



Conservation and Sustainable Use of Plant Genetic Resources in Bangladesh

# Conservation and Sustainable Use of Plant Genetic Resources in Bangladesh



Bangladesh Agricultural Research Council



# **CONSERVATION AND SUSTAINABLE USE OF PLANT GENETIC RESOURCES IN BANGLADESH**

**Md. Khalequzzaman A Chowdhury, *Ph.D***  
**Member Director (Crops)**

**&**

**National Focal Point for the Project**

“Capacity Building and Regional Collaboration for Enhancing  
the Conservation and Sustainable Use of Plant Genetic  
Resources in Asia”



**Bangladesh Agricultural Research Council**



**Food and Agriculture Organization**

**Published by:**

Bangladesh Agricultural Research Council (BARC)  
Farmgate, Dhaka, Bangladesh

Published in February, 2012

All rights reserved by BARC

**Photos:** M K A Chowdhury  
M A Maleque

***ISBN -978-984-500-016-1***

***Citation:*** M K A Chowdhury, 2012. *Conservation and Sustainable Use Plant Genetic Resources in Bangladesh. A Cooperative Programme of Bangladesh Agricultural Research Council and Food and Agricultural Organization of the United Nations. Dhaka, Bangladesh. 175p*

# Table of Contents

<b>List of Tables</b>	v
<b>List of Photos</b>	vi
<b>Foreword</b>	ix
<b>Preface</b>	xi
<b>Acronyms</b>	xvi
<b>Chapter 1</b>	
Executive Summary	1
Group 1: State of Diversity in PGRFA	4
Group 2: Ex-Situ Management of PGRFA	5
Group 3: State of Utilization of PGRFA	6
Group 4: National Programmes and Training Needs	7
<b>Chapter 2</b>	
1. Crop Agriculture of Bangladesh	12
2. Plant Genetic Resources for Food and Agriculture and related species	13
3. Crop products and Food security at National and Household levels	16
4. Land use system for crop agriculture	16
5. Subsistence Commercial Agriculture: Needs and Priorities	18
6. Crop agriculture, seed production and use system	18
7. Present and future Plant Breeding & PGR needs	18
8. Methodology used for preparation of report	19
9. Priority Activity Areas of Global Plan of Action and NISM	20
9.1 Issues covered and the system followed	20
9.2 Priority Activity Areas (PAA) studied using NISM-GPA Data base	21
9.3 Relevant issues of the stakeholders	25
<b>Chapter 3</b>	
Group 1: State of Diversity of PGRFA in Bangladesh	26
GPA PAA 1: Survey and Inventory of PGRFA	26
GPA PAA 2: On-Farm Management and Improvement of PGRFA	30
GPA PAA 3: Assisting Farmers in Disaster Situations	33
GPA PAA 4: Promoting In-situ Conservation of CWR/WFP	34
Group 2: State of Ex-Situ Management of PGRFA	37
GPA PAA 5: Sustaining Existing Ex-Situ Collections	37
GPA PAA 6: Regenerating Threatened Ex-Situ Accessions	46

GPA PAA 7: Supporting Planned and Targeted Collections	49
GPA PAA 8: Expanding Ex-Situ Conservation Activities	51
Group 3: State of Utilization of PGRFA	52
GPA PAA 9: Expanding Characterization, Evaluation and Number of Core Collections to Facilitate Use	52
GPA PAA 10: Genetic Enhancement and Base Broadening	55
GPA PAA 11: Promoting Sustainable Agriculture through Diversification of crop Production and Broader Diversity in Crops	56
GPA PAA 12: Promoting Development and Commercialization of Under Utilized Crops and Species	57
GPA PAA 13: Supporting Seed Production and Distribution	60
GPA PAA 14: Developing New Markets for Local varieties and Diversity-Rich products	62
Group 4: State of National Programmes and Training Needs	64
GPA PAA 15: Building Strong National Programmes	64
GPA PAA 16: Promoting Networks for PGRFA	65
GPA PAA 17: Constructing Comprehensive Information system	66
GPA PAA 18: Developing Monitoring and Early Warning System (EWS) for Loss of PGRFA	67
GPA PAA 19: Expanding and Improving Education and Training	68
GPA PAA 20: Promoting Public Awareness of the Value Conservation and Use of PGRFA	69
<b>Chapter 4</b>	
National Information Sharing Mechanism (NISM) on GPA Implementation at Individual Stakeholders Level	71
<b>Chapter 5</b>	
Plant Genetic Resources (PGR) of Forestry and Livestock	75
A. PGR of Forestry	75
B. PGR of Livestock Fodder	85
<b>Chapter 6</b>	
Capacity Building and Project Management Activities	88
A. The stakeholders' capacity	88
(i) Manpower	88
(ii) Linkage with in-country and international organizations	90
(iii) Project activities of the stakeholders	91
(iv) Project Achievements in 2011	92

(v) The Activity Report (2009-2011) of the Project on “Capacity Building and Regional Collaboration for Enhancing the Conservation and Sustainable Use of PGR in Asia”	92
List of Annexures	99
List of Participants and Information Providers	107

<b>List of Tables</b>	<b>Page</b>
<b>Table 1:</b> List of accessions conserved at PGRC, BARI up to June 2008 and in other organizations	14
<b>Table 2:</b> List of Institutional Focal Points for PGRFA activities	25
<b>Table 3:</b> Under-utilized crops of Bangladesh with their relative importance and progress	63
<b>Table 4:</b> GPA Priority Activity Areas (Times) covered by different stakeholders through project activities as recorded in NISM-GPA data base in 2011	77
<b>Table 5:</b> GPA Priority Activity Areas covered by different stakeholders through project activities as recorded in NISM-GPA data base in 2011	79
<b>Table 6:</b> Conservation of Plus tree of timber Tree species at BFRI	81
<b>Table 7:</b> List of threatened /endangered species conserved in the field and SR stations at BFRI	83
<b>Table 8:</b> Types, number of species, genera and families of the medicinal PGR in Bangladesh.	84
<b>Table 9:</b> Types and number of species and genera and families of ornamentals available in Bangladesh	86
<b>Table 10:</b> Species conserved in the Sundarban mangrove forest of Bangladesh	88
<b>Table 11:</b> List of PGR conserved at BLRI for use as fodder and feed sources of livestock	91
<b>Table 12:</b> Number of available manpower of the individual stakeholder in the fields of PGRFA (as reported in August 2011)	93
<b>Table 13:</b> Qualifications of manpower working in different fields of PGRFA	94
<b>Table 14:</b> NARS institutes with MoUs with other national PGR related organizations	95
<b>Table 15:</b> International linkages for PGRFA networks showing participation of Bangladesh	96
<b>Table 16:</b> Activity Report (2010-2011) of the project “Capacity Building and Regional Collaboration for Enhancing the Conservation and Sustainable use of Plant Genetic Resources in Asia” Funded by FAO	98

<b>List of Photos</b>	<b>Page</b>
<b>Photo 1:</b> Participants attended the training workshop	xiv
<b>Photo 2:</b> Participants attended the training workshop	xv
<b>Photo 3:</b> Map of Bangladesh showing AEZs	17
<b>Photo 4:</b> Some species of fiber crops (a-c) and sugarcane (d-f) in Bangladesh. (a) Jute (BJRI Deshi-6), (b) Jute (BJRI Tossa-3), (c) Kenaf ( <i>Hibiscus cannabinus</i> ) (d) Sugarcane (Isd 25), (e) Sugarcane (Isd 37), (f) Sugarcane (Isd 53)	35
<b>Photo 5:</b> Diversity of cereal and tuber crops in Bangladesh. (a) Rice (BRRI dhan-29), (b) Wheat (BARI Gom 25), (c) BARI Hybrid maize-10, (d) Barley (BARI Barley-5), (e) BARI Foxtail millet-1, (f) Proso Millet (BARI Cheena-1), (g) Potato (BARI Alu-7), (h) Sweet potato (BARI Misti Alu-7), (i) Taro (BARI Mukhikachu-1)	44
<b>Photo 6:</b> Diversity of major pulse and oilseed crops in Bangladesh. (a) Cowpea (BARI Felon-2), (b) Grasspea (BARI Khesari-1), (c) Blackgram (BARIMash-3), (d) Mungbean (BARIMung-2), (e) Mungbean (BARIMung-4), (f) Mungbean (BARIMung-6), (g) Mustard (BINASarisha-6), (h) Ground nut (BINA Cheenabadam-1), (i) Sesame (BARI TIL-4)	45
<b>Photo 7:</b> Diversity of vegetable crops in Bangladesh. (a) Brinjal/Eggplant (BARI Hybrid Begun-1), (b) Tomato (BARI Tomato-9), (c) Okra (BARI Dherosh-1), (d) Cauliflower (BARI Fulkopi-2), (e) Cabbage (BARI Bandha Kopi-2), (f) Bitter gourd (BARI Karola-1), (g) Bottle gourd (BARI Hybrid Lau-1), (h) Sweet gourd (BARI Mistikumra-1), (i) Ridge gourd (BARI Jhinga-1), (j) Country bean (BARI Sheem-1), (k) French bean (BARIJhar Sheem-1), (l) Pea (BARI Motor suti-2), (m) Sponge gourd (BARI Hybrid Sponge Gourd-1), (n) Radish (BARI Mula-1), (o) Pointed gourd (BARI Patal-2), (p) Capcicum (BARI Mistimorich-1) (q) Amaranthus (BARI Danta-1 (Laboni)), (r) Kankon (BARI Gimakolmi-1)	47
<b>Photo 8:</b> Diversity of fruits in Bangladesh. (a) Mango (BARI Aam-2), (b) Litchi (BARI Lichu-3), (c) Guava (BARI Peyara-2), (d) Pineapple (Giant Kew), (e) Banana (BARI Kola-4), (f) Sapota (BARI Safeda-3), (g) Jackfruit (BARI Kanthal-2), (h) Papaya (Shahi Pepe), (i) Toikor (BARI Toikar-1), (j) Hugplam (BARI Amra-1), (k) FTIP-BAU Kul-1, (l) Wax apple (BARI Jamrul-1), (m) Star apple (BARI Kamranga-1), (n) BARI Latkon-1, (o) Amla (BARI Amloki-1), (p) Sweet orange (BARI Malta-1), (q) FTIP-BAU Kagozi lebu-1, (r) Pummelo (BARI Batabilebu-3)	49

<b>Photo 9:</b> Diversity of spices crops in Bangladesh. (a) Onion (BARI Piaz-2), (b) Garlic (BARI Rasun-1), (c) Turmeric (BARI Halud-3), (d) Ginger (BARI Ada-1), (e) Chili (BARI Morich-1), (f) Black cumin (BARI Kolozira-1)	50
<b>Photo 10:</b> Some threatened species of plants in Bangladesh. (a) <i>Desmos longiflorus</i> (Roxb.) Safford, (b) <i>Hydnocarpus kurzii</i> (King) Warb (Chaulmugra), (c) <i>Mantisia spathulata</i> (Roxb.) Schult., (d) <i>Munronia pinnata</i> Harms., (e) <i>Pinanga gracilis</i> Blume, (f) <i>Pycnarrhena pleniflora</i> Miers., (g) <i>Rauwolfia serpentina</i> (L.) Benth ex. Kurz (Sarpogandha), (h) <i>Sagerea listeri</i> King., (i) <i>Sonerila maculata</i> Roxb.	53
<b>Photo 11:</b> Some local rice germplasm of Bangladesh. (a) Rodhuni Pagal, (b) Badshabhog, (c) Pathor Nati, (d) Khorma, (e) Katak Tara, (f) Hati Sail	55
<b>Photo 12:</b> In situ conservation facilities at BARI	60
<b>Photo 13:</b> Some timber trees in Bangladesh	82
<b>Photo 14:</b> Medicinal plants in Bangladesh. (a) <i>Abroma augusta</i> (L.) (Ulat Kambal), (b) <i>Acacia catechu</i> (L.f.) Willd (Khayer), (c) <i>Acorus calamus</i> L. (Bos kachu), (d) <i>Adhatoda vasica</i> Nees (Basok), (e) <i>Catharanthus roseus</i> (L.) G. Don (Nayan tara), (f) <i>Centella asiatica</i> (L.) Urban (Thankuni), (g) <i>Hydnocarpus kurzii</i> (King) Warb (Chaulmugra), (h) <i>Kaempferia galanga</i> L. (Akanghi), (i) <i>Mesua ferrea</i> L. (Nagesswar), (j) <i>Phyllanthus emblica</i> L. (Amloki), (k) <i>Rauwolfia serpentina</i> (L.) Benth ex. Kurz (Sarpogandha), (l) <i>Saraca asoca</i> (Roxb.) de Wild. (Asok), (m) <i>Terminalia chebula</i> Retz., (n) <i>Withania somnifera</i> (L.) Dunal (Aswagandha), (o) Nim ( <i>Azadirachta indica</i> )	85
<b>Photo 15:</b> Ornamental plants in Bangladesh. (a) Gerbera ( <i>Gerbera jamesonii</i> -2), (b) Gerbera ( <i>Gerbera jamesonii</i> -1), (c) Gladiolus (BARI Gladiolus-3), (d) Anthurium (BARI Anthurium-1), (e) Chrysanthemum (BARI Chrysanthemum-2), (f) Lotus flower, (g) Water lily, (h) Marigold, (i) Dahlia, (j) Shefali, (k) Shimul, (l) Champa	87
<b>Photo 16:</b> Mangrove forests in the Sundarban of Bangladesh (a-f)	89
<b>Photo 17:</b> Fodder germplasm (Napier, Splendida, Paspalum)	92
<b>Photo 18:</b> Training-Workshop (a-d) held at BARC	102



<b>List of Annexures</b>	<b>Page</b>
<b>Annexure-1:</b> Crop acreage-wise seed requirement and supply target from public and private sectors during 2010-2011	104
<b>Annexure-2:</b> Status of the use of PGR by different stakeholder organizations during 2007-2011	105
<b>Annexure-3:</b> Number of varieties released by different stakeholder organization upto 2011	106

## **Foreword**

Biological Resources particularly the plant genetic resources are no more the human heritage and has no more free access to all genetic resources anywhere in the world. It is the sovereign rights of the country to protect its own resources within its geographical jurisdiction. This in fact limits the access to genetic resources of one nation by another. Thus, it is important that each nation has the responsibility of conserving and utilizing its own plant genetic resources and sharing for R&D purposes under formal MTA agreement between two parties within a country or between countries.

Plant genetic resources are the basic building blocks for development of agricultural technology for improved varieties with specific gene source. In order to keep pace with the needs for continuous improvement of crop cultivars, especially in respect of product quality and production efficiency, the availability of diversified PGR within species and within the genus are very important. The local and biotic resources are not only numerous but also genetically variable to adapt to adverse biotic and abiotic stresses. Unfortunately, very little of these valuable resources have been conserved, documented and utilized in Bangladesh.

With the development and use of more HYV and Hybs during the past decades, non-uses of traditional and ecologically stable varieties/genotypes have declined. Their protection as good adaptable gene source is very important. The increased population needs increased land for homestead as well as for food production. These two factors increase the chance of erosion of obsolete varieties, land races and wild relatives of PGR. In a country like ours the need to protect the PGR for many other factors including indiscriminate bio-piracy is of high priority, which we have not been able to provide for these long years. The National Agricultural Research System (NARS), ARIs, Universities and other related private and public organization have been conducting studies and organizing collection and survey of PGR.

Global awareness has grown for conservation of these valuable resources for the benefit of the society and for posterity. Coinciding with the establishment of the Global Plan of Action, the National Information Sharing Mechanism of Global Plan of Action (NISM-GPA) is under use. This report is the product of GPA- 20 Priority Activity Area, project activities to share under NISM-GPA, specific cases and the project management issues. This report is prepared with the technical assistance of the Food and

Agriculture Organization of the United Nations (FAO). I thank Dr. Md. Khalequzzaman A Chowdhury, Member-Director (Crops) of Bangladesh Agricultural Research Council (BARC) and the National Focal Point, for spearheading participatory process in preparing this report in collaboration with Prof. Dr. Lutfur Rahman, with inputs from National Stakeholders. We would like to thank Dr. Duncan Vaughan, Chief Technical Adviser of the project for his technical guidance in implementation of the project and preparation of the NISM-GPA report. We would like to express our thanks to FAO for technical and financial assistance to the project. We are grateful to the Government of Japan for financial support to the project.

Wais Kabir, Ph D  
Executive Chairman  
Bangladesh Agricultural Research Council

## **Preface**

Plant Genetic Resources are important sources of genetic materials for use in fast-growing molecular and conventional plant breeding and biotechnology industries. These materials are very important and will continue to remain so for years to come. Production of plant foods of diverse nature and nutrients for human, livestock and diversity in forest species would not have materials for improvement without the genetic variability that exist in nature or created artificially. Conserving and maintaining genetic variability is thus important. Genetic resources, therefore, will continue to play important roles for development of new cultivars possessing unique characteristics. So, for sustainable development, conservation and use of genetic diversity is very important.

The world's biological wealth is being depleted at an ever-increasing rate to adversely affect future well being of people. The opportunity to collect, identify and study wild relatives as potential breeding materials is increasingly limited under Bangladesh conditions. Insufficient effort has been made in the past to ensure the conservation of agro-biodiversity in the face of extensive destruction of habitats, species extinction and genetic erosion. We do not have yet a complete inventory plan and a GIS based location specific identification programme. Again we have not been able to organize our activities for PGRFA through appropriately designed institutional frame work to serve this field of high diversity. On-farm conservation has limitations for intensive farming and the farming community for poor knowledge to conserve PGRFA.

The intense pressure for use of plant genetic diversity will continue to increase in improving varieties with target oriented traits to serve the food needs of increased population. Therefore, appropriate measures for conservation and sustainable use of genetic diversity, particularly of the native landraces, primitive cultivars and their wild relatives will be needed. The development of appropriate conservation strategies would require adequate knowledge on the extent and location of genetic diversity and appropriate assessment of any threats to diversity.

Bangladesh Agricultural Research Council (BARC) is the nodal organization for undertaking and coordinating activities related to plant genetic resources for improvement of food and agriculture under the technical assistance of FAO. It has developed a national network involving different stakeholders working in the area of plant genetic resources for improvement of food and agriculture.

This report on plant genetic resources for food and agriculture is an outcome of the project “Capacity Building and Regional Collaboration for Enhancing Conservation and Sustainable use of Plant genetic Resources in Asia” (GCP/RAS/240/JPN) supported by FAO RAP Bangkok. The contents of the report are presented in 7 chapters stating 20 Priority Activity Areas of Global Plan of Action through NISM-GPA data base. Chapter 1 provides the Executive Summary. Chapter 2 the Introductory Chapter- An Introduction to Bangladesh and Its Agriculture, presents an overview of Bangladesh agriculture, the geographical location, topography and soil, climate, farming systems, crops/plant products, the state of food security, the changing scenario in agriculture, the seed supply systems, the process followed in preparing the report, etc.

The Chapter 3 includes results generated by using the information provided by the stakeholders on each of 20 PAA. This chapter has been divided into four groups of Priority Activity Areas with a comprehensive analysis and suggestions made by individual stakeholders.

These four groups are (i) State of Diversity in PGRFA, (ii) State of on-farm management of PGRFA, (iii) State of utilization of PGRFA and (iv) State of National programmes and training needs. The chapter 4 includes the project-based information provided by the stakeholders using NISM-GPA data bases. The Chapter 5 covered the information on PGR of Forestry and Livestock domain, as these are different from the PGRFA. The Chapter 6 includes information and management system of the project along with institutes, legislation and acts needed for appropriate development of activities on PGRFA and other PGRs of Bangladesh.

The task of compiling the information generated through numerous questions/points against each of the 20 Priority Activity Areas is a stupendous job within such a short period. There are some lackings due to inadequate understanding about some of the issues by some of the stakeholders also. Dr. Lutfur Rahman, Former Professor of the Department of Genetics and Plant Breeding, BAU extended his help in shaping and finalizing the report. Mr. Abeed Hossain Chowdhury, Director (Computer), BARC helped in getting information of the NISM-GPA database following the software of FAO. I have always been in constant touch with Dr. Duncan Vaughan, Chief Technical Adviser (CTA), Capacity Building and Regional Collaboration for Enhancing the Conservation and Sustainable Use of PGR in Asia Project to get his advice in finalization of the report. It was a very useful backstopping technical service provided by the CTA, FAO. I am also grateful to Dr. M. Wais Kabir, Executive Chairman, BARC, for his encouragement in writing this report. I would like to specially thank

FAO for technical support in preparation of this report. We are indebted to the Government of Japan for financial support to the project. The report contains comprehensive scientific viewpoint and databases on different facts/issues of plant genetic resources for food and agriculture as well as Crops Wild Relatives and Wild Food Plants.

I hope that the report on “Capacity Building and regional Collaboration for Enhancing the Conservation and Sustainable Use of Plant Genetic Resources in Asia” the first of its kind in Bangladesh would benefit and encourage scientists, researchers, teachers, policy makers, users and those who are interested in safeguarding plant genetic resources for food and agriculture.

Md. Khalequzzaman A Chowdhury, *Ph D*  
Member Director (Crops)  
Bangladesh Agricultural Research Council  
&  
National Focal Point for the Project  
(CGP/RAS/240/JPN)



**Photo 1:** Participants attended the Training-Workshop on NISM-GPA held at BARC during 18-19 July 2010 (under the project ‘Capacity Building and Regional Collaboration for Enhancing the Conservation and Use of PGR in Asia’)



**Photo 2:** Participants attended the Training-Workshop on NISM-GPA held at BARC during 01-02 November 2010 (under the project 'Capacity Building and Regional Collaboration for Enhancing the Conservation and Use of PGR in Asia')



## Acronyms

ACUC	Asian Centre for Underutilized Crops
AEZ	Agro Ecological Zone
ASC	Agro Services Centre
AVRDC	Asian Vegetable Research and Development Centre
BAAG	Bangladesh Academy of Agriculture
BBS	Bangladesh Bureau of Statistics
BADC	Bangladesh Agricultural Development Corporation
BARC	Bangladesh Agricultural Research Council
BARI	Bangladesh Agricultural Research Institute
BAU	Bangladesh Agricultural University
BFD	Bangladesh Forest Department
BFRI	Bangladesh Forest Research Institute
BGASA	Bangladesh Golden Agricultural Seed Associates Ltd.
BINA	Bangladesh Institute of Nuclear Agriculture
BJRI	Bangladesh Jute Research Institute
BLRI	Bangladesh Livestock Research Institute
BNH	Bangladesh National Herbarium
BRAC	Bangladesh Rural Advancement Committee
BRII	Bangladesh Rice Research Institute
BSA	Bangladesh Seed Association
BSRI	Bangladesh Sugarcane Research Institute
BTRI	Bangladesh Tea Research Institute
CBD	Convention on Biological Diversity
CBO	Community Based Organization
CDB	Cotton Development Board
CHT	Chittagong Hill Tracts
cDNA	c Deoxy Ribonucleic Acid
CFC	Common Fund for Commodity
CIMMYT	International Maize and Wheat Improvement Centre
CIP	International Potato Centre
COGENT	Coconut Genetic Resources Network
CSO	Chief Scientific Officer
CTO	Chief Technical Officer
CWR	Crop Wild Relative
DAE	Department of Agriculture Extension
DFO	Divisional Forest Officer
DoF	Department of Forest

## **Acronyms**

DNA	Deoxy Ribonucleic Acid
DU	University of Dhaka
EIA	Environmental Impact Assessment
EWS	Early Warning System
EWS	East West Seed (Bd.) Ltd. (Now Lal Teer Seed Limited)
FAO	Food and Agriculture Organization of the United nations
GDP	Gross Domestic Products
GIS	Geographical Information System
GKF	Grameen Krishi Foundation
GO	Government Organization
GPA	Global Plan of Action
GPS	Global Positioning System
GRSD	Genetic Resources and Seed Division
HRC	Horticulture Research Centre
HDC	Horticulture Development Centre
HYV	High Yielding Variety
IARC	Indian Agricultural Research Council
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
IJSG	International Jute Study Group
IK	Indigenous Knowledge
INIBAP	International Network for Banana and Plantain
IPGRI	International Plant Genetic Resources Institute
IPM	Integrated Pest Management
IRRI	International Rice Research Institute
MoA	Ministry of Agriculture
MCC	Mennonite Central Committee
NARS	National Agricultural Research System
NFP	National Focal Point
NPGRI	National Plant Genetic Resource Institute
NCPGR	National Committee on Plant Genetic Resources
NEAP	National Environmental Action Plan
NMS	Nursery Malik Samity
NGO	Non Government Organization

## **Acronyms**

NISM	National Information Sharing Mechanism
NISM-GPA	National Information Sharing Mechanism – Global Plan of Action for Conservation and Sustainable Utilization of Plant Genetic Resources
PAA	Priority Activity Area
PGR	Plant Genetic Resources
PGRC	Plant Genetic Resources Centre
PGRFA	Plant Genetic Resources for Food and Agriculture
PSO	Principal Scientific Officer
PVFRPA	Plant Variety and Farmers’ Right Protection Act
PVS	Participatory Variety Selection
QC	Quality Control
QTL	Quantitative Trait Loci
R&D	Research and Development
RWC	Rice Wheat Consortium
SAARC	South Asian Association for Regional Cooperation
SAAO	Sub-Assistant Agriculture Officer
SAU	Sher-e-Bangla Agricultural University
SCA	Seed Certification Agency
SDC	Social Development Committee
SSO	Senior Scientific Officer
SO	Scientific Officer
SPGR	Sub-Project Grants for Research
TAMNET	Tropical Asia Maize Network
TCRC	Tuber Crops Research Centre
TLS	Truthfully Labeled Seed
TPS	True Potato Seed
TTMU	Technology Transfer and Monitoring Unit
WFP	Wild Food Plant

# Chapter 1

## Executive Summary

Plant Genetic Resources (PGR) for Food and Agriculture is the most important resource for any country of the world. The Convention on Biological Diversity (CBD) has therefore declared that every country has the sovereign right on the PGR within its territorial jurisdiction and to protect the same under all circumstances. Bangladesh is close to the mega centre of plant genetic diversity, the Chinese center, and is within the other mega center, the Indian centre. The country is blessed with favourable ecological conditions that help sustain a large number of PGR materials. We are in fact fortunate to have quite wide diversity. It is thus our important obligation to conserve these diverse populations and study those to utilize their potential characters to develop newer plant varieties to support higher needs of food and to nutritional security. The ever increasing population is demanding more pragmatic approach for conservation and utilization of the PGR for Food and Agriculture of this country. We have potential plant resources, trained and partly trained manpower, have institutions and laboratories with somewhat limited facilities. The country has weak legal frame-work for protection of the PGR.

