



FEED THE FUTURE

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



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

October 1, 2019-March 31, 2020



USAID
FROM THE AMERICAN PEOPLE

KANSAS STATE
UNIVERSITY



Cover caption:

Two farmers and long-time friends talk about their practices for rice seed in Jessore, Bangladesh.

Photo credit: Dena Bunnell

This report is made possible by the generous support of the American people through the United States Agency for International Development (USAID) under the Feed the Future initiative. The contents are the responsibility of the Post-Harvest Loss Innovation Lab and do not necessarily reflect the views of USAID or the United States Government.

RESEARCH AND SCALING PROGRESS SUMMARY

Research Progress: October 1, 2019-March 31, 2020

The first half of fiscal year 2020 saw our Phase II research and associated scaling objectives come into full swing; progress on our research and associated scaling activities is detailed below by country and objective.

Bangladesh

1. Scaling of the BAU-STR Dryer

PHLIL-Bangladesh is continuing to work with local engineering workshops, farmers, the Department of Agricultural Extension (DAE) and Palli Karma-Sahayak Foundation (PKSF) to increase adoption of the BAU-STR dryer through training and logistical support. DAE distributed 184 dryers to farmer field schools, and the Food and Agriculture Organization (FAO)'s Missing Middle Initiative (MMI) program distributed 7 dryers in the 2019 Boro season. Training of trainers (ToT) sessions were held with farmer groups through these partnerships with the FAO-Bangladesh and DAE. Refresher trainings were held for previously trained farmers (on the dryer and hermetic storage of seed), and BAU provided as-needed advising for local workshops producing the dryers.

2. Modification of the BAU-STR Dryer for liquid petroleum gas (LPG) as a fuel source

In the design modifications to the BAU-STR Dryer so that it can operate on LPG, the BAU team selected a suitable burner for LPG from the local market. The dryer performance was evaluated with rice husk briquette and LPG heating units, as well as local and imported blowers in a combination of treatments to assess drying efficiency, germination rates and cost-benefit ratios. Analysis showed that the LPG based heating system of the BAU-STR Dryer with the locally made modified blower is the best drying option for the farmers and seed producers of Bangladesh, with slightly higher dryer efficiency and germination rates and a comparable cost-benefit ratio.

3. Development of a meso-scale rice dryer for parboiled paddy

After an extensive literature review and industry consultation, the BAU team selected the design and specifications for a six metric ton recirculating batch dryer for meso-level rice mills. The dryer will be based on existing dryers and modified for local conditions and improved processes. It will be able to dry both rough and parboiled rice, as demanded by stakeholders. The dryer will be co-funded by and built at Moti Auto Rice Mill; this public-private partnership will ensure that research and training can take place at the mill for the life of the dryer. As part of our meso-level engagement, and at the request of the millers, a small number of samples were collected from traders and small- and meso-level mills to test aflatoxin and fumonisin levels in paddy. All samples were below maximum allowable limits.

4. Testing of hermetic storage for seed with BADC

In the 2019 Boro season, hermetic storage was placed alongside existing storage protocols at two bulk BADC seed storage centers to assess efficacy and cost efficiency. A second trial is currently underway, set to be completed in May 2020. Preliminary results suggest that current, traditional storage practices are adequate for up to three months, but for longer storage, especially greater than 9 months, hermetically stored seeds lead to higher germination rates. Over four months of storage, using traditional storage methods, germination rates dropped by 4-6% while grains stored using hermetic storage saw no loss in germination rates.

5. Randomized control trial on liquidity and risk for hermetic bags for rice seed storage

A randomized control trial on farmer adoption of hermetic storage for seed began in fall 2019. Helen Keller International, Bangladesh is implementing the survey; BAU liaised with extension officers and provided technical training to survey enumerators on hermetic storage. The baseline survey was successfully conducted in December 2019 and January 2020 in two target districts: Sherpur and Narail. The data are currently being analyzed from the baseline survey.

