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Bangladesh Agricultural Research Council
Overview of presentation

- Bangladesh at a glance
- Bangladesh agriculture: an overview
- Success in agriculture
- Constraints of crop production
- Meeting the Future Challenge
- Biotech crop R&D in Bangladesh
- Conclusion
Bangladesh at a glance

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>Total Area</strong></td>
<td>147,570 Sq Km</td>
</tr>
<tr>
<td></td>
<td>14.85 mha</td>
</tr>
<tr>
<td><strong>Total Population</strong></td>
<td>156.86m (GR: 1.48)</td>
</tr>
<tr>
<td><strong>Population/Sq Km</strong></td>
<td>1051</td>
</tr>
</tbody>
</table>

30 AEZ
Population Trend in Bangladesh

![Population Trend in Bangladesh](image)

<table>
<thead>
<tr>
<th>Year</th>
<th>Population (in million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>149.69</td>
</tr>
<tr>
<td>2015</td>
<td>158.96</td>
</tr>
<tr>
<td>2020</td>
<td>169.54</td>
</tr>
<tr>
<td>2025</td>
<td>180.21</td>
</tr>
<tr>
<td>2030</td>
<td>189.85</td>
</tr>
</tbody>
</table>
Physiography of Bangladesh

- Low lying riverine country
- **Topography**
  - High land: 18%
  - Medium High land: 32%
  - Medium Low land: 12%
  - Low land: 6%
  - Very lowland: 2%
  - Hilly land: 11%
  - Miscellaneous: 19%
## Bangladesh Agriculture: an overview

<table>
<thead>
<tr>
<th>Category</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net Cropped Area</td>
<td>8.20 mha</td>
</tr>
<tr>
<td>Irrigated Area</td>
<td>53%</td>
</tr>
<tr>
<td>Cropping Intensity</td>
<td>191%</td>
</tr>
<tr>
<td>Contribution of Agr. to GDP</td>
<td>18.7 percent</td>
</tr>
<tr>
<td></td>
<td>(Crops &amp; Horticulture: 10.25; Animal Farming: 2.34; Forest: 1.52; Fishing: 3019)</td>
</tr>
<tr>
<td>Population in Agriculture</td>
<td>Around 60%</td>
</tr>
<tr>
<td>Labour Force</td>
<td>36.74%</td>
</tr>
<tr>
<td>Major Crops</td>
<td>Rice, Wheat, Maize, Potato, Jute, Sugarcane, Fruits &amp; Vegetables, Pulses and Oilseeds</td>
</tr>
</tbody>
</table>
Land Utilization

- Not available for cultivation: 25%
- Forest: 17%
- Cultivable waste: 2%
- Current fellow: 3%
- Single cropped area: 15%
- Double cropped area: 28%
- Triple cropped area: 10%
- Quadruple cropped area: 0%

Source: BBS 2011
Sharing of areas in major crops of Bangladesh

- Rice: 77%
- Potato: 3%
- Sugar: 1%
- Wheat: 3%
- Oil Seeds: 3%
- Jute: 5%
- Fruits: 1%
- Maize: 1%
- Pulse: 2%
- Spices & Drugs & Cond. Narcotics: 1% (Summer & wint.)
- Veg.: 2%
- Others (Min. cereal, Sweet Potato, Cotton, Flower): 0.001%
Success in Agriculture

- During the past 4 decades significant progress in research has occurred.
- After green revolution in mid-60 increasing yield through adoption of HYV rice, wheat, maize.
- Increased cropping intensity with expansion of irrigation (GR & surface Water). Targeted research, increased investment and favorable policy made significant success in production system.
Rice Production in Bangladesh

