

Feed the Future Innovation Lab for Collaborative Research on Sustainable Intensification Annual Performance Report FY 2016



Feed the Future Innovation Lab for Collaborative Research on Sustainable Intensification

Annual Performance Report FY 2016

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Table of Contents

Feed the Future Sustainable Intensification Innovation Lab	6
A. Management Entity Information	6
B. External Advisory Board	10
C. Focus Countries	12
D. List of Program Partners	13
E. Acronyms.....	15
I. Executive Summary.....	17
II. SIIL Program Activities and Highlights:	18
A. Geospatial and Farming Systems Research Consortium (GFC)	18
B. Appropriate Scale Mechanization Consortium (ASMC).....	18
C. Integrated Research Subawards Portfolio.....	18
D. Center of Excellence on Sustainable Agricultural Intensification and Nutrition (CE SAIN).....	18
E. Communication, Knowledge Sharing, and Capacity Building	18
F. Sustainable Intensification Indicators Framework	18
III. SIIL Key Accomplishments.....	19
A. Awarded Six Research Subaward Contracts.....	19
B. Established the Center of Excellence on Sustainable Agricultural Intensification and Nutrition (CE SAIN) in Cambodia	19
C. Invited to Join CAADP Technical Networks	19
D. U.S. Ambassador Visited SIIL Research Sites in Burkina Faso.....	19
IV. Research Program Overview and Structure	20
A. The Geospatial and Farming Systems Research Consortium (GFC).....	20
B. The Appropriate Scale Mechanization Consortium (ASMC)	20
C. Focus Country Research Subawards.....	20
D. Developing Indicators for Sustainable Intensification.....	20
V. Research Project Reports.....	21
A. Geospatial and Farming Systems Research Consortium	21
1. Summary of GFC activities	21
2. GFC Subaward I	22
3. GFC Subaward II	23
4. GFC Subaward III.....	24
5. GFC Subaward IV	25
B. Appropriate Scale Mechanization Consortium (ASMC).....	26
1. Summary of ASMC Activities.....	26
2. ASMC - Bangladesh	27
3. ASMC – Burkina Faso	28
4. ASMC - Cambodia.....	29

	4
5. ASMC - Ethiopia.....	30
C. Focus Country Research Subawards.....	31
1. Bangladesh	31
2. Burkina Faso.....	32
3. Cambodia.....	33
4. Ethiopia.....	34
5. Senegal.....	35
6. Tanzania.....	36
D. Developing Indicators for Sustainable Intensifications	37
VI. Associate Award Research Project Reports	38
VII. Human and Institutional Capacity Development.....	39
A. Short-term training.....	39
B. Long-term training.....	39
C. Institutional Development.....	40
VIII. Innovation Transfer and Scaling Partnerships	41
A. Description of Innovation	41
1. Steps taken	41
2. Partnerships.....	41
3. Technologies Ready to Scale.....	41
B. Description of Innovation	41
1. Steps taken	41
2. Partnerships.....	41
3. Technologies Ready to Scale.....	41
IX. Environmental Management and Mitigation Plan (EMMP)	42
X. Open Data Management Plan.....	42
XI. Governance and Management Entity Information.....	43
A. Engagement of External Advisory Board (EAB).....	43
B. Strengthening Relationships with Partners	43
C. Regional and Country Coordinator Activity	43
D. Continued Expansion of Reporting Hub Tools	43
E. Growth of SIIL Communication Platforms	43
XII. Other Topics.....	44
A. Center of Excellence on Sustainable Agricultural Intensification and Nutrition (CE SAIN) at the Royal University of Agriculture.....	44
1. Goal.....	44
2. Key activities	44
XIII. Issues	46

XIV. Future Directions..... 47

- A. Pursue Collaboration with the Feed the Future Innovation Labs 47
- B. Organize Regional Summits..... 47
- C. Implementation of the SI Indicator Framework 47

Appendix A List of Awards Given to U.S. Universities.....48

Appendix B Success Stories.....50



Feed the Future Sustainable Intensification Innovation Lab

A. Management Entity Information

The Feed the Future Innovation Lab for Collaborative Research on Sustainable Intensification (SIIIL) is housed at Kansas State University in Manhattan, KS. The SIIIL Management Entity (ME) experienced significant growth in FY 2016 with three new staff members: Dr. B. Jan Middendorf, Associate Director, Dr. Manuel Reyes, Research Professor and Dr. Zachary Stewart, Research Associate. The new staff additions enhance support to SIIIL's activities in Senegal, Burkina Faso, Tanzania, Ethiopia, Bangladesh and Cambodia.

The ME staff includes the following individuals:



Dr. Vara Prasad - Director

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Vara Prasad, University Distinguished Professor of Crop Ecophysiology, serves as the Program Director of SIIIL. He earned his B.S. and M.S. in agronomy from Andhra Pradesh Agricultural University in India, and his Ph.D. in crop physiology from The University of Reading in England. He has extensive international experience in both Africa and Asia, and has had significant involvement with several USAID projects in these regions. His research focuses on understanding the response of food-grain crops to changing environments and management practices; developing strategies for management of crops, soil, water and nutrients for the efficient use of resources; and using farming-system approaches to provide food and nutritional security to smallholder farmers. Prasad provides leadership to SIIIL and oversees all of the research, capacity building, knowledge sharing and communication activities of the program. He administers technical and financial aspects of SIIIL and serves as the primary contact for donors, advisory groups and partner organizations.



Dr. B. Jan Middendorf - Associate Director

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Phone: 1.785.532.3480

B. Jan Middendorf serves as the SIIIL Associate Director. She earned her B.S. in business administration at the University of Rhode Island, her M.S. in international affairs at Ohio University and her Ph.D. in curriculum and instruction and evaluation practice at Kansas State University. Her primary interests are institutional and program improvement through strategic planning, change management and evaluation. She has over 25 years of experience in project development, management, implementation and evaluation of multi-institutional, interdisciplinary programs and projects in national and international settings. As Associate Director, Middendorf serves as the administrative officer alongside the Program Director and oversees the Management Entity (ME) in organizing activities to facilitate technical and administrative goals of the SIIIL program. She conducts research and lead SIIIL's impact assessment, monitoring and evaluation efforts. She is responsible for establishing and maintaining effective partnerships with other U.S. and international institutions, industry, USAID Missions and developmental partners.



Dr. Manny Reyes – Research Professor

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Phone: 1.919.475.7763

Manuel Reyes, research professor, has more than 30 years of experience working with water quality modeling, natural resources management and conservation agriculture. He is an agroecological engineer, designing food production systems that mimic nature. Reyes has extensive expertise across the globe in research, extension, teaching and project implementation. Reyes will focus his efforts in Cambodia working with the Royal University of Agriculture and University of Battambang to enhance human and institutional capacity to conduct research and training of scholars and youth. He will facilitate partnerships with other Feed the Future Innovation Labs, international organizations and private industry in Cambodia.



Dr. Jessie Vipham – Assistant Professor

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Phone: 1.785.532.4386

Jessie Vipham is a Food Microbiologist by training, and serves as the SIIL faculty hire in Global Food Systems and Nutrition. She holds a B.S. in Agriculture Business from Kansas State University, as well as an M.S. and Ph.D. in Animal Science from Texas Tech University. While at Texas Tech, Jessie was involved with faculty members of the International Center for Food Industry Excellence (ICFIE). She is experienced in international food security research, and has spent a significant amount of time strengthening food systems in Latin America.



Dr. Zachary Stewart – Research Associate

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Zach Stewart serves as the SIIL Research Associate. He earned his M.S. in Control of Infectious Diseases from the London School of Hygiene and Tropical Medicine and his Ph.D. in Agronomy from the University of Nebraska-Lincoln. He has done extensive research on crop physiology and production as well as worked with smallholder farmers in East Africa on agronomic and human health topics. The 2008 recipient of the John Chrystal Award from the World Food Prize Foundation, Zach has been able to use his multidisciplinary background to advance agricultural production while keeping in mind the well-being of those impacted. As part of the SIIL management entity, Zach leads knowledge management and sharing efforts and conducts research related to global food and nutrition security for smallholder farmers.



Molly McKneight – Program Coordinator

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Phone: 1.785.532.3586

Molly McKneight serves as the SILL Program Coordinator. She supports the development of subcontract awards, research project monitoring, knowledge management, and oversight of the reporting and information platform. She holds a B.S. in Food Science and an M.S. in Plant Breeding and Genetics from Purdue University. Molly has experience collaborating with international partners in Turkey, Senegal, and Haiti and has also worked for Purdue's Center for Global Food Security.



Katy Bach – Business Manager

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Katy Bach serves as the Business Manager for SILL. She is responsible for all components of financial management, post-award accounting, procurement, travel planning, and business management of the Innovation Lab. Katy holds a B.S. in Business Administration and is licensed as a Certified Public Accountant. Prior to joining the SILL team, she worked with Kansas State University Athletics and numerous small businesses in their accounting departments.



Jovin Lwehabura – Regional Coordinator, East Africa

Email: j.lwehabura@cgiar.org

Mr. Jovin Lwehabura has more than 10 years of experience working on applications of geospatial science & technology in sustainable management of natural resources. He holds an M.S. degree in Geographic Information Systems (MS GIS) from the University of Redlands, California as well as a B.S. in Geomatics from the University of Dar es Salaam. Mr. Lwehabura is a member of Global society for Conservation Geographic Information Systems (SCGIS). He has developed several GIS Databases, guide mapping and support implementations of land use planning for more than 50 local communities in Tanzania. Mr. Lwehabura currently works for the International Center for Tropical Agriculture (CIAT) under the Sustainable Intensification Innovation Lab. He is the SILL's Coordinator in East Africa and lives in Arusha, Tanzania.



Shahida Sarker Parul – Regional Coordinator, Asia

Email: S.PARUL@cgiar.org

Shahida Sarker Parul has approximately three decades working experience with Bangladesh Rice Research Institute and Food and Agriculture Organization of the United Nations. Her working area is adaptive research and technology transfer in the field of agriculture. She has worked in Bangladesh, Philippines, India, Nepal, Solomon Islands and Fiji. She holds an MS in Natural Resource Management and Sustainable Agriculture from the Agricultural University of Norway and a Ph.D. in Agronomy from Bangladesh Agricultural University. She has published 36 research articles in different scientific journals on crops, social sciences and gender, and she has also developed several training materials and modules related to crop, livestock, aquaculture, nutrition and beneficiary selection procedure. Parul is currently working for International Maize and Wheat Improvement Center (CIMMYT) under the Sustainable Intensification Innovation Lab. She is the SIIL's Coordinator in Asia and lives in Dhaka, Bangladesh.



Aliou Faye – Country Coordinator, Senegal

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Aliou Faye has two decades of research experience with the Senegalese Agricultural Research Institute (ISRA), the French Institute of Research for Development and the International Centre for Cooperation in Agricultural Development (CIRAD). Faye worked also for 5 years as Chief of Agency of a Saudi group dealing with non-timber forest products in the Tambacounda and Louga regions of Senegal. Faye holds a B.S. in Tropical Forestry, a M.S. in Agronomy, and a Ph.D. in Plant Biology from the Cheikh Anta Diop University of Dakar with field experience at the Tropical Soil Biology and Fertility (CIAT) in Nairobi Kenya. Faye has published at least 20 research articles in different scientific journals. Dr. Faye is currently the head of the Soil-Water and Plant Laboratory of the Centre National de la Recherche Agronomique (CNRA) of ISRA in Bambey, Senegal and serves as the Country Coordinator of the SIIL in Senegal.



Michael Lee – Communications Assistant

Email: mrlee11@ksu.edu

Michael Lee is a senior at Kansas State University majoring in Animal Science Communications with a minor in Leadership Studies planning to graduate in December of 2016. He helps the lab with editing publications, social media management and other communication-related tasks. After graduation, Michael plans to continue to support the efforts of Feed the Future and Innovation Labs like SIIL.

B. External Advisory Board

The External Advisory Board (EAB) is chaired by Jules Pretty. In FY 2016, the EAB was actively engaged in evaluating the proposals for focus country research subawards and was responsible for making final decisions on project selection.



Professor Jules Pretty – Chair

University of Essex

Dr. Jules Pretty is Deputy Vice-Chancellor at the University of Essex, and Professor of Environment and Society. His 18 books include *This Luminous Coast* (2011), *Nature and Culture* (2010), *The Earth Only Endures* (2007), and *Agri-Culture* (2002). He is a Fellow of the Society of Biology and the Royal Society of Arts, former Deputy-Chair of the government's Advisory Committee on Releases to the Environment, and has served on advisory committees for a number of government departments and research councils.

He was a member of two Royal Society working groups that published *Reaping the Benefits* (2009) and *People and the Planet* (2012), and was a member of the UK government Foresight project on *Global Food and Farming Futures* (2011). He is the founding Chief Editor of the *International Journal of Agricultural Sustainability*. He received an OBE in 2006 for services to sustainable agriculture, and an honorary degree from Ohio State University in 2009. More details can be found at www.julespretty.com.



