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Genetically Engineered Eggplant Delivers on Food Security in Developing Countries

Bangladesh



TRANSFORMING EVALUATIONS INTO ACTION

*An impact evaluation of insect-resistant *Bacillus thuringiensis* (Bt) eggplant in Bangladesh is informing USAID decision-making about genetically engineered crops, quelling critics, and validating Agency investment in agricultural technologies as tools for food security.*

CONTEXT

Farming eggplant in Bangladesh typically requires significant use of toxic pesticides to deter destructive fruit and shoot borer pests. To address this reliance on pesticides, in 2003 the U.S. Agency for International Development (USAID) funded a Cornell University-led public-private partnership with the Bangladesh Agricultural Research Institute and Indian seed company Mahyco, Inc to develop genetically engineered (GE) eggplant varieties. These GE eggplants produce a protein from a common bacterium, *Bacillus thuringiensis* (Bt), which protects against the fruit and shoot borer pests. In 2013, Bangladeshi officials approved four locally adapted varieties of Bt eggplant, which were grown by an initial 20 farmers in 2014. Thanks to locally led scaling efforts by Bangladesh's public extension agency, today more than 27,000 farmers in Bangladesh grow Bt eggplant.

USAID's investment in the Bt eggplant partnership was motivated by expectations that the product could improve food security for smallholder farmers as well as improve environmental sustainability. However, critics of GE crops have long claimed they are harmful to the environment, damaging to human health, and inaccessible to smallholder farmers for cost or intellectual property reasons. Some critics also contest whether GE crops like Bt eggplant confer yield benefits, pointing out that past research was based on observational data or statistical modeling rather than randomized controlled trials. Bt eggplant—the first USAID-funded GE food crop released in a developing country—offered a critical opportunity, therefore, to test the Agency's development hypothesis for Bt eggplant while also probing the rationale for USAID's food security investments in GE crops in general.

EVALUATION METHODOLOGY

In order to capture independent, rigorous scientific information and understand the impact of uptake and adoption of the Bt brinjal technology among Bangladeshi farmers, USAID commissioned the International Food Policy Research Institute (IFPRI) to conduct an impact evaluation. IFPRI's impact estimation strategy for the Bt brinjal impact evaluation used a clustered randomized controlled trial design that randomly assigned 200 villages to receive either seedlings of Bt eggplant or the comparable non-Bt variety. Using villages as clusters, 100 villages each were randomly assigned to the treatment group and the control group. From 2017 to 2018, the researchers measured farm-level differences in pest infestation, pesticide application, productivity, profits, and farmer and environmental health. To estimate treatment impact, the evaluators used analysis of covariance regression (i.e., ANCOVA). For a full description of the evaluation methodology, [see the report](#).¹

EVALUATION FINDINGS

The analysis showed that farmers who grew Bt eggplant experienced a 95 percent reduction in fruit and shoot borer pest infestation; a 39 percent reduction in the quantity of pesticides applied; a 56 percent reduction in environmental toxicity; a 42 percent higher net yield; a 14 percent increase in net profit;² and a 10 percent reduction in the likelihood of reporting symptoms consistent with pesticide exposure, among other impacts. Key findings are summarized in [this brief](#).

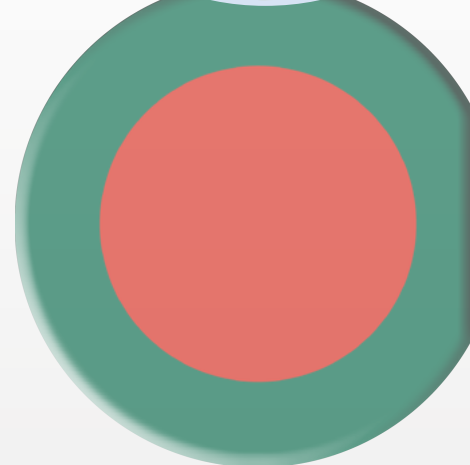
USAID's initial farm-level impact evaluation also triggered a 2019 follow-up study that probed broader [market-level trends and adoption drivers](#), which confirmed similar productivity and profitability gains. The research also identified significantly higher satisfaction among farmers growing Bt eggplant than conventional varieties, and suggested unmet demand for additional varieties that would suit diverse growing conditions and local-market preferences across other areas of Bangladesh.

