



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, 2017-March 31, 2018



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RESEARCH PROGRESS SUMMARY

The Feed the Future Innovation Lab for the Reduction of Post-Harvest Loss (PHLIL) entered its fifth year of programming starting January 1, 2018. Through the current “engagement phase” of the program, we have disseminated our research findings in both academic and practical settings with researchers, farmers, extension networks, governmental leaders, private sector actors and non-governmental organizations working in the post-harvest space. Our country programs have trained 1,258 people in post-harvest loss reduction techniques in the first half of Fiscal Year 2018. PHLIL also adapted intervention packages ranging from moisture meters and BAU-STR dryers in Bangladesh to the Post-Harvest Loss Prevention Manual in Guatemala. Each intervention package was developed using our research findings from Years 1-4 to ensure the package was contextualized to meet the needs of each community.

In addition, a holistic program assessment was conducted for each of our program countries to assess progress to date, existing gaps, opportunities, future priority areas and key partnerships. PHLIL enlisted Humanitas Global to do this exercise, which will be an incredibly useful tool to gather lessons learned and establish a forward-looking approach to reducing post-harvest loss and improving livelihoods in our program countries. The final outputs from this report will be completed in mid 2018.

Research Progress: October 1, 2017-March 31, 2018

Bangladesh

Objective 1: Research into Practice - Expansion of Post-Harvest Intervention Technologies

Geographic Expansion: The Bangladesh in-country partners added twenty-four villages, increasing the total number of villages engaged by PHLIL from 20 to 44 villages in six districts (Bogra, Dinajpur, Jessore, Khulna, Sherpur, Mymensingh and Netrokona) to scale up drying post-harvest intervention technologies.

Objective 2: Develop Capacity of PHLIL Stakeholders

Trainings and Workshops: Four hands-on trainings on the moisture meter, BAU-STR Dryer, hermetic bags and mycotoxin awareness were conducted in four different villages including 25 households in each training session. The participants learned how to operate and maintain the BAU-STR dryer for seed and grain. They also learned how to use hermetic bags, store seeds in hermetic bags and operate the moisture meter. During the training session, the participants also learned about mycotoxins and their effects on human health, and that proper drying and storage can deter mycotoxin development. A total of 100 hermetic GrainPro bags were distributed among the participants.

Objective 3: Develop Dissemination Materials

Training Materials: Posters and leaflets on the moisture meter, BAU-STR dryer and storage bags were prepared for awareness development and training purposes. The trainers found that these materials help facilitate more effective communication between the trainer and training participants. Training modules on moisture measurement, paddy drying in the BAU-STR dryer, paddy storage in hermetic bags and awareness on gender and mycotoxin issues, in Bangla and English, were approved for printing. The script for the animation to be created by Scientific Animation Without Borders (SAWBO) for operation of the BAU-STR dryer has been finalized, and the video animation is being prepared. Meanwhile a draft video on usage of the hermetic GrainPro bag was produced.

Objective 4: Develop Market Linkages

Entrepreneurs: Several potential entrepreneurs for commercializing the BAU-STR dryers were identified

and supported in different intervention areas, and their business plans are being prepared. Additionally, Kamal Machine Tools and Bhai Bhai Engineering workshop employees were trained on manufacturing, selling and servicing of the BAU-STR dryer and were linked to ACI motors for the appropriate parts. ACI Motors imported 50 blowers from Vietnam to be used in manufacturing of the dryers.

Objective 5: Workshops and Symposiums

Policy Dialogues & International Implementers: PHLIL Bangladesh is in discussions with public and private organizations regarding promotion of the BAU-STR dryer and hermetic bags. The in-country coordinator is a member of the agricultural mechanization committee of the Department of Agricultural Extension (DAE), and the PHLIL team is seeking to add the BAU-STR dryer in a government subsidy program. The BAU-STR dryer was exhibited in a national agricultural machinery fair in February 2018 at the Krishibid Institution in Dhaka. The BAU-STR dryer was highlighted in the keynote presentation at the inaugural session of the Machinery Fair. Minister of Agriculture, Begum Matia Chowdhury, and Minister of Local Government and Rural Development, Engr. Khondokar Mosharraf Hossain, were present and expressed interest in the BAU-STR dryer being available at the farmer level. Additionally, a National Symposium will be arranged later in 2018 in Dhaka involving policy makers, national and international PHL project implementers in Bangladesh, farmers, NGOs and agribusiness enterprise customers.

Objective 6: Engagement Activities

Post-Harvest Loss Integrated into the Classroom: A group was formed with relevant faculty members of the Department of Farm Power and Machinery at Bangladesh Agricultural University. Two advanced undergraduate and graduate level courses (FPM 403 Agricultural Process Engineering and FPM 509 Advanced Agricultural Process) revised their course syllabi to include post-harvest processing of horticultural crops, as well as material on the BAU-STR dryer and hermetic storage technologies.