6. Conduct a gender technology assessment for PHL technologies

AgReach and the BAU team conducted gender-based training and field surveys on PHLIL technologies (the BAU-STR dryer and hermetic storage bags) through assessments in Mymensingh, Netrokona and Jessore districts. These assessments will be evident in gender-based technology profiles and solidified evidence of women's involvement in post-harvest activities and constraints faced in Bangladesh. This further strengthens Phase I findings that women hold the primary responsibility of post-harvest activities.

7. Youth engagement in post-harvest activities

PHLIL-Bangladesh hosted a workshop for agricultural engineering undergraduate students on the design and development of the BAU-STR dryer and entrepreneur development for agricultural technologies.

8. Engagement activities

Drs. Md. Monjurul Alam and Chayan Saha presented at conferences in Dhaka and New Delhi highlighting PHLIL-Bangladesh research findings. In addition, two PHLIL-funded BAU graduate students presented at the 2019 International Conference on Sustainable Agriculture, which was held at BAU. The BAU team provided seven trainings on topics ranging from BAU-STR dryer and hermetic bag use to gender issues and economic constraints in technology adoption.

Ethiopia

1. Evaluate the performance of a mechanical sheller/thresher

Experiments to evaluate the performance of two types of mechanical shellers/threshers (500kg/hour and 100kg/hour) for two moisture contents (22% and 17%) of maize prior to drying began in December 2019. Some breakage of grains was observed at 22% moisture content, with promising results at 17%. This research will help inform recommendations for appropriate timing of threshing.

2. Engagement of National PHL Advisory Committee

This committee is still engaged in our program and is offering guidance relevant to our work. The Director General of Ethiopian Institute of Agricultural Research, the Crop Research Director, and Regulatory Directorate General are involved in the PHL Advisory Committee, which has elevated the agenda of post-harvest issues to the level of national institutes and government.

3. Evaluate integrated drying/storage systems for on-farm reduction of sorghum post-harvest loss

The study to test appropriate drying and storage systems in an integrated manner has begun with sampling every two months. The study is comparing traditional and improved technologies for sorghum storage on-farm. Underground pits, both with and without a liner, serve as the traditional storage method being assessed. Improved technologies are PICS bags, ZeroFly® hermetic bags and filtercake. Filtercake will not be stored on farm, but at a local research experiment station to help replicate similar environmental conditions. The study seeks to provide analysis of a post-harvest intervention package, rather than only individual technologies.

4. Assess the adoption of post-harvest technologies and the presence of spill-over adoption

The adoption study will analyze different teaching methods utilized in Ethiopia and Ghana, including group teaching events as well as individual teaching events and identify foundational, regionally relevant barriers to education and adoption of post-harvest interventions. This research will assist development practitioners in understanding the most effective way to train people that leads to adoption. Revision of the survey instrument was completed after the pilot testing in FY2019. The revised instrument was to be administered in Ghana in March 2020 but was postponed due to travel restrictions from the COVID-19 pandemic. This may also impact survey implementation in Ethiopia this spring/summer. An abstract related to theory and instrument development was to be presented at the 2020 Association for International and Agricultural Extension Education Conference but was canceled due to COVID-19.

Prior to the suspension of Lab work, PHLIL Ethiopia continued to conduct training in groups. This has become a target variable for adoption research, group trainings in Ethiopia and one-on-one in Ghana.

5. Formalize the inclusion of PHLIL knowledge and technologies in extension education

As requested by the Ministry of Agriculture, national technical and extension mycotoxin manuals are still under revision with updates from our Phase I findings. An English language draft is currently in review by related faculty and researchers. Village-level demonstrations of post-harvest technologies was conducted in two locations in Tigray.

Ghana

1. Scaling of GrainMate moisture meters and hermetic technologies

In December, the PHLIL Ghana team offered trainings to poultry farmers in Dormaa, both in group and individual settings, on post-harvest loss reducing technologies, including the ZeroFly® Hermetic (ZFH) bag and the GrainMate moisture meter. The training on these technologies involved both talking about the technologies and setting up a demonstration of hermetic technologies in each poultry farm. After 3 months, maize stored in the polypropylene and ZFH bags on the farms visited will be opened in the presence of poultry farmers and their staff to establish insect infestation levels and maize weight loss. This training also instructed poultry farmers on good sanitation and why it is central in insect pest and mycotoxin mitigation. The farmers' own storehouses were used for teaching good sanitation practices.

