
**Feed the Future Innovation Lab for Soybean Value Chain Research**
**Soybean Innovation Lab, SIL**
**Annual Report**
**October 1, 2016 – September 30, 2017**

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Management Entity Information:
University of Illinois at Urbana-Champaign (UIUC)

Technical and/or Advisory Committee Information:
SIL has an Advisory Board of 10 individuals from the U.S. and Africa representing the public and private sectors with expertise in international soybean development and research; private sector and higher education investment and collaboration; and human and institutional capacity building.

1. Dr. Ken Dashiell, Deputy Director General for Partnerships and Capacity Building, International Institute for Tropical Agriculture
2. Dr. Brady Deaton, Chancellor Emeritus, University of Missouri
3. Dr. Robert Easter, President Emeritus, University of Illinois
4. Dr. Dan Gustafson, Deputy Director-General, Operations, Food and Agricultural Organization
5. Dr. Mark Keenum, President, Mississippi State University
6. Dr. Earl Kellogg, Senior Fellow, Association of Public and Land Grant Universities
7. Dr. Marc Linit, Associate Dean for Research and Extension, College of Agriculture, Food and Natural Resources, University of Missouri
8. Dr. Paul Rose, Owner, Sossi Company, Kenya
9. Dr. Abdulai Salifu, Former Director General, Council for Scientific and Industrial Research, Ghana
10. Angela Dee, Owner, Dee River Ranch Farms

Map or List of Countries Where the Project Works:
Please see below list of countries where we work.

List of Program Partners[1]:
In addition to SIL's direct collaboration with its core partners in its 5 project countries, the lab has expanded its network and services to additional practitioner groups engaged in soybean development. A comprehensive list of program partners to-date is reflected below.

- U.S.: 2Blades Foundation; DuPont Pioneer; Monsanto; MU; MSU; PHLIL; UMES; UGA; USDA/ARS
- Australia: CSIRO
- Benin: 2SCALE
- Brazil: Embrapa
- Colombia: Semillas Panorama S.A.
- Costa Rica: Costa Rica Seeds
- Cote d'Ivoire: Clinton Development Initiative (CDI)
- Ethiopia: EIAR; EthioChicken; Faffa Foods; Guts Agro Industries; Hilina Enriched Foods; Kunifira Agro-Processing; TechnoServe; USDA/FAS
- Germany: BASF
- Ghana: AA Pure Soy Milk Factory; ACDI/VOCA; BASF; CRS; CSIR; GTA; Green-Ef Eco Business Village; IFDC; IITA; MEDA; MoFA/Ghana; Omya International; RING; SADA; SFSA; Tamale Implement Factory; UDS; USAID/Ghana; WACCI; WFP
- Indonesia: SFSA
- Kenya: AATF; Greenspec Ltd.; IITA; KALRO; Omya International; SFSA
- Malawi: AATF; AgDiv; Alliance One; DARS; Exagris Africa; IITA; LUANAR; Philip Morris; SFSA; SunSeed; USAID/Malawi
- Mali: SFSA

[1] U.S. partners (e.g., universities, private sector, USDA) and international partners by country.

- Mozambique: IIAM; IITA
- Nicaragua: TechnoServe
- Nigeria: COB; IITA
- Pakistan: FAO; MNSUAM
- Rwanda: RAB
- South Africa: Sensako
- Switzerland: Omya International; SFSA
- Tanzania: CRS; IITA
- Uganda: Makerere University
- Zambia: IITA; Syngenta; ZamSeed
- Zimbabwe: AATF; Seed Co Ltd.; SFSA

Acronyms:

| | |
|---|---|
| AATF | African Agricultural Technology Foundation |
| ACDI/VOCA | Agricultural Cooperative Development International/Volunteers in Overseas Cooperative Assistance |
| CDI | Clinton Development Initiative |
| CGIAR | Consortium of International Agricultural Research Centers |
| COB | Church of the Brethren |
| CRS | Catholic Relief Services |
| CSIR | Council for Scientific and Industrial Research |
| CSIRO | Commonwealth Scientific and Industrial Research Organisation |
| DARS | Department of Agricultural Research Services |
| EIAR | Ethiopian Institute of Agricultural Research |
| FAO | Food and Agriculture Organization of the United Nations |
| FRI | Food Research Institute |
| GAIN | Global Alliance for Improved Nutrition |
| GHS | Ghana Health Services |
| GCP | Generation Challenge Programme |
| GTA | Ghana Tourism Authority |
| IBP | Integrated Breeding Platform |
| IFDC | International Fertilizer Development Centre |
| IIAM | Mozambique Institute of Agricultural Research |
| IITA | International Institute of Tropical Agriculture |
| IT | Information Technology |
| JARC | Jimma Agricultural Research Center |
| KALRO | Kenya Agricultural & Livestock Research Organization |
| LUANAR | Lilongwe University of Agriculture and Natural Resources |
| MRA | Managed Research Area |
| MEDA | Mennonite Economic Development Associates |
| MoFA | Ministry of Agriculture |
| MNSUAM | Muhammad Nawaz Sharif University of Agriculture |
| MS | Master of Science |
| MSU | Mississippi State University |
| MU | University of Missouri |
| NARS | National Agricultural Research System |
| NGO | Non-Governmental Organization |

| | |
|---|---|
| PHLIL | Post-Harvest Loss Innovation Lab |
| RAB | Rwanda Agricultural Board |
| RING | Resiliency in Northern Ghana |
| SADA | Savannah Accelerated Development Authority |
| SARI | Savanna Agricultural Research Institute |
| SFSA | Syngenta Foundation for Sustainable Agriculture |
| SIL | Feed the Future Innovation Lab for Soybean Value Chain Research (Soybean Innovation Lab) |
| SMART | Soybean Management with Appropriate Research & Technology |
| SUNS | Soybean Uptake & Network Survey |
| SSA | Sub-Saharan Africa |
| TIF | Tamale Implement Factory |
| UDS | University for Development Studies |
| UGA | University of Georgia |
| UGL | University of Ghana Legon |
| UIUC | University of Illinois at Urbana-Champaign |
| UMES | University of Maryland Eastern Shore |
| USAID | United States Agency for International Development |
| USDA/ARS | United States Department of Agriculture Agricultural Research Service |
| USDA/FAS | United States Department of Agriculture Foreign Agriculture Service |
| WACCI | West Africa Centre for Crop Improvement |
| WEAI+ | Soy-adapted Women's Empowerment in Agriculture Index Survey |
| WFP | World Food Prize |

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# Contents

**Feed the Future Innovation Lab for Soybean Value Chain Research**
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## I. Executive Summary

The Feed the Future Innovation Lab for Soybean Value Chain Research (Soybean Innovation Lab, "SIL") continues to expand its portfolio of research-for-development (R4D) products. As a lab, we successfully engage with soybean development practitioners in Sub-Saharan Africa (SSA) and in other regions to scale these R4D products, reaching thousands of farmers. Further, the team continues to develop new activities and engagements that effectively build the technical, evidence-based, and scientific foundation to enable the development of soybean in SSA to improve smallholder farmer profitability and nutrition, and generate regional economic growth.

In this Executive Summary we focus on new and burgeoning activities, while activities noted in previous annual reports continue on track. SIL embarked on a partnership with the Agricultural Diversification (AgDiv) project of Malawi to expand the Pan-African Soybean Variety Trials to 9 locations in Malawi in collaboration with IITA and two private seed companies. Each location will trial approximately 30 different commercial and pre-commercial soybean varieties from various public and private sector partners spread across the globe, representing both public and private sector partners. SIL and its collaborators leverage their roles as independent third parties as well as their unique access to international, regional, and national supplies of high-yielding and disease resistant germplasm. The team's ability and experience in operating high-quality, formal trials provides a transparent platform necessary for smallholder farmers to access improved seeds that perform well in their local environments. The Pan-African trials "fast track" the introduction and testing of commercial soybean varieties in order to provide local seed companies, farmers, seed buyers, and others with access to a broader selection of seed than what is currently available.

Also in Malawi, SIL partnered with AgDiv to develop a training-of-trainer model to cascade nutrition education to eight different regions in Malawi through forty NGO personnel. The training focused on dietary diversity, integration of soy foods into local dishes, and food safety concepts taught in a village-level setting where large numbers of people can be reached with potentially limited literacy. The SIL-AgDiv collaboration also involves business training for new soy dairy establishments and detailed metrics of the inputs and outputs of the soy dairies. Through this effort, SIL can assess the barriers to making these businesses sustainable and work with the soy dairy entrepreneurs to develop solutions to their production and marketing challenges.

This year, SIL expanded its Soybean Kick-off and Soy Food Bazaar events to Ethiopia, drawing over 300 attendees, 20 different presenters and exhibitors involved in the Ethiopian soybean industry to both events. The Soybean Kick-off event showcased the new SIL agronomic soybean research farm (Soybean Management with Appropriate Research and Technology (SMART) farm), thresher mechanization, and soybean breeding for new, high-yielding and disease resistant soybean varieties at the Jimma Agricultural Research Center (JARC) in Jimma, Ethiopia. Both events featured delicious soy lunches and snacks. The Soy Food Bazaar was held in Addis Ababa and featured exhibitors from the Ethiopian soy foods industry, a soy industry panel session, nutrition presentations, and the first steps towards the development of a soy foods industry in Ethiopia.

Finally, the SIL perfected the development of its low-cost, locally produced and small-scale soybean thresher in northern Ghana. In field testing, the SIL-designed thresher performed better than other locally produced and imported threshers, and at 8,000 Ghanaian Cedis (GHC), the SIL thresher is cost-effective for smallholder farmers. The thresher can be operated by only two people, has zero loss in both soybean and maize, uses 1.1 L of diesel per hour and saves over 40 man hours when compared to manual (stick) threshing. Further, no seed cracking was observed. The thresher thus improves on labor, seed and grain quality, and profitability for smallholder farmers engaged in soybean production. The next steps are for SIL to develop a business model and business plan to roll out the perfected thresher design to thousands of farmers in northern Ghana, and throughout SSA.