Objective 7: Gender Equality and Cross-cutting Issues

Gender issues were incorporated into training modules for post-harvest technologies. Participants were deeply engaged in discussions about gender and post-harvest loss. A gender sensitization training was conducted in Dumuria, Khulna involving male and female participants.

Objective 8: Capacity Building Overseas

PHLIL Bangladesh met with researchers in Bihar, India in March at the ADM Institute for the Prevention of Postharvest Loss's program village and shared information with farmers on drying and storage. Additionally, PHLIL team members will attend the 2018 American Society of Agricultural and Biological Engineers annual meeting in Detroit, where two abstracts have been accepted.

Objective 9: Preparation of Scientific Manuscripts and Interim and Final Reports.

Five abstracts were presented and published in national and international conferences. Two abstracts have been accepted for the 2018 ASABE annual meeting. Three manuscripts were submitted in peer reviewed national and international journals.

Presentations:

Alam, M. (January 2018) Combating challenges of future agriculture of Bangladesh through agricultural mechanization. Presentation at 1st International Conference on Challenges for Future Agriculture, BAU, Mymensingh, Bangladesh.

Hossain, M., Awal, M., Ali, M., & Alam, M. (January 2018) Efficacy of Diversified Paddy Storage Technologies. Presentation at 1st International Conference on Challenges of Future Agriculture, Mymensingh, Bangladesh.

Hossain, M., Awal, M., Ali, M., & Alam, M. (October 2017) Quality of Milled Paddy in Different Storage Technologies. Presentation at 1st National Conference on Food and Nutrition Security in Bangladesh: Interdisciplinary Approaches, Dhaka, Bangladesh.

Alam, M., Saha, C. K., Alam, M., Ali, M., & J. (January 2018) Role of BAU-STR dryer for strengthening food security in Bangladesh. Presentation at 1st International Conference on Challenges for Future Agriculture, BAU, Mymensingh, Bangladesh.

Alam, M., Ali, M., Awal, M., Saha, C. K., Ali, M., et al. (March 2018) USAID Postharvest Loss Reduction Innovation Lab (PHLIL)-Bangladesh Component. Presentation at Annual Workshop on BAU Research Progress- 2018, BAU, Mymensingh, Bangladesh.

Ethiopia

Objective 1: Conduct Training Programs and Transfer Knowledge and Technology on Integrated PHL Practices (Drying, Moisture Measurement, Mycotoxin and Insect Management)

Training Programs: Two November workshops hosted by Mekelle and Bahir Dar universities used lectures and hands-on sessions on moisture measurement and drying, molds and mycotoxins, and insect pest management to educate farmers, government employees, researchers and vocational instructors. The trainings were facilitated by professors and graduate students from Kansas State University, Mekelle University and Bahir Dar University and also addressed nutrition, gender and effective teaching methods in post-harvest loss. Purdue Improved Crop Storage (PICS) and Super GrainPro bags were demonstrated, and wheat stored in polypropylene and jute bags was compared to wheat stored in PICS and Super GrainPro Bags. In addition, trainings on the solar bubble dryer and the moisture meter were held in late November to early December.

In collaboration with the Integrated Seed Sector Development Program (ISSD), training was delivered in January to seed producer cooperative leaders from the Amhara region on post-harvest seed handling with special emphasis on seed storage in PICS and Super Grain bags. Bahir Dar University PHLIL team members conducted a practical training aimed at introducing PICS bags for grain storage to reduce post-harvest loss and prevention of grain/seed deterioration in mid-January. They also participated in a National Agricultural Exhibition and Trade Fair, organized by USAID Feed the Future Ethiopia Value Chain Activity on January 27-28, 2018 in the Amhara Region.

In collaboration with the East Africa Trade and Investment Hub and Eastern African Grain Council, the Feed the Future Ethiopia Value Chain Activity organized a 3-day training program on “Grain Standards and International Export Procedures” in March in Adama where PHLIL experiences with farmers on demonstration of hermetic bags were also discussed and shared.

The Mekelle University PHLIL team is also developing training materials to train 700 regional extension educators, who will in turn train development agents each responsible for 30 farmers at the village level.

Objective 2: Roll-out of PHL Mitigation Strategies at Household Level

A total of 50 PICS bags were distributed to 50 farmers in Bahir Dar district representing five kebeles. Researchers will survey farmers to gauge their perception about the utility of PICS bags for proper grain quality management.

Karta Kalsa, a graduate student at Bahir Dar University, initiated a project to assess stored grain pesticide use, practices and safety hazards to smallholder farmers in Northwestern Ethiopia (West Gojjam, Awi, and East Gojjam). The survey includes 26 households across 16-18 districts that use pesticides on stored grains.

Objective 3: Develop Educational Materials by the Extension/Engagement Advisory Committee

A comprehensive 55-page extension bulletin, “Integrated protection of stored maize and wheat,” written by three PhD students, was shared with each participant at the trainings at Bahir Dar University. The text was in English and Amharic and has techniques for proper grain storage and monitoring of grain during storage.

