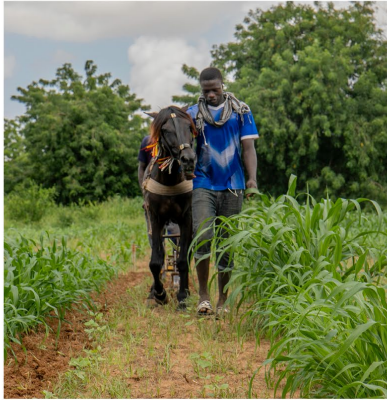


2021

ANNUAL PERFORMANCE REPORT



Innovation Lab for Collaborative Research on Sustainable Intensification

transforming farming systems for smallholders



Feed the Future Innovation Lab for Collaborative Research on Sustainable Intensification

Annual Performance Report FY 2021

This annual performance report for FY 2021 is made possible by the generous support of the American people through the United States Agency for International Development (USAID). The contents are the responsibility of Kansas State University and do not necessarily reflect the views of USAID or the United States Government.

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Cover Photos

Top Left: Weeding of the plot of millet variety Souna3 intercropped with Mungbean at the agricultural technology park set at ISRA-CNRA research station of Bambey, Senegal. Photo credit: Jimmy. September 2021.

Top Center: The U.S. Ambassador W. Patrick Murphy and USAID had a field visit to the Agricultural Technology Park at the Bosknor Conservation Agriculture Research Station in Kampong Cham province. The field visit was hosted by CE SAIN and Department of Agricultural Land Resources Management of General Directorate of Agriculture to present the research and demonstration activities, innovations, and achievements on conservation agriculture and sustainable intensification practices. Photo credit: Sina Nov. June 2021.

Top Right: A farmer in his maize field in Basurabad, Polder 30 using conventional tillage. Photo credit: SIIL Polder Team. May 2021.

Bottom: The Lead farmer organization of the Senegalese peanut basin visited CERAAS. Photo credit: Aliou Faye. October 2020.



Management Entity Information

The Feed the Future Innovation Lab for Collaborative Research on Sustainable Intensification (SIIL) is housed at Kansas State University in Manhattan, KS. The management entity staff includes the following individuals:



Dr. P.V. Vara Prasad – Director

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P.V. Vara Prasad, University Distinguished Professor of Crop Ecophysiology, serves as the Program Director of SIIL. 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 SIIL and oversees all of the research, capacity building, knowledge sharing and communication activities of the program. He administers technical and financial aspects of SIIL and serves as the primary contact for donors, advisory groups, and partner organizations.



Dr. B. Jan Middendorf – Associate Director

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B. Jan Middendorf serves as the Associate Director for the SIIL at Kansas State University (KSU). As Associate Director, Dr. Middendorf conducts research and leads SIIL's impact assessment and monitoring and evaluation efforts. She is also responsible for establishing and maintaining effective partnerships with other U.S. and international institutions, industry, USAID Missions, and developmental partners. As part of these efforts, she develops and implements strategic planning and capacity building initiatives to enhance collaborative research and support organizational change. This experience includes working with various stakeholders at the community, regional, national, and international levels. Dr. Middendorf 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. Dr. Middendorf earned her Ph.D. from KSU after completing her Master's and Bachelor's from Ohio University and University of Rhode Island, respectively.



Dr. Manny Reyes – Research Professor

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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 has focused 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, as well as helping to lead the Center of Excellence on Sustainable Agricultural Intensification and Nutrition (CE SAIN). He has facilitated partnerships with other Feed the Future Innovation Labs, international organizations and NGOs, local non-profits, and private industry in Cambodia.



Andra McCowen – Program Administrator

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Andra Williams serves as the Program Administrator for the SIIL. She collaborates with the Lab's domestic and international partners to help manage the program's monitoring and evaluation, communication, reporting, and knowledge management needs. Andra received a B.A. in French, with a minor in Community Nutrition, from the University of California, Davis, and a Master's in International Development and Sustainability from the Université Grenoble-Alpes in France. She served as a Peace Corps health volunteer in Senegal from 2013-2014 and has worked in both Senegal and Guinea as a part of USAID projects. Andra was most recently employed with the Horticulture Innovation Lab at UC Davis prior to coming to the SIIL. She speaks fluent French and passable Seerer.