Rice Production: 33.8 million MT (MoA/BBS: 2013)
Challenges

- Increasing population in a decreasing land
- Growing enough diversified quality food for large and growing population
- Deteriorating soil & water resources - WT going down
- Climate change (pest attack, salinity, drought, cold, submergence, etc.)
- Production in the constrained area - coastal saline, drought prone & depressed area (haor)
<table>
<thead>
<tr>
<th>Crops</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>Drought, Salinity, Tidal submergence, Stem borer, Bacterial blight, Tungro virus, Low temp., Nutritional, Postharvest losses</td>
</tr>
<tr>
<td>Wheat</td>
<td>Drought, Flooding, Salinity, Leaf blight, Temperature, Conversion to maize</td>
</tr>
<tr>
<td>Potato</td>
<td>Blight Disease, Virus</td>
</tr>
<tr>
<td>Eggplant</td>
<td>Insects, Weeds</td>
</tr>
<tr>
<td>Lentil, Chickpea, Peanut, Mungbean</td>
<td>Root rot, Rust, Blight, Leaf Spot, YMV</td>
</tr>
<tr>
<td>Papaya, Tomato</td>
<td>Virus</td>
</tr>
<tr>
<td>Sugar Cane</td>
<td>Stem borer, Red rot</td>
</tr>
<tr>
<td>Jute</td>
<td>Blight, Insects, Stem rot</td>
</tr>
</tbody>
</table>
Meeting the Future Challenge

Through improvement of present technologies, cropping intensification and introduction of frontier technology.

Biotechnology offers a hope to meet the future challenge of increased food production. It is a compliment to the conventional research. It helps where conventional research has limitations.

Bangladesh has given the priority to introduce modern BT R&D activities.

Bangladesh signed the Cartagena Protocol on Biosafety in 2000; Ratification in 2004.
**Biotechnology: New Tool**

- Biotechnology is a set of powerful tools that employ living organisms (or parts of organisms) to make or modify products, improve plants or animals, or develop microorganisms for specific uses.
- The “new biotechnology” includes the use of recombinant DNA, cell fusion, novel bioprocessing techniques, MAS and bioremediation.

### Major characteristics of different GE/GM concepts

| Transgene | - gene from outside the sexual compatibility group  
|           | - could be from any organism  
|           | - may contain marker genes of any origin for selection |
| Cisgene   | - gene from the plant itself or from crossable sps  
|           | - use of *Agrobacterium* for gene transfer (T-DNA) selection, markers are removed |
Prospects of Modern Biotechnology

Possibility to develop crop variety:

- Tolerant to abiotic stresses (drought, salinity, heat, submergence)
- Tolerant to diseases, insect pest, herbicides.
- Improvement of nutritional quality & vitamin content
Biotechnological/GE Research activities in Bangladesh
<table>
<thead>
<tr>
<th>Organization</th>
<th>Initiation of research on T. Culture and BT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh Agricultural Research Institute (BARI)</td>
<td>BT research started with the establishment of a TC lab in 1985. BT division established in 1998. Contained Green House and CFT facilities developed.</td>
</tr>
<tr>
<td>Bangladesh Rice Research Institute (BRRI)</td>
<td>BT research started with the establishment of a TC lab in 1987. BT division established in 1996. Contained Green House and CFT facilities developed.</td>
</tr>
<tr>
<td>Bangladesh Sugarcane Research Institute (BSRI)</td>
<td>BT research activities started in 1997. In 2011 established BT Division.</td>
</tr>
<tr>
<td>Bangladesh Jute Research Institute (BJRI)</td>
<td>BT lab was established in 1993</td>
</tr>
<tr>
<td>BD Inst. of Nuclear Agr.</td>
<td>BT division established in 2005</td>
</tr>
<tr>
<td>National Inst of Biotech.</td>
<td>BT research started since 2010</td>
</tr>
<tr>
<td>BCSIR</td>
<td>Plant TC was first initiated in 1993</td>
</tr>
</tbody>
</table>
Physical facilities developed/available in some leading Universities of Bangladesh to conduct Biotechnological Research

<table>
<thead>
<tr>
<th>Universities</th>
<th>Initiation of research on Tissue Culture and Biotechnology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh Agricultural University (BAU)</td>
<td>BT research started functioning since 2002.</td>
</tr>
<tr>
<td>University of Rajshahi (RU)</td>
<td>Modern lab established in 1989.</td>
</tr>
<tr>
<td>University of Chittagong (CU)</td>
<td>TC &amp; BT research first initiated in mid 1980’s.</td>
</tr>
</tbody>
</table>
GM research activities in Bangladesh

National Technical Committee on Crop Biotechnology has already approved the importation of some biotech products for contained trials of GM crops:

- golden rice
- salinity tolerance of rice
- fruit and shoot borer-resistant eggplant
- late blight-resistant potato

Some leading national research institutes and universities has initiated research on the development and introduction of transgenic crops recently
## Transgenic Crop Development Programme (other than rice)

<table>
<thead>
<tr>
<th>Name of organisation</th>
<th>Crop</th>
<th>Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh Agricultural Research Institute (BARI)</td>
<td>Egg plant</td>
<td>Fruit and shoot borer insect resistant Bt gene</td>
</tr>
<tr>
<td></td>
<td>Potato</td>
<td>LB resistant RB gene</td>
</tr>
<tr>
<td></td>
<td>Tomato</td>
<td>Tomato LC virus resistance</td>
</tr>
<tr>
<td>Bangladesh Jute Research Institute (BJRI) &amp; Molecular Biology Dept, DU</td>
<td>Jute &amp; Kenaf</td>
<td>Stem rot, Insect resistance</td>
</tr>
<tr>
<td>Dhaka University</td>
<td>Lentil, Mungben, Peanut &amp; chickpea</td>
<td>Fungal resistance</td>
</tr>
</tbody>
</table>
GE Crops approved for Contained and Confined Trial

<table>
<thead>
<tr>
<th>Crops</th>
<th>Organizations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Golden rice</td>
<td>BRRI</td>
</tr>
<tr>
<td>Salt &amp; Drought tolerance rice</td>
<td>BRRI</td>
</tr>
<tr>
<td>Bt-brinjal</td>
<td>BARI</td>
</tr>
<tr>
<td>Late blight resistance potato</td>
<td>BARI</td>
</tr>
<tr>
<td>Salt tolerance rice</td>
<td>DU</td>
</tr>
<tr>
<td></td>
<td>(in process)</td>
</tr>
</tbody>
</table>
Research Progress for Transgenic saline and drought tolerance rice at BRRI, DU and BINA

<table>
<thead>
<tr>
<th>Trait</th>
<th>Progress/achievements</th>
</tr>
</thead>
</table>
| Salt tolerant              | **BRRI**
|                            | AeMDHAR (Morodehydro Ascorbate Reductase) gene from Mangrove Plant.  
|                            | *Gly I* (glyoxalase-1) and *Gly II* (glyoxalase-II) from *Brassica spp*  
<p>|                            | About 40 and 20 transgenic plants were regenerated from BRRI dhan28 and BRRI dhan29 (T₀ Gen).                                                                                                                     |
| Salt tolerant              | <strong>DU</strong> : Salt tolerant transgenic rice with the Helicase gene (pea) produced in the genetic background of HYV rice, BR28, 29, 36 and 47.                                                                                     |
| Drought and salt tolerant  | <strong>BINA</strong> : Transformation protocol has been developed.                                                                                                                                                              |
| Drought and salt tolerant  | <strong>BRRI</strong>: TPSP (Trehalose Phosphate Synthase Phosphatase) gene from <em>E. coli</em>. A total of 27 selected plants from the hygromycine containing (50mg/l) medium were transferred to earthen pot after acclimatization. |</p>
<table>
<thead>
<tr>
<th>Trait</th>
<th>Progress/achievements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transgenic Golden Rice</td>
<td>Golden Rice was developed in the background of US japonica rice variety Kaybonnet through <em>Agrobacterium</em> transformation using phytoene synthase (psy) from <em>Zea mays</em> and phytoene desaturase (crtI) from <em>Erwinia uredovora</em>.</td>
</tr>
<tr>
<td></td>
<td>A set of advanced backcross introgression lines derived from a cross between BRRI dhan29 and Kabonnet Golden rice event GR2-R were imported from IRRI in 2012 and evaluated in the contained glass house and screen house.</td>
</tr>
<tr>
<td></td>
<td>Thirteen introgression lines were found very similar to BRRI dhan29 in agronomic performance in the contained condition.</td>
</tr>
<tr>
<td></td>
<td>In 2014, twenty two advanced BC progenies from the selected 13 introgression lines were evaluated in the confined field trial.</td>
</tr>
</tbody>
</table>
## Research Progress using MAS technology for rice at BRRI