Objective 4: Finalize and Summarize Research Data Collected in Years 2-4

Presentations: The PHLIL team from Bahir Dar University participated in the Amhara Agriculture Forum held January 19, 2018, in Bahir Dar. Research results from BDU students were shared at this forum.

Publications: The PHLIL Ethiopia Program published one and submitted three articles in *the Journal of Stored Products Research* and submitted an additional article to *the Journal of Plant Breeding and Crop Science*. One article is under final review for publication in *World Medical and Health Policy*. In addition, the team has six articles in various stages of the writing and revision process.

In Press:

Tadesse, M. T. and Bh. Subramanyam. (2018) Efficacy of filter cake and Triplex powders from Ethiopia applied to concrete arenas against *Sitophilus zeamais*. *Journal of Stored Products Research*. **76**: 140-150.

Objective 5: Complete Pending Insect and Mycotoxin Research

Insect Research: Effectiveness of hermetic technologies against insect and mold and mycotoxins production in both sesame and chickpea were evaluated in controlled conditions. Moisture content, temperature, relative humidity, oxygen level, insect and mold incidence and mycotoxin levels, seed germination, grain damage and weight loss were determined before storage and after every 60 days during storage. Among tested technologies PICS and GrainPro Super bags were more effective compared to commodities stored in jute and polypropylene bags.

Mycotoxin Research: More than 90% of the research is completed in insect and mycotoxin research. Three years of survey and preliminary data revealed that the grain storage structures being used by the majority of farmers in Ethiopia are traditional structures where post-harvest losses are serious (>35% weight loss) and are inadequate to meet the needs of food protection in terms of quality and quantity. Sample testing results revealed occurrences of insects and mycotoxins in chickpea and sesame across locations, storage structures, storage period, and production seasons. The storage period had strong effects on grain moisture content and mycotoxins, all increasing with an increase in the storage period. These data corroborate other studies that long-term storage duration under poor conditions can cause rapid aflatoxin accumulation.

Objective 6: Build Capacity at Bahir Dar University and Mekelle University

Bahir Dar University: Bahir Dar University has established a Postharvest Technology Program through the support of PHLIL and internal support within Bahir Dar University. Currently, there are 11 PhD students in the program, three of whom are supported by PHLIL and completing their degrees in 2018-19.

Mekelle University: A similar postharvest technology program is being explored at Mekelle University, and with the construction of new laboratories such a program will be valuable to strengthen their teaching and research capacity.

Objective 7: Continue Work on Nutrition and Gender Topics as They Relate to Post-harvest Issues

Gender and nutrition training was integrated into the post-harvest food safety workshop in November. A manuscript on the focus group surveys carried out is currently under final review by the World Medical and Health Policy Journal. The paper outlines findings of the surveys, including that women’s role in agricultural activities increases to as much as 80% in post-harvest. Poor storage technologies resulting in fungal/pest

infestations and chemicals in stored grains pose serious health risks for women, and poor women consume grains with up to 50% damage.

Objective 8: Pathway to Impact Partnerships

The Management Entity spent time in Ethiopia meeting with the Minister of Agriculture, Dr. Eyassu Abraha, and the USAID Mission. During these visits, the Ethiopian Minister stressed the need for education, engagement, human resource capacity development, and the integration of various organizations including NGOs, extension educators and researchers. He also expressed strong interest in organizing a national workshop focused on post-harvest issues and loss mitigation strategies, with PHLIL team members providing the technical training leadership. The USAID Mission discussed moving end users to rely less on chemicals and more on better storage practices and use of environmentally benign pest management products. They also recommended pursuing partnerships with the Ethiopian seed exchange, USAID, WFP and NGO warehouses.

The Fintrac-led Feed the Future Ethiopia Value Chain Activity is involved in drying, storage, food safety and packaging, and they have requested PHLIL graduate students to assist them in facilitating trainings. Africa Rising, GTZ, Sasakawa Global and others are using PHLIL research findings for printed materials meant for end users.

PHLIL Ethiopia established regional engagement teams to set action plans and communicate each activity with the identified beneficiaries. These include, but are not limited to, workshops to provide training and information dissemination and communication with the Ministry of Agriculture and the USAID Mission.

The ISSD cooperatives purchased 400 PICS bags to store their seeds based on information shared by Mekelle University PhD students.

Ghana

Objective 1: Complete Writing and Submitting Manuscripts on Research Data Collected in Years 2-4 to Peer Reviewed Journals

Writing and Publications: The Ghana PHLIL team conducted analysis and wrote manuscripts for various research studies using data collected in Years 2-4 of the program. Three papers have been published in the *Journal of Stored Products Research*, and one paper has been published by the American Society of Agricultural and Biological Engineers. Two additional papers are submitted and awaiting responses from journals, and two papers are in the final stages of preparation for submission. Please see below for citations of the aforementioned publications and manuscripts.

