal exchange and formal commodity markets are dominated by fewer improved varieties and farmers are losing interest in maintaining genetically diverse traditional varieties and landraces. This trend can be slowed and even reversed by promoting the demand for genetically diverse traditional varieties and diversity-rich materials in the market place. This would need special efforts that would encourage farmers to maintain locally adapted diversity on-farm as 'living collections' of PGRFA. Regional / international programmes for traditional varieties/diversity rich materials involving IARCs would encourage stakeholders to undertake such programmes.

The market for modern varieties is well established and expanded. A limited number of new export markets have developed for traditional varieties (e.g. aromatic rice and vegetables) in recent times.

There does not appear to be any effort for developing value added processing of "diversity-rich" products for commercial purposes. No incentive is known to be given by any agency for value-added processing of "diversity-rich" products.

The constraints to increasing markets for local varieties and diversity rich products are:

- Lack of awareness about the intrinsic value of local varieties and diversity rich products
- Lack of value addition and processing facilities
- Problems in seed production and distribution of local varieties and 'diversity-rich' products
- Lack of communications and transport facilities in marketing
- Low yield of local / traditional varieties
- Lack of incentives for local varieties and "diversity-rich" products in the country
- Insufficient seed or planting material
- Emphasis on modern cultivars of staple crops
- Development / establishment of markets for local variety is not yet a national priority
- Industrial processing limitations for diversity rich products.

The needs are:

- A national programme should be undertaken for value addition, processing and creating awareness about nutritional value of 'diversity-rich' products and for export in overseas markets.
- The distribution points of seeds should be within the reach of seed dealers for quick availability of seeds.
- Farmwomen need training in modern methods of post harvest processing, preservation and storage of seeds.
- Enhancement of productivity of indigenous varieties that are disease resistant, flood-drought-salinity tolerant and capable of being grown 'organically'.
- Training of farmers and farmwomen in modern methods of cultivation.
- Extension approach should include small and marginal farmers.
- Studies to be undertaken for developing new markets for local varieties / 'diversity-rich' products.
- Policy and legal framework towards promoting cultivation of local varieties, 'diversity-rich' products should be developed and implemented.
- Research on gossypol free cotton seed products should be encouraged.
- Rural based small industries of diversity-rich products should be promoted.
- The trend of replacing traditional varieties by modern varieties needs to be reversed (through enhancement of productivity of indigenous varieties that are disease and pest resistant, flood-drought-salinity tolerant and capable of growing organically).

- Developing new markets for local varieties and diversity-rich products should be given importance.
- Manpower in value added processing of diversity rich products should strengthened through training.
- Strengthening laboratory facilities for research on traditional and 'diversity- rich' products
- Characterization and evaluation of local varieties.

Priorities for developing new markets for local varieties and diversity rich products are:

- A national programme for value addition and processing of traditional varieties.
- Creating awareness on nutritional value of diversity rich products.
- Exploring overseas markets for local varieties and 'diversity-rich' products.
- Decentralization of the seed production and distribution system.
- Extension approach should include small and marginal farmers also.
- Training of farmers and farmwomen in modern methods of cultivation.
- Training of farmwomen in modern methods of post harvest processing, preservation and storage of seeds.
- Enhancement of productivity of indigenous varieties that are disease resistant, flood-drought-salinity tolerant, capable of being growing 'organically'.
- Policy and legal framework towards promoting cultivation of local varieties vis-à-vis 'diversity-rich' products should be developed and implemented.
- Studies to be undertaken for developing new markets for local varieties / 'diversity-rich' products
- Market for local varieties should be promoted and incentive system for production of local varieties and
- 'diversity- rich' products should be introduced.
- The seed supply system for traditional varieties should be improved.
- Work on identification of economic potentials of local varieties and diversity 'rich-products should be geared up.

In addition, R&D activities on post harvest processing, preservation and storage technologies suitable for rural areas/ households should be emphasized. Nutritional awareness on diversified products should be created. Organic farming should be promoted. Packaging of products and marketing channels should be developed for local varieties and 'diversity-rich' products.

CHAPTER 8

THE STATE OF NATIONAL PROGRAMMES AND TRAINING NEEDS

8.1 GPA Activity Area 15: Building Strong National Programmes

Bangladesh was the first in South Asia to establish the National Committee on Plant Genetic Resources (NCPGR) soon after the FAO's Fourth Technical Conference on PGR held in Leipzig, Germany in 1996. The Committee, among other things, mobilized the national network on PGR and prepared draft Acts related to PGR in 1998. The Committee has since become dormant and so have the activities related to policy planning and development of strategies for PGR. It is important to revitalise the NCPGR in order to bring in a new momentum of PGR activities in the country.

National programmes for the conservation and sustainable use of PGRFA

- With the assistance of IPGRI, the NCPGR in collaboration with the Bangladesh Agricultural Research Council organized a National Workshop on PGR in 1997. The workshop recommendations included, inter alia, the development of national policy framework/legislation in pursuance of the principles of CBD.
- Based on this recommendation, the NCPGR drafted two complementary Acts related to PGR:
  - Biodiversity and Community Knowledge Protection ACT of Bangladesh; and
  - Plant Variety and Farmers' Rights Act of Bangladesh

  These are under active consideration of thegovernment.

Meanwhile, two documents:

- a report on Plant Genetic Resources of Bangladesh (by Bangladesh Agricultural Research Council/ Bangladesh Academy of Agriculture, 2001);
- a Red Data Book of Vascular Plants of Bangladesh (by Bangladesh National Herbarium, 2001) has been published, based on survey of literature, studies on herbarium specimens, other local herbaria as well as field work.

Legal framework regulating establishment of the national strategy of PGRFA

The proposed Biodiversity and Community Knowledge Protection Act aims:

- To ensure the conservation and sustainable use biological resources and related knowledge, culture and practice and to maintain and improve their diversity.
- To protect biological resources and related knowledge, culture and practice from destruction, erosion and pollution.
- To protect and support the rights, knowledge, innovations and practices of local and indigenous communities and national scientific and research institutions with respect to conservation, use and management of biological resources.
- To provide an appropriate system of access to biological resources and related knowledge based on prior informed consent of the state and of the concerned local or indigenous communities.
- To promote appropriate mechanism of a fair and equitable sharing of benefits arising from the use biological resources and related knowledge and technologies.
- To ensure participation and agreement of concerned communities in making decisions regarding the distribution of benefits which may be derived from the use of biological resources.
- To promote and encourage the building of national scientific and technological capacity relevant to conservation and sustainable utilization of biological resources.
- To promote new innovations and discoveries to reproduce, manage and enhance biodiversity.

- To ensure that the transfer and movement of biological resources and the knowledge of the community takes place in a transparent manner.
- To protect biological and ecological environment of the country from all pollution, particularly from potential hazards of biological pollution caused by genetic engineering technology and the release of genetically modified organism in the environment.

