

SUMMARY OF RESULTS AND INSIGHTS FROM POST-HARVEST LOSS TECHNOLOGY TESTING IN BANGLADESH

FEED THE FUTURE INNOVATION LAB
FOR THE REDUCTION OF POST-HARVEST LOSS



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BANGLADESH'S PATHWAY TO PROGRESS

The People's Republic of Bangladesh has a long-standing commitment to fighting poverty, improving health and nutrition outcomes and strengthening its agricultural sector. Bangladesh has demonstrated tremendous leadership in swiftly integrating programs that improve the health, nutrition and economic outcomes of vulnerable communities, but also investing its own resources to build country-level capacity and scale up transformative agriculture, food, nutrition and health programs. The results speak for themselves.

The United Nations Development Programme notes that Bangladesh has sustained a growth rate of over 6 percent achieved in recent years, and that played an important role in cutting poverty. In addition, there have been improvements in life expectancy, health and education, with life expectancy increasing from 59 years in 1990 to 69 in 2010, and today more than 90 percent of girls are enrolled in primary school. Bangladesh's track record for being associated with long-term hunger and malnutrition is well on its way to being erased, as Bangladesh has cut chronic hunger by more than half since 2000.

Bangladesh has a vibrant research community, civil society and private sector, and is an example of how progress can be sustainably fast-tracked when partners from across sectors come together.

Bangladesh has embraced and adopted innovations and approaches, and the Government has made its own investments to ensure that proven innovations can reach communities at scale.

TACKLING AGRICULTURAL, ECONOMIC AND NUTRITION CHALLENGES

Rice is the primary staple crop of Bangladesh, accounting for just over 90 percent of the total food produced, in addition to being the central component of Bangladeshi diets. This lack of dietary diversity and the lack of knowledge on a balanced diet challenges Bangladeshis' nutrition, especially that of women and girls. Though dietary diversity is a priority, rice will remain a dominant food and achieving self-

sufficiency in its production remains a national priority.

Agriculture plays a central role in the economic development of Bangladesh, but these financial benefits have evaded the 34 percent of the population living in poverty.¹ Nearly 75 percent of the national population resides in rural areas, sustained primarily by agriculture, with poverty concentrated in rural areas. Agricultural productivity is severely limited by lack of access to agricultural inputs such as credit, machinery and labor-reducing technologies, and land and labor constraints.



Both exacerbating and stemming from productivity issues are high levels of post-harvest losses (PHLs). Rice storage losses at the farmer level due to pests, atmospheric moisture, heat and microbial growth reduce surpluses and quality of rice that could be sold at market, or consumed safely later, and nutritional profiles of harvested rice, which further diminishes nutrition and food security and farmer profits. These post-harvest (PH) activities are predominately the responsibility of women, who lack access to agricultural extension, inputs, credit, and more. Sociocultural factors that disempower women, impact overall agricultural productivity, incomes, and most importantly, their own and future generation's health, nutrition status and livelihoods.

Rice is grown by nearly all farmers for personal consumption. Rice self-sufficiency, including the reduction and prevention of PHLs, would provide farmers with the security to pursue more lucrative farming or income-generating activities the rest of the year, and potentially make a transition out of subsistence farming and poverty.

¹ Feed the Future. Bangladesh Country Profile.

Increasing the use of farm machinery can reduce the cost of production, save time on the farm to free up farmers for other activities, increase cropping intensity and crop yield.² Drying and storing are noted by the Bangladesh Agricultural Research Council as labor-intensive activities that could be improved with machinery. Small and medium scale machinery equipment for drying rice is noted as a high-priority issue as part of the Agricultural Research Vision 2030 and Beyond, and national policies have encouraged increased domestic production of agricultural machinery.

Increasing agricultural productivity is essential to improved socio-economic, nutritional, and agricultural outcomes, and supports the Government's realization of becoming a middle-income country by 2021.

"Bangladesh is now a role model of development ... we want to take the country ahead further and we want Bangladesh to be established as a poverty-free developed Bangladesh."

- *The Honorable Sheikh Hasina Wazed, Prime Minister of the People's Republic of Bangladesh*

THE POST-HARVEST LOSS INNOVATION LAB TACKLES THREE POST-HARVEST CHALLENGES FOR RICE

As part of the USAID-funded Feed the Future Innovation Lab for the Reduction of Post-Harvest Loss Lab (PHLIL), Bangladesh Agricultural University (BAU), Kansas State University (KSU) and the ADMI Institute for the Prevention of Postharvest Loss at the University of Illinois (ADMI) are working together on three key areas with significant post-harvest challenges: drying, storage and mycotoxin contamination of rice through the testing and evaluation of traditional drying and storage technologies against improved technologies.