In Press:

Armstrong, P. R., S. McNeill, S., Manu, N., Bosomtwe, A., Danso, J. K., Osekre, E. A., & Opit, G. (2017) Technical Note: Development and Evaluation of a Low-Cost Probe-Type Instrument to Measure the Equilibrium Moisture Content of Grain. *Applied Engineering in Agriculture Journal* **33(5)**: 619-627.
<https://doi.org/10.13031/aea.12266>

Danso, J. K., Osekre, E. A., Manu, N., Opit, G.P., Armstrong, P., Arthur, F. H., Campbell, J. F., & Mbata, G. (2017) Moisture content, insect pests and mycotoxin levels of maize at harvest and post-harvest in the Middle Belt of Ghana. *Journal of Stored Products Research* **74**: 46-55.

Manu, N., Osekre, E. A., Opit, G. P., Arthur, F., Campbell, J. (2018) Population dynamics of stored maize insect pests in warehouses in two districts of Ghana. *Journal of Stored Products Research* **76**: 102-110.

Danso, J. K., Osekre, E. A., Opit, G. P., Manu, N., Armstrong, P., Arthur, F. H., Campbell, J. F., Mbata, G., McNeill, S. G. (2018) Post-harvest insect infestation and mycotoxin levels in maize markets in the middle belt of Ghana. *Journal of Stored Products Research* 77: 9-15.

Objective 2: Continue Supporting Scale Up of Promising Post-harvest Loss Mitigation Technologies

Identifying Collaborators & Obtaining Funding: The Ghana team obtained funding from the Assisting Management in the Poultry and Layer Industries by Feed Improvement and Efficiency Strategies (AMPLIFIES) project, USDA/FAS Scientific Cooperation Research Program, the Ghana Grains Council, the Adventist Development and Relief Agency Ghana, and the WFP Enhanced Nutrition and Value Chains project for ZeroFly© Hermetic Bags, PHLIL Moisture meters and Solar Biomass Hybrid Dryers. The AMPLIFIES project is independently funded by USDA, with complementary outputs leveraged across this program and PHLIL.

Solar Biomass Hybrid Dryer: The AMPLIFIES project gave funds to construct one solar biomass hybrid dryer for a poultry farmer. Ghana PHLIL worked with USDA/FAS Scientific Cooperation Research Program (SCRIP), which contributed funds for the construction of a second SBHD for a maize seed producer. The Enhanced Nutrition and Value Chains (ENVAC) project funded by the WFP is in the process of placing an order for three SBHD for their 87 Farmer Based Organizations (FBOs).

PHL Moisture Meters: AMPLIFIES also provided funding to construct the first 50 PHL moisture meters. A small enterprise, Sesi Technologies, was created by Isaac Sesi, a young recent KNUST graduate, in collaboration with other recent graduates, to manufacture the PHL moisture meters locally in Ghana, which will facilitate more rapid acquisition of the meters. Sesi Technologies has developed a business plan and renamed the meters “GrainMate.” The Ghana Grains Council purchased 16 PHL moisture meters, The Adventist Development and Relief Agency placed an order for 120 moisture meters, and ENVAC is placing an order for 550 PHL meters for their 87 Farmer Based Organizations.

PICS bags, ZeroFly© bags, Zerofly© Hermetic Bags: In March 2018, the PHL Ghana team established a channel for the distribution of ZeroFly© Hermetic Bags from Lagos, Nigeria to Kumasi, Ghana. Sesi Technologies became a dealer/distributor of Zero Fly© Hermetic bags, receiving 1,500 bags through this channel.

Objective 3: Plan and Conduct Post-Harvest Loss Mitigation Training

Post-Harvest Loss Mitigation Training: A training was held for stakeholders in Kumasi and Jamasi, Ghana on January 9-11, 2018, with revised curriculum and training materials from the 2017 Post-Harvest Loss Mitigation Training. The training took place at the Council for Scientific and Industrial Research-Crops Research Institute (CSIR-CRI) and Sacom Farms and was sponsored by PHLIL and the AMPLIFIES project with seven additional collaborating partners from US and Ghanaian institutions of higher education and the PENS Food Bank in Ejura, Ghana. The workshop included one day of lectures and two days of hands-on exercises; this was a shift toward increased hands-on sessions, based on input from PHLIL agricultural education experts. The goal of the workshop was to develop local capacity among Ghanaian poultry industry stakeholders (and other participants with indirect links to this industry) in modern stored grain handling and management practices in the grain value chain (mainly maize) beginning from on-farm storage; small, medium and large warehouses; and in silos. Trainees received instruction on stored grain fundamentals, appropriate methods for handling grain on-farm, in warehouses and silos, and how to diagnose and solve issues in grain handling and storage along the grain value-chain.

Additionally, two post-harvest loss mitigation animation videos on the PHL meter and DICE have been produced as a result of Ghana PHLIL work with SAWBO. These videos can be used by extension agents and poultry producers that have been engaged in PHLIL activities.