Dr. John Dixon

Australian Centre for International Agricultural Research

John Dixon is the Principal Advisor/Research Program Manager for the Cropping Systems and Economics program. The program aims to improve food security through enhanced productivity and sustainability of field crop farming systems using collaborative R&D partnerships for biophysical and economic research and development.

Dr. Dixon has over 30 years developing country experience with agricultural research and development, including cropping systems, economics and natural resource management in South, South-east and East Asia, Africa, Latin America and the Middle East, working for the CGIAR system and the FAO. He has served as Director, Impacts, Targeting and Assessment at CIMMYT, leading activities on impact assessment, value chains, impact knowledge sharing, systems agronomy and conservation agriculture; and also in various capacities with FAO in their global, regional and country programs. Dr. Dixon is a graduate from the University of New England with a Ph.D. (agricultural economics), Masters (natural resources), Masters (economics) and Bachelor in Rural Science.



Dr. Cornelia Flora

Iowa State University

Dr. Cornelia Flora is an Emeritus Distinguished Professor in the Department of Sociology at Iowa State University. Her research interests include international and domestic development, community, and the sociology of science and technology, particularly as related to agriculture and participatory change. Socio-technical regime changes and capitals transformations (natural, cultural, human, social, political and financial/built capitals) guide her current research includes work on the community development, sustainable agriculture and natural resource management, with particular attention to how class, gender, and ethnicity influence and are influenced by technology and policy.



Dr. Jemimah Njuki

Canada's International Development Research Center (IDRC)

Dr. Jemimah Njuki has fifteen years of experience overseeing gender-responsive and women-targeted research and development projects that link women smallholder farmers to markets, integrate gender in cooperatives, apply participatory gender-responsive research, and more. As senior program officer at the International Development Research Centre (IDRC), she manages the Cultivate Africa's Future program.



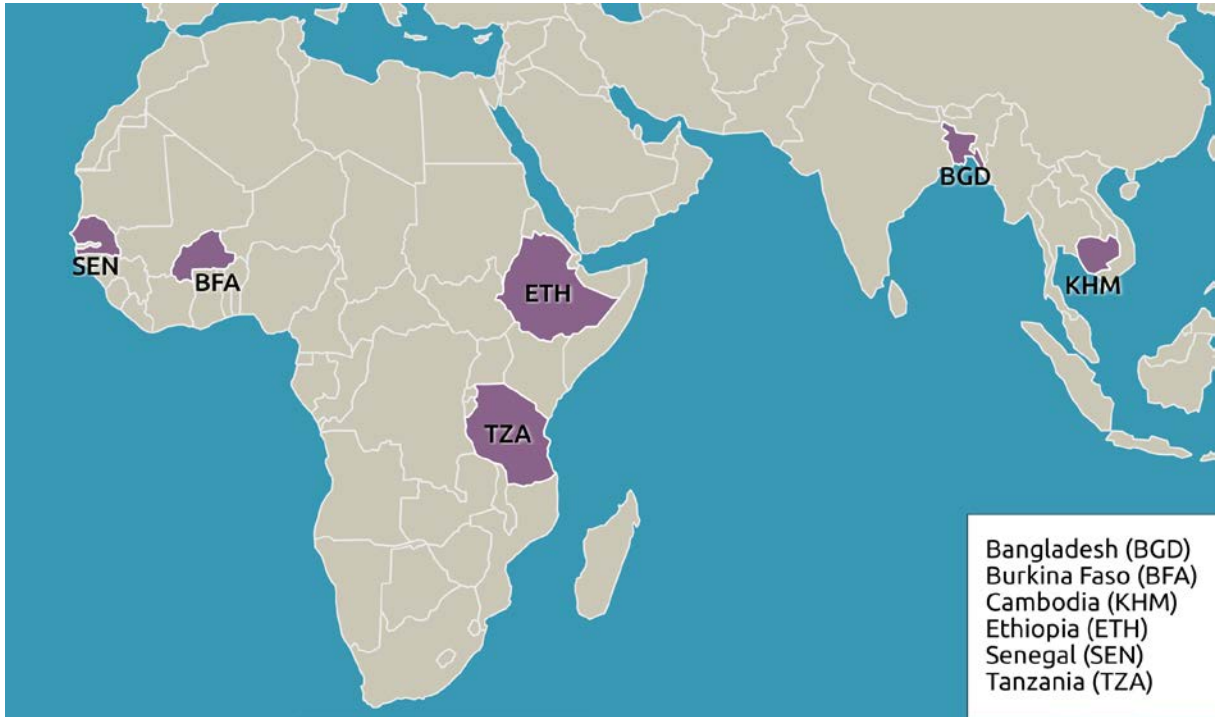
Dr. Peter Thorne

International Livestock Research Institute (ILRI)

Dr. Peter Thorne coordinates the Africa RISING project in the Ethiopian Highlands. He completed his Ph.D. at the University of Nottingham in animal nutrition, with a part of his research conducted at the University of the Philippines in Los Banos. His career has allowed him to work in both public and private sectors, focusing largely on the evolution of mixed farming systems in Africa and Asia. Prior to joining ILRI, Dr. Thorne was responsible for the national dairy benchmarking service in Britain.

C. Focus Countries

The Feed the Future Innovation Lab for Collaborative Research on Sustainable Intensification works in West Africa, East Africa and Asia. The six focus countries are listed and shown below.



D. List of Program Partners

United States

ADM Institute for the Prevention of Postharvest Loss
 Africa Soil Information Service (at the Earth Institute – Columbia University)
 Columbia University
 Feed the Future Innovation Lab for Collaborative Research on Nutrition in Africa
 Feed the Future Horticulture Innovation Lab
 Feed the Future Innovation Lab for the Reduction of Postharvest Loss
 Feed the Future Innovation Lab for Small Scale Irrigation
 Kansas State University
 Michigan State University
 North Carolina A&T State University
 Pennsylvania State University
 Quantitative Engineering Design, Inc.
 Stanford University
 Texas A&M University
 Tillers International
 University of California, Davis
 University of Illinois at Urbana-Champaign
 University of Maryland
 University of Tennessee Institute of Agriculture
 University of Wisconsin – Madison

Bangladesh

ACI Motors Limited
 International Rice Research Institute (IRRI)
 BRAC (Building Resources Across Communities) - Bangladesh
 Khulna University
 International Maize and Wheat Improvement Center (CIMMYT)

Burkina Faso

International Livestock Research Institute (ILRI)
 Institut de l'Environnement et de Recherches Agricoles (INERA)
 The International Union for Conservation of Nature (IUCN)
 La Federation Nationale des Groupements Naam (FNGN)
 Association pour la Promotion de l'Elevage en Savane et au Sahel (APESS)
 Polytechnic University of Bobo-Dioulasso

Cambodia

Agricultural Development Denmark Asia
 AVRDC – World Vegetable Center
 ECHO Asia
 Kasetsart University
 Royal University of Agriculture - Phnom Penh
 Conservation Agriculture Service Center
 University of Battambang

Ethiopia

Bahir Dar University
 International Water Management Institute (IWMI)
 International Food Policy Research Institute (IFPRI)

Africa Research in Sustainable Intensification for the Next Generation (Africa RISING)
 Livestock and Irrigation Value Chains for Ethiopian Smallholders (LIVES)
 International Livestock Research Institute (ILRI)

Senegal

Institut Senegalais de Recherches Agricoles (ISRA) – Centre National de Recherches Agronomiques de Bambeby (CNRA – Bambeby)
 University of Thies – College of Agriculture
 Institut de Technologie Alimentaire (ITA)
 Agence Nationale de Conseil Agricole et Rural (ANCAR)
 Réseau des Organisations Paysannes et Pastorales du Senegal (RESOPP)
 Institut de Recherche Pour le Développement (IRD)
 French Agricultural Research Center (CIRAD)

Tanzania

Sokoine University of Agriculture (SUA)
 Wageningen University and Research Center
 International Center for Tropical Agriculture (CIAT)
 Nelson Mandela African Institution of Science and Technology (NM-AIST)
 International Institute of Tropical Agriculture (IITA)
 Africa Research in Sustainable Intensification for the Next Generation (Africa – RISING)

E. Acronyms

ACIAR – Australian Centre for International Agricultural Research
 ADDA – Agricultural Development Denmark Asia
 ADS – Automated Directives System
 Africa RISING – Africa Research in Sustainable Intensification for the Next Generation
 AGRA – Alliance for a Green Revolution in Africa
 ANCAR - Agence Nationale de Conseil Agricole et Rural
 AOR – Agreement Officer’s Representative
 APESS - Association pour la Promotion de l’Elevage en Savane et au Sahel
 ASM – Appropriate scale mechanization
 ASMC – Appropriate Scale Mechanization Consortium
 AUC – African Union Commission
 AWP – Annual Work Plan
 BiT – Bahir Dar Institute of Technology
 CAADP – Comprehensive African Agriculture and Development Programme
 CASC – Conservation Agriculture Service Center
 CE SAIN – Center of Excellence on Sustainable Agricultural Intensification and Nutrition
 CGIAR – Consultative Group on International Agricultural Research
 CIAT – International Center for Tropical Agriculture
 CIMMYT – International Maize and Wheat Improvement Center
 CIRAD - Centre de Coopération Internationale en Recherche Agronomique pour le Développement
 CSA – Climate smart agriculture
 CSIRO - Commonwealth Scientific and Industrial Research Organisation
 EAB – External Advisory Board
 EMMP – Environmental Management and Mitigation Plan
 FAO – Food and Agriculture Organization
 FNGN - La Federation Nationale des Groupements Naam
 FTFMS – Feed the Future Monitoring System
 FY – Fiscal year
 GFC – Geospatial and Farming Systems Research Consortium
 ICRIAT – International Crops Research Institute for the Semi-Arid Tropics
 IDRC – International Development Research Centre
 IFPRI – International Food Policy Research Institute
 IITA - International Institute of Tropical Agriculture
 IL – Innovation Lab
 ILRI – International Livestock Research Institute
 ILSSI – Innovation Lab for Small Scale Irrigation
 INERA – Institut de l’Environnement et de Recherches Agricoles de Burkina Faso
 IRD - Institut de Recherche Pour le Developpement
 IRRI – International Rice Research Institute
 ISRA – Institut Senegalais de Recherches Agricoles
 ITA - Institut de Technologie Alimentaire
 IUCN - International Union for Conservation of Nature
 IWMI – International Water Management Institute
 HH – Household
 LIVES - Livestock and Irrigation Value Chains for Ethiopian Smallholders
 LSMS-ISA – Living Standards Measurement Study – Integrated Surveys on Agriculture
 ME – Management entity
 MSU – Michigan State University
 NARS – National Agricultural Research Systems
 NGO – Nongovernmental organization

NM-AIST - Nelson Mandela African Institution of Science and Technology
OMT – Organic-matter technologies
PI – Principal investigator
PMP – Plan for Monitoring Performance
RC – Regional (or country) coordinator
RESOPP - Réseau des Organisations Paysannes et Pastorales du Senegal
RUA – Royal University of Agriculture
SI – Sustainable intensification
SIIL – Sustainable Intensification Innovation Lab
SIPS – Sustainably intensified production systems
SOC – Soil-organic carbon
SUA - Sokoine University of Agriculture
UPB – Polytechnic University of Bobo-Dioulasso
USAID – United States Agency for International Development
WAgN – Women in Agriculture Network
WLE – Water land ecosystem
ZOI – Zones of Influence

I. Executive Summary

At the end of FY 2016, the Feed the Future Innovation Lab for Collaborative Research on Sustainable Intensification, (SIIL) completed its second year of its current five-year award. The SIIL focuses on integrated farming systems research and technologies to sustainably increase agricultural productivity and income that provides food and nutritional security to smallholder farmers in the focus countries of Bangladesh, Cambodia, Burkina Faso, Senegal, Ethiopia and Tanzania. The four main objectives are: 1) using geospatial tools to identify sustainable intensification (SI) needs, opportunities for intervention, scaling and assessing impact; 2) improving nutrition using integrated and environmentally sustainable technologies (nutrition-sensitive agriculture); 3) identifying enabling conditions and social networks to support and enhance SI; and 4) developing platforms for communication, knowledge sharing and capacity building. To achieve these objectives, the SIIL supports the integrated research and capacity building portfolios of six subawards, along with the Geospatial and Farming Systems Research Consortium (GFC), and the Appropriate Scale Mechanization Consortium (ASMC). Additional initiatives include continued development of the SI Indicator Framework and the newly established Center of Excellence on Sustainable Agricultural Intensification and Nutrition (CE SAIN) in Cambodia.

For the purposes of this annual report, the SIIL has identified four key accomplishments during FY 2016. The first includes finalizing the contracts for the six research subawards to support the vision of the SIIL to become a world leader in interdisciplinary research, knowledge-sharing and capacity building of SI with measurable impacts on reducing global hunger and poverty and improving nutrition of smallholder farmers. Specific outputs thus far from the funded SIIL initiatives including the GFC, the ASMC and the six research subawards represent 23 presentations, 10 short-term trainings that served 684 participants (70 percent male and 30 percent female), and five students (20 percent male and 80 percent female) accepted into Ph.D. programs for long-term training.