The salient features of the proposed Plant Variety and Farmer's Rights Act

- The Plant Variety and Farmer's Rights Protection Act will be governed by Plant Variety Protection Authority. The Authority shall grant Plant Variety Protection Certificates, providing the plant breeder's rights, and de-register such varieties as and when needed.
- There shall be a permanent Register of Protected Plant Varieties which will be available for consultation and check by anyone interested, except for certain materials for which breeders have given some limits as justifiably approved by the Authority.
- The following Bangladeshi nationals, and/or a legal person, whose headquarters is situated in Bangladesh; National(s) or legal person(s) of a country allowing Bangladeshi nationals or legal persons having head offices in Bangladesh to apply for protection in that country;
- The Plant Variety Certificate shall be granted only where the variety is (a) New, (b) Distinct, (c) Uniform, (d) Stable, and (e) the subject of a denomination pursuant to the provision of this Act.
- The Authority shall receive applications for variety protection. For each application, the Authority will designate an examiner to test the application against the criteria of Section 8.
- The holder of the New Plant Variety Certificate shall have an exclusive right to exploit the protected variety commercially for the following purposes:
  - (i) production or reproduction (multiplication);
  - (ii) conditioning of the purpose of propagation;
  - (iii) offering for sale;
  - (iv) selling or otherwise marketing;
  - (v) exporting, importing, and
  - (vi) stocking for any of the purposes mentioned in (a) to (e), above.
- The Plant Variety and Farmers' Rights Protection Authority of Bangladesh shall restrict the use of the Breeder's Rights for reasons of public interest in the following cases:
  - (i) when the necessity arises for the prevention of human diseases, the preservation and conservation of the environment and biological diversity and for the maintenance of public welfare.
  - (ii) the prevention of misuse of trade monopoly.
- The Authority shall declare a Breeder's Rights null and void when it is established
  - (i) that the variety was not new or distinct at the issuing of the New Plant Variety Certificate, or
  - (ii) that the certificate has been granted to a person who is not entitled to it, unless it is transferred to the person who is so entitled.
- The Authority shall cancel a Breeder's Rights when it is established that the variety is no longer uniform and stable.
- The period of protection shall be:
  - (i) 25 years for fruit trees, other tree species and vines of perennial habit;
  - (ii) 20 years for all other plant species.
- The Plant Variety and Farmers' Rights Protection Authority shall protect and promote Farmers' Rights, which will constitute the following:
  - (i) The rights of farmers and their communities to protect their traditional knowledge relevant to plant genetic resources for food and agriculture.
  - (ii) The right to equitably participate in the sharing of benefits arising from the utilisation of plant genetic resources.
  - (iii) The right to participate in making decisions on matters related to the conservation and sustainable use of plant genetic resources.
  - (iv) The right of farmers to seek cancellation and/or retribution, as the case may be, for appropriation by formal sector breeders of denominations traditionally in use for their varieties.
  - (v) The right that farmers have to grow, save, use, exchange, and sell farm-saved seed of any variety except selling of seed of a protected variety for the purpose of reproduction under commercial marketing

arrangements.
(vi) The right to have access to all information relevant to the exercise of their rights with respect to plant varieties.

- A Citation of Recognition can be awarded by the Authority in the form of a certificate to encourage and recognise the contribution of individuals, communities, or agencies in the development of a New Plant Variety.
- The Authority shall constitute a "Gene Fund"

International agreements

Bangladesh has signed / ratified the following international agreement:

- The Convention of Biological Diversity (CBD)
- TRIPS Agreement
- Cartagena Protocol
- International Treaty on Plant Genetic Resources for Food and Agriculture

Constraints in national programme building

Constraints in building a strong national programme include the following:

- Inadequate follow up activities of international agreements.
- Lack of clear organizational responsibilities to follow up international agreements.
- Weak national coordination on matters related to PGR.
- Focal points are not always clearly identified with clear responsibilities and accountability.
- Inadequacy of fund for PGRFA.

Needs

The priority needs for building the national programme in PGRFA are:

- Establishment of a national coordination body (such as the dormant NCPGR) to follow up international agreements vis-à-vis all other activities related to PGR.
- Clear identification of focal points with defined responsibilities and accountability.
- Adequate fund allocation to PGR activities.

8.2 GPA Activity Area 16: Promoting Networks for PGRFA

Establishing network(s) of organizations within the country as well as setting national, regional and global priorities in germplasm conservation, genetic enhancement and enrichment are all critical for the progress in PGR activities. Unfortunately, the awareness within Bangladesh on matters related to PGRFA is still very low.

This also has had an impact on the active participation of the country in regional and international networks.

The country has benefited through different PGRFA networks. These can be summarized as follows:

- Increased stakeholder participation in PGR activities
- Sharing of responsibilities of network activities
- Training for national programme scientists
- Increased awareness of PGRFA

Major constraints to effective participation of the country in regional and/or international PGRFA networks were:

- Material flow is not uniform.
- Dearth of trained manpower.
- Limited visits of scientists within participating countries.

Programmes/projects/activities carried out by different stakeholder organizations in collaboration with PGRFA network

- BARI-AVRDC collection of germplasm, conservation and utilization of indigenous vegetables.
- Collection of breeding lines from CIMMYT
- Collaboration with ICRISAT
- Collaboration through Rice-Wheat Consortium
- Characterization and evaluation of Jute, Kenaf and Mesta in collaboration with IJSG
- Exchange of sugarcane varieties, human resource development and development of sugarcane database software

(Cane Point) through Common Fund for Commodity / International Sugar Organization (ISO)
- Coconut Germplasm Collection and Training through Coconut Genetic Resources Network (COGENT)
- Banana Germplasm Collection, Conservation and Training through International Network for Banana and Plantain (INIBAP)
- International Germplasm Trials through Collaboration with International Network for Genetic Evaluation for Rice (INGER)
- Collection, Conservation and Training through Safeguarding of Biodiversity of Rice Genepool – SDC/IRRI/BRRI
- Germplasm Evaluation of Hybrid Maize through Tropical Asia Maize Network (TAMNET)
- Development of Conservation Facilities of Germplasm through Japan International Cooperation Agency (JICA)
- Germplasm Exchange and Evaluation of Vegetables through South Asia Vegetable Research Network (SAVERNET)
- Collection, Characterization, Documentation and Evaluation of Jute, Kenaf and Mesta in collaboration with International Jute Study Group (IJSG) – Bioversity
- Collection of Germplasm and Training for Potato and Sweet Potato (CIP)
- Collaboration in Rice Research through International Rice Research Institute (IRRI-BRRI Collaboration)
- Triticale Based Fodder/Feed Development through Collaboration between Bangladesh Livestock Research Institute (BLRI) and International Maize and Wheat Improvement Centre (CIMMYT)
- Germplasm Collection, Exchange and Training on Molecular Characterization of Lentil and Barley through Collaboration between Bangladesh Agricultural Research Institute and International Centre for Agricultural Research in Dry Areas (ICARDA).

Stakeholder organizations feel that the linkage between research organizations working in the field of PGRFA, within and outside the country, should be further strengthened. The South Asian Network for PGRFA under South Asian Regional Cooperation (SAARC) may be created and Bioversity and FAO may play an important role in such a network.

