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The U.S. Government's Global Hunger & Food Security Initiative

Bt Eggplant: A Genetically Engineered Crop Comes of Age in Bangladesh and the Philippines by PPP

- An example of the globalization of India's crop improvement research!
- Successful PPP

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Problem and the Solution

- Eggplant is severely damaged by **Fruit and Shoot Borer (FSB)**, causing severe yield loss
- Farmers **spray chemical insecticides** every other day

Problem



- **CryIAc** gene from Bt has potential to render eggplants resistant to FSB
- **Mahyco** developed Bt eggplant - a genetically improved eggplant (EE-I) by inserting cryIAc gene into eggplant

Technology



- Development of Bt eggplant varieties/hybrids by introgressing EE-I into local market preferred varieties / hybrids in Bangladesh, Philippines and India
- Regulatory approvals

Development and Release



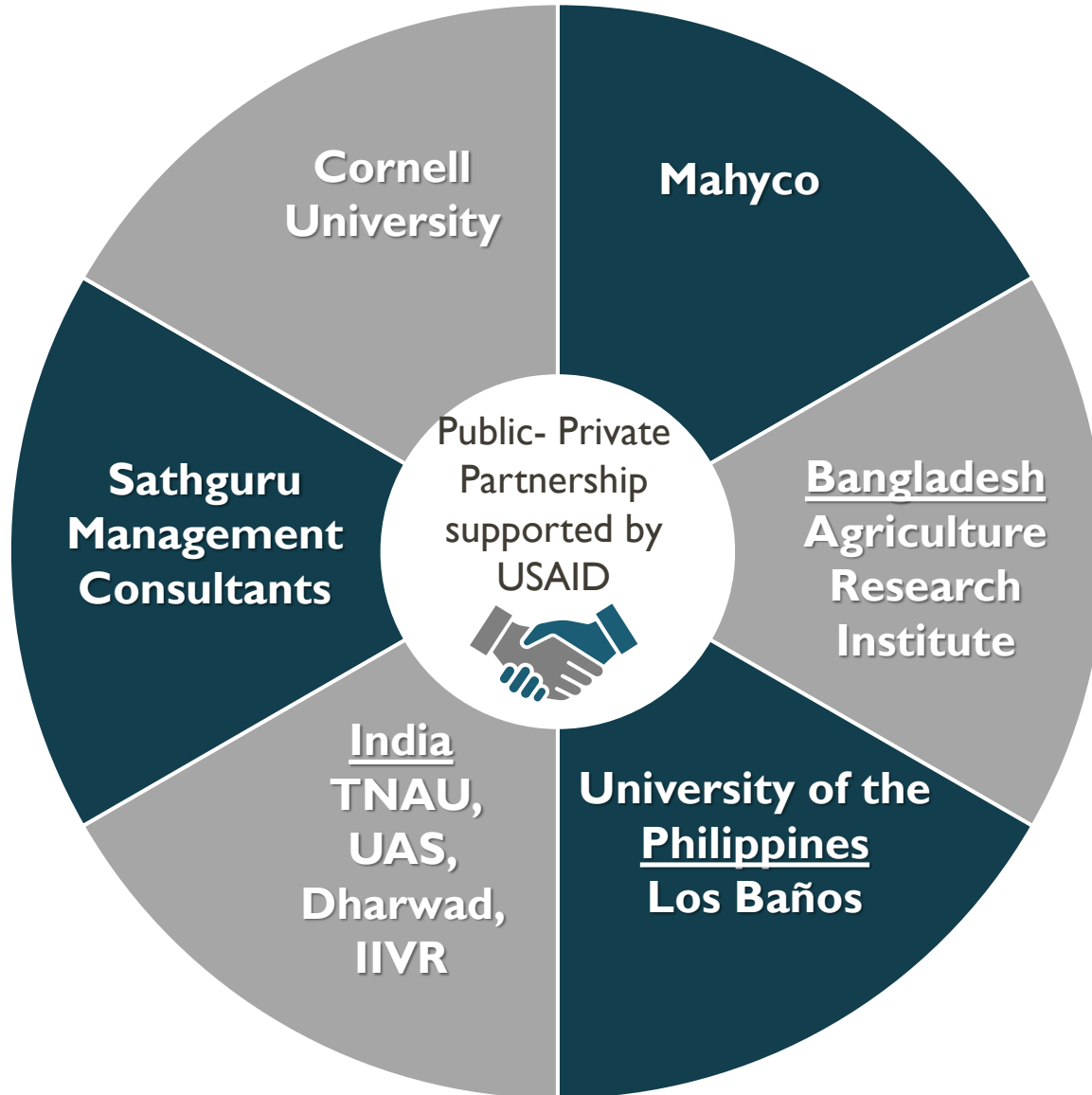
FSB – A problem across the three countries (Bangladesh, Philippines, India)₂



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Establishment of USAID funded Public Private Partnership



