

ADMI

Institute for the Prevention
of Postharvest Loss
University of Illinois



2019 Annual Report



From the Director



Reflections on ADM's activities for 2019 are hard to separate from the pandemic realities of 2020 that press on our minds as we assemble this annual report. The disruptions that COVID-19 brought to the world weigh on us, but they also shine a stark light on the importance of ADM's mission to address poverty and food insecurity through improved postharvest management. This report highlights the work ADM has supported in 2019 that is contributing to resilience in 2020.

In the face of unprecedented disruptions to many links in the food value chain, work to widen the options for executing postharvest activities can give vulnerable people cushions to buffer shocks and manage forward. When virus-induced travel bans restricted the flow of laborers to harvest, thresh and move grain, development of options for combine harvesters kept grain from rotting in smallholders' fields. When traders were unable to reach remote villages because COVID-19 limited trucking activities, improved hermetic storage enabled farmers and local traders to delay sales without risk of pests infesting their grain. When market failures meant that resource-poor farmers were suddenly holding more grain than before, small-scale dryers enabled them to do so without moisture-related degradation. Because of the work ADM supported in 2019, a broader array of options was available to soften the economic blows from the pandemic in 2020.

Scaling up innovations for impact was a theme of many activities in 2019. In Africa, ADM worked with the Soybean Innovation Lab to nurture the manufacture of appropriate-scale multi-crop threshers that can save labor and save grain. In Bangladesh, we worked with Bangladesh Agricultural University to advance dryers and harvesters from proven concepts to widely available technologies. In India, we worked with the Borlaug Institute of South Asia, Dr. Rajendra Prasad Central Agricultural University, and Bihar Agricultural University to increase awareness and use of hermetic storage options for smallholders. In each of these cases, ADM provided smallholders with technologies and techniques to enable them to better navigate the disruptions brought by COVID-19.

Looking to the future, the experiences of 2019 and early 2020 have reinforced the importance of using creative partnerships and creative methods for impact. We have been fortunate in our partnerships with the International Food Policy Research Institute (IFPRI), which leads our activities with the Bangladesh Ministry of Food. ADM and IFPRI co-hosted a forum on improved storage in Delhi in February 2020, which provided opportunities to build new relationships and partnerships with government agencies, private companies, and commercial organizations that will be key players in future work to address postharvest loss. We look forward to developing these new partnerships and new initiatives in 2020 and beyond.

—Alex Winter-Nelson

: ADM was established with a
: gift from the Archer Daniels
: Midland (ADM) Company to the
: University of Illinois in order to
: promote research, outreach,
: education, and capacity
: building to reduce postharvest
: losses in grains and oilseeds
: and enhance global food
: security and environmental
: sustainability.

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Funding

ADMI's projects have a number of funding sources. For each project, we have indicated the source of funding in a blue box.

ADMI

ADMI core funds

ADM CARES

Project-specific funding from ADM Cares, the social responsibility arm of Archer Daniels Midland Company

USAID

U.S. Agency for International Development

IFPRI

Subaward from International Food Policy Research Institute of funds from Government of Bangladesh

ADMI responds during pandemic lockdowns



Combine harvesters provided by Bangladesh Agricultural University helped farmers in Bangladesh harvest the spring paddy crop when the pandemic lockdowns made it impossible to hire laborers.

Early in 2020, India and Bangladesh went under lockdowns as governments grappled with the global pandemic. Restrictions on movement helped to control the spread of the coronavirus, but the negative effects on the livelihoods of smallholder farmers were undeniable. In both cases, the pandemic and resulting lockdowns delayed harvest and undermined markets in ways that jeopardized the crops and livelihoods. In the face of these challenges, ADMI affiliates helped farmers manage difficulties through postharvest innovations.

Because of the pandemic-induced supply chain disruptions, more harvested grain remained in rural communities of South Asia this spring than usual,

straining the capacity to store grain safely. To address this challenge in state of Bihar, India, ADMI collaborators at Dr. Rajendra Prasad Central Agricultural University (RPCAU) distributed hermetic grain bags to farmers to enable effective household storage in communities participating in the ADMI-funded Climate-Smart Villages (CSV) project. Before the pandemic, RPCAU agents had visited households in CSV communities to explain the benefits of hermetic bags. COVID-19 lockdowns initially impeded planned bag distribution, even as the need for safe and local storage intensified. Nonetheless, the project field investigators persevered and developed safe methods to distribute bags and demonstrate their use, a few farmers at a time, in many more CSV communities. Vishal Kumar, assistant professor at RPCAU reported that 475 households in seven communities received 1,900 hermetic bags during April 2020.

In Bangladesh, harvesting the Boro season crop usually depends on seasonal, migrant labor from around the country. Measures to control coronavirus restricted this labor movement and even in situations where farm laborers were allowed to work, many feared reprisals if they left their homes. As a result, smallholder farmers struggled to hire workers to bring in the harvest. To confront this threat, ADMI colleagues at the Department of Farm Power and Machinery at Bangladesh Agricultural University (BAU) deployed combine harvesters to help local farmers bring in the crop while maintaining safe social distancing. Thanks to advocacy from ADMI partners at BAU, the Government of Bangladesh approved a subsidy



Field investigators from Dr. Rajendra Prasad Central Agricultural University in the state of Bihar, India, found ways to distribute hermetic storage bags to farmers during the pandemic lockdown.

for combine harvesters, reducing the price by about half. The small-scale harvesters reduce postharvest loss and decrease the number of laborers needed to bring in the crop, a critical issue in this pandemic year. Through ADMI's partners at BAU, farmers in Bangladesh also continued to benefit from expanded access to the BAU-STR grain dryer, which improves the condition of stored grain.

ADMI partners in India and Bangladesh helped smallholder farmers complete essential farm operations, and demonstrated how postharvest interventions can build resilience and security among vulnerable populations around the world.