## II. Program Activities and Highlights[2]

- 231 lines tested in low-latitude and adaptation research in 2016 & 2017 field trials in Ghana
- Developed low-processing Jenguma variety through leveraged winter nursery in Costa Rica
- Developed first of its kind "Field Guide to African Soybean Diseases and Pests"
- Provided 550 accessions & 350+ breeding lines and populations sources from SIL global network
- Pan-African Soybean Variety Trial Program in 3 countries, expanding to 5 additional in 2018
- Provide mechanization and equipment (threshers, vehicles, push planters, envelopes, crossing supplies) and associated training to support 3 African soybean breeding programs
- Soybean disease management; safe pesticide application, storage and personal protection; soybean crossing; and marker-assisted selection training
- Delivered 4 new courses & 2 modules for SIL/WACCI Plant Breeding & Genetics Master's Degree Program; mentored junior WACCI faculty (participation in the Africa Plant Breeding Academy)
- Implemented 2nd year of graduate internship program for UG/WACCI students in plant breeding with funding from USAID/Ghana 2016 (177,635 USD) & 2017 (up to 672,365 USD) internships
- 9 graduate students participated in total between 2016 and 2017.
- Conducted field experiments studying soybean root morphology in low-Phosphorous soil contexts
- Trained 12 blacksmiths to produce local, small-scale soybean threshers and started 2-year study on thresher utility; Gained African licensing rights to Oggun tractor & Morrison seeder; created appropriate-scale mechanization for Africa network, reaching over 200 relevant organizations.
- Scaled SIL Soybean Success Kits to 20,000 farmers in northern Ghana thru partnership with IFDC
- Conducted 3rd year of research at SMART Farm and engaged in 2 new public-private partnerships testing low-bulk lime, herbicide, and inoculum products; expanded SMART Farm to Ethiopia
- Conducted soy-utilization trainings in Mozambique and a Train-the-Trainer program for NGOs in Malawi; Conducted soy dairy establishment trainings for 30 entrepreneurs in Malawi
- Created first-ever soy food recipe database showcasing 200+ soy food recipes worldwide
- Expanded Soy Dairy Entrepreneur Network from 5 core to 30 members in 9 countries
- Conducted early childhood nutrition study of soy and orange-flesh sweet potato-enhanced complementary food products among 200+ mother-infant pairs in northern Ghana
- Produced Mozambique & Ghana WEAI+ Data Summary Reports & Research in Action briefs on Soybean Seed Access and Practice & Women in Leadership
- Fielded SIL's Gender Responsive Agricultural Development Assessment (GRADA-SIL)
- Conducted focus groups on soy uptake & ICT; fielded WEAI+ & Soybean Uptake and Network Survey in Mozambique & Ghana; and started Network Pilot Survey (NPS) & Tasty! Mozambique Project
- Established SARI-SIL Environmental Analytical Lab (changed lab financing structure; provided basic training & standardization; provided personal protective & new equipment for new capabilities)
- Collected household & water source samples and conducted analysis in 2 districts of northern Ghana reaching 309 households; supported CRS & SARI to conduct monthly sampling and analysis
- Produced 50+ webinars reaching 1,200+ registrants in 20+ countries
- Implemented 2nd & 3rd annual Soybean Kick-off & 1st & 2nd annual Soy Food Bazaar Events in Ghana & 1st annual Soybean Kick-off & Soy Food Bazaar Events in Ethiopia
- Long-term training with 39 individuals; short-term training of 1,863 producers, 158 people in government, 82 people in private sector firms, and 1,011 people in civil society; 56 public-private partnerships
- Achieved $1,681,153.63 in new funding

[2] Summary of program activities for the year, no more than one page in length.

## III. Key Accomplishments[3]

- African breeders have testing genes identified so they can now more efficiently and effectively manage their breeding programs when crossing with newly introduced, high-yielding and disease resistant materials.
- African seed companies and the African soybean processing industry will now have access to a new, locally adapted variety that is less costly to process, improving the efficiency of the feed and food industries in Sub-Saharan Africa.
- Practitioners are able to identify and manage diseases and pests that reduce yield among Sub-Saharan Africa soybean farmers through the SIL "Field Guide to African Soybean Diseases and Pests"
- Local seed producers and the burgeoning soybean industries now have immediate access to adapted, high performing and commercially ready new varieties for their marketplace.
- African soybean breeders, and their technical teams, gain much-needed training and mentoring with the purpose of dramatically improving the productivity and output of their breeding programs, in a sustainable way. Integrated Breeding Platform provides 1) Seed inventory; 2) Field book; 3) Molecular marker set; and 4) SIL project database. African Plant Breeding Academy trained on genomics-based approaches to cultivar improvement.
- Through the SIL/WACCI Plant Breeding & Genetics Master's Degree Program, SIL delivered 4 new courses and 2 modules and mentored the junior WACCI faculty in the process.
- WACCI interns interfaced with the seed industry and other innovative product development programs and were introduced to the seed industry (pipeline process, scale, technology applications) and to various cultivar improvement techniques.
- 150 soybean lead women farmers, affecting 10,000 female soybean growers were trained in quality seed production. This training reflects the SIL research-for-development strategy where SIL technical support enabled practitioners, in this case the MEDA technical team, to successfully deliver on their objective of delivering improved seed technologies to 10,000 female soybean growers.
- Practitioners, for example the national agricultural research systems of Ghana & Mozambique and the MEDA technical team, were able to successfully deliver on their objectives of improving the agronomic practices of their beneficiary farmers through SIL-developed guides & extension publications for soybean development.
- Private-sector fabricators, blacksmiths and equipment manufacturers received the necessary training and transformative design to enable them to produce a low-cost, locally produced, and appropriate-scale thresher for use by smallholder farmers.
- Practitioners, agricultural development organizations and governments received evidence-based technical guidance on soybean production, replacing anecdotal information with regular, formal, and scientifically produced findings through the SIL SMART Farm.
- Through public-private partnerships at the SIL SMART Farm, partner companies receive high quality and formal testing of their soybean technologies, enabling their entry into new markets.

[3] Concise statement of achievements, linked to relevant section of annual workplan and Performance Management Plan, limited to one page in length that focuses on outputs, not process, such as Feed the Future indicators and distillation of program achievements across all program activities. Reporting on numbers of project meetings is not an output. Include how it links to the Performance Management Plan.

## IV. Research Program Overview and Structure

The mission of SIL is to provide soybean technical knowledge and innovation to directly support practitioners engaged in soybean production in the tropics. Practitioner groups include researchers, private sector firms, non-governmental organizations, extensionists, agronomists, technicians and farmer associations tasked with soybean development. SIL focuses its efforts on four key research pillars that comprise the essential components of sustained production, improved utilization and sustainable market linkages for soybean development:

- Pillar I: Genetic Improvement
- Pillar II: Crop Productivity and Quality
- Pillar III: Nutrition
- Pillar IV: Value Chains & Socio-Economic Research

To accomplish this mission SIL brings together leading U.S. and African soybean researchers, both natural and social scientists, to provide a sound research foundation to achieve the development to commercialization process of soybean in sub-Saharan Africa (SSA). SIL's approach is to listen and understand the needs of soybean practitioners, then design activities that provide the answers that lead to success. Our technical experts cross the entire soybean value chain from germplasm management, seed systems and agronomic practice to storage, processing, nutrition, and value chain economics.

The SIL is comprised of strong natural and social science research that is fundamental to soybean development. The concept of a research foundation is meant to symbolize, as well as literally serve as, the basis on which the soybean development to commercialization process can go forward. The research and learning outputs, such as germplasm development, plant breeder training, inoculum investigation, agronomic guidelines, and characteristics of economically sustainable soybean production, provide organizations along the value chain the critical information needed for investment, decision-making, and enterprise development.

The SIL is based on an integrated modular design that maximizes collaboration among consortium members and stakeholders with the SMART Farm as its platform. The modularity allows specific programs to be expanded, extended, and replicated in other regions and countries and provides the flexibility needed in order to adapt to in-country needs according to each country's current levels of soybean breeding, education, production, utilization, market development, and equitable access. All the modules play an important role in understanding the drivers of a sustainable soybean system.
SIL comprises four foundation pillars of activity. SIL researchers focus on nine Managed Research Areas (MRAs), led by the PIs at the primary SIL institutions the University of Illinois, University of Missouri, Mississippi State University and the University of Georgia:

- MRA 1 Plant Breeding and Germplasm: Brian Diers and Randy Nelson, University of Illinois
- MRA 2 Grain and Seed Quality: Kristin Bilyeu and Kerry Clark, University of Missouri
- MRA 3 Production and Agronomy: Dan Reynolds and George Awuni, Mississippi State University
- MRA 4 Plant Breeder Education: Rita Mumm, University of Illinois
- MRA 5 Utilization for Human Nutrition: Juan Andrade and Margaret Cornelius, University of Illinois
- MRA 6 Utilization for Livestock Nutrition: Mike Lacy, University of Georgia
- MRA 7 Gender Impacts: Kathleen Ragsdale and Mary Read-Wahidi, Mississippi State University
- MRA 8 Economic Impacts: Jill Findeis, University of Missouri
- MRA 9 Environmental Impacts: Jeremy Guest, University of Illinois
- MRA 10 Seed Systems: Dennis Thompson, University of Illinois

## V. Research Project Report[4]

### Objective 1: Genetic Improvement

i. Description: SIL collaborates with IITA and the NARS in SSA to establish a sound foundation for soybean breeding and improve the supply of high-quality soybean seed in Africa. SIL breeding partners are developing new cultivars that are resistant to soybean rust and bacteria pustule, can more efficiently fix nitrogen, can better tolerate the low phosphorus levels commonly found in tropical soils, can be easily processed for household consumption, and can produce high yields in local settings. Complementary investments are also being made in equipment, mechanization, training, and process improvement to enable the public breeding community to scale up their breeding programs to meet the rapidly changing needs of African soybean farmers. SIL also engages with the CGIAR GCP's IBP to create a soybean-specific module to support project breeders in crop improvement activities including phenotypic evaluation and deployment of marker-assisted selection. SIL developed the region's leading Master's Program in Plant Breeding at the UGL/WACCI to increase the pool of quality-trained individuals to manage African soybean research programs. SIL's Pan-African soybean varietal trial program provides transparent testing of commercially-available varieties to identify new varieties from other countries/regions for smallholder farmers.