Jessica Burden – Business Manager

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Jessica Burden serves as the Business Manager for the SIIL. She is responsible for the financial management of all grants, including post-award accounting, travel planning, distribution of funding for sub-awards, and working with pre- and post-award services. Jessica holds a B.S. in Business Administration – Accounting with a minor in Leadership Studies, as well as a Masters in Accountancy, both from Kansas State University. Additionally, she has previous experience as an auditor, providing her with much grant compliance and financial experience and prior university experience at Kansas State, Oklahoma State, and University of North Texas.



LaTrese Taylor – Program Manager

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LaTrese Taylor serves as Program Support for the SIIL at Kansas State University. LaTrese earned her B.A. in Psychology from the University of Nevada Las Vegas. She holds an M.A. and an M.S. in Human Resource Management and Organizational Management from Webster University, St Louis, and The George Washington University, Washington, DC respectively. LaTrese was in one of the last U.S. Peace Corps Master's International (MI) cadres, combining service with a degreed program. As an MI, she served as a Peace Corps agriculture volunteer in Senegal from 2016-2019. She received M.A. in International Development from American University, Washington DC in 2021. She brings experience in project management, monitoring/evaluation, combining research and local farmer programming, and agricultural technical training/extension in farming communities. She speaks Wolof.



Layne Wilson – Communications Specialist

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Layne Wilson serves as the International Communications Specialist for the SIIL. She is responsible for developing and implementing communication strategies, success stories and social media content from project activities for effective outreach. Layne graduated from Texas Tech University with a Bachelor of Science in Agricultural Communications and a minor in Agribusiness Management.



Dr. Aliou Faye – iREACH Initiative and 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 iREACH Initiative and Country Coordinator for the SIIL in Senegal.



Dr. Hamidou Traore – Country Coordinator, Burkina Faso

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Dr. Hamidou Traore has over 25 years of research experience in the field of agronomy. Dr. Traore holds a PhD in Weed Science from the University of Montpellier II, Sciences and Techniques of Languedoc, France, and a Diploma of Rural Development Engineering in Agronomy from University of Ouagadougou. Dr. Traore serves as Director of the Institut de l'Environnement et de Recherche Agricoles (INERA), Burkina Faso. He previously held the position of Regional Director of the Eastern and Sahelian Environmental and Agricultural Research Regional Centers. Dr. Traore was also a Fulbright Scholar at the Agronomy Department of Purdue University.



Araya Berhe – Research Associate

Email: aberhe@ksu.edu

Araya Berhe serves as a Research Associate in the Department of Agronomy and SILL. He received his Ph.D. in Production Ecology and Resources Conservation from Wageningen University, the Netherlands. Currently, his research is focused on the application of crop modeling, geospatial and agro-meteorological techniques for sustainable water management, developing climate change adaptation and resilience strategies, and optimizing resources use for sustainable agricultural production and food security. Addressing water shortage, climate change and climate variability, and nutrient management related challenges in agriculture at local, regional, and global level are some of his main research interests.



Prakash Kumar Jha – Postdoctoral Fellow

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Prakash Kumar Jha is a postdoctoral fellow at the Kansas Agricultural Experiment Station and works in collaboration with the SILL. He earned his B.S. in Agricultural Sciences from Banaras Hindu University, India, his M.S. in Environmental Sciences from Indian Agricultural Research Institute, India, and his Ph.D. in Crop and Soil Sciences from Michigan State University, USA. His advisors are PV Vara Prasad and Ignacio A. Ciampitti. Prakash is currently engaged in the projects on Lonsinger Sustainability Research Farm, and the Geospatial and Farming Systems Research Consortium (GFC) at Kansas State University.



Hardeep Singh – Postdoctoral Fellow

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Hardeep Singh is a postdoctoral fellow in the Department of Agronomy and works in collaboration with the USDA-ARS Grazinglands Research Laboratory, El Reno. He earned his B.S. in Agricultural Sciences from Punjab Agricultural University, India, M.S. in Horticultural Sciences and Ph.D. in Crop Sciences from Oklahoma State University, Stillwater, USA. Currently, his research is focused on testing different crop rotations for cropping system diversification in Southern Great Plains, lowering down greenhouse gas emissions from cover crops and application of crop modelling for sustainable use of water and nitrogen developing sustainable agricultural systems under Rainfed Agriculture Innovation Network (RAIN) project.



