Semi-Annual Report for the Feed the Future Innovation Lab for the Reduction of Post-Harvest Loss
October 1, 2014 - March 31, 2015

I. Research Progress Summary

A. Research progress made during the reporting period

Work Plans for Year 2 were developed and approved by USAID.

Bangladesh

1. Form Engagement Advisory and TRI Teams

Progress
A number of people that represent a cross section of our collaborators as well as government policy officials, other NGOs working in post-harvest related areas, grain traders, grain processors, and extension agents were identified and short listed for consideration. After discussing with them regarding their willingness to serve on the team and assessing their aptitude, team members will be finalized in the next couple of weeks. A meeting has been organized in Dhaka for the committee members on May 27, 2015. During this meeting Dr. Jason Ellis and Dr. Venkat Reddy will provide documents detailing the expected roles and responsibilities of both the Engagement and TRI Advisory Committees and familiarize the committee members with their advisory role responsibilities for Post-Harvest Loss Innovation Lab in Bangladesh. We are also organizing a meeting in August 2015 to review project progress during year 2 with committee members. We will summarize the feedback of the committees and discuss and prepare the action plan steps for making corrections and improvements in preparation for the Year 3 work plan for the project.

Challenges
Contacting a large number of people and screening the candidates based on their qualification and willingness to provide this service to the innovation lab before shortlisting the committee members.

2. Create Engagement Advisory Team Plan of Work

Progress
There is no progress to report at this time.

Challenges
N/A

3. Literature review

Progress
A comprehensive literature review was completed by Dr. Baqi under assignment from IRRI.

Challenges
Getting the finalized literature review report from IRRI was a challenge. It has been received.

4. Enrollment of PhD and MS Students

Progress
One Ph. D student in each of the three research areas of grain storage, grain drying and mycotoxin baseline testing have been selected from a pool of students from BAU and BRRI. The current MS students have been working on research related hermetic storage, solar drying and mycotoxin baseline testing. They are currently preparing their final thesis and will be graduating before the end of the 2015 calendar year.

Challenges
Selecting the most appropriate students was a challenge and it took quite a bit of effort recruiting the best ones by talking to the faculty members and potential students.

5. Selection of study areas and respondents with the help of local NGOs/Institutions

Progress
Progress has been made in selecting the study areas for the proposed research projects in consultation with the PIs, Co-PIs and local NGOs/institutions. They include farmer households in Phulpur and Jessore.

Challenges
Talking with farmers and farmer groups and selecting the most suitable farmer households was a challenge.

6. Collection of weather data

Progress
Weather data (temperature, relative humidity, rainfall etc.) is being collected from several government weather stations, as well as the university's weather station.

Challenges
Collecting, assembling and analyzing the data is a time consuming task which is being completed by the graduate students hired on the project.

7. Sample collection

Progress
Graduate students have been trained in sample collection procedures for mycotoxin testing. Training included learning how to visually inspect rice samples for maturity and discoloration due to fungi. Moisture meters from John Deere and those developed by USDA-ARS in partnership with the PHL IL were supplied to BAU. Graduate students were trained in their usage. Harvest is about to start and the goal is to collect 200 samples of one kg per farm household. Moisture measurements and quality assessment will be made on each harvested sample.

Challenges
Coordinating the sample collection at the various farm locations and measuring moisture of each sample as the harvest is in progress will be a challenge.

8. Conduct supplementary survey for recording information on gender, environment and sustainability issues

Progress

Gender specialist Shahana Begum has been appointed. She is working with our overall project gender consultant, Dr. Cheryl O'Brien, on a survey questionnaire for conducting supplementary focus group studies with farmer groups and women self-help groups. Collection of data will include gender, environmental and sustainability of the post-harvest drying and storage technologies in this project.

Challenges
N/A

9. Installation of equipment for mycotoxins measurement and data collection

Progress
Romer readers and kits for analyzing rice samples for mycotoxin presence have been received by BAU, and have been set up and calibrated in a laboratory. Graduate students are currently being trained on the standard procedures for operating the readers and incubator, and on using the test strips and how data collection is to take place.

Challenges
Organizing the reader and test kit shipment from the U.S. to Bangladesh and clearing customs was a challenge.

10. Interim Report

Progress
Project progress information and data were input into the Piestar reporting system in preparation for the semi-annual report and is now complete.

Challenges
N/A

11. Sample collection from farmers' storage and data collection

Progress
No progress to report at this time as the field research projects are just now getting underway.

Challenges
NA

12. Installation of Hohenheim solar bubble (HSB) and STR dryers

Progress
The solar bubble dryer has been ordered and shipped from GrainPro and is on its way to Bangaldesh. A quote from the supplier of the STR dryer is under review. Once the dryers are in place at the Department of Farm Power and Machinery (BAU), their technical performance will be investigated and subsequently optimized with computer modeling in terms of moisture removal rate, drying efficiency, drying capacity etc.

Challenges
The dryers are more costly to acquire for this project than initially budgeted.

13. Identification of storage technologies for farm households

Progress

A literature review by the graduate students and their faculty advisors on traditional storage systems, hermetic storage bags such as PICS and GrainPro, and small metal silos is underway. Interviews are planned with selected smallholders about their use of traditional storage systems.

Challenges
NA

14. Collection of Storage Samples

Progress
No progress to report at this time as the field research projects are just now getting underway.

Challenges
NA

15. Conduct experiments using identified technologies at lab and farm households

Progress
No progress to report at this time as the field research projects are just now getting underway.

Challenges
NA

16. Work plan for the year 3

Progress
No progress to report at this time.

Challenges
NA

17. Project Workshop and Annual Report

Progress
No progress to report at this time.

Challenges
NA

Ethiopia

1. Compile and analyze PHL assessment survey questionnaire data

Progress

The 13-page postharvest loss assessment survey of chickpea, maize, wheat, and sesame was conducted between September and November 2014 by in-country collaborators. The surveys were designed to collect

information from smallholder farmers by enumerators. All surveys were conducted in collaboration with Dr. Fetien Abay at Mekelle University, and with the US team members involved in Ethiopia. The chickpea survey was undertaken by the Debre Zeit Agricultural Research Center (DZARC) of the Ethiopian Institute of Agricultural Research by three teams of enumerators, two from DZARC who covered Amhara, Oromiya, and SNNP regions, while a team from Mekelle University collected data from the Tigray region. The survey locations were based on their potential in chickpea production. A total of 220 farmers were interviewed in the four regions. Of the 220 farmers 87.3% were male and 12.7% were female farmers. A majority of the farmers (77.3%) were from the midland agro-ecological zone, 3.2-13.6% of the farmers were from the highland, lowland, and humid agro-ecological zones. The average age of the male and female farmers was 45.7 and 39.5 years, respectively. Information was collected on the educational status of the farmers, primary and secondary sources of income, crops other than chickpea produced by the surveyed farmers, severity of postharvest losses and causes of losses attributed to insects, molds, and other animals. Information was collected on harvesting, drying, threshing, cleaning, storage, and transportation practices, and perceived losses in these operations. These losses were recorded in kilograms, and are not related back to total farm production to obtain percentage losses. Only 33.3% of the surveyed farmers received any training in postharvest protection, and the primary source of such information was the Bureau of Agriculture. Farmers preferred receiving information in large meetings. About 67% of the farmers emphasized need for additional training on various aspects starting from harvest to marketing. Nearly 90% of farmers inspect their grain visually. About 68% of farmers store their chickpeas in polyethylene bags in addition to storage in traditional storage structures. Chickpeas are stored for 6 months or less by a majority of farmers. The fumigant phosphine is used by 62% of the farmers--a practice that should be discouraged because proper training and safety precautions need to be followed when using such highly toxic insecticides. Farmers rarely follow personal safety measures when using insecticides. Survey data were also collected on crop production inputs, reasons for farmers for selling or not selling the grain, price fluctuations when selling grain at harvest and at other times of the year, types of foods consumed by the farmers, and choice of grains by farmers for consumption, types of special foods for women and children, and disposal/utilization of grain unfit for consumption by farmers. The survey collected information on the role of men, women, and children in chickpea value chain. Additionally, the survey gathered information on income used for other household activities besides farming.