In the back-drop of the issues stated above Bangladesh participated in one of the projects of FAO on NISM-GPA and GPA-PAA through National Focal Point during 2004 to 2007. Since 2004 BARC is handling the issues of PGRFA at the national level and coordinating the stakeholders meeting, training and studies. After 2007 there were two trainings and two stakeholders meetings. These were organized under the finance of FAO-Project on NISM-GPA. This was followed by another FAO-funded project on “Capacity Building and Regional Collaboration for enhancing the conservation and sustainable use of Plant Genetic Resources in Asia”. This project’s activities started in October 2010 and ended in February 2012.

The project’s objectives were as follows:

1. To update and extend information on GPA implementation in Bangladesh based on the National Information Sharing Mechanism (NISM);

2. To undertake a series of national trainings/ workshops with new and some previous stakeholders in the NISM to achieve an improved NISM system;
3. To undertake a series of other activities including data collection, compilation, and documentation to enhance capacity to sustainably conserve plant genetic resources in Bangladesh and enhance public awareness.

This report on the National Information System Mechanism for GPA activities on Plant Genetic Resources for Food and Agriculture is the second one after 2007. There have taken place changes in the management of the information system and the activities. Comparative performance determination related to accession numbers of PGR and varieties can be seen in the annexure tables 1 and 2. It is also observed that there has been some improvement in some of the 20 GPA activity areas in some of the crop species while not in others.

### **Organizing the report on Capacity Building project (2010-2011)**

The report of the year 2011 in fact covered the information generated through the NISM-GPA project Priority Activity Areas in 2007 (Razzaque 2007) and the follow-up Project, funded also by FAO, in November 2010.

The report contains six chapters starting with the executive summary in the chapter 1. It has been followed by the introduction in the chapter 2. The information generated and the discussions on the issues on GPA Priority Activity Areas belonging to four groups with specific emphasis on **progress, constraints** and **future needs** have been detailed in chapter 3. A synthesis the NISM (National Information Sharing Mechanism) as provided by the stakeholders is given in chapter 4. The chapter 5 covers the PGR of Forest and Livestock. The chapter 6 contains issues related to the project management including constraints and solutions.

### **The 4 groups of GPA Priority Activity Areas (GPA-PAA) are as follows:**

1. State of diversity in PGRFA;
2. State of *Ex-situ* Management of PGRFA;
3. State of utilization of PGRFA; and
4. State of National programmes and training needs.

**GPA Priority Activity Areas studied are as follows:**

1. Survey and Inventory of PGRFA;
2. Support On-Farm Management and Improvement of PGRFA;
3. Assist Farmers in Disaster Situations to Restore Agricultural Systems;
4. Promote in-situ Conservation of Crop wild Relatives and Wild Plants for PGRFA;
5. Sustain Existing Ex-situ Collections;
6. Regenerate Threatened Ex-Situ Accessions;
7. Support Planned and Targeted Collection of PGRFA;
8. Expand *Ex-situ* Conservation Activities;
9. Expand the Characterization, Evaluation and Number of Core Collections and Facilitate Uses;
10. Increase Genetic Enhancement and Base-Broadening Efforts;
11. Promote Sustainable Agriculture through Diversification of Crop Production and Broadening Diversity in Crops;
12. Promote Development and Commercialization of Under-Utilized Crops and Species;
13. Support Seed Production and Distribution;
14. Develop New Markets for Local Varieties and Diversity-Rich products;
15. Build Strong National programmes;
16. Promote Networks for Plant Genetic Resources for Food and Agriculture;
17. Construct Comprehensive Information System for PGRFA;
18. Develop Monitoring & Early Warning Systems for Loss of PGRFA;
19. Expand and Improve Education and Training for PGRFA; and
20. Promote Public Awareness of the Value of PGRFA Conservation.

During the project period training workshops on collection and management of the PGR Data, NISM-GPA Data base and review meetings of the stakeholders on the progress, constraints and future plans related to PGRFA have been conducted. The following stakeholders along with BARC as the National Focal Point participated in the project on capacity building during 2010-2011.

1. Bangladesh Agricultural Research Council (BARC) National Focal Point
2. Bangladesh Agricultural Research Institute (BARI)
3. Bangladesh Rice Research Institute (BRRI)

4. Bangladesh Institute of Nuclear Agriculture (BINA)
5. Bangladesh Sugarcane Research Institute (BSRI)
6. Bangladesh Jute Research Institute (BJRI)
7. Bangladesh Livestock Research Institute (BLRI)
8. Bangladesh Tea Research Institute (BTRI)
9. Bangladesh Forest Research Institute (BFRI)
10. Cotton Development Board (CDB)
11. Bangladesh Agricultural University (BAU)
12. Sher-e-Bangla Agricultural University (SAU)
13. Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU)
14. Dhaka University (DU)
15. Bangladesh Agricultural Development Corporation (BADC)
16. Seed Certification Agency (SCA)
17. Department of Agriculture Extension (DAE)
18. Bangladesh National Herbarium (BNH)
19. Supreme Seed Co. Ltd.
20. Lal Teer Seed Ltd.

### **Group 1: State of Diversity in PGRFA**

#### **Constraints**

1. National comprehensive plan and GPS use-based survey, inventory and collections have not been made except in parts by BNH, which again preserves mainly the herbarium samples and has no land area even within Botanical garden. However, there has been project based isolated & independent survey and use but inventory with sustainable conservation has not planned.
2. (i) There exist low level of awareness among most of the farming community about the economic and environmental value addition through conservation of PGR; and (ii) Non-availability of quality seeds and planting materials in the locality are the important factors that are not conducive to maintain higher diversity of PGR at local level.
3. Inadequate/Absence of National plan to assist farmers, recover and preserve PGRFA following disasters. Awareness campaigns on this should be undertaken with a sense of urgency. Campaigns among the policy makers to formulate national strategy are more important than others.

4. Immediate implementation of the (i) Biodiversity and Community Knowledge Protection Act; (ii) Plant Variety and Farmers Right Protection Act (PVFRPA) and establishment of the National Plant Genetic Resource Institute (NPGRI) for successful conservation and utilization of plant genetic resources for food and agriculture.

### **Future needs**

- a) Bangladesh has high PGR diversity future development of varieties to suit the needs of the climate change. The programme needs a well designed, coordinated long-term target oriented and expert level-participatory efforts on PGRFA and CWR/WFP.
- b) Development of strategies and activation of networking services are needed for collection, conservation and characterization of all types of PGR, CWR and WFP. The services of ethno-botanist, IK experts, local level nurseries, regional level public funded R&D centers and NGOs having links with NARS and Universities are needed.

### **Group 2: State of *Ex-situ* Management of PGRFA**

#### **Constraints**

1. There is weak coordination among the organizations working on PGRFA in Bangladesh. The sharing of information is also absent due to isolated project approach and funding by organizations and donors. This approach leads to short term project based collection, temporary use and consequent discontinuity of efforts and achievements of objectives.
2. Absence of institute/organization's in-built activities on defined priority area and PGR with trained manpower and appropriate documentation of the PGR for its wide circulation facilitate conservation and uses.
3. Although the Bangladesh National Herbarium is located within the Botanical Garden at Mirpur, Dhaka, but there is a very little effort to conserve materials collected by BNH in areas of botanical garden. Similarly there exist a little linkage among the NRAS organizations.



**Future needs**

1. The priority for the PGRFA is to undertake participatory decisions at NPGRI level (at present National Focal Point) with effective distribution of crops/PGR and identify study areas/locations for work by each of the identified stakeholders under a comprehensive coordination programme.
2. There is a need for appropriate documentation of the PGR and publication from the NPGRI at regular interval. This should be followed by NISM data-base information at least to be published annually.
3. A specialized group of scientists from different organizations including private companies should join hands to develop appropriate protocols for regeneration of threatened species, genetic finger printing and QTL determination. This can be done through out-sourcing of fund and maintaining of a central account of cDNA bank to share with others in the country and outside.

**Group 3: State of Utilization of PGRFA**

This group covers six priority activity areas. The six specific areas have constraints and possible solutions. However, the overall priority constraints and solutions are summarized bellow.

**Constraints**

1. There is no clear understanding about the core collections and the need for characterization and documentation. This is mainly because persons who are not appropriately trained in PGR working in most of the stakeholders' institutions. The characterization and documentation of PGR should be the regular activities of the stakeholders.
2. The approach to use PGR for broadening the genetic base is project dependent. Many genetic materials developed through such project do not have sustainable use in the main-frame activities of the stakeholders.
3. Crop diversification followed by variety diversification is better for PGR maintenance at local, regional and national level than

crop diversification alone with a few varieties of limited diversity. But the present approach is mainly limited to the specific variety.

4. Production and timely supply of quality seeds particularly in areas devastated by climatic hazards, are not well planned.

### **Future needs**

1. Many PGR for food and agriculture are also under-utilized and not much understood as a crop of promise. Such crop species require to be studied and put into commercial production systems. This is more so with fruits, vegetable, medicinal and ornamental PGR.
2. Local varieties are not only low yielding, cost-effective and stress-positive but also have limited market potentials because of high price. Development of market channels for local varieties can be an effective solution.

## **Group 4: State of National Programmes and Training Needs**

### **Constraints**

1. The most important constraints are (i) non-establishment of National Plant Genetic Resource Institute (NPGRI), (ii) non-enactment of Plant Variety and Farmers Right Protection Act (PVFRPA).
2. The stakeholders have limitations of funds and trained manpower, both at scientific and technician level, in programme areas on PGR. This is one of the major factors that regulate the activities of the GPA in relation to PGRFA and others.
3. No appropriate networking exists among and between the NARS institutes, universities, NGOs having special interest on PGR, and Nursery Malik Samities to collect, conserve, sustain, use, characterize and develop markets of all types of PGR.

### **Future needs**

1. The establishment of NPGRI is essential for coordination, monitoring and sharing PGR.

2. The PGR conservation in a country with highest density of population is extremely difficult and needed effective programme of creating awareness through all types of mass media.
3. Public awareness creation about the value of the PGR is a continuous activity that needs to include centrally planned and effectively developed programmes not only for display of posters and banners but also of televised plays that attracts population of all age-groups.
4. Adequately planned networking of NARS institutes, universities, NGOs having special interest on PGR is needed.

### **PGR of Forest and Livestock Fodder**

#### **Constraints**

1. BFRI has limited land areas for conservation of plus trees as well as PGR of trees with special traits. In addition there is limited linkage with the Department of Forest who has the maximum natural/ national/ conserved forests areas of the country where many species/varieties can be conserved by BFRI.
2. With the possible climate change there will be serious effect on the mangrove forest of the country. There is need for continuous studies to get the types having higher rate of adoption to adverse conditions.
3. The PGR species of high feed, fodder and medicinal values for the livestock are not well recorded and conserved. Studies on all these PGR species are urgently needed along with trained manpower to collect, characterize and conserve such materials at BLRI in collaboration with the universities having faculties of Animal husbandry and Veterinary medicines.

#### **Future needs**

1. The BFRI and BNH need, in addition to strong linkage with the department of Forest for land, trained manpower and fund.
2. The PGR related to feed, fodder and medicinal values need to be continuously studied, collected and conserved at BLRI in

collaboration with university's department working in such fields.

### **GPA Priority Activity Areas studied through project by stakeholders**

The project activities of different stakeholders of Bangladesh for PGRFA as recorded through the NISM-GPA data base indicate that Priority Activity Areas have received variable attention through projects of the stakeholders. Most important is that there was low level of attention by the important stakeholders to:

- Assist farmers in Disaster Situation,
- Develop Monitoring and Early Warning System,
- Construct comprehensive Information System,
- Develop new markets for local varieties and Diversity-Rich products,
- Develop and commercialize the under-utilized crops and species, and
- Promote *in-situ* conservation of CWR/ WFP and crops like oilseeds and pulses both of which are diversity-rich, nutrient-rich, import-sensitive and high value crop groups of immense potentials.

Among all types of PGR most of them are used in Food for Agriculture covered by the Ministry of Agriculture. PGR of high economic and environmental potential with indirect contribution to food and agriculture belongs to three different ministries viz: the Ministry of Forestry & Environment for PGR of Forest, the Ministry of Fisheries & Livestock for PGR of fodder and feed for livestock and the Ministry of industries for PGR of tea plants. However, for R&D purpose, the BARC acts as the umbrella organization covering all these institutes like the BFRI, BLRI, and BTRI. The Priority Activity Areas of these institutes should be as follows:

1. Receive adequate support from the respective ministries for fund and facilities to get the activities organized in collaboration with other NARS institutes wherever applicable and the Bangladesh National Herbarium for identification.

2. Maintain well the ex-situ conservation gardens of these organizations and all types of PGR used in each of these sub-sectors of importance.
3. Pay more attentions to regenerate protocols, GIS-based survey, construct comprehensive Information System, develop new markets for local varieties and diversity-rich products, develop and commercialize the under utilized crops and species and promote *in-situ* conservation of CWR/WFP and crops and maintain mother trees.

### **Recommendations of the Stakeholders**

1. Immediate establishment of the NPGRI along with enactment of Plant Varieties and Farmers Right Protection Act.
2. The NPGRI (at least the present National Focal Point) and stakeholders shall continue to organize activities on PGR.
3. National Planning Strategy about PGRFA, CWR/WFP should cover and coordinate participation of the NARS institutes, universities, large public holdings including botanical gardens, army installations and the nurseries spread over the country.
4. Organize annual workshop on all 20 PAA of GPA considering the questions/points within each to complete appropriate information. This will help organize NISM activities easy and usable.

### **Final Outputs of the Project:**

1. A National Information-Sharing Mechanism on GPA Implementation is updated and extended. However, it needs improvement not only through project based activities like meetings and workshops but also through institutionalized programme of activities with fund and facilities.
2. A report on the state of implementation of the GPA in the country is prepared and made available to interested parties. The present report includes information from many stakeholders which need to be appropriately recorded in future. This would be possible when stakeholders will have in-built system and trained manpower with adequate fund.
3. A report on the status of conservation, utilization, needs and priority of PGR for further work is prepared. This has not been

done as a central plan to fill up the gaps for execution at stakeholders' level with fund and facilities. Many of the stakeholders have isolated project based activity plans and reports as in the past.

4. A final report on the process of strengthening of the National Information-Sharing Mechanism on GPA Implementation is prepared and made available to interested parties. This is the final report on PGR activities in Bangladesh over years. The NISM is although strengthened but would not satisfy the future needs as there is no centrally planned and institutionally organized activities on PGR in Bangladesh.
5. A data set with the information on the Indicators and Reporting Format on GPA implementation has been collected and distributed throughout the country. This is made accessible to all stakeholders and other interested parties. This has been achieved with trainings of the staff members.
6. A new web site ([www. barc.gov.bd/pgrfa](http://www.barc.gov.bd/pgrfa)) of National Information-Sharing Mechanism on GPA Implementation has been established.

## Chapter 2

### Introduction

#### 1. Crop Agriculture of Bangladesh

Agriculture in Bangladesh has, in addition to crops, three other sub-sectors viz.; fisheries, livestock and forestry. The contribution of agriculture to GDP was 20.29% in 2009-2010 at constant price of 1995. In 2008 census it was observed that the number of farm holdings in rural areas increased from 10,045,299 hectares in 1983-84 to 14,870,576 hectares in 2008, but by percentage it was 72.7% in 1983-84 and decreased to 58.66% in 2008. Agriculture sector including fisheries employs more than 80% of the rural population of the country. The crop sector contributed 11.42% and the fisheries sector 4.49% of the 20.29% GDP agriculture in 2009-2010 while fisheries contributed 4.49%. The rest 2.65% and 1.73% of agriculture were contributed by animal farming and forestry. In writing anything on agriculture, the center point is not only food production and thereby ensuring food security, but also the center for employment of millions round the year. It is also necessary to record that almost all the family members of the rural households works daily either for crop raising, homestead gardening, poultry rearing, cows or bullock and goat rearing. The next important works of the rural household members are the plantation of crops and tree species of economic importance in their small homestead or in their raised lands or even in the vicinity of their cultivated lands. These they do mainly as a source of income as well as protection of diverse crops.

The Convention on Biological Diversity (CBD) that emphasized the need for protection of the same through the article 6 placed the obligation squarely on the countries to develop their own national strategies, plans and programmes for conservation and sustainable use of biological diversity. There have been attempts to develop appropriate plans for PGR collection, and conservation for use in early years of 1990s. In 1996-97 the Ministry of Agriculture Constituted the National Committee on Plant Genetic Resources (NCPGR) entrusted with responsibility for organizing, planning workshop and preparing plan of actions. The issues have been discussed in a FAO-BARC-NCPGR organized workshop in 1997, which among others developed the formulation of National Plant Genetic Resource Institute (NPGRI), the Bio-Diversity Act and Plant Variety and Farmers Right Protection Act (PVFRPA). All are still in the process of development by the Ministry of Agriculture (MoA). Bangladesh although signed the CBD but could not yet address the eight clauses of the preamble that recognizes and reaffirms: (i) the intrinsic values of bio-diversity, (ii) the sovereign rights

of state on their own biological resources, (iii) the fundamental need of *in-situ* conservation of the ecosystem with supporting role of *ex-situ* conservation, (iv) the role of community *vis-à-vis* that of women in the act of conservation, and (v) sharing knowledge benefits with others.

In case of crop agriculture the land use system indicates that cultivable lands of the country used the natural resources most intensively. The cropping intensity of the country in 2009-2010 was 186% with a range of 126-198% indicating the total land mass use was almost double the land resource. It is interesting to note that crops, fisheries, forestry and livestock all needed crops of very diverse types and quality of food/feed sources. Thus, the plant genetic resources of rural bases are more important than others in the line. There are more than 486 plant varieties of more than 92 crop species are being cultivated in 30 AEZ of the country (Photo 3: Map of AEZ Bangladesh).

The fruits and vegetable species are many so are their varieties. A huge number of herbs, shrubs and tree species are used for medicinal purposes. In addition to all these, the ornamentals and timber trees of the forest and agro-forestry are very important PGR in Bangladesh. The diversity is very high. The necessity is to use the products and the gene sources to produce new genetic materials of food, feed, fuel and other economic products. The good number of PGR of herbs, shrubs and trees are important fodder crops. These include among others a number of grasses, designated weeds of crop fields, plants not used for human uses, and others including water hyacinth.

## **2. Plant Genetic Resources for Food and Agriculture and related species**

The country is fortunate to be within the geographic domain of both Indian mega center of origin and closest to the Chinese mega center of origin and diversity of many economically important plant genetic resources of the world. The deltaic formation of the country with silts from three major rivers of the Indian sub-continent is blessed with large variations in aquatic, semi-aquatic and non-aquatic flora and fauna. These resources are in fact very rich as to both production and potential. The inhabitants of the region have taken special care in selecting large numbers of rice varieties as well as other crop species for food and herbal medicines. With the advent of the Mughal and British rules in this area, there has been large introduction and adaptation of variable plant genetic resources to feed the people. Like the introduction of english vegetables, wheat, maize, potato and many others. The breeding activities with crop species have also been continuously developing a large number of variable genetic resources out of the crossing/mutation/selection and introduction of the genetic



resources. The Plant Genetic Resources are the basic materials having genetic variations for development of new varieties for cultivation that can produce high yields per unit of area, per unit of time, per unit of investment and per unit of quality (Rahman, 1977 & 2008). This is where the PGR help the breeder to choose the traits and get them recombined in the new materials. The country at present has been divided into 30 AEZ, indicating a large variation in ecotypes of different crop species like the Aus, Aman, and Boro of rice, winter and summer vegetables, different species of jute and allied fibres, Oleiferous Brassica, food legumes, vegetables legumes of many diverse types and perennial fruits, timbers of tropics and subtropics. In fact, more than 500 varieties of more than 86 crop species are usually used in our agricultural production and product-use systems, which is really a high diversity. According to Khan and Fariduddin (2000) there are more than 5000 angiosperm species available within Bangladesh region. In addition to that there has been a large population of mangroves in the Sundarban areas of the country, which is uncommon in the other parts of the world.

**Table 1.** List of accessions conserved at PGRC, BARI up to June 2008 and in other organizations (Botanical gardens and universities not covered Accessions of 2011 are available in Annexure 1)

<b>Organizations</b>	<b>Species/types/groups</b>	<b>Accessions nos</b>	<b>Reference</b>
BARI	Cereals other than rice	1607	Haque, <i>et al.</i> 2008, p44
	Pulses	3523	Haque <i>et al.</i> 2008,
	Oilseeds	630	Haque <i>et al.</i> 2008,
	Vegetables	3947	Haque <i>et al.</i> 2008,
HRC	27 species of vegetables	1261	Rashid <i>et al.</i> 2008 p.70
	Fruits-Major species 12	900	Bhuiyan,2008 p90-91
	Minor 58 species	397	Bhuiyan, 2008 p90-91
	Flowers-18 species	359	Haque <i>et.al,</i> 2008 p114
TCRC	Potato 50+45+700	795	Hussain <i>et al.</i> 2008,p99
	Aroids of all species	467	Hussain <i>et al.</i> 2008,p99
	Others	86	Haque <i>et al.</i> 2008,
	Total BARI Crops	9649	Razzaque,2008,p41
BRRI	Rice: Indigenous Indica, LV,PL, Exotic	6745 incl. 121 wild	Bashar & Akhter 2008 p.49

Organizations	Species/types/groups	Accessions nos	Reference
	indica, Breeding lines wild		
BSRI	Sugarcane	1362	Razzaque,2008
CDB	Cotton	490	Razzaque,2008
BJRI	C. caps, C.olit, wild	4111	Begum, 2008, p127
	Hibiscus	1520	Begum, 2008, p127
	Allied genera+ interspec.hybrids	346+1	Begum, 2008, p127
BTRI	Tea (Cultivated & wild)	475	Razzaque,2008
BSMRAU	Various crops	764	Razzaque,2008
BRAC flowers	17 species + others	336	Haque <i>et.al</i> , 2008 p114
EWS(Bd) Ltd	Vegetables	6443	Razzaque,2008
Herbal medicinal	Top selling 7 Medicial plants are: Shimul, Shonkhomul, Bhuikumra, Hastikornopolash, Daudmul, Ashwagndha, Shotomul	73.53/mt./yr Kazi & Kazi farms raise 252 species. herbs, shrubs trees & climber =486 species	Ahmed and Halder 2008,,p142  2011 information from BNH
Herbal Global market	1980=4.5 billion US\$, 100% 1990=15.5billionUS\$ 245% 2000= 70billion 351% 2020= will be 3 Trillion	28 threatened/important	Islam R, 2008,p152
Mangrove PGR of Sundarban		23 species, 18 genera 14 families	BFRI source 2011
Timber Trees		10 species	BFRI source 2011

Source: Plant Genetic Resources for Food Security in Bangladesh: Proc. National workshop on Conservation and utilization of Plant Genetic Resources of Bangladesh. PGRC, BARI, June 17-18 2008 in different pages.

The data in Table 1 indicate that there is a huge collections of PGR for different economic activities, which need appropriate conservation in Bangladesh.

### **3. Crop products and Food security at National and Household levels**

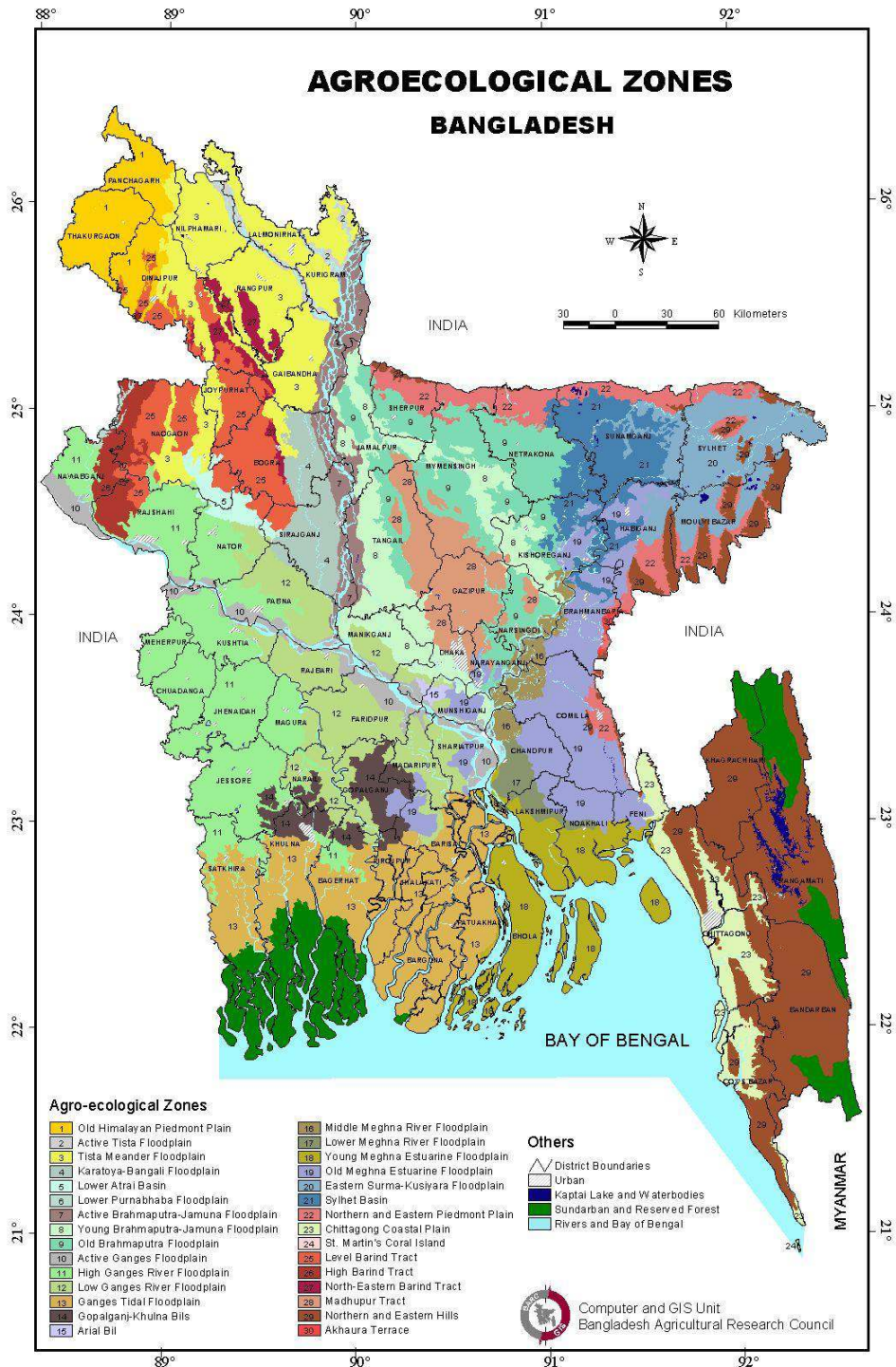
The food and agriculture of Bangladesh is in fact synonymous with crop agriculture. This is because total vegetable food sources contributed more than 95% of the total calorie intake in 2008-09. Within this group cereals contributed more than 84.98% of all vegetable and 80.89% of total calorie intake. Only about 4.81% of the calorie need of 2005-06 came from animal sources of food. There is no special improvement over that intake during these years. Therefore, the food security is highly dependent on the production and productivity of the crop sub-sector. In other words the gene sources and the diversity in relation to yields and quality and effective use for development of new varieties are very important. This is because the nutritional food security at household level is more important than at national level. The former helps reduction of hidden hunger at individual level.