Sanders Barbee – Communications Assistant

Sanders Barbee serves as the Communications Assistant for Feed the Future Innovation Lab for Collaborative Research on Sustainable Intensification (SII). As the Communications Assistant, Sanders helps to expand and promote communication strategies, success stories and social media content from project activities for effective outreach. Sanders is currently a sophomore majoring in Agricultural Economics, with a pre-law focus. She is also a fellow with the K-State's Food and Agriculture Policy Fellowship. She is an active leader in the student community in Manhattan, Kansas serving as Secretary in the college MANRRS chapter. Along with this, she participates in the University marching band where she plays the mellophone. Sanders has recently taken on a new role as the Conservation & Sustainability Fellow for the Kansas Grain Sorghum's Producer Association where she will assist Kansas Grain Sorghum in connecting with sustainability projects focusing on farm-oriented programming. She is scheduled to graduate in May 2023.

External Advisory Board

The External Advisory Board (EAB) is chaired by Jules Pretty. 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

Professor 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 - retired

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 in various capacities with FAO in their global, regional, and country programs. He also led ACIAR international program and is currently and Adjunct Professor at Queensland Alliance for Agriculture and Food Innovation, The University of Queensland. 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. Peter Thorne**

International Livestock Research Institute (ILRI) - retired

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.

Focus Countries

The Feed the Future Innovation Lab for Collaborative Research on Sustainable Intensification (SIIL) supports research in West Africa, East Africa, Asia, and Central America. This map includes all countries that SIIL has worked in, both past and present.



List of Program Partners

United States

ADM Institute for the Prevention of Postharvest Loss
 American Soybean Association (ASA)
 Feed the Future Innovation Lab for Collaborative Research on Nutrition in Africa
 Feed the Future Innovation Lab for Fish
 Feed the Future Innovation Lab for Horticulture
 Feed the Future Innovation Lab for Small Scale Irrigation
 Feed the Future Innovation Lab for the Reduction of Postharvest Loss
 Kansas State University
 Michigan State University
 Montana State University
 North Carolina A&T State University
 Northwestern University
 Oakland University
 Pennsylvania State University
 Stanford University
 Texas A&M University
 Tillers International
 Tufts University
 United States Peace Corps - Senegal
 University of California, Davis
 University of Colorado - Boulder
 University of Florida
 University of Illinois at Urbana-Champaign
 University of Maryland
 University of Minnesota
 University of Tennessee Institute of Agriculture (UTIA)
 University of Wisconsin – Madison

Bangladesh

ACI Motors Limited
 Bangladesh Agricultural Research Council (BARC)
 Bangladesh Agricultural Research Institute (BARI).
 Bangladesh Agricultural University
 Bangladesh Rice Research Institute
 BRAC
 International Maize and Wheat Improvement Center (CIMMYT)
 International Agricultural Research Center (IARC)
 International Rice Research Institute (IRRI)
 Institute of Water Modeling (IWM)
 Khulna University
 Shushilan (National NGO)

Burkina Faso

Association pour la Promotion de l'Élevage en Savane et au Sahel (APESS)
 Institut de l'Environnement et de Recherches Agricoles (INERA)
 International Livestock Research Institute (ILRI)
 La Fédération Nationale des Groupements Naam (FNGN)
 Polytechnic University of Bobo-Dioulasso (UPD)

The International Union for Conservation of Nature (IUCN)

Cambodia

Agricultural Development Denmark Asia
 AVRDC – World Vegetable Center
 Cambodian Agricultural Research and Development Institute (CARDI)
 Conservation Agriculture Service Center (CASC)
 Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD)
 Department of Agricultural Engineering (DAEng)
 ECHO Asia
 Institute of Technology of Cambodia (ICT)
 Kasetsart University
 Ministry of Agriculture Forestry and Fisheries (MAFF)
 Ministry of Education and Youth (MoEY)
 Provincial Department of Agriculture, Forestry and Fisheries (PDAFF)
 Royal University of Agriculture - Phnom Penh
 SmartAgro
 University of Battambang

Ethiopia

Africa Research in Sustainable Intensification for the Next Generation (Africa RISING)
 Bahir Dar University / Bahir Dar Institute of Technology
 International Food Policy Research Institute (IFPRI)
 International Livestock Research Institute (ILRI)
 International Water Management Institute (IWMI)
 University of Twente

