



# 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, 2021 - March 31, 2022



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**Cover caption:**

Gender sensitization training on post-harvest crop management is provided to the villagers of Bongaon, Phulpur, Mymensingh in Bangladesh.

*Photo credit: Dr. Chayan Saha, Bangladesh Agricultural University*

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## RESEARCH AND SCALING PROGRESS SUMMARY

PHLIL responded to a formal Request for Revised Application from USAID in mid-2021. This award raises the ceiling of the original PHLIL agreement by ~\$1 million and extends the period of performance by one year through December 2022, a 9th year of operation. For the first half of fiscal year 2022, PHLIL has focused on specific objectives laid out in the 9th year funding proposal, to focus on scaling innovations in Bangladesh and Ghana.

Year 9 focuses on extending research and partnerships to propel successful technologies along the product life cycle and into sustainable use. A set of innovations and activities were identified and prescribed in the Request for Revised Application letter from USAID. In Bangladesh, activities include: a grain dryer co-developed with mid-scale private sector mills; hermetic cocoons for use by the seed sector; adapting the Arc'teryx solar dryer for perishable high-nutrient foods as well as grains; and continuing support as the PHLIL-developed, locally produced BAU-STR dryer scales, including within the official agricultural mechanization subsidy program. In Ghana, these will include: characterizing improved poultry performance with properly stored feed, a key adoption consideration; research and dissemination of elevated platforms to reduce mycotoxins; expanded support to the Women in Poultry Association; adaptation of the Arc'teryx solar dryer; continue addressing post-harvest losses with smallholder farmers in Northern Ghana and the Ministry of Agriculture; and continued support to Sesi Technologies as they grow to meet increasing market demand.

A semi-annual summary of progress to date follows.

### Bangladesh

#### Research progress during reporting period, October 2021 – March 2022

- A 12-ton capacity mechanical grain dryer was manufactured, installed and tested successfully. The dryer is suitable for both parboiled and aromatic paddy.
  - A technical study was conducted on 20 rice mills (major: 8, automatic: 4, and semi-automatic: 4) and 7 recirculating dryers (parboiled: 3, aromatic: 04) of automatic and semi-automatic rice mills of Bangladesh and found that, (a) 12-ton capacity dryer is appropriate for major rice mills where the capacity utilization of the major rice mills would be about 72%, and (b) parboiled and aromatic paddy can be dried in one recirculating dryer just by controlling the operating parameters: drying temperature, and grain exposure time to hot air.
  - Based on the findings, a-12 ton capacity recirculating paddy dryer was developed locally on a cost-sharing basis (Public Private Partnership) with Moti Auto Rice Mill. Installation of the dryer was completed on January 11, 2022.
- A version of the Product Life Cycle of the BAU-STR dryer was developed and shared in the PHLIL annual meeting (January 2022) to assist future researchers in sustainable scaling of a technology.
- A training manual, business manual and video documentary of the BAU-STR dryer and hermetic bags and cocoons has been prepared for dissemination.
- A best management practice for large-scale paddy seed storage in hermetic cocoons has been prepared. Protocol to use and management of hermetic cocoon for large-scale paddy seed storage has been developed.
- 292 farmers (M: 219, F: 73) were trained on the BAU-STR dryer, 228 farmers (M: 173, F: 55) were trained on hermetic bag usage, 63 officers and employees (M: 58; F: 5) of Bangladesh Agricultural Development Corporation (BADC) were trained on hermetic cocoons, and 138 (M: 73, F: 65) participants received gender sensitization training in this tenure. Amongst the total participants of the respective technologies, 77 youth (M: 54, F: 23) were trained on the BAU-STR dryer, 27 youth (M: 20, F: 07) were trained on hermetic bag usage, 6 young officers and employees (M: 05, F: 01) of BADC were trained on hermetic cocoons, and 19 (M: 13, F: 6) youth received gender sensitization training in this tenure.

- For adoption of hermetic cocoons at BADC seed processing center, initial discussions with personnel of BADC seed wings has occurred successfully.
- The third set of Arc'teryx tent dryer materials was successfully shipped from Canada to Bangladesh in March 2022 for further validation experiments. The team is setting up to have an introductory meeting with the lead engineering team from Arc'teryx and PHLIL consultants, as well as review the manual for setup, in early April.
- [*gender team*] Reviews and commentary on BAU's drafts of gender technology assessments have occurred.
- [*agricultural economics team*] Data have been collected and cleaned for the GrainPro bags RCT study. The data analyses are in-progress. Manuscript drafting has begun.