<table>
<thead>
<tr>
<th>Traits</th>
<th>Progress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Submergence tolerance</td>
<td><em>Sub1</em> QTL has been introgressed into BRRI dhan33, BRRIdhan 44 and BRRI dhan49 for submergence tolerance. 9 selected introgression lines are being tested in the farmers field of flash flood prone areas in Bangladesh.</td>
</tr>
<tr>
<td>Salinity and submergence</td>
<td>Saltol and <em>Sub1</em> genes are being pyramided in the background of BRRI dhan49</td>
</tr>
<tr>
<td>Cold tolerance</td>
<td>QTL mapping is on progress from two potential donors (BR18 and Hbj.BVI) for seedling stage cold tolerance</td>
</tr>
<tr>
<td>Arsenic tolerance</td>
<td>QTL mapping is on progress from a potential donor BRRI dhan47</td>
</tr>
<tr>
<td>Bacterial Blight Resistance</td>
<td>Two Bacterial Blight resistance genes (<em>xa13 and xa21</em>) have been pyramided in BRRI dhan29.</td>
</tr>
</tbody>
</table>
Outcome of MAS:

Two submergence tolerant rice (BRRI dhan 51 and BRRI dhan 52) and

Three saline tolerant rice varieties (BRRI dhan 47, BRRI dhan 53 and BRRI dhan 54) are released.
<table>
<thead>
<tr>
<th>Crop</th>
<th>Trait</th>
<th>Progress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lentil, Chickpea, Mungbean (DU)</td>
<td>Fungal disease resistance</td>
<td><em>Agrobacterium</em>-mediated transformation has been carried out for the insertion of desired genes into the three important grain legumes: lentil, chickpea and mungbean. Stable integration of <em>GUS</em> and <em>nptII</em> (neomycin phosphotransferase II) genes was confirmed by PCR reaction and histochemical assay. Moreover integration of a fungal resistance protein gene has been successfully carried out in lentil. A number of transformed shoots have been recovered from the decapitated embryo explant of BARI Lentil-4 following their transformation and selection using PPT (phosphinothricin).</td>
</tr>
<tr>
<td>Crop</td>
<td>Trait</td>
<td>Progress</td>
</tr>
<tr>
<td>------------</td>
<td>----------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Potato</td>
<td>Salinity</td>
<td>Protocol developed for <em>Agrobacterium</em> mediated transformation of salinity resistance.</td>
</tr>
<tr>
<td>(BARI)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sugar cane</td>
<td>Salinity and drought</td>
<td>Protocol developed for <em>Agrobacterium</em> mediated stress tolerant (salt and drought) transgenic sugarcane.</td>
</tr>
<tr>
<td>(BSRI)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jute</td>
<td>Fungus resistance</td>
<td><em>Agrobacterium</em>-mediated genetic transformation method has been developed for different varieties of white jute (<em>Corchorus capsularis</em> L.).</td>
</tr>
<tr>
<td>(DU)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Genetic Transformation

<table>
<thead>
<tr>
<th>Crop</th>
<th>Trait</th>
<th>Progress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tomato</td>
<td>Viruses</td>
<td>PCR-based detection and characterization of tomato leaf curl and other related Gemini viruses. Transformation of tomato for broad spectrum resistance against leaf curl viruses. Development of tomato transformation protocol. Sequencing of the complete ‘A’ genome of 32 isolates has been done to facilitate their phylogenetic analysis. Transgenes was confirmed in 12 transformed tomato plants.</td>
</tr>
<tr>
<td>(BARI)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Recent Development of GE Crop in Bangladesh

BARI developed 9 genetically engineered brinjal varieties by inserting a crystal protein gene (Cry1Ac).

On October 30, 2013, the National Committee on Biosafety gave approval to the newly developed 4 GM brinjal Varieties namely BARI Bt Brinjal-1 (Uttara), BARI Bt Brinjal-2 (Kajla), BARI Bt Brinjal-3 (Nayontara) and BARI Bt Brinjal-4 (ISD006).

On January 22, Hon’ble Agriculture Minister Matia Chowdhury distributed the seedlings to 20 selected farmers.

Bangladesh has now joined a group of 29 countries that grows GM crops.
Diversity of brinjal cultivated in Bangladesh
Journey of Bt Brinjal development at BARI

2004 - 2005: USAID donated Cry 1Ac gene and Backcrossing program initiated ($BC_1$) for 9 local varieties at Mahyco.