8.3 GPA Activity Area 17: Constructing Comprehensive Information Systems for PGRFA

Stakeholder organizations are reasonably equipped with computer facilities which may be strengthened to facilitate the information systems for PGRFA. Data management and information systems in different stakeholder organizations need to be standardized and harmonized. Up till now, the stakeholder organizations have not consulted International PGR Information Systems.

Needs for constructing a comprehensive information system for PGRFA are:
- Awareness creation
- Staff training
- Appropriate software
- Financial support
- Development of facilities including high speed internet connectivity

8.4 GPA Activity Area 18: Developing Monitoring and Early Warning System for PGRFA

There are a number of recognizable threats of genetic erosion and genetic vulnerability mentioned below:
- The number of crop varieties in farmers' fields has reduced drastically since the introduction of green revolution technologies.
- An estimated 73 000 hectares of forest has been lost through encroachment for aquaculture and agriculture
- during 1970s and 1980s. About 8 000 hectares of forest are lost annually to homestead establishment, urbanisation and deforestation. With these disappeared and/or are threatened numerous plant genetic resources for food and agriculture, both in use currently and with potential use in the future.
- The first volume of the Red Data Book published in 2001 identified 106 species of vascular plants that are threatened at various degrees and many of these are no longer traceable in the country.

Apparently, the losses of genetic materials have not been reported to the FAO Global System on PGRFA authorities in any formal way. This probably owes to the fact that there is no clear institutional responsibility for Monitoring and Early Warning System on PGR.

There is no formal mechanism in the country for assessing genetic erosion. The only exception, however, is the publication of the first volume of the Red Data Book in 2001 by the Bangladesh National Herbarium. The need for assessing genetic erosion is strongly felt in the country.

Constraints to monitoring genetic erosion

The major constraints the country faces in monitoring genetic erosion are:

- Lack of a coherent national programme
- Dearth of skilled personnel
- Inadequacy of financial resources
- Lack of clear institutional responsibilities

The status of participation of stakeholder organizations in projects relating to assessment of magnitude and rate of genetic erosion is indeed poor.

Needs

- Development of an early warning system
- Manpower development
- Supporting planned and targeted collection
- Surveying, inventorying and collection of local and wild germplasm
- Monitoring of PGR erosion
- Infrastructure development

8.5 GPA Activity Area 19: Expanding and Improving Education and Training on PGR

Course curricula to address PGR issues, in general, are weak in the education system of the country. There are no courses/ programmes worth the name on population biology, ecology, ethno botany, *in situ* management, etc. in the universities. Experts on Taxonomy have become increasingly scarce. However, training courses covering the 20 GPA priority areas have been imparted to the staff of stakeholder organizations.

The satkeholder organizations consider further training on the following issues as important:

- Molecular characterization of germplasm
- Cryo-preservation of germplasm
- Germplasm documentation
- Geographical information system
- Statistical analysis
- Regeneration of species conserved *ex situ*
- Developing monitoring and early warning system for loss of PGRFA
- *In situ* and *ex situ* conservation including core collection and methodologies for *in situ* conservation
- Marker aided characterization
- Management of Genebank
- Information technology (IT) systems for PGR with special reference to information sharing mechanism on implementation of GPA for conservation and sustainable utilization of PGRFA.

The national strategy for education and training on PGRFA should be developed with a sense of urgency. The Greatest obstacles to training in PGRFA in the country include: (a) lack of awareness of the training needs within the country and (b) paucity of resource materials to improve existing training programmes.

8.6 Activity Area 20: Promoting Public Awareness of the Value of PGRFA Conservation and Use

Bangladesh is a country with rapid and large-scale genetic erosion. Yet, hardly any public awareness programme on PGRFA has been undertaken except some sporadic television clips and that is confined mainly to tree species. There is no regional or international organization yet that provide the country with support for public awareness activities on PGRFA.

Constraints in promoting public awareness of the value of PGRFA conservation and use include:

- Lack of effort for public awareness of the importance of PGRFA
- Staffs do not have sufficient skill and knowledge
- It is not clear which organizations is responsible for promoting public awareness of PGRFA
- No National strategy for education and training on PGRFA
- Inadequate support for PGRFA conservation and use
- Increasing density of population warrants producing more crops from less area and makes *in situ* conservation difficult

Therefore, the needs are:

- Training, publication and telecasting on PGRFA
- Audio-visual presentation, communications and consultations to promote public awareness on PGRFA
- Setting national priorities in relation to PGRFA
- Clear identification of an organization responsible for PGRFA conservation, use and awareness building
- Financial and technical support
- Institution and capacity building for conservation and use of PGRFA
- Public awareness building
- Education and training on PGRFA conservation and use and development of concerned course curricula
- Technical assistance from regional and international, organizations
- Financial support from regional and international organization for conservation, use and awareness building
- Support, especially for *in situ* conservation
- Awareness building on conservation and use of PGRFA for scientists, plant breeders and farmers should be promoted
- Training facilities and infrastructure development
- External support needed for capacity building in increasing public awareness.

CHAPTER 9

PRIORITY ACTIVITY AREAS FOR BANGLADESH

9.1 National Centre for PGRFA

Establishment of a National Genebank for conservation, use and enhancement of biodiversity with appropriate infrastructure for conservation of orthodox and recalcitrant seeds, vegetatively propagated materials, including facilities for a Cryo bank and a DNA bank.

9.2 Assessment of PGR

An assessment of genetic diversity, the rate and extent of PGR erosion and prioritization of PGRFA activities.

9.3 Development of national framework for PGRFA

The national framework or PGRFA needs to be formulated. The framework, among other things, should include the following:

- a *sui generis* system of plant variety protection
- access to and exchange of plant genetic resources
- recognition of farming communities, their conservation and use of PGR, and their indigenous knowledge (Farmers' Rights) and benefit sharing
- adopting means to curb biopiracy
- arrest genetic erosion and threat to conservation of biodiversity
- protection of habitats rich in native diversity
- biosafety regulation, and
- seed policies and other such concerns.
- *In situ* and *ex situ* conservation including long term seed bank, *in vitro* bank, field repositories for tree species, root and rhizome crops, National Herbarium for cultivated plants.
- Cryo preservation of germplasm.
- Documentation of germplasm.
- Geographical information system.

9.4 Coordination

- A strong coordination among different stakeholders involving research, the public and the private sector, NGOs, farmers organizations, etc. should be strengthened. Bangladesh Agricultural Research Council should lead the activities related to PGRFA for strengthening national programmes and international collaboration.

9.5 Capacity building

- Human resources development and capacity building in PGR in various fields that needs to be prioritized both for professional staff and technicians. (FAO and Bioversity can be of assistance)

9.6 PGR plan of activities

- Development perspective plan: vision 2025
- A national plan: a) to priorities PGR activities in germplasm collection, characterization, evaluation, documentation and conservation, (b) to prepare inventories of such resources for their better utilization; and (c) to develop a national database (including a sharing mechanism with NISM-GPA database).
- Strengthening and integration of national PGR network including field genebanks.
- Strengthening of national varietal improvement programmes and an integration of such programmes with PGR activities.
- Biochemical and molecular characterization of germplasm and its facility development. (FAO may provide technical l/ financial assistance in the above activities).