#### **Issues and Concerns encountered during the reporting period, October 2021 – March 2022**

- In-person meetings, training, experiments, and policy dialogue were often challenged logistically, or delayed, due to the ongoing COVID-19 pandemic.
- Timely procurement of hermetic cocoons during the pandemic was also a challenge.

## **Ethiopia**

While Ethiopian program objectives were not formally targeted for funding in the 9<sup>th</sup> year extension, a no-cost extension is in effect to graduate program students and close-out reporting.

The COVID-19 pandemic was a major issue in Ethiopia, but the struggles became even larger in November of 2020 and remain so today. Through FY21 and beyond, the Tigray region has been mired in war. As a result Mekelle University has been unable to conduct research. Two doctoral students have been displaced and have so far been unable to finalize their dissertation work. Efforts are underway to connect them with alternate institutions to complete their programs and defend their dissertations.

A mycotoxin training manual has progressed through several layers of revision. In 2021, the English version was revised in Ethiopia, reviewed and edited by Dr. Rizana Mahroof and Dr. Jonathan Ulmer. Currently the manual is being revised by PHLIL Director, Prof. Jagger Harvey for English and mycotoxin edits.

#### **Research progress during reporting period, October 2021 – October 2022**

- One M.Sc. student at Mekelle University successfully defended his research
- Arc'teryx tent dryer validation and on farm demonstrations were performed during difficult conditions
- A manuscript from previous work was developed and submitted for publication
- Multiple networking discussions and virtual meetings have taken place to encourage the completion of doctoral students' dissertations at alternate institutions due to displacement from the war

## Ghana

### Research progress during reporting period, October 2021 – March 2022

- The study to compare the performance of layers raised on feed from maize stored in ZeroFly Hermetic (ZFH) bags and polypropylene bags has been initiated. Three poultry farms where the storage of maize in ZFH bags and polypropylene bags were identified. Storage of maize in these two types of bags for a 4-month period then commenced.
- Field sample collections for studies to determine the effectiveness of elevated platforms in reducing mycotoxin contamination in heaped maize in the field during the minor season in the Middle Belt and Northern Regions of Ghana have been completed. Estimation of aflatoxin and fumonisin levels in these samples will be conducted beginning in April 2022. Test kits for mycotoxin analysis were shipped to Kwame Nkrumah University of Science and Technology (KNUST).
- Building on PHLIL's success in empowering the Women in Poultry Association (WPA) Dormaa Chapter, the program will promote awareness and adoption of ZFH bags, GrainMate moisture meters, and DICE (storehouse integrated pest management) in two additional chapters of the WPA. Members of the Dormaa chapter are using these improved practices and technologies to significantly improve profitability and grow their businesses, as well as selling the bags to generate further income as independent agents. In year nine, 20% of the ZFH bags purchased by PHLIL for marketing purposes will be used to promote awareness and adoption of ZFH bags in the new chapters.
  - During a November/December 2021 trip to Ghana by PHLIL leadership & external advisory team members, a meeting was held to link the WPA Dormaa East Chapter with the Dormaa Central Chapter in an effort to link the chapters together for mentorship purposes.
- During a November/December 2021 trip to Ghana by PHLIL leadership & external advisory team members, a meeting was held with the Ministry of Food and Agriculture (MoFA) Extension Agents regarding the facilitation of scaling ZFH bags in the Upper East Region. PHLIL partner and GrainMate Moisture Meter producer, Sesi Technologies, will receive ZFH bags with funds purchased from USAID. It is estimated that each bag will be sold for the local equivalent of USD \$1.60 adjusted for volume discounts, whole sale pricing, and any losses due to damage or returns. Sesi Technologies will be connected with and will work with the MoFA agents to further increase adoption of moisture meters and ZFH bags in the Northern Regions of Ghana.
- The Arc'teryx tent dryer for drying nutrient-dense perishables and maize has been set up for conducting research at Kwame Nkrumah University of Science and Technology (KNUST). KNUST researchers are preparing to conduct efficiency and adaptation tests with the dryer. An assembled team of economists, engineers, and food science & nutrition experts are working to determine nutrient-dense perishables that could be optimally dried using the innovative tent dryer.
- [**kernel sorting team**] It has been determined that one can effectively sort maize to remove mycotoxins using visually identified features that correlate to high-risk of mycotoxin contamination. This validation experiment used visual characteristics previously associated with aflatoxin and fumonisin contamination in corn to calibrate the sorter and then sort mycotoxin contaminated lots to remove toxins. Results show that most of the sample is accepted (median around 88% accepted), with about half total mass of aflatoxin removed and about 90% of the total mass of fumonisin removed.
- [**gender team**] A manuscript of the gender technology assessments is in progress and should be submitted by May 2022. Action research was conducted with the Women in Poultry Value Chain Apex (WiPVCA) to improve organizational capacity around post-harvest.