Objective 4: Complete Collection, Analysis and Write-up of Data to Evaluate and Improve the Solar Biomass Hybrid Dryer (SBHD) Technology & its Use for Disinfestation

Summarize and Analyze Data Collected to Evaluate and Improve the Solar Biomass Hybrid Dryer:

The first set of data collected on the solar biomass hybrid dryer in Ejura from 2016 was processed and analyzed. The second set of data collected on the solar biomass hybrid dryer in Jamasi will be completed in April 2018, and data analysis will begin immediately. A draft manuscript related to this experiment will be completed by the end of June 2018 and submitted to a journal upon completion.

Guatemala

Objective 1: Assessment of Economic, Nutrition and Gender Effects of Post-harvest Loss Mitigation Interventions

Cross-cutting Survey: Data related to economic, nutritional and gender effects of post-harvest loss mitigation interventions was collected by SHARE and analysis is being done by the PHLIL nutrition lead and a post-doc at KSU. The families that participated in the survey received post-harvest storage technologies (one plastic container of 250 kg capacity and/or one Grain Pro bag with 50 kg capacity each), in order to maintain maize quality during storage after the 2017/2018 harvest season. A total of 102 plastic containers and 204 Grain Pro bags were distributed. All the farming families that participated in the survey are storing their maize using the provided storage technologies, as instructed through training; collectively that is 35,700 kg of maize stored with the two post-harvest storage technologies. A second survey to measure behavior change related to better-stored grain following the distribution of the technologies will be conducted in fall 2018.

Training: Ten extension trainers have trained 204 participating farmers and their families on the correct usage of the post-harvest technology, best post-harvest practices, and safe consumption of food.

Objective 2: Continued Optimization of Drying Practices and Technologies in the Western Highlands

Refocusing on Traditional Drying: Due to the geographic and economic constraints in Huehuetenango, the PHLIL Guatemala team discontinued any optimization and comparison of the proposed dryers and shifted the focus on improving current drying practices using direct solar drying, but with better management techniques. Factors in this decision included accessibility, efficiency and affordability of dryers for remote farmers, down rough roads at high altitude, as well as the PHLIL team's estimation that adapted traditional drying could in itself achieve significant reduction of post-harvest losses.

Objective 3: Continuation of Best Post-harvest Strategies for Mitigation of Losses Based on Storage Technologies

Post-Harvest Loss Prevention Manual: The post-harvest loss mitigation strategies were finalized and incorporated into the Post-Harvest Loss Prevention Manual, which was reviewed by local partners and stakeholders. The manual was expanded to provide technical information in a contextualized and graphic design that is easy to use by the extension network. In addition to 204 farmers and their families, 42 professional technicians from the organizations and NGOs Asocuch, FUNDIT, Counterpart and Buena Milpa were trained by extension network trainers in post-harvest loss mitigation. SHARE has disseminated

the training manual at local agricultural events. Several partnerships have been developed with local NGOs and organizations to promote post-harvest loss mitigation and to share technology and the training manual. Additionally, university students from the University of Huehuetenango have been engaged in the project's research activities.

Objective 4: Continuation of Women's Empowerment Work

Gender Considerations: The gender consultant was actively involved in the development and implementation of the survey, post-harvest loss mitigation manual, and the trainings conducted for extension network of trainers. The gender consultant helped to develop and disseminate information about the role of gender in post-harvest activities to the agricultural extension network and many community leaders.

Objective 5: Economic Impact through Building Local Capacity for Post-harvest Loss Prevention Tools

Post-harvest loss mitigation kit: A total of twenty-five 600 kg capacity metal silos have been fabricated by a local artisan for farmers participating in the PHLIL project. A prototype of the post-harvest mitigation kit was developed to provide the essential equipment needed by farmers to mitigate post-harvest losses. The kit includes a storage technology (metal silo or plastic container), hygrometer to check for the maize moisture content and maize sheller. A market study is being conducted to determine the equipment needs by the farmers for post-harvest loss mitigation.

Objective 6: Engagement of Stakeholders and Collaborators

Engagement Team: An Engagement Team meeting and symposium was conducted with the local partners and stakeholders in Huehuetenango in order to validate the teaching material for the extension network trainers and the post-harvest loss mitigation material. All materials created are predominantly graphical and visual so that they are easy to understand.

Objective 7: Implementation of Engagement Strategy & Information Dissemination of Best Grain Quality Management Practices & Strategies to Foster Adoption

Engagement Strategy in Practice: Community meetings were conducted in several of the locations targeted by the project, enabling the exchange of post-harvest loss mitigation knowledge and experiences by the farmers and the extension network. The goal of this exercise was to engage farmers and families who have problems in adopting new post-harvest loss mitigation practices. Technical videos from partners including WFP detailing good post-harvest practices were also shared during these meetings. Additionally, extension network trainers conducted hands-on demonstrations on good post-harvest practices during technical visits to the farms.