9.7 Awareness building

- To promote dissemination of information and national concern on biodiversity conservation through increased public awareness (including introduction of course curricula in PGR/biodiversity in educational institutions at different levels), with participation of farming communities, NGOs and other partners.

9.8 Regulatory issues

- Development of a well structured national plant quarantine system/policy for import and export of materials (seeds, plant propagules, *in vitro* cultures, genetic finger-printing, strengthening of short-and medium-term storage facilities at existing genebanks at other institutes will be required.
- Drafting of policy and legal document (e.g. MTA, policy on PGR, Biodiversity Act, Plant Variety and Farmers' Rights Protection Act, Development of conceptual paper etc.).

9.9 Training and Monitoring

- Methodologies of *in situ* conservation and on-farm management.
- Regeneration of species conserved *ex situ*.
- Developing monitoring and early warning system for PGRFA.
- Marker aided characterization.
- Information Technology system (data base management) with special reference to information sharing on conservation and sustainable utilization of PGR.
- Management of gene bank.
- Negotiating skill development.
- Back-up research on conservation regime and protocols.
- Eco-tourism activities to be promoted.

9.10 Cross-cutting issues

- A strategic plan should be developed to expand scientific and technical education programmes, while promoting collaboration between government research institutes, academia and domestic and foreign entities.
- PGR activities should address entrepreurship development, project management, and marketing skills as well as scientific and technical training.

APPENDIX 1

CROP PLANTS OF BANGLADESH AND THEIR WILD CULTIVATED RELATIVES

Family	Crops and allied species		
	Common name	Scientific name	Local name
Agavaceae	Sisal	*Agave anguistifolia*	Agave
	-	*A.cantula* (Roxb.) *(Agave americana L)*	Cantala, Belatipat, Konga, Belatianaras,Bakaspata, Ghaial
	Bow-string Hemp	*Sensiviera hyacinthoides* (L.) Druce *(S. zeylinica* (L) Willd.*)*	Murba, Sutahara, Sutimukhi
Amaranthaceae	Amaranth	*Amaranthus gangeticus* L.	Lalshak, Denga, Data
	-	*Amaranthus lividus* Roxb.	Kanta notey, Gobura notey
	-	*A. polygamus L*	Champa notey, Lamchamia notey,Swetmugra
	-	*A. spinosus L*	Kanta notey, Kantamiris
	-	*A. tenuifolius* L.	Genti notey, Delechukali
	-	*A. viridus* L. *var fasciata*	Bon notey, Tuntuni noteyAam
Anacardiaceae	Mango	*Mangifera indica* L.	
	-	*Mangifera longipes* Griff.	Jangli aam, Uri aam
	-	*M. sylvatica* Roxb.	Jangli aam, Lakhi aam, Uri aam
	Cashewnut	*Anacardium occidentale* L.	Kaju, Kaju badam, Hujli badam
Annonaceae	-	*Anona reticulata* L.	Nona, Nona ata, Ram phal
	-	*A. squamosa* L.	Ata, Sharifa, Sita ata, Luna
Aquifoliaceae	Paraguay tea	*Ilex godejam* L.	Jangli gewa
Araceae	Taro	*Alocasia indica* (Roxb.) Schott.	Man kachu,
	-	*Colocasia esculanta (L)* Schott.	Mukaddam kachu
	-	*Colocasia antiquorum* Schott.	Mukhi kachu, Shilkeli kachu, Bahumukhikachu
	-	*Colocasia nymphaefolia* Kunth	Jangli kachu, Sar Kachu, Kali kachu
Asteraceae	Safflower	*Carthamus tonctorius* L.	Kusum phul, Kajira
	Chrysen-themum	*Chrysenthemum coronarium* L.	Chandra mallika, Gulchini, Guldani
	Niger seed	*Guizotia abysinica* Cass.	Kali til, Ram til, Guji, Surgoza
	Chicory	*Cichorium intybus* L.	Kashni, Hinduba
	Lettuce	*Lettuca sativa* L.	Lettuce
	Sunfower	*Helianthus annuus* L.	Surjamukhi
Averrhoaceae	Starfruit	*Averrhoa carambola* L.	Kamranga
Basellaceae	Indian spinach	*Basella alba* L. *(B. rubra* L.*)*	Puishak
Bombacaceae	Kapok	*Ceiba pentandra (L.)* Gaertn.	Shimul, Swet shimul, Kapok
Bromelliaceae	Pineapple	*Ananus sativus Schult. f. (A. cosmos (L.)* Merr.*)*	Anaras

Family	Crops and allied species		
	Common name	Scientific name	Local name
Camelliaceae	Tea	*Camellia sinensis* (L.) Kuntz. var. *assamica*	Assam tea
	-	*C. sinensis* (L.) Kuntz. var. *sinensis*	China tea
	-	*C. sinensis* (L.) Kuntz. var. *camboidiensis*	Combodian tea
	-	*C. caudata*	
	-	*C. japonica*	
	-	*C. kissi*	
	-	*C. irrawardiensis*	
	-	*C. sesanquc*	
	-	*Thea wallichi*	
Cannaceae	Indian shoti	*Canna indica* L.	Sarbajaya
Caricaceae	Papaya	*Carica papaya* L.	Pepe
Chenopodiaceae	Beet	*Beta vulgaris* L.	Beet
	Spinach	*Spinacea oleracea* L.	Beet palong
	-	*Chenopodium album* L.	Betoshak, Betuashak
	-	*C. ambroides* L.	Chandan beto
Convolvulaceae	Sweet potato	*Ipomea batatus* Lamk.	Misti alu
	-	*Ipmea alba* L.(*I. bonanox* L.)	Halkalmi, Didh kalmi
	-	*I. aquatica Forsk.* (*I. reptans* Poir.)	Kalmishak, Kalmi
	-	*I. pescaprae* (L.) *R.Br.* (*I. biloba* Forsk.)	Chhagalkhuri, Dupatilata
	-	*I. cairica* (L.) Sweet	Rail lata
Convolvulaceae (contd.)	-	*I. fistulosa* Mart. ex Choisy (*I. crassicaulis* (Benth) Roxb.	Dholkalmi, Darukalmi
	-	*I. hederaceae* Jacq. (*I. nil*)	Nilkalmi
	-	*I. indica (Burm. f.)* Merr (*I. learil Lam*)	Pravatrani
	-	*I. mauritania* Jacq. (*I. paniculata* (L.) *Br.*)	Bhuikumra, Muralia lata
	-	*I. maxima* (L. *f.*) Don (*I. sepiaria* Koen. *ex.* Roxb.)	Bonkalmi
	-	*I. pestigridis* L.	Languli lata
	-	*I. quamclit* L.(*Quamclit pinnata Boj.*)	Taru lata, Kunja lata
	-	*I. turpethum* (L.) *R. Br.*	Noa pata, Tori, Cheuri
	-	*I. vitifolia Bl.*	Karma lata, Kam lata
Crucifereae	Mustard	*Brassica campestris* L.var. *sarsoon Prain*	Sharisha
	-	*Brassica campestris* L. var. *toria* Duthie & Fuller	Tori sharisha
	White mustard	*B. alba* Hook	Sada sharisha, Dhup rai
	-	*B. integrifolia* (West.) Schultz. (*B. juncea* var. *agrostis Prain*)	Keel rai
	Brown mustard	*B. juncea* L.	Rai sharisha, Bara rai, Jhuni, Chanchi
	Rape-seed	*B. napus* L.	Maghi Tori, Sharisha
	Black mustard	*B. nigra* L.	Kalo sharisha
	Cauliflower	*B. oleracea* L. var. *botrydis*	Phulkopi
	Brocoli	*B. oleracea* L. var. *italica*	Brocoli
	Cabbage	*B. oleracea* L. var. *capitata*	Bandhakopi
	Knolkhol	*B. oleracea* L. var. *gangyloides*	Olkopi
	-	*B. rapa* L.	Shalgam
	-	*Brassica rugusa Prain.* var. *cunefolia*	Lahisag
	Garden cress	*Lepidium sativum* L.	Halimshak
	Radish	*Raphanus sativus* L.	Mula