A total of 280 maize farmers were surveyed from Tigray, Amhara, Oromia, and SNNP regions, and the surveyed farmers included 85% of male and 15% female farmers. This survey was undertaken by scientists at Hawassa and Bahar Dar Universities. The type of information gathered was similar to that explained above for chickpea, and the responses were consistent with those recorded for the chickpea survey. Losses due to insects and molds in storage were identified as serious and prevalent by the farmers. Theft was identified as another important postharvest loss. Farmers (82%) measure moisture, and among those that measure moisture 91% bite the grain. Therefore, there is a need for accurate methods to obtain to measure moisture, and if moisture is high proper methods to dry grain for safe storage. Maize is stored mostly in polypropylene bags and in traditional storage structures which are not pest proof and typically losses are high in such structures. Maize is stored for 10 months or less by farmers.

The wheat survey was conducted in the same four regions by interviewing 200 farmers. During the interview wheat samples were collected by the enumerators for moisture and mycotoxin analyses. The survey was conducted using a multi-stage sampling by scientists and enumerators at Kulumsa Agricultural Research Center of the Ethiopian Institute of Agricultural Research. First zones and districts where wheat is grown were selected from which 14 villages were selected for the survey. Of the 200 farmers, 92% were male and 8% were female farmers. About 58% of the respondents did not receive any training in postharvest protection. The responses of farmers in this survey were consistent with those summarized in the chickpea and maize surveys. Of the 14 causes identified for postharvest loss, farmers identified grain moisture and insects in storage as the major causes of the losses, followed by rodents in storage and field. Methods to control postharvest losses included grain drying, use of the fumigant phosphine, and a grain protectant pirimiphos-methyl (Actellic). Perceived wheat losses from harvesting to milling were estimated at 17.1%, with the maximum loss occurring at harvesting. Farmers (80%) used grain color as a measure to determine suitability of grain for consumption.

The survey of 200 sesame farmers was conducted in Tigray, Amhara, and Oromiya regions by researchers at Mekelle University and Sesame Business Network, a network owned and maintained by stakeholders of the agribusiness sector in NW Ethiopia. Sesame is a priority crop in the AGP with an annual turnover of greater than $ US 300 million. In Tigray farmers on average own 25 hectares, followed by Amhara (9.7 hectares), and Oromiya (5.6 hectares). The average production per household is 44 quintals (4.4 tonnes). The postharvest losses are estimated at 33 kg per hectare with losses as high as 368 kg per hectare. The average loss in the surveyed areas was about 13% of the total crop produced. At the household level the loss is 1.8 quintals which translates to US $ 282-340. Unlike, chickpea, maize, and wheat, postharvest losses are due to shattering of pods after harvest, losses due to poor weather at harvest, and termites. Harvesting losses are estimated at 33%, followed by drying (26%), and threshing (18%). Sesame seed bug is considered an important postharvest pest in storage. This is a pest from the field that is carried into storage. Sesame is stored in polypropylene bags and is stored for 3 months or less. Reducing postharvest losses of sesame predominantly includes drying, and to a lesser extent the use of malathion, a grain protectant, and the fumigant phosphine. Data on the roles of gender in sesame production and in postharvest protection were not collected.

Draft reports written by the Ethiopian collaborators from the survey date were reviewed and shared with USAID Mission Office personnel, in-country collaborators, and with the USAID AOR. Only input from the USAID AOR was received.

Challenges

The main challenge has been not having access to the actual survey data of some crops collected by the in-country collaborators. The chickpea survey was received in December 2014, and was reviewed and revised the same month. Survey data for the other three crops were submitted online to a Qualtrics system at Kansas State University. These data were analyzed by a consultant we hired to critically extract information from the survey data, identify issues in data submitted, and offer solutions for improvements. This exercise took more than two months, given the fact that the consultant had several other projects. As each survey was summarized by the consultant data were shared with in-country collaborators to summarize the reports. All reports were available as of February 24, 2015 during our visit to Mekelle University. At this time, the maize survey was yet to be analyzed by the consultant. After receiving the summary from the consultant, the information was shared with the maize survey researchers who updated the report and revised information and resubmitted a final reported during mid-March 2015.

There are some data gaps especially relating to postharvest losses from harvest to utilization. These were reported as percent of farmers reporting losses along the value chain without an actual loss estimate. Where loss estimates exist, these are noted by weight and not as a percentage of total produced. Similarly, the involvement of males, females, and children in various postharvest operations is given as number responding as being involved. However, there is very little information on the extent of involvement, reasons for involvement, and potential for greater involvement. These questions should be followed up by the gender specialist during years 2 and 3 by surveying females involved in these operations for each of the crops.

2. Evaluation of stakeholders and collaborators

Progress

Our primary collaborators included Dr. Fetein Abay from Mekelle University who is the in-country coordinator, and she was responsible for overall activities in Ethiopia related to the PHLIL project. Others at Mekelle involved in the project include Dr. Ibrahim Fitiway (Entomologist), Dr. Dereke Assefa (mycologist), and Mr. Michael Gebrejesus (Ag. Engineer). Other collaborators involved in the postharvest survey included Drs. Tadesse Dessalegn and Mekasha Chicheybelu from EIAR, Mr. Muez Berhe from Sesame Business Network; Dr. Yibrah Bayene from Hawassa University; Drs. Dereje Ayalew and Tadesse Enayew and Admase Fenta (Bahar Dar University). All of the in-country collaborators look for direction from Dr. Fetien Abay, which at times has been slow or lacking because she is busy with several other projects. We have

communicated lack of timely focus on the project progress on several occasions last year. We have access to individual collaborators via email. However, when it comes to making decisions all of them look to Dr. Abay for leadership and follow-up. The effectiveness of our in-country coordinator, though capable and well connected, has been less than satisfactory. We had to be constantly encouraging her to follow-up on the deliverables. In order to change this dynamic, during the February 2015 visit, we have requested Dr. Abay to appoint Dr. Fitiwy as a person to keep track of day to day activities. In addition, we hired Dr. Girma Demisse, a storage entomologist from EIAR to be the postharvest technical expert to oversee progress of projects implemented in the country and also be a source of information on postharvest protection.

We have met USAID Mission contact, Dr. Adam Silyagi, or his associates during three of our four visits to Ethiopia since January 2014. They have been very supportive, and have always encouraged in-country collaboration with NGOs and others, and also emphasized that work we do is complementary and not duplicative. We are yet to receive input from Dr. Silagyi on our draft survey reports.

We have met Mr. Tadele Gelan and his associates at ACDI/VOCA on two occasions last year, and they are willing to cooperate pending permission from the USAID Mission office. They are willing to allow us to be part of their training programs.

We have met with representatives of the Catholic Relief Services in February 2015 and they have offered to collaborate with us in conducting field research with farmers and also support us in our educational and training programs. We will follow up during the June 2015 trip and confirm dates for training this year. We have identified key players and those that are dedicated to accomplishing the project objectives and deliverables. We have set up a system of weekly reporting to ensure that our in country coordinator and others are completing tasks as needed to move the project forward. We have identified a technical coordinator with experience in postharvest research to ensure smooth running of in country activities and proposed research projects.

Challenges

We have an excellent dialogue when we are in the country. However, connecting with the in country coordinator and others associated with the project via phone and or via email at times is difficult because of poor connectivity. We have been open in communicating with our in-country collaborators about their lack of communication and follow-up. With the communication system we have set up during our February 2015 visit, there has been information being shared on progress of our project on a weekly basis.