Information Dissemination: Researchers from the PHLIL Guatemala team shared research findings by presenting at three conferences. Presentation topics included improving food security and food safety in the Western Highlands of Guatemala; post-harvest management practices in the Western Highlands as it relates to mycotoxins; and understanding the microbiota of native maize from the highlands of Guatemala. A poster presentation was given on maize storage technologies at the 2017 American Association of Cereal Chemist International annual meeting. One article, cited below, was accepted for publication in the *Journal of Food Protection*.

In addition, an animation about mycotoxins was created in partnership with SAWBO for uses in Guatemala and across PHLIL project countries.

In Press

Mendoza, R., Sabillon, L., Calmenares, A., Rodas, A., Oliva, A., et al. (2018) [Safety and Quality Assessment of Smallholder Farmers' Maize in the Western Highlands of Guatemala](#). *Journal of Food Protection* **71**: 14-21.

Issues or Concerns Encountered

Delay of funding strained many of our program efforts, requiring a high level of additional planning and adaptation by the Management Entity and partners. While we were able to mitigate the majority of challenges, some program activities were unavoidably delayed. Moreover, many of our partner organizations and universities were placed in difficult financial situations, especially those in our partner countries.

Bangladesh: The import cost of the blower from Vietnam increased and a delay in importing the blower meant that the BAU-STR dryer could not be supplied to interested farmers in the 2017 Aman harvesting season. A few hermetic bags were found with minor damage from ants but were repaired with seal tape for further use.

Ethiopia: Civil unrest and volatile conditions restricted access and ability to travel to and within Ethiopia. Internet accessibility has also made communicating with field partners challenging at times. Overall, progress has continued despite these challenges.

Ghana: Coordinating manuscript writing among multiple Principle Investigators required immense planning and proper steering of various activities involved. In the future, the Ghana PHL team will clearly assign roles and responsibilities to each PI at the beginning of the manuscript writing process.

Manufacturers, sales and marketing representatives and dealers of hermetic technologies have weaker marketing tactics than is appropriate for the Ghanaian market.

Guatemala: The adoption of new storage technologies and post-harvest practices to mitigate post-harvest losses has been difficult due to the strong belief in cultural practices that have been performed for thousands of years. However, the trainings and promotion of new storage technologies developed by the extension network of trainers has triggered positive changes in the post-harvest practices now utilized by the farmers.

Some of the equipment proposed in the post-harvest loss mitigation kit are expensive and hard to find in the Huehuetenango area, making the involvement of local entrepreneurs and industry even more important in order to make these kits available in the area.

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 moisture meter, BAU-STR dryer, hermetic bags use and awareness building on mycotoxin issues <i>Netrokona, Mothbaria, Dumuria, Khulna</i> (Two Trainings Dec 10 and Dec 13, 2017)	Rice Producers, Government Employees, Private Sector Actors, and Civil Society Actors	32	42	74

Bangladesh	Training on moisture meter, BAU-STR dryer and hermetic bags use <i>Jessore, Khulna</i> (Two Trainings: Dec 12 and Dec 13, 2017)	Rice Producers, Government Employees, Private Sector Actors, Civil Society Actors	61	40	101
Bangladesh	Gender sensitization training <i>Dumoria, Khulna</i> (December 24, 2017)	Rice Producers	16	14	30
<i>Bangladesh Subtotals</i>			<i>109</i>	<i>96</i>	<i>205</i>
Ghana	Post-harvest Loss Mitigation Workshop in <i>Kumasi</i> (Jan 9-11, 2018)	Producers, Government Employees, Private Sector Actors, Civil Society Actors	34	7	41
<i>Ghana Subtotals</i>			<i>34</i>	<i>7</i>	<i>41</i>
Guatemala	Education of Field Technical Professionals from Buena Milpa (USAID Project) in Post-harvest Management Trainees from: F Quetzaltenango, San Marcos, Totonicapan and Quiché <i>Huehuetenango</i> (Dec 5-6, 2017)	Maize Producers, Government Employees, Private sector actors, Civil Society actors	13	3	16
Guatemala	Training on the teaching methodology for the ten extension network trainers so they can learn how to effectively transmit the training modules to the 200 farmers' families <i>Huehuetenango</i> (October 17-18, 2017)	Civil Society actors	10	0	10
Guatemala	Presentation on mycotoxin during a regional expo called: Feria Regional del Cordero y Diversidad en Chiantla <i>Huehuetenango</i> (Nov 12-13, 2017)	Maize Producers	25	15	40
Guatemala	Follow-up training for extension network trainers <i>Huehuetenango</i> (Jan 10, 2018)	Civil Society actors	10	0	10
Guatemala	Training on mycotoxin awareness in maize Trainees from Tres Cruces & Todos los Santos <i>Huehuetenango</i> (Jan 17, 2018)	Maize Producers	5	19	24