### Issues and Concerns encountered during the reporting period, October 2021 – March 2022

- Funding transfer delays caused the study related to the assessment of layers fed on properly dried grain to commence in March 2022 rather than January 2022.

- The procurement of ZFH bags for marketing by Sesi Technologies and Extension Agents in Ghana has been delayed. The number of bags procured has also been reduced by the PHILIL M.E. due to budgetary constraints.
- Funding delays and miscommunications have caused multiple delays related to the Arc'teryx tent dryer desk study for selecting a crop(s) to be used for validation.
- [*kernel sorting team*] It has taken a long time to develop a protocol to ship the kernel sorter and have sufficient training materials ready that KNUST can use it without needed in-person training from the US team.



## 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 BAU-STR Dryer and Hermetic Bag at Sheskandi, Purbadhala, Netrokona (October 2, 2021)	Producers, Government	57	10	67
Bangladesh	Training on BAU-STR Dryer and Hermetic Bag at Ramkanda, Ghagra, Purbadhala, Netrokona (October 3, 2021)	Producers, Government	31	3	34
Bangladesh	Training on Gender Sensitization at Sheskandi, Purbadhala, Netrokona (October 4, 2021)	Producers	17	14	31
Bangladesh	Training on Gender Sensitization at Hogla, Purbadhala, Netrokona (October 5, 2021)	Producers	9	14	23
Bangladesh	Training on BAU-STR Dryer and Hermetic Bag at Sohagidohor, Hogla, Purbadhala, Netrokona (October 20, 2021)	Producers	44	23	67
Bangladesh	Training on Hermetic Technology for Large-Scale Paddy Seed Storage: Introduction and Management to the government officers of BADC, Madhupur (December 4, 2021)	Government	13	1	14
Bangladesh	Training on Hermetic Technology for Large-Scale Paddy Seed Storage: Introduction and Management to the government employees, BADC, Madhupur, Tangail (December 4, 2021)	Government	16	1	17
Bangladesh	Training on Hermetic Technology for Large-Scale Paddy Seed Storage: Introduction and Management to the government officers of BADC, Balashpur (December 6, 2021)	Government	15	2	17
Bangladesh	Training on Hermetic Technology for Large-Scale Paddy Seed Storage: Introduction and Management to the government employees of BADC, Balashpur (December 6, 2021)	Government	14	1	15
Bangladesh	BAU-STR Dryer: A Climate Smart Solution for Farmers and Small Traders (December 15, 2021)	Government, Civil Society	33	16	49
Bangladesh	Training on BAU-STR Dryer and Hermetic Bag at Technology Park, Charpara, Phulpur, Mymensingh (December 21, 2021)	Producers, Civil Society	41	19	60
Bangladesh	Training on Gender Sensitization at Technology Park, Charpara, Phulpur, Mymensingh (December 21, 2021)	Producers, Civil Society	41	19	60
Bangladesh	Training on Gender Sensitization at Bongaon, Phulpur, Mymensingh (December 21, 2021)	Producers	6	18	24
Bangladesh	Entrepreneur training workshop at conference room, Department of Farm Power and Machinery, BAU, Mymensingh (December 31, 2021)	Producers	13	2	15
<b>Bangladesh Subtotals</b>			<b>350</b>	<b>143</b>	<b>493</b>
Ghana	Women in Poultry Value Chain Apex Strategic Planning (March 16, 2022), Tamale	Producers, Private Sector, Civil Society	4	10	14
Ghana	Women in Poultry Value Chain Apex Strategic Planning (March 21, 2022), Dormaa	Producers, Private Sector	0	17	17
Ghana	Assessing Post-Harvest Technologies through a Gender Lens (March 25, 2022), Dormaa	Civil Society	24	13	37
<b>Ghana Subtotals</b>			<b>28</b>	<b>40</b>	<b>68</b>
<b>FY22 Semi-Annual Total</b>			<b>378</b>	<b>183</b>	<b>561</b>

\*Note: Number of trainees is lower than projected goals for semi-annual reporting season. PHLIL anticipates using the year 9 extension funding to operationalize scaling efforts. Harvests in Ghana and Bangladesh, and subsequent mass training opportunities, will come later in the 2022 calendar year allowing for growth in training numbers at that time.