2005 - 2006: Bangladesh Government imported $BC_1$, via MTA with Mahyco. $BC_2$ developed at BARI.

2007: $BC_3$ population were developed and Cry 1Ac gene identified.

2008: $BC_3$ ($F_2$) generation yielded through self-pollination and MLT with $BC_3$ $F_2$ with five varieties

2009: $BC_3$ ($F_3$), $BC_4$

2010:

✓ $BC_3F_4$, $BC_5$
✓ Next season of Multi-location field trials conducted at 7 locations; Organized Field day: 200 Farmers attended.
2010 – 2011
- BC$_3$F$_5$
- Confined field trials with 9 varieties were done in 7 locations

2011 – 2012
- MLTs was repeated in the same 7 locations with all the 9 varieties

2012 – 2013
- MLTs is being repeated in the same 7 locations with all the 9 varieties and applied for releasing 4 varieties.

2013
- Four varieties were released as BARI Bt Brinjal-1 (Uttara), BARI Bt Brinjal-2 (Kazla), BARI Bt Brinjal-3 (Nayantara), and BARI Bt Brinjal-4 (ISD-006) by 30 October/2013.

2014
- Honorable Agriculture Minster distributed Bt Brinjal seedlings among 20 farmers of four regions of Bangladesh on 22 Jan 2014, in a limited scale productions.
MLT sites of Confined Field Trial

- Gazipur
- Chittagong
- Jessore
- Ishurdi
- Rahmatpur
- Rangpur
- Jamalpur
Performance of Bt brinjal lines against BFSB during 2008-12

% infestation by number

- Uttara: Bt 6.4, Non-Bt 56.6
- Nayantara: Bt 6.9, Non-Bt 57.3
- Dohazari: Bt 4.2, Non-Bt 64.9
- Singhnath: Bt 10.0, Non-Bt 53.9
- Chaga: Bt 8.7, Non-Bt 49.3
- ISD006: Bt 8.2, Non-Bt 55.7
- Khatkatia: Bt 1.5, Non-Bt 56.3
- Islampuri: Bt 1.8, Non-Bt 12.3
- Kazla: Bt 3.9, Non-Bt 58.3
Bt-brinjal (Islampuri) field with no BFSB infestation

Non-Bt brinjal field with BFSB infestation

BFSB infested non-Bt brinjal field
Non-infected fruit of **Bt Uttara**

Infected fruit & shoot of **non Bt Uttara**
Visitors Bt trial site at BARI, Joydebpur
Confined field at Joydebpur for Bt brinjal trial
In Bangladesh, farmers spray insecticide even some times more than 100 times in a season for controlling fruit and shoot borer.

Thus using Bt brinjal cost of cultivation could be minimized substantially and it will also save the environment, farmers & consumers’ health.

Brinjal is grown in year-round in Bangladesh and is important source of income
Research Progress on LBR Potato

- Total area is 0.44 million ha and total production is 8.6 million tons in 2012-13
- The average yield is 19.55 ton/ha in 2012-13
- The per capita availability of potato is 56.0 kg/year
- Now Bangladesh is 7th among the world potato producers, 4 years before it was 14th
- 3rd largest in Asia after China and India.

All the tested clones showed resistant (R) to late blight (LB) over the locations.
Transgenic LBR Potato Variety Development

Sources of RB Gene (*Solanum bulbocastanum*)

Variety used

1. BARI Potato-7 (Cardinal)
2. BARI Potato-8 (Diamant)
Events of LBR Potato from 2006 to 12

**Conventional Breeding**
- Hybridization & Selection
  - Done in 2006 at LEHRI, Lenbang, Indonesia

**Transformation**
- Molecular Breeding
  - Wisconsin University USA
    - Done in 2007

Following year activities were done at BARI using lab and greenhouse facilities.
First CFT in **2008-09** at

Selected 87 hybrid clones & 40 transformed

2nd CFT in **2009-10** at two locations- Joydebpur and Burirhat

3rd CFT in **2010-11** at two locations- Joydebpur and Burirhat

Selected 8 hybrid clone (For MLT)