ii. Locations: Ghana, Ethiopia, Zambia and Malawi

iii. Collaborators:
   a. Individuals – Francisca Addae-Frimpongmaa, Benjamin Ahiabor, Ian Barker, Kristin Bilyeu, Saaka Buah, Godfree Chigeza, Nicholas Denwar, Brian Diers, Patrick Elia, Felix Fritschi, Glen Hartman, Dominik Klauser, Carrie Miranda, Rita Mumm, Randy Nelson, Andrew Scaboo, Abush Tesfaye, Jeremy Venable
   b. Institutions – AgDiv, IITA, JARC, MU, SARI, SFSA, UIUC, USDA/ARS

iv. Achievements:
   a. 231 lines tested in low-latitude and adaptation research in 2016 & 2017 field trials in Ghana
   b. Low-processing Jenguma variety developed through leveraged winter nursery in Costa Rica
   c. First of its kind "Field Guide to African Soybean Diseases and Pests" developed
   d. 550 accessions & 350+ breeding lines and populations provided from SIL global network
   e. Pan-African Soybean Variety Trial Program active in 3 countries, expanding to 5 additional in 2018
   f. Mechanization and equipment (threshers, vehicles, push planters, envelopes, crossing supplies) and associated training provided to support 3 African soybean breeding programs
   g. Soybean disease management
   h. Safe pesticide application, storage and personal protection
   i. Soybean crossing
   j. Marker-assisted selection training given
   k. 4 new courses & 2 modules for SIL/WACCI Plant Breeding & Genetics Master's Degree Program given
   l. Junior WACCI faculty (participation in the Africa Plant Breeding Academy) mentored

[4] These should be one page per project, limited to summaries of project objectives, key activities, highlights and process toward outcomes (not scientific reports or long detailed research papers).

m. 2nd year of graduate internship program for UG/WACCI students in plant breeding implemented
n. Field experiments studying soybean root morphology in low-Phosphorous soil contexts conducted

v. Capacity Building:
   a. Individuals – direct mentorship of soybean breeding leads and WACCI student cohorts
   b. Institutions – infrastructure (irrigation, seed lab), equipment, mechanization and IT connectivity support

vi. Lessons Learned: Focusing at the foundational level at the NARS & IITA affects the downstream seed system in terms of developing new, high-yielding and disease-resistant varieties; improving seed and grain quality; farmer profitability; and regional economic growth.

vii. Presentations and Publications[5][6][7][8]

[5] http://soybeaninnovationlab.illinois.edu/sites/soybeaninnovationlab.illinois.edu/files/Field%20Guide%20to%20African%20Soybean%20Diseases%20and%20Pests.pdf
[6] http://soybeaninnovationlab.illinois.edu/resources-15
[7] https://uofi.app.box.com/s/m1lz8ej6oy7xbyjqbxn01poa3qdmmiwi
[8] http://soybeaninnovationlab.illinois.edu/sites/soybeaninnovationlab.illinois.edu/files/High-Yielding%20Varieties%20Fact%20Sheet.pdf

## Objective 2: Crop Productivity and Quality

i. Description:
The SIL SMART (Soybean Management with Appropriate Research & Technology) Farm is a knowledge and technology hub, providing farmers, practitioners, agricultural development organizations and governments with evidence based technical guidance on soybean production. The SMART Farm replaces anecdotal guidance with regular, formal, and scientifically produced guidance for the industry, while simultaneously engaging in deep capacity and institution building with its in-country partners. The SMART Farm evaluates issues related to germination, planting date, soil amendments including phosphorous and inoculum, planting methods and varietal performance. The Farm serves as a hub for research related to seed quality, soil improvement, and nodulation, and involves capacity and institution building as the SIL team works hand-in hand with local researchers and technicians. The SMART Farm provides a distinct platform for public-private partnerships, offering transparent and reliable testing for agricultural products, innovations and technologies. Current public-private partnerships include trialing Calciprill, a low-bulk liming product, for Omya and trialing herbicide and inoculum products for BASF. SIL also engages with local fabricators and blacksmiths to develop and field-test locally-produced, low-cost and small-scale soybean (and multi-crop) threshers. SIL's thresher design improves on labor, seed and grain quality, and profitability for smallholder farmers engaged in soybean production. The next steps are for SIL to develop a business model and business plan to roll out the perfected thresher design to thousands of farmers in northern Ghana, and throughout SSA.

ii. Locations: Ghana, Ethiopia

iii. Collaborators:
   a. Individuals – Gabriel Abdulai, Mawuli Asigbee, Philip Atiim, George Awuni, Kerry Clark, Dan Reynolds, Abush Tesfaye
   b. Institutions – CRS, JARC, MSU, MU, SARI

iv. Achievements:
   a. Conducted 3rd year of research at SMART Farm and engaged in 2 new public-private partnerships testing low-bulk lime, herbicide, and inoculum products; expanded SMART Farm to Ethiopia
   b. Trained 12 blacksmiths to produce local, small-scale soybean threshers and started 2-year study on thresher utility; Gained African licensing rights to Oggun tractor & Morrison seeder; created appropriate-scale mechanization for Africa network, reaching over 200 relevant organizations.
   c. Scaled SIL Soybean Success Kits to 20,000 farmers in northern Ghana thru partnership with IFDC
   d. Perfected the development of a low-cost, locally produced and small-scale soybean thresher that is cheaper and performs better than other locally produced and imported threshers. The SIL-designed thresher can be operated by only two people, has zero loss in both soybean and maize, uses 1.1 L of diesel per hour and saves over 40 man hours when compared to manual (stick) threshing. Further, no seed cracking was observed.

viii. Capacity Building:
   e. Individuals – fabrication & business training in soybean thresher development
   f. Institutions – mentorship and training on the scientific rigor behind the SMART farm (as compared to more commonly used demonstration plots) in producing evidence-based, scientifically valid soybean agronomic guidance

v. Lessons Learned: SIL findings from the SMART farm and thresher design enable practitioners (NGOs, extensionists, the private sector) to successfully deliver on their objective of improving soybean production among their beneficiary farmers.

vi. Presentations and Publications[9][10][11][12][13]

[9] http://soybeaninnovationlab.illinois.edu/sites/soybeaninnovationlab.illinois.edu/files/SMART_2016_Report_0.pdf

[10] http://soybeaninnovationlab.illinois.edu/sites/soybeaninnovationlab.illinois.edu/files/Improving%20Mechanization%20Fact%20Sheet.pdf

[11] http://soybeaninnovationlab.illinois.edu/sil-thresher-mechanization

[12] http://soybeaninnovationlab.illinois.edu/sites/soybeaninnovationlab.illinois.edu/files/SIL%20Thresher%20O%26M%20manual_0.pdf

[13] http://soybeaninnovationlab.illinois.edu/sites/soybeaninnovationlab.illinois.edu/files/Thresher%20Design%20and%20Operation%20Manual%201.0_0.pdf

## Objective 3: Nutrition

i. Description: The focus of the soy for human nutrition research area is to 1) Integrate soy's high quality protein into diets of malnourished communities by adapting diverse forms of soy to local cuisines and flavors; 2) Promote soy utilization at the household level through NGO-capacity trainings on food processing, food safety, and nutrition education; 3) Introduce soy to national school lunch programs and other institutional feeding programs through food processing instruction, soy food supplier networking, and policy lobbying; 4) Establish and support soy food micro-enterprises through training on equipment use, food safety and packaging, marketing, FDA certification, and business development; and 5) Increase production capacity of medium and large-scale soy processing plants to increase market availability of soy foods.

ii. Locations: Benin, Ethiopia, Ghana, Malawi, Mozambique

iii. Collaborators:
   a. Individuals – Yussif Abubakari, Flora Amagloh, Francis Amagloh, Juan Andrade, Mawuli Asigbee, Margaret Cornelius, Frank Peget, Mary Glover, Maggie Muzungu, Joseph Osei, Edison Rwodzi
   b. Institutions – AA Pure Soy Milk, AgDiv, CRS, CSIR-SARI, CSIR-FRI, UDS, UIUC

iv. Achievements:
   a. Conducted soy processing and utilization Train-the-Trainer program for NGOs in Malawi
   b. Created first-ever soy food recipe database showcasing 200+ soy food recipes worldwide and expanded Soy Dairy Entrepreneur Network from 5 core to 30 members in 9 countries; and developed a curriculum and course book developed from Network research and expertise to promote sustainable enterprises among 30 entrepreneur trainees using 5 SoyCows and 30 SoyaKits
   c. Conducted early childhood nutrition study of soy and orange-flesh sweet potato-enhanced complementary food products among 200+ mother-infant pairs in Ghana
   d. Soy for Human Nutrition lectures delivered to over 200 people at 6 research institutes and government ministries in Ghana and Malawi to promote local research and awareness on the subject
   e. Developed recipes for Ghana School Lunch Program supplemented with soy that stayed within the Program's budget of 80 Ghanaian Cedis/child
   f. Led a pilot training for 12 School Lunch Caterers in the Tamale Metro Area including nutrition training led by UDS faculty member and recipe training led by Accra-based chef
   g. Conducted trainings with new soy dairy entrepreneurs about equipment utilization, business development, food safety, packaging, FDA certification, marketing, branding
   h. Conducted soy food industry promotional events (including 3 Soy Food Bazaars with over 450 people in attendance and 40 local entrepreneurs with industry booths) to network industry stakeholders involving the public and private sectors to highlight soy's benefits to human and livestock nutrition, promote patronage of local soy food businesses and expanded soy food entrepreneurship, and promote the integration of soy into government policies and development work
   i. Received buy-in from Agriculture Diversification/Malawi to establish 5 new soy dairies

v. Capacity Building:
   a. Individuals – entrepreneur, NGO staff training, and caterer training
   b. Institutions – training on the role of soy foods in school lunch programs and early child nutrition programs and highlighting the importance of developing benchmarking and data collection for sustainable soy dairy enterprises

vi. Lessons Learned: Business training and benchmarking are critical too establishing sustainable soy dairy enterprises; highlighting the economical role of soy protein in school lunch and early child nutrition feeding programs can ensure policy and government buy-in.