Sesi Technologies continues to grow, with 101 moisture meters sold in 2019. Paul Armstrong is still serving as an advisor to Sesi Technologies as they increase efficiency and continue to upgrade the GrainMate.

2. Assess the use of low-cost, locally built elevated platforms to mitigate high mycotoxin levels that are usually associated with heaping maize in the field

An MPhil student at KNUST began coursework in fall 2019 and will carry out research on both low-cost, locally produced, elevated platforms and ZFH bags. The research will also assess rodent damage, as well as the performance of broiler birds raised on maize stored in ZFH bags over a six month period. The student is being jointly advised by Drs. Enoch Osekre (KNUST) and George Opit (Oklahoma State University).

3. Conduct research into effective training methods

Discussions and planning has been ongoing; however, due to the outbreak of COVID-19 the engagement team's trip to Ghana in early March was postponed. It will be rescheduled in accordance with university travel guidance and restrictions. In case travel restrictions are longer than a few months, relationships and contacts have been formed and identified to conduct adoption research with local faculty and researchers. As the training in Ghana has adjusted to include a one-on-one component, a comparison will be conducted with the Ethiopia data for the impact of delivery.

4. Promote awareness and adoption by women and youth stakeholders in the agriculture sector

The AgReach team observed the PHLIL trainings in Dormaa, spoke with female and male farmers about how they use technologies and the barriers and benefits of these technologies. From this interaction the AgReach team developed several recommendations to increase the gender equity of PHLIL activities: training videos in Twi to reach more women and small holder farmers; increased engagement with the Women in Poultry Association (WPA) to provide post-harvest best practices training; and continuing training for Crop Aggregation Centers and village farmer-based organizations. The AgReach team also developed a relationship with the University of Development Studies in Tamale for future collaboration.

5. Test small-scale kernel sorting as an avenue to remove mycotoxin-contaminated maize

Matt Stasiewicz from the University of Illinois travelled to Ghana in December 2019 for a site visit and introductions to KNUST and the rest of the PHLIL Ghana team. Following the site visit, a specific experimental design has been developed for evaluating the effect of kernel sorting technologies in conjunction with local grain cleaning technology, both on grain that is well dried and stored (due to existing use of GrainMate and ZFH bags) or poorly stored.

Guatemala

While Guatemala has proved to be our biggest challenge due to restrictions in funding allocations this fiscal year, we were able to conduct a lowlands survey of agricultural practices, climatic limitations, and socio-economic factors along the maize value chain. SHARE Guatemala implemented the survey in fall 2019 and findings are contributing to updated post-harvest training materials.

Issues or Concerns Encountered

As we came upon the end of the second quarter, the novel coronavirus, COVID-19, began impacting program activities. Both international travel and local travel to field sites was interrupted in March 2020. At this time, all activities that require field visits or in-laboratory research are on hold. Work on analysis of data, manuscript writing, and program planning that can happen remotely are continuing. All PHLIL partners have been advised to follow local guidance, and we continue to follow guidance and updates from USAID. Additional travel will likely be impacted as the situation evolves.

Ghana: The Nigerian boarder has been closed for several months, disrupting our ability to source ZFH bags, which are manufactured in Nigeria.

Ethiopia: Consistent communication has proved challenging for this team. Additionally, due to health complications of a team member the development of pesticide residue analysis procedures has not begun. While published research on filter cake in Phase I indicated its efficacy, more research must be done to confirm that the inert dust does not have any detrimental health impacts. The Ministry of Agriculture is eager and anxious to learn more about this technology, especially given the known dire health risks associated with use (and misuse) of existing available pesticides; however, there is no funding to research health impacts in our current Phase II budget.