3. Identify the gaps in technology being used based on critical review of survey responses

Progress

Smallholder farmers do not accurately measure grain moisture at harvest. The role of moisture on mold incidence and mycotoxin production is also unknown. They dry grain on tarps in the field or on roads where they are exposed to dust and environmental pollution. Farmers store grain in traditional storages where losses due to insects and molds are greater than 30%. Stored grain is inspected visually but very few farmers use any methods to control insects in storage. The few that use control methods, rely on chemicals and not alternatives. Improved storage structures and non-chemical amendments added to grain can significantly reduce postharvest losses. Technological gaps include lack of quantifiable methods to determine grain moisture content at and after harvest, lack of facilities for grain drying, and lack of proper and cheap non-chemical tools available for controlling insect in grain. In addition to these gaps, training in the proper use of these technologies need to be provided.

From our survey data we have identified key on the shelf technologies to reduce postharvest losses, and these simple and novel technologies are currently not used by smallholder farmers. These include use of metal bins, use of triple bags (PICS), GrainPro Superbags, and use of domestically available plant products/industrial

products with insecticidal activity. Research by the WFP and others in sub-Saharan Africa have shown that the use of these simple methods can reduce storage losses to less than 2%.

We have given the in country researchers a simple moisture meter to use when they sample smallholder farmers grains, and we are in the process of acquiring the solar bubble dryer for determining its effectiveness in drying grain. These dryers have been recently delivered. This dryer will be compared with traditionally available chimney dryer, modified from drying fruits/vegetables to grain.

Farmers have been using Malathion, pirimiphos-methyl to protect grain from insects and during our visits we observed several farmers carrying tubes of the toxic gas fumigant phosphine. Our goal is to move farmers away from using toxic materials on their grain. They are using the phosphine tablets in their traditional storages that are inside their house!

Three potential areas of research have been identified for year 2. These include measuring moisture and temperature of grain stored by smallholder farmers and at warehouses, including private and those constructed by USAID, on a monthly basis, and sampling the grain to quantify types and numbers insects found, incidence of molds and mycotoxins in grain. In addition, traps with pheromone lures will be placed in farmers' households and in warehouses to monitor stored-product insects and molds/mycotoxins. Data collected on insects and molds/mycotoxins will be related to grain moisture/temperature and age of grain in storage. Grain will be assessed for loss due to insects and molds. Once grain is newly harvested, the moisture of grain will be determined at harvest and in storage following established protocols. The mycotoxins of concern are aflatoxins and fumonisins, and we are expanding this to include ochratoxins as well. The smallholder farmers (40) storing wheat and maize in Amhara region were sampled by Bahar Dar University researchers as of March 2015. This research is yet to begin at Mekelle University. The two universities will be conducting insects, drying, and molds/mycotoxin research by sharing two commodities each.

In addition, laboratory scale studies will be conducted at Bahar Dar and Mekelle Universities comparing the use of storing grain in metal silos, GrainPro Superbags, PICS bags, in traditional storages, and with the addition of inert dusts such as Silicosec or use of traditionally available materials such as Triplex and filter cake which have been shown to have insecticidal activity based on tests on maize. These laboratory scale tests will be conducted for a period of 6 months and the condition of grain and efficacy against insects and molds will be determined on a monthly basis following established protocols shared with the researchers.

During the June 2015 visit and during the conduct of these experiments, training sessions will be held at the two universities to educate end-users, including farmers, about the storage technologies, existing knowledge from scientific literature, and results of current experiments.

Limited trials will be conducted in smallholder farmer households and in warehouses of select technologies based on interest from the end-users.

Challenges

There has been very little research on postharvest protection in Ethiopia, and therefore the laboratories were ill-equipped to conduct research on moisture measurement, drying, evaluating molds/mycotoxins, and insect pest management research. Identifying these needs last year, and purchasing the equipment needed to equip laboratories has been our first priority. The mycotoxin test kits and readers have been given to Mekelle and Bahir Dar Universities, and now they are in a position to conduct mycotoxin analysis. However, equipment to conduct insect related research is still lacking. During early part of 2015, we purchased insect traps, vials for storing insects, and sieves for separating insects from grain. These have yet to be sent to Ethiopia. During May 12-31, 2015, Mr. Tesfaye Melak from Bahar Dar, who was admitted as a PhD student at Kansas State University, will be visiting K-State for training in insect identification, grain sampling, and mold/mycotoxin analysis. After training, he will be taking the items we have purchased to Ethiopia to help Bahar Dar and Mekelle conduct research on insect pest management. Mr. Melak will train others in Ethiopia, and will

continue research through the summer and return to K-State in fall to continue his course work. During our June 2015 visit we will take additional materials (Ochratoxin kits and reader to Mekelle University) to help in the year 2 research.

Sourcing materials on time to initiate our research projects has been slow due to reasons previously mentioned. Now all of the on the shelf technologies needed to initiate of year 2 projects have been ordered and being delivered. The metal bin fabricator sent an invoice to make 32 metal bins and this task is yet to be completed pending transfer of money from K-State.

4. Training farmer groups, NGOs, researchers, and extension agents on using moisture meters

Progress

The locations where training is needed include Tigray, Amhara, Oromiya, and SNNP. In these regions farmers storing sesame, chickpea, wheat, and maize will be trained. Training will include progressive farmers in each of the regions. NGOs we currently work with include CRS and we plan to include them in our trainings. The extension/engagement advisory team in Ethiopia is in the process of being formed and will be finalized during our June 2015 visit. During our July 2015 visit, Dr. Shannon Washburn, our extension/engagement expert will spend time with the advisory team to finalize actual locations of training, type of training needed based on our postharvest loss assessment survey, number of trainings, and develop metrics for gauging effectiveness of training.

Challenges

The extension/engagement expert has been more active in Ghana portion of the project, and as a result progress in Ethiopia has been limited. Dr. Washburn has been in contact with Dr. Fetein Abay and is finalizing the list of extension/engagement advisory team members in light of his July 2015 trip.

5. Comply with EMMP Procedures

Progress

An EMMP for all research projects in Ethiopia, and other countries has been developed and shared with all in-country collaborators in Ethiopia, Ghana, Guatemala, and Bangladesh. A check list is being developed to comply with each of the EMMP plan before experiments start. A person responsible for EMMP in the country will be identified during the June 2015 visit.

Challenges

There have been no challenges.

6. Conduct research on indigenous and imported solar dryers

Progress

The locations where the research should occur has been determined. The scientists responsible at Mekelle and Bahir Dar have been identified. Solar bubble dryer from GrainPro and cabinet dryers made by each of the universities have been identified to evaluate their performance. The project PIs from Mekelle University prepared an experimental plan and an outline of work with other team members. Extensive testing on drying of cereal grains will be conducted by the team members. Drying studies are being conducted at empty, half load and full load conditions in solar dryer. Based on the experimental results, the dryer performance will be

optimized by redesigning the traditional dryers, and the cost effectiveness will be compared with that of the solar bubble dryer.

Challenges

Computer modeling and simulation will be used to modify dryer design based on local weather conditions. Historical weather data collection has been a challenge. Various agencies are being contacted to obtain historical temperature, relative humidity and solar radiation data.

7. Determine occurrence and levels of mycotoxin in newly harvested and stored grain samples

Progress

Protocols for mold and mycotoxin analyses have been shared with in country researchers. Data collection has started at Bahir Dar to determine moisture and mycotoxin levels in grain sampled from smallholder farmers. The grains sampled include wheat and maize. Research on moisture and molds/mycotoxins has yet to start at Mekelle University. Results have not been communicated to farmers or other external constituents, including AflaStop folks.

Challenges

The test kits and the readers have been delivered to Mekelle and Bahir Dar, and the mycotoxin laboratories at both locations have placed them in their labs and the universities now have the capability to perform mycotoxin analyses. The degree to which these test kits are being used is unclear.