vii. Presentations and Publications[14][15][16][17]

[14] http://soybeaninnovationlab.illinois.edu/soy-food-recipe-database
[15] http://mailchi.mp/illinois/just-released-july-2017-soybean-innovation-lab-newsletter
[16] http://soybeaninnovationlab.illinois.edu/files/Soy%20Dairy%20Weekly%20Report%20%233_0.pdf
[17] http://soybeaninnovationlab.illinois.edu/soy-dairy-businesses-ghana-improve-nutrition-and-create-economic-development

## Objective 4: Value Chains & Socio-Economic Research

i. Description:
Women play a critical role in agricultural growth in developing countries, yet they face persistent obstacles and economic constraints. It is widely recognized that men and women farmers have different needs, priorities, access to resources, and decision-making power. In sub-Saharan Africa, women smallholder farmers are vulnerable to inequalities in access to resources, education or training, and power over agricultural decision-making. SIL's Socioeconomic/Gender Equity research team uses the Women's Empowerment in Agriculture Index (WEAI), developed by the International Food Policy Institute (IFPRI), to better understand and address the issues for women smallholder farmers adopting soybean. The WEAI is the first-ever measure to directly capture women's empowerment and inclusion levels in the agricultural sector. The index measures the empowerment, agency, and inclusion of women in the agriculture sector in an effort to identify ways to overcome those obstacles and constraints. The WEAI+ is a modified version of the original framework, and includes questions specific to soybean production. The adapted instrument addresses how: a) women smallholder farmers compare to men smallholder farmers in terms of empowerment across the WEAI's five domains of agriculture, and b) how women smallholder farmers compare to men in terms of soybean cultivation, access to soybean seed, and related outcomes. The goal of using the extra modules is to better capture farmers' past experiences with soybean production, including seeding access, varieties planted, planting methods, and use of inputs like fertilizers, inoculants, and pesticides. Soy-specific results from the survey will provide guidance on how policy actions can increase women's empowerment in soybean production.

ii. Locations: Ghana, Mozambique

iii. Collaborators:
   a. Individuals – Mawuli Asigbee, Jill Findeis, Nina Furstenau, Magalhaes Miguel, Fridah Mubichi, Emmanuel Osei-Mensah, Maria da Luz Quinhentos, Kathleen Ragsdale, Mary Read-Wahidi, Audrey Reid, Ewurabena Yanyi-Akofur
   b. Institutions – CRS, IIAM, MSU, MU

iv. Achievements:
   a. Produced Mozambique & Ghana WEAI+ Data Summary Reports & Research in Action briefs on Soybean Seed Access and Practice & Women in Leadership
   b. Fielded SIL's Gender Responsive Agricultural Development Assessment (GRADA-SIL)
   c. Conducted focus groups on soy uptake & ICT
   d. Fielded WEAI+ & Soybean Uptake and Network Survey in Mozambique & Ghana
   e. Started Network Pilot Survey (NPS) & Tasty! Mozambique Project

v. Capacity Building:
   a. Individuals – adaptation of the WEAI survey instrument for use by other soybean development practitioners and through training of NARS and CRS in survey development, implementation, and gender equity issues. Further, through the development of the GRADA survey tool that assesses gender equity within institutions.
   b. Institutions – enumerator training and through building awareness among research institutions, development agencies and other soybean practitioners about the importance of gender equity within their programs.

vi. Lessons Learned: Results from both countries suggest that women smallholder farmers can and do participate in soybean value chains, but additional efforts to ensure their continued inclusion could have important pay-offs. Cultural norms in both countries also have an impact on the kinds of resources and information to which women had access. The GRADA-SIL results indicate

that certain MRAs within the SIL program should be targeted for outreach to better incorporate gender equity into that MRA's activities.

vii. Presentations and Publications[18][19][20][21][22][23]

[18] http://soybeaninnovationlab.illinois.edu/sites/soybeaninnovationlab.illinois.edu/files/A%20COMPARATIVE%20STUDY%20BETWEEN%20MOZAMBIQUE%20AND%20MALAWI%20SOYBEAN%20ADOPTION%20AMONG%20SMALLHOLDER%20FARMERS.pdf

[19] http://soybeaninnovationlab.illinois.edu/sites/soybeaninnovationlab.illinois.edu/files/ICT%20USE%20BY%20SMALLHOLDER%20FARMERS%20IN%20RURAL%20MOZAMBIQUE-%20A%20CASE%20STUDY%20OF%20TWO%20VILLAGES%20IN%20CENTRAL%20MOZAMBIQUE.pdf

[20] http://soybeaninnovationlab.illinois.edu/sites/soybeaninnovationlab.illinois.edu/files/WEAI%20MozambiqueJan2017_1.pdf

[21] http://soybeaninnovationlab.illinois.edu/sites/soybeaninnovationlab.illinois.edu/files/Research%20in%20Action%20-%20Soybean%20Seed%20Access%20and%20Practice.pdf

[22] http://soybeaninnovationlab.illinois.edu/sites/soybeaninnovationlab.illinois.edu/files/Ragsdale_ICT4AgD%20Report_0.pdf

[23] http://soybeaninnovationlab.illinois.edu/sites/soybeaninnovationlab.illinois.edu/files/Ragsdale_WEAI%2BGH%20YR1_Prelim%20Report_120815%282%29_0.pdf

## VI. Human and Institutional Capacity Development[24]

a) Short-term training

| Country of Training | Brief Purpose of Training | Who was Trained[25] | Number Trained[26] | | |
|---|---|---|---|---|---|
| | | | M | F | Total |
| Ghana | Quality Seed Production | MEDA Lead Women Farmers | 0 | 150 | 150 |
| Ghana | Soybean Agronomics (Soybean Kick-off) | MEDA Lead Women Farmers, MEDA Extension Staff, Private Sector, SIL/CRS Soybean Success Kit Farmers, SARI research scientists & technicians, Ghanaian Ministry of Agriculture Extensionists, NGO/PVO groups | | | 188 |
| Ghana | Soybean Utilization (Soy Food Bazaar) | SARI research scientists & technicians, Ghanaian Ministry of Agriculture, Health & Education Staff, Private Sector, NGO/PVO groups | | | 147 |
| Ghana | SARI On-Farm Demonstrations | Smallholder Farmers | 252 | 158 | 410 |
| Ghana | Soybean Success Kit Extension | Smallholder Farmers | | | 1,200 |
| Ghana | Environmental Analytical Lab – Financials, Data Analysis, Equipment Utilization | SARI research scientists & technicians | 9 | 7 | 16 |
| Ghana | SMART Farm | SARI research scientists & technicians | | | 30 |
| Ghana | Pesticide Application, Storage & Personal Protective Equipment | SARI research scientists & technicians | | | 9 |
| Ghana | Soybean Disease Management | SARI research scientists & technicians | | | 30 |
| Ghana | Refresher Training in Production of Locally-produced Thresher | Blacksmiths, artisans, fabricators | 12 | 0 | 12 |
| Ghana | Household Water & Soil Data Collection for Environmental Impact Assessment | Enumerators | 12 | 2 | 14 |
| Ghana | Early Child Nutrition Data Collection for Acceptability & Feasibility Study | Enumerators | | | 18 |
| Ghana | Soybean Low-Latitude Research Design | SARI technician | 1 | 0 | 1 |
| Ghana | SMART Farm Management | SARI technician | 0 | 1 | 1 |
| Ghana | WEAI+ Wave II & SUNS Wave I Data Collection | Enumerators | 14 | 10 | 24 |
| Ghana | SMART Farm | Church of the Brethren Management & Program | 7 | 2 | 9 |

[24] This section is to serve as a compilation of all program training activities for the 12-month reporting period and not meant to duplicate the Capacity Building section under individual Research Project Reports.
[25] Such as farmers, government officials, women entrepreneurs
[26] Disaggregate by sex if known

| | | | | | |
|---|---|---|---|---|---|
| | | staff | | | |
| Ghana | Soybean Agronomics Forum | MEDA Key Facilitating Partners (KFPs) | | | 32 |
| Ghana | Molecular Marker Analysis | WACCI PhD & MSc students | | | 21 |
| Ethiopia | Soybean Crossing Demonstration | EIAR research scientists & technicians | 5 | 0 | 5 |
| Malawi | Village-Level Soy Nutrition Education, Processing & Utilization | Smallholder Farmers, Ministry of Agriculture, NGO/PVO groups | | | 42 |
| Mozambique | Crop Physiology & Rouging for Plant Breeding | IITA research scientists & technicians | 5 | 0 | 5 |
| Mozambique | *Tasty! Mozambique* Soy Utilization | Smallholder farmers | 0 | 7 | 7 |
| Nigeria | Marker-Assisted Selection (MAS) | IITA & NARS research scientists & technicians | 17 | 6 | 23 |
| Pakistan | Management Sciences Agribusiness Program Training | Lahore University faculty & research scientists | | | 35 |
| USA | IT Infrastructure for NARS | SARI management & research scientists, Iowa State development team | 9 | 1 | 10 |
| USA | WACCI Faculty Professional Development Short Course | WACCI Faculty | 6 | 0 | 6 |
| USA | Commercial Agriculture in Tropical Environments Symposium | Academics, development organizations, foundations | | | 111 |
| USA | SIL Technical Webinars (to-date) | NARS & IITA staff, research scientists, NGO/PVO groups, private sector | | | 537 |

b) Long –term training

| **Name (first, last)** | **Sex** | **University** | **Degree** | **Major** | **Program End Date[27] (month/year)** | **Degree Granted[28] (Y/N)** | **Home Country** |
|---|---|---|---|---|---|---|---|
| **Wisdom Edem Anyomi** | **M** | **WACCI** | **PhD** | **Plant Breeding & Genetics** | **May 2018** | **TBD** | **Ghana** |
| **Valerie Bauza** | **F** | **University of Illinois** | **PhD** | **Civil & Environmental Engineering** | **May 2019** | **TBD** | **USA** |
| **Kassaye Hussen Belay** | **M** | **WACCI** | **MSc** | **Plant Breeding & Genetics** | **May 2017** | **Y** | **Ethiopia** |
| **Patrick Kofi Bonney** | **M** | **WACCI** | **MSc** | **Plant Breeding & Genetics** | **May 2018** | **TBD** | **Ghana** |
| **Diana Byrne** | **F** | **University of Illinois** | **PhD** | **Civil & Environmental Engineering** | **May 2019** | **TBD** | **USA** |