Human and Institutional Capacity Development

Short-term training

Country of Training	Brief Purpose of Training	Who was Trained	Number Trained		
			M	F	Total
Bangladesh	Training on Gender Based Technology Assessment (October 12, 2019) Mymensingh	Civil Society	7	4	11
Bangladesh	Addressing Economic Constraints of Technology Adoption for Post-harvest Practices and Rice Seed Storage in Bangladesh (November 21, 2019) Jamalpur	Civil Society	19	2	21
Bangladesh	Training on BAU-STR dryer and Hermetic Bag Use (November 28, 2019) Bogura	Producers, Government, Private Sector, Civil Society	20	30	50
Bangladesh	Training on BAU-STR dryer and Hermetic Bag Use (December 1, 2019) Phulpur	Producers, Civil Society	19	29	48
Bangladesh	Training on BAU-STR dryer and Hermetic Bag Use (December 17, 2019) Barisha	Producers, Civil Society, Private Sector, Government	26	3	29
Bangladesh	Gender Workshop with Group Discussion (January 28, 2020) Mymensingh	Producers, Civil Society	13	25	38
Bangladesh Subtotals			104	93	197
Ghana	Poultry Farmers training on drying, storage, and good sanitation (December 16-20, 2019) Dormaa Ahenkro, Dormaa Central, Bono Region	Poultry Producers	15	8	25
Ghana	Poultry Farmers training on drying, storage, and good sanitation (March 16-20, 2020) Dormaa Ahenkro, Dormaa Central, Bono Region	Poultry Producers	0	11	11
Ghana Subtotals			15	19	36

Long-term training

Trainee Number	Sex	University	Degree	Major	Program End Date	Degree Granted	Home Country
Bangladesh Team							
1	F	Bangladesh Agric. Univ.	PhD	Plant Pathology	December 2020	In process	Bangladesh
2	M	BAU	PhD	Farm Power and Machinery	February 2020	Yes	
3	M	BAU	PhD	Farm Power and Machinery	February 2020	Yes	
4	M	BAU	MSc	Agricultural Engineering	December 2020	In process	
5	M	BAU	PhD	Agricultural Engineering	December 2022*	In process	
6	M	BAU	MSc	Farm Power and Machinery	December 2019	Yes	
Ethiopia Team							
7	M	Mekelle University	PhD	Plant Science	September 2020	In process	Ethiopia
8	M	Mekelle University	PhD	Plant Science	September 2020	In process	
9	M	Mekelle University	MSc	Plant Science	Summer 2019	Yes	
10	F	Bahir Dar University	PhD	Food Engineering	September 2020	In process	
11	M	Bahir Dar University	PhD	Food Engineering	July 2019	Yes	
12	M	Bahir Dar University	PhD	Food Engineering	September 2020	Yes	
Ghana Team							
13	M	Kwame Nkrumah University of Science and Technology	MPhil	Crop Protection (Entomology)	July 2021	In process	Ghana
Nepal Buy-In							
14	F	Kansas State University	MSc	Plant Pathology	August 2020	In process	Kenya

* This student will be supported by BAU after the end of the PHLIL program.

PHLIL has additional graduate students who are engaged in PHLIL-affiliated research activities but who are not funded by USAID. These students are enrolled and funded wholly separately from PHLIL funds; however, they are assisting in research activities, often due to their being advised by faculty on our team. Thus we still seek to capture their significant contribution to our program:

Trainee Number	Sex	University	Degree	Major	Degree Granted	Home Country
Ghana Team						
15	M	University of Illinois Urbana Champaign	PhD	Food Science	In progress	Guatemala
Guatemala Team						
16	M	University of Nebraska, Lincoln	PhD	Food Science and Technology	In progress	Guatemala
Engagement Team						
17	F	Iowa State University	PhD	Ag Education	In progress	Cameroon
Ag Econ Team						
18	F	Kansas State University	PhD	Ag Economics	In Progress	Pakistan
19	M	Kansas State University	MSc	Ag Economics	In Progress	Guatemala

Innovation Transfer and Scaling Partnerships

Bangladesh: *BAU-STR Dryer*

The BAU team is continuing to work with small scale, regional manufacturers for commercialization of the BAU-STR dryer and for adaptations to the dryer, including a new fuel source, liquefied petroleum gas (LPG). This new fuel source will allow the scaling of this dryer across all regions of Bangladesh as rice briquettes are not available in every part of the country, but LPG is more widely available. Since a local electronic company produced a lighter and less expensive blower during FY19, the dryer is completely produced locally.