Guatemala	Training on mycotoxin awareness in maize Trainees from San Antonio de las Nubes, Chiantla <i>Huehuetenango</i> (Jan 18, 2018)	Maize Producers	4	39	43
Guatemala	Training on mycotoxin awareness in maize Trainees from San Francisco, Las Flores, Chiantla <i>Huehuetenango</i> (Jan 19, 2018)	Maize Producers	14	31	45
Guatemala	Training on mycotoxin awareness in maize Trainees from San Jose Las Flores, Chiantla San Jose Las Flores, Chiantla <i>Huehuetenango</i> (Jan 22, 2018)	Maize Producers	4	10	14
Guatemala	Training on mycotoxin awareness in maize Trainees from Villa Alicia y San Martin, Todos Los Santos <i>Huehuetenango</i> (Jan 23, 2018)	Maize Producers	9	27	36
Guatemala	Training on mycotoxin awareness in maize <i>Huehuetenango</i> (Jan 24, 2018)	Maize Producers	27	1	28
Guatemala	Training on mycotoxin awareness in maize. Trainees from Tica, Todos los Santos, <i>Huehuetenango</i> (Jan 29, 2018).	Maize Producers, Government Employees	12	11	23
Guatemala	Training on Post-harvest Management in the Western Highlands Trainees from the university in Huehuetenango called the University Center for the Northwest CUNOROC <i>Huehuetenango</i> (March 5, 2018)	Civil Society actors	27	11	38
Guatemala	Training on Post-harvest Management in the Western Highlands Trainees from the university in Huehuetenango called the University Center for the Northwest CUNOROC <i>Huehuetenango</i> (March 12, 2018)	Civil Society actors	27	11	38

Guatemala	Training on Post-harvest Management Centro Universitario de El Petén –CUDEP El Peten <i>Huehuetenango</i> (March 1, 2018)	Government Employees, Private Sector actors, Civil society actors	11	11	22
Guatemala	Principles and Technology for Maize Storage University Center for the Northwest CUNOROC in <i>Huehuetenango</i> (March 20, 2018)	Maize Producers	21	9	30
Guatemala	Farmer focus groups to exchange experiences on post-harvest management between participating farmer families <i>San Francisco, Las Flores, Chiantla</i> <i>Huehuetenango</i> (March 13, 2018)	Maize Producers	2	11	13
Guatemala	Farmer focus groups to exchange experiences on post-harvest management between participating farmer families <i>Tres Cruces and Chicoy, Todos los Santos,</i> <i>Huehuetenango</i> (March 15, 2018)	Maize Producers	11	35	46
Guatemala	Farmer focus groups to exchange experiences on post-harvest management between participating farmer families <i>Chemal II en Todos los Santos, Huehuetenango</i> <i>and Yerba Buena, Chiantla</i> (March 20, 2018)	Maize Producers	5	29	34
Guatemala	Farmer focus groups to exchange experiences on post-harvest management between participating farmer families <i>Aldea San Martin and Chanchimil, Todos los</i> <i>Santos,</i> <i>Huehuetenango</i> (March 21, 2018)	Maize Producers	8	33	41
Guatemala	Farmer focus groups to exchange experiences on post-harvest management between participating farmer families Caserio El Llano, Chiantla Huehuetenango (March 23, 2018)	Maize Producers	6	8	14

Guatemala	Farmer focus groups to exchange experiences on post-harvest management between participating farmer families <i>San Jose, Las Flores, Chiantla Huebuetenango</i> (March 26, 2018)	Maize Producers	5	15	20
Guatemala	Training on mycotoxin in maize <i>Huebuetenango</i> (Feb 10, 2018)	Maize Producers	9	16	25
Guatemala	Training on mycotoxin in maize <i>Chanchimil, Todos los Santos, Huebuetenango</i> (Feb 12, 2018)	Maize Producers	8	18	26
Guatemala	Training on mycotoxin in maize <i>Yerba Buena, Chiantla Huebuetenango</i> (Feb 14, 2018)	Maize Producers	8	21	29
Guatemala	Improvement of maize post-harvest handling practices for smallholder farmers <i>Huebuetenango</i> (Oct 24-25, 2017)	Maize Producers, Civil Society, Government Employees	32	11	43
<i>Guatemala Subtotals</i>			<i>313</i>	<i>395</i>	<i>708</i>
Ethiopia	Food Safety Training workshop in Bahir Dar (Microorganisms, Toxins, Insects and Pesticide Residues) associated with grains in Ethiopia <i>Amhara Region, Gojjam</i> (Nov 4-7, 2017)	Grain Producers, University Researchers, Ag Experts, Government Employees, Private Sector actors, USAID staff	44	13	57
Ethiopia	Post-Harvest Seed Handling Emphasizing Seed Storage <i>Amhara Region, Agew Awi Zone</i> (Jan 1, 2018)	Grain Producers, Maize Producers	46	6	52
Ethiopia	National Agriculture Exhibition and Trade Fair: Working Principle of the Solar Bubble Dryer and Improved Techniques for moisture measurement <i>Amhara Region, West Gojjam Zone</i> (Jan 27-28, 2018)	Grain Producers, Maize Producers	Unable to disaggregate		800
Ethiopia	Drying of maize using solar bubble dryer at farmers' site in <i>Kudmi village Mecha District, West Gojjam Zone</i> (Nov 25- Dec 3, 2017)	Grain Producers, Government Employees	20	30	50