The small-scale harvesters reduce postharvest loss and decrease the number of laborers needed to bring in the crop, a critical issue in this pandemic year.

PHL 101 meets demand for online education during pandemic

The year 2020 has been an unusual one. People all over the world have had their regular routines disrupted—unable to work, shop, socialize, or learn as they normally would. Under the circumstances, online learning opportunities have attracted increased interest, and ADMI has served that interest.

“Global Postharvest Loss Prevention: Fundamentals, Technologies, and Actors,” colloquially known as PHL 101, was launched on the Coursera platform in early 2015 as one of the earliest University of Illinois online courses. In July 2016, it changed to an on-demand format, and learners can join a group that forms every four weeks. There is no charge to access the course and participate in quizzes and assignments. There is a \$50 fee for participants to receive a certificate of completion.

In March 2020, ADMI started regularly promoting PHL 101 and related courses from other organizations in our newsletter and on Facebook and Twitter. The response has been dramatic and sustained. The number of learners who started the course rose by more than 200% over the same period in 2019. In March through May of this year, 59 learners completed the course.

Sign up or learn more!
go.illinois.edu/PHLcoursera

Scaling Technologies

ADMI

ADM CARES



Climate-Smart Villages in Bihar

ADMI and research partners in the state of Bihar, India, joined a new project in 2019: “Scaling up Climate-Smart Agriculture (CSA) through Mainstreaming Climate-Smart Villages (CSVs) in Bihar.” The CSV project, initiated in 2018 by the Government of Bihar, focuses on a variety of climate-smart innovations that can help smallholder farmers adapt to changing weather patterns by planting new crops, rotating crops, and changing planting schedules, among other things. Although food loss is a major contributor to climate change, postharvest management was not part of the original project. With support from ADM Cares and other sources, ADMI added postharvest management to the project, under the coordination of the Borlaug Institute of South Asia (BISA).

In early 2019, BISA and partners at Bihar Agricultural University (BAU) and Dr. Rajendra Prasad Central Agricultural University (DRPCA) identified 100 villages in four “corridors,” each in a different agro climatic zone, to participate in the project. Researchers Rajkumar Jat (BISA), Vishal Kumar (DRPCA), and Satish Kumar (BAU) lead project activities in the respective corridors.

The CSV project focusses on three objectives to provide postharvest technologies and information to build climate resilience among farmers in Bihar:

- 1 Provision of grain dryers and drying services
- 2 Subsidized distribution of grain storage bags leading to a sustained distribution system through local entrepreneurs
- 3 Deploying trainers to provide information and training to service providers on postharvest practices and technologies

Field investigators improve outreach to farmers

In 2019, the CSV project made multiple strides, including hiring and training community-based field investigators (FIs) as local trainers. Each institution works with four to six field investigators who are responsible for each of the four corridors. The FIs work closely on a day-to-day basis with farmers to provide technical assistance on using hermetic bags, storing grain, drying grain and other topics as requested.

COVID-19 disrupted food supply chains, which created new challenges for postharvest grain management in Bihar, and also impeded getting face-to-face support from PIs. At the same time, COVID-19 lockdowns triggered increased uptake of digital mobile platforms. In response, Vishal Kumar helped launch multiple farmer WhatsApp groups near the Pusa corridor for CSV farmers in Gopalpur, Dhruvgama, and Ladaura villages. Participants in these WhatsApp groups are extremely active, sharing pictures of how farmers are using the hermetic bags, noting the quality of grain in storage, and using the STR dryer for



ADMI board member Bob Zeigler (second from left) talks with field investigators at one of the CSV project sites during a visit in February 2020.



Accomplishments

In the past year, project managers have begun to scale up operations. Key accomplishments include:

- 62 village trainings
- 2,846 postharvest trainees, including 1,086 women
- 12 information fairs (kisan ghostis)
- 7,026 bags distributed to 2,818 farmer households
- Knowledge and outreach products including flyers created and distributed
- 20 field investigators providing training and extension services



WhatsApp groups are allowing more feedback from farmers as well as a means to share knowledge with them.

drying wheat grains. Farmers are also using the WhatsApp groups to request FI visits and provide extension advice, or requesting additional hermetic bags for grain storage.

WhatsApp groups are allowing more feedback from farmers as well as a means to share knowledge with them. Farmer feedback and technical observations motivated researchers based at BAU and DRPCA to engage with Bangladesh Agricultural University about performance and efficiency issues with the STR dryer. Modifications and lab testing on these small-scale dryers to address local needs are currently underway.

Impacts from demonstration villages

In February 2020, ADMI staff along with Bob Zeigler, ADMI External Advisory Board member, and Prasanta Kalita, former ADMI director, visited CSV project sites and observed work in progress and storage technologies in use in several villages. Interactions with men and women in Bihar confirmed previous observations about hermetic storage there. Farmers who had experience with the bags remarked that they work well, and they are particularly inclined to use the bags for grain stored for home consumption. Women in the households expressed appreciation that they can avoid chemical treatments for the grain stored in the hermetic bags.

The work of ADMI-supported researchers through the CSV project and the earlier ADMI Village project created a powerful evidence base on the benefits of hermetic storage for smallholder households. ADMI partners like Rajkumar Jat, Satish Kumar and Vishal Kumar have worked to make that evidence known to policy makers and a recent policy intervention promises facilitate wider adoption of improved storage. In late 2019, the Government of Bihar announced a 50% subsidy for hermetic bags. If implemented fully, this policy will

make the bags affordable for farmers and attractive for retailers, and contribute to the growth of a viable market for hermetic storage technologies in Bihar.



An example of traditional grain storage in a Bihar village household. The home-made clay containers do not adequately protect grain from pests or moisture.