Through a phased approach BAU, KSU and ADMI are building capacity, conducting research to develop and identify post-harvest innovations to benefit rice farmers, and identifying pathways that can create

access to these technologies and impact at scale in Bangladesh.

PHLIL FINDINGS AND FARMER PREFERENCES GUIDE DECISIONS ON POST-HARVEST TECHNOLOGIES

Drying: The team adapted the STR dryer, originally from Vietnam, for the Bangladesh context and renamed it the BAU-STR dryer. The BAU-STR dryer can run on biomass, electricity or diesel in absence of the sun. This was tested against the Hohenheim Solar Bubble Dryer (SBD), which relies exclusively on energy from the sun. The BAU-STR dryer outperformed the SBD and traditional practiced sun drying in testing as the most efficient and affordable drying option. The dryer is currently not capable of drying parboiled rice, a common practice in Bangladesh. Women farmers have expressed a keen desire for the dryer to be compatible for this task, which is currently under development. The dryer was tested by the team for maize, wheat and rice. The BAU-STR dryer can be used successfully to dry a variety of cereal grains.



Storage: PHLIL evaluated storage containers for seed and grain for consumption. Hermetic bags, which prevent air and water from coming into contact with stored seed, including GrainPro and PICS bags were assessed against traditional technologies including the plastic drum, plastic bag, dole and motka.

Rice seed quality was found to be best in PICS bags, followed by GrainPro as compared to traditional/existing storage practices. The hermetic bags had no change in the moisture content after five

² International Development Enterprises (iDE). (2012). Commercialization of selected agricultural machines in Bangladesh.

months of storage, no insect infestation, no weight loss, and had the highest percentage of germination. Follow-ups with farmers who have received and been trained in GrainPro bag usage found that nearly 100 percent of farmers were correctly packing the bag, and 95 percent were producing their quality seed.

Mycotoxin: There has been no systematic research in Bangladesh for mycotoxin contamination in rice. In Bangladesh boro paddy is harvested during hot, humid weather conditions, which favor the growth of molds including *Aspergillus* spp and *Fusarium* spp. Additionally, farmers store paddy in the home in porous containers that favor mold growth. The PHLIL team conducted research covering 200 households in eight villages of Phulpur (Mymensingh) and Monirampur (Jessore) to detect and quantify aflatoxins and fumonisin in rice. Overall, aflatoxin and fumonisin levels were found to be low across two tested seasons. Romer Lab test kits were delivered to BAU for assessing mycotoxin contamination levels. **This is the first functional mycotoxin-testing lab in the country.**

PHLIL'S WORK SUPPORTS NATIONAL PRIORITIES OF BANGLADESH

PHLIL's efforts in Bangladesh support the country's agriculture development strategy, focusing on improved agricultural performance in the post-harvest stage of the value chain. The increased availability of food and provision of safe food associated with PHLIL work provides pathways to increased nutritional status, greater recognition of health, a transition out of poverty, and the tools necessary for children to adequately learn, develop and prosper.

Agriculture development as a means of poverty alleviation and socio-economic emancipation is a national priority. The agriculture sector remains the economic foundation of Bangladesh, yet the smallholder farmers who comprise the sector are often unable to escape poverty. A lack of labor and access to capital, agricultural inputs, land and extension constrains their productivity and profitability. Additionally, women farmers are disproportionately impacted by poverty as a result of inequitable gender norms. Women farmers lack access to and control over assets, resources, agricultural inputs, services, information, and property, which prevents profitability of agricultural activities. Policies such as the National Agriculture Policy, National Agricultural Extension Policy, and National Women Development Policy include

objectives to increase the productivity and profitability of smallholder farmers, mainstream women in agriculture and ensure equal opportunity to agricultural inputs.



Additionally, as the backbone of the agricultural sector, smallholders need low-cost appropriate technologies and machinery, and supportive programs to enable adoption. The National Agriculture Policy, National Food Policy and the Agricultural Research Vision 2030 and Beyond note that drying and storage are labor-intensive activities that could be improved with the adoption and use of time-saving machinery and include objectives to introduce and encourage adoption of appropriate technologies. The National Agricultural Extension Policy even provisions a subsidy to farmers when purchasing certain farm machinery.

National agricultural growth depends on improving quality seed production and supply to farmers. Production of quality seed to meet demand and timely supply to farmers are noted issues to the agricultural sector. A number of policies have focused on the issues constraining seed production and dissemination, providing policy directives to increase quality production and improving the technical skill of producers. Seed preservation and storage are specific areas of focus that align with the outputs of PHLIL.

