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

FY 2018 SEMI-ANNUAL REPORT

INNOVATION LAB FOR COLLABORATIVE RESEARCH ON SUSTAINABLE INTENSIFICATION

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Collaborative Research on Sustainable Intensification
FEED THE FUTURE INNOVATION LAB

KANSAS STATE UNIVERSITY

Feed the Future Innovation Lab for Collaborative Research on Sustainable Intensification (SIIL)

FY 2018 Semi-Annual Report

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Cover Photos

Top left: Dr. Joseph Messina of Michigan State University launches a drone for data collection during a field visit to Malawi in February 2018. *Photo credit: Brad Peter.*

Top right: Village-based agro-dealers collaborate with national research groups and seed companies to make mini packs of bean seeds available across the Mbozi and Mbeya districts in Tanzania. *Photo credit: Jovin Lwehabura.*

Bottom left: A mini combine harvester for paddy rice is tested in Wazirpur, Barishal, Bangladesh in December 2017. *Photo credit: Md. Arifur Rahman*

Bottom right: Females farmers in Cambodia harvest leafy greens in the Battambang province. *Photo credit: Dave Ader.*

I. Research Progress Summary

A. Research progress made during the reporting period

1. Management Entity Operations

a. The Sustainable Intensification Assessment Framework was officially launched at the American Society of Agronomy Annual Meeting in Tampa, Florida in November 2017. The SIIL management entity is currently developing a web tool that will operationalize the framework.

b. The third SIIL Annual Meeting was held in Phnom Penh, Cambodia in January 2018 with the theme "Innovate, Collaborate, and Communicate". An emphasis was placed on the operationalization of the SI Assessment Framework within each research subaward.

c. The SIIL management entity and Center of Excellence on Sustainable Agricultural Intensification and Nutrition (CE SAIN) Cambodia co-hosted the First International Sustainable Agricultural Intensification and Nutrition Conference and Field Trips in January 2018. One hundred sixty-five individuals from 16 countries attended the conference, and over 60 individuals participated in the field trips.

d. Through a competitive award process, the SIIL selected Dr. Nancy Allen of the University of California, Davis to lead a new subaward entitled the "Research Output Dissemination Study" (RODS), which will focus on evaluating the path from development to end-user for selected innovations produced by the Feed the Future Innovation Labs. Progress updates from the RODS project will be available in the FY 2018 Annual Report.

e. SIIL subawards have started to upload complete datasets to SIIL's Dataverse (https://dataverse.harvard.edu/dataverse/SIIL), hosted by Harvard Dataverse, with additional datasets anticipated for upload in the remainder of FY 2018.

2. Geospatial and Farming Systems Research Consortium (GFC)

a. The GFC project on generating cropland extent of Ethiopia by capturing field boundaries from high-resolution imagery (PI Andy Nelson) is now complete. This study used high spatial resolution imagery within an online digitizing tool and trained users to manually digitize field boundaries from those images. This resulted in a unique crowd-sourced database of over 7,000 field boundaries in the Amhara highlands and Oromia region of Ethiopia. Two semi-automated field boundary-mapping techniques (gPb and eCog) were applied to the same imagery, and the resulting boundaries were compared against the manually digitized boundaries.

b. Training events on Unmanned Arial Vehicles (UAV)-based remote sensing data collection and processing were organized in Cambodia and Senegal. In-country partners in these two countries now have a complete kit (UAV+RGB & Multispectral camera) for near-surface remote sensing data collection. They will use the instruments to collect images of the experimental plots (or study locations) at frequent intervals during the growing seasons.

c. Two new projects have been identified for subawards: i) CIMMYT-Ethiopia will lead a study on spatial profitability of alternative production strategies in maize-based smallholder farming systems in sub-Saharan Africa; ii) Cropnuts-Kenya will analyze different properties (N, P, K, pH, SOM, CEC) of 2000 soil samples (1000 locations at two depths) to be collected across the crop-growing regions in Senegal.