The farming communities are well trained and motivated to use the technology appropriate for production under given context of the socio-economic conditions. However, they are shy in faster adoption of new technology. This is because a vast majority is small farmers. But with recent approach to commercial of agriculture, awareness has been crated for participation in production of crops having better market price than others except rice, which is their insurance for food at home. With gradual approach to commercial agriculture and hybrid varieties, the uses of traditional varieties uses are loosing grounds and eroding from the source of production. The traditional varieties need to be very carefully assessed and preserved/conserved in a regenerative form. This is also needed for use of their genes to improve the new materials at the time of need.

### **4. Land use system for crop agriculture**

The total land area of Bangladesh available for cultivation is about 14.8 million ha. The land is mostly used in three crop seasons and the intensity of cropping is 186% or more. Net area sown in 2005-06 was 7.8 million ha which was 52.60% of the total land and 56.82% of the total cropped area. In addition to these cropped area forest covered about 17.5%+ areas having various plant genetic resources and that of animals and birds. Most of the cultivable land is used for rice cultivation as Aus, Aman and Boro ecotypes. The acreage covered by rice alone is 76.97% of the total cropped area; 71.25% of the total area of 14.8 million ha and 135.46% of the net cropped area (BBS 2008). This scenario calls for attention of the PGRFA for rice gene sources within Bangladesh. There are 92 crop species being cultivated in this small land mass for supporting most of the foods of about 160 million

people. A GIS map is produced below to indicate the variation in AEZ of Bangladesh (Photo 3).



**Photo 3: Map of Bangladesh Showing AEZs**

## **5. Subsistence Commercial Agriculture: Needs and Priorities**

Agriculture in Bangladesh till recently was mostly traditional and rainfed. However, with the increasing pressure of population and the advent of new technologies having provisions for increased yields and diversity, the people have tendency towards commercial agriculture. But the approach and adoption vary. This is more noticed among the producers groups who are not appropriately organized. At the same time, the market channels are not developed as per expectations of the producers. The contract farming in some areas are although developing, but the price support is not very ethics bound. So, this is in fact a transitional period of appropriately operated commercial system to emerge. However, with the advent of commercialization and market force to use the highly priced hybrid seeds, farmers are gradually abandoning the traditional but ecologically important varieties. This has been due to use of hybrids of different types from different areas. But there is a feeling amongst our farming community to use the varieties whose seeds they can produce and preserve for use in production system, even if the production is somewhat lower than the new one. This will help increase the diversity. At the same time, the possibility of decoding the coded varieties by scientists of the country could result in developing a large number of good adaptable varieties/genotypes for further uses in breeding programmes.

## **6. Crop agriculture, seed production and use system**

The quality seeds are the basic ingredient for increased production. Our quality seed production is very low compared to the needs. On an average the quality seed use is close to 15% and there are some crop varieties which has 99% percent, highest being in maize hybrids (Annex-2). However, the seed demand varies due mostly to the crops, value of the crop products, needs of the market either internal or external and above all the quality of seeds made available by BADC and private companies, which has higher credibility in respect of quality control. These issues actually reduce the genetic diversity of the plant kingdom used mainly for the production of crops for food, feed and other important traits under demand.

## **7. Present and future Plant Breeding & PGR needs**

Plant Genetic resources are the most important ingredient for creating variations and selection of desirable traits of crop variety which can improve the production, reduce use of pesticides, fertilizer, irrigation water and maintains high standard of sustainability of crop productivity. We have the most successful use of the conventional plant breeding methods in rice, wheat, jute, sugarcane, oilseeds, pulses and

in many vegetables. The present trend has been maximum use of conventional together with advanced methods, particularly the use of known gene source from the morphological and molecular level assessment. This has become more important in the fields of stress conditions of production where varieties that are resistant or tolerant to such production conditions also can perform much better than those developed previously. In these efforts, the public sector has started assessing the farmer's acceptability of the materials through Participatory Variety Selection (PVS). The future breeding programme will demand further use of science to develop more specialized plant varieties mostly through use of QTL, gene pyramiding and modern biotechnology. Participatory Plant Breeding for faster adoption of the variety performed better over locations and conditions of production will further increase diversity and sustainability. These in fact will lead to more specific use of genes. The selection of such materials in different areas of the country will increase diversity and can be preserved for future use.

## **8. Methodology used for the preparation of report**

The National Focal Point organized two review meetings of the Institutional Focal Points and reviewed the progress of activities of the project. Within this time period the National Focal Point also organized two training workshops where the stakeholders' organizations participated. The collection of filled-in format of different data bases was done within this project period.

A two-day long training-workshop on the "Collection and Management of PGR Data" was organized by Bangladesh Agricultural Research Council during July 18-19, 2010 under the project entitled "Capacity Building and Regional Collaboration for Enhancing the Conservation and Sustainable Use of Plant Genetic Resources in Asia". A total of 44 participants from 20 stakeholders attended the programme.

A two-day long second training-workshop on the "National Information Sharing Mechanism-Global Plan of Action Database" was organized by Bangladesh Agricultural Research Council during November 1-2, 2010. A total of 40 participants from the aforementioned organizations (stakeholders) attended the programme. In order to further organize the activities three review meetings of the Institutional Focal Points of the stakeholders were conducted.

The first review meeting was held on August 30, 2011. A total of 20 participants from stakeholders' organizations attended the meeting. The second one was on May 16, 2011 where a total of 22 participants from different stakeholders participated in the meeting. The third one was on June 15, 2011. A total of 20 participants from different organizations attended the meeting. The Chief Technical Adviser (CTA) of the project Dr. Duncun Vaughan was present, attended the meeting.

## **9. Priority Activity Areas of Global Plan of Action and NISM**

### **9.1 Issues covered and the system followed**

Based on the importance of the plant genetic resources in the process of development of food and agriculture of any nation, the Global Plan of Action was formulated by the FAO. This was formulated based on the concept that with increase in population and advancement in science and technology the demand for plant varieties of specific nature/trait has increased. The result is decrease in use of plant genetic resources of general purpose with increase in their rate of erosion for non-use, and subsequent non-protection. In addition to these, the increase in population is also causing increase in growth of human habitation with increase in encroachment of the boundaries of natural vegetation. These necessitated the formation of Global Plan of Action (GPA) on PGRFA with 20 priority areas as common agenda for sharing the information on both the *in-situ* and *ex-situ* management of PGR. Thus, the National Information Sharing Mechanism of Global Plan of Action for Plant Genetic Resources for Food and Agriculture (NISM-GPA for PGRFA) has been established by FAO.

### **Planned Objectives and Outputs of the present project (2010-2012)**

The activities/objectives for which the funds provided by FAO under this Agreement were used on the followings:

- To update and extend information on GPA implementation in Bangladesh based on the National Information Sharing Mechanism (NISM);
- To undertake a series of programmes for national trainings/workshops with new and some previous stakeholders in the NISM to achieve an improved NISM system;
- To undertake a series of other activities including data collection, compilation, and documentation to enhance capacity

to sustainably conserve plant genetic resources in Bangladesh and enhance public awareness.

### **Final outputs of the project**

- A National Information-Sharing Mechanism on GPA Implementation updated and extended.
- A report on the state of implementation of the GPA in the country prepared and made available to the interested parties.
- A report on the status of conservation and utilization of PGR in the country, needs and priority for further work prepared
- A final report on the process of strengthening of the National Information-Sharing Mechanism on GPA Implementation prepared and made available to the interested parties
- A data set information on the Indicators and Reporting Format of GPA implementation collected throughout the country and made accessible to all stakeholders and other interested parties.
- A new web site of the National Information-Sharing Mechanism on GPA Implementation established.

### **9.2 Priority Activity Areas (PAA) studied using NISM-GPA Data Base**

1. Survey and Inventory of PGRFA;
2. Support On-Farm Management and Improvement of PGRFA;
3. Assist Farmers in Disaster Situations to Restore Agricultural systems;
4. Promote in-situ Conservation of Crop wild Relatives and Wild Plants for PGRFA;
5. Sustain Existing *Ex-situ* Collections;
6. Regenerate Threatened *Ex-Situ* Accessions;
7. Support Planned and Targeted Collection of PGRFA;
8. Expand *Ex-situ* Conservation Activities;
9. Expand the Characterization, Evaluation and Number of Core Collections to Facilitate Use;
10. Increase Genetic Enhancement and Base-Broadening Efforts;
11. Promote Sustainable Agriculture through Diversification of Crop Production and Broader Diversity in Crops;
12. Promote Development and Commercialization of Under-Utilized Crops and Species;
13. Support Seed Production and Distribution;
14. Develop New Markets for Local Varieties and “Diversity-Rich” products;
15. Build Strong National programmes;



16. Promote Networks for Plant Genetic Resources for Food and Agriculture;
17. Construct Comprehensive Information System for PGRFA;
18. Develop Monitoring & Early Warning Systems for Loss of PGRFA;
19. Expand and Improve Education and Training (for PGRFA); and
20. Promote Public Awareness of the Value of PGRFA Conservation.

These areas can further be grouped into four major areas. These are in case of Bangladesh:

1. State of Diversity of the PGRFA
2. State of *Ex-situ* management of the PGRFA
3. State of Utilization of PGRFA and
4. State of National programme and training

**Group 1** The major group, the State of Diversity of PGRFA includes the four subgroups:

1. Survey and Inventory of PGRFA;
2. Support On-Farm Management and Improvement of PGRFA;
3. Assist Farmers in Disaster Situations to Restore Agricultural Systems;
4. Promote in-situ Conservation of Crop Wild Relatives (CWR) and Wild Food Plants (WFP) for PGRFA;

**Group 2** The major group, the *Ex-situ* State of Management of PGRFA includes the four subgroups:

5. Sustain Existing *Ex-situ* Collections;
6. Regenerate Threatened *Ex-situ* Accessions;
7. Support Planned and Targeted Collection of PGRFA; and
8. Expand *Ex-situ* Conservation Activities;

**Group 3** The major group, the State of Utilization of PGRFA includes six subgroups:

9. Expand the Characterization, Evaluation and Number of Core Collections to Facilitate Use;
10. Increase Genetic Enhancement and Base-Broadening;
11. Promote Sustainable Agriculture through Diversification of Crop Production and Broader Diversity in Crops;
12. Promote Development and Commercialization of Under-Utilized Crops and Species;
13. Support Seed Production and Distribution;
14. Develop New Markets for Local Varieties and “Diversity-Rich” products;

**Group 4** The major group National Programmes and Training Needs includes six sub-groups:

15. Build Strong National programmes;
16. Promote Networks for Plant Genetic Resources for Food and Agriculture;
17. Construct Comprehensive Information System for PGRFA;
18. Develop Monitoring & Early Warning Systems for Loss of PGRFA;
19. Expand and Improve Education and Training for PGRFA; and
20. Promote Public Awareness of the value of PGRFA Conservation.

**The implementation stages in Bangladesh**

Based on the activities/objectives and the expected output as planned in the project for the Bangladesh part was implemented by the Member Director (Crops), BARC. He acted as the National Focal Point who started working on organizing the stakeholders meetings and training of the stakeholders' staff members to push forward the activities.

**The stakeholders**

In Bangladesh the Agricultural Research and Development issues are handled directly by the Ministries of Agriculture, Fisheries & Livestock and Forestry and Environment through a number of R&D institutions and extension departments. In addition to these there are six public universities which take care of the higher education in all fields of agricultural sciences. Three general universities also have programmes of higher education in advance fields of crop research like the tissue culture, genetic engineering, biotech etc. Among the programmes of the government and project supported by donor funds there are many that cover the activities related to collection, characterization, conservation, and sharing of the Plant Genetic Resources that are essential and important for food and agriculture. The studies also include development of varieties and breeding lines of diverse quality for use in the production system. The specific stakeholder along with its contribution to the PGRFA has been discussed individually against each of the GPA formats developed and used in the National Information Sharing Mechanism (NISM). However, the list of the identified Focal Point of the stakeholders is given in Table 2.

**Table 2.** List of Institutional Focal Points for PGRFA activities

Sl.No.	Name Designation and Address	Telephone & email address
01	Dr. Md. Khaled Sultan CSO, PGR Center, BARI, Joydebpur, Gazipur	sultankbari_2010@yahoo.com 01921 857809
02	Dr. Md. Khairul Bashar CSO, GRSD,BRRI, Joydebpur, Gazipur	<a href="mailto:mkbashar.brri@gmail.com">mkbashar.brri@gmail.com</a> 01711 283982
03	Dr. Mirza Mofazzal Islam, PSO, Breeding Division, BINA, Mymensingh	<a href="mailto:Mirza_mislam@yahoo.com">Mirza_mislam@yahoo.com</a> 01716 280720
04	Dr.Md. Abbas Ali CSO, Genetic Resource & Seed Divisition, BJRI, Dhaka	<a href="mailto:abbasbjri@yahoo.com">abbasbjri@yahoo.com</a> 01673 376105
05	Dr. Md. Abdur Rahim Prof, Horticulture Department, BAU, Mymensingh	<a href="mailto:Marahim1956@yahoo.com">Marahim1956@yahoo.com</a> 01711 854471
06	Ms. Shameema Begum Cotton Breeder, Cotton Development Board, Kamarbari, Dhaka	01912 701072
07	Mr. Delwar Hossain Senior Plant Breeder, R&D Farm (Veg), Supreme Seed Co. Ltd.	<a href="mailto:Dhossai_07_bd@yahoo.com">Dhossai_07_bd@yahoo.com</a> 01713 145212
08	Mr. G.M. Mohsin Chief Plant Breeder & Head, R&D Farm Office, Lal Teer Seed Ltd, Joydebpur, Gazipur	<a href="mailto:Mohsin_Its@yahoo.com">Mohsin_Its@yahoo.com</a> 01554 323678, 01718 304137
9	Mr. Sarder Nasiruddin SSO,Bangladesh National Herbarium, Mirpur, Dhaka.	<a href="mailto:nsarder@yahoo.com">nsarder@yahoo.com</a> 01914 007503
10	Dr. Md. Rezaul Karim Deputy Director (QC), BADC, Krishibabhon, Dhaka	<a href="mailto:mrkarimbadc@gmail.com">mrkarimbadc@gmail.com</a> 01713 201941
11	Dr. Nathuram Sarker SSO, BLRI, Savar, Dhaka	01711733119
12	Md. Khairul Bashar Quality Control Officer, SCA, Joydebpur, Gazipur.	01720 379535
13	Mr. Kabir Uddin Ahmed DFO,BFRI, Chattagram, Bangladesh	<a href="mailto:Kabir_bfri@yahoo.com">Kabir_bfri@yahoo.com</a> 01720 379535
14	Dr. Md. Golam Rasul Prof.,Deptt. Genetics & Plant Breeding, BSMRAU, Salna, Gazipur	<a href="mailto:mdgolam@yahoo.com">mdgolam@yahoo.com</a> 01715 401448
15	Dr. M. Khalilur Rahman PSO, Agronomy Division, BSRI, Ishurdi, Pabna	<a href="mailto:Drmkrahman57@yahoo.com">Drmkrahman57@yahoo.com</a> 01715 507788
16	Dr.Md.Shahidur Rashid Bhuiyan Prof.,Genetics & Plant Breeding Department, SAU, Dhaka	<a href="mailto:Ibbscfc2009@gmail.com">Ibbscfc2009@gmail.com</a> 01552 467945
17	Dr. M. Khalequzzam A. Choudhury Member-Director (Crops), BARC & National Focal Point, PGRFA	<a href="mailto:md-crops@barc.gov.bd">md-crops@barc.gov.bd</a> 01552338790

### 9.3 Relevant issues of the stakeholders

The manpower of the stakeholders has been shown against each organization in Table 12 in Chapter 6. The collected information indicated that in many of the cases there was no specific manpower for the PGR activities other than the NARS where there are specific centers like the PGRC, BARI and the GRSD, BRRI. Even in case of BRRI the seeds have been put together with the genetic resource division putting the pressure of seed production and distribution and related activities on all the scientists available in the division. In case of other stakeholder organization most of these activities are done by breeders and geneticist available in plant breeding and genetics division or only by plant breeding division.

In this report attempt has been taken to consolidate the information generated against each of the 20 fields covered in the GPA priority Activity Area data base, where a number of institutions have participated as stakeholders. It is important to indicate that among the stakeholders many have not participated. A shift from the presentation pattern of original data base system has been followed to consolidate the information which will help understand the issues of each of the organizations in compiled form.

This report in addition to compilation from the stakeholder data has also included two specific texts one on the PGR available in general forest areas specialized mangrove forests and the other one is the PGR used mostly for fodder production for the livestock. The list of the first forest and mangrove has been provided by the BFRI and that of the fodder by BLRI. The list of endangered plant species as recorded in the Red Data book has also be included in this report as ready reference.

## Chapter 3

### Group 1: State of Diversity of PGRFA in Bangladesh

#### GPA PAA 1: Survey and Inventory of PGRFA

In Bangladesh there had been attempts to collect, identify and classify the plant Genetic Resources for long years under the leadership of late Prof. Dr. M. Salar Khan, a well known plant taxonomist of the country. It was he who started organized documentation of the flora of Bangladesh and gave leadership also in the development of the Red Data Book of Bangladesh. The necessity of survey and inventory of PGRFA is very important issue in a country which depends much on the plant sources for food items. This also calls for not only comprehensive survey and inventory but also conservation of the appropriate type for future use. According to Khan and Fariduddin (2000) about 5000 angiosperm species are available in Bangladesh. This large resource also needs appropriate recording by area, type, and density so that its utilization for improvement of plant varieties becomes easy and less time consuming.

Survey of PGRFA as well as all genetic resources is a vital and very important job in works for conservation, management and sustainable uses of plant resources of the country. Moreover, as Bangladesh is the signatory to Convention on Biological Diversity (CBD) it has legal bindings to protect her biodiversity through sustainable use and to ensure their best utilization and fair and equitable sharing of benefits arising out of its use. Fortunately, Bangladesh is blessed with a high plant genetic diversity. But these are being depleted rapidly through increasing population pressure and man made activities of diverse types. Many species are now endangered due to over exploitation, illegal trade and competition with introduced alien species. Natural calamities like flood or drought are occurring almost every year, massive deforestation, introduction of modern varieties and remarkable socio-economic changes in the country are causing severe threat of extinction to PGR of different crops including their wild relatives, medicinal plants and ornamentals. The diversity of many native economic plants is also endangered. So, there is an urgent need to undertake survey programmes in coordination with relevant

organizations. But there are some reasons for not undertaking regular surveys and inventories among them the most important one is the absence of national organization in Bangladesh. Such organization could plan for organizing all activities of PGRFA including surveying and monitoring and play vital role to manage all sorts of National and Global PGR activities to meet the national needs.

The survey and inventory of the PGRFA could be studied through (i) activities already conducted by the stakeholders; (ii) listing of any area that has priority for survey and inventory of PGRFA, and (iii) the inclusion of survey in the NEAP, training needs of the staff for survey, adequacy of the efforts of the stakeholders, financial constraints of survey, etc. Based on the above points information was collected from the participating stakeholders on the following fields:

- (i) Biosystematic studies of Cucurbitaceae,
- (ii) Wild PGR of Kaptai lake,
- (iii) Taxonomic studies in the family of Araceae,
- (iv) Inventory of threatened plants to publish in Red data book,
- (v) Legume flora of Bangladesh,
- (vi) Survey and documentation of plant diversity in Flora of Bangladesh- Six families, and
- (vii) Survey and documentation of pteridophytic flora.
- (viii) Rice diversity and Local knowledge survey,
- (ix) Studies on bamboo germplasm,
- (x) Exploration and collection of PGR in 13 districts of Bangladesh,
- (xi) Survey and identification of medicinal plants of CHT,
- (xii) Survey of vegetable cultivation in Bangladesh.

This was followed by the collection of information on survey and inventory of the areas with priority where BNH has indicated for (a) Evergreen forests of Sylhet, Chittagong and Chittagong Hill Tracts; (b) Mangrove forests of Sundarbans; and (c) Forests of northern districts of Bangladesh. While BADC has indicated the necessity for use of its 9 Horticulture Development Center (HDC), 13 Agro-Service Center (ASC), 20 Seed Multiplication (SM) Farms, 2 Vegetables farms and 2 Jute farms. The BFRI proposed for studies in Natural hill forest and mangrove forests of Bangladesh. The priority for BARI was the survey, collection and inventory of PGRFA in Chittagong Hill Tracts as well as

of the Barind tract of northern districts. The Department of Agriculture Extension (DAE) has 40 horticulture bases all over the country and one trained SAAO for 1200 farm families who can organize both collection from and *in-situ* conservation at community farmers level.

While summarizing the recorded information of the individual stakeholder, it was observed that the survey and inventory activities were not as per NEAP (National Environment Action Plan) or as per the National Biodiversity Action Plan. In fact the studies were on ad-hoc basis and isolated in nature. The training needs have been assessed. While rating the adequacy of the survey and inventory, it was clear that the areas have not been prioritized as yet. There are needs for immediate prioritization followed by assigning specific institutional responsibilities for studies.

The important comments on survey and inventory, priorities, needs, constraints and opportunities for further action at the national level, and support needed from regional and international organizations in Bangladesh have been recorded here. These will give a clear picture of the present state of the PGRFA activities in Bangladesh. These are the selected ones. The information provided by these organizations along with other stakeholders as per data base has been reviewed.

### **Constraints of PGRFA activities in Bangladesh**

1. Absence of the National Plant Genetic Resources Institute (NPGRI) is the main constraint. Such organization is needed for proper planning and organizing surveys and monitoring of PGRFA, developing strategies, plans and programmes, related to PGRFA.
2. There is no Plant Varieties and Farmers Right Protection Act of Bangladesh and Biodiversity & the Community Knowledge Protection Act of Bangladesh. These need to be approved as early as possible. The drafts were submitted to the Government.
3. There is insufficient staff in stakeholder's programmes on PGRFA. The programmes need to be supported with fund and facilities and establishment of central committee on PGRFA at BARC to coordinate the function.

## Needs and Priorities

1. Awareness campaigns on conservation of plant genetic resources should be strengthened and widened.
2. Organizational responsibilities for carrying out PGR activities should be clarified and coordinated.
3. Survey and monitoring of PGRFA should be taken up with urgency using a specially designed activity plan at specific regions and sub-regions level of the country continuously from for at least five years from now.
4. Training needs in PGRFA, especially for survey and monitoring, should be properly assessed and training provided. Where necessary, training of existing staff of the stakeholders to upgrade skills should be organized based on institutional priority areas.
5. Adequate funds for carrying out activities related to PGRFA, including survey, inventory and monitoring by the stakeholders' organization are essential.
6. Collaboration and sharing of information on PGR with countries of the region and international organization/institutions should be strengthened.
7. Bangladesh is a signatory to the CBD (1992) and the government is committed to the implementation of the Global Plan of Action for Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture. Hence the establishment of NPGRI is necessary.
8. More private sector seed industries require association with mainframe PGR activities of the country as stakeholders. A large numbers of genetic materials as parent lines and hybrids of different crops are handled by these organizations.
9. It is necessary to establish "Bangladesh PGR Records" as the official document to be used for protection of the PGR as per sovereign rights of the country. This will publish all information updating the activities of the PGR on a regular monthly basis. This will cover all the 20 GPA areas so that the updated information becomes available to all stakeholders.



10. National comprehensive plan and GPS use-based survey, inventory and collection have not been made except in parts by BNH, which again preserves only the herbarium samples.
11. Bangladesh has a high PGR diversity and can very easily use the genetic diversity available in these materials for future development of varieties to cope with the needs of the climate change and reduce the poverty and food insecurity.
12. A coordinated well planned and expert level-participatory long term project on characterization and documentation of PGRFA and CWR/WFP should be immediately undertaken with participation from NARS Institutes, BNH and Universities.

### **GPA PAA 2: On-Farm Management and Improvement of PGRFA**

In the Data base of the GPA Priority Activity Area (GPA-PAA) there were primary questions followed by sub questions in each. There were also provisions for comments of the stakeholders. In this priority activity area, BADC, BFRI, BARI, Lal Teer ltd. BFD, BLRI and DAE participated through filling up the data sheet. The data sheets include issues like (i) Presence of any programme/project/activity addressing on-farm management and improvement of PGRFA and its level of integration with NEAP; (ii) incentives to promote on-farm management conservation; (iii) major limitation of on-farm management of the PGR

The information indicated that there was no specific priority fixed by any central body to work on “On-Farm management of the PGRFA” by the organizations. However, BADC in its Horticultural Farms, ASCs Seed Multiplication Farms have determined the possibilities of conservation at on-farm level and their characterization as to quality mother trees for perennial and foundation seeds of the newly bred varieties. These regional stations of BADC can be used as the centers of on-farm management of PGRFA. The farming community can be benefited through collection of the propagating materials and training on the value and importance of the PGRFA. During this period BFRI has completed two important works on in-situ maintenance of the forest tree species. The established seed orchard and the clonal bank are very positive indications of continuing works to conserve the species when some of these are under threat of extinction. However, its

programme with selection for plus trees will slowly eliminate or help erosion of the original gene source. This approach (Plus Tree Selection) is good for commercial competitive forestry. Careful consideration is needed to preserve most of the species and diversity we have in the country. In case of perennial fruit trees, the BAU has established on fruit tree repository where both local and exotic species are being maintained with potentials for extension of seed materials for other areas of the country both at institutional as well at farmers' level.

PGRC of BARI has initiated some activities in on-farm conservation and management of PGR. The major limitations identified by stakeholder organizations in on-farm conservation and improvement of PGRFA were as follows;

### **Limitations**

1. On-farm management and improvement of PGRFA are not yet a National priority.
2. The other important constraints are; (i) Lack of incentives to farmers; (ii) Insufficient number of staff for conservation work; (iii) Insufficient skills of staff; (iv) Lack of staff training; (v) Lack of financial support; and (vi) Insufficient seeds/planting materials.
3. Increasing population and scarcity of land warrant more crop production from the limited land area. Traditional varieties with lower yield have a low premium for farmers.
4. Low level of awareness among the farming community about the economic and environmental value addition through conservation of diverse PGR in whatever land area available at the command of the family.
5. Non-availability of quality seeds and planting materials to the farming community and absence of appropriate system in supporting families with such materials.
6. Absence of comprehensive plan and execution of plans without using networks of local level GOs, NGOs, CBOs, Clubs, Nursery Malik Samity (NMS).