8. Check for pest infestation of the grains and conduct research on key storage and pest management methods

Progress

Traps have yet to be sent, and will be given to Mr. Tesfaye Melak from Bahir Dar that I invited for May 12-31, 2015 training in my lab. He will take several boxes of traps dedicated for research in smallholder farmers' homes and in USAID and other private warehouses. Currently Bahir Dar has started visiting smallholder farmers (40), and collected maize and wheat samples for mold/mycotoxin enumeration and for determining types and numbers of stored-product insects. Sampling of smallholder farmers storing chickpeas and sesame has yet to be initiated by Mekelle University.

Hermetic bags (PICS and Super Grainbags) have been recently shipped to Ethiopia and Dr. Fetein Abay has confirmed delivery. We are not using Vestergaard-Frandsen insecticide-treated bags in Ethiopia, as the goal is to move away from relying on chemicals use alternatives to pesticides. Protocols for sampling in smallholder farmers' households and warehouses have been shared. Information on conducting laboratory scale research at Bahar Dar and Mekelle Universities has been shared with the researchers. During our June 2015 trip, we will be there to help in the final design and execution of the research trials. we will also visit several smallholder farmer's households and warehouses to determine how grain is being sampled and handled for molds/mycotoxins as well as insect research.

Challenges

Identifying researcher’s needs and trying to get the needed equipment and supplies on time are some challenges. These are being overcome on a case by case basis. All of the necessary equipment and experimental treatments will be in-place during our June 2015 visit.

9. Develop equal gender assessment and capacity building

   Progress

   The gender consultant, Mr. Solomon Aya Fikir from Mekelle University has been identified and a contract was recently issued for him to serve on the project. he will be working closely with Dr. Fetein Abay. Mr. Solomon was given papers on USAID's WEAI, specific information from Dr. Cheryl O'Brien, consultant to PHLIL on gender issues, and a draft proposal to conduct focus group surveys of women to determine their importance and role in postharvest protection. Funds have been allocated for this effort, pending a proposal from Mr. Solomon. During the June 2015 visit we will discuss the gender survey, and proposed training in the future.

   Challenges

   We have been in discussions with Dr. Fetein Abay about identifying a gender expert and one was identified only recently.

10. Form engagement advisory teams

    Progress

    A list of key representatives was developed by our in country coordinator, and after reviewing the names we recommended inclusion of individuals directly involved in extension/education of farmers. We expect this to be complete by June 15, 2015.

    Challenges

    None

11. Create engagement advisory team plan of work

    Progress

    No progress has been made to date.

    Challenges

    Aspects related to this effort will be addressed in July by Dr. Shannon Washburn during our July visit. A tentative frame work for the plan exists, but has not been shared or discussed with team members because we are in the process of identifying those members.

12. Capacity building

    Progress

    Moisture meters have been given to all researchers involved in the PHLIL projects, and these individuals are from universities and from EIAR institutes. Mycotoxin test kits and readers have been sent to Bahir Dar and Mekelle universities. Insect identification tools (books) have been given to all four crop leaders (sesame, maize, wheat, and chick pea), along with books on stored-product insects, their ecology, and management. metal bins are being built. Solar dryers have been sourced and delivered. Scientists and PhD students involved in dryer, mold/mycotoxin, and insect research have been identified. PhD students will be enrolling at Bahir Dar, Makelle, and/or Hawassa universities. The next steps are to develop relevant curriculum, provide training to in country researchers on postharvest protection, and develop active learning tools, and gender inclusion strategies.

Challenges

There have been no challenges.

13. Complete year 2 annual report and develop year 3 work plans

Progress

No progress to report at this time.

Ghana

1. Identify and facilitate admission of one Ghanaian M.S. student to Oklahoma State University (OSU) in the Fall Semester of 2015

Progress

Ms. Abena Fowaa Ocran has been identified to join Oklahoma State University (OSU) to pursue an M.S. degree in Entomology. Dr. Opit worked with Abena to complete her application to OSU in January 2015 and on May 4, 2015 she was admitted. Therefore, Abena will be starting her MS program at OSU in the Fall 2015 Semester. Abena's thesis research will involve investigating the use of non-chemical approaches for the control of stored-product insect pests.

All goals and objectives have been met.

Challenges

None that are noteworthy.

2. (A) Gain overall understanding of the maize value chain and conduct the 2nd PHL verbal survey (face-to-face interviews) in Northern Ghana [visit maize producing areas in Northern Ghana during maize harvest - 2nd PHL survey]; (B) Refine researchable areas in PHL where breakthroughs in research and development could lead to significant improvements in food security, and identify research topics and locations; (C) Write a report on the 2nd PHL survey

(A) Visit maize producing areas in Northern Ghana during maize harvest - 2nd PHL survey

Progress

The initial questionnaire used in the Middle Belt verbal survey in May 2014 was modified. The PHL-IL Ghana team visited several parts of Northern Ghana in December 2014 and successfully conducted a verbal survey of maize PHL.

A two-week in-country assessment (December 8 to 19, 2014) of postharvest losses (PHL) in the Ghana maize value chain was conducted in Northern Ghana by seven experts in communications and agricultural education, post-harvest engineering technology, and stored-products protection from four different U.S. Land-Grant Universities (Oklahoma State University, Kansas State University, University of Kentucky, and University of

Illinois at Urbana-Champaign); the USDA-ARS Center for Grain and Animal Health Research (CGAHR); Kwame Nkrumah University of Science and Technology (KNUST); and University of Ghana – referred to hereafter as 'Team' (Appendix A). The assessment covered the period December 8-19, 2014 (in country).

The Team visited stakeholders in Accra and traveled to Northern Ghana (Northern Region and Upper West Region), a major maize growing part of Ghana. During visits to these areas, the Team acquired knowledge on postharvest losses that occur along the value chain. Stages of the maize postharvest system such as harvesting, pre-drying in the field, threshing (shelling), drying, cleaning, bagging, and storage were discussed. Additionally, the capacity and operations of grain storage systems in these regions and maize losses that occur in them were assessed. The Team observed current grain handling and pest management tactics, stored-product insect activity, drying systems, and post-harvest grain losses in small-, medium-, and large-scale storage warehouses. The ultimate goal was to identify researchable areas in PHL that are perceived "critical control points" where breakthroughs in research and development could lead to significant improvements in grain quality and food security. Important stakeholders in the maize value chain such as nucleus farmer aggregators, government and parastatal entities, the private sector, non-governmental institutions, research institutions, universities, etc. were visited as part of the second PHL assessment.

This objective was accomplished

Challenges

None that are noteworthy.

(B) Refine researchable areas in PHL where breakthroughs in research and development could lead to improvements in food security; identify research topics and locations.

Progress

The list of promising "on the shelf" technologies from the first PHL survey was successfully refined. A list of successful tactics already in use in Ghana that have not been widely adopted has been refined. We have identified research topics based on the referenced refining and modification. Plans for research of promising technologies have also been modified and we have formalized partnerships to conduct this research. Some technologies that will be pilot tested for implementation in Ghana are: (1) low cost, microchip-based sensors for grain moisture determination, (2) simple tools to detect fungal infection and quantitative tests for measuring mycotoxin levels, (3) using AflaSafe™ to mitigate aflatoxin-related maize losses, (4) food and pheromone-baited traps for monitoring insects inside and outside warehouses and strategic grain reserve sites, (5) storing grain in insecticide-incorporated polypropylene bags (ZeroFly® Storage Bags) to prevent infestations, (6) using Purdue Improved Crop Storage (PICS) hermetic triple-layer bags to prevent infestations, (7) using commercial 100-kg Super Grain Bags, (8) using commercial 100- to 150-kg Plastic Silos, (9) using 2.5- to 6-MT Kikapu Steel Silos (by Kepler Weber), and (10) using solar dryers for rapid drying and insect disinfestation.