A second key accomplishment is the establishment of the CE SAIN in Cambodia. This SIIL initiative was collaboratively developed with the Royal University of Agriculture (RUA), the USAID Mission in Cambodia and other key stakeholders and partners invited to share detailed knowledge about the need for research and priority areas related to SI in Cambodia and CE SAIN. The project includes coordinating and leveraging ILs and other SAIN activities; building human and institutional capacity of the RUA; and establishing five technology parks to showcase high-potential technologies and strategies to sustainably intensify smallholder farming systems and encourage interaction between the private sector, researchers and farmers.

The third key accomplishment is the engagement with the African Union Commission by accepting the invitation to join the *Research and Extension and Knowledge Management, Policy Analysis and Accountability for Results* Technical Networks led by the Comprehensive African Agriculture and Development Programme (CAADP). The linkage between CAADP and SIIL is a critical partnership to ensure the alignment of the SIIL's current and future efforts with the objectives of the African Union and African organizations pursuing similar activities. The alignment of SIIL activities with country-led priorities is critical to the sustainability and long-term transfer of new Feed the Future IL innovations to farmers and end users. Without focus on country-led priorities and partnership with established African institutions, the successful delivery of new innovations after project end is often limited. Therefore, the SIIL recognizes this partnership as a key element for the sustainability of this IL's work and relationships developed throughout the life of the project.

The fourth highlight includes the visit from the U.S. Ambassador to Burkina Faso, **H. E. Tulinabo S. Mushingi**, to one of SIIL's research sites led by Dr. Augustine Ayantunde from ILRI. The event was attended by more than 300 people and showcased potential for the intensification of crop-livestock systems to facilitate farmer learning and adoption of intensification options. A positive outcome from the visit was the raised awareness of the Feed the Future research activities and the support and encouragement from the Ambassador Mushingi by highlighting the importance of sustainable agricultural intensification and the need to promote it to enhance food security.

These are just a few highlights of the progress achieved during this reporting period. This annual report provides additional details related to the individual project descriptions, collaborators, achievements, capacity building efforts, lessons learned and presentation outputs. In summary, SIIL continues to make progress towards the objectives set in each of the GFC, ASMC, and the six research subawards, as well as the SI Indicator Framework project and the newly established CE SAIN initiative.

II. SIIL Program Activities and Highlights:

A. Geospatial and Farming Systems Research Consortium (GFC)

Four subaward contracts were funded by the GFC to support the consortium's objectives. High-resolution global climate data was developed and a new website was released that contains tutorials focused on utilizing the **R programming** language for geospatial data exploration, analysis and visualization. An **R** package to support integrated study and analysis of agriculture, nutrition and health data has been developed. The GFC also conducted a short-term training for 41 participants in Arusha, Tanzania.

B. Appropriate Scale Mechanization Consortium (ASMC)

Highlights from the ASMC activities are as follows: Innovation Hubs have been established in Bangladesh, Burkina Faso, Cambodia and Ethiopia and are in the process of developing field hubs and demonstration plots for training and outreach programs. Two-day workshops were held at in-country partner universities with key stakeholders and baseline surveys were conducted. Field visits were conducted to interact with farmers to capture ASM opportunities related to food production systems.

C. Integrated Research Subawards Portfolio

In December 2015, the SIIL management entity, in collaboration with its External Advisory Board and the Geospatial and Farming Systems Research Consortium, selected and funded six research subawards. Activities and highlights from these subawards during FY 2016 include:

- **Bangladesh** – 218 farmers (20 percent women) are growing high-yielding varieties of rice in four villages; successfully demonstrated the mat bed nursery and mechanical transplanting of rice; and selected four M.S. and one Ph.D. student out of 20 applicants to engage in adaptive research in the coastal zone.
- **Burkina Faso** – Baseline survey of 400 households was completed; project launch was held with project partners, USAID Burkina Faso officials and key stakeholders; and U.S. Ambassador visited research sites.
- **Cambodia** – Joint baseline survey with the SIIL ASMC conducted in three provinces; recruited one local to pursue Ph.D. at Penn State University; and identified existing and potential SI technologies and practices for rice-horticulture production in limited resource settings.
- **Ethiopia** – Joint planning and coordination with ASMC was achieved with explicit linkages to the ILSSI; and household survey instruments were developed to obtain human subject approval at the regional level.
- **Senegal** – Five Ph.D. students were recruited for this project; three on-station field trials using dual-purpose pearl millet were initiated; and IRD and CIRAD started field research in Dakar and Bambey.
- **Tanzania** – Technical expertise to support the measurement of biological nitrogen fixation and soil organic carbon on research trials evaluating maize and legumes are underway.

D. Center of Excellence on Sustainable Agricultural Intensification and Nutrition (CE SAIN)

The CE SAIN in Cambodia was developed and established in collaboration with the SIIL, Royal University of Agriculture (RUA) and the USAID Mission in Cambodia. The project includes coordinating and leveraging ILs and other SAIN activities; building human and institutional capacity of the RUA; and establishing five technology parks to showcase high-potential technologies and strategies to sustainably intensify smallholder farming systems and encourage interaction between the private sector, researchers and farmers.

E. Communication, Knowledge Sharing, and Capacity Building

The SIIL has engaged with CGSpace to disseminate agricultural research outputs and results. This will allow the SIIL to improve its knowledge sharing efforts and reach a broader group of stakeholders. The SIIL has also joined select Technical Networks, which will promote program sustainability and long-term transfer of new Feed the Future Innovation Lab innovations to farmers and end users.

F. Sustainable Intensification Indicators Framework

During FY 2016, the "Developing Indicators for SI" team conducted in-depth interviews with over 33 researchers, conducted site visits in four countries and administered an online survey of 48 scientists to further refine the framework. A training manual has been developed in preparation for training and identification of appropriate indicators for the SIIL subawards in FY 2017.

III. SIIL Key Accomplishments

Key accomplishments outlined in this section are identified in the FY 2016 SIIL annual work plan and Performance Management Plan and are aligned with the project objectives. Explicit linkages between the FY 2016 Annual Work Plan (AWP) and SIIL achievements are made in Section V – Research Progress Reports.

A. Awarded Six Research Subaward Contracts

In December 2015, the SIIL ME, in collaboration with its External Advisory Board and the Geospatial and Farming Systems Research Consortium (GFC), selected and funded six research subawards that represent a balanced portfolio that spans the six focus countries and directly support SIIL's four objectives. The progress during FY 2016 was primarily focused on planning meetings, project launching and completion of the subaward contracts at both the management entity and subaward institution level.

Specific outputs from the funded SIIL initiatives that include the ME, the GFC, the ASMC and the six research subawards represent 23 presentations, 10 short-term trainings that served 684 participants (70 percent male and 30 percent female), and five students (20 percent male and 80 percent female) accepted into Ph.D. programs for long-term training.

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

The proposal was developed by SIIL, in collaboration with the Royal University of Agriculture (RUA) and the USAID Mission in Cambodia, and based on input from key stakeholders and partners invited to share detailed knowledge about the need for research and priority areas related to SI in Cambodia and CE SAIN. The ceremonially launch and signing of the memorandum of understanding to establish CE SAIN was held in September 2016 and included officials from the Cambodian government, USAID and Kansas State University. CE SAIN is funded at \$2.5 million for a five-year period, starting July 1, 2016 and ending June 30, 2021. The aim of this initiative is to create a center of excellence that will foster private-sector innovation, agricultural research, education and training, and public-sector capacity building through improved collaboration and knowledge sharing that is focused on improving food and nutritional security while enhancing quality of soil, water and biodiversity. The project includes coordinating and leveraging ILs and other SAIN activities; building human and institutional capacity of the RUA; and establishing five technology parks to showcase high-potential technologies and strategies to sustainably intensify smallholder farming systems and encourage interaction between the private sector, researchers and farmers. Details outlining the goals and objectives are included in the "Other Topics" section of this annual report.

C. Invited to Join CAADP Technical Networks

SIIL, through an invitation from the African Union Commission (AUC), has joined the *Research and Extension and Knowledge Management, Policy Analysis and Accountability for Results* Technical Networks, which will steer the agenda of the African Union led Comprehensive African Agriculture and Development Programme (CAADP) in support of the Malabo Declaration. The linkage between CAADP and SIIL is a critical partnership to ensure the alignment of SIIL's current and future efforts with the objectives of the African Union and African organizations pursuing similar activities. Alignment of SIIL activities with country-led priorities is critical to the sustainability and long-term transfer of new Feed the Future Innovation Lab innovations to farmers and end users. Without focus on country-led priorities and partnership with established African institutions, the successful delivery of new innovations after project end is often limited. Therefore, SIIL considers this partnership a key accomplishment in FY 2016.

D. U.S. Ambassador Visited SIIL Research Sites in Burkina Faso

In October 2016, the U.S. Ambassador to Burkina Faso, **H E Tulinabo S Mushingi**, visited one of SIIL's research sites led by Dr. Augustine Ayantunde from ILRI. The ambassador was accompanied by the Burkina Faso country representative for the USAID and SIIL's director and other ME representatives. The event was attended by more than 300 people and also showcased a farmer field school that is led by FNGN, which is demonstrating the potential intensification of crop-livestock systems to facilitate farmer learning and adoption of intensification options. Members of the field school demonstrated early maturing dual-purpose cowpea and improved dwarf sorghum varieties. Ambassador Mushingi highlighted the importance of sustainable agricultural intensification and the need to promote it to enhance food security.

IV. Research Program Overview and Structure

The research program for the Feed the Future Innovation Lab for Collaborative Research on Sustainable Intensification (SIIL) is comprised of four primary components: The Geospatial and Farming Systems Research Consortium, the Appropriate Scale Mechanization Consortium, a portfolio of research subawards and a project that focuses on developing indicators for sustainable intensification.

A. The Geospatial and Farming Systems Research Consortium (GFC)

The Geospatial and Farming Systems Research Consortium (GFC) is led by Dr. Robert Hijmans at the University of California-Davis and supports SIIL by providing spatially-explicit data and analysis to:

- Identify current patterns of agricultural intensification in regions of interest.
- Analyze the determinants of these patterns.
- Identify opportunities for sustainable intensification (target regions, technologies and their potential impacts).
- Help develop strategies for increasing adoption and diffusion of technologies taking into consideration not only agro-ecological conditions, but also market and socio-economic and environmental conditions and risks.
- Develop case studies on technology, targeting and scaling that will be made available online and used in regional workshops/training courses.
- Make available all geospatial and farming systems data collected and produced by the projects in an interoperable, online data-management platform.

B. The Appropriate Scale Mechanization Consortium (ASMC)

The Appropriate Scale Mechanization Consortium (ASMC), led by Dr. Alan Hansen at the University of Illinois at Urbana-Champaign, aims to introduce multifunctional and modular mechanized technologies that are technically, environmentally and economically appropriate for use by smallholder farmers with the flexibility to accommodate different power sources. These technologies will contribute to enhanced labor productivity and increased land productivity, thus sustainably reducing poverty among smallholders. The ASMC includes members with substantial institutional capacity and expertise, and active collaborations with institutions and entry-point organizations in four designated countries: Bangladesh, Cambodia, Ethiopia and Burkina Faso.

The ASMC has six key functions:

- Engage entry-point organizations to establish Innovation Hubs.
- Assess country-specific mechanization challenges, opportunities and priorities.
- Implement country-specific activities utilizing participatory research methods.
- Build human capacity with an emphasis on gender.
- Monitor and evaluate the impact of activities.
- Share knowledge with in-country stakeholders.

C. Focus Country Research Subawards

In November 2016, six focus country subawards were selected utilizing input from the SIIL EAB and USAID Mission leaders. Together, the subawards investigate a diverse range of sustainable intensification practices and innovations across the SIIL's six focus countries. The SIIL research subawards are implemented and led by collaborations of U.S. universities, NARS centers, NGOs, and CGIAR partners.

D. Developing Indicators for Sustainable Intensification

The goal of this project is to develop a sustainable intensification (SI) framework comprised of indicators and metrics to assess the degree or trajectory of sustainability of agricultural intensification efforts. The SI indicators and metrics are categorized into five domains (productivity, economic, environmental, social, and human condition) using three scales: field level, farm or household level and landscape level. The project evaluates SI indicators and metrics, assesses robustness and sensitivity of indicators, carries out participatory systems modeling to assess performance of the metrics from different perspectives, and further develops a framework for understanding and optimizing SI trade-offs for presentation to stakeholders.