### Priority needs

1. Awareness building on indigenous PGRFA, their extent and significance, their erosion, and their potentials for improvement, through seminars, publications of booklets and biodiversity fairs.
2. Promotion of traditional varieties in identified pocket areas (rain-fed areas and marginal lands) where farmers still depend on them. These farmers should be provided with appropriate incentives and markets.
3. Development of markets for products originating from traditional and under-utilized varieties and crops.
4. Initiatives from the private sector for development of small-scale seed production enterprises at local level.
5. Provision of incentives, including awards, to farmers for on-farm conservation, management and improvement of PGRFA.
6. Provision training on on-farm management and improvement of PGRFA with special emphasis on seed enhancement, preservation, post-harvest processing and consumption.
7. Organization of visit to successful models of on-farm management.



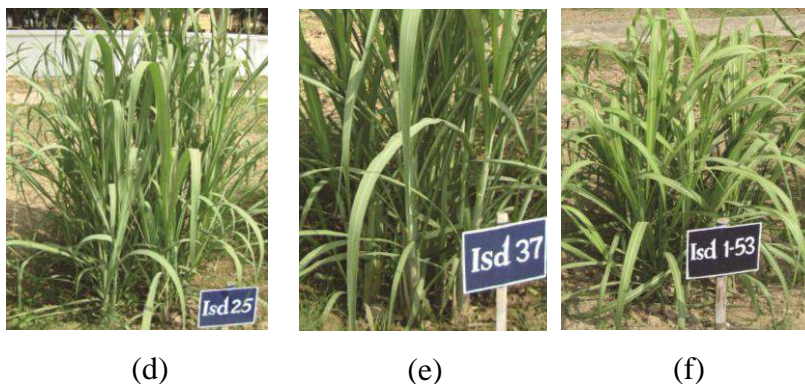
(a)



(b)



(c)



**Photo. 3.2.1.** Some species of fiber crops (a-c) and sugarcane (d-f) in Bangladesh. (a) Jute (BJRI Deshi-6), (b) Jute (BJRI Tossa-3), (c) Kenaf (*Hibiscus cannabinus*) (d) Sugarcane (Isd 25), (e) Sugarcane (Isd 37), (f) Sugarcane (Isd 53)

### **GPA PAA 3: Assisting Farmers in Disaster Situations**

In Bangladesh the disaster is a regular occurrence through floods, drought, saline water tides, cyclones and tornadoes. These situations create problems for farm families having low income, no technical know-how and low level of access to appropriate inputs at the time of needs. It is not only for the population living in the coastal belts but also for others living in the hills and the northern districts. Additional problems often comes in with river erosion which is considerably higher in the upper riverine areas than the lower ones. The mighty rivers like Padma and Brahmaputra are devouring homestead of thousands living on either bank of these rivers. The PGRFA in theses areas along with their seeds and other propagules are lost under such situations. Therefore, replacement of the varieties they use to grow becomes more important than the new one with which they are less acquainted. Thus, the information generated using GPA-PAA data bases from the participating stakeholders will help understand the issues at national and international level.

The collected information indicated inadequate involvement of the stakeholders in “Assisting Farmers in Disaster Situations to Restore Agricultural System” This is however, not due to their inability to extend help but due to non-availability of priority programmes and guidance set by the respective.

### **Constraints and Priorities**

1. A National plan to assist farmers, to recover and preserve PGRFA following disasters, is yet to be developed. This is important to restore the genetic resources lost due to natural disasters could be restored. Awareness campaigns on this issue should be undertaken with a sense of urgency.
2. Establishment of community gene bank, organization of the local groups of seed companies and the local level nurseries through local leadership and national back-up support will improve the present non-adoption of planned activities.
3. There is need for strategy development and implementation of the PGRFA activities in Bangladesh so as to facilitate adoption in any future disaster and make modification whenever necessary.

### **GPA PAA 4: Promoting In-situ Conservation of CWR/WFP**

The promotion of *in-situ* conservation of wild plants and wild relatives of the cultivated plants are very important in the context of their potentials for improving the already available cultivated species. The NARS institutes and the universities, having programmes on improvement of the plant varieties with special traits, require these types of plant genetic resources. But in some of the programmes, there is no organized perennial orchard for tree species. The medicinal plants, herbs and shrubs along with the wild ornamentals are quite important for new variety development and economic improvement of the farming community.

This part of information is available in the GPA-PAA data bases. In many cases, the information generated are not of much use, but the awareness created on regional, national and international understanding of the activities and the status of the wild relatives and wild plants in Bangladesh is important. Stakeholders provided information on (i) status of conservation of CWR/WFP and national policy support/impact if any; (ii) use of EIA in relation to CWR/WFP and other related issues.

The information generated is not adequate enough. This indicates that many of the stakeholders have not been well conversant with this form of studies. In this field, Bangladesh can take up an inventory of the Nursery Malik Society registered by the government and develop a good networking with them in conservation and marketing of CWF/WFP on large scale. This will also assist in understanding the types, the conservation mode and the traditional knowledge associated with these materials.

Although there is no plan to conserve CWR and WFP in Bangladesh, but BARI has been working on CWRs identified by ethnic people, involvement of local communities, implementation of plans to encourage public participation, arrangements for *ex-situ* conservation of threatened and endangered species of CWR/WFP. According to such studies for promoting *in-situ* conservation of CWR/WFP, the following needs were identified:

### Needs

1. Concerted efforts should be taken to preserve traditional knowledge related to PGR, with special reference to CWR/WFP;
2. Incentives to farmers for conservation of CWR/WFP should be established;
3. Markets should be developed for products originating from traditional and underutilized varieties and crops.

Bangladesh National Herbarium has capacity to identify threatened plant species, CWRs, WFPs and species with other economic importance like medicinal plants, fibre plants, etc. But it does not have capacity for *in-situ* conservation because of no access to land. The forest lands of Bangladesh mainly belong to the Department of Forest, the Ministry of Agriculture and the Ministry of Land. Hence integrated efforts are needed for successful *in-situ* conservation of plant species. In case of other organizations who owned land for *in-situ* conservation may take assistance from National Herbarium for identifying wild relatives of cultivated crops, and threatened plant species and also may share experience for *in-situ* conservation. In this regard, establishment of strong network for intra-organizational linkage is necessary. According to BFRI more National park and Eco-park should be

established. More diverse species should be conserved in arboretum. In protecting forest, forest policy must be reviewed. Introduction of exotics should be controlled.

### **Priorities**

1. The draft Biodiversity and Community Knowledge Protection Act and the Plant Variety and Farmers Right Protection Act (PVFRPA) should be formulated and implemented immediately.
2. R&D activities on *in situ* conservation of CWR/WFP should be promoted and strengthened;
3. Model testing of *in situ* methodology, especially in marginal land should be initiated;
4. Homestead forestry, agro-forestry and fodder raising programmes should be strengthened; and in doing so, it would be necessary to establish networking of the Nursery Malik Society with the NARS and the universities:
5. The crop and plant species that supports livelihood and reduce poverty with less effect on environment should be identified and promoted for their conservation;
6. The importance of ethno-botany and the traditional knowledge is high for both PGRFA and CWR/WFP. These need to be studied and compiled and preserved for future use.
7. Regional approach in *in-situ* conservation of PGR should be undertaken.

It is important to note that in most cases of the state of diversity of the PGRFA, the attempts in Bangladesh are isolated and individualistic type. The country needs to pay attention for formation of appropriate body to develop strategies, programmes, projects and activities at a much faster rate and in cohesive fashion. It is also important to actively consider formation of a unit in the BARC to be attached with the division of crops for dealing specifically with PGRFA, CWR/WFP along with the establishment of the NPGRI.

## **Group 2: State of *Ex-Situ* Management of PGRFA**

### **GPA PAA: 5: Sustaining Existing *Ex-Situ* Collections**

The information on this sub-topic covers 10 different issues. The question of sustainability of the *ex-situ* collected materials is more important than the collection. The collected materials if not conserved the effort is failed. The institutions working in the fields of PGRFA develop facilities for collection and maintenance of both field grown and stored crop species. The storage system can be of variable types based on the necessity, importance, linkages and sharing of materials with national and international organisations. The stakeholders participated in this study have variable information on: (i) sustaining *ex-situ* collections; (ii) families and taxon of collected materials; (iii) frequency of monitoring on viability of the materials; (iv) publications related to the collection including storage facilities; (v) participation in regional net-work organization; and (vi) identifications of major constraints.

The issues raised through this priority area indicate the necessity of looking at our own initiatives and the activities that are helping such maintenance of the PGRFA. The participating stakeholders except a few have also no strong programme. Some of the important information and observation by some stakeholders are reviewed.

PGRC, BARI has reported that it has undertaken activities on exploration and collection of PGR of Buckwheat, Proso millet, Foxtail Millet, Triticale, Chickpea, Lentil, Cowpea, Blackgram, Mungbean, Grasspea, Horsegram, Pigeonpea, Mustard, Sesame, Groundnut, Sunflower, Flax/Linseed, Niger, Amaranth, Hyacinthbean, Pumpkin, Bottle gourd, Okra, Ash gourd, Sponge gourd, Ridge gourd, Snake gourd, Bitter gourd, Tomato, Brinjal, Cucumber, Indian spinach, Spinach, Fababean, Radish, French bean, Ricebean, Sorrel, Sowrd bean, Cabbage, Cauliflower, Winged bean, Indigenous vegetable germplasm, Black cumin, Chili, Coriander, Musk melon Traditional cultivar/Landrace Hill tracts, South-west coastal region, Northern region of Bangladesh. A total of 8969 and safety duplicates of 580 in ICRISAT and World Vegetable Center is preserved. Arrangements should be made for maintenance of duplicate germplasm samples with other national gene banks as well as with regional/international gene banks like ICRISAT, ICARDA. Conservation of Germplasm is done in



Active and Base Collection, Seed gene bank (long term collections); Seed gene bank (medium term collections); *In vitro* conservation; field gene bank; DNA gene bank and Participatory Variety Selection. The Cotton Development Board collected from Chittagong Hill Tracts *Gossypium arboreum* Cotton advanced/ improved cultivar Bangladesh Accession # 2 safety duplicate # 2 and conserved at BJRI through a project on Integrated Development and Rehabilitation Programme (CDB part). According to BFRI propagation, management and centralization of medicinal plants *Acorus calamus* have been completed. It has also studied on the establishment of clonal bank and biodiversity conservation of the major forest trees Arboretum; Field gene bank, and clonal plantation/ forests.

BLRI which has need for a special group of PGR has indicated that (1). Some species of plant/fodder is very difficult to rear for their habit relative to habitat; (2) Rare species is difficult to grow in large scale production system; (3) At present it is essential to rear threatened species of fodder /plant; and (4) There are some constraint such as lack of funding, lack of training, lack of facility, insufficient staff and insufficient equipment.

### Major constraints

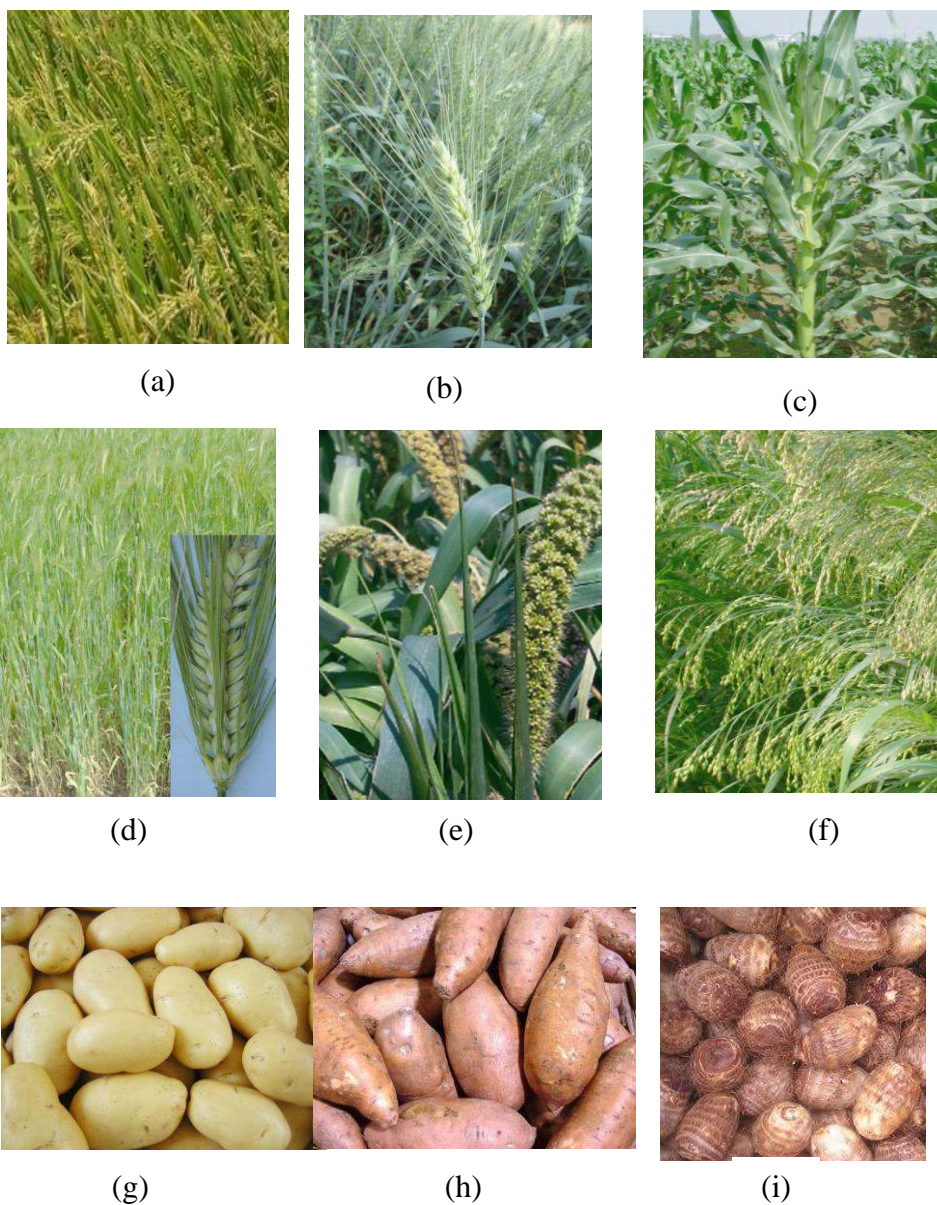
Major constraints in sustaining *ex-situ* collections mentioned by stakeholders are:

- Lack of fund;
- Lack of trained personnel;
- Lack of insufficient training;
- Insufficient equipment for seed drying and processing;
- Irregular electric supply;
- Disaster-prone environment (mainly floods and tidal surges in the coastal regions; Riverbank erosion);
- Occurrence of pests and diseases;
- Lack of long-term storage facilities with field gene banks; and
- Absence of genotypes resistant/tolerant to Red-rot disease of sugarcane.

## Needs and Priorities

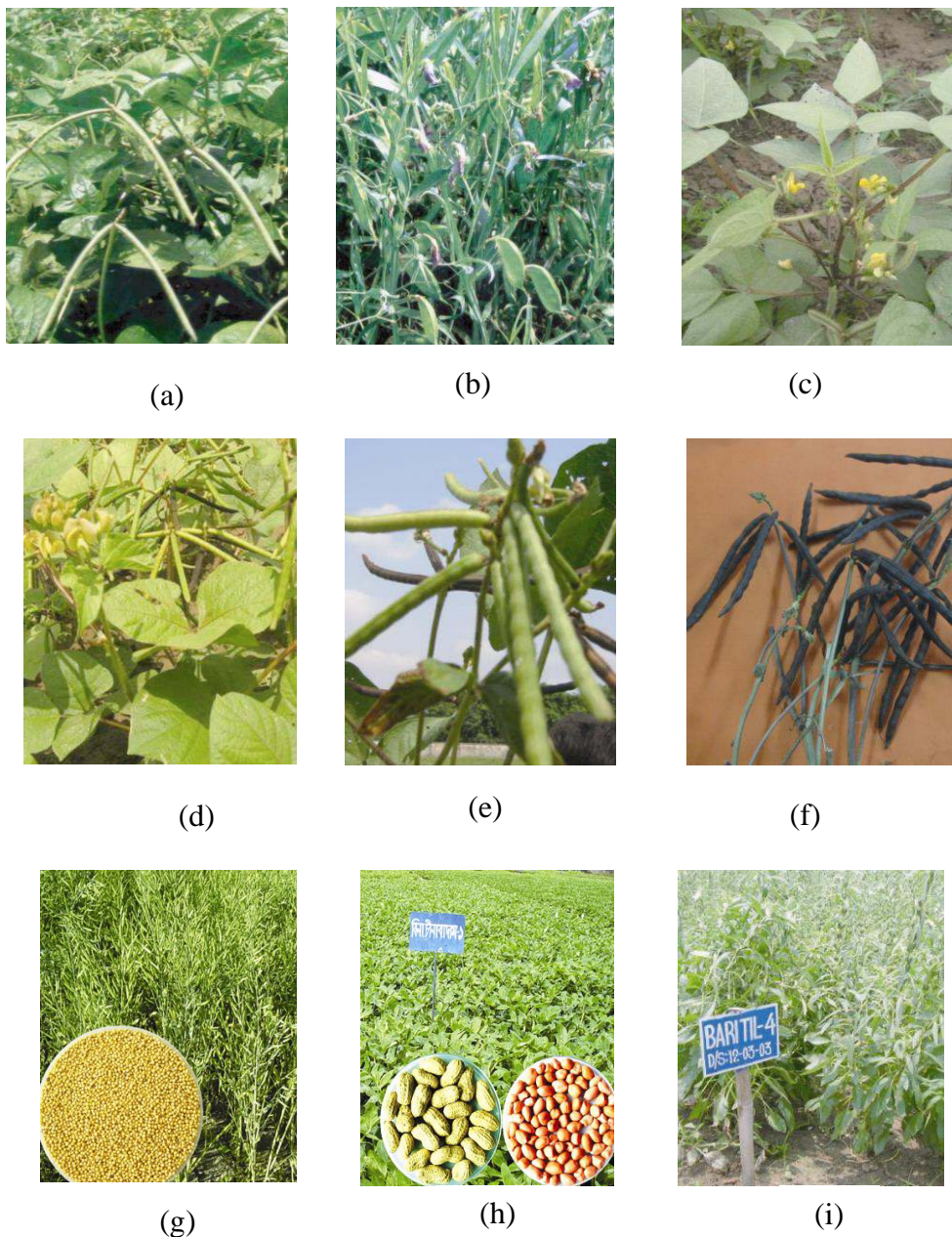
1. Support to existing gene banks should be strengthened, with particular reference to their modernization;
2. Establish the National Plant Genetic Resources Institute (NPGRI) for coordinated and coherent activities on PGR, especially for *ex-situ* collection, evaluation, characterization, and management;
3. Regeneration of activities should be improved for maintaining the collected germplasm and safeguarding their losses and degeneration;
4. Continuous support should be ensured, in terms of trained staff and finance, particularly for active collections and prevention of losses;
5. Participatory *ex-situ* conservation system should be developed with involvement of local farmers/peoples so that collection of indigenous germplasm can be strengthened, information on local knowledge and practices, as well as uses of indigenous PGR can be gathered and documented and preserved. Establishment of Community Gene Banks and their networks would be an appropriate approach.
6. Contingency plans for maintaining a buffer stock of indigenous PGR should be developed to support farming systems following disasters. This activity should be maintained in collaboration with seed farms of BADC, universities and research institutes;
7. Regional / international collaboration should be strengthened. A regional SAARC programme on PGR vis-à-vis gene bank may be developed in order to strengthen regional PGR activities;
8. Arrangements should be made for maintenance of duplicate germplasm samples with other national gene banks as well as with regional/ international gene banks (i.e. IRRI, CIMMYT, AVRDC, etc.);
9. Awareness campaign on conservation of Plant Genetic Resources should be strengthened and widened.

### Diversity of cereal and tuber crops in Bangladesh



**Photo 5.** Diversity of cereal (a-f) and tuber (g-i) crops in Bangladesh. (a) Rice (BRRi dhan-29), (b) Wheat (BARI Gom 25), (c) BARI Hybrid maize-10, (d) Barley (BARI Barley-5, (e) BARI Foxtail millet-1, (f) Proso Millet (BARI Cheena-1), (g) Potato (BARI Alu-7), (h) Sweet potato (BARI Misti Alu-7), (i) Taro (BARI Mukhikachu-1).

## Diversity of pulse and oilseed crops in Bangladesh



**Photo. 6.** Diversity of major pulse and oilseed crops in Bangladesh. (a) Cowpea (BARI Felon-2), (b) Grasspea (BARI Khesari-1), (c) Blackgram (BARIMash-3), (d) Mungbean (BARIMung-2), (e) Mungbean (BARIMung-4), (f) Mungbean (BARIMung-6), (g) Mustard (BINASarisha -6), (h) Ground nut (BINA Cheenabadam-1), (i) Sesame (BARI TIL-4)

## Diversity of vegetable crops in Bangladesh



(a)



(b)



(c)



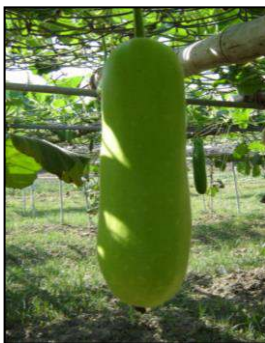
(d)



(e)



(f)



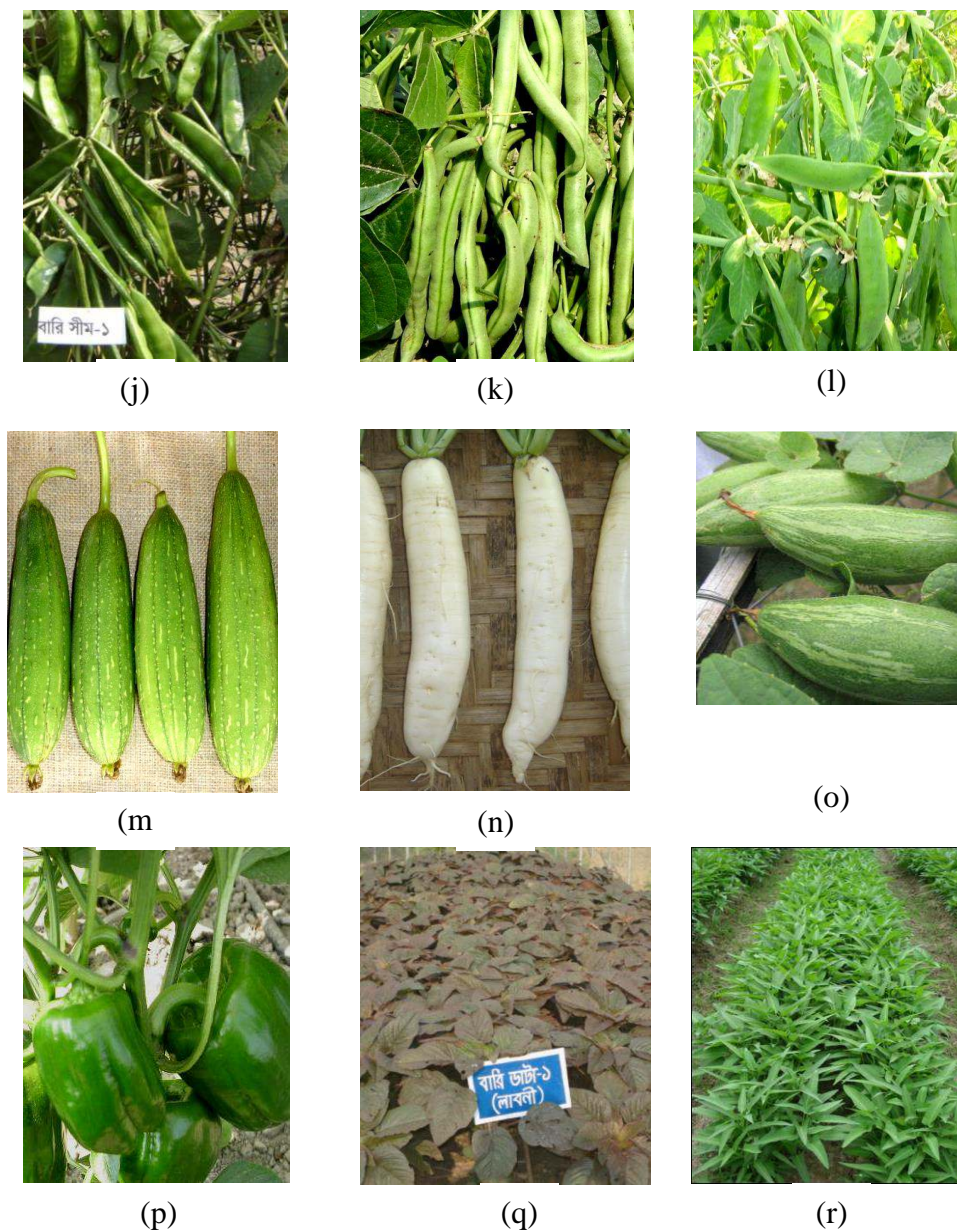
(g)



(h)



(i)



**Photo 7.** Diversity of vegetable crops in Bangladesh. (a) Brinjal/Eggplant (BARI Hybrid Begun-1), (b) Tomato (BARI Tomato-9), (c) Okra (BARI Dherosh-1), (d) Cauliflower (BARI Fulkopi-2), (e) Cabbage (BARI Bandha Kopi-2), (f) Bitter gourd (BARI Karola-1), (g) Bottle gourd (BARI Hybrid Lau-1), (h) Sweet gourd (BARI Mistikumra-1), (i) Ridge gourd (BARI Jhinga-1), (j) Country bean (BARI Sheem-1), (k) French bean (BARIJhar Sheem-1), (l) Pea (BARI Motor suti-2), (m) Sponge gourd (BARI Hybrid Sponge Gourd-1), (n) Radish (BARI Mula-1), (o) Pointed gourd (BARI Patal-2), (p) Capsicum (BARI Mistimorich-1) (q) Amaranthus (BARI Danta-1 (Laboni)), (r) Kankon (BARI Gimakolmi-1).

**Diversity of fruit crops in Bangladesh.**



(a)



(b)



(c)



(d)



(e)



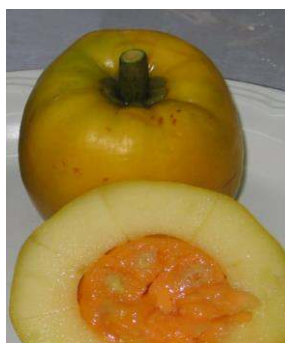
(f)



(g)



(h)



(i)



(j)



(k)



(l)



(m)



(n)



(o)



(p)



(q)



(r)

**Photo 8.** Diversity of fruit crops in Bangladesh. (a) Mango (BARI Aam-2), (b) Litchi (BARI Lichu-3), (c) Guava (BARI Peyara-2), (d) Pineapple (Giant Kew), (e) Banana (BARI Kola-4), (f) Sapota (BARI Safeda-3), (g) Jackfruit (BARI Kanthal-2), (h) Papaya (Shahi Pepe), (i) Toikor (BARI Toikar-1), (j) Hugplam (BARI Amra-1), (k) FTIP-BAU Kul-1, (l) Wax apple (BARI Jamrul-1), (m) Star apple (BARI Kamranga-1), (n) BARI Latkon-1, (o) Amla (BARI Amloki-1), (p) Sweet orange (BARI Malta-1), (q) FTIP-BAU Kagozi lebu-1, (r) Pummelo (BARI Batabilebu-3)



### Diversity of spices crops in Bangladesh



**Photo 9.** Diversity of spices crops in Bangladesh. (a) Onion (BARI Piaz-2), (b) Garlic (BARI Rasun-1), (c) Turmeric (BARI Halud-3), (d) Ginger (BARI Ada-1), (e) Chili (BARI Morich-1), (f) Black cumin (BARI Kolozira-1).