Reducing and preventing PHL supports improved health and nutrition outcomes through women's empowerment. Gender equality is cited as the single most important determinant of food and nutrition security and consequently, plays a major role

in PHL and the related impacts.³ Rice drying and storage are primarily women's responsibility, but women have little to no economic empowerment or leadership within the home as it relates to post-harvest, and lack access to agriculture extension training and information. Bangladeshi women in agriculture are roughly two times as disempowered as men, and these gender inequities constrain the avoidance and reduction of PHLs.

Losses at the drying and storage stages result in less grain for consumption and/or for sale to purchase other nutritionally-diverse foods. Women are the last to eat, left with whatever remains after the man and children have eaten. Any shortage of food or income for food due to PHL will further ravage a woman's nutrition status. Mycotoxin contamination may not be visible in stored grain, or the severity of the fungus may not be known. Consumption of mycotoxin-contaminated grain has a range of health implications including immunity suppression, impaired growth, nutritional interference, liver cancer and death.⁴

“Ninety percent of post-harvest efforts are implemented by women, not by men. While men are responsible for a range of things on the farm, women are focused on post-harvest loss-related activities. If we can train women with the technology, technologies will continue to exist, because women stick to them. If we educate women directly then they will understand and make sure to keep using those practices.”

- Md. Hasan Aref, Director of Programmes, Jagorani Chakra Foundation

Access to and adoption of PHL-reducing technologies leads to reduced PHLs and impacts women's empowerment. Adoption and use of time-saving technologies by women reduces the amount of time she spends on drying and storage activities. This time can now be spent on homestead gardening, income-generating activities, pursuit of healthcare, or education. Reducing women's time poverty further allows them to improve resiliency to climate change through participation in community decision-making,

learning about adaptation strategies or investing in new livelihoods.⁵

Women are not only tantamount to sustainable reductions in PHL but also beneficiaries of the improved productivity that may translate into personal health, nutrition, and education opportunities. Furthermore, women have frequently been shown to have greater impact on the health, education and nutrition of children when they benefit from the increased opportunities and incomes that increased productivity allows.⁶

THE PATH FORWARD REQUIRES MULTI-SECTORAL COLLABORATION AND ACTION

PHLIL has and continues to support the Government of Bangladesh in its agriculture-led strategy for economic growth. Raising the capacity of smallholder farmers to reduce and prevent PHL, in addition to increasing productivity, paves the way to attain self-sufficiency in food production and a dependable food system.

To truly make progress, the path forward must support scale up and adoption of PHLIL innovations. A sustainable food system, free of rice losses, requires full participation, holistic approaches and partnerships from all sectors. The following specific calls to action to each stakeholder group will help reduce PHLs and create the food system envisioned for Bangladesh.

UN/Multi-laterals:

- **Share and promote PHLIL PHL-reducing technologies.** UN agencies, international and regional institutions provide unparalleled technical support, leadership and capacity development, shape the research agenda and facilitate partnerships that support sustainable food systems. Sharing and promoting the PHLIL PHL-reducing technologies will create a more enabling environment for dissemination, adoption and scale of the innovations.
- **Help strengthen public-private collaboration to improve PH outcomes.** Successful delivery and adoption of PH technology requires a multi-sectoral approach with multi-level support and

³ De Schutter, O. (2013). Gender equality and food security: Women's empowerment as a tool against hunger.

⁴ Ochieng, P. J., Okun, D., Runo, S., Njagi, N. J., & Murage, J. (2013). Public Health Strategies for Preventing Aflatoxin Exposure. *B/C*, 45, 1-22.

⁵ UNDP. UNDP Climate Change Adaptation: Impact Gender - Time Poverty.

⁶ De Schutter. (2013).

engagement in place. UN agencies and multi-lateral institutions can engage stakeholders and facilitate efforts across a range of sectors for the greatest impact.

Government:

- **Include PHL-reducing technologies within agricultural mechanization subsidy program.** Profitability is a critical component of farmer practices and adoption of new techniques. Unfortunately, the current agricultural subsidy program fails to incorporate machinery that supports the post-harvest stage. A subsidy would make the BAU-STR dryer even more advantageous to farmers, improve accessibility and demonstrate the importance of mechanization along the entire value chain.
- **Provide high-quality training on PHL reduction for extension agents.** Extension agents are a trusted source of agricultural knowledge and practices to farmers throughout Bangladesh. Ensuring this resource is adequately trained on PHL reduction is a critical link to on-the-farm PHL reductions.
- **Address challenges to food safety, seed viability and reduced PHLs within the Jute Regulation Act.** Hermetic bag technology is an invaluable component to addressing the challenge of PHLs and food security. The Jute Regulation Act prohibits the production and use of plastic bags to store rice, which leaves farmers to rely on traditional storage and drying practices that lead to losses from moisture, pests and mycotoxin contamination. Changes to the Jute Regulation Act to allow the production and use of hermetic storage technology supports reduced PHLs and increased food safety, and supports national priorities of improving quality seed production.