Research locations in the Middle Belt will comprise areas in the maize "triangle" comprising Techiman, Nkoranza, Kintampo, Wenchi, and Ejura-Sekyedumase. In Northern Ghana, research locations will be in Tamale, Wa, and Tumu. Because of the collaborative research PHL-IL Ghana will be conducting with Strengthening Partnerships, Results, and Innovations in Nutrition Globally (SPRING), Agriculture Technology Transfer (ATT) and Africa Research in Sustainable Intensification for the Next Generation (Africa RISING), research locations will also be in places where these entities are active. PHL-IL Ghana has cooperators such as Pens Food Bank, several Farmer Based Organizations (FBOs), Ministry of Food and Agriculture (MoFA) and Sahel Grains in the Middle Belt. In Northern Ghana, some of the cooperators include Big Ajar Enterprises,

Antika Warehouse, Masara N'Arziki Farmers Association (MAFA), MoFA, and Savanna Agriculture Research Institute (SARI).

This objective was accomplished

Challenges

None that are noteworthy.

(C) Write a report on the 2nd PHL survey.

Progress

A 3-page summary of the visit (assessment) was prepared and submitted to USAID Ghana Mission office, USAID AOR for the PHL IL, and all PHL IL team members, including in-country collaborators. The complete survey results and findings have been compiled in a report that was shared with the PHL IL team members and in-country collaborators, USAID AOR and USAID Ghana Mission office in the middle of April 2015.

Major findings of the PHL assessment of the maize value chain in Northern Ghana found in the report were:

- There are multiple tactics in use for monitoring of insects and moisture at both the on-farm storage level as well as in warehouses. Many of these are not effective or reliable. Methods for monitoring moisture content are not widespread, so this is an area ripe for introduction of simple low-cost technologies that are more reliable than traditional methods. As new more effective air-tight storage systems are introduced, the use of reliable moisture detection techniques will become more critical to reduce losses due to molds.
- Farmers are not patronizing warehouse storage systems except when agricultural production-related service packages of pre-harvest mechanization, fertilizers, pesticides, and other inputs are offered by the storage provider. These arrangements tend to establish stronger working partnerships with farmers and as a result, warehouses offering the referenced services enjoy greater patronage from farmers for storage. A common risk with this system is that collection (recovery) of cash or in-kind payment at harvest time for input or service expenses is sometimes difficult. Another risk is the timely provision of services when service providers are dependent on governmental entities for financing or release of inputs.
- Farmers are resistant to investing in new technology to produce quality grain when there is no economic reward for increased input costs. A lack of affordable credit facilities with ease of access adds another obstacle to farmer adoption of capital investments in postharvest technologies.
- We identified several organizational entities for delivery of training that could assist farmers to adopt new technologies. These organizations include nucleus farmers and agricultural inputs and production service packages providers such as Masara N'Arziki Farmer Association (MAFA), as well as other smaller farmer based organizations (FBOs). We found women's groups, nucleus farmers, and other service providers to be good models for delivering new methods and scaling them up. Women's groups were cited by multiple sources as tending to be relatively more honest, reliable, and more willing to follow protocols and objectives addressed through training than are male farmers. The connections established on this trip will allow us to expand our reach.
- Aflatoxin-related issues can be exacerbated most by current handling practices such as: harvest timing mismatched with maize maturity (early or late), heaping maize ears in the field until a sheller is available, and the lack of proper drying facilities during harvest. Promising aflatoxin mitigation techniques including Aflasafe™ currently in development offer an affordable method to reduce aflatoxin

levels. We have initiated working relationships with Africa Research in Sustainable Intensification for the Next Generation (Africa RISING); International Institute of Tropical Agriculture (IITA); Strengthening Partnerships, Results and Innovations in Nutrition Globally (SPRING); Resiliency in Northern Ghana (RING); Agricultural Development and Value Chain Enhancement (ADVANCE), Agriculture Technology and Transfer (ATT), and Council for Scientific and Industrial Research - Savanna Agriculture Research Institute (CSIR-SARI) that will enable us to deliver training and scale up to make progress on the aflatoxin issue in the near term.

- Current local and on the shelf technologies exist that may address identified problems while capitalizing on private sector partnerships. These include ZeroFly® bags, Purdue Improved Crop Storage Bags (PICS bags), and plastic silos. Adoption of these technologies will require accurate measurement of grain moisture content and proper drying. We are implementing field-based pilot testing of a low cost moisture meter that could address the moisture measurement issue. We are also exploring approaches to more rapid and cost efficient means of drying via an improved solar dryer model.
- We identified potential partners for engagement and for assisting us in data collection . These include the previously listed organizations in addition to Kwame Nkrumah University of Science and Technology (KNUST), Ministry of Food and Agriculture (MoFA), Pen's Food Bank Ent., Wienco, and a number of other postharvest handling and storage service (PHHS) providers.
- Training is needed on PHHS, aflatoxin-related issues, stored-product pest identification, and correct pesticide use and handle. Based on results of the first Postharvest Loss Assessment, we have initiated development of training materials and scientific animations. We are also exploring training of stakeholders with the PICS bag providers in 2015. We have identified multiple players throughout Northern Ghana and the Middle Belt who are eager and willing to facilitate the implementation of training.
- The lack of reliable storage facilities in close proximity to farms coupled with the lack of available shellers and ill-timed harvest are key contributors to postharvest loss.
    - Community warehouses appear to be a viable model if operated by the private sector, and if they offer production inputs and services.
    - The mechanized shelling business model appears lucrative, but entrepreneur investment is limited due to lack of affordable credit, issues with supervision and maintenance, and a shortage of trustworthy sheller operators.
- Women play a major role in the PHHS system and therefore have a significant role in the adoption of new technologies. Women-based organizations have been demonstrated to be a good vehicle in the adoption and scale up of new technologies and for obtaining financing. Multiple sources indicated women are more reliable, better able to follow prescribed protocols, and more likely to repay extended credit. We identified key seasons and times of day to maximize women's participation in future training offerings.
- Collaboration with RING and SPRING can have an impact on gender and nutritional aspects of our project and theirs.
- There is an opportunity to reduce environmental and health impacts due to over-reliance on pesticide use via the new technologies we are investigating for potential scale up.

This objective was accomplished.

Challenges

None that are noteworthy.

3. Write and submit semi-annual and annual reports.

Progress

Review of information from the second PHL assessment verbal survey has been completed. As a result of the review, gaps in technology in the maize postharvest system have been identified. Some technologies that will be pilot tested for implementation in Ghana are: (1) low cost, microchip-based sensors for grain moisture determination (with special emphasis on the USDA-ARS hand-held moisture probe), (2) simple tools to detect fungal infection and quantitative tests for measuring mycotoxin levels, (3) using AflaSafe™ to mitigate aflatoxin-related maize losses, (4) food and pheromone-baited traps for monitoring insects inside and outside warehouses and strategic grain reserve sites, (5) storing grain in insecticide-incorporated polypropylene bags (ZeroFly® Storage Bags) to prevent infestations, (6) using Purdue Improved Crop Storage (PICS) hermetic triple-layer bags to prevent infestations, (7) using commercial 100-kg Super Grain Bags, (8) using commercial 100- to 150-kg Plastic Silos, (9) using 2.5- to 6-MT Kikapu Steel Silos (by Kepler Weber), and (10) using solar dryers for rapid drying and insect disinfestation.

The semi-annual report has been submitted and entered into PieStar before the requested due date. The annual report for the first year has been completed and submitted to USAID Ghana Mission office, USAID AOR for the PHL IL, and all PHL IL team members, including in-country collaborators.

This objective was accomplished.

Challenges

None that are noteworthy.

4. Comply with EMMP Procedures

Progress

EMMP for the ZeroFly storage bags has been written and is in use in Ghana. A senior Technician in the Kwame Nkrumah University of Science and Technology (KNUST) Entomology Lab, Mrs. Josephine Asante, has been selected as the person who will be responsible for maintaining the EMMP-related log sheets, equipment, or PPEs for the project.