### **GPA PAA 6: Regenerating Threatened Ex-Situ Accessions**

Bangladesh is one of the best abode of a large number of species of flora and fauna. There are reports that 5000 angiosperm species of plants are available in this country of about 148,000 km square. The studies of the Bangladesh National Herbarium over these years indicate that in the Cucurbitaceae family there were 37 species and 3 varieties under 18 genera, of which 12 species are used as vegetable crops of economic importance. There are two species considered to be extinct as they are not found in recent studies. Among the wild PGR of the Kaptai National Park there are 423 species under 292 genera and 93 families. Among those, 25 are considered to be under threat of extinction. Among 423 species, 59 have medicinal value and 30 produces fruits of diverse nature. In the *Araceae* family there are 53 species identified under 20 genera. Ten species are used as vegetables while 15 are used as medicinal plant. 16 species are found to be threatened and needed protection. Five of them have not been recorded in recent studies.

There are 106 species recorded in the Red Data Books of Vascular Plant of Bangladesh. Of the 332 legume species of 98 genera available in Bangladesh 50 species are under threat. Out of the total species available 21 and 23 species of legume flora are used as vegetables and medicinal plants respectively. These along with other species of importance are under different degrees of threat and required serious attention by those who are policy makers for PGRFA. In summary, there are more than 150 species under variable degrees of threat of extinction. Thus, there is a need for regenerating threatened *ex-situ* accessions. Collections and protocols are required to get those regenerated materials maintained under somewhat controlled conditions. The review of the information from the stakeholders on the regeneration of threatened Ex-situ accessions on collection and capacity of the organization, the taxons regenerated, guidelines for regeneration protocols, studies on genetic integrity of the materials etc have been done keeping track of the points raised on the questions in the format of FAO for collection of such information.

The information generated is discussed on their summarized version. According to the information by National Focal Point the regeneration of *ex-situ* accessions is weak, even though some stakeholder organizations have had regeneration projects. Other constraints include: (i) Lack of fund for regeneration; (ii) Lack of trained staff; and (iii) Insufficient equipment facilities.

### **Needs and priorities**

1. Improving regeneration facilities;
2. Developing documentation facilities;
3. Improving facilities for long term conservation;
4. Collection from remote areas;
5. Developing genetic finger printing facilities and gene mapping aiming at determination of QTL;
6. Human resource development on PGR with emphasis on germplasm;
7. Identification of threatened species and development of site specific facilities for regeneration of threatened species/ accessions with farmers' participation; exchange of germplasm

between countries of the region and improvement of storage facilities (short-, medium- and long-term);

8. In case of regeneration there is need for continuation of works at the labs and in collaboration with agencies that were spearheading the collection; and
9. International collaboration.

### Diversity of threatened species of plants



(a)



(b)



(c)



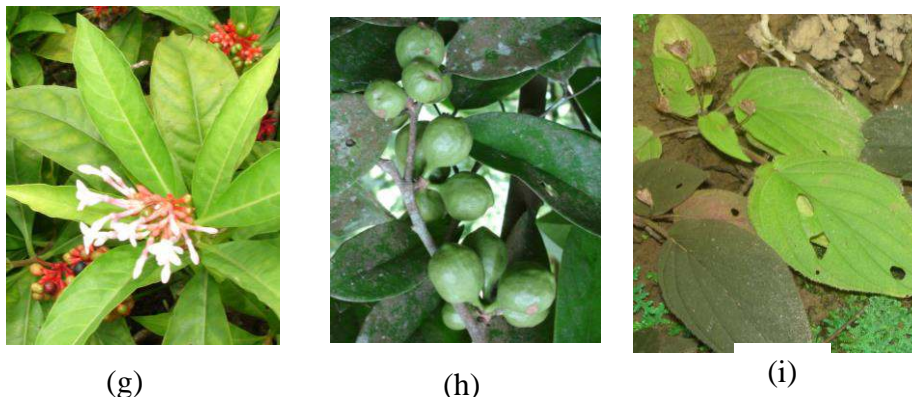
(d)



(e)



(f)



**Photo 10.** Some threatened species of plants in Bangladesh. (a) *Desmos longiflorus* (Roxb.) Safford, (b) *Hydnocarpus kurzii* (King) Warb (Chaulmugra), (c) *Mantisia spathulata* (Roxb.) Schult., (d) *Munronia pinnata* Harms., (e) *Pinanga gracilis* Blume, (f) *Pycnarrhena pleniflora* Miers., (g) *Rauvolfia serpentina* (L.) Benth ex. Kurz (Sarpogandha), (h) *Sagerea listeri* King., (i) *Sonerila maculata* Roxb.

### **GPA PAA 7: Supporting Planned and Targeted Collections**

Bangladesh National Herbarium (BNH) had programmes of targeted collection of the PGR of all sorts, part of which are also non-conventional food crops. This organization in fact identifies the plant species, but do not conserve the vast resources. The academic information generated through its studies becomes the important source of information at all levels for identification, conservation and specific characterization by others as per their needs. The targeted collection has thus been an individual programmes and in their own interest. There is no centralized programme of activities covering the entire geographical locations of the country. The effectively planned collection and documentation could support future generation in detecting the areas of importance for erosion or extinction. There is evidence that once in Indian subcontinent targeted collection of PGR of East Bengal was made by Chalres Baron Clarke (1832-1908) after 1866 when he was posted as Inspector of Schools in East Bengal. He collected more than 7000 botanic collections from Sylhet, Madhupur Jungle and Comilla (Banglapedia-4p171-2).

In the priority activity area 7 there were five points/questions on which the information from the stakeholders were collected. Among these (i) collecting missions carried out with GIS; (ii) information on endangered species, methods and technology for collections were important ones to review for this report. The information generated has been recorded here with some observation of the focal point. Collecting missions have been undertaken by different stakeholder organizations but these are of ad-hoc and isolated nature and there are many gaps in collections.

Collection of Plant Genetic Resources, their wild relatives and related species have been considered to be important by all the participating stakeholders. According to them primitive landraces, indigenous varieties and specifically adapted ecotypes are important genetic resources. The genetic diversity of crops, represented by traditional local cultivars and wild relatives, has been disappearing rapidly. Therefore, collection and exploration needs to be strengthened urgently. Periodic surveys of germplasm should be undertaken to find out species diversity. Technical assistance and financial support from regional and international organization is needed for identification of gaps in collections.

### **Needs and priorities**

1. Collection through exploration needs to be strengthened in all stakeholder organizations;
2. Periodic surveys of germplasm should be undertaken to assess changes with time;
3. Virtually all stakeholder organizations need support in skill development, in characterization and evaluation as well as in identification of gaps in collections; and
4. Effective planned and targeted collection of the PGRFA will require a centrally planned and decentralized execution of the activities considering the zones determined through GIS.



**Photo 11.** Some local rice germplasm of Bangladesh. (a) Rodhuni Pagal, (b) Badshabhog, (c) Pathor Nati, (d) Khorma, (e) Katak Tara, (f) Hati Sail

### **GPA PAA 8: Expanding Ex-Situ Conservation Activities**

Expansion of *ex-situ* conservation of PGRFA is considerably difficult in a country where population density is high and poor people's involvement in production systems, as sharecroppers, is large. This is possible only when a mass attention could be drawn on the value of the PGRFA. This is possible when the known PGR under threat are propagated and distributed to the people of specific areas where the original habitat of the PGR is located. Such activities require specific project-based funding and trained manpower.

The information as to how the *ex-situ* conservation can be expanded from the stakeholders' point of view was collected using the format

developed for this purpose. The issues were the methodologies for *ex-situ* conservation and their availability through publication in journal or bulletins etc. The information obtained is not comprehensive .

In general, there is need for capacity building for *ex-situ* conservation in most of the stakeholder organizations and a focused national attention on *ex-situ* conservation.

### Constraints

- There is low coordination among the organizations working on PGRFA, CWR/WFP in Bangladesh. The sharing of information is absent and the project approach and funding by organizations are isolated;
- Organization's in-built activity on PGR with trained manpower is absent. There is no appropriate documentation except the "flora of Bangladesh";

### Needs and Priorities

- Improvement in long term storage facilities;
- Training of staff and nursery personnel on conservation;
- Development of appropriate protocols for regeneration of threatened species, genetic finger printing and QTL determination;
- There is need for appropriate documentation of the PGR which can practically be done with publications at regular interval where the pass-port data of the accessions be published. This should be followed by NISM data-base information at least to be published annually;
- Regional/ international collaboration should be strengthened.

## Group 3 State of Utilization of PGRFA

### GPA PAA 9: Expanding Characterization, Evaluation and Number of Core Collections to Facilitate Use

PGR without appropriate characterization as to different characters of importance including their ancestry, habitat, cultivation procedure, use

systems and the impact on its uses of different dimensions, are in fact a dead material without any potentials. But when such materials are characterized and its general performance becomes known along with the traits for which the material should be protected becomes a very valuable genetic resource not only for the country but also for others globally. The characterization and evaluation are as important as the collection and maintenance of the core collection. Other than having core collection appropriately preserved the studies on characterization and evaluation will not be useful. Therefore, the state of utilization of the PGRFA is very much important in the context of development of agriculture in any country. In order to ascertain the activities in this field the GPA-PAA data base has been designed and information collected from the stakeholders on (i) present level/rate of characterization and possible expansion with mentions of the taxon and families and species characterized; (ii) capacity of the organization to act on such technology, protocols and manpower; (iii) the present level of storability of the data for their future use; (iv) country' or organization's exposure to global or regional programme areas and in doing so the constraints faced and means of overcoming those.

Plant Genetic Resource Center (PGRC) of Bangladesh Agricultural Research Institute (BARI) has conducted exploration and collection of PGR of Buckwheat, Proso millet, Foxtail Millet, Triticale, Chickpea, Lentil, Cowpea, Blackgram, Mungbean, Grasspea, Horsegram, Pigeonpea, Mustard, Sesame, Groundnut, Sunflower, Flax/Linseed, Niger, Amaranth, Hyacinthbean, Pumpkin, Bottle gourd, Okra, Ash gourd, Sponge gourd, Ridge gourd, Snake gourd, Bitter gourd, Tomato, Brinjal, Cucumber, Indian spinach, Spinach, Fababean, Radish, French bean, Ricebean, Sorrel, Sowrd bean, Cabbage, Cauliflower, Winged bean, Indigenous vegetable germplasm, Black cumin, Chilli, Coriander, Musk melon. 45% characterized; 2% at molecular level; 17% for agronomic traits and 11% for biotic stresses.

According to Lal Teer collection and characterization of the taxon Momordica; species Cucurbits, Solanaceae, Crucifereae, Alliaceae, field crops have been conducted. 100% characterized for morphological traits, no molecular characterization, 100% evaluated for agronomic traits; 30% for abiotic stress and 10% for biotic stress. BFRI has characterized bamboos and timber trees at morphological trait level.



### Constraints and priorities

1. lack of adequate short and long term facilities,
2. Lack of trained personnel,
3. Need for core collection not recognized as yet by stakeholders;
4. Lack of access to germplasm needed to establish core collections;
5. Inadequate information available on accessions; methodology too complex;
6. Research on establishment of methodologies for core collection should be initiated with backstopping support from national organizations.; and
7. Networking of projects to share knowledge, experience and facilitation in the exchange of expertise should be developed and implemented along with national/regional and international organizations.



Inside view of midterm conservation

**Photo 12.** In situ conservation facilities at BARI

## **GPA PAA 10: Genetic Enhancement and Base Broadening**

Genetic enhancement is very important for development of new varieties. In order to increase the genetic enhancement there is a need for identification of the traits through morphological, physiological and molecular level studies. Gene pyramiding has become an important tool to increase genetic variation as well as to broaden the base. This is within intra-species level. The interspecies level cross programmes and selection can also assist in increasing the genetic enhancement. Specific studies are required by the breeders for broadening the base of the population. The other part of the base broadening technique is to use participatory plant breeding from early generations of the cross products. These along with studies on genotype-environment interactions in fact are closely linked and they can give the indications of better stability in the materials in future. But the entire process needs coordinated and comprehensive studies.

The observations on the issues related to the activity area 10 of the GPA have two broad approaches for genetic enhancement. 'Introgression' and Base-broadening, some introgression programmes have been undertaken by some stakeholder organizations but for base-broadening there is hardly any attempt.

### **Constraints**

- Lack of trained and skilled scientific manpower and lack of knowledge about gene and gene sourcing;
- Lack of fund.

### **Needs**

- Strengthening breeding programmes, with emphasis on enhancing genetic base including molecular techniques;
- Strengthening germplasm collection, characterization, evaluation and documentation for easy flow of information and sharing of genetic materials with national/ regional/ international organizations;
- Fund for improving research and facilities with achievable targets; and
- Strengthening inter-institutional linkages.

### **GPA PAA 11: Promoting Sustainable Agriculture through Diversification of crop Production and Broader Diversity in Crops**

In Bangladesh, a large number of crop species are under cultivation in 30 AEZ having considerable variations in soil fertility and soil water balance. In rice alone there are three ecotypes with a good number of varieties within each to be put under cultivation under different conditions of production. Local summer and winter vegetables, winter vegetables of variable day length and temperature requirement and crops like safflower, sunflower, soybean, niger, etc. all have types to suit abiotic stress factors. The variability in crops and the gen variability in varieties make the sustainability of agricultural production meaningful. In order to keep the diversity sustained the necessity is to organize development of more diversified crops and varieties through use of molecular breeding. The information collected on the following two points were reviewed (i) improvement of diversity within and among crops or crop production; and (ii) major constraints in diversifying crop production and broadening diversity in crops.

It has been reported that lack of knowledge, insufficient supply of inputs and legal restrictions, are obstacles to broadening diversity. Incentives should be provided regarding the programme for diversified crop production, processing or marketing for diversified crop. Breeding programmes with the objectives of crop diversification should be promoted. Regional/international programmes for food security through crop diversification should be emphasized. Programme for diversified crop production should be strengthened in remote areas. It is important to note that many fodder PGRs are neglected plant species but they are very useful for utilization either wild or domesticated as those have economic potential. Also lack of genetic variation within and among the cultivars has a high level of risk in agricultural system. There should be reliable assessment of genetic diversity with provision for development of appropriate marketing and commercial systems for diversification of crop.

#### **Needs**

- Marketing incentives should be introduced for diversified crops.

- Breeding programmes with objectives of crop diversification should be promoted & National/ Regional/International programmes for food security through crop diversification should be emphasized.
- Development of market niches and promotional activities for diversified crops would promote diversification.
- It is important that the crop diversification and the diversity in crop varieties are done in a comprehensive way taking the needs of the producers in one hand and the market force having pulling effect on the other end of the commodity market.

### **GPA PAA 12: Promoting Development and Commercialization of Under Utilized Crops and Species**

Bangladesh has a large number of PGR. The use pattern is not only for food, but also for fuel, fiber, timber, paper, fruits, vegetables, herbals, ornamentals and other crops of economic importance. This large array of PGR is in fact not very well studied as to the diversity in production and processing. A few examples are: the genotypes of Neem trees, which are very good source of bio-pesticides and used extensively in many countries. Amaranth, Carrot, drumstick all are very important commercial crops. However, it is important to indicate at what use level one will be designated as under-utilized crops and crop species. Under Bangladesh context there are about 100 crop species and more than 486 registered varieties (while many more are not registered) are used for variable purposes. On the other hand there are a number of crop species which are pushed to marginal lands and marginal inputs but has high potentials as crops. The information generated in this sub-section on (i) The main under-utilized taxa or crops identified in the country; (ii) activity related to the development or commercialization of under-utilized crops or species, local varieties and/or 'diversity-rich' products; (iii) any other issues related to this.

The PGRC, BARI has a strong programme on collection and conservation of Indigenous vegetable germplasm under-utilized crops or species. Local varieties of Chittagong Hill Tract's Jhum crops (Maize, Marpha, Taro, Termaric, Ginger, Cassava, Brinjal, Indigenous vegetable germplasm) have been collected and conserved.

**Table 3.** Under-utilized crops of Bangladesh with their relative importance and progress

Crop	Scientific Name	Uses/Products	Relative importance	Progress achieved
Barley	<i>Hordeum vulgare</i>	Food grain	Food security	-
Fox Tail Millet	<i>Setaria italica</i>	Food grain	Food security	One variety released (BARI)*
Pearl Millet	<i>Panicum milliaceum</i>	Food grain	Food security	One variety released (BARI)*
Black gram	<i>Vigna mungo</i>	Protein crop	Food & nutrition security	Two varieties released, one each by BARI and BINA
Pigeon pea	<i>Cajanus cajan</i>	Protein crop	Food security	-
Linseed	<i>Linum usitatissimum</i>	Oilseed	Food security	Two varieties released, one each by BARI and BINA
Niger	<i>Guizotia abyssinica</i>	Oilseed	Food security	-
Safflower	<i>Carthamus tinctorius</i>	Oilseed	Food security	-
Bathua	<i>Chenopodium album</i>	Vegetable	Food & nutrition security	-
Cheena sak	<i>Brassica spp</i>	Vegetable	Food & nutrition security	One variety released (BARI)**
French bean	<i>Phaseolus vulgaris</i>	Vegetable	Food & nutrition security	-
Kalmi sak	<i>Ipomoea aquatica/reptans</i>	Vegetable	Food & nutrition security	One variety released (BARI)**
Lima bean	<i>Phaseolus lunatus</i>	Vegetable	Food security	-
Marfa, Phuti	<i>Cucumis melo</i>	Vegetable	Food security	-
Squash	<i>Cucurbita moschata/pepo</i>	Vegetable	Food security	-
Winged bean	<i>Psophocarpus tetragonolobus</i>	Vegetable	Food & nutrition security	-
Yam	<i>Dioscorea spp.</i>	Vegetable	Food security	-
Yam bean (Shak alu)	<i>Pachyrhizus tuberosus</i>	Vegetable	Food security	-
Black cumin	<i>Nigella sativa</i>	Spice	Food security, medicinal value	-
Black pepper	<i>Piper nigrum</i>	Spice	Food security, medicinal value	One variety released (BARI)**
Coriander	<i>Coriandrum sativum</i>	Spice	Food & nutrition security	-
Cumin seed (Jeera)	<i>Cuminum cyminum</i>	Spice	Food security	-
Fenugreek (Methi)	<i>Trigonella foenum-graceum</i>	Spice	Food security, medicinal value	-
Join	<i>Carum capticum</i>	Spice	Food security, medicinal value	-
Amloki	<i>Phyllanthus emblica</i>	Fruit	Nutrition & medicinal value	-
ArBoroi	<i>Cicca acida</i>	Fruit	Nutrition	-
Carambola (Kamranga)	<i>Averrhoa carambola</i>	Fruit	Nutrition & medicinal value	-
Cashew nut	<i>Anacardium occidentale</i>	Fruit	Food & nutrition security	-
Chalta	<i>Dillenia indica</i>	Fruit	Nutrition & , medicinal value	-
Custard Apple (Sharifa)	<i>Annona squamosa</i>	Fruit	Nutrition security	-
Dewa	<i>Artocarpus lacucha</i>	Fruit	Nutrition security	-

Crop	Scientific Name	Uses/Products	Relative importance	Progress achieved
Jamrul	<i>Syzygium samarengense</i>	Fruit	Nutrition security	-
Kothbel	<i>Feronia limonia</i>	Fruit	Nutrition security	-
Lime	<i>Citrus aurantifolia</i>	Fruit	Nutrition security / medicinal value	-
Mandarin	<i>Citrus reticulata</i>	Fruit	Nutrition security	-
Nona	<i>Annona reticulata</i>	Fruit	Nutrition security	-
Pomegranate	<i>Punica granatum</i>	Fruit	Nutrition security	-
Pummelo	<i>Citrus grandis</i>	Fruit	Nutrition security	-
Rose apple (Golapjam)	<i>Syzygium jambos</i>	Fruit	Nutrition security	-
Safeda	<i>Achras zapota</i>	Fruit	Nutrition security	-
Sweet orange (Malta)	<i>Citrus sinensis</i>	Fruit	Nutrition security	-
Tamarind	<i>Tamarindus indica</i>	Fruit	Nutrition & medicinal value	-
Cotton	<i>Gossypium</i> spp.	Fibre	Economic value	Two varieties released (BARI)* and 12 varieties released by CDB***
Mesta and Kenaf	<i>Hibiscus sabdariffa</i> spp.	Fibre, leaf, calyx and bark	Economic vegetables, sauces jelly and fibre	-
Sunnhemp	<i>Crotalaria juncea</i>	Fibre	Economic	-
Date palm	<i>Phoenix sylvestris</i>	Sugar/ gur making & fruits	Food & nutrition security	-
Palmyra Ppalm	<i>Borassus flabellifer</i>	Gur making & fruits	Food & nutrition security	-

\*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.

Public awareness for conserving and using these local varieties have been an associated activity in addition to documentation of indigenous knowledge and establishment of community gene bank.

BLRI at Savar has a very good start of a medicinal PGR garden, needs more of the herbs and shrubs. This organization has indicated that many under utilized crops and fodder species are useful sources of food and can be used and developed as a human food by genetic improvement. However, these need market demand, value addition and conservation along with studies on their economic importance.

Barley (*Hordeum vulgare*, sub-species *vulgare*) is an under-utilized crop species in Bangladesh. In fact, this and some other species like, safflower, niger, foxtail millet, pearl millets pigeon pea, marfa, winged bean and others as per list are under-utilized crop species. Stakeholders' report further indicated that there are nearly 100 under-utilized crops grown in Bangladesh. Programme/ project/ activity

related to commercialization of under-utilized crops are practically non-existent.

### **Needs and Priorities**

1. Development of national programmes on under-utilized crops should be promoted, with emphasis on their identification for large-scale consumption/industrial use, through market development.
2. Improvement in seed supply and processing/storage needs serious attention. Regional / international programmes should be developed for commercialization of under-utilized crops and species.
3. Incentives to researchers, producers, processors should be provided.
4. Policy/ legal framework needs to be developed to promote development of under-utilized crops and their commercialization in view of their large number, their market potentials and their value in nutrition and food security.

### **GPA PAA 13: Supporting Seed Production and Distribution**

In Bangladesh the seed production and distribution are quite erratic. The system requires more attention by all stakeholders for agricultural production and product development. It is very important to look into different aspects of seed production and distribution while working for the Plant Genetic Resources and their utilization. There are seed policies, seed rules, seed companies of variable dimensions and interests including a good number of working breeders in different organizations. The quantity of quality seeds being produced and marketed in Bangladesh can be seen in the Annexure 1.

There are eleven specific points/ questions on different sub-issues of the issue supporting seed production and distribution including (i) variety registration requirement; (ii) quality standards of the seeds; (iii) major constraints in producing seeds of new varieties, specific varietal information; (iv) incentive for quality seed production of local varieties and/or under-utilized crops and support for expansion of local seed growers' associations.

A BADC report indicates that total rice seed production of 2009-2010 was 62,944 metric tons as against requirement of 214,125 metric tons for 89.65 lakh hectare of lands. The requirement was raised to 238,375 metric tons in 2010-2011, with the increase in seed production to 80,204 metric tons or 34% only. Considering seeds requirement and supply of all crops, BADC supplied only 10% of total seed requirement of 103,5782 Mt during 2009-2010. This huge gap in the availability of quality seeds is being supported mostly through farmer's own saved seeds, seeds from local markets and partly by the seed companies and trading centers. Although the Seed Replacement Rate in Bangladesh is higher than many of the SAARC countries, but the quality is not that high because of the seed grade, Truthfully Labeled Seeds (TLS), where the declared grade has variable quality by different agencies and companies.

### **Constraints**

1. Breeders often produce low quantity seeds of new varieties while seeds of imported varieties need strong adaptation trials before seed marketing;
2. Insufficient availability of basic/foundation/certified seeds; and
3. Poor seed storage facilities, poor seed production and distribution system.

### **Needs**

1. Creation of awareness about the use of quality seeds;
2. Development of national programmes for purification, seed production and supply of traditional/local varieties;
3. Creation of incentives through market promotion for production of quality seeds of traditional/local varieties;
4. Promotion of quality seed production by the public sectors;
5. 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;
6. Establishment of seed village at different parts of the country; and
7. Encourage and provide incentives to private sector for quality seed production.



## Opportunities

1. A significant percentage of crops grown still belong to traditional/local varieties;
2. Some seed growers are coming up in the private sector that produce local popular varieties;
3. The private sector is now thriving with seed production of improved as well as traditional varieties;
4. Tissue cultured materials for potato and banana are gaining popularity; and
5. Nursery owners are now investing in the production and supply of seeds and saplings.

### **GPA PAA 14: Developing New Markets for Local varieties and Diversity-Rich products**

Development of markets for local varieties and diversity-rich products depends much on their market value, which is why many of the traditional crop varieties are being eroded or are not being used in cultivation as their yields and returns are very low. In recent years however, there has been an understanding about the quality, nutrient-richness and capability to produce better seeds under stress condition compared to HYVs. The necessity is to motivate the community of consumers and the producers to be in the line of use which will in fact lead to better economic returns to the producers. The summary of the stakeholders' opinion has been included in this part of the report. The issues for information collection as per GPA-PAA Data base are: (i) Number of local varieties in the market, (ii) value added product processing, (iii) markets of diversity-rich products and their constraints.

According to BARI, a number of vegetables viz.; *Vigna sesquipedalis*; *Trichosanthes anguina*; *Colocasia esculenta*; *Moringa oleifera*; *Momordica charantia*; *Dolichos lablab*; *Solanum melongena*; *Coccinea grandis*, Ivy gourd, Snake gourd, Yard long bean, Country bean, Aroids, Bitter gourd, Drum stick, Brinjal of traditional types have good market potentials. About 120 materials are available in the market and fetch high acceptability. In addition to that Post Harvest Division of BARI

has developed value added processing technologies of different crops which create 'diversity-rich' products for commercial purposes, like jackfruit chips, candy from jackfruit and mango, preparation of mixed ketchup based on banana with tomato and tamarind, preparation of vinegar pickling using cucumber, carrot, capsicum, green chilli and garlic.