Donor funded projects

- Agricultural Biotechnology Support Project II (2002-2015)



- FtFBP - South Asia Eggplant Improvement Partnership Bangladesh (2015-2021)



- FtF-IREP –Insect Resistant Eggplant Partnership (2021-2026)

Bangladesh takes the lead - Driven by a political will

- Mahyco technology - eggplant bioengineered for Cry I Ac (EE-1 event) demonstrating resistance to the FSB
- BARI developed Bt brinjal by introgression of Mahyco's EE-1 event into **9 popular brinjal varieties from Bangladesh**
- Efficacy trials conducted in Bangladesh by BARI
- BARI secured regulatory approval for commercial release.
- **4 varieties of BARI Bt brinjal commercialized in October 2013**



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PPP in Bangladesh driving the technology adoption

Bangladesh Agricultural Development Corp. (BADC)

Private sector, Bangladesh

Ministry of Agriculture (MoA) & Ministry of Environment (MoE)



Bangladesh Agricultural Research Institute (BARI)

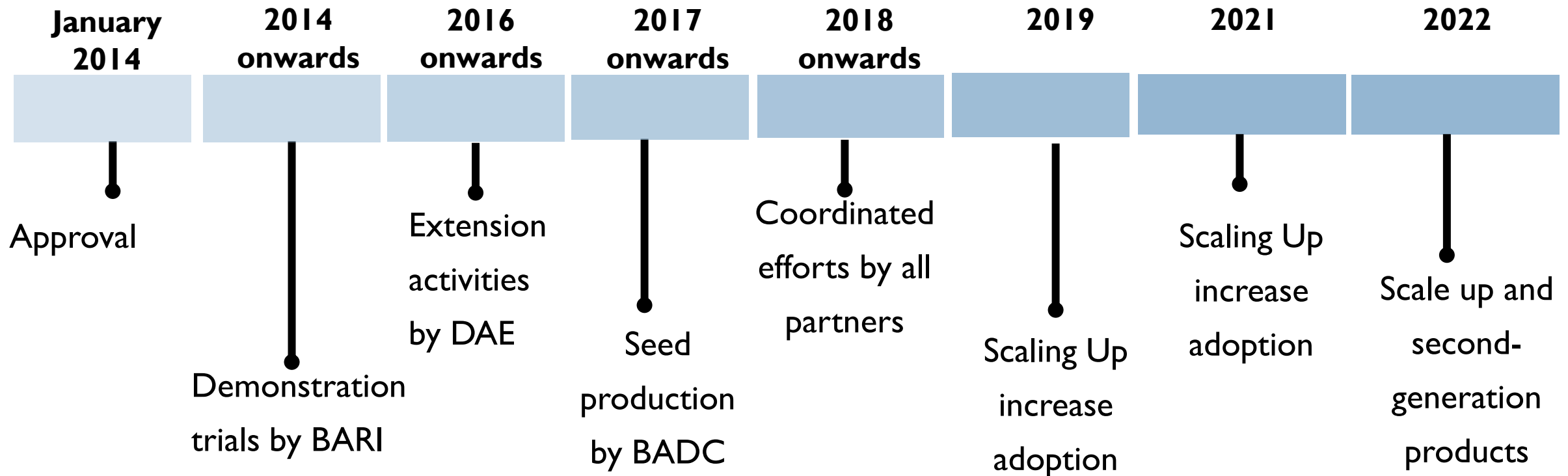
Department of Agricultural Extension (DAE)

Farming Future Bangladesh (FFB)

Sathguru Services, Bangladesh

Mahyco

Incremental and strategic steps to sustain the technology in Bangladesh





Economic and health benefits derived by Bt eggplant growing farmers in Bangladesh



Negligible fruit infestations in Bt eggplant compared to

45%

in the non-Bt eggplant¹



61%

saving on pesticide cost to farmers as compared to non-Bt eggplant farmers².



6X

increase in farmers net returns to \$2,151/ha for Bt eggplant/ha as compared to \$357/ha for non-Bt eggplant²



21%

increase in gross revenue³



19.6%

higher fruit yield in Bt eggplant against non-Bt eggplant³



41%

reduction toxicity of pesticides applied, measured by Pesticide Use Toxicity Score (PUTS)⁴



Way Forward to sustain Bt eggplant technology in Bangladesh

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- Release of new and agronomically superior varieties/hybrids

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- Implement laboratory and field stewardship practices to sustain the technology

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- Development of second-generation products

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- Creation of enabling environment - policy & regulatory

Philippines follows footsteps of Bangladesh



- A PPP *between* UPLB, Mahyco and Cornell University
- Navigated through evolving regulatory system
- Approval for use as food & feed - July 21, 2021
- Approval for commercial propagation Oct 18, 2022
- Demonstration trials in progress

Stalemate in India continues.....