3. Appropriate Scale Mechanization Consortium (ASMC)

a. Appropriate Scale Mechanization Innovation Hub – Bangladesh (ASMIH-Bangladesh)

i. Training manuals for transplanting, harvesting, conservation agriculture machinery, and gender issues were developed in English and Bengali.

ii. The ASMIH-Bangladesh hosted a weeklong mechanization symposium in November 2017, which included a conference, innovation competition, field visits, and a machinery fair.
iii. Inspired by the ASMC demonstrations and activities in their communities, at least two farmers have utilized government subsidy programs to purchase rice transplanters and mini-combine harvesters.

b. Appropriate Scale Mechanization Innovation Hub – Burkina Faso (ASMIH-Burkina Faso)
   i. Continuous improvements were made to the maize tillage and planting system, and training on improved tillage techniques was conducted for the farmers that will receive the systems.
   ii. A small national grant was obtained to scale up the use of the maize planter developed in previous years by the ASMC and local partners, and this initiative will help produce 20 planters, train 10 local blacksmiths, and ultimately plant 40 hectares of maize.
   iii. A partnership with ILRI (SIIL subaward leader in Burkina Faso) was formed, resulting in production and transfer of eight choppers for making silage, to be used in eight villages.

c. Appropriate Scale Mechanization Innovation Hub – Cambodia (ASMIH-Cambodia)
   i. Several prototypes developed by the ASMIH-Cambodia underwent field testing, including seeders for two- and four-wheel tractors, a no-till seeder for four-wheel tractor, and a seed broadcaster. A field demonstration of laser land leveling prototypes also took place.
   ii. Field days were held with groups of farmers currently practicing conservation agriculture (CA) as well as two private companies to discuss benefits and constraints associated with CA practices. ASMIH-Cambodia team members also hosted visitors from the University of Battambang (UBB) to discuss the principles of rice cultivation under CA as well as the development of a CA course for UBB students.

d. Appropriate Scale Mechanization Innovation Hub – Ethiopia (ASMIH-Ethiopia)
   i. ASMIH-Ethiopia team members at the Bahir Dar Institute of Technology launched a PhD program in Mechanization Engineering.
   ii. Improved maize shellers were produced and underwent testing and field demonstrations.
   iii. Short-term trainings were held on the manufacturing and promotion of the maize shellers, majipumps, and improved plowing tools, with a target audience of small enterprises and prospective entrepreneurs.

4. Research Prioritization and Subawards

a. Unlocking the production potential of "polder communities" in coastal Bangladesh
   i. Harvesting rice by machine (reaper) reduced both time and labor, with a few community members considering to buy reapers and to act as service providers. More units of the reaper will allow for more synchronized harvesting, making way for early establishment of rabi crops.
   ii. Better germination was achieved from cocoon-stored seeds in 2017, which resulted in more farmers storing even their traditional seeds in cocoons in 2018.
   iii. All farmers that grew zinc biofortified rice (BRRI dhan72) kept the grain for home consumption, indicating potential to improve household nutrition.
   iv. Gravity drainage was shown to be possible (smaller areas within the catchment) in the *aman* season. Thus, with proper drainage, improved cropping can be implemented in the polders that will increase land productivity.

b. SI integration of crop and livestock production systems in the Sahelian zone of Burkina Faso

i. Agronomic trials with improved dual-purpose sorghum and cowpea varieties in the eight project communities were completed, with grain yield, fodder yield, and nutritional quality evaluated for each treatment.
ii. Surveys on natural resource management as well as gender roles in the intensification of crop and livestock systems were conducted in the project communities.
iii. Data was collected on household nutrition and growth of children between six and 36 months during three periods: low food availability (August 2017), high food availability (November 2017), and modest food availability (March 2018). Twenty-five households were studied per community.
iv. Land use maps of the Seno and Yatenga provinces were produced. Analyses of village land endowments and wealth endowments in the project communities were also initiated.