### **Constraints**

1. Less attention to the production and distribution of seeds and the planting materials of the traditional varieties of different crops;
2. Lack of organized market with appropriate price structure and lack of awareness creating programmes;
3. Lack of useful information and inadequate supply of quality seeds of local varieties. As a result farmers are losing interest in maintaining genetically diverse traditional varieties and landraces;
4. Screening of local varieties as per demand of farmers, informal exchanges and formal commodity markets are dominated by fewer advanced varieties replacing traditional local varieties;\_and
5. Low yield of local / traditional varieties and lack of incentives for local varieties and “diversity-rich” products in the country; limited industrial processing limitations for diversity rich products.

### **Needs and priorities**

1. Studies to be undertaken for developing new markets for local varieties /diversity-rich' products;
2. Expansion of overseas markets for local varieties and diversity rich products market development and incentive system for production of local varieties and diversity rich products;
3. Improvement of the seed supply system;
4. Strengthening of manpower through training, research for improving local varieties and diversity rich products and identification of economic potentials of local varieties and diversity rich products; and
5. Packaging of products and marketing channels should be developed for local varieties and 'diversity-rich' products.

## **Group 4: State of National Programmes and Training needs**

### **GPA PAA 15: Building Strong National Programmes**

National programmes undertaken after the report published in 2007 till the present reporting time has been summarized against each of the issues raised in areas 15 to 20 covering aspects like (15) strong national programme, (16) promoting network for PGRFA, (17) constructing comprehensive Information system, (18) monitoring and EWS; (19) Expanding and Improving Education and Training and (20) Creating Public awareness of value of the PGRFA. As reported from 2004 the activities on PGRFA were coordinated by the National Focal Point (NFP) at BARC. There has been PGRFA programme of activities in different NARS institutes and universities after the first report. In this part of the report the information generated on each of the points raised from each of the stakeholders in area 15 have been illustrated here.

#### **Constraints**

1. Lack of specific office and appropriate level officers for the management of the functions and activities of the PGRFA and related species attached to the NFP;
2. Lack of clear organizational responsibilities to follow up international agreements; and
3. Lack of National coordination on matters related to PGR.

#### **Needs and Priorities**

1. Establishment of a National Plant Genetic Resource Institute to follow up international agreements vis-à-vis all other activities related to PGRFA;
2. Fund to PGR activities to be operative with flexible rules and regulations; and
3. External support is needed for capacity building in increasing public awareness.

## **GPA PAA 16: Promoting Networks for PGRFA**

Promoting network for Plant Genetic Resources for Food and Agriculture is very important. Networking actually encourages development of sharing of germplasm and the knowledge either modern/advanced or traditional among the networked organizations more easily than with others. In Bangladesh, there has been low level activity of the PGRFA since 1998 because of lack of institutional frame work other than involvement of BARC as the National Focal Point. The networked organizations as reported in 2007 appeared to be the same in 2009-2011 (Table 2). The issues of promoting networks in PGRFA have been studied through (i) status of network and its support from the government through different organizations; and (ii) major benefits and constraints of such networks within and outside country organizations. From the information available there it is seen that some organizations have developed some projects incorporating coordination and networking with others. However, some positive activity of networking was reported within the country where national institutes and private companies have MoU established for sharing of PGRFA.

The issues of promoting networks for PGRFA favor the following activities.

1. Transfer of technology to the end-users;
2. Back up safety duplication of germplasm;
3. Exchange of germplasm;
4. Increase in stakeholder participation;
5. Access to financial resources through participation;
6. Increase in research facilities;
7. Sharing of responsibilities for network activities;
8. Exchange of technical expertise;
9. Exchange of information; Access to advanced research results;

### **Constraints**

1. Lack of financial resources;
2. Appropriate national partners/stakeholders are not identified;  
and
3. Material flow is not uniform.

## Needs

1. There is need for support building up the facilities for information system to share with others in the same format and software;
2. There is need for trained software personnel and or scientist for such activities in many of the stakeholders' institutes; and
3. A comprehensive long term project be immediately formulated to organize the stakeholders in relation to PGRFA. The project should have provisions for training, awareness creation, equipment support for networking, software use and regular monitoring system.

Bangladesh has established networking activities with the following organizations.

- International Center for Under Utilized Crops/UTFANET,
- Asian Center for Under Utilized Crops for Need Assessment of underutilized fruits,
- Biodiversity International for Information Sharing, and
- INGER for sharing and evaluation of breeding lines

## **GPA PAA 17: Constructing Comprehensive Information System**

The system in operation is not comprehensive. The individual stakeholder having expertise and interest are developing its own system of data processing. Some are taking advantage of the data system in operation at the International level, while others are sitting tight for not having trained persons in the institution for handling such programmes. This situation is creating imbalance in getting the information shared with others and are not appropriately recorded for use. The recorded information was further updated with information from stakeholders at the National Focal Point office to regulate the issue. So, the question of constructing Comprehensive Information System at the National level and its use by the stakeholders at the time of giving information needs to be done through Institutionalization of the PGRFA. The information generated from the stakeholders on the issues is given below:

## Needs

1. There are still some stakeholders who need support for building up the facilities for information system to share with others in a same format and software;
2. There is need for trained software personnel and or scientist for such activities in many of the stakeholders' institute; and
3. There is inadequate fund and facilities relevant to the PGRFA, in fact most of the stakeholders do not have any specific unit to work on PGRFA

## Priorities

In order to organize the stakeholders in relation to PGRFA, a comprehensive long-term project be immediately formulated where the provisions for training, awareness creation, equipment support for networking as well as software use are made and the works are regularly monitored leading to success.

## **GPA PAA 18: Developing Monitoring and Early Warning System (EWS) for Loss of PGRFA**

In Bangladesh early warning system for cyclone has started somewhat functional in recent years. The same with floods have shown positive results. But those forecasts are based on information collected through electronic media and are mostly from satellites images. The information that we have in the field of PGRFA are not organized and GPS area-based. These are not also institution based having specific area identified through digitalized maps of the area. Therefore, the basic necessity is to develop a EWS for loss of PGRFA. These are the recognizable threats of genetic erosion, the identified loss of materials, assessment system for erosion, constraints and other relevant issues.

Based on the information above the following summarization has been done for recording and getting works done on these issues.

1. The emerging situation for development of Early Warning System (EWS) for PGRFA has not been recognized by the researchers and the planners except the production of one Red Data Book in 2001. Expert committee should be formed and the information

in the book and outside should now be matched and 2<sup>nd</sup> edition completed soon.

2. The incoming changes in the climate will make the environment different from the existing one causing a number of PGR not to withstand the conditions either of their propagation system or otherwise.
3. Every year there is serious erosion of a large part of the river banks, which causes extensive damage to homestead and crop lands, including the PGR of diverse nature available in the area. Not only the crops and the PGR but also the herbs shrubs and trees that are usually found in the vicinity of the homestead.
4. Annual loss of cultivable land is estimated to be around 1% of net cultivable lands of the country. This is in fact a continuous threat of erosion to the PGR.
5. The evergreen forest lands and mangrove forests are also being threatened by ever increasing population of the country. Therefore the increasing loss of PGRFA can only be reduced through *ex-situ* conservation through participation of all stakeholders. A programme should be undertaken to create awareness among all sections of the population including schools, colleges and madrashas of the locality.
6. Unplanned urbanization, industrial intervention, highly unethical pressure for housing settlements, uncontrolled felling of the forest trees, low level of government intervention to control these issues has been inflicting serious threats to PGRFA and related species.
7. Survey and inventories are not at regular interval. Hence the warning for PGR loss is not scientifically observed.

### **GPA PAA 19: Expanding and Improving Education and Training**

In a country like Bangladesh with a huge population density and low income families of millions the conservation efforts for PGRFA require creation of awareness about the future potential and the present economic value. Only creation of lab facilities, survey and conservation in selected areas of the forest will not be sufficient. The information

from the stakeholders who have participated in the GPA-PAA data base are recorded, reviewed and discussed here.

### Needs

1. Survey and inventory of PGRFA including taxonomy;
2. Indigenous knowledge;
3. Germplasm characterization and/or evaluation;
4. Plant breeding;
5. Promoting development and commercialization of Under-Utilized Crops and Species;
6. Supporting seed production, distribution and seed testing;
7. Phenotypic and molecular characterization of germplasm; and inspection of seed crops at national level;
8. Developing new markets for local varieties and 'Diversity-Rich' products;
9. Building strong national programmes; and
10. Expanding and improving education and training.

### Priority areas

1. Establishing, improving and expanding training facilities on conservation and sustainable use of PGRFA;
2. Coordinated programme by FAO and/or other international/regional organizations with local stakeholders;
3. International/regional support for development of lab facilities and training materials;
4. Higher training (Master's and PhD level) in the form of scholarships to the PGR scientists working in different organizations; and
5. Lack of financial resources causing paucity of resource materials to improve existing training programmes; and that of human resources to provide quality training.

### **GPA PAA 20: Promoting Public Awareness of the Value of Conservation and Use of PGRFA**

It is important to note that whatever technical capabilities generated for collection and conservation of the PGRFA the important issue is the public awareness to attend the issues. The issues related to assessing



public awareness about the value of the PGRFA there were nine discrete parameters in the GPA-PAA data base. These are: constraints of public awareness creation facilities, educational programmes to make students of primary secondary and other levels aware of the importance of PGRFA, the involvement of personalities to work on creating awareness, etc.

Bangladesh is a country with rapid and large-scale genetic erosion. There are no national, regional or international organizations that provide the country with support for public awareness activities on PGRFA in a sustained form. The specific issues that need attention are indicated here.

### Constraints

1. No or little effort for the creation of public awareness of the importance of PGRFA;
2. Civil Societies are not having adequate understanding about the activities of PGRFA. Staff of the programmes are not adequately trained to extend the knowledge and skills to protect PGRFA;
3. No National strategy for education and training on PGRFA;
4. Lack of support for PGRFA conservation and use; and
5. Increasing density of population warrants more production from less area and makes *in situ* conservation difficult.

### Needs

1. Setting national priorities with clear identification of an organization;
2. Training, publication and telecasting on PGRFA and audio-visual presentation, communications and consultations to promote public awareness responsible for PGRFA conservation, use and awareness building;
3. Education and training on PGRFA conservation and use;
4. Technical assistance from regional and international, organizations; and
5. Financial support for conservation, use and awareness building.

## Chapter 4

### **National Information Sharing Mechanism (NISM) on GPA Implementation at Individual Stakeholders Level**

The information obtained have been summarized and presented in a modified tabular form so that one can determine the comparative situation. The project activities in many cases have long term activities with newer one having a parent project, which completed. A very brief table is given below to get the first hand information of the number of projects the stakeholders have completed or on going. The recorded information as summarized in Tables 4 and 5 clearly indicate that there are some priority areas which have received more attention in most of the projects of five stakeholders studied here. Very low level attended Priority Activity Areas are:

1. Developing Monitoring & Early Warning Systems for loss of PGRFA- only 5 times among 246 projects of five stakeholders.
2. Developing New Markets for Local Varieties and “Diversity-Rich” products- only 7 times among 246 projects of five stakeholders.
3. Assisting Farmers in Disaster Situations to Restore Agricultural Systems- only 9 times among 246 projects of five stakeholders
4. Constructing Comprehensive Information System for PGRFA- only 10 times among 246 projects of five stakeholders.
5. Development and Commercialization of Under-Utilized Crops and Species- only 12 times among 246 projects of five stakeholders.

On the other hand a few of the Priority Areas have received much more attention than expected. These areas are as follows and also can be seen in the Tables 4 and 5 for further details.

1. Increasing Genetic Enhancement and Base-Broadening Efforts; received attention over 65 times in 246 project cases.
2. Sustaining Existing Ex-situ Collections; received attention over 59 times in 246 project cases.
3. Promoting Sustainable Agriculture through Diversification of Crop Production and Broader Diversity in Crops; received attention over 59 times in 246 project cases.
4. Supporting Seed Production and Distribution; received attention over 59 times in 246 project cases out of which BFRI alone has 29.

The compilation of data in the present form (Tables 4 and 5) can give one scientist or the policy maker a clear idea about the present conditions of the PGRFA studies and can effectively plan for the areas where low priority was given all these years. Further details of the activities can be obtained from the next Table 5. It is suggested that in each of the stakeholder's organization of the PGRFA should plan activities using the PAA chart in the forefront so that priority areas can be addressed effectively in future.

**Table 4.** GPA Priority Activity Areas (Times) covered by different stakeholders through project activities as recorded in NISM-GPA data base in 2011.

<b>Priority Activity Areas</b>	<b>BARI</b>	<b>BRRRI</b>	<b>BINA</b>	<b>BSRI</b>	<b>BFRI</b>	<b>Total times</b>
1. Surveying and Inventorying of PGRFA;	07	03	02	8	23	43
2. Supporting On-Farm Managt. and Improvement of PGRFA	03	03	02	6	15	29
3. Assisting Farmers in Disaster Situations to Restore Agricultural Systems	03	04	01	0	01	9
4. Promoting in-situ Conservation of Crop wild Relatives and Wild Plants for PGRFA;	04	04	0	4	11	23
5. Sustaining Existing Ex-situ Collections;	07	02	16	7	27	59
6. Regenerating Threatened Ex-Situ Accessions;	07	03	0	3	27	40
7. Supporting Planned and Targeted Collecting of PGRFA;	05	01	1	7	12	26
8. Expanding Ex-situ Conservation Activities;	10	04	1	8	26	49
9. Expanding the Characterization, Evaluation and Number of Core Collections to Facilitate Use;	12	06	2	9	08	37
10. Increasing Genetic Enhancement and Base-Broadening Efforts;	06	12	17	7	23	65
11. Promoting Sustainable Agriculture through Diversification of Crop Production and Broader Diversity in Crops;	08	12	16	9	11	56
12. Development and Commercialization of Under-Utilized Crops and Species;	06	0	0	2	04	12
13. Supporting Seed Production and Distribution;	07	05	16	1	29	58
14. Developing New Markets for Local Varieties and "Diversity-Rich" products;	02	04	0	0	01	7
15. Building Strong National	11	09	16	2	07	45

programmes;						
16 Promoting Networks for Plant Genetic Resources for Food and Agriculture;	06	03	2	1	0	12
17. Constructing Comprehensive Information System for PGRFA;	04	05	0	0	01	10
18. Developing Monitoring & EEWS for PGRFA;	04	0	0	0	01	5
19. Expanding and Improving Education and Training	03	01	0	0	21	25
20. Promoting Public Awareness of the Value of PGRFA Conservation	07	06	0	0	14	27
<b>Number of projects under information</b>	<b>47</b>	<b>38</b>	<b>17</b>	<b>10</b>	<b>34</b>	

**\*\*Data in a column represent the times the individual area was included in the project activities of the individual stakeholders**

**Table 5.** GPA Priority Activity Areas covered by different stakeholders through project activities as recorded in NISM-GPA data base in 2011.

<b>Priority Activity Areas</b>	<b>Lal Teer</b>	<b>BADC</b>	<b>CDB</b>	<b>SCA</b>	<b>BJRI</b>	<b>Total</b>
1. Surveying and Inventorying of PGRFA;	02	0	07	0	0	09
2. Supporting On-Farm Managt. & Improvement of PGRFA	0	0	03	0	01	04
3. Assisting Farmers in Disaster Situations to Restore System	0	04	01	01	0	06
4. Promoting in-situ Conservation of CWR & rop WFP for PGRFA;	01	04	03	0	0	08
5. Sustaining Existing Ex-situ Collections;	03	0	04	0	0	07
6. Regenerating Threatened Ex-Situ Accessions;	04	0	0	0	01	05
7. Supporting Planned and Targeted Collecting of PGRFA;	01	0	02	0	0	03
8. Expanding Ex-situ Conservation Activities;	02	01	02	0	0	05
9. Expanding the Characterization, Evaluation and Number of Core Collections to Facilitate Use;	04	0	01	03	<b>28</b>	36
10. Increasing Genetic Enhancement and Base-Broadening Efforts;	03	0	0	0	0	03
11. Promoting Sustainable Agriculture through Diversification of Crop Production and Broader Diversity in Crops;	<b>21</b>	08	08	02	01	40
12. Development and Commercialization of Under-Utilized Crops and Species;	09	07	01	0	0	17
13. Supporting Seed Production and Distribution;	15	09	05	03	0	32
14. Developing New Markets for	14	09	0	0	0	23

Local Varieties and “Diversity-Rich” products;						
15. Building Strong National programmes;	01	07	01	06	<b>28</b>	43
16. Promoting Networks for Plant Genetic Resources for Food and Agriculture;	02	0	05	0	<b>28</b>	35
17. Constructing Comprehensive Information System for PGRFA;	0	0	0	0	0	0
18. Developing Monitoring & Early Warning Systems for Loss of PGRFA;	0	0	0	01	0	01
19. Expanding and Improving Education and Training (for PGRFA)	0	03	0	06	0	09
20. Promoting Public Awareness of the Value of PGRFA Conservation	0	0	03	0	0	03
<b>Number of projects under information</b>	<b>24</b>	<b>09</b>	<b>09</b>	<b>06</b>	<b>28</b>	

**\*\*Data in a column represent the times the Individual Area was included in the project activities of the individual stakeholders**

It is interesting that in case of Lal Teer only sustainable agriculture received 21 project attentions amongst 24 total projects. For BJRI it is further interesting that all projects served only three areas, Building National (# 15), Promoting Networks (#16) and Expanding characterization (#09).

## Chapter 5

### Plant Genetic Resources (PGR) of Forestry and Livestock

#### A. PGR of Forestry

Bangladesh has very limited forest coverage. Although the country belongs to the region covering tropical-sub-tropical belt, but has low level of hilly areas. The hilly areas available are also being inhabited by populations of various clans. This is also because of high population density of the country. The Chittagong hill tract is in fact has the biggest hill belt area. This is followed by the next one in Sylhet belt which is also very active evergreen forest areas of very diverse plant genetic resources. In this belt also present is the most important water basin area (Beels) of the country which also has a number of aquatic PGR of importance as food. The Foot hills of Garo hills on the north of Netrokona have some forest areas, which has also inhabitation of Garo tribes. There are also some forest areas inside Dhaka division, which is called Madhupur Tract where a number PGR of economic importance are available. The last but the most important mangrove forests in the south of the country, the biggest in the world is Sundarban. The PGR resources available in it are not only diverse in look but also highly potential gene sources to support saline tolerant programme for the PGR of the upstream. The mangrove forest is not only the source of important PGR and biodiversity but also helps protection of the hinterland during cyclone and tidal bore, which is very frequent here in Bangladesh.

The Bangladesh Forest Research Institute located in Chittagong has the mandatory provision to work on all types of problems related to forest plant species and their maintenance. The department of forest has botanical gardens also. But a very low key contact of the BFRI and DoF (Department of Forest) creates some difficulties in the maintenance of the PGR for long time without having inbuilt mechanism in the main-frame. About the PGR other than the ones used as food and feed, the BFRI (Ministry of Forestry) and Bangladesh National Herbarium (Ministry of Agriculture) use to survey, monitor, make inventory, keep records of availability and loss of these PGR by the BFRI.









The participation of the BFRI as stakeholder of the PGRFA is also important because many of the PGR available in the forest eco-system has high value for food and income of the population. There are records of 486 + (plus) tree of 11 species being maintained in the field gene bank of the BFRI. After 2007 only 85 plus trees of three species were conserved. These were Teak, Teli garjan, Gamar, Dhekijam, Dholi garjan, Askashmony, Rubber, Hybrid acacia, Mahogany and Sissoo of two different species as indicated in Table 6. BFRI has a number of on-going project to conserve different species as well as to select plus trees. Among the projects, the important ones are: Buddha-bihar based tree biodiversity conservation, clonal selection and development of orchard for conservation, conservation of endangered forest tree species, community-based biodiversity conservation, Conservation of threatened species through domestication, establishment of seed orchard. Those project activities have resulted into selection of plus trees (Table 6), clonal selection and conservation of threatened species (Table 7). The Sundarban mangrove forest has special status in the context of Bangladesh and the biodiversity of the area has to be conserved under all circumstances. The BFRI has also special programme for conservation of species available in mangrove forests. According to the information (Table 8) available 23 species of 18 genera and 14 families have been under conservation process since 2011. According to the records in the Red Data book there are 105 species of 46 families which are reported by BNH, 2001 of the Red Data Book of the vascular plants of Bangladesh.

**Table 6.** Conservation of Plus tree of timber Tree species at BFRI

Species	Number of Plus trees selected		
	Up to 2007	After 2007	
1. Teak ( <i>Tectona Grandis</i> )	20	-	20
2. Teli garjan ( <i>Dipterocarpus terbinatus</i> )	X	80	80
3. Gamar ( <i>Gmelina arborea</i> )	20		20
4. Dhaki jam ( <i>Syzygium grande</i> )		30	30
5. Dholi garjan ( <i>Dipterocarpus pilosus</i> )		30	30
6. Akashmony ( <i>Acacia auriculiformis</i> )	45		45
7. Rubber ( <i>Hevea brasiliensis</i> )		32	32
8. Hybrid Acacia		86	86

9. Mahogany ( <i>Swietenia mahogany</i> )		78	78
10. Sissoo ( <i>Dalbergia sissoo</i> )		35	35
11. Sissoo ( <i>D. latifolia</i> )		30	30
Total Plus trees selected and maintained	85	401	486

### Diversity of timber trees in Bangladesh

			
(a) Akashmony	(b) Mahogany	(c) Garjan	(d) Gamar
			
(e) Sissoo	(f) Jackfruit	(g) Dhaki jam	(h) Teak
<b>Photo13.</b> Diversity of timber trees in Bangladesh, (a) Akashmony, (b) Mahogany, (c) Garjan, (d) Gamar (e) Sissoo, (f) Jackfruit, (g) Dhaki jam, (h) Teak.			



**Table 7.** List of threatened /endangered species conserved in the field and SR stations at BFRI (Source: August 2011; BFRI, Chittagong)

Sl. #	Common names	Scientific names	Sl. #	Common names	Scientific names
1	Haldu	<i>Adina cordifolia</i>	16	Gurja-batna	<i>Lithocarpus pachyphylla</i>
2	Boilum	<i>Anisoptera scaphula</i>	17	Menda	<i>Litsea monopetala</i>
3	Moos	<i>Brownlowia elata</i>	18	Raktan	<i>Lophopetalum frimbriatum</i>
4	Shil-batna	<i>Castanopsis indica</i>	19	Uri-am	<i>Mangifera sylvatica</i>
5	Gila-batna	<i>Castanopsis tribuloides</i>	20	Gandhi-gajari	<i>Miliusa velutina</i>
6	Barun	<i>Crataeva magna</i>	21	Kanaidinga	<i>Oroxylum indicum</i>
7	Hargaza	<i>Dillenia pentagyna</i>	22	Tali	<i>Palaquium polyanthum</i>
8	Dhali-garjan	<i>Dipterocarpus gracilis</i>	23	Banspata	<i>Podocarpus nerifolius</i>
9	Bandarhola	<i>Duabanga grandiflora</i>	24	Putranjiv	<i>Putrangiva roxburghii</i>
10	Udal	<i>Firmiana colorata</i>	25	Kanak	<i>Schima wallichii</i>
11	Kannyari	<i>Gardenia coronaria</i>	26	Dharmara	<i>Stereospermum personatum</i>
12	Chalmugra	<i>Gynocardia odorata</i>	27	Parul	<i>Stereospermum suaveolens</i>
13	Jawa	<i>Holigarna caustica</i>	28	Civit	<i>Swintonia floribunda</i>
14	Bhutum	<i>Hymenodictyon orixensis</i>	29	Toon	<i>Toona ciliate</i>
15	Bazna	<i>Lanthoxylum rhetsa</i>	30	Goda/awal	<i>Vitex peduncularis</i>
Number of endangered/threatened species = 30, genera = 28					

The Bangladesh National Herbarium has another list of plant species that are used for different medicinal purposes. The list is quite exhaustive and one interested in these genetic materials can become absorbed in the list and find quite valuable information on their production, productivity and the income potentials. The short list of the materials is given in table 8.

**Table 8.** Types, number of species, genera and families of the medicinal PGR in Bangladesh (Source: BNH).

Types	No. of species	Number of genera	Number of families
Herbs	328	226	85
Shrubs	121	61	38
Trees	166	120	49
Shrubs/Trees	5	4	4
Climbers/herbs	85	58	24
Climbers/shrubs	29	23	17
<b>Total</b>	<b>734</b>	<b>492</b>	<b>217</b>

These species invariably needs protection of the country system through protection act

### Diversity of Medicinal Plants in Bangladesh



(a)



(b)



(c)



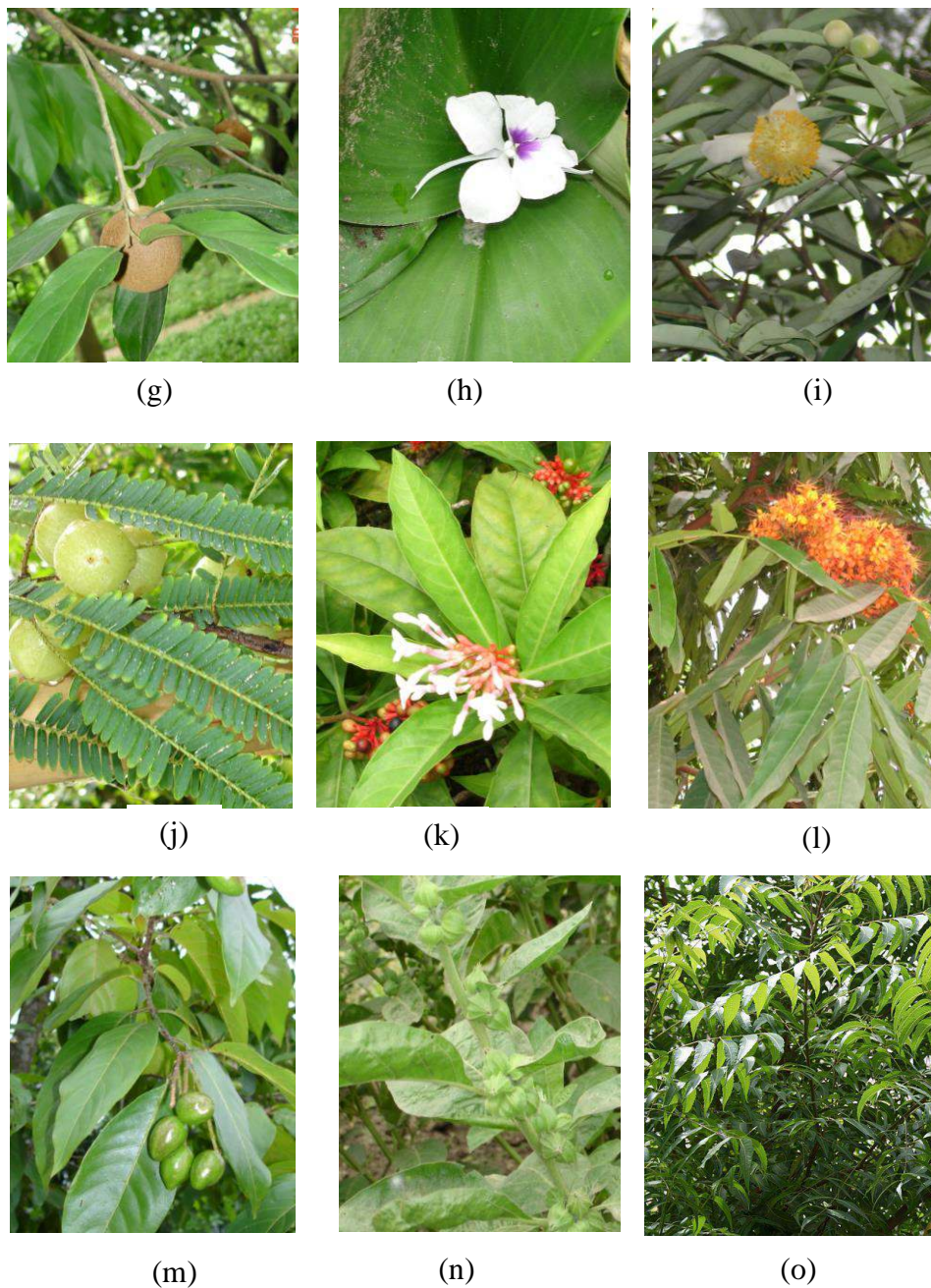
(d)



(e)



(f)



**Photo. 14.** Medicinal plants in Bangladesh. (a) *Abroma augusta* (L.) (Ulat Kambal), (b) *Acacia catechu* (L.f.) Willd (Khayer), (c) *Acorus calamus* L. (Bos kachu), (d) *Adhatoda vasica* Nees (Basok), (e) *Catharanthus roseus* (L.) G. Don (Nayan tara), (f) *Centella asiatica* (L.) Urban (Thankuni), (g) *Hydnocarpus kurzii* (King) Warb (Chaulmugra), (h) *Kaempferia galanga* L. (Akangkhi), (i) *Mesua ferrea* L. (Nagesswar), (j) *Phyllanthus emblica* L. (Amloki), (k) *Rauvolfia serpentina* (L.) Benth ex. Kurz (Sarpogandha), (l) *Saraca asoca* (Roxb.) de Wild. (Asok), (m) *Terminalia chebula* Retz., (n) *Withania somnifera* (L.) Dunal (Aswagandha), (o) Nim (*Azadirachta indica*).