PHLIL Phase 2: Scaling up postharvest solutions

The BAU-STR dryer was designed for smallholder farmers and small-scale seed traders. It has a capacity of 500 kg and can dry a batch of grain within 4–5 hours.

The dryer reduces grain loss during drying to 0.5% (compared to 3–4% using conventional methods). When coupled with hermetic storage, the dryer enables farmers to reduce storage losses significantly.



BAU researchers conduct a farmer training session about the use of the modified BAU-STR dryer.

ADMI has a longstanding relationship with researchers at Bangladesh Agricultural University (BAU) on multiple projects, co-funded through USAID, IFPRI, and ADMI. One such project is the Feed the Future Innovation Lab for the Reduction of Post-Harvest Loss (PHLIL), in which USAID and ADMI co-fund BAU's activities. BAU's goal within the PHLIL is to reduce post-harvest paddy loss by improving drying and storage practices through technology development and dissemination, as well as human capacity building. In PHLIL phase 1, BAU developed the BAU-STR small-scale grain dryer. Scaling up use of this and other innovations is a priority for phase 2.

Modifying and scaling up small-scale dryers

BAU's approach to scaling the BAU-STR dryer has included:

- **Listening to farmers and modifying the fuel source:** While the BAU-STR dryer was initially developed with rice husk briquettes as a fuel source, BAU has recently modified the design to use liquefied petroleum gas (LPG). In addition to being a cleaner-burning fuel, LPG is widely available in Bangladesh, enabling easy fuel accessibility. Farmers requested the LPG modification in spite of the slightly higher cost, since it simplifies the dryer's operation. By using LPG, farmers save time they would have used feeding rice-husk briquettes into the burner to maintain a consistent temperature.
- **Scaling adoption through focus on farmer organizations and public-private partnerships:** Farmer organizations enable smallholders to more easily access and manage information, inputs, and markets, ultimately leading to lower costs and higher profits for individual farmers. BAU worked with two Bangladesh Ministry of Agriculture projects to scale the BAU-STR dryer with farmer organizations known as Common Interest Groups. In partnership with the Department of Agricultural Extension's (DAE) Integrated Agricultural Approach for Ensuring Nutrition and Food Security project, 184 farmer organizations in six districts each received a BAU-STR dryer. In 2020, DAE plans to distribute 1,400 additional LPG fuel-source BAU-STR dryers. Additionally, in partnership with FAO's Missing Middle Initiative, the dryer was distributed to seven farmer organizations in two districts. Mechanized drying creates value for smallholders in these groups, because the selected districts are prone to flash floods, as well as rain during the spring harvest. In both projects, BAU worked with local manufacturers to provide the dryers, provided technical assistance, and conducted train-the-trainer workshops for sub-assistant agricultural officers and other trainers. BAU continues to monitor these farmer organizations and provide technical support as needed.
- **Building local fabricator capacity:** Over the duration of PHLIL phases 1 and 2, BAU has invested in building the capacity of local manufacturers and fabricators such as Bhai Bhai Engineering and Kamal Machine Tools. These agricultural machinery manufacturers have received hands-on training to design and manufacture the BAU-STR dryers and are now manufacturing dryers at scale for distribution to farmer organizations and other interested buyers.

Scaling up off-farm dryers

In collaboration with small and meso-scale private sector millers, BAU is also developing a recirculating batch grain dryer. Bangladesh has about 14,500 small and medium scale private rice husking mills, which together account for 45% of total paddy production in the country. These millers typically dry grain in open air and face challenges when drying during the rainy Boro and Aus seasons. They report an increasing tendency for farmers to sell “wet paddy,” which is difficult for millers to accept in the absence of mechanized dryers. Enabling traders and millers to dry and store more effectively can help address smallholders’ problem of finding a market at the Boro harvest.

BAU is collaborating with Moti Auto Rice Mill, a small-scale private sector rice milling enterprise, to develop and manufacture a local recirculating batch grain dryer design with locally available parts and components. After conducting a needs assessment, BAU researchers have identified the need for a 12-ton capacity paddy dryer. BAU has established a cost-share partnership with Moti auto rice mill, who will be providing \$50,000 to develop the dryer for the mill and install it in on the premises. This dryer will also serve as a research and demonstration site. This activity has potential for manufacturing and scaling batch dryers to other mills, large-scale farmers, and traders.

Promoting large-scale adoption of hermetic storage

In phase 1, BAU focused on farm-level hermetic storage adoption. In phase 2, the focus has shifted to assessing the effectiveness of using hermetic storage for large-scale seed storage in partnership with Bangladesh Agricultural Development Corporation’s (BADC) seed processing centers.

In 2019, BAU examined the technical and financial performance of hermetic bags for seed storage compared with BADC’s traditional seed storage system. The experiments used a randomized design and were performed in two seed processing centers in Mymensingh and Tangail over the Boro and Aman seasons with 180 hermetic bags. Due to BADC’s practices of fumigation, spraying, re-drying and re-lotting, experimental results did not indicate insect infestation and showed minor differences in moisture content. However, researchers saw significant changes in seed germination rates, with hermetic storage offering high germination rates of 88% in comparison to 81–85% observed with traditional storage methods.



U.S. Ambassador Earl Miller learned about the development and success of the BAU-STR dryer during a visit in April 2019. The ambassador visited Bhai Bhai Engineering Workshop, and praised this unique example of collaboration between USAID, public and private sectors, and BAU.

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continued on next page

Read more about the BAU-STR dryer: go.illinois.edu/BAUSTRdryer

Furthering adoption of hermetic bags for paddy seed storage among smallholder farmers

BAU has helped pioneer the ADMI Grain Handling technique of pairing hermetic bag use with a community or group level BAU-STR dryer. In 2019, BAU distributed 108 hermetic bags for storing paddy seed among farmers in the Mymensingh, Bagura, and Barishal districts through four farmer groups. In the well-known Maria village, in Bagura district, BAU worked with a women-run farmer group to encourage further adoption of hermetic storage coupled with the dryer usage amongst women farmers.