- Bt eggplant with EE-I event was rigourously *field tested from 2004 to 2008 in more than 50 locations*
- *Eight hybrids and 16 varieties* developed by Mahyco, TNAU, UAS-Dharwad and IIVR, Varanasi
- Even after GEAC approval, moratorium since 2012 !!

India – An opportunity missed !

- Potential of the Bt eggplant technology not fully exploited in Bangladesh
- Land under eggplant cultivation: India (7.50 lakh ha) > Bangladesh (53,000 Ha) > Philippines (21,000 Ha)
- Business model that worked well in India – Technology licensing to multiple private sector seed companies
- Developed seed sector in India has the potential to take benefits to a large number of farmers across different agroclimatic zones – repeat the Bt cotton story!
- Had India deregulated Bt eggplant - It would have been a win-win for both farmers and seed companies

Scientific publications resulting from the partnership

1. Anthony M. Shelton, **Vijay Paranjape**, M. J. Hossain, Des Hautea, M.Z.H. Prodhan, M A. Hossain, Rituparna Majumder, Sayed H. Sarwer, Dilafroza Khanam, M Kamrul Hasan, A. K. Azad, Bharat Char and Vijay Vijayaraghavan **2021**. Bringing Bt Eggplant to resource poor farmers in Bangladesh and the Philippines. In book: G Gujar, Y Andi Trisyono, Mao Chen (eds.) Genetically Modified Crops in Asia Pacific. CSIRO Australia (<https://www.publish.csiro.au/book/7858#preview>)
2. Shelton, A. M., S. H. Sarwer, M. J. Hossain, G. Brookes and **V. Paranjape**. **2020**. Impact of Bt brinjal cultivation in the market value chains in five districts of Bangladesh. Front. Bioeng. Biotechnol., 25 May 2020 | <https://doi.org/10.3389/fbioe.2020.00498>
3. Shelton, A.M., M.J. Hossain, **Vijay Paranjape**, M.Z.H. Prodhan, Ritu Majumder, S. H. Sarwer and M.A. Hossain. **2019**. Bt brinjal in Bangladesh: the first genetically engineered food crop in a developing country. Chapter in Book title: Plant Genetics and Agriculture, edited by Pam Ronald (Cold Springs Harbor Publishing). <http://dx.doi.org/10.1101/cshperspect.a034678>
4. Prodhan, M.Z.H.; Shirale, D. K., M Z Islam, M.J. Hossain, **Vijay Paranjape**, and A.M. Shelton. **2019**. Susceptibility of Field Populations of Eggplant Fruit and Shoot Borer (*Leucinodes orbonalis* Guenée) to CryI Ac, the Protein Expressed in Bt Eggplant (*Solanum melongena* L.) in Bangladesh. Insects, 10, 198.
5. Shelton, Anthony M., M. J. Hossain, **V. Paranjape**, A. K. Azad, M. L. Rahman, A. S. M. M. R. Khan, M. Z. H. Prodhan et al. **2018**. Bt Eggplant Project in Bangladesh: History, Present Status, and Future Direction. Frontiers in Bioengineering and Biotechnology. 1 August 2018, Volume 6, Article 106.
6. Shelton AM, Hokanson KE, Hautea DM, Hossain MJ, Hossain MA, **Paranjape V**, Hautea RA, McCandless L, Sarwer SH. Bt eggplant: A genetically engineered 'minor' crop comes of age in Bangladesh and the Philippines. ISB News Report. **2017**; August 2017.

Blogs and case studies



Eggplant Related Blogs

Steps for keeping Bt eggplant technology sustainable and durable in Bangladesh

In the seven years since Bangladesh approved its first genetically modified crop — insect-resistant eggplant (Bt brinjal) — the number of farmers growing it has increased from just 20 to well over 60,000.

[Read More](#)



Eggplant Related Blogs

Bt eggplant in Bangladesh: Public sector paved the path for success, time now for private sector to step-in!

Historically, private sector companies have been dominating the development, introduction, distribution and growth of biotech crop market around the world. Bt eggplant is one of the few genetically modified products

[Read More](#)



Eggplant Related Blogs

Bt Brinjal farmers of Bangladesh reaping surplus benefits from the technology

Abdul Hossain, a brinjal growing farmer from Rangpur district of Bangladesh, is into his second year of enjoying the benefits from the cultivation of Bt brinjal in his one-fourth acre of land.

[Read More](#)



Seed Industry Program in Bangladesh

Author: Poornima Gade Globally the seed industry is undergoing significant transformation due to rapid strides made in trait development, trait convergence, and smarter reach of products to growers and application of information analytics for strategic business growth. There is a need for the Bangladesh seed [...]

Summary

- Bt Eggplant - A perfect example of a successful PPP, where the private sector in India partnered with the public sector in Bangladesh and the Philippines, leading to the release of a commercial product
- An example of the globalization of India's crop improvement research!
- Regulations and political will affect success of Bt eggplant in Bangladesh, Philippines and India
- India – An opportunity missed !



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Thank You

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