## PGR of Ornamental Values

Bangladesh also has a large number of PGR of ornamental values which are being used at commercial levels. The products and their markets are available all round the years from areas like Jessore. There are farmers and groups of farmers linked with appropriate level at both regional and national level for marketing of the product they raise. Orchids and roses with many other seasonal flowers are having high market price, although the cost is also high for cultivation. The short list of the species genera and families of ornamentals as per records of the BNH are given in the Table 9.

**Table 9.** Types and number of species and genera and families of ornamentals available in Bangladesh.

Types	Number of species	Number of Genera	Number of families
Herbs	188	123	49
Shrubs	126	82	30
Tree	72	43	24
Orchids	179	71	
Total	565	319	
These species invariably needs protection of the country system through protection act			

### Diversity of Ornamental plants in Bangladesh



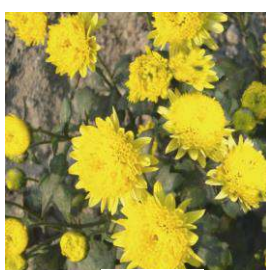
(a)



(c)



(d)



(e)



(f)



(g)



(h)



(i)



(j)



(k)



(l)

**Photo 15.** Ornamental plants in Bangladesh. (a) Gerbera (*Gerbera jamesonii*-2), (b) Gerbera (*Gerbera jamesonii*-1), (c) Gladiolus (BARI Gladiolus-3), (d) Anthurium (BARI Anthurium-1), (e) Chrysanthemum (BARI Chrysanthemum-2), (f) Lotus flower, (g) Water lily, (h) Marigold, (i) Dahlia, (j) Shefali, (k) Shimul, (l) Champa.

## PGR conserved at Sundarban Mangrove Forests of Bangladesh

The PGR at sundarban is the best resources of the nature that not only creates environment favourable for all of us in the hinterland but acts as the cyclone and tornado barriers/protectors for the coastal belts of the country. We are fortunate to have such a huge chunk of area under mangrove forests with very diverse plant genetic resources. BFRI has undertaken a programme to conserve many of the species that are being available in the area. The species being conserved are given in the list below (Table 10).

**Table 10.** Species conserved in the Sundarban mangrove forest of Bangladesh

Sl. No.	Common names	Scientific name	Family name	Sl.No,	Common names	Scientific name	Family name
1	Hargoza	<i>Acanthus ilicifolius</i>	Acanthaceae	13	Goran	<i>Ceriops decandra</i>	Rhizophoraceae
2	Tiger fern	<i>Acrostichum aureum</i>	Pteridaceae	14	Jhana	<i>Rhizophora mucronata</i>	Rhizophoraceae
3	Khalshi	<i>Aegiceras corniculatum</i>	Myrsinaceae	15	Shingra	<i>Cynometra ramiflora</i>	Leguminosae
4	Amur	<i>Amoora cucullata</i>	Meliaceae	16	Gewa	<i>Excoecaria agallocha</i>	Euphorbiaceae
5	Dhundul	<i>Xylocarpus granatum</i>	Meliaceae	17	Sundri	<i>Heritiera fomes</i>	Sterculiaceae
6	Pasur	<i>Xylocarpus mekongensis</i>	Meliaceae	18	Bhola	<i>Hibiscus tiliaceous</i>	Malvaceae
7	Sada baen	<i>Avicennia alba</i>	Avicenniaceae	19	Kirpa	<i>Lumnitzera racemosa</i>	Combretaceae
8	Morcha baen	<i>Avicennia marina</i>	Avicenniaceae	20	Golpata	<i>Nypa fruticans</i>	Palmae
9	Baen	<i>Avicennia officinalis</i>	Avicenniaceae	21	Hantal	<i>Phoenix paludosa</i>	Palmae
10	Kankra	<i>Bruguiera gymnorhiza</i>	Rhizophoraceae	22	Kewa katta	<i>Pandanus foetidus</i>	Pandanaceae
11	Kankra	<i>Bruguiera parviflora</i>	Rhizophoraceae	23	Keora	<i>Sonneratia apetala</i>	Sonneratiaceae
12	Bakul kankra	<i>Bruguiera sexangula</i>	Rhizophoraceae				
<b>Total numbers of species = 23, genera = 18, family = 14</b>							
<b>Source:</b> Divisional Officer, Mangrove Silviculture Division, Bangladesh Forest Research Institute (BFRI), Muzgunni, Khulna.							

### Diversity of Mangrove Forests in Bangladesh



(a)



(b)



(c)



(d)



(e)



(f)

**Photo 16.** Mangrove forests in the Sundarban of Bangladesh (a-f).

## **B. PGR of Livestock Fodder**

Livestock is an important sub-sector of Agriculture. This sub-sector contributes to the national health needs, economic development through not only milks and milk products but also through hides and skins of variable grades and dimensions. The product value is quite high and requires special attention particularly in respect of health management of individuals as well as the herds of different numbers. The livestock such as cattle, beef cattle, milk cow, goats, poultry birds of different farming types require a number of plant species of special nature as feeds and fodder. These fodder species although belong to the PGR but not directly to PGRFA. There are relatives of the PGRFA which are valuable feeds and fodder species.

Another important need of the PGR for livestock is the medicinal values of many of these species which are very helpful in combating different livestock diseases. The nutritional inadequacy also creates many health disorders in the livestock herds as in the case of human. The rural settings of rearing the livestock and birds of all types call for feeds and fodder species that can support better nutrition and effective disease-prevention. Bangladesh Livestock Research Institute has participated in the NISM-GPA data base studies including the Priority Activity Areas. Many of the information suggested the necessity of organizing the PGR activities with emphasis on the needs of livestock. The Institute itself has an area at Savar, Dhaka and planted with a number of PGR species that has both medicinal values and important fodder quality. There were 26 varieties identified before 2007 and 32 by 2011 and all are conserved in field gene bank (Table 11).

According to its participation in the data base including comments the following important points need serious and immediate considerations.

1. Organized study on the potentials of PGR in respect of nutrient contents in the portion used as fodder as well as feeds including determination of toxins, if any.
2. Organized conservation strategy and plans for active field lab samples and preservations of seeds/tissues materials for ex-situ conservation.



3. Development of protocols and on-farm conservation locations in important fodder crop zone of the country for local level conservation of important and threatened species.
4. Specialized lab and garden support provisions including outsourcing to study and conserve species of special interest. This will need adequate fund and manpower support initially as project to be absorbed in the revenue with the main-frame BLRI.

**Table 11.** List of PGR conserved at BLRI for use as fodder and feed sources of Livestock

1. BLRI- Napier-1 (*Pennisetum purpureum-Bajra*);
2. BLRI- Napier-2 ( *Pennisetum purpureum var. L- Arusa*)
3. BLRI -Napier -3 (*Pennisetum purpureum var. L- hybrid*)
4. Andropogon ( *Andropogon gyanus*)
5. Pangola (*Digitaria decumbens*),
6. Para (*Brachiara mutica*).
7. Splendida ( *Setaria splendida*) –line 1, line -2, line-3
8. Ruzi (*Brachiaria ruziziensis*)
9. Jumbo ( *Hybrid sorghum*)
10. Guinea (*Panicum maximum*)
  - a. Guinea -1
  - b. Guinea-2 (Soft)
  - c. Guinea -3 (Hard)
11. Signal (*Brachiaria decumbens*)
12. German (*Echinochloa crousali*)
13. Buffel (*Cenchrus ciliaris* )
14. Dal grass ( *Hymenachne psedointerruta*)
16. Baksha
17. *Desmodium intortum*
18. Paspalum: *Paspalum plicatulum cv paspalum*
19. Plicatulum *Paspalum plicatulum*
20. Orchard grass
21. Super Hayati
22. Tall fescue
23. Rhodes grass

**Perennial legumes:**

1. Centro (*Centrosema pubescens*),
2. Stylo (*Stylosamthes guiannensis*),

3. Ipil-ipil (*Leucaena leucocephala*),
4. Tropical Kurdzo
5. *Arachis pintoi*

**Tree fodder :**

1. Gliricidia ( *Gliricidia sepium*)
2. Dumor ( Deshi)
3. Dumor ( Malaysian)



**Photo 17.** Fodder germplasm (Napier, Splendida, Paspalum).

## Chapter 6

### Capacity Building and Project Management Activities

#### A. The stakeholders' capacity

##### (i) Manpower

In almost all cases of NISM-GPA format filling and submitting the information it was observed that the lack of manpower and finance have been recorded as the important problem. These two issues could be seen in the tables prepared to show the availability of the staff member and their level of qualification for each of the stakeholders (Table 12 and 13).

**Table 12.** Number of manpower of the stakeholder in the fields of PGRFA (as reported in August 2011)

SN	Organization	Number of manpower				
		SO	SSO	PSO	CSO	Total
1	BARI	12	4	4	1	21
2	BRRRI	6	2	1	1	10
3	BJRI	1	1	1	1	4
4	BINA	-	-	-	-	None
5	BSRI	4	1	-	2	7
6	BFRI	-	1	-	-	1
7	BLRI	1	1	-	-	2
8	BADC	-	-	-	-	None
9	CDB	3	2	-	-	5
10	DACB	2	1	2	0	5
11	BAU	1	4	-	-	5
12	BSMRAU	-	4	3	14	21
13	SAU	1	-	2	4	7
14	SCA <sup>c</sup>	4	1	1	-	6
15	Lal Teer Seed <sup>d</sup>	7	4	2	1	14
16	Supreme Seed.	-	-	-	-	None

<sup>a)</sup> SO, SSO, PSO and CSO are Scientific, Senior Scientific, Principal Scientific & Chief Scientific Officers respectively.

<sup>b)</sup> Respective designations at university level should be Lecturer, Assistant Professor, Associate Professor and Professors

<sup>c)</sup> SCA =Variety Testing Officer, Senior Variety Testing Officer, Deputy Director

(VT) will be in place of SO, SSO, PSO.

<sup>d</sup>Lal Teer Seed Ltd. = Assistant Plant Breeder, Plant Breeder, Senior Plant Breeder, Chief Plant Breeder will be in place of SO, SSO, PSO, CSO.

However, the other indication of capability to organize project works, has been discussed elaborately in the Chapter 4 of this report.

**Table 13.** Qualifications of manpower working in different fields of PGRFA

SN	Organization	Number of manpower with qualifications				
		PhD	MS	BS	Technician	Total
1	BARI	2	17	2	2	23
2	BIRRI	12	14	-	6	32
3	BJRI	-	-	-	-	None
4	BINA	1	1	-	-	2
5	BSRI	-	-	-	-	None
6	BFRI	-	-	-	-	None
7	BLRI	1	1	1	1	4
8	BADC	-	-	-	-	None
9	CDB	-	2	3	-	5
10	DACB					None
11	BAU	Not available				
12	BSMRAU	17	4	-	-	21
13	SAU	4	4	15	2	25
14	SCA	-	4	2	-	6
15	Lal Teer Seed Ltd.	1	2	-	1	3
16	Supreme Seed Co. Ltd.	-	-	-	-	None
17	BRAC					
18	BNH					
	Total	36	49	23	12	

The degrees are not necessarily on PGR but mostly on Genetics & Plant Breeding.

The organizations having no manpower for works on PGRFA are getting supports of Plant Breeders and Geneticists available in the department or division of the University or Institute. However, the picture of the resource managing manpower indicates that the public fund support for this subject is at its lowest. Capability and credibility of the scientists engaged are quite high but the time period, number of staff and the funds are inadequate. In respect of the qualification of scientific staff members of different stakeholders' institution it has been observed that the information has been given without attention to the correctness of the data. There is imbalance in the number of staff available and the number with qualifications. This has been the case because of the gaps in information collection system, which needs to be corrected for future use.

### **(ii) Linkage with in-country and international organizations**

The stakeholders during the period from 2007 to 2011 did not provide any new contact with in-country (Table 14) and out-side country (Table 15). This indicates that the information collection and participations of the stakeholders were not as expected. In future, these issues should be carefully planned. However, these old contacts remain in operation during the period from 2007 to 2011.

**Table 14.** NARS institutes with MoUs with other national PGR related organizations

<b>NARS institutes</b>	<b>Organizations within the country having MoUs</b>	<b>Purpose</b>	<b>Status of collaboration</b>
Bangladesh Agricultural Research Institute	A. East West Seed (Bd) Ltd, B. Supreme Seed Co., C. Omni Group, D. PRAN Group, E. GETC Agro Vision	F. PGR utilization, Seed production & marketing G. PGR utilization, Seed production & marketing H. PGR utilization, Seed production & marketing I. PGR utilization, Seed production & marketing J. PGR utilization, Seed production & marketing	K. On-going L. On-going M. On-going N. On-going O. On-going
Bangladesh Rice Research Institute	P. BRAC (NGO) Q. GKF (NGO) R. Syngenta (multinational company) S. Padakhep (NGO) T. 7 (Seven ) national universities U. 15 (Fifteen) Private Co./NGOs	V. Seed production W. Seed Production X. Seed production Y. Seed Production Z. Germplasm exchange AA. Seed Production	BB. On-going CC. On-going DD. On-going EE. On-going FF. On-going GG. Under process
Bangladesh Jute Research Institute	HH. East West Seed (Bd) Ltd	II. Seed production	JJ. On-going

Bangladesh Sugarcane Research Institute	KK. BINA LL. BARI MM. BRRI NN. BJRI OO. BAU PP. BSMRAU	QQ. Collaboration on seed production and collaborative research	RR. On going - -
Bangabandhu Sheikh Mujibur Rahman Agricultural University	A. Bangladesh Agricultural Research Institute B. Bangladesh Rice Research Institute C. ACI D. Kyushu University, Japan E. Asian Vegetable Research and Development Centre F. International Crops Research Institute for the Semi-Arid Tropics	G. Germplasm exchange H. Germplasm exchange I. Under process J. Germplasm exchange K. Germplasm exchange L. Germplasm exchange	
Bangladesh Livestock research Institute	M. Milk Vita	N. Napier cutting supply	On-going
	O. CIMMYT	P. Triticale as fodder and feed production	On-going
	Q. BRAC	R. Seed/cutting supply of fodder crops	On-going
	S. Youth Training Centre	T. Seed/cutting supply of fodder crops	On-going
	U. MCC	V. Seed/cutting supply of fodder crops	On-going

### (iii) Project activities of the stakeholders

There is a complete chapter on this issue (Chapter 4). In order to understand the capability of the stakeholders' one can see the projects of these organizations which have been operating since long even with limited qualified man-power facilities (Tables 4, 5 and 13). The BARI, BRRI, BFRI, BJRI, BADC, CDB, SCA and Lal Teer ltd. have conducted 47, 38, 34, 28, 09, 09, 06 and 24 projects respectively covering different priority areas of GPA for PGRFA.

**Table 15.** International linkages for PGRFA networks showing Bangladesh participation

Name	Acronym	Network activity description	Network national focal point
Bioversity (former International Plant Genetic Resources Institute (South Asian Region))	Bioversity	Sharing information and technical cooperation in PGR	BARI
International Network for Genetic Evaluation of Rice	INGER	International germplasm trials	BARI
Coconut Genetic Resources Network	COGEN	Coconut germplasm collection and training	
International Centre for Maize and Wheat Improvement	CIMMYT	International trials with breeding lines of wheat and maize and technical cooperation.	Wheat Research Centre, BARI
Asian Vegetable Research and	AVRDC	Trials and exchange of	Horticultural

Development Centre		vegetable germplasm / breeding lines.	Research Centre, BARI
International Potato Centre	CIP	International trials and germplasm exchange of potato.	Tuber Crops Research Centre, BARI
International Crops Research Institute for the Semi-Arid Tropics	ICRISAT	International trials and sharing of breeding lines of pulse crops	Pulses Research Centre, BARI
International Rice Research Institute	IRRI	International trials, exchange of germplasm and technical cooperation involving rice.	Bangladesh Rice Research Institute (BRRI)
Rice Wheat Consortium	RWC	Development of rice-wheat cropping systems	BARI and BRRI
International Jute Study Group Organization	IJSG	Sharing of germplasm and technical cooperation	Bangladesh Jute Research Institute (BJRI)
Tropical Asia Maize Network	TAMNET	Germplasm evaluation of hybrid maize.	Bangladesh Agricultural Research Institute.
Common Fund for Commodity	CFC	Sugarcane germplasm exchange	BSRI
International Network for Banana And Plantain	INIBAP	Collection and conservation of banana germplasm	Bangladesh Agricultural Research Institute.

#### **(iv) Project Achievements in 2011**

The planned activities and level of achievements are summarised in Table 16. From the information of table it was clear that only recommendation or plan for activities were not adequate to serve the PGRFA. Actions are required for Enhancing Conservation and sustainable Use of Plant genetic Resources.

#### **(v) The Activity Report (2009-2011) of the Project on “Capacity Building and Regional Collaboration for Enhancing the Conservation and Sustainable Use of PGR in Asia”**

The National Focal Point at BARC has organized two training workshops and two review meetings covering the period from January 2010 to September 2011. In June 2011 the Chief Technical Officer of the project was available in the programme to discuss the issues of the PGRFA activities in Bangladesh. The completed activities have been summarized in the Table 16. The total number of participants in different meetings was 146 representing 20 stakeholders’ organizations of the country including BARC. The final compilation of the report of stakeholders and that of the BARC has been done. The NFP has completed the planned activities and recorded in the report.

**Table 16.** Activity Report (2010-2011) of the project “Capacity Building and Regional Collaboration for Enhancing the Conservation and Sustainable use of Plant Genetic Resources in Asia” Funded by FAO

Date of activities	Type of activities	Title of activities	Organizations participated	No.
18-19 July 2010	Training Workshop	Training programme on data collection and data management of NISM-GPA and PGR activities	BARC, BADC, DAE, BARI, BRRI, BSRI, BLRI, BJRI, BFRI, BINA, BTRI, BNH, CDB, SCA, Lal Teer, SAU. BAU, DU, BSMRAU, ACI ltd, Supreme seeds ltd.	44
30 August 2010	Review Meeting	Review meeting on Institutional Focal points on the progress of PGR Information	BARC, BADC, DAE, BARI, BRRI, BSRI, BLRI, BJRI, BFRI, BINA, BTRI, BNH, CDB, SCA, Lal Teer, SAU. BAU, DU, BSMRAU, ACI ltd, Supreme seeds ltd.	20
01-02 November 2010	Training Workshop	Review workshop on updated NISM-GPA activities	BARC, BADC, DAE, BARI, BRRI, BSRI, BLRI, BJRI, BFRI, BINA, BTRI, BNH, CDB, SCA, Lal Teer, SAU. BAU, DU, BSMRAU, ACI ltd, Supreme seeds ltd.	40
16 May, 2011	Review meeting	Review meeting on Institutional Focal points on the evaluation of the updated GPA data of different organizations progress of PGR Information	BARC, BFRI, BAU-GPC, BADC, DAE, BARI, BRRI, BSRI, BLRI, BJRI, BFRI, BINA, BNH, CDB, Lal Teer,. BAU, SAU, BSMRAU, Supreme seeds co. ltd.	22
15, June, 2011	Review Meeting	Progress review of updated GPA data of different organizations in presence of Chief Technical adviser of the project	BRAC, FAO-RAP, BAU,SAU,BSMRAU,BARI,BRRI, BINA, CDB, SCA, BFRI, BLRI, BJRI, BSRI, BNH, Supreme Seed Co.ltd, Lal teer Seed ltd.	20
				146

Details of the activities of the project are given here.

### **1. First Training-workshop on “Collection and Management of PGR Data”**

A two-day long training-workshop on the **“Collection and Management of PGR Data”** was organized by Bangladesh Agricultural Research Council during July 18-19, 2010 under the project entitled “Capacity Building and Regional Collaboration for Enhancing the Conservation and Sustainable use of Plant Genetic Resources in Asia”. A total of 44 participants from the following organizations (stakeholders) attended the programme.



1. Bangladesh Agricultural Research Council (BARC)
2. Bangladesh Agricultural Research Institute (BARI)
3. Bangladesh Rice Research Institute (BRRI)
4. Bangladesh Institute of Nuclear Agriculture (BINA)
5. Bangladesh Sugarcane Research Institute (BSRI)
6. Bangladesh Jute Research Institute (BJRI)
7. Bangladesh Livestock Research Institute (BLRI)
8. Bangladesh Tea Research Institute (BTRI)
9. Bangladesh Forest Research Institute (BFRI)
10. Cotton Development Board (CDB)
11. Bangladesh Agricultural University (BAU)
12. Sher-e-Bangla Agricultural University (SAU)
13. Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU)
14. Bangladesh Agricultural Development Corporation (BADDC)
15. Seed Certification Agency (SCA)
16. Department of Agriculture Extension (DAE)
17. Bangladesh National Herbarium (BNH)
18. University of Dhaka (DU)
19. Supreme Seed Co. Ltd.
20. Lal Teer Seed Ltd.

Honourable Chief Guest, Mr. C Q K Mustaq Ahmed, Secretary, Ministry of Agriculture, Government of the Peoples Republic of Bangladesh formally inaugurated the training-workshop held under the Chairmanship of Dr. Wais Kabir, Executive Chairman, Bangladesh Agricultural Research Council. Mr. Ad. Spijkers, FAO Representative in Bangladesh, was present as Special Guest. Dr. Md. Khalequzzaman A. Chowdhury, Member Director (Crops) and the National Focal Point of PGRFA, welcomed the participants and highlighted the objectives of the Training-Workshop. Dr. Chowdhury mentioned that the plant genetic resources are the key components of any agricultural production systems of any eco-system. Therefore, conservation and proper management of plant genetic resources are very important. The intense pressure on plant genetic resources will continue to increase unless appropriate measures for conservation and sustainable uses are undertaken.

Mr. Mustaq Ahmed congratulated Bangladesh Agricultural Research Council for arranging such type of important workshop. He stated that in recent years population pressure leads to over exploitation of natural resources, frequent natural calamities, and shifting cultivation threatens plant genetic resources (PGR), which hampers crop improvement. Effective conservation, exchange and use of PGR could help develop new crop variety for sustainable crop production. He strongly believed that this training workshop would be very effective for those who are dealing with PGR by acquiring updated knowledge of conservation, characterization, utilization and use of PGR.

## **2. Second Training-workshop on the “National Information Sharing Mechanism-Global Plan of Action Database”**

A two-day long training-workshop on the “**National Information Sharing Mechanism-Global Plan of Action Database**” was organized by Bangladesh Agricultural Research Council during November 1-2, 2010. A total of 40 participants from the aforesaid organizations (stakeholders) attended the programme. Dr. Wais Kabir, Executive Chairman, Bangladesh Agricultural Research Council formally inaugurated the training-workshop as Chief Guest. Dr. Md. Khalequzzaman A. Chowdhury, Member Director (Crops) and the National Focal Point of PGRFA chaired the programme. Dr. Chowdhury highlighted the importance of collecting and preserving information on plant genetic resources to enhance crop production.

## **3. First Review Meeting of the Institutional Focal Points**

The first review meeting of the Institutional Focal Points was organized by Bangladesh Agricultural Research Council on August 30, 2011. A total of 20 participants from the stakeholders organizations attended the meeting.

Dr. Md. Khalequzzaman A. Chowdhury presided over the review meeting. The progress of PGR information was discussed in the meeting. The participating focal points selected/scrutinized updated GPA information of different organizations.

#### 4. Second Review Meeting of the Institutional Focal Points

The second review meeting of the Institutional Focal Points was organized by Bangladesh Agricultural Research Council on May 16, 2011. A total of 22 participants from the stakeholders organizations attended the meeting.

Dr. Md. Khalequzzaman A. Chowdhury presided over the meeting. The progress of PGR information was discussed in the meeting. The institutional focal points evaluated all updated GPA data of different organizations.

#### 5. Third Review Meeting of the Institutional Focal Points

The third review meeting of the Institutional Focal Points was organized by Bangladesh Agricultural Research Council on June 15, 2011. A total of 20 participants from the stakeholder organizations attended the meeting.

Dr. Md. Khalequzzaman A. Chowdhury presided over the meeting. The progress of PGR information was discussed in the meeting in presence of Dr. Duncan Vaughan, Chief Technical Adviser of the project. Dr. Chowdhury, participating institutional focal points and Chief Technical Adviser discussed in details the updated GPA information of different organizations.



(a)



(b)



(c)



(d)

**Photo18.** Training-Workshop (a-d) held at BARC.

## 6. Development an website on PGRFA Bangladesh.

A new website of National Information Sharing Mechanism on GPA Implementation has been established ([www.barc.gov.bd/pgdfa](http://www.barc.gov.bd/pgdfa)). All kinds of information related to PGR is available in this website.