Farmers received training through multiple programs, refresher trainings, and continued monitoring and technical assistance with the help of a doctoral student. In addition to training on technical knowledge of using and maintaining the bags, BAU helped arrange capacity building exercises, such as weighing the grain stored and noting the grain moisture and weight. The Rural Development Activity and Ara Bangla Society collaborated with BAU to identify the groups and conduct trainings.

IFPRI

Exploring new options for off-farm storage in Bangladesh

Researchers at Bangladesh Agricultural University are testing off-farm hermetic grain storage techniques to determine the feasibility and effectiveness of these options for long-term storage. Several 5-ton capacity hermetic cocoons have been set up alongside traditional rice storage practices for a period of four months. During the experiment, researchers have taken regular readings for moisture and humidity. We look forward to reporting results from the ongoing activity in the coming months.



Multi-crop thresher fabrication training

By the numbers

Ethiopia

26

trained

2

threshers built during training

Zimbabwe

17

trained (including 1 woman)

3

threshers built during training



A thresher operator in Ghana talks about his experiences with the SIL multi-crop thresher.

View a video from the Ethiopia program: go.illinois.edu/threshertraining

Learn more about SIL at soybeaninnovationlab.illinois.edu/

The Feed the Future Innovation Lab for Soybean Value Chain Research (SIL) is dedicated to soybean research for economic development and the reduction of poverty and hunger by nurturing improved soybean value chains in Africa. Soybean threshing remains one of the larger bottlenecks for improving productivity among soybean producers. The lack of access to mechanical threshing reduces planted hectares because of the extensive labor demands of threshing at harvest. It also reduces seed quality and germination levels among seed producers. In addition, farmers receive lower sale prices when poor threshing results in poor grain quality. A shared commitment to reduce quality and quantity losses associated with poor threshing is the basis of an ongoing partnership between SIL and ADMI.

To address the thresher bottleneck, SIL has worked with manufacturers in multiple African countries since 2016 to develop low cost, locally produced, medium-scale multi-crop threshers that can shell maize and thresh soybean, rice, beans, sorghum, and other crops. The threshers have been under continuous improvement through testing, redesign, and direct engagement between engineers, fabricators, and users. In 2018, after two years of research and development, the thresher went fully commercial with sales in northern Ghana.

With funds from ADMI through the ADM Cares program, SIL received a grant to support multi-crop thresher trainings in four African countries: Ethiopia, Kenya, Nigeria, and Zimbabwe. Trainings in Ethiopia and Zimbabwe have already taken place. Because of the COVID-19 pandemic, the workshop in Nigeria has been delayed. The last workshop was going to be in Mali, but due to unrest in that country, it will be in Kenya instead.

The Soybean Innovation Lab mechanization team trained 26 local equipment manufacturers and educators in thresher fabrication at the Wolkite Polytechnic School in Wolkite, Ethiopia, from November 18-25, 2019. The training was organized by the Ethiopian Emerging Technology Center (EETC), a division of the Ethiopian Biotechnology Institute (EBTI). The training program included a seminar involving all participants and interested parties including funders, local NGOs, USAID, media, Government of Ethiopia officials, agro-businesses, and farmer groups. The seminar provided a platform to inform the public of the capacity of Ethiopian businesses to provide thresher fabrication services.

SIL conducted a similar thresher fabrication training in Harare, Zimbabwe, in March 15-23, 2020. This workshop included train-the-trainer elements and was conducted in coordination with the International Maize and Wheat Improvement Center (CIMMYT), which was invited to suggest commercial fabricators for the workshop. ADM Cares financed the SIL trainers at this event and the materials used for one of the three threshers constructed. CIMMYT received the thresher produced with ADM Cares funds so the international organization could utilize and demonstrate it for farmers.



SIL trainers Imoro Donmuah (left) and Hakeem Abdul-Karim (right), from Ghana, show trainees in Ethiopia how to cut a pipe using a plasma cutter.

Gender Integration

USAID

ADMI

Integrating gender into PHL reduction efforts in Bangladesh, Brazil and Ghana

Globally, women smallholder farmers are responsible for multiple postharvest activities such as threshing, drying, winnowing, storage, cleaning, processing and marketing. In many rural households, women manage harvested grain to ensure there is food for home consumption throughout the year and sufficient seed stock for the next season.

Bangladesh

At Bangladesh Agricultural University (BAU), gender expert Ismat Ara Begum, in collaboration with AgReach, led three initiatives in 2019 to integrate gender considerations into ADMI's programming with the Feed the Future Innovation Lab for the Reduction of Post-Harvest Loss (PHLIL). The initiatives involved:

- Conducting gender technology assessments of the BAU-STR dryer and hermetic bags. The assessment utilized a tool originally developed by AgReach to identify gendered impacts of the technology, and assess both barriers and enablers in accessing and adopting the technology. Initial data from the assessment suggests that both technologies save women's time and labor associated with sun drying, monitoring, and cleaning stored grain in households.
- Working with a women's group in Maria village, Bagura, by providing a dryer and hermetic bags. The women participants in Bagura are early adopters of various technologies and form a model group for testing adoption of postharvest practices and technologies.
- Training local women entrepreneurs, such as Khadeja Begum, to provide drying services to the community for a fee. This commercial service provider model will be developed further in 2020.

Check out the blog post describing gender integration work in Bangladesh: go.illinois.edu/genderintegration



Ismat Ara Begum (left), Bangladesh Agricultural University, speaks with a woman farmer as part of gender technology assessment in Bangladesh.



Bangladesh Agricultural University professor Monjurul Alam (left) speaks with a village farmer as part of the BAU gender technology assessment project.