c. Women in Agriculture Network (WAgN) Cambodia
   i. The "Wild Garden" component of the project, evaluating underutilized perennial plant species with potential economic, nutritional, and/or medicinal value, has continued with on-farm trials, market surveys, and farmer surveys.
   ii. Project leaders conducted group interviews on farms in Siem Reap and Battambang to investigate and assess the gendered division of labor and access to leadership roles, specifically related to sustainable intensification practices.
   iii. The project has readily engaged with the CE SAIN Technology Parks to provide technical training to farm managers and prepare the parks for demonstrations of SI technologies and practices.
   iv. Tomato grafting trainings and trials of market-demanded varieties have continued as part of the project's efforts to improve rainy season vegetable production.
d. Sustainably Intensified Production Systems Impact on Nutrition (SIPSIN) in Ethiopia
   i. A water use survey was conducted with over 150 households in November 2017, with a focus on gender and multi-purpose water abstraction.
   ii. The number of farmers planting irrigated forages and utilizing management approaches that increase forage and food production from the same area was increased to 217.
   iii. A second round of finger prick surveys measuring anemia and malaria in women and children (in SIPSIN households) was conducted in the rainy season. No malaria was found in the first dry season, and almost no malaria was detected during the rainy season. Slightly higher anemia levels were observed in the dry season compared to the wet season.
e. Adoption of SI in dual-purpose millet – leguminous crops – livestock systems in Senegal
   i. In addition to ongoing agronomic field trials of five dual-purpose millet varieties, new study components assessing the five accessions for root physiology and livestock feeding suitability were initiated during the reporting period.
   ii. Biochemical analysis of millet grain showed that two dual-purpose millet accessions contained higher concentrations of Zn, Mg, and Fe than the other accessions.
   iii. Focus groups were held in eight villages to understand and analyze the obstacles to adoption of the improved varieties of pearl millet. A report summarizing the results of the analysis will be completed in FY 2018 by a graduate student working on the project.
f. Raising crop response: bidirectional learning to catalyze SI at multiple scales in Tanzania
   i. The first year of agronomic nitrogen fixation and maize-legume intercrop performance trials was completed.

ii. Data was collected for a soil and socioeconomic survey to support the objective to determine soil properties and SI practices that enhance maize-bean responses to fertilizer.

iii. An analysis of the World Bank's Living Standards Measurement Study (LSMS) Tanzania survey data was completed to assess sustainable intensification adoption and nutrition impacts, and a draft report has been completed.

g. Center of Excellence on Sustainable Agricultural Intensification and Nutrition in Cambodia (CE SAIN)

i. The number and diversity of SAIN innovations showcased in the CE SAIN Technology Parks expanded. Additionally, during this reporting period, 840 people from 56 groups visited the Technology Parks.

ii. CE SAIN has introduced promising technologies from U.S. Government-funded projects and other international organizations into the Technology Parks. These partner organizations include: iDE Cambodia, IRRI, the World Vegetable Center, and four Feed the Future Innovation Labs (Sustainable Intensification, Integrated Pest Management, Livestock Systems, and Horticulture). Collaborations with two private companies have also been initiated.

iii. In regards to capacity building, the second rounds of the competitive CE SAIN research grant and scholarship programs for RUA faculty and staff were released. Six small grants were also awarded earlier in FY 2018 with the intent to promote improvement of course materials and content for RUA.

iv. CE SAIN participated in a career fair and STEM ceremony organized by the Ministry of Education Youth and Sport in Phnom Penh.

h. Precision Agriculture for Smallholder Systems in Africa

i. The project developed methods to collect ultra-high spatial resolution data in Malawi using a specialized drone and is now developing a framework for understanding the relationships among production factors and their relative importance for site-specific decision-making.

ii. A crop model is under development that will highlight return on investment for using remote sensing and farm improvement technologies. In this process, significant improvements were made to the Agricultural Production Systems sIMulator (APSIM) model.

5. Crosscutting Impacts on Gender and Nutrition

a. The SIIL subaward in Burkina Faso established pilot nutrition gardens with moringa in two provinces for women's groups, and 25 women at each location were trained in the maintenance of the nutrition garden. The subaward team also trained 245 women in best nutrition practices with a focus on child nutrition and consumption of animal-sourced foods.

b. The SIIL subaward in Cambodia completed an initial nutrient analysis of underutilized vegetables, and a manuscript highlighting the contribution of underutilized species to household nutrition is in development.

B. Issues or concerns encountered during the reporting period

The Appropriate Scale Mechanization Consortium identified a gap in their efforts to incorporate gender into their research activities. As a result, they have formed a new partnership with the Integrating Gender and Nutrition within Agricultural Extension Services (INGENAES) team at the University of Illinois. INGENAES will provide support through application of their technology assessment toolkit, which is utilized to recognize potential impacts of agricultural technologies on gender and nutrition.