Ethiopia	Grain Standards and International Export Procedures for 14 Farmers Cooperative Unions <i>Adama Zone</i> (March 26-29, 2018)	Grain Producers	Unable to Disaggregate	20	
Ethiopia	Food Safety Training workshop in Mekelle (Microorganisms, Toxins, Insects and Pesticide Residues) associated with grains in Ethiopia <i>Tigray Region, Mekelle Special Zone</i> (Nov 4, 2017)	Grain Producers, University Researchers, Ag Experts, Government Employees, Private Sector actors, USAID staff	47	15	62
<i>Ethiopia Subtotals</i>			157	64	1041

Long-term training

Support for graduate education is an important part of PHLIL’s mission to build capacity for the next generation of post-harvest experts. Graduate students are also essential in performing PHLIL’s activities, including lab and on-farm research and assisting in PHLIL trainings. In FY2018 in Bangladesh, PHLIL directly funded three graduate students at Bangladesh Agricultural University. The students are working on master’s or doctoral degrees in our three key areas of drying, storage or mycotoxin analysis. In addition, one PhD student in agricultural and applied economics at the University of Illinois at Urbana-Champaign is working on PHLIL research, but direct funding for his academic program is from other sources. In Ethiopia in FY2018, there were seven graduate students directly funded by USAID through PHLIL – three at Mekelle University, three at Bahir Dar University and one at Kansas State University. Two additional master’s students are engaged in PHLIL-related research at Bahir Dar University. In Ghana, one graduate student from Oklahoma State University was funded in FY2018 and engaged in PHLIL research and activities. Three additional students at KNUST, two PhD and one bachelor’s, are engaged in PHLIL research, but are not receiving USAID funds. For the Guatemala team, one graduate student at the University of Nebraska-Lincoln who was funded jointly by USAID and USDA in FY2017 to engage in PHLIL research and training is continuing PHLIL research in a PhD program at UNL (utilizing non-USAID funds). An additional PhD student at UNL and a master’s student at Kansas State University comprised the Guatemala research team, but were externally funded.

Innovation Transfer and Scaling Partnerships

Bangladesh: *BAU-STR Dryer*

As outlined earlier, the BAU team is continuing to work with small scale, regional manufacturers for commercialization of the BAU-STR dryer. The blower for the dryer remains a challenge.

Ethiopia: *Solar Bubble and Cabinet Dryers*

The construction of a large scale forced convection solar cabinet dryer at BDU is close to completion, and it will be installed in Kudmi village to help farmers dry their harvested maize. The Solar Bubble Dryer will be field tested by BDU researchers this year.

Ghana: *PHL Moisture Meter*

The PHL Ghana team has worked to engage the private sector by facilitating the development of Sesi Technologies, which will allow the PHLIL moisture meter to be locally produced in Ghana. The small business was created by four young graduates of Kwame Nkrumah University of Science and Technology, who have received and filled orders for approximately one hundred seventy units.

ZeroFly© Hermetic Bags

Sesi Technologies is now serving as a distributor of the ZeroFly© bags to improve its availability in the market.

Guatemala: *Post-Harvest Loss Prevention Manual*

The manual has been finalized and a line of information products developed around the messaging (including a calendar with timely post-harvest management tips) based on feedback from stakeholders. Several local organizations are utilizing these materials, as outlined earlier.

Design of Optimized Metal Silo Mechanical and Post-harvest Mitigation Kit

In Guatemala, the development of the post-harvest mitigation kit also required the engagement of local artisans to build metal silos for participating farmers. The kit is incorporating the new silo design with other useful post-harvest practice tools.

Future Work

Workplans are driving our future work as we prepare for the wrap up of year five in the next eight months. The Annual Meeting scheduled to be held at the University of Illinois at Urbana-Champaign on May 1-2, 2018, will allow our program staff to reflect on the engagement phase and look forward to identifying future post-harvest research priorities. The Humanitas Global exercise will also guide the Annual Meeting strategy sessions.

The remainder of 2018 will focus on graduate students finalizing their research and completing their degree programs and continuing to work with stakeholders and partners along the scaling pathway for effective uptake and subsequent scaling of the BAU-STR dryer, GrainMate moisture meter, SBHD Dryer and ZeroFly© bags. In Guatemala, a focus will be on establishing partnerships where the Post-Harvest Loss Prevention Manual can be further disseminated.