## a. Long-term Training

Trainee Number	Sex	University	Degree	Major	Program End Date	Degree Granted	Home Country
<b>Bangladesh</b>							
1	F	Bangladesh Agric. Univ.	PhD	Plant Pathology	March 2022	In progress	Bangladesh
4	M	BAU	MSc	Agricultural Engineering	March 2022	In progress	
5	M	BAU	PhD	Agricultural Engineering	December 2022	In progress	
20	F	BAU	MSc	Agricultural Engineering	May 2022	In progress	
21	F	BAU	MSc	Agricultural Economics	May 2022	In progress	
<b>Ethiopia</b>							
7	M	Mekelle University	PhD	Plant Science	July 2022	In progress	Ethiopia
8	M	Mekelle University	PhD	Plant Science	July 2022	In progress	
26	M	Bahir Dar University	MSc	Food Technology	March 2022	Yes	
<b>Ghana</b>							
13	M	Kwame Nkrumah University of Science and Technology	MPhil	Crop Protection (Entomology)	July 2022	In progress	Ghana
<b>Nepal Buy-In</b>							
14	F	Kansas State University	MSc	Plant Pathology	December 2022	In progress	Kenya

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
<b>Ghana</b>						
15	M	University of Illinois Urbana Champaign	PhD	Food Science	In progress	Guatemala
25	M	Kwame Nkrumah University of Science and Technology (KNUST)	MPhil	Agricultural and Biosystems Engineering	In progress	Ghana
<b>Guatemala</b>						
16	M	University of Nebraska, Lincoln	PhD	Food Science and Technology	In progress	Guatemala
<b>Engagement</b>						
17	F	Iowa State University	PhD	Ag Education	In progress	Cameroon
<b>Ag Econ Team</b>						
18	F	Kansas State University	PhD	Ag Economics	In progress	Pakistan
19	M	Kansas State University	MSc	Ag Economics	In progress	Guatemala



## Future Work

### Bangladesh

- An integrated paddy drying method with sensor based control system suitable for both parboiled and aromatic paddy will be developed.
- Field surveys will be conducted to assess the potential health hazards of hermetic cocoons in the BADC seed processing center.
- Experimental trials of the Arc'teryx tent dryer will be conducted.
- According to the suggestions of BADC personnel, PHLIL-Bangladesh project will conduct one more piloting on the hermetic cocoons at Netrakona seed processing center of BADC for paddy seed storage.
- PHLIL-Bangladesh team is planning to arrange a sharing meeting with BADC high level personnel.
- Gender sensitization on the Arc'teryx dryer and meso-scale dryer will be conducted and trainings on the BAU-STR dryer, meso-scale dryer and hermetic cocoon will also be arranged.
- Final stakeholder and knowledge transfer meetings will be hosted in-country.
- [*gender team*] Review and comment on the gender tech assessments of the Arc'teryx dryer when it becomes available.
- [*agricultural economics team*] A stakeholder meeting to disseminate the finding is planned for late 2022.

### Ethiopia

- All future work in Ethiopia centers on the finalization of student theses and dissertations as well as close-out procedures and reporting.

### Ghana

- Continuation and monitoring of the study to compare the performance of layers raised on feed from maize stored in ZeroFly Hermetic (ZFH) bags and polypropylene bags.
- Increased marketing and scaling efforts of hermetic storage bags and moisture meters via Sesi Technologies.
- A design for drying experiment protocols for the Arc'teryx tent dryer will be drawn up, and quality analysis of dried fruits and vegetables will take place during validation trials.
- Final stakeholder and knowledge transfer meetings will be hosted in-country.
- [*gender team*] Follow-up surveys will be conducted with participants from the WiPVCA trainings to monitor progress.
- [*kernel sorting team*] A graduate student at KNUST is set to collect additional maize samples from poultry farmers for sorting. He will then receive the sorter from the Illinois team, set it up at KNUST, and use it to sort the newly collected samples. He will analyze the samples for mycotoxins using a lab developed through previous work of PHLIL.

## Additional Attachments

- Trip Report: George P. Opit, November and December 2021, Ghana
- Trip Report: Anna Snider, March 2022, Ghana