V. Research Project Reports

A. Geospatial and Farming Systems Research Consortium

I. Summary of GFC activities

- (1) Name: Geospatial and Farming Systems Research Consortium (PI: Robert Hijmans, University of California, Davis)
- (2) Location: United States, Tanzania, Senegal, Bangladesh, Ethiopia, Cambodia, Burkina Faso
- (3) Description: The GFC conducts geospatial analysis to provide data, analysis, and capacity building for SILL and the larger agricultural development community.
- (4) Collaborators: University of Maryland, Stanford University, ILRI, CIAT, Wageningen University and Research Center, IFPRI, Quantitative Engineering Design, Inc.,
- (5) Achievements (See FY 2016 AWP Objective 2):
 - (a) The GFC has developed high-resolution global climate data that is now available at <http://worldclim.org/version2>.
 - (b) A new website has been released that contains tutorials focused on utilizing the R programming language for geospatial data exploration, analysis and visualization (<http://rspatial.org>). This website contains a limited set of materials, which will be expanded in FY 2017.
 - (c) A new website hosting spatial data on climate, environment and socio-economic factors has been released (<http://gfc.ucdavis.edu/data/>). New dataset will be added on the website in FY 2017.
 - (d) An R package has been developed to support integrated study and analysis of agriculture, nutrition, and health data. An R package for crop modeling is also in development.
 - (e) GFC leadership has engaged with SILL subawards in Senegal, Tanzania and Bangladesh to develop work plans for specific geospatial research associated with each project.
 - (f) In quarters 3 and 4 of FY 2016, the GFC selected four subawards to fund that align with the consortium's objectives. Brief progress reports for each of these subawards are included in the succeeding pages.
- (6) Capacity Building: The GFC conducted a short-term training program on "Spatial Data Analysis and Modeling for Agricultural Development, with R" on August 15-19, 2016 in Arusha, Tanzania. A total of 41 individuals from government, private sector and civil society were trained at this event. A website containing the training materials used in the workshop will be made available in FY 2017.
- (7) Lessons Learned: (a) Initial correspondence and consultation during project planning are very important to incorporate geospatial component in any proposed research. It is difficult to get involved with projects at later stages; (b) Subaward granting is a time intensive process and requires continuous communication between different agencies. A system for the subaward process is now operational which is proving to be helpful for future project planning; (c) There is significant demand for training courses on spatial data in developing countries. The GFC continues to develop training materials and events that aim to address this demand.
- (8) Presentations and Publications:
 - (a) Hijmans, Robert. (2016, September 7) *2016 CGIAR-CSI & Partners Meeting*.

2. GFC Subaward I

- (1) Name: Using new satellites to assess maize productivity in Tanzania (PI: David Lobell, Stanford University)
- (2) Location: Morogoro, Tanzania
- (3) Description: This project's goal is to test methods to map maize area and yields within Tanzania, utilizing a variety of sensors that are capable of resolving smallholder fields. This will allow for better understanding of yield constraints in the region and the scope for intensification. The project's approach relies on microsatellite data provided by Skybox and Planet Labs sensors, along with algorithms designed to leverage crop simulation models and thus minimize the need for ground calibration. An important component is detailed field work to map field boundaries and obtain ground-based measures of crop type and production as validation. To do this, the PI plans to leverage the work of Inbal Becker-Reshef at University of Maryland, who is leading a study aimed at large-scale crop forecasting using coarse resolution sensors, and has some field work in the Morogoro district aimed at validating crop type classifications.
- (4) Collaborators: University of Maryland
- (5) Achievements (See FY 2016 AWP Activity 2.8):
 - (a) A field campaign was successfully completed to conduct whole-field harvests and farmer interviews on 30+ fields, and also to obtain self-reported production for additional fields.
 - (b) Images from various sources were obtained and integrated into Google Earth Engine.
 - (c) Planet and Skysat images were georeferenced and radiometrically corrected using RapidEye and Sentinel data as references for each step.
 - (d) Masking of clouds and cloud shadows in all images was achieved by selecting hundreds of training points and using random forest classification
 - (e) Crop model simulations were performed to assist in yield estimation.
 - (f) Whole-field harvests were compared to imagery vegetation indices to determine the potential predictive skill of each image.
- (6) Capacity Building: None to report for FY 2016.
- (7) Lessons Learned: None to report for FY 2016.
- (8) Presentations and Publications: None to report for FY 2016.

3. **GFC Subaward II**

- (1) Name: Spatial Targeting Agricultural Sustainable Intensification Investments: Linking Household Surveys with Spatial Data in Africa (PI: An Notenbaert, CIAT-Kenya)
- (2) Location: Focus countries include Tanzania and Ethiopia
- (3) Description: This project supports targeting of agricultural sustainable intensification investments by identifying where there is urgent need in combination with high attractiveness and potential success of sustainable intensification.
- (4) Collaborators: ILRI, CIAT, Wageningen University and Research Center
- (5) Achievements (See FY 2016 AWP Activity 2.6):
 - (a) At the household level, the World Bank LSMS-ISA 2010 database of 3440 households in Tanzania was cleaned and prepared for analysis. Spatio-temporal patterns were analyzed and HH-to-regional mapping was carried out. Additionally, benchmarking of SI (HH-level indicators) included the following economic and performance indicators:
 - (i) Gross income
 - (ii) Food Availability
 - (iii) Market Orientation
 - (iv) Importance of off farm income
 - (v) Farm size: land and livestock holdings
 - (vi) Crop and livestock productivity
 - (vii) Nitrogen Balance
 - (viii) Greenhouse gases (Tier I)
 - (b) The second key achievement of this project was a comprehensive review of five SI indicator domains. This entailed cleaning a spatial database of 50+ indicators and preparing it for analysis. Mapping of indices for SI and testing for SI potential was completed. Additionally, an ArcGIS/python tool for mapping suitability of SI interventions was developed.
 - (c) The third key achievement was the development of a conceptual framework for operationally quantifying sustainable intensification. To accomplish this, SI working definitions were prepared, and a conceptual framework for data analysis (linking HH-level and spatial data) was proposed.
- (6) Capacity Building: A workshop for vetting the project's conceptual framework was held on September 27-28, 2016 in Arusha, Tanzania.
- (7) Lessons Learned: None to report for FY 2016
- (8) Presentations and Publications: None to report for FY 2016

4. **GFC Subaward III**

- (1) Name: Geospatial Data and Analysis Support to the SIIIL Geospatial and Farming Systems Research Consortium (PI: Jawoo Kim, IFPRI)
- (2) Location: All SIIIL focus countries
- (3) Description: The objective of this GFC subaward is to provide SIIIL partners and sub-grantees with multi-disciplinary, high-resolution geospatial datasets to support analysis on targeting, priority setting, and ex-ante assessments of potential impacts and risk, as well as strategy development for scaling-up adoption of sustainable intensification technologies.
- (4) Collaborators: IFPRI
- (5) Achievements (See FY 2016 AWP Activity 2.9):
 - (a) Mapping of crop production statistics
 - (i) Ethiopia and Tanzania: Preliminary results from the mapping of spatially-disaggregated crop production data at 30 arc-second spatial resolution using subnational level two statistics circa 2010 were developed and reviewed for consistency.
 - (ii) Bangladesh and Senegal: Subnational level two crop statistics between 2009 and 2011 were collected and preprocessed.
 - (iii) Burkina Faso: Administrative level-one crop production statistics for 2009 – 2011 were obtained as well as level-two data for previous years.
 - (iv) Cambodia: Crop statistics data for 2013 at administrative level one was collected and preprocessed.
 - (v) By the end of 2016, the project expects to have a 1 km² map of crop production statistics for all SIIIL focus countries.
 - (b) Study on the adoption of sustainable intensification technologies
 - (i) The project team is in the process of compiling underlying data and preparing them for the econometric analyses described in Achievement (a).
 - (c) Spatial analysis framework for accessibility assessment
 - (i) The Tanzania updated road data from 2010 and onwards were collected from different sources and the preliminary results of the harmonized road network have been generated. The preliminary results of 2010 market accessibility have been produced and are currently under review.
 - (d) Price modeling of inputs and outputs
 - (i) The farm-gate maize price in Tanzania is being collected, and progress is being made to georeference tabular data with spatial coordinates. The redesign of the price model has been discussed in technical meetings with collaborators from CGIAR centers. The variables from household surveys have been also reviewed.
- (6) Capacity Building: None to report for FY 2016.
- (7) Lessons Learned: None to report for FY 2016.
- (8) Presentations and Publications: None to report for FY 2016.

5. GFC Subaward IV

- (1) Name: Generating a Land Cover Land Use Database to Support GFC Research Activity in Bangladesh and Cambodia (PI: William Wu, Quantitative Engineering Design, Inc.)
- (2) Location: Bangladesh, Cambodia and other Feed the Future countries in Asia
- (3) Description: The project will deploy single-pass Geosurveys (web-based surveys of satellite imagery) using CSV files of latitudes and longitudes to answer the following three questions based on a visual inspection of a 250m-by-250m square of satellite imagery centered at each point to detect croplands, woody cover and human settlements.
 - (a) Croplands present? (0% / 1-50% / 51-100% / Don't Know)
 - (b) Woody cover > 60%? (Yes / No / Don't Know)
 - (c) Human settlements present? (Yes / No / Don't Know)

The GFC will develop training materials to help survey participants understand how to answer these questions correctly with examples of satellite imagery, answers and detailed commentary. There will be 400,000 sample locations (250 sq. meter) surveyed. In addition, 3,000 survey points coupled with the correct answers to the above three questions will be generated for validation.

- (4) Collaborators: None
- (5) Achievements (See FY 2016 AWP Activity 2.7):
 - (a) The survey is complete and the data will be delivered in October, 2016. This dataset will be publicly hosted by GFC.
 - (b) Developing a comprehensive training material/guide for interpreting aerial photos to identify different land use classes (cropland, plantation, grazing, building, etc.).
- (6) Capacity Building: None to report for FY 2016.
- (7) Lessons Learned: Grazing land and croplands are very difficult, and sometimes impossible, to differentiate even with sub-meter resolution satellite data. Temporal remote sensing data may be useful for this purpose.
- (8) Presentations and Publications: None to report for FY 2016.

B. Appropriate Scale Mechanization Consortium (ASMC)

I. Summary of ASMC Activities

- (1) Name: Appropriate Scale Mechanization Consortium (PI: Alan Hansen, University of Illinois – Urbana, Champaign)
- (2) Location: Bangladesh, Burkina Faso, Cambodia, Ethiopia
- (3) Description: The ASMC will introduce multifunctional and modular mechanized technologies that are technically, environmentally, and economically appropriate for use by smallholder farmers. These technologies will contribute to enhanced labor productivity and increased land productivity, thus sustainably reducing poverty among smallholders. The overall objective of this project is to intensify smallholder farmers' cropping systems and on-farm operations through mechanization in a sustainable manner. Sustainable intensification will integrate social, economic and environmental impacts with a specific focus on easing the burden on women. The ASMC includes members with substantial institutional capacity and expertise, and active collaborations with institutions and entry point organizations in the project's four designated countries.
- (4) Collaborators: U.S. collaborating institutions include: Kansas State University, Michigan State University and North Carolina A&T State University. Additional collaborators are listed under each ASMC country report.
- (5) Achievements (See FY 2016 AWP Objective 3):
 - (a) Two-day workshops were held in each of the four countries at in-country partner universities in quarters two and three of FY 2016. Local stakeholders, including farmers, government representatives, nongovernment organizations and university staff and students, helped identify top challenges and opportunities related to appropriate scale mechanization as well as tasks and needs to be addressed through projects, tertiary capacity building and outreach education and training.
 - (b) Two-day field trips also took place in each country to visit farms and interact directly with farmers in the field, particularly women, and observe firsthand the challenges they face in their food production systems.
 - (c) The Appropriate Scale Mechanization Innovation Hubs have been established in each country and each location is in the process of developing field hubs and demonstration plots as ideal locations for training and outreach programs. The model presented should allow for training in any agricultural discipline easy access to the local rural community.
- (6) Lessons Learned:
 - (a) The Appropriate Scale Mechanization Consortium team learned of the complexity involved in managing a project of this size. For project success, there is a need to work closely with in-country partners and rely on their expertise. Coordinating ASMC team members requires constant efforts and remains a priority of the ASMC management team.
 - (b) Adopting a systems approach to evaluate interventions associated with each value chain is essential to successful project implementation. It is vital to understand the dynamics of individual processes and their interactions within the entire system.
- (7) Presentations and Publications:
 - (a) Hansen, A. (2016, July 17). Appropriate Scale Mechanization Innovation for Sustainable Intensification. Orlando, Florida.

2. ASMC - Bangladesh

- (1) Name: Appropriate Scale Mechanization Consortium in Bangladesh
- (2) Location: Durumia and Wazirpur, Bangladesh
- (3) Description: The ASMC has targeted the following interventions in Bangladesh:
 - (a) Selection and demonstration of appropriate machinery for both rice harvesting and rice transplanting
 - (b) Provision of service providers
 - (c) Improved sluice gate management system
 - (d) Conservation agriculture including conservation of freshwater and use of irrigation/efficient water conveyance system methods
- (4) Collaborators: Bangladesh Agricultural University (Bangladesh), Bangladesh Rice Research Institute (Bangladesh), Bangladesh Agricultural Research Institute (Bangladesh), ACI Motors Ltd. (Bangladesh)
- (5) Achievements (See FY 2016 AWP Objective 3):
 - (a) The Appropriate Scale Mechanization Innovation Hub-Bangladesh team has identified target villages for demonstration and testing in Durumia and Wazirpur. These plots will serve as a field hub to provide locals in the surrounding area an opportunity to engage with the new technology.
- (6) Capacity Building: ASMC leadership introduced the project to 43 local stakeholders and in-country management staff. The event included sharing baseline survey strategies, presenting the status of gender equity, emphasizing the importance of data management and knowledge sharing, and additional activities.
- (7) Lessons Learned: None to report for FY 2016.
- (8) Presentations and Publications:
 - (a) Alam, M. (2016, July 22). Appropriate Scale Mechanization Innovation Hub in Bangladesh. Champaign, Illinois.
 - (b) Sarker, P. (2016, March 7). Integrating production technology with gender and nutrition. Dhaka, Bangladesh.