Brazil

Understanding women's participation in farm decisions can be crucial to increasing farm income and reducing postharvest loss. University of Illinois professor Mary Arends-Kuenning has been working with colleagues at two Brazilian universities—Unioeste and Universidade Federal da Integração Latino-Americana (UNILA)—to study the impact of women's empowerment on postharvest management in western Paraná State. The project, funded by an ADMI open window research grant, adds a gender component to the prior work on postharvest loss in soybeans with Brazilian cooperative 'Cooperativa Lar' that has 10,607 members. Using the Women's Empowerment in Agriculture Index, the researchers interviewed women members of the cooperative to measure the extent to which women make farm decisions, especially after harvest. Initial results indicate that women have strong decision-making roles in their households and in the cooperative. The team plans to use the data to develop postharvest interventions targeted at women members. The project is funded through an ADMI open window research grant.

Ghana

AgReach

In Ghana, AgReach is leading efforts to reach women farmers with postharvest technologies by working with the Women's Poultry Association (WPA), a subsidiary of the National Poultry Farmers Association. WPA is active in the Dormaa region, with 50 female members and offers its members access to technology, extension information and a market network. University of Illinois professor Paul McNamara and post-doctoral researcher Anna Snider are providing WPA members in-depth training on best practices for post-harvest management. Furthermore, AgReach is exploring training WPA members to start entrepreneurial ventures, including distributing hermetic bags and GrainMate moisture meters. AgReach will also lead gender technology assessments of postharvest technologies in collaboration with faculty and students at the University of Development Studies, Tamale. AgReach's work in Ghana is part of PHIL phase 2.

Women farmers in Ghana examine hermetic storage bags as part of AgReach's work with the Women's Poultry Association.

AgReach is providing WPA members in-depth training on best practices for post-harvest management and is exploring training WPA members to start entrepreneurial ventures.

Ghana

Soybean Innovation Lab

ADMI supported further gender-related postharvest work in Ghana with the Soybean Innovation Lab (SIL) women's thresher project. SIL has sought to expand women's access to post-harvest agricultural mechanization through multi-crop threshers. Mechanized threshing reduces post-harvest loss in grain production and has implications for women farmers' time and labor. SIL worked with 20 women's Village Savings and Loan Associations who had received threshers from the Mennonite Economic Development Associates, to evaluate the benefits and challenges that women smallholder farmers encounter as members of thresher micro-enterprises. SIL researchers Kathleen Ragsdale, Mary Read-Wahidi, and Kerry Clark also analyzed models that were the most productive and sustainable for female group ownership of agricultural equipment.

Through focus group discussions, SIL found that successful women-led thresher groups reported positive outcomes such as increased income through thresher services and crop sales, and decreased time and labor spent in threshing. The groups provided thresher services for a fee and retained the profits. Successful groups also had effective thresher ownership and operating practices, and had a sustainability and expansion plan. The study revealed some challenges the women faced with the thresher design, which SIL plans to improve. Data from the research will assist governments and NGOs in developing programs to ensure that mechanization strategies are inclusive of female farmers. The SIL women's thresher project was funded through an ADMI open window research grant.



SIL researcher Edward Martey (left), along with SIL collaborator and SAYeTECH CEO Jeffrey Appiagyei (right), interview Juliana, leader of a women-led thresher group in rural Ghana.

Read more about SIL's work with the women's thresher project in Ghana here: go.illinois.edu/SILwomenthresher and the latest project evaluation report here: go.illinois.edu/SILwomenthreshereval

Among thresher project participants:



58%

no longer needed
cash to pay for
threshing services



61%

reported better
prices for their
crops



55%

increase in cash
on hand and
access to credit

Research and Innovation

ADMI

ADM CARES

Improving the nutritional quality of food consumed through low-cost testing for fortified food

Why food fortification?

Hidden hunger is a form of undernutrition that occurs when intake and absorption of vitamins and minerals (such as zinc, iodine, and iron) are insufficient to sustain good health. Globally, hidden hunger afflicts more than 2 billion individuals or one in three people (FAO 2013). The effects can be devastating especially for children's health and survival, and can curtail socioeconomic development in low- and middle-income countries. Postharvest interventions, like food fortification, can combat hidden hunger by enhancing the nutrient quality of foods people consume. ADMI is supporting postharvest interventions to raise nutrient quality of the food that vulnerable people eat.

Fortification programs are a means of addressing micronutrient deficiencies and hidden hunger in low-income countries. However, many such programs lack resources needed to determine if an appropriate amount of fortified nutrients is consistently present in food products. Traditional methods to verify nutrient content, such as atomic absorption or emission spectroscopy, are expensive and require trained personnel and laboratory facilities, which create barriers to delivering effective mass food fortification programs. Responding to this problem, University of Illinois professor Juan Andrade and doctoral student Anna Waller have developed an affordable, reliable paper-based sensor called NU3PX to detect levels of iron in fortified food products. The paper-based assay, which changes color to a bright magenta in response to iron in fortified foods, is inexpensive and easy to use.

In 2019, ADMI open window funding helped Andrade connect the paper-based sensor to a smartphone app. Developing the smartphone application eliminates the need for a computer and software to perform image analysis, which is currently required to obtain precise results. With the app, MinVits, the user can upload a photo of the paper sensor after the color appears and the app determines the iron level. This bridges the gap between an assay test geared towards chemists and a test that can be fielded in a low-income setting. Over the past year, Waller has successfully validated the app and paper-based assay in Mexico using 50 local corn flour samples from various producers.

The app can be used in many other countries, in many languages, and for various micronutrients such as zinc, vitamin A and folate. The team has filed a provisional patent for the technology and the algorithm. Next, the team will conduct a qualitative study to understand the technological needs and limitations of the food industry in Mexico, especially among the companies focused on fortification of maize flour. The team will focus on improving the user interface for the app and developing and validating a low-cost product.