[27] Anticipated graduation date or end of program support
[28] Indicate if program support resulted in a degree

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Godfree Chigeza | M | IITA | PhD | African Plant Breeding Academy | N/A | N/A | Zimbabwe |
| Agyemang Danquah | M | WACCI | PhD | Continuing Education | N/A | N/A | Ghana |
| Nicholas Denwar | M | SARI | PhD | African Plant Breeding Academy | N/A | N/A | Ghana |
| Daniel Dzidzienyo | M | WACCI | PhD | Continuing Education | N/A | N/A | Ghana |
| John Eleblu | M | WACCI | PhD | Continuing Education | N/A | N/A | Ghana |
| Gameli Collins Gborvi | M | WACCI | MSc | Plant Breeding & Genetics | May 2017 | Y | Ghana |
| Mesfin Hailemariam | M | Jimma University | MSc | Plant Breeding | May 2017 | Y | Ethiopia |
| Gregory Householter | M | University of Illinois | BA | Agricultural & Applied Economics | May 2018 | TBD | USA |
| Foster Kangben | M | WACCI | MSc | Plant Breeding & Genetics | May 2018 | TBD | Ghana |
| Prince Buertey Kpentey | M | WACCI | MSc | Plant Breeding & Genetics | May 2017 | Y | Ghana |
| Amanda Lardizabal | F | University of Illinois | PhD | Civil & Environmental Engineering | May 2019 | TBD | USA |
| Edward Martey | M | University of Illinois | PhD | Agricultural & Applied Economics | May 2018 | TBD | Ghana |
| Michael Maw | M | University of Missouri | MSc | Crop Physiology | May 2017 | Y | USA |
| Isaac Mbawine | M | University for Development Studies | BSc | Agronomy | May 2018 | TBD | Ghana |
| Leander Dede Melomey | F | WACCI | PhD | Plant Breeding & Genetics | May 2020 | TBD | Ghana |
| Carrie Miranda | F | University of Missouri | PhD | Plant Breeding | May 2018 | TBD | USA |
| Fridah Mubichi | F | University of Missouri | Post-Doc | Rural Sociology | N/A | N/A | Kenya |
| Anacelta Mugabe | F | Stellenbosch University | BSc | English language training | N/A | N/A | Mozambique |
| Doreen Mutoni | F | University of Missouri | PhD | Plant Breeding | May 2020 | TBD | Rwanda |
| Godson Nyawudzo | M | WACCI | MSc | Plant Breeding & | May 2017 | Y | Ghana |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | **Genetics** | | | |
| **Sandra Esi Odonkor** | **F** | **WACCI** | **PhD** | **Plant Breeding & Genetics** | **May 2020** | **TBD** | **Ghana** |
| **Maria da Luz Quinhentos** | **F** | **University of Missouri** | **PhD** | **Agricultural & Applied Economics** | **May 2017** | **Y** | **Mozambique** |
| **Mary Rebecca Read-Wahidi** | **F** | **Mississippi State University** | **Post-Doc** | **Medical Anthropology** | **N/A** | **N/A** | **USA** |
| **Audrey Reid** | **F** | **Mississippi State University** | **MA** | **Sociology** | **May 2018** | **TBD** | **USA** |
| **Rebecca Savoie** | **F** | **University of Missouri** | **PhD** | **Rural Sociology** | **May 2018** | **TBD** | **USA** |
| **Liz Sloffer** | **F** | **University of Illinois** | **PhD** | **Food Science & Human Nutrition** | **May 2018** | **TBD** | **USA** |
| **Katelyn Swiderski** | **F** | **Mississippi State University** | **Summer Internship** | **Biological sciences/Pre-medicine** | **N/A** | **N/A** | **USA** |
| **Abush Tesfaye** | **M** | **EIAR** | **PhD** | **African Plant Breeding Academy** | **N/A** | **N/A** | **Ethiopia** |
| **Armand Tossou** | **M** | **University of Illinois** | **PhD** | **Agricultural & Applied Economics** | **May 2018** | **TBD** | **Benin** |
| **John Trimmer** | **M** | **University of Illinois** | **PhD** | **Civil & Environmental Engineering** | **May 2019** | **TBD** | **USA** |
| **Harrison Tsamenyi** | **M** | **WACCI** | **MSc** | **Plant Breeding & Genetics** | **May 2018** | **TBD** | **Ghana** |
| **Sam Woessner** | **M** | **University of Illinois** | **BSc** | **Actuarial Science** | **May 2018** | **TBD** | **USA** |
| **Husen Yesuf** | **M** | **Jimma University** | **MSc** | **Plant Breeding** | **May 2017** | **Y** | **Ethiopia** |

c) Institutional Development

i) Description: SIL directly engages at the human and institutional level in capacity building to successfully implement its programs and ensure partner practitioner groups are successful when the SIL program concludes. This involves direct mentorship of research leads and technical guidance to institutions on research infrastructure investments, process improvements, financial management, project reporting, communications and IT infrastructure support and event management. Capacity building and institutional development also involve providing the technical guidance and innovation to enable practitioner partner groups to be successful in providing future training and guidance to their farmer groups and other beneficiaries.

ii) Partners:

1. IFDC - SIL (Multi-focus)

2. ADVANCE - SIL (Multi-focus)
3. RING - SIL (Multi-focus)
4. MEDA - SIL (Multi-focus)
5. CRS - SIL (Multi-focus)
6. SFSA - SIL (Agricultural Production)
7. AATF - SIL (Agricultural Production)
8. Seed Co - SIL (Agricultural Production)
9. IITA - SIL (Multi-focus)
10. GCP - SIL (Agricultural Production)
11. WISHH - SIL (Nutrition)
12. Malnutrition Matters - SIL (Nutrition)
13. JIMMA - SIL (Multi-focus)
14. IIAM - SIL (Multi-focus)
15. SARI - SIL (Multi-focus)
16. Agona Pure Soy Milk - SIL (Nutrition)
17. Associaçao Pala Wassokoti, Namaacha - SIL (Nutrition)
18. CSIR-FRI - SIL (Nutrition)
19. EMBRAPA/Sensako (Production)
20. BASF (Production)
21. Omya (Production)
22. Monsanto (Production)
23. Pioneer (Production)
24. Semillas Panorama SAS (Production)
25. Syngenta Company (Production)
26. ZamSeed (Production)
27. Makerere University (Production)
28. KALRO (Production)
29. TechnoServe (Multi-focus)
30. Ghana Tourism Authortiy (Multi-focus)
31. World Food Programme (Nutrition)
32. LUANAR (Multi-focus)
33. UDS (Nutrition)
34. WACCI (Production)
35. Faffa (Nutrition)
36. Golden Sunbeam (Nutrition)
37. Guts Agro (Nutrition)
38. Hilina (Nutrition)
39. SESACO (Nutrition)
40. Sojagnon (Nutrition)
41. Ploutizo Enterprise (Benedicta) (Nutrition)
42. Progressive Healthy Foods (Ghana) (Nutrition)
43. Humu (Nutrition)
44. Baaru Soymilk (Nutrition)
45. ELFORA (Production)
46. CSIRO (Australia) (Production)
47. CASB (Haiti) (Multi-focus)
48. Church of the Brethren (Production)

49. AgDiv ~~SoyCow Network (Malawi) (~~Nutrition & Production~~)~~
50. PNBS Soy Dairy Network (Colombia) (Nutrition)
51. Yedent AgroProcessing (Nutrition)
52. MNSUAM (Production)
53. RAB (Production)

## VII. Innovation Transfer and Scaling Partnerships

While this is not a requirement of the SIL program, the research team is committed to developing scalable technologies and innovations useful for the practitioner community seeking to develop soybean in the tropics.

a) Plan of Action

i) Steps taken

SIL directly engages with practitioner groups (researchers, the private sector, firms, non-governmental organizations, extensionists, agronomists, technicians, farmer associations, government agencies) as well as with in-country USAID-mission funded programs, the private sector and with programs funded by other governments, foundations and institutions to provide them with data-driven, evidence-based technical knowledge and innovation to help them achieve success in their soybean development efforts. SIL engages in partnerships, trainings, event development, resource sharing, field visits and meetings to provide technical guidance and direction to these practitioner groups.

ii) Partnerships made

To date, SIL has engaged in technical guidance partnerships with the following practitioner groups. Please see list of "Partners" under the "Institutional Development" section.

iii) Technologies transferred

1. Diverse germplasm from USDA Soybean Germplasm Collection
   ~~1.~~(a) Transferred to 6, 7, 8, 9, 13, 14, 15, 27, 52, 53
2. Plant breeding equipment including planters and threshers
   ~~2.~~(a) Transferred to 9, 13, 15
3. Low-cost, locally-produced crop threshers
   ~~3.~~(a) Transferred to 1, 2, 3, 4
4. Soybean Success Kits (improved seed, fertilizer, inoculum, pictorial extension)
   ~~4.~~(a) Transferred to 1, 5, 14
5. ~~A Statistics for Plant Breeders course~~Master's Degree in Plant Breeding & Genetics
   ~~5.~~(a) Transferred to 34
6. ~~An Introduction to Plant Breeding course~~Integrated Breeding Platform
   ~~6.~~(a) Transferred to 9, 10, 13, 15, 34
7. A SMART Approach to Soybean Production
   ~~7.~~(a) Transferred to 1, 2, 3, 4, 5, 13, 15, 20, 21, 45, 48
8. A Pesticide Safety for Farm Workers, a training course
   ~~8.~~(a) Transferred to 15
9. Soy Dairy Entrepreneur Network Technical Training Program
   ~~9.~~(a) Transferred to 4, 11, 12, 15, 16, 17, 18, 32, 36, 38, 39, 40, 41, 42, 43, 44, 49, 50
10. Soy Processing, Utilization & Nutrition Education Village-Level Training Program
    ~~10.~~(a) Transferred to 9, 14, 15, 31, 32, 33, 49
11. Pan-African Soybean Varietal Trial Program
    (a) Transferred to 6, 7, 8, 9, 13, 15, 19, 24, 25, 26, 27, 28, 46, 49
12. Soy-enhanced complementary feeding
    (a) Transferred to 5, 15, 33
13. Tasty! Mozambique Low-Literacy Cookbook
    (a) Transferred to 14
14. Empowering Women through Soybean Farming
    (a) Transferred to 5, 14
15. Environmental Analytical Testing Lab