3. ASMC – Burkina Faso

- (1) Name: Appropriate Scale Mechanization Consortium in Burkina Faso
- (2) Location: Innovation Hub located near Koumbia, Burkina Faso
- (3) Description: The ASMC has targeted the following interventions in Burkina Faso:
 - (a) Establishment of test/experimental plots for students with focus on planting machines, e.g. seed drill not used much now
 - (b) Development of mechanization systems – Zai technique and address water issues
 - (c) Acquire and evaluate existing equipment
- (4) Collaborators: Polytechnic University of Bobo-Dioulasso (Burkina Faso), Tiller's International (United States)
- (5) Achievements (See FY 2016 AWP Objective 3):
 - (a) It was decided to establish the country's field hub at a farm near Koumbia, Burkina Faso. The owner of the farm has worked on research projects with the Polytechnic University of Bobo-Dioulasso (UPB) for several years and thus was specifically selected by ASMC collaborators at UPB. The Field Hub will serve as the focal point for demonstration and research purposes for the Appropriate Scale Mechanization Innovation Hub-Burkina Faso. The project team has demarcated and leased the land for the field hub.
- (6) Capacity Building: Dr. Tim Harrigan (Michigan State University) led a short-term training event on ox training and yoke making for precision planting and weeding in September 2016. The objectives of this workshop were to teach and demonstrate gentle and responsive ox training techniques and methods, introduce the training of oxen as young calves at 3 months of age, and to teach local farmers how to make ox yokes designed for specific animals and tasks to allow the animals to supply tractive power throughout the day without injury and only one traveler. At a separate event in Burkina Faso, ASMC also introduced the project to 81 local stakeholders and in-country management staff.
- (7) Lessons Learned: None to report for FY 2016.
- (8) Presentations and Publications:
 - (a) Millogo, V. & Kere, M. (2016, July 22). Appropriate Scale Mechanization Consortium Update from Polytechnic University of Bobo-Dioulasso, Burkina Faso. Champaign, Illinois.

4. **ASMC - Cambodia**

- (1) Name: Appropriate Scale Mechanization Consortium in Cambodia
- (2) Location: Banan district (Battambang province), Puok district (Siem Reap province), and Stung Chinit (Kampong Thom province)
- (3) Description: The ASMC has targeted the following interventions in Cambodia related to rice and vegetable production:
 - (a) Rice
 - (i) Land preparation
 - (ii) Easy to operate, low-cost, multi-tasking machinery
 - (b) Vegetables
 - (i) Task analysis of entire value chain to develop local, low-cost, labor saving tools
 - (ii) Crop protection through soil management/rotation
 - (iii) Low-cost, precision drip irrigation
- (4) Collaborators: Royal University of Agriculture (Cambodia), CASC (Cambodia), CIRAD (France), Ministry of Agriculture Forestry and Fisheries (Cambodia), University of Battambang (Cambodia)
- (5) Achievements (See FY 2016 AWP Objective 3):
 - (a) Rice
 - (i) The Appropriate Scale Mechanization Innovation Hub Cambodia has partnered with the Conservation Agriculture Service Center (CASC) Cambodia. CASC has existing demonstration plots in the targeted intervention areas that will be leveraged by the Appropriate Scale Mechanization Innovation Hub-Cambodia. There are both upland and lowland rice plots available for demonstration and research purposes.
 - (b) Vegetables
 - (i) Fifty Farmers in the Battambang province have been selected to partake in the Commercial Home Vegetable Garden project of the ASMC. These home plots are situated within the rural communities and will serve as demonstration plots to neighboring agricultural families.
- (6) Capacity Building: ASMC leadership introduced the project to 40 local stakeholders and in-country management staff. The event included sharing baseline survey strategies, presenting the status of gender equity, emphasizing the importance of data management and knowledge sharing, and additional activities.
- (7) Lessons Learned: None to report for FY 2016.
- (8) Presentations and Publications:
 - (a) Lor, L. & Chao, S. (2016, July 22). Sustainable Intensification for small-scale farming in Cambodia. Champaign, Illinois.
 - (b) Reyes, M. & Mercado, A. (2016, July 20). Conservation Agriculture with Trees a Sustainably Intensified System for Sloping Terrains. Colorado Springs, Colorado & Orlando, Florida.
 - (c) Reyes, M. (2016). Drip Irrigation and Conservation Agriculture for Commercial Vegetable Home Gardens: Improving Tasks and Tools. Orlando, Florida.

5. ASMC - Ethiopia

- (1) Name: Appropriate Scale Mechanization Consortium in Ethiopia
- (2) Location: Dangashita, Ethiopia
- (3) Description: The ASMC has targeted the following interventions in Ethiopia:
 - (a) Maize seeder (driller) and fertilizer spreader
 - (b) Adaptation of manually/mechanically operated rotary type maize sheller
 - (c) Modification of traditional water well digging tools and developing of water lifting mechanisms
- (4) Collaborators: Bahir Dar University (Ethiopia), Bahir Dar Institute of Technology (Ethiopia), Innovation Lab for Small Scale Irrigation (United States), International Water Management Institute
- (5) Achievements (See FY 2016 AWP Objective 3):
 - (a) Maize
 - (i) The Appropriate Scale Mechanization Innovation Hub-BiT is still in the process of developing demonstration plots. A potential demonstration plot will be located in a “modern village” affiliated with Bahir Dar University that is used as a focal point for agricultural innovations.
 - (b) Vegetables
 - (i) Fifty farmers in Dangashita have been selected to partake in the Commercial Home Vegetable Garden Project of the ASMC. These home plots are situated within the rural communities and will serve as demonstration plots to neighboring agricultural families.
- (6) Capacity Building: ASMC leadership introduced the project to 77 local stakeholders and in-country management staff. The event included sharing baseline survey strategies, presenting the status of gender equity, emphasizing the importance of data management and knowledge sharing, and additional activities.
- (7) Lessons Learned: None to report for FY 2016.
- (8) Presentations and Publications:
 - (a) Tsegaw, A. & Birhan, Z. (2016, July 22). Appropriate Scale Mechanization Consortium- Bahir Dahr Institute of Technology, Ethiopia. Champaign, Illinois.

C. Focus Country Research Subawards

I. Bangladesh

- (1) Name: Unlocking the production potential of “polder communities” in coastal Bangladesh through improved resource use efficiency and diversified cropping systems. (PI: Krishna Jagadish, Kansas State University)
- (2) Location: Polder 30 in the Khulna district of Bangladesh
- (3) Description: The goal of this project is to increase farm income and nutrition security by intensifying polder farming systems through implementation of sustainable and economically viable practices. The main challenges encountered by polder communities for intensification of production systems are ineffective water management and inadequate drainage infrastructure. These have invariably resulted in the use of low yielding traditional rice varieties and minimal rabi (dry season) crop production. The proposed project aims to work with the farming community in a pilot sub-polder (~600 ha) to develop and adapt cropping system options for sustainable intensification, together with improved drainage management. Specifically, the project will advocate for improved high yielding and stress tolerant rice varieties (including rice with high grain zinc), improve productivity of rice + fish cultivation and introduce high value rabi crops to significantly increase farm income and improve household nutrition
- (4) Collaborators: IRRI (Bangladesh), BRAC (Bangladesh), Kansas State University (United States)
- (5) Achievements (See FY 2016 AWP Activity 4.4):
 - (a) 218 farmers are now growing high yielding varieties of rice in four villages within the Katakali sub-polder; among them 20% were women. Highly nutritious fish (Rui, Mrigel, Tilapia, mirror carp, bata) were integrated with rice cultivation on five individual farms of about 1 ha and a community consisting of 21 farmers across three villages (Basurabad, Hetalbunia and Kismat Fultala).
 - (b) The project has provided access to climate resilient and high zinc nutritious rice and successfully demonstrated the mat bed nursery and mechanical transplanting of rice.
 - (c) The project advertised for M.S. and Ph.D. students to get involved in adaptive research in the coastal zone. 20 applications were received, and 4 M.S. students and 1 Ph.D. student were selected.
- (6) Capacity Building: The project’s capacity building efforts will involve training farmers, extension workers, and future agricultural scientists, and it will provide mentorship for at least 5 Ph.D. and 12 M.S. local graduate students. BRAC extension specialists will lead the dissemination activities with key sustainable outputs generated from the project.
- (7) Lessons Learned: The complexity of the polder ecosystem was seen during a visit to the target polder 30 and the villages in which the project objectives would be implemented. The farmers were pragmatic and open to some of the newer technologies as long as there was an economic and social improvement. Some activities such as the mechanical transplanting for the high yielding rice varieties and rice + fish culture initiated in the water land ecosystem (WLE; end in 2016) will be intensified after identifying the regions in the polder that are best suited (relatively high elevations) for these advanced semi dwarf varieties in the coming aman season.
- (8) Presentations and Publications:
 - (a) Reyes, L. (2016, March 17). *New project to benefit “polder communities” in Bangladesh.* <http://irri-news.blogspot.com/2016/03/new-project-to-benefit-polder.html>
 - (b) Reyes, L. (2016, May 1). *Polder tidings.* <http://irri-news.blogspot.com/2016/03/new-project-to-benefit-polder.html>

2. **Burkina Faso**

- (1) Name: Sustainable intensification through better integration of crop and livestock production systems for improved food security and environmental benefits in Sahelian zone of Burkina Faso (PI: Augustine Ayantunde, International Livestock Research Institute (ILRI))
- (2) Location: Dori and Ouahigouya districts, Burkina Faso
- (3) Description: The overall goal of this project is to improve household food production and nutrition and enhance ecosystem services through better integration of crop and livestock production systems in Burkina Faso. The specific objectives are:
 - (a) To increase crop and livestock integration in these mixed systems, through improved crop production (dual-purpose sorghum and cowpea varieties), soil fertility (application of manure and inorganic fertilizer), water harvesting (zai and stone-bunding with vegetation strips) and livestock feed enhancing interventions (forage sorghum, dual purpose cowpea, efficient feeding systems).
 - (b) To assess the economic, social, nutritional and environmental benefits and tradeoffs of the productivity enhancing interventions, and their potential for cost-efficient outscaling.
 - (c) To build capacity of smallholder farmers and researchers on sustainable intensification and improved nutrition through multi-stakeholders' platforms and to provide platforms for co-learning.
- (4) Collaborators: Institut de l'Environnement et de Recherches Agricoles (Burkina Faso), The International Union for Conservation of Nature (IUCN) (Burkina Faso), University of Wisconsin, Madison (USA), Fédération Nationale des Groupements Naam (FNGN) (Burkina Faso), and Association pour la Promotion de l'Élevage en Savane et au Sahel (APESS) (Burkina Faso)
- (5) Achievements (See FY 2016 AWP Activity 4.5):
 - (a) The project was launched with an inception workshop, which brought together all project partners and USAID Burkina Faso officials.
 - (b) The project's baseline survey was completed, and it was conducted in two project sites and included 400 households.
- (6) Capacity Building: A Farmer Field School was held on the topic of sustainable intensification to expose 137 farmers to soil and water conservation techniques.
- (7) Lessons Learned:
 - (a) Strong and effective partnerships are critical for the successful implementation of the project activities. Effective engagement of all project partners is therefore necessary.
 - (b) The drivers of production intensification are mainly income and food security.
 - (c) Higher income does not necessarily translate into improvements in poverty status nor diet diversity.
- (8) Presentations and Publications: None reported for FY 2016.