Journal publication link:
go.illinois.edu/nutrients

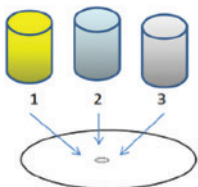
Video demonstration of the testing app:
go.illinois.edu/nutrientapp

Waller created a video about the project:
go.illinois.edu/fortificationvideo

MANUFACTURER

1

Deposit reagents onto paper



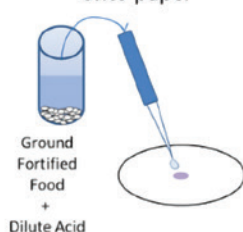
2

Reagents dry 60C



3

Deposit supernatant onto paper



4

User takes photo



5

App converts image



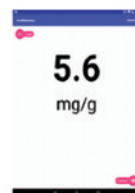
6

User selects ROI



7

App applies algorithm & output to user



Soy-fortified staples in Ghana: Storage stability and sensory evaluation

In sub-Saharan Africa, high poverty rates cause many people to consume diets concentrated on low-cost starchy staples, which are limited in many essential nutrients. In this context, food fortification is at an early stage and is limited to a few items, such as salt and cooking oil. Soybeans represent an inexpensive source of high-quality protein that could be integrated into food items to increase nutritional value.

In Ghana, soymilk is an increasingly popular drink, but is primarily imported. One of the main byproducts from local processing of soymilk is okara, which is commonly used to make wet food for pigs. However, okara has 22–25% protein, 30–33% carbohydrates, 12–15% fat, and 20–23% fiber, making it a potentially attractive nutritional ingredient for food products.

With ADM Cares funding, University of Illinois professor Juan Andrade is working with the Soybean Innovation Lab in Ghana to explore fortification of commonly used flours—*gari* (cassava) and *tuo zaafi* (maize and millet)—with dried okara-soy flour. *Gari* and *tuo zaafi* provide a good source of energy, but are limited in quality protein and micronutrients. Both flours are widely consumed in Ghanaian households and included in national institutional feeding menus, and can benefit from soy fortification.

Andrade will examine the incorporation of dried okara flour, defatted soy flour, and full-fat soy flour into the traditional staple flours. This includes developing a dryer that can be used to dry okara and process it into flour, and conduct a nutrition composition analysis of the dried flour. He will also evaluate the shelf stability of the flour fortification with soy and other micronutrients under real storage conditions, by measuring oil oxidation and monitoring the changes in vitamin content. The project will also include a sensory acceptability test with food-insecure populations in Kumasi and Tamale, Ghana.

The project is delayed due to COVID-19. However, Andrade and his team have already joined with a soymilk company in northern Ghana to provide okara, and partnered with local fabricator SAYeTECH to design and fabricate the dryer. The initial design rendering for the dryer is complete, and fabrication will take place once restrictions lift. The dryer will also be able to dry other high-moisture foods.

Andrade will examine the incorporation of dried okara flour, defatted soy flour, and full-fat soy flour into the traditional staple flours.

Spectral sorting: Removing a few bad kernels to reduce overall losses

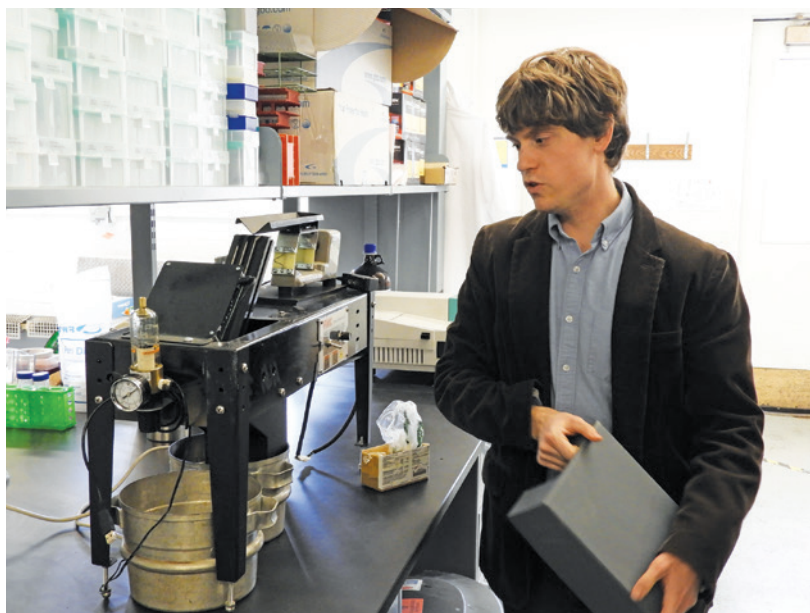
University of Illinois professor Matt Stasiewicz has been researching the development of a spectral kernel sorting system for the past few years. However, when he got on the ground in Ghana for a site visit in late 2019, he realized that there was already a potentially helpful system in place—a grain cleaning system. Stasiewicz is modifying the research design to find out if the existing grain cleaning system can assist in removing mycotoxin.

The kernel sorting system Stasiewicz is working with uses spectral sorting to identify maize kernels that show aflatoxin contamination. Removing contaminated kernels can reduce postharvest losses, both in terms of the numbers of kernels that are safe to consume and the nutrition content of the kernels that remain. One contaminated kernel in a closed container can allow the aflatoxin to spread to surrounding kernels. Removing one bad grain could leave the rest uncontaminated.

Stasiewicz discovered some Ghanaian poultry farms have a cleaning system for corn kernels, and some do not, which presents a research opportunity. Stasiewicz and PHL Scholar Ruben Chavez now have three hypotheses and will be testing the implementation of single-kernel spectral sorting before, after, or in place of a cleaning system. Tests will be conducted with grain that is well dried and stored, and grain that is poorly stored.