Family	Crops and allied species		
	Common name	Scientific name	Local name
Cucurbitaceae	Wax Gourd	*Benincosa hispida (Thumb.)* Cogn. *(B. cerifera Savi.)*	Chalkumra
	-	*Citrullus colicynthis* (L.) Schrad.	Makal, Indrayan
	-	*Coccinia indica* L.	Telakucha
	Melon	*Cucumis melo* L.	Bangi, Kakri, Kharbuj, Khermia
	Cucumber	*Cucumis sativus* L.	Shasha, Khira, Mome
	Sweet Gourd	*Cucurbita maxima* Duch.	Misti Kumra, Kumra
	Squash	*Cucurbita pepo D.C.*	Dhada kadu
	Watermelon	*Citrallus lanatus (Thumb.)* Mans *(C. vulgaris* Schrad.*)*	Tarmuj
	-	*Hodgsonia macrocarpa* (Bl.*)* Cogn. *(H. heteroclita* Gk. f.*)*	Makal
	Bottle Gourd	*Lagenaria siceraria (Mol.)* Stan. *(*L. *vulgaris* Ser.*)*	Lau, Kadu, Pani lau
	-	*Luffa achinata* Roxb.	Bidal, Ghosa lata
	-	*Luffa amara* Roxb.	Tita Dhundul
	Ribbed Gourd	*Luffa acutangula* Roxb.	Jhinga, Ghosa lata
	Sponge Gourd	*Luffa cylindrica* (L.*)* Roem *(*L. *aegytiaca* Mill.*)*	Dhundul, Purul
	Bitter Gourd	*Momordica charantia* L.	Korola, Kerala, Uchhe
	Teasle Gourd	*Momordica cochichinensis Spreng.*	Kakrol
Cucurbitaceae	Teasle Gourd	*Momordica dioica* Roxb.	Kakrol
	Snake Gourd	*Trichsanthes anguina* L.	Chichinga
	-	*Trichosynthes bracteata* (Lam.*)* Vogt.	Makal
	-	*T. cordata* Roxb.	Bhui kakra
	-	*T. cucumerina* L.	Bon patol
	Pointed Gourd	*T. dioca* Roxb.	Patol
	-	*T. lobata* Roxb.	Bon chchinga
	-	*T. palmata* Roxb.	Makal
Dioscoreaceae	Yam	*D. alata* L.	Mete alu, Kham alu, Chupri alu
	Yam	*D. belophyla (Prain.)* Haines	Shora alu
	Aerial Yam	*D. bulbifera* L. *(D. sativa* Thunb.*)*	Roth alu
	Lesser Yam	*D. esculanta* (Lour.*)* Burk. *(D. aculeata* L.*)*	Sushni alu, Mou alu
	-	*D. pentaphylla* L.	Jhum alu, Jhunihana Alu
	-	D. wallichi Hook. *(D. aculeata* (Lour.*)* Burk	Goantia alu
Euphorbiaceae	Tung	*Aleurites molluccana* Willd.	Akhrot, Japhal akhrot
	Cassava	*Manihot esculanta* Crantz. *(M. ultissima* Pohl.*)*	Shimulalu, Kassava, Tapoica
	Castor	*Ricinus communis* L.	Bherenda, Reri, Venna

Family	Crops and allied species		
	Common name	Scientific name	Local name
Gramineae	-	*Coix gigantica* Roxb.	Denga gurgur
	-	*C. lachryma-jobi* L.	Tasbi, Kalo kunch, Gurgur
	-	*Echinocola colonum (L.) Link*	Shyama ghas
	-	*E. crussgalli (L.)* P. Beauv.	Bara shyama ghas
	-	*E. stagnina (*Retz.*)* P. Beauv.	Dul, Parua
	-	*Eleusine coracana (L.) Gaertn.*	Marna, Marua
	-	*E. indica (L).* Gaertn.	Malanga kuri, Mala kuri
	Teff	*Eragrostis tenella (L.)* P. Beauv	Koni
	Barley	*Hordeum vulgare* L. *Pennisetum typhoides (*Burm.*)* Stapf.*(P. typhoidum* Rich.*)*	Jab
	Rice	*Oryza sativa L*	Dhan
	-	*O. minuta*	Buno dhan
	-	*O. nivara*	Buno dhan
	-	*O. officinalis*	Buno dhan
	-	*O. rufipogon (*Griff.*) (O. fatua* Koen. ex Trin.*)*	Buno dhan
	-	*Portersia coarctata (Oryza coarctata* Roxb.*)*	Buno dhan
	Rice	*Oryza hybrid swarms (rufipogon-nivera)*	-
	Pearl Millet	*Panicum milliaceum* L.	Cheena
	Bulrush Millet	*Pennisatun tyohoides (*Burm.*)* Stapf. *(P. typhoidum)*	Bajra
	Sugarcane	*S. officinarum* L.	Akh, Kushair, Kushail, Gandari
	Sugarcane allies	*Saccharum bengalense* Retz. *(S. munja* Roxb.*)*	Munja ghash
	-	*S. spontaneum* L.	Kash, Khagra, Kaisha, Khag
	-	*Sclerostachya fusca (*Roxb.*) Camus*	Khuri
	-	*Setaria glauca (*L.*)* P. Bauv. *(Panicum flavescens Sw.)*	Kauni, Banaspati ghash
	Foxtail Millet	*Setaria italica (*L.*)* P. Bauv.	Kaon, Kangu, Kangui, Kora,Kaknidana
	-	*S. pallide-fisca (Schum.)* Stapf	Pinginachi
	-	*S. verticillata (*L.*))* P. Bauv.	Dorabiari
	Sorghum	*Sorghum bicolor (S. vulgare* Pers.	Joar
	-	*S. halepense (*L.*)* Pers.	Kanta much
	Triticale	*Triticosecale*	Triticale
	Wheat	*Triticum aestivum* L. *(T. vulgare* L.*)*	Gom
	Maize	*Zea mays* L.	Bhutta
	Other grasses	*Cynodon dactylon* Pers.	Durba, Dubla, Durba ghas
	-	*Panicum paludosum* Roxb.	Barti, Barati, Kalam
	-	*P. punctatum Burm.*	Karing ghas
	-	*P. satigerum* Retz.	Bara jalgenti
	-	*Paspalidium flavidum (*Retz.*) A. camus (P. punctatum* Burm.*)*	Petinar
	Kodo Millet	*Paspalum scrobiculatum* Boj.	Goicha, Khoda dhan
Guttifereae	-	*Garcinia cowa* Roxb.	Kau, Kaglichu
	Mangosteen	*Garcinia mangostana* L.	Mangostin
	-	*G. morella Desr.*	Swarna Khiri
	-	*G. xanthochymus* Hook. f	Tamal, Dumbel