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**Comment [KA(1]:** Is it possible to list the partners or the number that correspond to the partner from the list above next to these transferred innovations, e.g. low-cost, locally produced threshers transferred to #4 or MEDA

**Comment [TCA2]:** We included to which partners these technologies were transferred.

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(a) Transferred to 5, 15

16. Soybean Disease Diagnostic Guide
    (a) Transferred to 9, 13, 15, 49
17. Soybean Extension for Smallholder Farmers
    ~~11.~~(a) Transferred to 1, 2, 3, 4, 5, 14, 15, 48

iv) Technologies scaled

1. Diverse germplasm from USDA Soybean Germplasm Collection
2. ~~Low-cost, locally-produced crop threshers~~
3. ~~3.~~2. Soybean Success Kits (improved seed, fertilizer, inoculum, pictorial extension)
4. ~~4.~~3. A SMART Approach to Soybean Production, an extension program
5. ~~5.~~4. Soy Dairy Entrepreneur Network Technical Training Program
6. ~~6.~~5. Pan-African Soybean Varietal Trial Program
6. Soy Food Bazaar & Soybean Kick-off Event Platforms
7. Tasty! Mozambique Low-Literacy Cookbook
8. Soybean Disease Diagnostic Guide
7. ~~7.~~

v) Technologies ready to scale

1. Plant breeding equipment including planters and threshers
2. Master's Degree in Plant Breeding & Genetics
2. ~~A Statistics for Plant Breeders course~~
3. Integrated Breeding Platform
3. ~~An Introduction to Plant Breeding course~~
4. ~~A Pesticide Safety for Farm Workers, a training course~~
4. Pan-African Soybean Varietal Trial Program
5. Empowering Women through Soybean Farming
6. Environmental Analytical Testing Lab
7. Soybean Disease Diagnostic Guide
8. Soybean Extension for Smallholder Farmers
5. ~~5.~~

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**Comment [KA(3]:** Do you have a number to add next to these? e.g. 200 threshers produced and bought by farmers..ect

**Comment [TCA4]:** Diverse germplasm – approximately 800 crosses
Soybean success kits – developed kits to serve 20,000 farmers in northern Ghana
SMART Farm – expanded to 1 additional country (Ethiopia)
Soy Dairy Entrepreneur Network – expanded to 20 entrepreneurs globally
Pan-African Soybean Varietal Trial Program – implemented in 4 countries with plans for implementation in 5 additional countries in 2018
Soy Food Bazaar & Soybean Kick-off Event Platforms – expanded to 1 additional country (Ethiopia)
Tasty! Mozambique – cookbook reaching 500 smallholder farmers in Mozambique
Soybean Disease Diagnostic Guide – scaled to approximately 10 in-country soybean breeders and agronomists

**Comment [KA(5]:** There is repetition of the technologies in the various stages, e.g. the threshers, the statistic course appears in the three stages –could you explain why is that? Is it something that has been transferred & scaled but you still working on refining it and the new versions are ready to scale & / transfer?

**Comment [TCA6]:** 1.Diverse germplasm
a.Transfer was lines introduced to breeding collaborators from USDA Soybean Germplasm Collection
b.Scaling was crosses in-country through our breeding collaborators
2.Plant breeding equipment
a.Transfer was introduction of equipment to our 3 original breeding collaborators
b.Ready to scale is the delivery of equipment to both expanding core breeding collaborators, and also to additional members of our African plant breeding network.
3.Soybean Success Kits
a.Transfer of soybean success kit concept to 4,800 smallholder farmers in Ghana and Mozambique.

## VIII. Environmental Management and Mitigation Plan (EMMP)

SIL is a leader in implementing, tracking and monitoring a robust EMMP for its project. To facilitate communication within SIL and with USAID, the team set up a Google Drive folder that includes 1) documentation of Personal Protective Equipment (PPE) purchases, trainings, etc. and 2) maps of protected environmental areas and Ghana SMART farm locations. Finally, the SIL team also discusses progress towards its EMMP at its annual researcher retreat meeting held every December and also briefs the USAID AOR on progress.

SIL is also engaged in understanding the environmental (soil, air, water) impacts of soybean production within smallholder farming communities. To improve the capacity and capabilities of SARI, SIL established the SARI-SIL Environmental Analytical Lab and focused on 1) changing the laboratory financing structure; 2) providing basic training and standardization; 3) providing personal protective equipment; 4) providing new equipment for new capabilities; and 6) lead water quality monitoring. The training conducted reached 13 SARI technical staff members (7 females, 6 males), the provision of equipment to test *E. coli* quantification and field analysis of pH, dissolved oxygen, conductivity, and temperature.

Finally, the SIL environmental impact assessment team, led by Dr. Jeremy Guest at the University of Illinois, engaged in field data collection for environmental monitoring. In two districts of northern Ghana, the team conducted a field sampling campaign with CRS and SARI using a household survey instrument modified from the WEAI+ survey, focusing on pesticide and fertilizer use; manure management; water, sanitation, and hygiene; and child health. The survey reached 156 households in the Tolon District and 153 households in the Karaga District of northern Ghana. Surveys showed that pesticides are commonly used in both districts, primarily in maize production (85% in Karaga, 71% in Tolon) as well as fertilizer for maize production (42% in Karaga, 77% in Tolon). As some of these pesticides can negatively affect health, SIL is supporting CRS as they conduct their own monthly environmental sampling and analysis of water sources in the two districts. The newly trained staff at SARI, equipped with the necessary tools for analysis within the SARI-SIL Environmental Analytical Lab, will analyze the samples.

**Comment [KA(7]:** What would CRS do with these information? How they are going to help improve water quality? Also were these pesticides found in the water source? It's not clear from this paragraph if the survey found the water contaminated with pesticides or not! Also what other contaminant were found related to the manure testing ..etc

## IX. Open Data Management Plan (not changed from last year)

The SIL Data Management Plan (DMP) was submitted to USAID/BFS/D.C. on October 22, 2015.

**Comment [TCA8]:** In response to your questions:

1.The issue of water quality as a function of human, as well as agricultural, effects is fairly well understood at a conceptual level. Dr. Guest, through his efforts, has advanced the concept of human and agricultural effects through the implementation of an environmental analytical testing lab and associated training. For example, CRS knew how important the intersection of human health and water quality was, but benefitted from actual testing, evidence, identification of effects, sources, pathways, etc. SARI as well had a strong interest in this area but the lab required the intervention by Dr. Guest to advance the skills of the staff and procure the equipment needed to create a functioning, public testing lab to service the northern region of Ghana. Per the SIL mission of research for development, Dr. Guest and his team provided the facility, training, equipment, evidence and understanding of the intersection between human and agricultural activities, and human health. Now, the development partners engaged at this intersection have an institutional lab to service their testing needs to assure that their programs are performing well in the area of water quality and human health.

2.At this stage, the lab is focused on testing for biological contaminants associated with run-off, etc.

3. Nitrates were tested at three periods throughout the year in proximity to boreholes, dams and shallow wells. Highest levels of nitrates were found at 28 mg/L in proximity to dams in the May-June period. *E. coli* was tested at three periods throughout the year in proximity to boreholes, dams and shallow wells. Highest levels of *E. coli* were found at 1700 MPN/100 mL in proximity to shallow wells in the January-April period.

## X. Project Management Activity

The SIL team is managed by the Principal Investigator, the Program Manager and the Communications Director. The duties of the administrative team are to:

- Provide logistical support, promote collaboration, and coordinate project planning and implementation
    - Oversee financial management of 15 subawards and 4 explosion accounts within SIL and collect monthly invoices from subawardees
    - Provide financial reporting to USAID (quarterly accruals, pipeline/burn-rate estimates, SF-425 forms, and other financial reports as requested)
    - Determine upcoming travel plans of team members and report to USAID
    - Promote collaboration and coordination among team members and collaborators
    - Convene monthly conference calls for team members
    - Convene annual SIL researcher meetings
    - Coordinate project planning and implementation including travel to Africa to monitor research progress
- Monitor and evaluate project progress and ensure alignment with critical needs
    - Submit semi-annual and annual technical reports to USAID
    - Submit FTFMS narratives & data annually
- Provide communication on SIL activities & research
    - Convene annual Spring virtual and Fall in-person SIL Advisory Board meetings
    - Give seminars and publish project results via webinars, SIL website, SIL social media suite (Facebook, Twitter), and through in-person conferences, meetings, symposia and events
    - Meet with USAID missions, soybean development stakeholders, new and potential collaborators and partners (agricultural development organizations, Ministries of Agriculture, the private sector, academia, foundations and donors)
    - Provide input for Feed the Future newsletters, Agrilinks communication platform, USAID publications and USAID events as well as to other agricultural development platforms
    - Respond to Request for Proposals (RFPs) from USAID-funded mission programs, public, and private donors
    - Issue press releases, news stories and website articles
    - Implement online webinars using GoToWebinar and Agrilinks Adobe Connect platforms
    - Build a soybean network across Africa (and elsewhere in the tropics) focused on low-technology mechanization for soybean production (threshers, planters, irrigation, etc.); soy dairy processing & utilization; soybean breeding and varietal testing
- Continue dissemination of SIL Monthly Newsletter & Weekly Digest publications, utilization of Twitter, Facebook, YouTube and other social media platforms to communicate SIL activities and objectives
- Collaborate with USAID missions to determine ways in which SIL can strengthen and provide research background for mission efforts
- Implement new projects with outside funding to expand the scope, impact and output of SIL research, knowledge, technologies and innovation
- Collaborate with LUANAR in Malawi to provide technical support to LUANAR aquaculture program as the international lead for their World Bank Center of Excellence project focusing on aquaculture nutrition, feed production, and industry research and service partnership development