Chavez plans to travel to Ghana later in 2020, if global conditions will accommodate travel. If not, partners within Ghana will receive training to collect the necessary data. Currently, Stasiewicz and Chavez have continued work to improve the spectral sorting system by using grain from Texas. The project is part of the Feed the Future Innovation Lab for the Reduction of Post-Harvest Loss (PHLIL) phase 2 and funded by ADMI.

Review paper on single kernel analysis by Chavez and Stasiewicz published in the open access journal *Foods*: [mdpi.com/2304-8158/9/3/297](https://doi.org/10.3390/foods23040815)



Matt Stasiewicz demonstrates one of the early examples of a kernel spectral sorting machine. Stasiewicz is refining this technology for use in Ghana.

Drying crops in humid conditions with stored solar energy

Over the past few years, University of Illinois professor Bruce Elliott-Litchfield has developed and refined a stored solar thermal technology called “Sun Buckets.” While the most prevalent use of Sun Buckets has been for cooking, Litchfield envisions wider applications for its use. In 2018, he received an open window award from ADMI to design, build, and test a prototype dryer that uses stored solar energy to dry peanuts.

In Haiti, a substantial amount of the peanut crop is lost after harvest to a number of factors, including animals and poor drying and storage conditions. Warm and humid temperatures during the harvest season make air-drying difficult. The process generally takes four to five days, and farmers often pick the crop and store it in their homes overnight to avoid theft and pest damage.

Litchfield’s team designed and built a prototype dryer that successfully ran for more than seven hours from the energy stored in a standard Sun Bucket. The dryer achieved airflow rates between 10 and 15 cubic feet per minute (CFM) which is appropriate for drying two bushels of peanuts. Litchfield and his team tested the dryer in Illinois with rewetted and wet/green peanuts. One Sun Bucket was able to remove 1 kg of water from about 2 bushels of rewetted peanuts in seven hours, which was in line with expectations.

The team had planned field tests in Haiti, but political situations made that location impossible. Instead, the dryer was tested with apricots on a family farm in India, where dried apricots are a valuable cash crop. The dryer completed the task in about one-half of the time that air-drying normally takes, and the quality of the dried apricots was good. Litchfield and his team plan to continue developing and testing drying technologies in India in partnership with Indian Oil.



Drying fresh apricots at a family farm near Leh and Ladakh, India, using the prototype dryer.

Preventing grain loss by predicting cracks in rice

University of Illinois professor Pawan Takhar and graduate student Fidele Abedi have been researching the problem of stress cracking in rice. Rice is easily broken, and once the rice grains have cracked, in storage and in transport, they are vulnerable to further damage from pests and microbes.

With an ADMI open window research grant, Takhar and Abedi are developing mathematical models that can better predict the drying conditions that most often produce stress cracking in rice kernels. Takhar is collaborating with researchers at Haryana Agricultural University (HAU), India, to gather data on actual drying conditions and measure stress cracking to build an accurate mathematical model. After the model is fine-tuned, Takhar’s team will be able to create sample results for a diverse range of conditions.

Takhar believes that when farmers and rice buyers have more information, they will be able to create conditions that protect the grain from cracking. Fewer cracks will lead to less postharvest loss in the rice supply chain and increased prices.

Capacity Building

IFPRI

Ministry of Food course builds knowledge, partnerships

ADMI hosted its second short course for persons engaged in food policy issues with the Government of Bangladesh as a component of the Bangladesh Integrated Food Policy Research Program in 2019. The program is a joint activity of ADMI, International Food Policy Research Institute (IFPRI) and the Bangladesh Institute of Development Studies; and is part of the Government of Bangladesh's Modern Food Storage Facilities Program funded through the World Bank.

From August 19–September 13, 2019, a cohort of eight officials from the Bangladesh Ministry of Food visited the University of Illinois for a series of seminars, workshops, and field trips to give them new perspectives on food systems, food policy, and postharvest management. Participants learned from experts in a range of fields, including commodity marketing, food fortification, grain storage and processing, and food policy analysis. They focused on guided research and writing related to a professional project identified in advance. In addition, the group also went on field trips to local farms and grain elevators, historical sites in Springfield, and urban farm locations in Chicago.

On the last day, each individual presented a policy brief on some aspect of food policy in Bangladesh to University of Illinois faculty members. Presentation topics included mechanization in Bangladesh, cash transfers vs. food distribution in government assistance programs, increasing paddy procurement by the Ministry of Food, rice fortification, and the feasibility of public-private partnerships for grain storage. Participants later made these presentations to an audience of scholars and policy makers at the IFPRI headquarters in Washington, D.C.

Illinois faculty members who participated in the short course include: Alex Winter-Nelson, ADMI and Agricultural & Consumer Economics; Juan Andrade and Matthew Stasiewicz, Food Science & Human Nutrition; Mary Arends-Kuenning, David Bullock, Jonathan Coppess, and Craig Gundersen, Agricultural & Consumer Economics; and Prasanta Kalita, Agricultural & Biological Engineering.



Subsistence Marketplaces: Partners in building knowledge for farmers



One of the biggest barriers to improving the lives and livelihoods of smallholder farmers worldwide has been the challenge of disseminating information to the people who could most benefit from it. For the past two decades, Madhu Viswanathan's Subsistence Marketplaces Initiative at the University of Illinois has made great strides in breaking down that barrier and reaching farmers where they are. ADMI has been in partnership with the Subsistence Marketplaces Initiative since the institute's creation in 2011. In the past year, Subsistence Marketplaces has worked on two related projects with funding from ADMI and from ADM Cares.

In the 2018–19 academic year, with open window funding from ADMI, Subsistence Marketplaces expanded the entrepreneurial marketplace literacy program and its unique teaching approach to begin its first agriculture-centered marketplace literacy program. The project aimed to help

subsistence farmers gain appropriate market knowledge, awareness of rights and opportunities and the self-confidence to move forward in creating their own market conditions and outcomes, with the intent of keeping more of their profits in hand.