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	Common name	Scientific name	Local name
Lguminosae	Acacia	*Acacia auriculiformis A. Cunn. ex. Benth*	Akashmoni
	Kutch Tree	*A. catechu (Lam.)* Willd. *(A. arabica* Willd.*)*	Khair
	-	*A. catechuoides* Wall.	Khair
	-	*A. concinna D.C.*	Bonritha, Lal babul
	-	*A. farnesiana (*L.*)* Willd.	Gokul, Belatibabul
	-	*A. intsia* Willd.	Kuchai
	Black Babul	*A. nilotica (*L.*) Del. (A. arabica (*Lam.*)* Willd.*)*	Babla, Babul, Kikor
	-	*A. pennata (*L.*)* Willd.	Aila, Bisoal, Sembi
	-	*A. suma* Ham.	Swet Khoir, Sami, Sankanta, Laingach,Chaikanta, Saukanta
	-	*A. tomentosa* Willd.	Sisal babla
	Groundnut	*Arachis hypogeae* L.	Cheena badam
	Pigeon pea	*Cjanus cajan (*L.*)* Huth. *(C. indicus* Spreng.*)*	Arhar
	Chickpea	*Cocer arietineum* L.	Chhola. Chana, Boot
	Sunnhemp	*Crotalaria juncea* L.	Shonpat, Shon, Ghore shon
	-	*C. incana* L.	Chhota jhunjhuna
	-	*C. postrata* Roxb.	Chhota jhunjhuna
	-	*C. retusa* L.	Atasi, Bil jhunjhuna
	-	*C. saltiana Andr.*	Chhota jhunjhuna, Jhanjani
	-	*C. spectabilis Roth. (C.sericea* Retz.*)*	Pipli jhanjhani
	-	*C. verrucosa* L.	Jhanjhania
	Derries	*Deris elliptica* Benth.	Tubamul
	-	*D. indica (*Lamk.*)* Benth	Makrigilla
	-	*D. robusta* Benth.	Korol,Jangaria, Jumurja, Miringa, Jamurja
	-	*D. scandens* Benth.	Noalata, Kamirialata, Maora gota, Noshoth
	-	*D. trifolia* Lour. *(D. Uliginosa Benth.)*	Kalilata, Felialata,Panlata, Pan gota, Gilalata,Goali lata

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Lguminosae	Soybean	*Glycine max.* (L.) Merr. *(G. soja (L.)* Sweib. & Zuce*).*	Soyabean,Gari kalai
	-	*Indigofera linifolia* Retz.	Bhangara
	Indigo	*I. tinctoria* L.	Nil
	Lentil	*Lens culinaris Medik. (*L. *esculenta Moen.)*	Musur, Musuri dal
	-	*Medicago denticularia* Willd.	Moyna
	Yam Bean	*Pachyrrhizus erosus (*L.*)* Urban	Shak alu
	Bean	*Phaseolus aconitifolius* Jacq.	Bon moog, Gaheri, Birimoog
	-	*P. adenanthus* Mey	Bon barbati
	-	*P. lunatus* L.	Bon barbati
	-	*P. mungo* L.	Mashkalai
	-	*P. sublobatus* Roxb. *(Vigna sublobetus*	Ghoramoog
	-	*P. radiatus* L.	Sonamoog
	-	*P. trilobatus*	Rakhal kalai, Magani, Mugani
	French bean	*P. vulgaris (* L.*)* Schr.	Farasshbean, Bakla, Kalobasak
	-	*Pisum arvense* L.	Chhoto motor
	Pea	*Pisum sativum* L.	Motor, Motorshuti, Kabuli motor
	Winged bean	*Psophocarous tetragonolobus D.C.*	Rakhal sim, Kumari sim, Karat sim
	Tamarind	*Tamarindus indica* L.	Tetul, Amli
	Field bean	*Vicia faba* L.	Bara sim, Bakla sim
	-	*V. hirsuta* Coch.	Masur chana
	-	*V. sativa* L.	Ankari
	Blackgram	*Vigna mungo* (L.) Hepper *(Phaseolus mungo* L.*)*	Mashkalai, Tikha kalai
	-	*V. pilosa bak*	Jhikrai, Malkenia
	Mung	*V. radiata* (L.) Wilezck *(Phaseolus radiatus* L.*)*	Sona moog, Moog
	Yard Long Bean	*V. sinensis* Endl. Ex hassk. *(V. catjang* Walp. var. *sinensis* Prain*)*	Barbati, Lalsha
	Cowpea	*V. unguiculata* Endl. ex Hassk.	Barbati
Liliaceae	-	*Alium ampelopraseum* L.	Gandini
	Onion	*Allium cepa* L.	Piaz
	Garlic	*A. sativum* L.	Rasun
	-	*A. tuberssum* Roxb.	Banga gandini
	Asparagus	*Asparagus racemosus* L.	Shatamulu, Hilum
	-	*Urginia indica* Kunth	Jangli piaz
Linaceae	Fax/Linseed	*Linum usitatissimum* L.	Tishi, Chikna, Masina
Malvaceae	Okra/*Lady's Finger*	*Abelmoschus esculentus* (L.) *Moen. (Hibiscus esculentus* L.*)*	Dherosh, Bhindi
Malvaceae	Tree Cotton	*Gossypuim arboreum* var. *conansis* L.	Kapas, Karpas tula
	Comilla Cotton	*G. arboreum/herbaceum* L.	Tula
	Khaki cotton	*G. arboreum/herbaceum* L.	Khaki tula
	-	*Hibiscus abelmoschus* L.	Mushakdana, Kalo kasturi
	Kenaf	*H. cannabinus* L.	Kenaf, mesta pat, Bimli
	-	*H. ficulenus* L.	Jangli Bhindi, Jangli dherosh, Bon dherosh
	-	*H. hirtus* L.	Lal surjamukhi
	-	*H. macrophyllus* Roxb.	Kashipata, Kashia udal, Chania
	-	*H. manihot* L.	Gajasudhi, Dumbula, Paresh, Palas pipul, Paresh pipul