- Continue collaboration with the USAID/Malawi mission-funded Agricultural Diversification (AgDiv) Program focused on Soy Utilization, Processing & Nutrition Education Village-Level Train-the-Trainer Curriculum; Soy Dairy Establishment & Business Training; Pan-African Soybean Variety Trial Program; SMART Farm; Inoculum Supply Chain

## XI. Other Topics[29]

- SIL license holder for an open source tractor
- SIL publishes special issue of Tropical Conservation Science
- SIL hosts a conference on Commercial Agriculture in the Tropics
- SIL hosts the first ever Chef's Soy Food Competition for Caterers serving the National School Lunch Program of Ghana
- SIL expands SMART Farm to Ethiopia
- SIL expands the Pan African Soybean Variety Trials to Malawi
- SIL scales the Soybean Kick-off and Soy Food Bazaar events to Ethiopia
- SIL publishes Africa's first Soybean Disease Diagnostic Guide
- SIL scales its Soybean Success Kit through the USAID ATT project in Ghana
- SIL implements Crop Protection Training program
- SIL hosts over 50 webinars reaching 1,200+ registrants in 20+ countries
- SIL highlights its 23 products across 10 MRAs on its website reaching 50,000 unique visitors annually
- SIL hosts over 20 recorded events, both in-person and web-based
- SIL monthly newsletter reaches 5,000+ subscribers in 25+ countries
- SIL social media reaches 400+ followers
- SIL YouTube channel hosts 70+ videos providing soybean technical guidance and information

[29] Such as Regional Centers of Excellence, impact assessment, gender initiatives

## XII. Issues and how they are being addressed [30]

No issues.

[30] Such as financial, management, regulatory

## XIII. Future Directions

The Soybean Innovation Lab has a mission to establish the foundations for a sustainable soybean complex in Africa. To that end, SIL has focused its efforts in ten management areas that reflect the value chain nature of soybean as a development crop. While we have learned and passed along our findings to our partners, the overarching lesson learned has been that the establishment of a sustainable soybean system in Africa requires transformation across a number of specific fronts.

To this end going forward SIL will be investing in seven critical areas: 1) the soybean breeding and seed production network to assure farmers will have access to high quality and well adapted seed supplies; 2) a Pan-African variety trial system to provide market access for regional seed companies and transparency for the seed trade; 3) small scale mechanization to reduce the labor burden, increase yields, reduce post-harvest losses, and improve grain quality for farmers; 4) assure the availability of high quality and reliable seed, soils, and inoculum testing laboratories to support practitioners promoting soybean development; 5) expand the SMART Farm concept geographically to southern and East Africa to bring high quality reliable production, agronomic, and environmental guidance to farmers and programmatically with the establishment of a matched practitioner extension platform; 6) bring business management skills to soy food entrepreneurs to assure the development and proliferation of viable enterprises that support economic development and youth employment; 7) continue longitudinal study of soybean adoption by small holders to better understand the role of soybean as a development crop and its implications for gender equity.

# Appendix

List of awards given to U.S. partners (university, USDA, private sector, etc.) to include project name, dates and funding (current year and total) for each partner.

| Funding Agency | Title | Funding Year(s) | Total Funding |
|---|---|---|---|
| University of Illinois | SIL Undergraduate Research Internship Program | 2014-2018 | $50,000 |
| USAID/Ghana | Implementation of 1st Annual Soybean Kick-off Event in Ghana | 2015 | $6,300 |
| Office of International Programs, College of ACES | Evaluating Plant Breeding Education in Ghana | 2015 | $5,000 |
| Office of International Programs, College of ACES | Identification of Soybean Diseases and Pests in Africa: Development of a Diagnostic Guide | 2015 | $4,245 |
| United States Agency for International Development– Accra, Ghana | Improving Seed Selection and Storage | 2015 | $65,000 |
| Global Alliance for Improved Nutrition | Technical Support to Winnua Lda (Mozambique) for Soy Yoghurt development, Market Study, Investment Plan & Business Plan development | 2016 | $14,620 |
| Agricultural Technology Transfer (ATT) and ADVANCE Projects | Tamale Implement Factory blacksmith training for smallholder thresher production | 2016 | $9,549 |
| Church of the Brethren | SMART Farm Outreach for Church of the Brethren Nigeria & Liberia Delegations | 2016 | $8,664 |
| University of Illinois | Morgan Fund Endowment | 2016-2017 | $80,000 |

| | | | |
|---|---|---|---|
| Alliance for a Green Revolution in Africa | African Plant Breeding Academy (SIL Breeding Partners Class I & II Support) | 2016-2017 | $67,000 |
| United States Agency for International Development– Accra, Ghana | Mentoring Plant Breeders | 2016-2018 | $850,000 |
| World Bank | Aquaculture and Fisheries Science (Aqua Fish) Centre of Excellence | 2016-2019 | $138,865 |
| United States Department of Agriculture – Foreign Agricultural Service (Ethiopia) | Soybean Kick-off & Soy Food Bazaar Events in Ethiopia | 2017 | $12,185 |
| Agricultural Diversification (AgDiv) Project of Malawi | Village-Level Soy Utilization & Soy Dairy Establishment Trainings | 2017 | $101,194 |
| BASF | SMART Farm Inoculum & Herbicide Product Trialing | 2017 | $10,500 |
| Omya | SMART Farm Concentrated Lime Product Trialing | 2017 | $5,000 |
| International Food Security Institute, University of Illinois | Commercial Agriculture in Tropical Environments Symposium | 2017 | $10,888 |
| World Soybean Research Conference | USAID Soybean Program in Africa Session | 2017 | $2,000 |
| Office of International Programs, College of ACES & WACCI (Matching Grant) | Soybean Improvement Initiative for Increased Productivity at WACCI | 2017-2018 | $40,000 |
| Agricultural Diversification (AgDiv) Project of Malawi | Pan-African Soybean Variety Trial Program in Malawi | 2017-2019 | $256,677 |

Three distinct success stories[31]

# These Soybean Experts and Farmers Say Their 'Success Kits' Live Up to the Name

*By Rose Keane, Courtney Tamimie and Peter Goldsmith*


**University of Missouri Innovation Lab researcher Kerry Clark provides extension training to soybean success kit recipients in northern Ghana.** *Kerry Clark*

## All-in-one packages supply necessary inputs—including seed, fertilizer and instructions—to ensure higher yields and incomes for growers in sub-Saharan Africa.

Researchers at the **Feed the Future Innovation Lab for Soybean Value Chain Research** led by the University of Illinois are seeing how soybean is taking root in sub-Saharan African countries like Mozambique and Ghana. And the success of their aptly named **soybean success kits** over the last several years is resulting in high yields and better incomes. All of this, from a commercial crop that is a relative newcomer to these regions.

The kits are designed to be an all-in-one crop improvement tool, with each containing 2.5 kilos of high-quality soybean seed, 2 kilos of fertilizer, a small sachet of inoculant and pictorial instructions that explain planting and harvesting printed on each bag. The innovative soybean success kits bundle inputs for soybean production that can be difficult to access because of supply, distance to markets, or access to input dealers and sales agents in smallholder farmer communities.

[31] Each should: a) be limited to 500 words, b) be results oriented, c) written in layman's terms, d) avoid acronyms, e) address Feed the Future priorities, and f) include a high resolution digital photo with caption and photo credit. It is okay to reference a website for more detailed information.


**Catholic Relief Services agricultural program and Ministry of Agriculture officers provide soybean agronomic extension to recipients of the soybean success kits in northern Ghana.**
*Kerry Clark*

The inputs contained in the kits improve soybean yields by focusing on soil health, high-quality seed and appropriate agronomic practices. Farmers using the kits saw soybean yields more than double from 1,000

kilograms per hectare to 2,300 kilograms per hectare. This shows that, with the correct inputs and training on appropriate agronomic practices, smallholder farmers can drastically increase their crop yields and, in turn, their incomes.

University of Missouri Innovation Lab researcher Kerry Clark collaborated with Catholic Relief Services, Ghana's Savanna Agricultural Research Institute (SARI), the Ghanaian Ministry of Agriculture, and the Mozambican Institute of Agricultural Research (IIAM) to distribute 4,800 kits in Mozambique and Ghana in 2015 and 2016. In addition to distribution, the Soybean Innovation Lab also provided training to ministry extension service personnel on how to arrange and distribute the kits and the appropriate extension guidance on how they should be used.

**"The important thing about the soybean success kit is that it packages all of the needed inputs together and ensures that the producers will get the best outcome from their months of sowing, weeding and harvesting."**

The kits were distributed as part of a study conducted by the Soybean Innovation Lab to understand the relationship between soybean production and gender equity, input and seed access, farmer networks, and land use changes. Results from the study will guide development practitioners, NGOs, government ministries and other agricultural organizations as they seek to bring soybean farming to smallholder communities.

"The important thing about the soybean success kit is that it packages all of the needed inputs together and ensures that the producers will get the best outcome from their months of sowing, weeding and harvesting," says Clark. "It is also vital that the kit comes with extension communication so that fertilizer and inoculant are properly used and best able to bring about positive impact in yield increases."

"If inputs aren't seen as necessary for good crop production practices, yields will remain low and smallholder farmers will continue to struggle to feed themselves," Clark continued. "Packaging inputs together shows the importance of each component in a growing system—good seed, fertilizer, inoculant for legumes, and knowledge on how to best grow and store the crop are all equally vital to improved yields."

Soybeans represent a considerable opportunity for financial, nutritional and agronomic security in sub-Saharan Africa for smallholder farmers who have increasingly adopted the crop to supplement their income and provide a safety net for themselves and their communities.