Over the course of nine months, the project reached 516 women smallholders through training sessions held in rural and semi-rural villages. Training materials were developed used bottom-up methodologies and participants received a total of six to 10 contact hours of instruction. Postharvest loss prevention was highlighted within the broader value chain as an entrepreneurial opportunity.

Post-program evaluations were conducted using farmer diaries and pre- and post-surveys. Viswanathan reported many positive outcomes from the farmers who attended the program, including:

- The farmers report higher feeling of well-being, a feeling of control in their own lives and the lives of their family, contribution to family decisions, and stability at home
- As marketplace literacy improves, people feel more autonomous in all aspects of their travels outside the home—they feel less need for permission to visit a market, community center, and other places



Background

Over the past two decades, Marketplace Literacy communities in Chennai have provided marketplace literacy education to more than 60,000 women in Tamil Nadu, India. These programs have focused on knowledge to help producers participate in local marketplaces: financial resources and market access. The educational programs are designed with the assumption that the audience cannot read or write. Local teams in Tanzania, Argentina, Honduras, a refugee settlement in Uganda, and Mexico oversee local marketplace literacy programs. To see examples of the materials, visit www.business.illinois.edu/subsistence

2019–20 PHL Scholars

Educating the next generation of scholars and teachers in postharvest loss prevention is central to the mission of ADMI. To that end, ADMI began the PHL Scholars program during the 2018-19 academic year, with two scholars. In 2019, three students were selected for the program. PHL Scholars receive graduate research assistantship funding and additional support to advance their postharvest-related research.

Subsistence Marketplaces expanded the entrepreneurial marketplace literacy program and its unique teaching approach to begin its first agriculture-centered marketplace literacy program.

- With higher marketplace literacy, the farmers feel decreased satisfaction with financial means, household condition, and changes in economic situation.
- The trainings helped women farmers think more broadly about marketplace issues

Viswanathan received a grant from ADM Cares for 2019–20 to develop a sustainability literacy program for farmers, emphasizing postharvest loss prevention, in Honduras, India, Tanzania, and Uganda. The new program addresses climate change challenges specific to each country and how agriculture is impacted.

Between November 2019 and March 2020, the Subsistence Marketplaces team designed, piloted, and delivered the program to participants in the four target countries: 100 farmers in Honduras, 158 participants in Uganda, 385 farmers in Tanzania, and 330 participants in India. The program served people in groups of 15 to 25 participants in different settings—rural/semirural village clusters near Chennai, India, tribal communities in Tanzania, a refugee settlement in Uganda, and a rural area in Honduras. These sessions concluded successfully in March, before the coronavirus pandemic made gatherings impossible.

The sustainability literacy programs designed for each country were based on “bottom-up understanding,” which Viswanathan uses to describe the process of getting information and gauging knowledge from the farmers while the program is being designed. In this way, the marketplace literacy program meets the farmers where they are and enhances their understanding. The program focused on the impact of environmental challenges on agriculture, including postharvest loss, and enhancing their capacity to respond to challenges through marketplace solutions.



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Amir Jafari
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Ph.D.



Congratulations to Pallavi Shukla, who recently received her Ph.D. in Agricultural and Applied Economics at the University of Illinois and is now working at Johns Hopkins University. Shukla was part of ADMI's inaugural group of PHL Scholars in 2018–2019.

Knowledge Sharing

ADMI/IFPRI

Forum convened in New Delhi to examine problems of storage loss

To help move innovations in grain storage into widespread use in India, ADMI and IFPRI-South Asia convened “Securing the Harvest: A forum on improved grain storage for smallholder agriculture” on February 5, 2020, in New Delhi, India. The event brought together thought leaders, researchers, and practitioners from the public and private sectors to discuss ways to promote proven methods of improved grain storage and reduce postharvest losses in India.

The forum included four sessions featuring presentations, panel discussions and breakout groups. Throughout the day, presenters discussed the scope and scale of the postharvest loss problem; gave evidence on the effectiveness of improved storage in enhancing food safety and food security; discussed barriers to adoption and unintended consequences of improved storage systems; and suggested interventions to capitalize on the potential of improved storage.

Several ADMI-affiliated researchers presented at the forum, including Monjurul Alam and Chayan Saha, Bangladesh Agricultural University; Rajkumar Jat, Borlaug Institute of South Asia; and Kathy Baylis, Pallavi Shukla, and Prasanta Kalita, University of Illinois.

Those in attendance agreed that to prevent postharvest loss, more granular information from across the value chain is necessary to paint a more complete picture of the situation. Solutions to prevent postharvest loss at the farm level also have to make sense for the food system as a whole, and those needs are different for different crops and locations. Technology providers emphasized the need for markets for postharvest technologies like hermetic bags to penetrate rural communities.

“Today everyone talks about nutritional security, which is a paradigm shift from food security. We need such a paradigm shift with postharvest management,” ICRIER Infosys Chair Professor for Agriculture Ashok Gulati said in his concluding remarks. “From a resource point of view, securing food loss might be much cheaper than producing extra food. However, we need more granular data to bring policy reforms on food losses.”

Session chairman Ashok Gulati (center) and panel presenters Rajkumar Jat, Kathy Baylis, Chayan Saha, and Pallavi Shukla at the “Securing the Harvest” forum.



A complete collection of videos, presentations, photos, and supporting materials from the forum is available on the ADMI website at go.illinois.edu/ADMIforum



Bangladesh Agricultural University professor Monjurul Alam speaking at the “Securing the Harvest” forum.

“Today everyone talks about nutritional security, which is a paradigm shift from food security. We need such a paradigm shift with postharvest management.”

—Ashok Gulati, ICRIER Infosys Chair Professor for Agriculture

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