II. Human and Institutional Capacity Development

A. Short-term training

Country of Training	Brief Purpose of Training	Who was Trained	Number Trained		
			M	F	Total
Bangladesh	Mechanical harvester: use of reaper for harvesting rice	Producers	105	37	142
Bangladesh	Nutritional awareness (sunflower, maize and mungbean)	Producers	3	52	55
Bangladesh	Hermetic storage – community seed bank model	Producers	35	29	64
Bangladesh	Rabi crops (sunflower, maize, mungbean and sesame) cultivation procedure	Producers	129	55	184
Bangladesh	Safe pesticide application	Producers	25	8	33
Bangladesh	Power tiller operated seeder (PTOS) - Strip tillage	Producers	60	28	88
Bangladesh	Training program on reaper and mini-combine harvester in Haldibaria, Kalapara, Patuakhali	Producers, Private Sector	11	0	11
Bangladesh	Training program on reaper and mini-combine harvester in Alamin Bazar, Shubarnochar, Noakhali	Producers, Private Sector	10	0	10
Bangladesh	Training on rice transplanter operation and maintenance at Dumuria, Khulna	Producers, Government, Civil Society	14	2	16
Bangladesh	Training on rice transplanter operation and maintenance at Kalapara, Patuakhali.	Producers, Government, Private Sector, Civil Society	17	3	20
Bangladesh	Training on seedling raising at Kalapara, Patuakhali	Producers, Civil Society	18	0	18
Bangladesh	Training on rice transplanter operation and maintenance at Wazirpur, Barisal.	Producers, Government Civil Society	16	3	19
Bangladesh	Hands on training on Soybean cultivation using CA machinery at Subornochar, Noakhali	Producers, Government, Civil Society	15	0	15
Bangladesh	Hands on training on Mungbean cultivation using CA machinery at Kalapara, Patuakhali	Producers, Government, Civil Society	15	1	16
Bangladesh	Hands on training on Mungbean cultivation using CA machinery at Mundopasa, Wazirpur, Barisal	Producers, Government, Civil Society	13	5	18
Bangladesh	Hands on training on Mungbean cultivation using CA machinery at Voroshakathi, Wazirpur, Barisal	Producers, Government, Civil Society	15	0	15
Burkina Faso	Nutrition training	Government	9	6	15
Burkina Faso	Best nutrition practices, Seno province	Producers	20	104	124
Burkina Faso	Best nutrition practices, Yatenga province	Producers	20	101	121
Burkina Faso	Training of women on nutrition gardens, Bani	Producers	0	25	25
Burkina Faso	Training of women on nutrition gardens, Tougou	Producers	0	25	25
Burkina Faso	Training of making rippers and use of planter and rippers by farmers	Producers, Private Sector	10	4	14
Cambodia	Unmanned aerial systems field training	Civil Society	12	5	17
Cambodia	High school gardens teacher training	Government, Civil Society	30	7	37
Cambodia	Tomato grafting for improved disease resistance	Civil Society	38	17	55

Country of Training	Brief Purpose of Training	Who was Trained	Number Trained		
			M	F	Total
Cambodia	Diversifying agricultural systems for improved nutrition and income	Producers, Government, Civil Society	25	36	61
Cambodia, Thailand	ECHO Asia - CE SAIN farm manager training	Producers, Private Sector, Civil Society	19	3	22
Ethiopia	Demonstration and participatory evaluation of engine driven maize sheller with farmers	Producers, Government	344	81	425
Ethiopia	Gender mainstreaming and the roles of agricultural mechanization for gender equality	Producers, Government	59	40	99
Ethiopia	Manufacturing of motorized maize sheller for local manufacturers	Producers, Government	21	0	21
Ethiopia	Entrepreneurship Training	Private Sector	9	13	22
Myanmar	Myanmar seed saving workshop	Producers, Private Sector, Civil Society	44	29	73
Senegal	Field day with farmers to visit, evaluate and learn how to intensify the cultivation of pearl millet varieties	Producers, Government, Private Sector	20	15	35
Senegal	Training on the development of nutritious infant foods	Producers, Government, Private Sector	2	22	24
Senegal	Training in root phenotyping	Civil Society	7	7	14
Senegal	UAV and data collection training	Civil Society	17	4	21
Senegal	Creating Enabling Environments to Enhance Innovation Adoption	Civil Society	22	15	37
			1229	**782**	**2011**