3. Cambodia

- (1) Name: Women in Agriculture Network (WAgN) Cambodia: Gendered- and Ecologically-Sensitive Agriculture (PI: Ricky Bates, Pennsylvania State University)
- (2) Location: Banan district (Battambang province), Puok district (Siem Reap), and Stung Chinit (Kampong Thom province)
- (3) Description: The project aims to empower women and improve nutrition by promoting women's participation in the value chains for horticultural crops and rice produced via sustainable intensification (SI) practices. The overarching goal of the project is to provide a scientifically rigorous and comprehensive understanding of the nexus of gender and SI. This will enable the project to develop, inform and deploy synergistic programs to enhance women's status and advance SI. The project aspires to improve the socio-economic and nutritional status of women and their families as well as identify, develop and strengthen existing and potential SI technologies, practices and policies that promote production of nutritious and marketable food while protecting agro-ecological resources.
- (4) Collaborators: University of Tennessee Institute of Agriculture (UTIA) (United States), Agricultural Development Denmark Asia (ADDA), World Vegetable Center (AVRDC), Asia Impact Center – ECHO (Cambodia), Kasetsart University (Thailand), Royal University of Agriculture (Cambodia), Conservation Agriculture Service Center (Cambodia), University of Battambang (Cambodia)
- (5) Achievements (See FY 2016 AWP Activity 4.6):
 - (a) Implementation of a joint household baseline survey in Battambang, Siem Reap and Kampong Thom Provinces with the SIIL ASMC.
 - (b) Successful recruitment of a Cambodian student to pursue a Ph.D. program at Penn State University.
 - (c) Conducted strategy meetings with collaborators and key stakeholders to identify existing and potential SI technologies and practices for rice-horticulture production in limited resource settings.
- (6) Capacity Building: An extensive effort was made through USAID, NGO, university and other networks to recruit female Ph.D. candidates for study at Penn State University. Eventually, two (male) Cambodians applied for Ph.D. studies in Penn State's Department of Agricultural Economics, Sociology and Education. One of these candidates withdrew his application due to circumstances requiring that he remain in Cambodia; it is anticipated that the second applicant will begin his Ph.D. program in January 2017.
- (7) Lessons Learned:
 - (a) Agriculture in Cambodia is based primarily upon rain-fed, paddy rice production. Sustainable intensification of this system inherently increases its management complexity. To improve adoption of SI technologies and practices, rice farmers must be offered a palette of options and strategies for diversification of paddy rice.
 - (b) The reality 'on the ground' is often very different than published or "official" data, particularly regarding country demographics and statistics.
 - (c) There exists a high number of development projects within certain provinces, particularly in less remote regions such as Siem Reap. In some villages, the phenomenon of "survey fatigue" is real, and may represent a constraint to obtaining unbiased and robust survey data.
- (8) Presentations and Publications:
 - (a) Ader, D. (2016). Information Technology in a Changing Agricultural Environment. American University of Phnom Penh (Phnom Penh, Cambodia).
 - (b) Bates, R.M. (2016, March 16). *Diversifying rainfed rice with vegetable crops*. Bangkok Thailand.

4. Ethiopia

- (1) Name: Sustainably Intensified Production Systems Impact on Nutrition (SIPSIN) (PI: Neville Clarke, Texas A&M University)
- (2) Location: Dangeshita, Ethiopia
- (3) Description: The project will evaluate the implications of sustainable intensification of crop and livestock production systems (SIPS) on human nutrition in northern Ethiopia. The existing infrastructure and ongoing research and development of the Innovation Lab for Small Scale Irrigation (ILSSI) in the Lake Tana basin of Northern Ethiopia is used as a platform to efficiently conduct research to evaluate SIPS for crop and livestock production and their environmental, economic and nutritional consequences.
- (4) Collaborators: North Carolina Agricultural and Technical State University (United States), Feed the Future Innovation Lab for Collaborative Research on Nutrition in Africa (United States), Feed the Future Innovation Lab for Small Scale Irrigation (United States), Bahir Dar University (Ethiopia), International Water Management Institute (IWMI), International Food Policy Research Institute (IFPRI)
- (5) Achievements (See FY 2016 AWP Activity 4.7):
 - (a) Detailed planning and coordination with collaborators in the ASMC was completed, and explicit linkages to the Innovation Lab for Small Scale Irrigation have been made. Field studies are ready to be launched.
 - (b) Subcontracts with partners have been completed except for Bahir Dar University which is in progress.
 - (c) Household survey instruments have been designed and are being used to obtain human subject use approval at the regional level in Ethiopia.
- (6) Capacity Building: None to report for FY 2016.
- (7) Lessons Learned: The current political unrest in Ethiopia, if not settled in the near future, will at worst threaten the project's completion and, at best, could result in a delay.
- (8) Presentations and Publications: None to report for FY 2016.

5. Senegal

- (1) Name: Adoption of Sustainable Intensification in Dual-Purpose Millet - Leguminous Crops - Livestock Systems to Improve Food and Nutritional Security and Natural Resources Management for Rural Smallholder Farmers in Senegal (PI: Doohong Min, Kansas State University)
- (2) Location: Louga, Diourbel, Kaffrine, Kedougou, Kolda and Sedhiou regions in Senegal
- (3) Description: Senegal is facing a difficult food situation, and the gap between national production and the needs of an increasing population has continued to widen in recent years. Millet is one of the most important cereal crops in Senegal due to good adaptation to high temperatures, severe drought conditions and soil types in most regions of Senegal. This project utilizes millet in innovative farming systems, maintaining the following primary objectives:
 - (a) To improve food and nutritional security in six regions of Senegal.
 - (b) To establish resilient farming systems via a holistic approach for rural smallholder farmers, particularly women.
 - (c) To improve the nutritional and socioeconomic status in particular for women and children in six regions of Senegal.

These objectives will be achieved by using sustainably intensified production and management practices of dual-purpose millet and leguminous crops (cowpea and groundnut) with small ruminant livestock (goats and sheep) integration.
- (4) Collaborators: Institut Senegalais de Recherches Agricoles (ISRA) – Centre National de Recherches Agronomiques de Bambey (CNRA/Bambey) (Senegal), University of Thies (Senegal), Institut de Technologie Alimentaire (ITA) (Senegal), Agence Nationale de Conseil Agricole et Rural (ANCAR) (Senegal), Le Réseau des Organisations Paysannes et Pastorales du Sénégal (RESOPP) (Senegal), Institut de Recherche pour le Développement (IRD) (France), CIRAD (France)
- (5) Achievements (See FY 2016 AWP Activity 4.8):
 - (a) Three on-station field trials using dual-purpose pearl millet were initiated in July 2016.
 - (b) The French subawardee groups (IRD and CIRAD) started their field research this summer in both Dakar and Bambey.
 - (c) Five Ph.D. students were identified for the SIIL project in Senegal and 2-3 more Ph.D. students will be identified in the next fiscal year.
- (6) Capacity Building: As stated above, significant progress has been made in recruiting Ph.D. students to be trained as part of this project in Senegal.
- (7) Lessons Learned: It is very critical to keep communicating with the project coordinator and Co-PIs in Senegal to make sure research progress is being made.
- (8) Presentations and Publications: None to report in FY 2016.

6. Tanzania

- (1) Name: Raising crop response: bidirectional learning to catalyze sustainable intensification at multiple scales (PI: Sieglinde Snapp, Michigan State University)
- (2) Location: Babati, Iringa rural, Mufindi, Wanging'ombe, Njombe rural, Songea rural, Mbeya rural, and Mbozi districts in Tanzania
- (3) Description: The project is fully engaged with Africa RISING, CIAT and AGRA efforts in Tanzania and ready to address five "unknowns" that impede broad scaling-up of Sustainable Intensification (SI).
 - (a) It is currently unclear what constitutes 'best practices' for organic-matter technologies (OMT) such as push-pull, pigeonpea rotations, doubled up legumes and manure over the range of microenvironments, within which smallholder farmers operate.
 - (b) The project will measure on-farm nitrogen fixation of OMTs and test threshold levels of soil-organic carbon (SOC) and other aspects of soil quality, below which crops respond poorly to inorganic fertilizer. OMTs have been shown to improve nitrogen fixation, phosphorus availability, SOC and related processes, however performance on-farm is rarely documented and the number of years required to rehabilitate highly degraded soils enabling crops to respond favorably to fertilizer is not understood, nor are the range of factors that influence this.
 - (c) Knowledge is needed concerning effectiveness of novel approaches to outreach. Bidirectional learning supports an iterative process by which information providers (agrodealers, extension services and NGOs) and farmers fine-tune recommendations on OMTs, seeds and fertilizers. The team will test if this bidirectional learning, linked to mini-packs of inputs, is an effective means to support limited-resource farmers, and particularly women, to adapt and adopt these technologies.
 - (d) It will be estimated what little is known about the effects of OMT/SI take-up on nutritional outcomes of women and children.
 - (e) The project will quantify system-wide barriers to OMT/SI and engage with the Tanzanian government to guide the design of policies and programs for supporting and scaling-up SI in maize- and bean-based systems of Tanzania.
- (4) Collaborators: Sokoine University of Agriculture (SUA) (Tanzania), Wageningen University and Research Center (Netherlands), CIAT-Tanzania, The Nelson Mandela African Institution of Science and Technology (NM-AIST) (Tanzania), International Institute of Tropical Agriculture (IITA)
- (5) Achievements (See FY 2016 AWP Activity 4.9): The project has developed collaborative research plans, particularly for objectives 1 and 2, in which value is being added to a TAMASA survey of about 700 farmers through more multidimensional measurements including legumes and soil properties. The project is also providing technical expertise to support the measurement of biological nitrogen fixation and soil organic carbon on research trials evaluating maize and legumes (lablab, pigeonpea and bean).
- (6) Capacity Building: One Ph.D. student is supported by this project. In future years of the project, an emphasis will be placed on providing short-term training.
- (7) Lessons Learned: There is clear, tremendous interest in sustainable intensification in Tanzania, which has allowed for impressive engagement with many partners.
- (8) Presentations and Publications: None to report in FY 2016.

D. Developing Indicators for Sustainable Intensifications

- (1) Name: Developing Indicators for Sustainable Intensification (PIs: Cheryl Palm – University of Florida, Sieglinde Snapp – Michigan State University)
- (2) Location: Ethiopia, Tanzania
- (3) Description: The project's primary goal is to develop and recommend indicators and metrics for the sustainable intensification of agriculture within a framework of domains using three scales: field level, farm or household level and landscape level. In this project, Professors Cheryl Palm and Sieglinde Snapp both supervise Research Scientists who evaluate SI indicators and metrics, assess robustness and sensitivity of indicators, conduct data gap analysis by various groups involved in the SI indicator work, refine the SI indicators and metrics for their usefulness, and develop a framework for understanding and optimizing SI trade-offs for presentation to stakeholders.
- (4) Collaborators: Columbia University and Michigan State University (United States)
- (5) Achievements (See FY 2016 AWP Activity 4.3):
 - (a) A detailed understanding of scientists' current practice in measuring indicators related to SI was attained through in-depth interviews with over 33 researchers, site visits in 4 countries, and an online survey of 48 SI scientists. This resulted in identifying gaps and challenges in applying SI indicators.
 - (b) The SI indicator framework was developed with feedback from a wide range of scientists with widespread agreement on the domains and indicators. Practical applications of the SI indicator framework are being demonstrated through manuscripts being developed using data from Malawi and Tanzania.
 - (c) The project developed an outline of a manual for assessing SI with the indicator framework, including documents to guide researchers in identifying synergies and tradeoffs, selecting indicators, and creating visualizations to effectively communicate the results.
- (6) Capacity Building: No capacity building activities took place in FY 2016. Short-term training is planned for FY 2017.
- (7) Lessons Learned: Holistic quantitative analysis of SI technologies being researched is difficult with existing data because of small sample sizes, significant data gaps (focusing on only a few domains) and complex interactions across indicators and domains. Observations were made that there are many protocols that are implemented with a number of participants and selection criteria. Some of the intervention trials are on very small plots of 5x5 meters and 10x10 meters, while other protocols like the community seed multiplication were on fields of about 0.25 hectares. In both these cases some questions arose: 1) At what scale is sustainability going to be assessed for the project?; 2) Will the scale differ by intervention?; 3) Are there possibilities of generating indicators of these interventions at the household scale?
- (8) Presentations and Publications:
 - (a) Grabowski, P. (2016, March 4). Global Agri-Summit – Dordt College. Sioux Center, Iowa.
 - (b) Snapp, S., Grabowski, P., Chikowo, R., Anders, E., Smith, A., & Bekunda, M. (2016, June 30). Assessment of sustainable intensification: experiences from best bet technologies in Malawi. Dar es Salaam, Tanzania.

VI. Associate Award Research Project Reports

SIIL has no Associate Awards to report for FY 2016.

VII. 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	Mat nursery preparation training	Farmers	21	12	33
Bangladesh	Machine transplanting of rice	Farmers	94	77	171
Bangladesh	Appropriate Scale Mechanization Consortium workshop	Farmers, government, private sector, civil society	36	7	43
Burkina Faso	Farmer Field School on sustainable intensification	Farmers	94	43	137
Burkina Faso	Ox training and yoke making for precision planting and weeding	Farmers, private sector, government	18	8	26
Burkina Faso	Appropriate Scale Mechanization Consortium workshop	Farmers, government, private sector, civil society	59	22	81
Cambodia	Appropriate Scale Mechanization Consortium workshop	Farmers, government, private sector, civil society	33	7	40
Ethiopia	Appropriate Scale Mechanization Consortium workshop	Farmers, government, private sector, civil society	69	8	77
Tanzania	Sustainable intensification indicators training	Government, private sector, civil society	26	8	34
Tanzania	Spatial Data Analysis and Modeling for Agricultural Development with R	Government, private sector, civil society	32	10	42
			482	202	684

B. Long-term training

Name (first, last)	Sex	University	Degree	Major	Program End Date (month/year)	Degree Granted (Y/N)	Home Country
Hossain, Shakhawat	M	Sher-e-Bangla Agricultural University	M.S.	Agronomy	August/2017	N	Bangladesh
Lin, Yingqian	F	Michigan State University	Ph.D.	Biosystems and Agricultural Engineering	May/2017	N	China
Faye, Awa	F	Cheikh Anta Diop University	Ph.D.	Agronomy	March/2019	N	Senegal
Mofini, Marie-Thérèse	F	University of Thies-ENSA	Ph.D.	Agronomy	September/2019	N	Central African Republic
Nord, Alison	F	Michigan State University	Ph.D.	Agroecology	December/2019	N	United States

C. Institutional Development

Two SILL projects specifically promote institutional development.