**Women farmers in northern Ghana were among the many soybean success kit recipients.**
*Kerry Clark*

Nicolas Denwar, a senior research scientist with SARI, believes that the kits offer farmers an opportunity to improve their yields in a way they would not otherwise have been able to access.

"Soybean, as with any legume, requires some form of phosphorus fertilizer. So the success kit concept is a novelty that is helping; it is bringing these seeds to farmers that would not otherwise have access to them. They're mostly in rural areas, and the seed companies don't have sales outlets there. Aside from getting them the seed, the kits are also educating the farmers on the importance of fertilizer and inoculum for improving their yields," he said.

Clark hopes that the increased knowledge and yields provided by the success kits will help drive consumer demand for the inoculants and fertilizers. "Low levels of knowledge about inputs amongst smallholder farmers leads to low yields because they don't have the information they need to make sure that, when they buy seeds, that they also get inoculant and fertilizer that does not contain nitrogen," she says. "Agricultural dealers may not supply these necessary inputs because there is currently little demand, but demand is based on the customer actually knowing that the product exists. Using success kits helps sensitize smallholders to all of the components of a successful production system."

Before using the kit, Yahaya Gonga, a farmer near Chereponi, Ghana, said his yields were low due to bad weather, poor soil fertility and lack of access to good quality seeds. He barely grew enough to feed his family.

"This was the first year that I've used the inoculant when planting," says Gonga, whose yield has now improved considerably. "The germination is very good. When I didn't have inoculant, some germinated and some didn't." Improved seed germination is a result of the high-quality, viable soybean seed that is contained in the kits.

Mariama Imoro, another smallholder farmer in the Chereponi region, also saw noticeable improvement in her yields. "The success kit and the training on how to grow soybeans has had great impact on the growth of the plants compared to previously. So I am confident that if you dedicate yourself to growing the soybean, you will make a lot of money from it."

Soybean Innovation Lab researchers talked with other community members about their experiences with the kits and asked for feedback on how the lab could help improve soybean adoption in the countries. It intends to continue working within these communities with annual follow-up surveys to better understand and improve future soybean development programs, focusing on gender equity and the provision of necessary, high-quality inputs.

As awareness among farmers builds through the use of appropriate agronomic inputs, the private sector can play a critical role in fulfilling the growing demand.

# Soybean Researcher Returns to His Roots in Ghana

**From left: Dan Reynolds, lead researcher for the Soybean Innovation Lab SMART Farm; Saaka Buah, director of the Savanna Agricultural Research Institute's station located in Wa, Ghana; and George Awuni, SMART Farm manager.** *Courtesy of George Awuni*

## Improving soybean yields for smallholder farmers means higher incomes and better nutrition for struggling households.

In sub-Saharan Africa, soybeans are a profitable cash crop as well as a high-quality protein source. That is good news for operators striving to feed the growing poultry industry here and for the country's soy oil processing facilities. Unfortunately, it's bad news for many farmers whose soybean yields remain low, in fact, well below world averages, at the moment they could demand higher prices for the now in-demand crop.

George Awuni, a post-doctoral research associate at Mississippi State University and manager of the SMART Farm, is working to change those smallholder farmers' fortunes. Awuni, 53, is a native of Ghana and grew up in the Upper East Region. He has known hunger and understands the difficulties smallholder farmers in Ghana face.

**George Awuni, Soybean Innovation Lab SMART Farm manager, right, discusses soybean yields with attendees of the SIL Soybean Kick-off Event in northern Ghana.**
*Courtesy of George Awuni*

"While pursuing my studies and working with the agriculture ministry in Ghana, it occurred to me that poverty reduction and the transformation of livelihoods in developing countries can only be achieved by a concerted effort of all stakeholders in the agricultural sector, both national and international," Awuni said. "Through this project, I have the opportunity to make a difference in the lives of my countrymen."

The SMART Farm is unique in that smallholder farmers receive guidance and information that they can readily apply to their production practices to improve their soybean yields. Higher soybean yield increases smallholder farmer productivity and, in turn, raises incomes, reduces malnutrition and promotes economic development.

The SMART Farm is part of the **Feed the Future Innovation Lab for Soybean Value Chain Research**, or SIL (Soybean Innovation Lab), for short. SMART stands for Soybean Management with Appropriate Research and Technology. The lab, led by the University of Illinois, is part of a network of U.S. universities working with USAID to help solve problems of food insecurity throughout the world. **Feed the Future** is the U.S. Government's global hunger and food security initiative led by USAID. The **SIL SMART Farm** began four years ago. It provides recommendations to improve soybean yields for smallholder farmers, and generates best management practices for seed and row spacing, planting dates, fertilizer and pesticide application rates,

inoculum use and the best soybean varieties for the region. The SMART Farm operates in collaboration with the **Savanna Agricultural Research Institute(link is external)**(SARI), a center within the Ghanaian National Agricultural Research System. They're located in three locations in northern Ghana: Nyankpala in the Northern Region, Manga in the Upper East Region and Bawku in the Upper West Region. These regional locations enable the SMART farm to gather data for millions of smallholder farmers in northern Ghana.

Awuni left Ghana in 2010 to pursue his Ph.D. in entomology at Mississippi State University's Department of Plant and Soil Sciences with the hope of returning to put his degree to work in his home country. Today, his development research and associated outreach activities are bringing critical knowledge the region needs to grow soybeans.

"George is an exceptional researcher and I knew this project would be a great opportunity for him. As a native of Ghana, George provides an incredible opportunity for the university to have seamless credibility and a direct connection with the Ghanaian people," said Dan Reynolds, who leads the Soybean Innovation Lab's research at the SMART Farm and is a professor and Edgar E. and Winifred B. Hartwig Endowed Chair in Soybean Agronomy at Mississippi State. Reynolds works with Awuni on the research conducted at the SMART Farm in northern Ghana.

Awuni spends six months of the year in Ghana at the SMART Farm working to generate critical data to improve soybean yields in the region. That includes overseeing trials, testing new varieties, monitoring soil health and looking for ways to reduce weeds—and the need for the chemicals that control them.

## Science Meets Soybeans

The research Reynolds and Awuni conducted has shown that, when combining appropriate agronomic practices, soybean yields using locally available varieties can be increased over 2.5 times what farmers commonly experience in northern Ghana.

Awuni says the next step is to get this information into the hands of the farmers.

"Soybean yields from farmers' fields are less than 1,000 kilos a hectare, and if research tells us that we can increase yields to over 2,000 kilos or more a hectare, that means we should be able to extend that into the farmers' fields," said Awuni.

**George Awuni, Soybean Innovation Lab SMART Farm manager, collects soil samples in a field plot at the Savanna Agricultural Research Institute in Wa, Ghana.**
*Courtesy of George Awuni*

The SMART Farm provides an ideal training center on soybean agronomics for practitioners from countries in West Africa due to its regional location and support from SARI.

Awuni conducts numerous outreach trainings at the SMART Farm on soybean agronomic and production practices for government and non-governmental agencies. The **SIL Soybean Kick-off Event**, held annually at SARI, provides another venue to share the findings of the SMART Farm with the regional agricultural community. The event brings together smallholder farmers, the private sector, researchers, development organizations, agricultural extension agencies and government ministries to learn about the innovation, knowledge and technologies generated by the SMART Farm to improve soybean production in Ghana.
The Soybean Innovation Lab plans to establish similar SMART Farm hubs in Eastern and Southern Africa to improve agricultural techniques and innovations in these regions as part of its pan-African strategy to increase soybean productivity across the continent.

“Expanding the SMART Farm to other African countries will have multiple benefits for smallholder farmers. Farmers’ yields will increase with the introduction of new seed varieties and using improved agronomic

practices. With higher yields, farmers will have new income, will increase utilization and, as a result, nutrition will be improved," said Awuni.

*In Malawi, soy, groundnut, and orange-fleshed sweet potato are commonly grown, but underutilized crops. Almost half of the country's children suffer from malnutrition and stunting, with a significant proportion of those children living in rural areas. The ability to successfully grow and process these foods in those rural areas would have a considerable impact on childhood health; however, these highly nutritious foods are not being used to their full potential due to a knowledge gap in food safety and food processing. The Soybean Innovation Lab (SIL) is partnering with the Feed the Future Agricultural Diversification (FTF Ag-Div) project in Malawi to disseminate nutrition, food processing, and food safety education across the country.*

*The SIL-AgDiv team is using a training-of-trainer model to cascade nutrition education to eight different regions in Malawi. The roll out began in late July, when forty NGO personnel responsible for leading village-level trainings met at the Lilongwe University for Agriculture and Natural Resources (LUANAR) campus for a week of hands-on learning. Not only did the training focus on topics of dietary diversity, integrating nutritious foods into local dishes, and mitigating food safety hazards, but also how to teach these concepts in a village-level setting, to a large group of people, presumably with limited literacy.*

*These techniques for village-level trainings were developed by the SIL nutrition researchers who conducted pilot trainings and follow-up visits in rural Mozambique, where researchers evaluated the cooking tools and energy sources available in the villages and the trainees' information retention. Trainees provided feedback about the most useful recipes and the adoption of new techniques, and with these results, the researchers developed a week-long curriculum. The content of the program aims to share these proven methods with development agencies working in rural Sub-Saharan Africa.*

*Trainers from NGOs such as Save the Children, Feed the Children, Self-Help Africa, and World Relief gathered on the LUANAR campus to spend the week cooking in conditions that mirrored village kitchens. Trainees learned six new recipes to introduce to the villages where they work: roasted groundnuts, groundnut butter, sweet potato mandazi, sweet potato bread, soy milk, and tofu. The trainees also left the training with new skills in food safety, such as "Zeer pot" refrigeration, aflatoxin identification and disposal, hand washing, and shelf life extension.*

*Faculty from LUANAR Department of Food Science and Nutrition collaborated with SIL representatives Dr. Juan Andrade, Professor of Global Nutrition at the University of Illinois, Program Coordinator Maggie Cornelius, and Dr. Emmanuel Alamu, researcher for the International Institute of Tropical Agriculture in Lusaka, Zambia.*

*Watch a video about the training.*

*Learn more on the trainings by visiting our website.*