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Malvaceae	-	*H. mutabilis* L.	Sthalpadma
	China Rose	*H. rosa-sinensis* L.	Jaba, Jabaphul, Rakta jaba, Daru
	China rose	*H. schizapetalus* L.	Jhumko jaba, Latkan jaba
	Roselle	*H. sabdariffa* L. var. *altissima*	Mestapat, Kenaf, Mesta
	Roselle	*H. sabdariffa* L. var. *sabdariffa*	Chukair, Chukur
	-	*H. syriacus L*	Sada jaba, Nil jaba
	-	*H. tiliaceus* L.	Bolai, Bhola, Belapata, Chewla
	-	*H. vitifolius* L.	Bon kapas
Marantaceae	Arrowroot	*Maranta arundinacea* L.	Araroot, Takhur
Moraceae	Breadfruit	*Artoarpus altilis (*Park.*)* Fos.	Breadfruit
	Chaplash	*A. chaplasha* Roxb.	Chaplash, Chambal, Cham
	Jackfruit	*A. heterophyllus* Lamk. *(A. integrifolia* L. *f.)*	Kanthal
		A. lacucha Buch.-Ham. *(A. lakoocha Roxb.)*	Deua, Deophal, Dephal
	Ficus and allies	*Ficus altissima* Bl.	Bot, Prab
	Banyan Tree	*F. benghlensis* L. var. *krishnae (C. DC)* Corner *(F. krishnae C. DC)*	Krishna bot
	-	*F. comosa (F. benjamina* L. var. *comosa (*Roxb.*)* Kurz.	Pakur, Jir, Kamrup
	-	*F. carica* L.	Dumur
	-	*Ficus cunea* Buch.-Ham	Jagadumur, Sadimadi, Joyadumur
	-	*F. elastica* Roxb.	Bor, Atabor, Bharotio rubber
	-	*F. glaberrima* Bl.	Kakri
	-	*F. heterophylla* L. *f.* var. *heterophylla* L.	Ghati shaora, Baladumur, Bolalat
	-	*F. heterophylla* L. *f.* var. *repens*	Bhuidumur
	-	*F. hispida* L. *f.*	Kakdumur, Dumur, Thoska
	-	*F. hirta* Vahl.	Dangra, Khandadumur
	-	*F. lacor* Buch.-Ham. *(F. infectoria* Roxb.*)*	Pakur
	-	*F. lanceolata* Ham.	Butidumur, Erogachh
	-	*F. lepidosa* Wall.	Katgularia, Jir, Kamrup
	-	*F. microcarpa* L.f. *(F. retusa* Hook. f.*)*	Baltrella
	-	*F. recemosa* L. *(F. glomerata* Roxb.*; F. scandens Roxb.)*	Jagadumur, Gulangdumur
	Peepul Tree	*F. regiosa* L.	Asswath, Panbot, Pipal
	-	*F. rostrata* Lamk.	Paraboha
	-	*F. rumphii* Bl.	Hijuli, Gaya asswath
	-	*F. semicordata* Buch.-Ham ex Smith	Jagadumur, sadimadi
	Malberry	*Morus indica* L. *(M. alba* L.*)*	Tut, Tunt
Muaceae	Bananas	*Musa cordata* Roxb.	Ram kola,
	-	*M. paradisiaca* L. var. *paradisiaca*	Kachkola
	-	*M. paradisiaca* L. var. *sapientum*	Kola, kathalikola
	-	*M. sapientum* L.var. *sylvestris*	Aittakola, Aitekola
Myristicaceae	Nutmeg	*Myristica fragrans* Houtt	Jaiphal, Jayatri
	-	*M. longifolia* Wall.	Amboala
	-	*M. malabarica* Lamk.	Jayatri
Myrtaceae	Clove and allies	*Syzygium aqueum (*Burm. f*)* Alston *(Eugenia aquea* Burm. f.*)*	Jambo
	-	*Eugenia balsamea* Wt.var. *angustifolia*	Ekdarya
	-	*E. bracteata* Roxb.	Hijli menadi

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Myrtaceae	Clove	*E. caryophyllaceus* (Spreng.) *Bull.*	Labanga, Lang
	-	*Syzygium clavifoliun* (Roxb.) Wall *(Eugenia claviflora* Roxb.*)*	Nalijam, Lambanalijam
	-	*Syzygium syzygiodes* (Miq.) Merr. *(E. cymosa Ram.)*	Khoirjam
	-	*Syzygium formosanum* Hayata Mor. *(Eugenia. formosa* Wall.*)*	Panijam, Hanihak, Phulijam
	-	*Syzygium fruticosum* (Roxb.) *DC (Eugenia fruticosa* Roxb.*)*	Bonjam, Khudijam
	Indian Black Berry	*Syzygium cumini* (L.) Skeels *(Eugenia jambolana Lam.)*	Jam, Jamon, Kalojam
	-	*Syzygium grande* (Wt.) Wall. *(Eugenia grandis* Wt.*)*	Dhakijam
	Rose Apple	*Syzygium jambos* (L.) Alston *(Eugenia jambos* L.*)*	Golapjam
	-	*Syzygium malaccensis* (L.) Mer. & Perry *(Eugenia malaccensis* L.*)*	Amritaphal
	Wax Jambu	*Syzygium samarangense* (Bl.) Merr. & Perry *(Eugenia javanoca Lamk.)*	Jamrul
	-	*Eugenia lancaefolia* Roxb.	Parajam
	-	*E. macrocarpa* Roxb.	Chaltajam
	-	*Syzygium operculatum* (Roxb.) Niedz. *(E. operculata* Roxb.*)*	Botijam, Thengajam, Patiajam, Dhepajam
	-	*Syzygium wallichi* Wall. (Eugenia wallichi Wt.*)*	Kharkharajam
	Guava	*Psidium guajava* (L.) Bat. *(P.guayava* L.*)*	Payara, Sabri
Nymphaeaceae	Water Lily	*Nymphaeae nouchalli* Burm. f. *(N. lotus* Hook	Shapla, Raktabhanga, Kamol, Kumud. Kumudini, Shaluk, Sadashapla
	-	*Nymphaeae stellata* Willd.	Nilshapla, Nilpadma, Nilshaluk, Sundishaluk
	-	*Nelumbo nucifera* Gaertn. *(Nelumbium speciosum* Willd.*)*	Padma, Raktapadma, Jalapadma
Oxalidaceae	Oxalis	*Oxalis corniculata* L.	Amrul, Amboli, Chukatriphal
Palmeae	Betelnut	*Arecha catechu* L.	Supari, Gua
	-	*A. trindra* Roxb.	Bon gua, Bon supari
	Palmyra Palm	*Borassus flabellifer* L.	Tal
	Coconut	*Cocos nucifera* L.	Narikel, Dab
	Datepalm	*Phoenix sylvestris* (L.) Roxb.	Khajur, Khejur, Khagi Khejur
	-	*Ph. Paludosa* Roxb.	Hintal, Hital, Hantal
Pedaliaceae	Sesame	*Sesamum indicum* L. *(S. orientale* L.*)*	Til, Jangli til, Shanki til, Kalo til
Piperaceae	Piper	*Piper betel* L.	Pan, Tambuli
Piperaceae	-	*P. chaba* Hunter	Choi, Chab
	-	*P. cubeba* Vahl.	Kababchini
	-	*P. longum* L.	Peepul, Pipla
	Black Pepper	*P. nigrum* L.	Gol marich
	-	*P. peepuloides* Roxb.	Peepul
	-	*Peperomia pellucida* Kunth	Luchi pata
Polygonaceae	Buckwheat	*Faghopyrum esculentum* Moen.	Dhanchi
Puniaceae	Pomegranate	*Punica granatum* L.	Dalim, Anar
Rhamnaceae	Jujuba	*Zizyphus mauritania* Lamk.	Kul, Boroi
	-	*Z. oenoplea* (L.) Mill.	Bon boroi, Gram boroi, Got boroi
	-	*Z. rugusa* Lamk.	Anai, Jangli boroi