ACTION BASED ON EVIDENCE FROM THE FINDINGS

The study findings contributed to USAID decision-making on multiple levels. Programmatically, they informed the Agency's 2021 decision to support a new phase of the Bt eggplant project. The new phase will develop additional local varieties and explore demand-driven dissemination strategies in partnership with local horticultural seed companies to complement Bangladesh's public extension agency-led efforts that launched the initial four varieties. The project's analytical and learning approach has also continued to grow alongside the needs of the project, partners, and USAID, with additional research planned on the intra-household gender and nutrition impacts of Bt eggplant adoption in Bangladesh. Additionally, USAID communicated the findings to Bangladeshi and other partner-country policymakers and stakeholders to inform locally led policy and agricultural extension efforts.

¹ All impact evaluations in the Evidence to Action briefs follow USAID standards as defined in ADS 201.3.6.4. For more information, see the [USAID Evaluation Policy](#) and the full [Impact Evaluation](#).

² The study was conducted over a single season, so potential recurring seed costs across multiple, future seasons were not explicitly considered. However, these initial Bt Eggplant varieties were open-pollinated varieties that allow farmers to keep seeds, and additional seeds are disseminated via Bangladesh's public extension system at negligible cost to the farmer.



Beyond the Bt eggplant project in Bangladesh, the evaluation findings are also informing USAID decision-making around its agricultural biotechnology investments more broadly. As a case study, Bt eggplant provided evidence validating the potential for a GE crop to drive food security and environmental sustainability gains in a smallholder-farmer, developing-country context. The results also highlighted the value of rigorous evaluation for fostering evidence-based discussion, particularly when faced with programmatic or policy options that may be contentious. The studies also established methodological approaches for analyzing farm- and market-level outcomes and impacts of improved crop varieties. Looking forward, USAID is now adapting these approaches to field an impact evaluation of Bt cowpea in Nigeria, which became the first sub-Saharan African country to release a GE food crop for smallholder cultivation last year.

LESSONS LEARNED

- **Partner with Missions.** The Bt eggplant impact evaluation leveraged co-investment and joint activity design across the USAID Bureau for Resilience and Food Security and the USAID Mission in Bangladesh. Shared ownership across Washington, D.C.-based and in-country operating units fostered extensive input and development of evaluation questions, design, and dissemination, ensuring relevance to both the country-level and global learning objectives of [Feed the Future](#), the U.S. government's global hunger and food security initiative.
- **Narrow and clarify the evaluation questions as much as possible.** Given that studies cannot address every worthwhile question, a good starting point is to prioritize evaluation questions based on the underlying activity theory of change. It's also useful to consider the potential for evaluation results to inform broader program- and portfolio-level learning objectives.
- **Do not underestimate the importance of time and resources.** Impact evaluations require advance planning, sufficient budget resources to implement, and follow-up to ensure progress and dissemination. As early as possible (ideally at the activity design phase), identify opportunities for an impact evaluation, budget resources, and ensure high-level commitment and understanding for the time and resources needed to complete the evaluation.
- **Sustain commitment over time to support an iterative, ongoing analytical and learning approach.** This contributes significantly to Agency learning about the impact of the activity's interventions and the most effective strategic approaches to support development goals.
- **Publicize and share the evaluation results broadly, through various channels.** The USAID Development Experience Clearinghouse alone is not enough! Be proactive: seek opportunities to present results to relevant communities of practice, working groups, and at appropriate external fora. For Bt eggplant, the partner developed non-technical talking points, frequently asked questions lists, and infographics to communicate key points to general audiences. The Bureau for Resilience and Food Security [posted these materials](#) to the Feed the Future AgriLinks platform, and both USAID and the partner have used the materials in presentations and documents.
- **Find an evaluation mechanism with a performance period that extends long enough to collect the endpoint data.** Given that many of USAID's award mechanisms are limited to five years, this can be a logistical challenge. In this case, the team found that the public international organizations grant with CGIAR, the global research partnership on food security, met their needs for award duration, allowed flexible co-creation of the evaluation scope, and gave access to an implementing partner (IFPRI) with both evaluation expertise and knowledge of the technical subject matter.

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