The image displays two screenshots of the website for the National Information Sharing Mechanism on GPA Implementation. Both screenshots show the website's header with the BARC logo and navigation tabs for 'DOWNLOADS', 'GALLERY', and 'CONTACTS'. The left screenshot shows the 'What is National Mechanism?' page, which includes a search bar, a 'Main Menu' sidebar, and a central text area describing the mechanism's objectives and goals. It also features a 'National Link' section with links to various documents and an 'International link' section. The right screenshot shows the 'The National Focal Point' page, which includes a search bar, a 'Main Menu' sidebar, and a central text area detailing the role of the National Focal Point. It also features a 'National Link' section with links to various documents and an 'International link' section. Both screenshots include images of mangoes and a map of Bangladesh.

## Literature consulted

- Khan.M.S and Fariduddin, A. 2000. Plant genetic resources of Bangladesh, Dhaka, Bangladesh: Study supported by BAAG, Winrock International & BARC.
- Khan. M.S., Rahman. M.M., and Ali. M.A. (eds.) 2001. Red Data Book of Vascular Plants of Bangladesh. Bangladesh National Herbarium, Dhaka. p 179.
- Islam, K.H. K. Fatema, M.M. Rahman and M.N.Islam 2011. Nursery Industry in Bangladesh: Quality Planting material Seed Bank and Food security. Seed Congress and Fair 2011, Dhaka, Bangladesh. Seed Wing, MoA, BSA and SAARC Agriculture center Dhaka page 62-69).
- Razzaque, M.A. 2007. Final report on the establishment of the National Information Sharing Mechanism (NISM) on the implementation of the Global Plan of Action (GPA) for the Conservation and Utilization of Plant genetic Resources for Food and Agriculture (PGRFA) in Bangladesh. FAO Field Document No. 2007/04, AG-GCP/RAS/186/JPN
- Rahman, L. 1977. Crop production policy, human nutrition and status of production and Research on Oilseeds and Pulses in Bangladesh (invited paper). Proc. Sem. on Sci. and Techn. in Agric., BARC. 49-63).
- Rahman. L. 2008. Plant Genetic Resources for Food Security in Bangladesh. Keynote paper in the Proceedings National workshop on conservation and utilization of Plant genetic resources. June 17-18, 2008, BARI, Joydebpur, Gazipur. 1-15pp.
- Zaman, S.M. H. 2005. Plant genetic Resources in SAARC Countries: Their conservation and Management. Second Edition 2005. Chapter 3

### List of Annexures (1-3)

**Annex-1:** Crop acreage-wise seed requirement and supply target from public and private sectors during 2010-2011

Crops	Acreage '000ha	Seed Need M.ton	Seed Supply	Seed deficit	Supply %
<b>1. Rice: Total</b>	<b>11542</b>	<b>301885</b>	<b>129102</b>	<b>172783</b>	<b>43</b>
Aus: HYV	800	20,000	3970	16030	20
Local	325	11,375	0	11375	0
<b>Total Aus</b>	<b>1125</b>	<b>31375</b>	<b>3970</b>	<b>27405</b>	<b>13</b>
T.Aman:HYV	3990	99750	51691	48059	52
Local	1212	42420	505	41915	1
<b>Total T.Aman</b>	<b>5202</b>	<b>142170</b>	<b>30972</b>	<b>111198</b>	<b>22</b>
B.Aman	415	14420	3	14417	0
Boro:HYV	5092	102300	91776	10524	90
Hybrid	658	9870	2271	7599	24
Local	50	1750	110	1640	6
<b>Total Boro</b>	<b>4800</b>	<b>113920</b>	<b>94157</b>	<b>19763</b>	<b>83</b>
Wheat	373	45000	36685	8315	82
Maize	228	4560	1369	4530	30
<b>2. Jute Total</b>	<b>769</b>	<b>6419</b>	<b>1605</b>	<b>6394</b>	<b>25</b>
Deshi	89	979	625	915	64
Tosha	680	5440	980	5422	18
<b>3. Pulses Total</b>	<b>640</b>	<b>22210</b>	<b>2347</b>	<b>19863</b>	<b>11</b>
Lentil	161	5635	1070	4565	19
Mungbean	163	4075	738	3337	18
Chickpea	6	300	110	190	37
Blackgram	50	1500	290	1210	19
Grasspea	250	10000	101	9899	1
Pea	10	700	38	662	5
<b>4. Oilseeds</b>	<b>712</b>	<b>16270</b>	<b>1696</b>	<b>14574</b>	<b>10</b>
Mustard	481	4810	1224	3587	25
Groundnut	90	8550	213	8338	2
Sesame	76	760	153	608	20
Soybean	60	2100	105	1996	5
Others	5	50	3	47	6
<b>5. Vegetables</b>	<b>718</b>	<b>4100</b>	<b>388</b>	<b>3712</b>	<b>9</b>
Winter	463	2315	242	2073	10
Summer	255	1785	146	1639	8
<b>6. Spices</b>	<b>506</b>	<b>156906</b>	<b>128</b>	<b>156778</b>	<b>0.0</b>
Onion	177	1062	52	1010	5
Garlic	61	30500	0	30500	0
Ginger	16	32000	0	32000	0
Turmeric	37	92500	0	92500	0
Chilli	180	144	0	144	0
Corriander	35	700	76	624	11
<b>7. Seed Potato</b>	<b>477</b>	<b>477000</b>	<b>17341</b>	<b>459659</b>	<b>4</b>
<b>Crops total</b>	<b>15965</b>	<b>1034350</b>	<b>190661</b>	<b>846608</b>	<b>18% of Need</b>

Source: Seed Wing, Ministry of Agriculture

**Annex-2:** Status of the use of PGR by different stakeholder organizations during 2007-2011

Stakeholder	Name of crop	No. PGR accessions in 2007	No. of PGR accessions in 2011	Breeding use of 2011 stock	Seed Enhancement	Supply to others	
BARI	Wheat	02	602	100	-		
	Foxtail millet	200	515	-	01		
	Proso millet	185	197	-	01		
	Sorghum		185	-	-		
	Maize		92	-	13		
	Barley		54	24	-		
	Buck wheat		5	-	-		
	Triticale		5	-	-		
	Pearl millet		2	-	-		
	Teff		2	-	-		
	Oat		1	-	-		
	Marua		1	-	-		
	Grass pea			1793	-	402	
	Chickpea	100		760	74	-	
	Lentil			412	-	102	
	Blackgram			62	-	03	
	Pigeon pea			79	-	-	
	Mung bean			87	85	01	
	Horse gram			32	-	-	
	Cowpea			29	03	-	
	Pea			153	45	03	
	Mustard			198	29	02	
	Sesame			86	85	-	
	Soybean			50	30	-	
	Sunflower			48	-	-	
	Ground nut			23	-	-	
	Lin seed			18	-	-	
	Niger			3	-	-	
	Castor (Veranda)			1	-	-	
	Amaranth	21		664	75	37	
	Hyacinth bean	05		550	13	10	
	Sweet Gourd	07		449	-	17	
	Brinjal	09		257	-	-	
	Bottle gourd	05		304	-	17	
	Okra	31		223	-	-	
	Ash gourd	05		204	-	-	
	Sponge gourd			150	20	-	
	Yard long bean			171	20	-	
	Ridge gourd			138	-	-	
	Snake gourd	05		134	-	-	
	Bitter gourd	05		37	10	03	
Tomato			63	50	01		
Cucumber			59	-	-		
Indian spinach			34	-	-		
Spinach			33	-	03		
Faba bean			13	-	-		

	Radish		30	-	03	
	French bean		17	-	09	
	Rice bean		6	-	-	
	Sorrel		6	-	-	
	Sword bean		5	-	-	
	Batisak		3	-	-	
	Bush bean		3	-	-	
	Chinese cabbage		3	-	-	
	Cabbage		2	-	-	
	Butterfly pea		1	-	-	
	Cauliflower		1	-	-	
	China shak		2	-	-	
	Gima kalmi		1	-	-	
	Lia sak		14	-	-	
	Wild brinjal		1	-	-	
	Winged bean		1	-	-	
	Zhar seem		1	-	-	
	Napa sak		1	-	-	
	Velvet bean		1	-	-	
	Chili	05	134	104	03	
	Coriander		18	-	07	
	Black cumin		6	-	02	
	Fenugreek		4	04	-	
	Joein		1	-	-	
	Sulfa		1	-	-	
	Postodana		1	-	-	
	Musk melon		91	20	03	
	Yam bean		1	-	-	
	Tobacco		23	-	-	
	Sun hemp		5	-	-	
	Jute		7	-	-	
	<b>Total</b>	<b>590</b>	<b>9368</b>	<b>791</b>	<b>643</b>	
BRI	Rice	6259	7290	665	7290	6790
BTRI	Tea	475	-	-	-	
CDB	Cotton	490	467	60	5	Farmers
BSRI	Sugarcane	902	1091	325	6.1 tons	*
BJRI	Jute (Corchorus capsularis)	2368	2400	266	447	252
	Jute (C. olitorius)	1465	1498	1724	529	599
	Wild Corchorus	278	282	11	245	-
	Kenaf	675	675	203	702	51
	Mesta	453	476	24	315	56
	Wild Hibiscus	310	310	25	49	17
	Allied genera	252	252	-	-	-
	Interspecific	1	118	-	-	-



	hybrid derivatives					
	Rice	300	1000	300	200	25
	Mustard	35	30	15	15	0
	Sesame	0	21	7	14	0
	Soybean	0	70	8	62	10
	Groundnut	42	75	15	50	0
	Mung bean	100	140	10	40	0
	Lentil	150	190	8	60	0
	Chickpea	0	65	25	20	15
	Tomato	0	34	12	15	0
	Jute	0	11	3	11	0
	Onion	0	30	13	0	0
	<b>Total</b>	<b>627</b>	<b>1666</b>	<b>416</b>	<b>487</b>	<b>50</b>
Lal Teer Seed Limited	Bitter Gourd	800	800	720	√	-
	Bottle Gourd	730	730	450	√	-
	Ridge Gourd	150	150	120	√	-
	Watermelon	34	34	34	√	-
	Pumpkin	842	842	642	√	-
	Snake Gourd	112	112	110	√	-
	Cucumber	200	200	200	√	-
	Ash Gourd	631	631	600	√	-
	Tomato	1200	1200	1200	√	-
	Chili	200	200	130	√	-
	Brinjal	800	800	600	√	-
	Onion	112	112	80	√	-
	Radish	120	120	120	√	-
	Cauliflower	60	60	53	√	-
	Yard Long Bean	26	26	25	√	-
	Okra	123	123	120	√	-
	Hyacinth Bean	16	16	16	√	-
	Stem Amaranth	6	6	6	√	-
	Papaya	29	29	29	√	-
	Leaf Amaranth	8	8	8	√	-
Spinach	14	14	14	√	-	
Indian Spinach	8	8	8	√	-	
Kangkong	6	6	6	√	-	
Coriander	12	12	12	√	-	
	<b>Total</b>	<b>6239</b>				
BSMRAU	Rice	95				
	Total	6239				
	Pea	88				
	Radish	20				
	Mung bean	100				
	Black gram	50				
	Chick pea	25				
	Snake Gourd	27				
	Rapeseed	22				
	Pumpkin	28				
	Ginger	19				
	Onion	38				
	Brinjal	84				
	Ash Gourd	46				
	<b>Total</b>	<b>547</b>				



**Annex-3:** Number of varieties released by different stakeholder organizations up to 2011.

Stakeholder	Name of crop	Scientific name	No. of varieties released prior to 1996	No. of Varieties released after 1996 upto 2007	No of varieties released after 2007 till 2011
BARI	Wheat	<i>Triticum aestivum</i>	18	06	2
	Maize	<i>Zea mays</i>	4	13	2
	Proso Millet	<i>Panicum miliaceum</i>	1	0	-
	Foxtail Millet	<i>Setaria italica</i>	1	2	-
	Barley	<i>Hordeum vulgare</i>	2	4	-
	Mustard	<i>Brassica spp.</i>	4	11	1
	Sesame	<i>Sesamum indicum</i>	1	1	2
	Groundnut	<i>Arachis hypogaea</i>	4	4	1
	Sunflower	<i>Helianthus annuus</i>	1	1	
	Niger	<i>Guizotia abyssinica</i>	1	-	-
	Mung Bean	<i>Vigna radiata</i>	2	4	-
	Chickpea	<i>Cicer arietinum</i>	3	5	-
	Blackgram	<i>Vigna mungo</i>	1	2	-
	Lentil	<i>Lens culinaris</i>	2	4	-
	Grasspea	<i>Lathyrus sativus</i>	1	1	-
	Onion	<i>Allium cepa</i>	0	3	2
	Methi	<i>Trigonella foenumgraceum</i>	0	2	-
	Turmeric	<i>Curcuma domestica</i>	2	1	-
	Garlic	<i>Allium sativum</i>	0	2	-
	Chilli	<i>Capsicum frutescens</i>	0	1	-
	Tomato	<i>Lycopersicon esculentum</i>	5	11	3
	Potato	<i>Solanum tuberosum</i>	15	13	4
	Sweet Potato	<i>Ipomoea batatas</i>	5	2	2
	Taro	<i>Colocasia esculenta</i>	2	0	2
	Brinjal	<i>Solanum melongena</i>	3	5	2
	Cabbage	<i>Brassica oleracea var. capitata</i>	1	1	-
	Cauliflower	<i>Brassica oleracea var botrytis</i>	0	2	-
	Radish	<i>Raphanus sativus</i>	2	2	-
	Bottle Gourd	<i>Lagenaria siceraria</i>	0	2	2

Stakeholder	Name of crop	Scientific name	No. of varieties released prior to 1996	No. of Varieties released after 1996 upto 2007	No of varieties released after 2007 till 2011
	Bitter Gourd	<i>Momordica charantia</i>	0	1	-
	Ash Gourd	<i>Benincasa hispida</i>	0	2	-
	Pointed Gourd	<i>Trichosanthes anguina</i>	0	2	-
	Hyacinth Bean	<i>Lablab purpureus</i>	0	4	1
	Garden Pea	<i>Pisum sativum</i>	0	3	-
	Yard Long Bean	<i>Vigna sinensis</i>	0	1	-
	French Bean	<i>Phaseolus vulgaris</i>	0	2	-
	Okra	<i>Hibiscus esculentus</i>	0	1	-
	Kangkong	<i>Ipomoea raptans</i>	1	0	-
	Indian spinach	<i>Basella alba</i>	0	2	-
	Amaranth	<i>Amaranthus spp.</i>	0	4	-
	Guava	<i>Psidium quajava</i>	0	3	-
	Papaya	<i>Carica papaya</i>	1	0	-
	Mango	<i>Mangifera indica</i>	0	4	4
	Litchi	<i>Litchi sinensis</i>	0	3	1
	Sapota	<i>Achras sapota</i>	0	2	1
	Orange	<i>Citrus sinensis</i>	0	1	-
	Pommelo	<i>Citrus maxima</i>	0	4	-
	Taikaar	-	0	1	-
	Coconut	<i>Cocos nucifera</i>	0	2	-
	Lemon	<i>Citrus spp.</i>	0	3	-
	Jamrul	<i>Syzygium samarangense</i>	0	1	-
	Longan	<i>Dimocarpus longan</i>	0	1	1
	Banana	<i>Musa spp.</i>	0	4	1
	Kul (Jujuba)	<i>Zizyphus mauritiana</i>	0	2	1
		<b>Total</b>	-	<b>83</b>	<b>158</b>
BRI	Rice	<i>Oryza sativa</i>	31	16	11 + 3*
	<b>Total</b>	-	<b>31</b>	<b>16</b>	
BSRI	Sugarcane	<i>Saccharum officinarum</i>	28	10	2
	<b>Total</b>		<b>28</b>	<b>10</b>	<b>2</b>
CDB	Cotton	<i>Gossypium hirsutum</i>	2	10	1
		<i>Gossypium arboreum</i>	0	2	0
	<b>Total</b>		<b>2</b>	<b>12</b>	<b>1</b>
BINA	Rice	<i>Oryza sativa</i>	2	3	2

Stakeholder	Name of crop	Scientific name	No. of varieties released prior to 1996	No. of Varieties released after 1996 upto 2007	No of varieties released after 2007 till 2011
	Mustard	<i>Brassica campestris</i>	2	1	2
		<i>Brassica napus</i>	0	3	0
	Sesame	<i>Sesamum indicum</i>	0	1	1
	Groundnut	<i>Arachis hypogaea</i>	0	3	1
	Mungbean	<i>Vigna radiata</i>	2	5	1
	Chickpea	<i>Cicer arietinum</i>	2	2	2
	Lentil	<i>Lens culinaris</i>	0	3	3
	Grasspea	<i>Lathyrus sativus</i>	1	1	0
	Jute	<i>Corchorus capsularis</i>	0	2	0
		<i>Corchorus spp.</i>	0	1	0
	Tomato	<i>Lycopersicon esculentum</i>	1	4	2
Soybean	<i>Glycine max Merrill</i>	x	x	2	
	<b>Total</b>		<b>10</b>	<b>29</b>	<b>16</b>
BJRI	White Jute	<i>Corchorus capsularis</i>	20	0	1
	Tossa jute	<i>Corchorus olitorius</i>	12	1	1
	Kenaf	<i>Hibiscus cannabinus</i>	2	0	1
	Mesta	<i>Hibiscus subdariffa</i>	1	0	1
		<b>Total</b>		<b>35</b>	<b>1</b>
BTRI	Tea	<i>Camellia sinensis</i>	12	9	
		<b>Total</b>	<b>12</b>	<b>9</b>	
Lal Teer Seed Ltd	Bitter Gourd	<i>Momordica charantia</i>	0	1	2
	Bottle Gourd	<i>Lagenaria siceraria</i>	0	2	4
	Ridge Gourd	<i>Luffa acutangula</i>	0	3	2
	Pumpkin	<i>Cucurbita moschata</i>	0	3	2
	Cucumber	<i>Cucumis sativus</i>	0	3	1
	Ash Gourd	<i>Benincasa hispida</i>	0	3	2
	Tomato	<i>Lycopersicon esculentum</i>	0	1	2
	Brinjal	<i>Solanum melongena</i>	0	1	3
	Onion	<i>Allium cepa</i>	0	2	1
Chilli	<i>Capsicum annum</i>	0	3	2	

Stakeholder	Name of crop	Scientific name	No. of varieties released prior to 1996	No. of Varieties released after 1996 upto 2007	No. of varieties released after 2007 till 2011
	Radish	<i>Raphanus sativus</i>	0	1	1
	Cauliflower	<i>Brassica oleracea var. capitata</i>	0	1	2
	Okra	<i>Abelmoschus esculentus</i>	0	2	4
	Coriander	<i>Coriandrum sativum</i>	0	2	2
	Kangkong	<i>Ipomoea reptans</i>	0	1	0
	Stem Amaranth	<i>Amaranthus gangeticus</i>	0	2	1
	Red Amaranth	<i>Amaranthus tricolor</i>	0	1	0
	Beet Spinach	<i>Spinacea oleracea</i>	0	1	1
	Indian Spinach	<i>Basella alba</i>	0	2	0
	Broccoli	<i>Brassica alboglapa</i>	0	0	1
	Papaya	<i>Carica papaya</i>	0	0	1
	Sponge gourd	<i>Luffa cylindrica</i>	0	0	1
	Water melon	<i>Citrulus vulgurus</i>	0	0	1
	Yard long bean	<i>Vigna unguiculata</i>	0	1	1
	Mustard	<i>Brassica juncea</i>	0	0	2
	Cotton	<i>Gossypium hirsutum</i>	0	0	1
	Total	-	0	34	
BSMRAU	Pea	<i>Pisum sativum</i>	6	0	
	Radish	<i>Raphanus sativus</i>	0	3	
	Mungbean	<i>Vigna radiata</i>	0	3	
	Cabbage	<i>Brassica oleracea</i>	0	1	
	Total	-	6	7	

3\* Recommended by Technical Committee of NSB

## List of Participants and Information Providers

### Bangladesh Agricultural Research Council

1. Dr. M. Khalequzaman A. Chowdhury  
Member-Director (Crops)  
md-crops@barc.gov.bd  
8118275
2. Mr. Abeed Hossain Chowdhury  
Director (Computer)  
dir-computer@barc.gov.bd  
8118274
3. Dr. Abul Kalam Azad  
Chief Scientific Officer (Crops)  
drakazad61@yahoo.com  
9126664, 01727210995
4. Dr. Md. Aziz Zilani Chowdhury  
Principal Scientific Officer (Crops)  
zilani71@gmail.com  
01552355393
5. Dr. Mian Sayeed Hassan  
Principal Scientific Officer (Crops)  
sayeed63@gmail.com  
01911740390
6. Dr. Monowar Hossain  
Principal Scientific Officer (TTMU)  
01711466781
7. Dr. M.A. Maleque  
Senior Scientific Officer, IPM  
maleq68@yahoo.com  
01758571672
10. Md. Rais Uddin Choudhury,  
Senior Scientific Officer  
Plant Genetic Resources Division,  
01764932586
11. Dr. Mahbub Alam Patwary,  
Senior Scientific Officer,  
Agriculture Research Centre  
Pahartoli, Chittagong.  
mahbub.a@bari.gov.bd  
01712210951
12. Md. Anwar Hossain Khan,  
Scientific Officer  
Citrus Research Centre,  
Jointapur, Sylhet.  
anukhananwar@yahoo.com  
01714238551
13. Md. Ishkhar Ahmed  
Scientific Officer  
Plant Genetic Resources Division,  
ifti.bari@gmail.com  
01556535942
14. Md. Abu Kawochar,  
Scientific Officer(Plant Breeding)  
Tuber Crop Research Centre  
kawocharpgrc@yahoo.com  
01724287793
15. Mukaddasul Islam Riad  
Scientific Officer  
RARS, BARI, Jamalpur.  
miriadpgrc@yahoo.com  
01711069470

### Bangladesh Agricultural Research Institute

8. Dr. Md. Khaled Sultan  
Chief Scientific Officer  
Plant Genetics Resources Centre  
sultankbari\_2010@yahoo.com  
01921857809
9. Dr. Md. Abdul Malek,  
Senior Scientific Officer  
Plant Genetic Resources Division  
abmalekbd@yahoo.com  
01712178568

16. Md. Rezwana Molla  
Scientific Officer  
Plant Genetic Resources Centre  
rezwanbt@gmail.com  
01712570443

### Bangladesh Rice Research Institute

17. Dr. Md. Khairul Bashar,  
Chief Scientific Officer  
Genetic Resources Division  
mkbashar.brri@gmail.com  
01711283982

18. Dr. Mohammad Khalequzzaman  
Principal Scientific Officer  
Genetic Resources Division,  
zamanmk64@yahoo.co.uk  
01715752595
19. Mohammad Zahidul Islam  
Scientific Officer  
Genetic Resources Division  
zahidbrri@yahoo.com  
01818819295
20. Ms. Shahinur Islam  
Scientific Officer  
Genetic Resources Division  
shahinur\_brri@yahoo.com  
10717729919
21. Ms. Sangeeta Mitra  
Scientific Officer  
Genetic Resources Division  
sangeetamitra.brri@gmail.com  
01717623373
22. Md. Abubakar Siddique  
Scientific Officer  
Genetic Resources Division  
mabr198401@yahoo.com  
01731643193

#### **Bangladesh Institute of Nuclear Agriculture**

23. Dr. Mirza Mofazzal Islam  
Principal Scientific Officer  
mirza\_mislam@yahoo.com  
01716280720
24. Ms. Snigdha Roy  
Senior Scientific Officer  
snigdha.roy94@yahoo.com  
01195111006

#### **Bangladesh Sugarcane Research Institute**

25. Mr. Bisnupada Podder  
Chief Scientific Officer and Head  
Breeding Division  
01816641334
26. Dr. M. Khalilur Rahman  
Chief Scientific Officer & Head,  
Agronomy Division  
drmkrahman57@yahoo.com  
01715507788

#### **Bangladesh Jute Research Institute**

27. Dr. M. Abbas Ali  
Chief Scientific Officer  
Genetic Resources & Seed Division  
abbasbjri@yahoo.com  
01673376105
28. Dr. Chandan Kumar Saha  
Principal Scientific Officer  
Genetic Resources & Seed Division  
chandanjri@yahoo.com  
01716510338
29. Md. Mahboob Hussain  
Principal Scientific Officer  
Genetic Resources & Seed Division  
mhussainbjri@yahoo.com  
01713603089
30. Md. Rafiqul  
Principal Scientific Officer  
Genetic Resources & Seed Division  
rafiqbjri@yahoo.com  
01721266846

#### **Bangladesh Livestock Research Institute**

31. Dr. Nathuram Sarker  
Senior Scientific Officer  
sarkernr@yahoo.com  
01711733119

#### **Bangladesh Tea Research Institute**

32. Md. Ismail Hossain,  
Principal Scientific Officer (In-charge)  
Plant Science Division  
01749515305

#### **Bangladesh Forest Research Institute**

33. Mr. Kabir Uddin Ahmed  
Divisional Officer  
kabir\_bfri@yahoo.com  
01720047746

#### **Bangladesh Agricultural University**

34. Dr. Md. Abdur Rahim  
Professor, Department of Horticulture  
marahim1956@yahoo.com  
01711854471



**Bangabandhu Sheikh Mujibur Rahman  
Agricultural University**

35. Dr. Md. Golam Rasul  
Professor  
Genetics and Plant Breeding Deptt.  
mdgolam60@yahoo.com  
01715401448
36. Mr. Umakanta Sarker  
Assistant Professor,  
Deptt. of Genetics and Plant Breeding  
umakanta\_sarker@yahoo.com  
01716606098

**University of Dhaka**

37. Dr. Rakha Hari Sarker  
Professor, Deptt. of Botany  
rhsarker2000@yahoo.co.uk  
01711547429

**Sher-e- Bangla Agricultural University**

38. Md. Harun-Ur-Rashid  
Lecturer  
Deptt. of Genetics and Plant Breeding  
sumonsau@gmail.com  
01712612417

**Cotton Development Board**

39. Mrs. Shameema Begum  
Cotton Breeder  
01912701072
40. Mr. Khalequzzaman  
Scientific Officer (Soil Science)  
khalequzzaman30@yahoo.com  
01712146447

**Bangladesh National Herbarium**

41. Mr. Sarder Nasiruddin  
Senior Scientific Officer  
msarder@yahoo.com  
01914007503

**Bangladesh Agriculture Development  
Corporation**

42. Dr. Md. Rezaul Karim  
Deputy Director (Quality Control)  
mrkarimbdc@gmail.com  
01713201041

**Seed Certification Agency**

43. Md. Khairul Bashar  
Quality Control Officer  
01720379535

**Supreme Seed Ltd**

44. Mr. Delwar Hossain  
Senior Plant Breeder  
R & D Farm (Veg.)  
dhossain\_007\_bd@yahoo.com  
01713145212

**Lal Teer Seed Ltd**

45. Mr. GM Mohsin  
Chief Plant Breeder & In-charge,  
Research and Development Farm Office  
mohsin\_lts@yahoo.com  
01554323678, 01718304137