This objective was accomplished.

Challenges

None that are noteworthy.

5. Dr. Opit oversees the setting up of experiments in Ghana.

Progress

As a result of the first year PHL assessment, PHL IL Ghana has prioritized the following research experiments:

1) Experiments/pilots to assess and compare the ZeroFly storage bags with other traditionally used technologies such as untreated polypropylene bags practical storage technologies have been initiated by Kwame Nkrumah University of Science and Technology (KNUST) graduate students in Wenchi, Ejura, and Techiman in the Middle Belt.

2) Testing/piloting of the USDA-ARS low-cost moisture meter has been initiated in several locations in the Middle Belt (Wenchi, Techiman, Ejura, etc) and Northern Ghana (Tamale and Wa) by nucleus farmer

aggregators and Farmer Based Organizations. KNUST, Pens Food Bank (a project Cooperator), and our in-country coordinator are overseeing testing/piloting of the low-cost moisture meter.

3) Collection of baseline moisture content, insect infestation levels, and aflatoxin data has commenced in several locations in the Middle Belt such as Wenchi, Techiman, Ejura, etc; activities are overseen by KNUST, Pens Food Bank (a project cooperator), and our in-country coordinator.

In the interest of furthering research, pilots, and scale up of highly promising PHL mitigation technologies, Dr. Opit held meetings with representatives of ATT, SPRING, and Africa RISING on a recent trip to Ghana during the period February 27 to March 13, 2015. These meetings resulted in the drafting of memoranda of understanding (MoU) between PHL IL and each of these entities. The referenced MoU will be signed before the end of May 2015. Details of areas of collaboration with each of these entities are stated below:

ATT

Accomplish promotion of the ZeroFly® Storage Bags by working with elite farmers, opinion leaders, and several smallholder farmers. ATT and PHL IL will engage in training and a large demonstration in Northern Ghana to create demand for ZeroFly Storage Bags.

SPRING

1-Participatory community-based demonstration/trials of groundnut storage technologies (ZeroFly Storage Bags; PICS bags; 100-150-kg plastic silos), with the activity objective (beyond the research objective) of creating awareness in communities among SPRING's target 1,000 day households (SPRING focuses on women groups).

2-Roll-out/scale up of some of these groundnut technologies because they have been proven effective in Senegal and elsewhere (e.g., ZeroFly and PICS bags), parallel to the PHL IL effort with USAID ATT in maize, soybean and/or rice.

AFRICA RISING WEST AFRICA

1. Conduct experiments/pilots on storage techniques in selected project intervention communities.

2. Purchase and pilot test the low-cost moisture meter in selected intervention communities.

3. Liaise with ATT on the feasibility of scaling out post-harvest technologies.

4. Liaise with PHL IL engineers in the design and implementation of Africa RISING research on drying technologies.

5. Conduct aflatoxin tests on the samples generated from activities 1, 3 and 4 listed above (location for aflatoxin testing not yet determined).

6. Design and conduct experiments on the synergistic effects of aflasafe and other technologies (storage, drying techniques) and aflatoxin concentration.

7. Africa RISING recognizes farmers/stakeholder training as a major channel of technology transfer and adoption. Training provides understanding on what the problem is, possible solutions that improve crop quality. Joint training will be pursued with PHL IL Ghana.

PHL IL Ghana is on course to accomplish this objective in a timely fashion.

Challenges

Getting the various US-based collaborating investigators to be actively engaged and monitor research projects they are responsible for is challenging at times.

6. KNUST team visits USA for stored-product insect pest management training.

Progress

The KNUST team visiting the USA for stored-product pest management training is now in the process of securing visas for their visit. The team will comprise Dr. Enoch Osekre, Mr. Evans Nsiah, Ms. Naomi Manu, and Mr. James Kofi Danso. The KNUST team will be in the USA during the period July 24 to August 23, 2015.

PHL IL Ghana is on course to accomplish this objective in a timely fashion.

Challenges

Sorting through some TraiNet system-related issues and the length of time it takes for each short-term trainee to obtain the USAID required J1 visa.

7. Training farmer groups and extension agents on using moisture meters during harvest.

Progress

PHL IL Ghana is going to collaborate with ATT, Africa RISING, and SPRING to train farmers and extension agents. Memoranda of understanding with these entities are nearly complete.

PHL IL is also developing collaborations with PICS 3 and ADVANCE to train farmer groups and extension agents.

Because we are only 1.5 years into the project, no training of the referenced groups has taken place. However, training should commence later in Year 2 or early in Year 3.

PHL IL Ghana is on course to attain all planned goals and objectives.

8. Develop equal gender assessment and capacity building

Progress

The PHL IL Ghana Gender Consultant, Dr. Irene Egyir has completed preparing a document with detailed protocols for obtaining baseline gender-related data based on Feed the Future Women's Empowerment in Agriculture Index (WEIA). This document will also guide collection of similar data towards the end of the project in 2018. Workshops to address issues have not been organized to shortage of funds.
PHL IL Ghana is on course to accomplish this objective in a timely fashion.

Challenges

There is a shortage of funding to undertake all activities the Gender Consultant wants to conduct to collect more reliable and representative data.

9. Conduct research to evaluate and improve solar dryer technology and Zero Fly® Storage Bags.

Progress

Experiments/pilots to assess and compare the ZeroFly storage bags with other traditionally used technologies such as untreated polypropylene bags practical storage technologies have been initiated by Kwame Nkrumah University of Science and Technology (KNUST) graduate students in Wenchi, Ejura, and Techiman in the Middle Belt. This research is being conducted in collaboration Pens Food Bank, an entity working with PHL IL Ghana in the Middle Belt.

Dr. Samuel McNeill will be travelling to Ghana in June 2014 to initiate research on solar dryer technology in Sekyedumase and Ejura in the Middle Belt. Sam will transport data logging supplies and work with Paul Armstrong to train in-country partners on data collection protocols, which will be implemented during maize harvest in both the Major Season (anticipated in August 2015) and Minor Season (December 2015).

PHL IL Ghana is on course to accomplish this objective in a timely fashion.

Challenges

Delivery of the solar 'bubble' dryer that was shipped to Ghana was delayed in arriving at the final destination (Kumasi) because of customs/import restrictions at the point of entry (Accra).

10. Obtain baseline data on aflatoxin levels in stored maize in the Middle Belt and Northern Ghana.

Progress

Collection of maize baseline aflatoxin data in the Middle Belt has been initiated. Aflatoxin test kits have been shipped to Ghana and the mycotoxin lab at KNUST has been upgraded to handle anticipated sample analysis for this project. Preparations for more aflatoxin testing materials to be shipped to Ghana are ongoing. Dr. Paul Armstrong has completed training on use of aflatoxin materials that have been shipped to Ghana and will travel to Ghana in June 2015 to train collaborators in Ghana and to assess progress in aflatoxin data collection.

PHL IL Ghana is on course to accomplish this objective in a timely fashion.

Challenges

None that are noteworthy.

11. Obtain baseline data on insect pest infestation levels in stored maize in the Middle Belt and Northern Ghana.

Progress

Collection of baseline data on insect pest infestation levels in stored maize has been initiated by Kwame Nkrumah University of Science and Technology (KNUST) graduate students in Wenchi, Ejura, and Techiman in the Middle Belt.

PHL IL Ghana is on course to accomplish this objective in a timely fashion.

Challenges

None that are noteworthy.

12. Form Engagement Advisory Teams and Technology Research Implementation Team.

Progress

Engagement Advisory Teams (EATs) for Northern Ghana and the Middle Belt have been formed. The EAT for the Middle Belt has 11 members and that for Northern Ghana has 10 members. The 11 members of the Middle Belt EAT are:
Mr. Sam Okang-Boye (Ghana Grains Council), Mr. Maxwell Adu (Pens Food Bank), Mr. Evans Nsiah (Pens Food bank), Mr. Kenneth Afo Osei Atiemo (Yedent Agro Group), Mr. Kwame Boateng (Sahel Grains), Mr. Benson Acheampong (Farmer), Dr. J.A. Bakang (Kwame Nkrumah University of Science and Technology [KNUST]), Ms. Beatrice Acheampong (Farmer), Mr. Kwame Ahiadu McLawrence MoFA Nkoranza), and Mr. Yew Opoku (Grain Processor).