Donors:

- **Fund trial of BAU-STR dryer and hermetic bags by large audience of farmers.** Trial is an integral part of the adoption process but smallholders cannot afford to experiment with new technologies that may or may not impact an issue on the farm. Allowing a large group of farmers with opinion leadership to try out the dryer and hermetic bags without the economic risk not only increases their overall adoption, it also supports adoption at scale.
- **Frame PHL reduction within national priorities for increased action.** Reducing PHL links to economic growth, food systems strengthening, farmer resiliency, improved

markets, gender equity, and nutrition security. Making the link between PHLIL practices/ technologies and national priorities will allow for increased PHL efforts and impact.

Research Institutions:

- **Focus research into specific impact points along the value chain.** PHL can occur at different places along the value chain. While losses of any dimension challenge a farmer's productivity, health and well-being, some losses have a bigger impact than others. It is also important to take into account the cost of investment and consequent benefit for loss-reducing practices. Research into PHL reduction must focus on the best points in the PH pathway to support reduced PHLs and improved livelihoods.
- **Tailor research findings for specific audience groups.** Research drives investment, needed interventions and helps build awareness. It is critical that research findings be tailored to resonate with specific stakeholder groups that may not be familiar with or close to the research.



Private Sector:

- **Produce dryer blower in Bangladesh.** The blower of the BAU-STR dryer is currently imported from Vietnam. If the blower was manufactured in Bangladesh, it would reduce the cost of the dryer for farmers while providing a profitable opportunity for Bangladeshi industry.

“Feed the Future harnesses the power of American development leadership and innovation to partner with host governments, and community leaders and the private sector to build resilient communities with the goal of helping people stand on their own two feet, no matter what challenge may come their way.”

- USAID Administrator Mark Green

Furthermore, the Government of Bangladesh has encouraged in-country production of agricultural machinery noting the supply of appropriate support as necessary.

- **Manufacture, distribute and market hermetic bags.** Farmers have already expressed interest in purchasing hermetic bags, but the current price is unaffordable. The current demand can be met with in-country production, which would help lower the price to farmers and increase demand to a wider set of end-users.

Civil Society:

- **Promote PHLIL PHL-reducing technologies in programming.** Reducing PHL impacts agricultural productivity, income, gender-based roles, nutrition and health of farmers. Alignment with other priority sectors allows for a wider audience to be exposed to and trained on PHL-reducing technologies from trusted entities, while addressing key impact areas of training entities.
- **Provide education and advocacy on PHL and PHLIL technologies.** Awareness and education on the issue of PHL and its impact along the value-chain cannot be performed by government extension agents alone. NGOs and other institutions are needed to increase farmer awareness about post-harvest issues and identified solutions. Advocacy roles can also be utilized to pressure for changes to prohibitive policies, such as the Jute Regulation Act.

THE U.S. GOVERNMENT'S COMMITMENT
TOWARD A PROSPEROUS AND RESILIENT
BANGLADESH

Bangladesh remains committed to achieving progress and prosperity for all. In that aim, it has always opened doors and fostered positive and productive collaborations with institutions around the world, including the United States. In collaboration with the U.S. Government, Bangladesh has overcome formidable development challenges and continues

making progress toward realizing its' development goals.

The U.S. Government's Feed the Future initiative is tackling root causes of poverty, hunger and malnutrition. Through the Innovation Labs, it has propelled innovative research and academic institutions forward, and fostered mechanisms to develop, test and scale technologies and approaches that can have a transformative impact on the lives of the poor around the world. Due to its commitment to food security investment and potential for agricultural growth, and to sustain the successful partnership and development gains made, Bangladesh was selected as one of the target Feed the Future countries.

Moving forward, the Feed the Future Post-Harvest Loss Innovation Lab will continue working with Bangladesh to address PH technology adoption challenges, build upon strengths and achievements to date, foster awareness and engagement to improve post-harvest practices, and support the country's leadership in building a vibrant food system through tools and technologies that hold the promise of great impact at scale.

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