Future Work

Across the entire program, we are actively adapting to and anticipating COVID-19-related disruptions to planned activities. Travel, group trainings and other planned activities will continue to be delayed due to the pandemic. The extent of delays is yet to be seen. We are working with our AOR as we learn more and adapt, to minimize disruption while putting safety of our project teams and partners/target beneficiaries first.

Bangladesh: The seed storage adoption RCT will conduct the endline survey in summer 2020. DAE plans to disseminate another 1,400 LPG-based BAU-STR dryers; 150 will be purchased and disseminated during the 2020 Boro season, and the remaining dryers will be purchased and distributed in the coming rice harvesting seasons. PKSf will promote the BAU-STR dryer through their partner NGOs, and PHILIP-Bangladesh will provide training of trainers to the respective users of DAE and PKSf.

Ethiopia: Adoption research will continue in Ethiopia after the resumption of travel. The integrated research experiments will be a focus of the coming months. With program adaptations related to Guatemala-related activity shifts as well as the pandemic-related travel restrictions, we are assessing the most practicable and informative expanded mycotoxin research exercise to deploy. Engagement team faculty will be traveling in fall 2020 to collect adoption data that was anticipated during winter/spring 2020. If travel restrictions are still in place, personnel from within Ethiopia will be trained to collect the needed data.

Ghana: Activities will continue as detailed in the workplan. The Ag Reach team plans to establish a partnership with Women in Poultry Associations and with the University of Development Studies in Tamale. Engagement team faculty will be traveling in fall 2020 to collect data that was anticipated during winter 2020. If travel restrictions are still in place, personnel from within Ghana will be trained to collect the needed data.

Guatemala: Our Guatemala project wrapped up during FY20 due to funding constraints. There will be no future activity in Guatemala using USAID funds.

Appendix: Vignette

Poultry farmer finds value in improved post-harvest practices

Thompson Takyi of TK Takyi Farms owns a 1,000-layer poultry farm in the Dormaa area. He was trained on using ZeroFly® Hermetic (ZFH) bags in August 2019, and he then purchased 30 ZFH bags. He produces maize on his land mostly to make poultry feed for his layers. The maize stored in the 30 ZFH bags was produced on his farm. He has been impressed by the ability of ZFH bags to preserve the quality of maize stored in them. He has also purchased a GrainMate moisture meter for his poultry farm. According to him, poultry feed made using maize stored in ZFH bags results in eggs with much more brown color, stronger shells, and bigger size; in addition to increased total egg numbers*. Thompson also stated that egg production by his layers has been at >97% in the last few months. On his farm, he has found that ZFH bags are not only effective against stored-product insect pests, but that they are also effective against rodents. He has seen no sign of rodent damage on the ZFH bags he is using for storage. In contrast, rodent activity does great damage to the polypropylene bags he typically uses for storage, resulting in large tears and maize spillage in the storage area. During the PHLIL Ghana team's visit to Thompson's farm on December 20, 2019, he bought an additional 25 ZFH bags. Thompson hopes to produce 100 bags of maize from the 2019 minor season harvest and will store all this maize in ZFH bags. He is anticipating purchasing many more ZFH bags for storing maize in 2020. Thompson has expressed a willingness to train other farmers and potentially serve as a marketing agent for ZeroFly® Hermetic bags and the GrainMate moisture meter. Thompson presents one example of users serving as the best advocates for new technologies and putting both purchasing and marketing power in their hands can be a great pathway to scaling these proven technologies.

*PHLIL has no direct evidence of ZFH bags impacting egg quality, however this observation makes sense given increased grain quality and reduced mycotoxins from use of these bags; future research into directly confirming these perceptions would be valuable to help propel adoption.