- (1) First, the CE SAIN aims to build institutional capacity of the Royal University of Agriculture in Cambodia, in addition to human capacity. As one example, this effort will entail creation of an innovation incubator at RUA to better train and connect students and faculty to the private sector. The CE SAIN will also formalize and improve partnerships between Innovation Labs and RUA in a strategic effort to strengthen both degree and non-degree programs at RUA. This will ultimately enhance the University's capacity to deliver training to students, extension professionals, NGO employees, and additional individuals. Finally, the CE SAIN project financially supports the addition of key administrative staff positions to RUA. These positions will better support the acquisition and maintenance of funds for long-term sustainability of the University.
- (2) The ASMC also maintains a goal to improve institutional capacity in each of their target countries, with a specific focus on developing curriculum addressing appropriate scale mechanization at each partner institution. The institutions in which this tertiary capacity building is taking place include: Royal University of Agriculture (Cambodia), Polytechnic University of Bobo-Dioulasso (Burkina Faso), Bahir Dar Institute of Technology (Ethiopia), and Bangladesh Agricultural University (Bangladesh).

VIII. Innovation Transfer and Scaling Partnerships

A. Description of Innovation

Research Subaward Title: Women in Agriculture Network (WAgN) Cambodia: Gendered- and Ecologically- Sensitive Agriculture

Lead PI: Dr. Ricky Bates

Institution: Pennsylvania State University – US Partner

Innovation Title: Sustainable intensification of rain-fed paddy rice production Management Practices

Innovation Phase: Phase II “Under field testing as a result of USG assistance” [EG.3.2-7]

1. Steps taken

Management strategies and research designs were explored focusing on the sustainable intensification of rain-fed paddy rice. Options include relay cropping with cash crops (sesame, niger seed), livestock fodder (green manure cover crops), and vegetables.

2. Partnerships

Partnerships have been developed with:

NGO's: AVRDC-World Vegetable Center (Bangkok, Thailand and Siem Reap, Cambodia), ECHO Asia Impact Center (Chiang Mai, Thailand), Agricultural Development Denmark Asia-ADDA (Siem Reap, Cambodia), Appropriate Scale Mechanization Consortium (SILL-funded, Univ. of Illinois)

Universities: Kasetsart University (Bangkok, Thailand), Royal University of Agriculture (Phnom Penh, Cambodia), University of Tennessee (Knoxville, TN, USA)

3. Technologies Ready to Scale

Innovation in Phase II: The following activities will be undertaken in FY 2017: Continued meeting with partners to develop and assess research strategy for intensification of rice with sustainable vegetable and agronomic crop production; Evaluate preliminary Year-1 experiences and field trial data; Develop Year-2 research strategy and establish additional trials and demonstrations on farmers' fields; and Plan outreach activities including a field day at selected sites.

B. Description of Innovation

Research Subaward Title: Sustainable intensification through better integration of crop and livestock production systems for improved food security and environmental benefits in Shelia zone of Burkina Faso

Lead PI: Dr. Augustine Ayantunde

Institution: International Livestock Research Institute (ILRI) – Burkina Faso Partner

Innovation Title: Testing of improved varieties of cowpea and sorghum

Innovation Phase: Phase III “Made available for transfer as a result of USG assistance” [EG.3.2-7]

1. Steps taken

The improved cowpea variety "KVX 745-1 Ip" and sorghum variety “Sariasso 16” developed by the Department of Crop Productions of Institut de l'Environnement et de Recherches Agricoles (INERA) were used in the ongoing on-farm agronomic trials in the 2 project sites involving 48 farmers per site.

2. Partnerships

The improved varieties were already developed by INERA and this project only used them for on-farm testing and in the farmers' field school to facilitate adoption by the farmers. The project partners involved in scaling of the improved cowpea and sorghum varieties under this project are farmers' umbrella organization in Burkina Faso FNGN and APSS (agro-pastoral organization for West and Central Africa).

3. Technologies Ready to Scale

Innovation in Phase III: Testing of improved varieties of cowpea and sorghum is currently taking place. The next step is to promote adoption of these 2 crop varieties by the farmers in Burkina Faso.

IX. Environmental Management and Mitigation Plan (EMMP)

In FY 2016, the SIIL management entity consulted the leadership of each subaward to identify any environmental concerns associated with planned research. An emphasis was placed on reviewing any activities classified as negative determinations in SIIL's Initial Environmental Examination. After these consultations, the Environmental Management and Mitigation Plan (EMMP) was developed for the Innovation Lab and submitted to the Bureau Environmental Officer for the Bureau for Food Security.

Once the EMMP was finalized, a new module was created in the SIIL Reporting Hub to assist monitoring efforts of the plan. The module allows PIs, Co-PIs, and coordinators to report an EMMP compliance support visit or upload documentation that corresponds to activities outlined in the EMMP. Below is a screenshot of the site visit form available through the module.

Progress
0% Complete
← Previous Next →

Research Status Modules
Background & Demographics
Data Management 1
Project Overview
Project Researchers 1
AOP Progress
Progress Report
Publications & Presentations
International Travel Plans
EMMP & Site Visits
Project Photos
FIF Indicator Modules
Policies - 4.5.1-24
Short-term Training
Long-term Training - 4.5.2-6
Technology Transfer - 4.5.2-39
Started
Completed

Add Environmental Mitigation and Monitoring & Site Visits ✕
Use the form below to report a compliance support visit or upload EMMP documentation.

Type Environmental Compliance Support Visit
Is this a support visit report or EMMP documentation?

Attachments + Upload Files

Description
Please briefly describe each attachment and which monitoring activity it addresses.

Country Please select...

Site Location
Please provide the specific town or research station name.

Contacts
Please provide the specific names of people involved with and / or discussed with during this support visit.

Date of Visit [Calendar icon]
If your visit lasted more than one day, enter the first day.

Observations
Provide any key observations for fertilizers and pesticides in relation to safe procurement, transport, storage, container disposal, use of personal protective equipment, surface water runoff buffers, as well as any other relevant information.

Capacity Gap

X. Open Data Management Plan

SIIL submitted its first Data Management Plan to USAID in FY 2016. All subawards specified their plans for collection and curation of datasets, all of which will be made public according to ADS 579. The first submission of data/metadata to the USAID Data Development Library will take place in FY 2017.

XI. Governance and Management Entity Information

ME activities in FY 2016 have focused on engaging external partners, strengthening communication platforms, refining management practices and expanding in additional directions that enhance the SILL's mission.

A. Engagement of External Advisory Board (EAB)

The EAB served in a critical role in the selection of the SILL Research subawards portfolio. As outlined in the Plan for Monitoring Performance (PMP), the ME held its first Annual Meeting in January 2016 and invited the EAB to critique the research subaward presentations and suggest future considerations based on their expertise. During the Annual Meeting the EAB members were able to provide input, feedback, and insightful direction for the ME. The ME also held a one-day meeting with the EAB to discuss these issues, document key observations and seek future directions from the EAB for further consideration and guidance. The ME also provides a bi-monthly update that includes SILL programmatic and research updates, events and offers an opportunity for questions and/or concerns.

B. Strengthening Relationships with Partners

The SILL has continued to strengthen working relationships with all domestic and foreign partner management teams. Webinars and trainings were held with the regional and country coordinators, as well as administration and finance teams of the SILL partners to share knowledge in the areas of subaward management, timelines, reporting requirements, web hub reporting tools and post award accounting. Future administration and finance support visits will be organized to a few of our domestic university partners to meet with the principal investigators and their administration and finance support teams. Additional guidance notes have also been developed where relevant to address common issues.

C. Regional and Country Coordinator Activity

The SILL's regional and country coordinators (RC) are a key part of the ME team and regularly interface with the USAID mission offices and key project partners. The RCs have attended and continue to be invited to project launch events, USAID quarterly development partner meetings and other critical trainings to strengthen their relationship with key stakeholders. Each RC is also engaged in professional development activities and research endeavors in the host countries to augment their leadership and research skills. The ME has also provided additional capacity building activities for the RCs to strengthen SILL's communication, knowledge sharing and dissemination efforts.

D. Continued Expansion of Reporting Hub Tools

The SILL Resource and Reporting Hub has seen continued development throughout this fiscal year. The ME developed a new module to aid in the monitoring and implementation of SILL's Environmental Mitigation and Monitoring Plan (EMMP). This module allows PIs, Co-PIs, RCs and ME staff to document and address environmental issues observed in the field. Aligned with the new Data Management Plan requirement for ILs, the SILL ME also designed a Data Management module in the SILL Resource and Reporting Hub. This allows PIs to plan collection and dissemination of their datasets, which ultimately aids SILL's compliance with USAID's ADS 579.

E. Growth of SILL Communication Platforms

The communication platforms utilized by SILL were significantly expanded in FY 2016, both in number and level of engagement. A program blog was launched in June 2016 to showcase SILL activities and engage collaborators as well as the general public in conversations related to SI. There have been nearly 600 unique visitors to the blog since its inception, and a regular SILL newsletter highlighting top posts from the blog is disseminated to a growing network of interested individuals. The SILL website experienced growth as well, with nearly 19,000 views from 3,000+ unique visitors representing 109 countries in FY 2016. SILL is also active on social media networks including Twitter, Facebook and Instagram, allowing the program to reach a larger (1000+ individuals/week) and more diverse audience. The ME has plans for further expansion of communication efforts in FY 2017.

XII. Other Topics

A. Center of Excellence on Sustainable Agricultural Intensification and Nutrition (CE SAIN) at the Royal University of Agriculture

1. Goal

- (1) To create a Center of Excellence (CE) that will foster private sector innovation, agricultural research, education and training, and public sector capacity building through improved collaboration and knowledge sharing focused on improving food and nutritional security in Cambodia.
- (2) To meet this goal, a platform will be developed where scientists and practitioners from academia, government agencies, nongovernmental agencies and private companies can showcase their cutting edge technologies on sustainable agricultural intensification and nutrition to citizens, policy makers and donor agencies. CE SAIN will be the focal point for activities of Feed the Future Innovation Labs (ILs) in Cambodia and their partners, which will include education, research, communication and knowledge sharing, training, capacity building, and nutrition and gender studies. This center will foster a culture of innovation, leverage on-going activities and partners by playing a coordinating role between ILs, USAID/Cambodia, donors, and national public and private sector partners.

2. Key activities

- (1) Coordinate and leverage Feed the Future Innovation Lab activities.
Six FtF Innovation Labs (ILs) are currently active in Cambodia and working in the identified zone of influences (ZOI) on primary value chains identified by Feed the Future Cambodia. The common goal of the ILs is to conduct research and capacity building activities to address food and nutritional security in Cambodia. Some of these ILs have proven technologies that are ready for scaling by developmental partners. However, there is a lack of coordination between ILs, USAID/Cambodia, and Cambodian institutions and other partners to communicate and share knowledge. This has been due to the limited scope of the ILs' activities, which did not include resources for the transaction costs associated with communicating and collaborating with other ILs and organizations outside of their primary partnerships. Local universities and research organizations also have limited resources to better utilize and leverage IL activities to improve their own research and training capacity. Therefore, CE SAIN will be the hub for leveraging, synergizing, and coordinating of Innovation Labs, other donor projects and public and private institutions on the 'sustainable agricultural intensification and nutrition' theme.
- (2) Build human and institutional capacity of the Royal University of Agriculture.
As Cambodia's primary agricultural university, RUA serves as an important focal point for capacity development on research, education, and administration. CE SAIN will draw on the expertise and outputs of the ILs, which can strengthen the capacity of RUA in several areas:
 - Increase faculty education, research and extension capacity through long-term training and degree enhancement.
 - Create a business/innovation incubator associated with RUA to better train and connect students and faculty to private sector agri-business networks.
 - Strengthen RUA's capacity to deliver vocational and non-degree training to extension professionals, government and NGO employees, and farmers through the many US universities involved in Innovation Lab activities. This would fill specific gaps in the knowledge of working professionals and farmers.

- Provide technical expertise and research opportunities in the areas of sustainable agricultural intensification and nutrition related to horticulture, rice, livestock and aquaculture production.
 - Develop educational programs (courses, curriculum, and training) for secondary and tertiary students.
- (3) Establish Technology Parks to showcase high potential strategies and technologies that sustainably intensify smallholder agriculture production systems.
- Technology Parks have been successfully established by other USAID projects to demonstrate new and promising technologies and strategies, attract private-sector participation within research and farmer networks, and to organize innovation fairs, field days, and workshops. Technology Parks offer the opportunity to demonstrate individual technologies within a systems context in a field setting. CE SAIN will build five Technology Parks in different agro-hydro-ecological zones in Cambodia located in Battambang, Kampong Thom, Kampong Cham, Siem Reap and in Phnom Penh.

XIII. Issues

As indicated in the Semi-Annual Performance Report, there were no serious concerns during the reporting period. However, there were slight delays in the initiation of the research subawards due to multiple factors. The longest delay was with Pennsylvania State University, due personnel changes in their Sponsored Research Office as well as the development of the Anti-Trafficking Compliance Policy and Plan. Kansas State University has since developed an Anti-Trafficking Compliance Policy and SILL has developed an Anti-Trafficking Compliance Plan that is being shared with other Feed the Future Innovation Labs as well as the SILL subawardees.