MLT in **2011-12** and **2012-13** at six locations

Selected 6 hybrid clones

MLT in **2013-14** at six locations
Research executed in 2013-14

Multilocational trial of CFT of LBR potato

Location: 06

Number of LBR clone: Six
CONFINED FIELD TRIAL OF LBR POTATO

Design: RCB
Replication: 3

Treatments:
- 08 Clones / Varieties
- C₁ = D-951(2)
- C₂ = D-951(3)
- C₃ = BARI-Au-7 (Diamond)
- C₄ = BARI-Au-6 (Cardinal)

Unit plot: 3m x 1.8m
Spacing: 66cm x 30cm

Organized by: Biotechnology Division, BARI, Gazipur
Funded by: USAID (ARSP-II)
Date of planting: 01.12.2013
Status: 5th year

ARS, Burirhat, Rangpur: 2013-14
Field Day at ARS, Burirhat, Rangpur

MLT of LBR potato
100 foliage damaged in check varieties at 62 DAS, Feb 8, 2014
Insecticide spraying without taking any precautionary measures
CONFINED FIELD TRIAL OF LBR POTATO

OBJECTIVE:
1. Development of late blight resistant potato variety

MATERIAL: 6 Hybrid clones
DESIGN: RCB
REPLICATION: 3
PLOT SIZE: 3.0 X 1.8 m
SPACING: 60 X 30 cm
DATE OF PLANTING: 11-12-2013

IMPLEMENTING AGENCY: BARI FUNDED BY USAID (ABSP II)

USAID
ABSP
Before infection of Late blight in transgenic potato

Before infection of Late blight in Non transgenic potato

60 DAP
CONFINED FIELD TRIAL OF LBR POTATO

Objective: To develop late blight resistant potato variety

Materials: 6 hybrid clones with 2 checks
- D-951 (2), D-951 (3), D-951 (12), D-951 (13), D-951 (317), D-951 (304)
- BARI Alu 7 (Diamant), BARI Alu 8 (Cardinal)

Design: RC

Replications: 3

Plot size: 3 m x 1.8 m

Spacing: 40 cm x 30 cm

Number of line per plot: 3

Number of seed tuber per line: 10

Date of planting: 10-12-2013

Location: RARS, Jessore

Biotechnology Division
Regional Agricultural Research Station, Jessore
Funded By: USAID (ABSP II)
MLT of LBR potato (CFT)
Late blight infected plot of Non transgenic potato

Disease presence in Non-Transgenic Border

No disease presence in Transgenic line
Assessment of Transgenic Crop

Crop Development in Lab

Contained Greenhouse Trial

Confined Field Trial

Open Field Trial

Field data, risk analysis & other data collection.
Future Needs

Human and infrastructure capacity in RA & RM:

- Toxicity to human, animals, bird, fish and soil microbes
- Pathogenicity
- Allergenicity
- Gene flow
- Nutritional compositional change
- Digestibility and digestion products
- Stability of gene product
- The fate of genes and gene products in food processing
Regional cooperation

- Harmonization of Biosafety act, rules, guidelines etc
- Development of unified methodology for testing and assessment
- Sharing knowledge/experiences
- Replication of developed technology
Conclusion

GE plants have the potential to meet the challenge of improved yields, enhanced nutritional value, longer shelf life, resistance to drought, salinity, pest, disease or herbicide.

Science-based and effective regulatory systems are required for the adoption of modern biotechnology. The management should be systematic but not complex.

Capacity building mechanism is needed in region (South Asia), because the countries in this region are highly diversified in terms of R & D, human resources development and in basic infrastructure facilities.
Regional efforts may be initiated with mutual understanding of regulatory systems, sharing of information including risk assessment dossiers, capacity strengthening for risk assessment, management, handling and detection of GMO’s.

Awareness building at different level viz. political leaders, scientists, policymaker, consumer, extension people who are engaged in technology transfer as well as media people is very important for the acceptance of GMO.
Gratefully acknowledge

Concerned scientist of NARS institutes (BARI, BRRI, BJRI, BSRI, BINA), DU and BAU

Contributors of 7th International Plant Tissue Culture & Biotechnology Conference, 01-03 March 2014, Dhaka, Bangladesh
Thanks to all