The 10 members of the Northern Ghana EAT are:
Mr. Antiku Abdulai (Antika Co. Ltd.), Ms. Matilda Exornam (Masara N'Arziki Farmers Association), Mr. Huudu Abu (Upper West MoFA Office), Ms. Elizabeth (Upper West MoFA Office), Prince Fuseini Haruna (Northern Region MoFA Office), Mr. Dokurugu Salifu Ziba (SPRING), Chief Kuri B Limann (Takhilla Farms Ltd.), Mr. Musah Alhassan (Gundaa Produce), Mr. Musa Salifu Taylor (Agriculture Technology Transfer project).

The Technology Research Implementation (TRI) Team for Ghana has also been formed and comprises eight members, namely, Prof. Ebenezer O. Owusu (University of Ghana), Prof. R. T. Awuah (KNUST), Dr. Joseph Ofei Darko (KNUST), Dr. Joseph Atehnkeng (Africa RISING), Dr. Abdulai Mumuni (Savanna Agricultural Research Institute), Prof. Daniel Obeng Ofori (University of Energy and Natural Resources), Mr. Evans Nsiah (Pens Food Bank Ent.), and Mr. Kwame Boateng (Sahel Grains)

This objective has been accomplished.

Challenges

We have 1 female member in the Middle Belt EAT and two in the EAT for Northern Ghana. Getting more females on the EATs has been a challenge. Similarly, we have no qualified female on the TRI due to the challenge in identifying and recruiting suitable women.

13. Create Engagement Advisory Team Plan of Work.

Progress

During a 10 day series of one-on-one meetings, we met with all members of the Engagement Advisory Team for the North and the Engagement Advisory Team for the Middle Belt. The team in the North consists of 9 members including representatives of: two farmer-based organizations, MOFA regional extension specialists, Masara N'Arziki, SPRING and ATT, and a village chief. In the Middle Belt, the team consists of 10 members including representatives of: Ghana Grains council, a farmer-based organization, two grain processing firms (Yedent and Sahel Grains), Kwame Nkoranza University, two maize farmers, and a MOFA regional extension specialist. All members enthusiastically agreed to participate as members of the team and will contribute input via email discussions as well as annual face-to-face meetings which will commence next year.

Challenges

The primary challenge faced this year is that for members of the engagement advisory team, travel costs are prohibitive for their involvement in group meetings that requires travel to a central location and for year 2, no budget was allocated to address these expenses. This is the reason we elected to assemble two regional teams

rather than one national team. For this reason, we were unable to accomplish some of the planned activities that necessitate a group meeting. Funds will be reallocated for year 3 to initiate group meetings in the North and in the Middle Belt by covering travel expenses for team member attendance.

14. Capacity Building, i.e., to identify capacity building needs in both technical (moisture meter, toxin testing, solar dryer usage, storage systems, insect identification and monitoring) and engagement/outreach areas (active learning, curriculum development, assessment, use of multi-media tools, gender inclusion strategies).

Progress

Capacity building needs were identified during the maize PHL assessments conducted in the Middle Belt and Northern Ghana. Details of these capacity building needs have been provided in reports on these assessments.

Training is needed on postharvest handling and storage (PHHS), aflatoxin-related issues, stored-product pest identification, and correct pesticide use and handling. Based on results of the two postharvest loss assessments, we have initiated development of training materials and scientific animations. We are also exploring training of stakeholders with the PICS bag providers in 2015. Training is also planned with ATT, SPRING, Africa RISING, and ADVANCE. We have identified multiple players throughout Northern Ghana and the Middle Belt who are eager and willing to facilitate the implementation of training. Farmers also need to be trained on how to successfully engage in agriculture as a business so that they are not reluctant to invest in new technologies to produce quality grain.

PHL IL Ghana is on course to accomplish this objective in a timely fashion.

15. Complete Year 2 intermediate progress report and develop Year 3 work plans.

Progress

No progress to report at this time.

Guatemala

1. Compile and analyze PHL assessment survey questionnaire data

Progress

The postharvest assessment survey was completed on January 15, 2015. It was conducted in 9 communities in Todos los Santos and 5 communities in Chiantla, all from the department of Huehuetenango. A total of 272 families (smallholder farmers) were interviewed out of the 500 possible ones from the 14 communities that grow and purchase maize for self-consumption. The number of interviews was determined based on statistical analysis and chosen randomly. In the assessment it was obtained information on nutrition, economy, social and equal gender issues, and the current postharvest practices from the farmers. For more details on the methodology and objectives of the assessment, geographical and sociological information of the farmers, general results, and conclusions, please see the full report.

Among the main results obtained from the assessment were:

- Maize is the main source for carbohydrates for the farmers in Huehuetenango.
- The majority of farmers do not have enough land to produce all the maize needed for self-consumption of their families. Therefore, the majority will buy maize from the lowlands of Guatemala or from southern Mexico. The average maize yield in all 14 communities is 90 kg per 400 m^2.

- The average farmer will grow 400 to 460 kg of maize per year which will last normally for about 3 to 4 months based on a family size of 5 to 6 members. The average consumption per family is around 2.5 kg, but can increase up to 7.5 kg depending on the number of family members and their age.
- Their current identified postharvest practices do not show positive effect in reducing post-harvest losses. The farmers are usually reluctant to accept new technologies.
- The average loss of maize per household is approximately 46 kg out of 400 to 460 kg produced per year. Their several reasons why this lossess occurred and are summarized in the report.
- There is very little knowledge on the health problems caused by mold and mycotoxin presence in the maize.
- There is little involvement of women and children in corn harvest practices, but their role is strengthened in housework.

Challenges
N/A

1.2 Identify promising areas for developing projects to be implemented in Year 2

Progress
The information obtained from the assessment survey on the current postharvest practices was used to determine the baseline for the storage and drying research trials that will use the on-the-shelf technologies for the reduction of postharvest losses. Among their current postharvest practices for drying maize are: drying on the field before harvesting, drying of cobs on bags exposed to the sun, and drying of cobs on the attics of the farmer's house. Very few drying occurs on shelled corn. For storage, maize is stored on the cob in bags and in the attic's of the farmer's houses. Less than 10 farmers utilized 1-ton capacity metal silos to stored shelled corn. These farmers obtained the metal silos by participating in other postharvest related projects. Based on these results, it was concluded that the following drying technologies will be tested after the November 2015 ahrvest to measure their efficiency and cost. They are:Bubble Dryer by Grain Pro one forced air furnace type dryer model (similar to the AflaStop shallow bed dryer)being built by UVG (following guidance of the PHLIL team), the STR dryer developed in Vietnam, and a solar dryer developed by a university in India. The UVG dryer will be developed and initially tested in the Guatemala City campus in June. The storage technologies that will be tested starting in November 2015 are: Super Bags by Grain Pro, PICS bags by Purdue University, and the modified attic developed by the PHLIL team.

Challenges
N/A

2. Capacity Building (Training farmer groups and extension agents on using moisture meters during harvest and grain sampling techniques, and collaborators on the usage of mycotoxin analysis kits)

Progress
The extension agents (grain quality assessment promoters and farmers) of SHARE (local partner) were trained on November 2015on how to use the John Deere moisture content meters and the relative humidity and temperature sensors (that are used to quantify the weather conditions inside the current storage facilities that are used by the farmers) when assessing grain quality of the selected smallholder farmers. The laboratory personnel of the Universidad del Valle (local partner university) were trained on November 2015 on how to use the mycotoxin testing equipment that were supplied for their laboratory as part of this project.