Other issues are related to the varying degrees of political unrest in our focus countries, specifically Bangladesh and Ethiopia. The U.S. Department of State has requested heightened awareness when traveling to Bangladesh and has instituted restrictions for U.S. government personnel. Thus far, the SILL projects in Bangladesh are progressing with no known delays.

In regard to Ethiopia, the U.S. Department of State warns U.S. citizens to defer all non-essential travel to Ethiopia due to ongoing unrest, and the Government of Ethiopia declared a State of Emergency effective October 8, 2016. Thus far, the SILL projects in Ethiopia are in a holding pattern until the unrest subsides.

To address these issues, SILL is in the process of developing safety procedures and protocols in addition to the standard institutional policies. As part of standard practice, the management entity is in constant communication with the researchers and personnel engaged in the SILL projects to ensure safety issues are addressed and risks are minimized whenever possible.

These delays can potentially impact our budget pipeline, and corrective measures are currently being taken with discussion with our AOR from USAID.

XIV. Future Directions

A. Pursue Collaboration with the Feed the Future Innovation Labs

The SILL will continue to build synergies with the Feed the Future Innovation Labs at Kansas State University as well as the other IL's to leverage resources, coordinate efforts in focus countries, and share lessons learned. Particular attention will be given to the ILs engaged with CE SAIN activities to foster private sector innovation, agricultural research, education and training, and public-sector capacity building through improved collaboration and knowledge sharing in Cambodia.

B. Organize Regional Summits

The SILL will explore opportunities to organize regional summits (one per region) in FY 2017 and/or FY 2018 designed to showcase SILL's research projects, as well as serve as an information exchange with other entities working in the region. The regional summits could also provide capacity building opportunities that would include RCs, SILL ME, relevant PI's for that region, the consortia leaders, and members of the EAB or consortia steering committees within that region. Other invitees could include relevant stakeholders, ranging from farmers to development partners to NARS personnel, as well as USAID and private sector representatives. In addition to information exchange, the Regional Summits would be used to provide training to personnel on a selection of issues, including the use of geospatial tools, sustainable intensification practices, appropriate scale mechanization, grant writing, and effective means of technology transfer. Every effort would be made to meet in conjunction with other relevant conferences, workshops, or gatherings within the regions.

C. Implementation of the SI Indicator Framework

The SI Indicator Framework project intends to hold regional trainings for Research Subaward project teams to assist in the identification of the appropriate indicator per domain (productivity, economic, environmental, social, and human conditions). The SILL ME will engage with these efforts as appropriate to ensure the framework is a viable approach to assessing SILL's outcomes. If feasible, the SILL intends to integrate the SI Indicator Framework into the Reporting Hub data reporting systems to capture aggregate data for reporting and evaluation purposes.

Appendix A – List of Awards Given to U.S. universities

Title: Geospatial and Farming Systems Research Consortium

Awarded institution: University of California, Davis

Dates: September 16, 2014-September 15, 2019

Current year funding: \$1,000,000

Total funding: \$5,000,000

Title: Appropriate Scale Mechanization Consortium

Awarded institution: University of Illinois at Urbana-Champaign

Dates: October 1, 2015 -September 15, 2019

Current year funding: \$1,254,661

Total funding: \$4,700,000

Title: Unlocking the Production Potential of “Polder Communities” in Coastal Bangladesh through Improved Resource Use Efficiency and Diversified Cropping Systems

Awarded institution: Kansas State University

Dates: October 1, 2015 -September 15, 2019

Current year funding: \$249,958

Total funding: \$999,508

Title: Adoption of Sustainable Intensification in Dual-Purpose Millet - Leguminous Crops – Livestock Systems to Improve Food and Nutritional Security and Natural Resources Management for Rural Small Holder Farmers in Senegal

Awarded institution: Kansas State University

Dates: October 1, 2015 -September 15, 2019

Current year funding: \$253,755

Total funding: \$996,360

Title: Raising Crop Response: Bidirectional Learning to Catalyze Sustainable Intensification at Multiple Scales

Awarded institution: Michigan State University

Dates: October 1, 2015 -September 15, 2019

Current year funding: \$249,951

Total funding: \$996,764

Title: Women in Agriculture Network (WAgN) Cambodia: Gender- and Ecologically – Sensitive Agriculture

Awarded institution: Pennsylvania State University

Dates: October 1, 2015 -September 15, 2019

Current year funding: \$250,310

Total funding: \$1,000,000

Title: Evaluation of the Relationship Between Sustainably Intensified Production Systems and Nutritional Outcomes (SIPSIN)

Awarded institution: Texas A&M University

Dates: October 1, 2015 -September 15, 2019

Current year funding: \$249,369

Total funding: \$999,198

Title: Developing Indicators for Sustainable Intensification

Awarded institution: Columbia University

Dates: September 1, 2015- November 30, 2016

Current year funding: \$184,990

Total funding: \$184,990

Title: Developing Indicators for Sustainable Intensification

Awarded institution: Michigan State University

Dates: July 1, 2015 – September 30, 2016

Current year funding: \$140,938

Total funding: \$140,938

Appendix B – Success Stories

Success Story 1: East African Researchers Engage with SIIL Consortium in Spatial Data Workshop



Figure 1 - Geospatial and Farming Systems Research Consortium Director Dr. Robert Hijmans interacts with workshop participants in Arusha, Tanzania. (Photo credit: Jovin Lwehabura)

The [Geospatial and Farming Systems Research Consortium \(GSFRC\)](#) held its first short-term training event in Arusha, Tanzania with 46 early-career research and development professionals from across East Africa gathering to advance their skills in programming, modeling and mapping of spatial data. The workshop was organized by the Feed the Future Sustainable Intensification Innovation Lab, the [African Soil Information Service](#) and the [International Center for Tropical Agriculture](#).

Over 300 people applied to attend the workshop and 46 of East Africa's up-and-coming researchers were selected to attend; each showing both motivation and applicability of this training to their work. The training was free of charge and lodging and meals were provided. Participants traveled from Rwanda, Ethiopia, Kenya, Uganda, Mozambique, and Tanzania and had backgrounds ranging from agronomy, plant breeding and soil science to hydrology, climatology, wildlife conservation and virology.

[This five-day, hands-on workshop on data science](#) for agricultural development covered an introduction to [R software](#) and how to use R for data analysis and modeling with an emphasis on spatial data.

“R is a widely used programming language and software environment that has advanced capabilities for dealing with spatial and spatio-temporal data and provides unparalleled opportunity for analyzing such data,” Dr. Robert Hijmans, director of the GSFRC, said.

Participants learned how to integrate various data types and analytical approaches (e.g. machine learning and simulation modeling) into a single work flow and did so through case studies using climate, soils, crop, human health and remote sensing data.

The coursework was rigorous but motivation throughout the week was high as numerous participants shared just how important this skill set was to the advancement of their specific work. The coursework built upon an online training tool developed by Dr. Hijmans and his GSFRC team which provided a platform of examples and resources for the continuation of learning beyond the workshop and for those who were not able to attend.

Each day, there was an introductory lecture to a new topic followed by hands-on training. The linkage of the hands-on training with the online modules made it possible for participants to reference all tools once the course was over. These online modules also provided further guidance beyond what was feasible to work through during the course of a day by providing introductory discussions on each method, step-by-step trainings, example data sets for further practice, links to useful references and troubleshooting resources. This online resource is a tremendous tool to have as each of the participants return home and begin to apply what they learned to their specific research questions.

The GSFRC online platform has also compiled [geospatial data sets](#) as well as [country profiles](#) showing examples of what spatial data is available for each country and paired this with training on how to import and use such available spatial data sets for every participant’s own research.

The successful launch of this workshop leads into three more upcoming regional workshops across Sub-Saharan Africa and Southeast Asia.

Success Story 2: Intensifying Animal Husbandry Practices in Burkina Faso



Figure 2 - Dr. Millogo, Director of Appropriate Scale Mechanization Innovation Hub Burkina Faso and workshop participants with their new and improved yokes. Pictured Left to Right: Fankani Tchitchi, Millogo Vinsoun, Bognini Solange, Bonkian Thérèse, Bognini Mark (Photo Credit: Dr. Vinsoun Millogo)

Members of the [Appropriate Scale Mechanization Consortium \(ASMC\)](#) led the first hands-on training at their field training hub in Burkina Faso from September 5-16, 2016. It brought together smallholder farmers, local artisans and university students. The workshop was conducted by team members from [Michigan State University](#) in cooperation with [Tillers International](#).

In Burkina Faso, traditional yokes are still being used to team pairs of oxen. “These yokes are narrow, concentrating the pulling forces on a small area on the neck of the oxen, making long work days difficult and painful,” Elsa Kanner, Tillers International employee, said. Another problem facing farmers in this area is training. The animals are most receptive to training at a young age, but farmers are waiting until they are mature to begin the process. These factors combined make for uncooperative oxen, which require 2-3 workers to handle.

These old practices for yoke design and animal handling are not conducive to farm intensification that will benefit farmers economically and physically. Gentler animal training and more modern yokes would make the jobs of these farmers easier because the animals would be more willing to work. The ASMC and many farmers in Burkina Faso realize that improved animal-husbandry and yoke-construction techniques will lead to more intensified production with higher yields.

The goals for this training session were to demonstrate and teach gentle and responsive oxen-training techniques, introduce the training of oxen as young calves at three months of age and teach how to make yokes designed for specific oxen and tasks to allow the animals to supply tractive power throughout the day without

injury under the handling of only one farmer. These changes would not only improve productivity, but ease the physical burden of farmers and handlers to improve livelihoods.

The trainees were broken up into two groups, and participated in a four-day training workshop. Both groups contained farmers that were selected based on region, artisans from various areas who sell agricultural equipment to farmers and students from the [Institute of Rural Development at Polytechnic University of Bobo-Dioulasso](#).

“Our goal from the outset has been to involve both men and women farmers, extension educators, students and local artisans, as well as other stakeholders in the training and learning process,” Tim Harrigan, professor at Michigan State University, said. “This develops a participatory approach.”

Participants were uncertain at the beginning of the training, but they soon learned of success with new practices in short classroom learning sessions every morning. During these lessons, participants were able to observe the outcomes of improved yokes and animal-husbandry practices in the U.S., Mozambique, Uganda and other areas.

“This training was even more successful than we expected at the onset,” Dr. Vinsoun Millogo, a member of the ASMC in Burkina Faso who attended this workshop, said. “Every participant is going to make a yoke and train his or her oxen. The next steps are to share this with more people and continue to check animal health, feeding of oxen and use appropriate equipment.”

At the end of the training, the attendees had crafted about 20 new yokes that will help farmers improve precision, planting and weeding and help to intensify crop production. The new yokes are more flexible than the old and will be more comfortable for the oxen, making them more willing to cooperate.

Success Story 3: Graduate Student Seeks to Cultivate New Farming Practices in Bangladesh



Figure 3 A demonstration of machine transplanting of rice takes place in a polder community. (Photo provided by Krishna Jagadish)

Coastal Bangladesh is sinking. To protect the region and its inhabitants, embankments were built around the most vulnerable delta islands in the 1960s, creating polders. Though the polders have provided protection to the region's eight million inhabitants, they have created difficulty for the area's farming families. Graduate student Aaron Shew is working to change that.

According to Shew, the low farm productivity stems from water management issues. The nature of the polders requires water to be managed with sluices. In the dry season, the lack of fresh water in the rivers makes water sources too salty. In the rainy season, flooding wreaks havoc on crops.

"In the dry season, more than 90 percent of the farmland on the polders is fallow," Shew, an [environmental dynamics](#) doctoral student, said. "In the rainy season, rice crops frequently become submerged in water and die before they can be harvested." The Distinguished Doctoral Fellow believes these problems could be solved by finding crops better suited to the polders' unique environmental conditions. "Not enough has been done to determine what the viability of certain crops actually is," he said.

Shew's plan to address the polders' agricultural woes is three-fold. First, he wants to complete a land survey of one of the polders. He would use the information gathered to develop a topographical model outlining which crops should be grown in each region of the polder during both the rainy and dry seasons.

Second, he plans to complete a risk aversion survey of the region's farmers. This would give him a better idea of farmers' willingness to plant certain crops, and help him learn what barriers exist that may prevent them from adopting new agricultural practices.

The final step of the process is to provide insight into which training and educational programs can bridge the knowledge gap and facilitate the adoption of improved agricultural practices and technologies.

"The idea is to be able to tell a farmer what percentage of certain crops to plant in which areas, in order to avoid risk and maximize return, and then help them begin to implement those changes," Shew said.

Shew, who is advised by [Lanier Nalley](#), said his work in the Bangladeshi region has often raised more questions than answers, but said he finds enjoyment in the rewarding nature of the work he and his colleagues are producing.

"We're answering questions that aren't just being published in academic journals, where practical implications are often overlooked," Shew said. "We're using this research to answer questions that directly impact the livelihoods of people."

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