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Rosaceae	-	*Rosa centifolia* L.	Golap, Swetgolap,
	-	*Rosa damacena* Mill.	Golap, Knatagolap,
	-	*Rosa indica* L.	Knatagolap
	-	*Rosa involucrata* Roxb.	Bannyagolap, Bunogolap
	-	*Rubus hexagynus* Roxb.	Hira-charra, Hirachura
	-	*Pyrus cumunis* L.	Nashpati
	-	*Eriobotrya japonica Lindl.*	Loket, Loketphal
	-	*Prunus domestica* L. *(P. communis Huds.)*	Alu-Bokahra
Rubiaceae	Coffee	*Coffea arabica* L.	Kafi
	-	*Coffea benghalensis* Roxb.	Baynya kafi
	-	*Rubus tinctorium* L.	Manjistha
Rutaceae	Lime, Lemon	*Citrus aurantifolia* (Christ. & Panz.) *Sw.*	Kagzilebu, Nebum Nimbu, Lebu
	Shaddock	*C. grandis* (L.) Osbeck	Jambura, Batabilebu,
	Lime	*C. limettoides*	Mithanebu
	Lemon	*C. limon* (L.) *Burm. f. (C. medica* var. *limon*	Goralebu, Karnalebu
	Orange	*C. reticulata Blanco (C. chrysocarpa* Lush)	Kamla, Kamlalebu
	Orange	*Citrus sinessis (Linn.)* Osbeck	Malta, Moushandhi
Sapindaceae	Litchi	*Litchi chinensis Sonn. (Nephelium litchi Camb.)*	Lichu
	-	*Nephelium longana* Camb.	Ashphal
Sapotaceae	Sapodila	*Manilkara zapota* (L.) *P. van Royen (Achras sapota* L.*)*	Safeda, Chabeda
Solanaceae	Pepper	*Capsicum annuum* L.	Morich, Lanka
	Pepper	*C. frutescens* L.	Morich, Lanka morich, Dhani anka, Dhanimorich
	Tomato	*Lycopersicon esculentum* Mill. (L. *lycopersicum* (L.) Karst	Tomato, Bilati begun, Gur begun
	Tabocco	*Nicotiana rustica* L.	Deshi Tamak
	Tobaccio	*Nicotiana tabacum* L.	Tamak
	-	*N. plumbaginifoloa Viv.*	Bon tamak
	Egg plant allies	*Solanum melongena* Wall.	Begun, bagun
		S. melongena Wall var. *esculenta*	Kulibegun
	-	*S. filicifolium Ort.(S. tovrum* Sw.*)*	Tit begun, Goth begun, Hat begun
	-	*S. ferox* L.	Gota begun, Ram begun, Bagh gota
	-	*S. indicum* L.	Phutki begun, Baikur begun, Tit begun,Brithati begun
	-	*S. nigrum* L.	Gurkamal, Kakmachhi, Phuti begun
	-	*S. spirale* L.	Bagua
	-	*S. surrattense* Burm. f. *(S. xanthocarpum* Schrad. Wendl.*)*	Kanti kari, Kanta kini
	Potato	*Solanum tuberosum* L.	Alu, Gol alu, Bilati alu
	-	*S. verbascifolium* L.	Urusa
Sterculiaceae	Coco	*Theobroma cacao* L.	Koko, Chocolet
Tiliaceae	-	*Corchorus aestuans* L. *(C. acutangulus* Lamk.*)*	Titapat, Jangli pat
	Jute	*C. capsularis* L.	Desi pat,Tita pat, Bogi pat, Sada pat, Nalitapat,
	-	*C. fascicularis Lam.*	Jangli pat, Bil nailta
	-	*C. olitorius* L.	Tosha pat, Mitha pat, Bogi tosha

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Umbeliferae	Celery	*Apium graveolens* L.	Chiruli
	Coriander	*Coriandrum sativum* L.	Dhania, Dhoney
	Fennel	*Foeniculum vulgare Gaertn.*	Pan mouri
	Ajowan	*Carum copticum Benth. (Trachyspermum ammi)*	Jowan
	Cuminseed	*. Cuminum cyminum* L. *(Carum carvi L)*	Jira
	Carrot	*Daucus carrota* L.	Gajor
	Dropwort	*Oenanthe benghalensis Benth. & Hk. f*	Panturasi
	-	*Seseli diffusum* Roxb. Ex Sm. Sent. & Wagh *(S. indicum* Wt. *&Arn.)*	Bon jawan
Urticaceae	Ramie	*Boehmaria nivea (L.) Gaud.*	Kankhura, Kankura
	-	*B. platiphylla D. Don.*	Ulichara
Vitaceae	Grapes & allies	*Vitis adnata* (Roxb.*)* Wall.	Alinga lata
	-	*V. assamica* Laws	Asham lata
	-	*V. glabrata* Heyne	Goda gauria
	-	*V. lanceolaria* Laws	Horinia lata
	-	*V. latifolia* Roxb.	Govila, Panibel
	-	*V. pedata* Vahl	Goali lata
	-	*V. quadrangulais* Wall.	Har bhanga lata
	-	*V. setosa* Wall.	Goali lata
	-	*V. trifolia* (L.*)* Don	Anal lata, Amal lata, Sonekeshar
	Grape	*Vitis vinifera* L.	Angur, Kismis
Zingiberaceae	Turmeric	*Curcuma longa* L. *(C. domestica Vahl)*	Haldi, Halud
	Shoti	*C. zodoria Roscoe*	Shathi, Ekangi, Phulga, Kachuri
	Cardamom	*Elettaria cardamomum Maton*	Elachi
	Zinger allies	*Zingiber purpureum Roscoe (Z. casumnar* Roxb.*)*	Bon ada, Baumugra gachh
	Zinger	*Zingiber officinale Roscoe*	Ada
	Ginger allies	*Zingiber rubens* Roxb.	Murga gachh
	-	*Zingiber zerumbet Sm.*	Mohabari gachh, Narkasur