Challenges

N/A

3. Evaluation of stakeholders and collaborators, and development of semi-annual and annual reports

Progress
The main collaborators (UVG and SHARE) were evaluated in order to determine whether they are fulfilling their tasks based on the completion of the milestones developed for Year 1 and the first half of 2015. Both UVG and SHARE fulfilled all the milestones and their tasks.

Challenges
N/A

4. Analyze the survey response data to identify the gaps in technology currently being used

Progress
The assessment survey data was analyzed completely. It was necessary in order to understand the current postharvest practices and fine tune the research ideas for Year 2. Among the main conclusions that the PHLIL team determined were:

- The farmers do not have an effective way to determine the moisture content of the maize during harvest and after drying.
- The current drying practices are not very effective and rely mainly on putting some time the maize under the sun or under the metal roof in the attics.
- The current storage practices rely mainly on storing maize on the cob in some cases with husks on the attics and in wood boxes.
- Very few farmers shelled their maize for drying or storage. The shelled maize is usually stored on bags and in some cases in small metal silos.
- The current drying and storage practices have been done for many years.
- There is a slight understanding on the effects of bad grain quality, but in some cases nothing is done to mitigate it.
- There is a lack of understanding on the equal gender issues.

Challenges
N/A

5. Comply with EMMP Procedures

Progress

The information on the approved EMMP's developed by the PHLIL was received on February 2015. The EMMP's for Guatemala are not yet developed, but will include all the log sheets and forms necessary for compliance.

6. Form Engagement Advisory Teams

Progress
A list of potential members for the Engagement Advisory Team was developed by Dr. Jason Ellis in conjunction with the SHARE extension leader and UVG personnel on Febraury 2015. Members will be invited in the next trip by the PHLIL Guatemala team on June 2015.

Challenges
N/A

7. Identify mycotoxin and mold presence in maize after harvest

Progress
The identification of the presence of mold and mycotoxins is currently being developed from maize samples taken from volunteer farmers from the communities of Chiantla and Todos los Santos. The samples are being analyzed at UVG with the Romer Labs mycotoxin analysis kit. The analysis of the grain samples started after harvest between November 2014 and February 2015, but will be finished once the storage period of 0, 30, 60 and 90 days is finished in May. All data will be received from UVG once the last sampled will be analyzed.

Challenges
N/A

8. Develop equal gender assessment and capacity building

Progress
The equal gender assessment survey developed by the equal gender consultant (Ada Rocina Chavarria) is finished. The report is being currently translated from Spanish into English for further analysis. The assessment survey is needed in order to develop the equal gender training workshops. The USAID Women Empowerment Indexes will be included in the upcoming workshops.

Challenges
N/A

9. Select appropriate dryer technology through a research study

Progress
The baseline work to develop the drying research trials is currently in progress. It is necessary in order to start developing all the documentation, analysis and base line to conduct the drying research trial in the next harvest season that starts in November. Currently, the UVG students in conjunction with the PHLIL team are developing the research protocol which includes the methodology. It will be finished by May 15. In summary, the drying research trials will consist of:

- Design, building, and optimization of a forced air furnace dryer.
- Measurement and quantification of drying efficiency and building costs and comparison with the Bubble Dryer, STRv dryer, and the solar dryer from the university in India.

Challenges
N/A

10. Develop study for storage efficiency with recommended technologies

Progress
The baseline work to develop the storage research trials is currently in progress. It is necessary in order to develop the baseline and initial work to develop the storage research trials after the upcoming harvest season. It

has been determined that an optimization of the attics is needed in order improve the current storage practices. Then, it will be compare with the Super Bags and PICS bags for maintaining grain quality by measuring any possible insect, mold and rodent infestation, temperature rise inside the storage technology, and purchasing or remodeling (for the attic) costs.

Challenges
N/A

11. Complete Year 2 annual report and develop Year 3 work plans

Progress
The Year 2 semi-annual report was completed.

Challenges
N/A

11.2 Develop Year 3 work plans

Progress
No progress to report at this time.

12. Create Engagement Advisory Team Plan of Work

Progress
No progress to report at this time.

Challenges
N/A

B. Issues or concerns encountered during the reporting period

- Gender Coordinators – The initial gender coordinator (Dr. Nina Lilja) had to step aside from this role due to her leadership duties at the college level. Thus, a new overall gender coordinator has been hired as a consultant (Dr. Cheryl O'Brien). Also, the hiring of a gender consultant in each of the four countries has been completed.

- Hiring in-country staff – This took longer than anticipated but has now been completed in the remaining countries of Ethiopia and Bangladesh.

C. Data Sharing and Dissemination

No progress to report in this area.

II. Human and Institutional Capacity Development

A. Short-term training

- Plans have been made for a group of KNUST scientists to travel to Oklahoma State University to receive 3 weeks of training in stored insect monitoring this July.
- Plans have been made for a faculty member from Bahir Dar University to travel to Kansas State University to receive 2 weeks of training in stored grain insect monitoring this June.

B. Long-term training

- During project planning visits to Bangladesh in January and Ethiopia in February, funds were budgeted in both country projects to support graduate students who will conduct research in support of the FtF PHL Innovation Lab:
    - 3 PhD students at Bangladesh Agricultural University (BAU) working respectively on a mycotoxin, drying and storage project with PhD advisory committee membership including Bangladesh project team members from UIUC and/or KSU.
    - 3 PhD students at Bahir Dar University (Ethiopia) working respectively on a mycotoxin, drying and storage project with PhD advisory committee membership including Ethiopia project team members from KSU and/or SCSU.
    - 3 PhD students at Mekelle University (Ethiopia) working respectively on a mycotoxin, drying and storage project with PhD advisory committee membership including Ethiopia project team members from KSU and/or SCSU.
- Although not directly funded by the FtF PHL Innovation Lab, the following graduate student will be contributing to various aspects of in-country projects:
    - Achint Sanghi, M.S. Student in Grain Science, Department of Grain Science and Industry, Kansas State University (computer simulation analysis of solar drying systems; major professor: Dr. Kingsly Ambrose)

C. Institutional capacity development

- Discussions have further advanced with Dr. Eneyew Tadesse Malaku, Chairman of Food & Beverage Process Technologies, Bahir Dar University and Dr. Baylie Damtie, President, Bahir Dar University about collaborations between faculty experts from KSU and Bahir Dar University on milling and baking technologies. Additional conversation has recently taken place about select PHL IL faculty experts becoming adjunct graduate faculty at Bahir Dar University to serve on PhD student advisory committees in support of the newly formed Post-Harvest Technology and Management MS and PhD program.
- Plans have been refined for set up and equipping of a Grain and Flour Quality Lab at Bahir Dar University to support training and certification of Ethiopian industry personnel. The President of Bahir Dar University has pledged an initial sum of funds to purchase equipment.
- Collaboration with TechnoServe and Partners in Food Solutions (PFS) is on-going to help the Ethiopian milling industry to improve flow quality and functionality through improvement in flow extraction and quality.

III. Technology Transfer and Scaling Partnerships

- Five (5) solar bubble dryers from GrainPro have been purchased and are being shipped to project sites in Bangladesh (1), Ethiopia (2), Ghana (1), and to Kansas State University (1) as a control project.

IV. Future Work

- As a follow up to attending the Innovation Labs Directors meeting in Lilongwe, Malawi, April 20-23, 2015, Dr. Maier will be following up on several leads with USAID country mission officers as well as other organizations that have expressed interest in PHL reduction research, demonstration, scale up, and education/training.
- As a follow up to attending the USAID Ethiopia quarterly partners meeting in Addis Abeba, Ethiopia, April 16, 2015, Dr. Maier will be following up on several leads with USAID partner organizations that have expressed interest in PHL reduction research, demonstration, scale up, and education/training.
- Site visits for the AOR to all four project countries are being planned with the first trip this June.