B. Long-term training*

Name	Sex	University	Degree	Major	Program End Date (month/year)	Degree Granted (Y/N)	Home Country
Nasiba Aktar	F	Bangladesh Agriculture University	Ph.D.	Gender Research (Women's Engagement)	April 2017	N	Bangladesh
Monoj Biswas	M	Khulna University	M.S.	Agricultural Economics	September 2017	N	Bangladesh
Priyanka Saha	F	Khulna University	M.S.	Agriculture Economics	September 2017	N	Bangladesh
Boureima Sayaogo	M	Institute of Rural Development/Polytechnic University of Bobo-Dioulasso	M.S.	Agriculture Engineering	December 2017	N	Burkina Faso
Feleke Kuraz	M	Bahir Dar University	Ph.D.	Water Resources Management	January 2018	N	United States
Shakhawat Hossain	M	Sher-e-Bangla Agricultural University	M.S.	Agronomy	January 2018	Y	Bangladesh
Puja Roy	F	Khulna University	M.S.	Agricultural Economics	February 2018	N	Bangladesh
Sujat Ahmed	M	Sher-e-Bangla Agricultural University	M.S.	Agronomy	February 2018	N	Bangladesh
Deb Nath	M	Bangladesh Agricultural University	Ph.D.	Water Governance	February 2018	N	Bangladesh
Nibir Shah	M	Patuakhali Science and Technology University	Ph.D.	Agronomy	March 2018	Y	Bangladesh
Victor Ye	M	Institute of Rural Development/Polytechnic University of Bobo-Dioulasso; University Nazi Boni	M.S.	Agriculture Engineering	June 2018	N	Burkina Faso
Fatoumata Ganou	F	Institute of Rural Development/Polytechnic University of Bobo-Dioulasso	M.S.	Agriculture Engineering	July 2018	N	Burkina Faso
Awa Faye	F	Cheikh Anta Diop University	Ph.D.	Agronomy	November 2018	N	Senegal
Mohammed Rokonuzzaman	M	Bangladesh AgriculturalUniversity	Ph.D.	Agriculture Extension	February 2019	N	Bangladesh
Jayanta Bhattacharya	M	Patuakhali Science and Technology University, Patuakhali	Ph.D.	Agronomy	February 2019	N	Bangladesh
Marie-Thérèse Mofini	F	University of Thies	Ph.D.	Agronomy	March 2019	N	Central African Republic
Md. Mahamudun Noby	M	Bangladesh Agricultural University	M.S.	Farm Power and Machinery	September 2019	N	Bangladesh
Tadisual Asamin	M	Bahir Dar University	M.S.	Engineering Hydrology	October 2019	N	Ethiopia

Name	Sex	University	Degree	Major	Program End Date (month/year)	Degree Granted (Y/N)	Home Country
Chantha Thay	M	University of Battambang	M.S.	Horticulture	August 2020	N	Cambodia
Md. Abdul Motalib	M	Bangladesh Agricultural Research Institute	Ph.D.	Agricultural Engineering	September 2020	N	Bangladesh

* Table includes new or revised long-term training since the FY 2017 Annual Report

III. Future Work

A. An initial version of the Sustainable Intensification (SI) Assessment Framework web tool will be developed by the end of FY 2018. The purpose of the web tool will be to facilitate greater access and usability of the framework for the SI research community. The tool will be showcased at several venues, including the American Society of Agronomy – Crop Science Society of America – Soil Science Society of American Conference in November 2018.

B. The SIIL, Peace Corps Senegal, and the Institut Sénégalais de Recherches Agricoles (ISRA) co-developed a knowledge sharing platform to work collaboratively on understanding barriers of adoption and potential solutions within the Senegalese agriculture system. The intent is to strengthen the linkages between research for development and project implementation at the local level. This past December, a Memorandum of Understanding (MOU) was developed and finalized outlying how each partner will play a vital role in supporting the work of the other. In addition, the first pilot training was held in Thies, Senegal with 37 attendees (5 Team Leaders, 23 Peace Corps Volunteers, 4 Peace Corps technical staff members, and 5 ISRA students). Additional trainings will be held in the next two quarters, and pilot research projects with ISRA and Peace Corps Senegal will be initiated with guidance from SIIL.

C. The SIIL will highlight its youth engagement activities at the World Food Prize Borlaug Dialogue in October 2018. The side event will include a panel of youth members from its projects in Cambodia and Senegal. The event will focus on the youth sharing transformational events that have influenced their decisions to work in agriculture or agricultural related professions. The panel will also provide insights on how best to recruit, retain, and sustain youth in agricultural professions, and why their involvement is so critical in solving our global challenges related to food security and improved livelihoods.

D. The final cohort of graduate students (4 MS and 4 PhD) will recruited and launched by the CE SAIN and Royal University of Agriculture.

E. The SIIL and CE SAIN team will be closely working with USAID on engaging multiple partners (other international donor, private sector, Department of Agricultural Engineering of the Ministry of Agriculture, Food and Fisheries (MAFF), and Center for Sustainable Agricultural Machinery) in Cambodia on pathways for enhancing use of agricultural machinery in Cambodia.