Senegal

Agence Nationale de Conseil Agricole et Rural (ANCAR)
 Bureau d'Analyse Macro Economiques (BAME)
 Centre d'Etude pour l'Amélioration de l'Adaptation à la Sécheresse (CERAAS)
 Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD)
 Institut de Recherche Pour le Développement (IRD)
 Institut de Technologie Alimentaire (ITA)
 Institut Sénégalais de Recherches Agricoles (ISRA) – Centre National de Recherches Agronomiques de Bambey (CNRA – Bambey)
 ISRA – Laboratoire National d'Élevage et de Recherches Vétérinaire (LNERV)
 ISRA – Laboratoire National de Recherche sur les Production Végétales (LNRPV)
 Réseau des Organisations Paysannes et Pastorales du Sénégal (RESOPP)
 University of Thies – College of Agriculture

Tanzania

Africa Research in Sustainable Intensification for the Next Generation (Africa – RISING)
 International Center for Tropical Agriculture (CIAT)
 International Institute of Tropical Agriculture (IITA)
 International Maize and Wheat Improvement Center (CIMMYT)
 N2Africa
 Nelson Mandela African Institution of Science and Technology (NM-AIST)
 Sokoine University of Agriculture (SUA)

Additional Partners or Collaborators

African Economic Research Center (AERC)

aWhere

Conseil Ouest et Centre Africain pour la Recherche et le Développement Agricoles (CORAF)

Corteva Agriscience

Descartes Labs

Innovation Research, Extension, and Advisory Coordination Hub (iREACH)

International Fertilizer Development Center (IFDC)

International Institute for Applied Systems Analysis (IIASA)

ITC – Netherlands

Kifiya Financial Technology Plc.

One Acre Fund

Quantitative Engineering Design

Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA)

Swiss Federal Institute of Aquatic Science and Technology (EAWAG)

Swisscontact

Taking Maize Agronomy to Scale in Africa (TAMASA)

University of Gaston-Berger

University of Rwanda

University of Western England

Wageningen University and Research Center

World Agroforestry Center

World Vision

Acronyms

ACIAR – Australian Centre for International Agricultural Research
 ADDA – Agricultural Development Denmark Asia
 ADS – Automated Directives System
 AERC – African Economic Research Center
 Africa RISING – Africa Research in Sustainable Intensification for the Next Generation
 AfSIS – Africa Soil Information Service
 AGRA – Alliance for a Green Revolution in Africa
 ANCAR - Agence Nationale de Conseil Agricole et Rural
 AOR – Agreement Officer’s Representative
 APES – Association pour la Promotion de l’Elevage en Savane et au Sahel
 ASA – American Soybean Association
 ASM – Appropriate scale mechanization
 ASMC – Appropriate Scale Mechanization Consortium
 AUC – African Union Commission
 AWP – Annual Work Plan
 BAME – Bureau d’Analyse Macro Economiques
 BARC – Bangladesh Agricultural Research Council
 BARI – Bangladesh Agricultural Research Institute
 CA – Conservation Agriculture
 CT – Conventional Tillage
 CASC – Conservation Agriculture Service Center
 CASF – Conservation Agriculture Service with a Fee
 CAST – Commercialization of Aquaculture for Sustainable Trade
 CERAAS – Centre d’Etude pour l’Amélioration de l’Adaptation à la Sécheresse
 CE SAIN – Center of Excellence on Sustainable Agricultural Intensification and Nutrition
 CE MARCH – Center of Excellence on Mitigation, Adaptation and Resilience to Climate-Change in Haiti
 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
 CNRA – Centre National de Recherches Agronomiques (CNRA)
 CORAF – Conseil Ouest et Centre Africain pour la Recherche et le Développement Agricoles
 CSA – Climate smart agriculture
 CSISA-MEA – Cereal Systems Initiative for South Asia – Mechanization Extension Activities
 CSIRO – Commonwealth Scientific and Industrial Research Organization
 DAEng – Department of Agricultural Engineering
 DDL – Data Development Library
 EAB – External Advisory Board
 EMMP – Environmental Management and Mitigation Plan
 EAWAG – Swiss Federal Institute of Aquatic Science and Technology
 FAA – Federal Aviation Administration
 FABI – Faculty of Agricultural Biosystems Engineering
 FAO – Food and Agriculture Organization
 FGD – Focus Group Discussions
 FNGN – La Fédération Nationale des Groupements Naam
 FLMLA – Faculty of Land Management and Land Administration
 FTFMS – Feed the Future Monitoring System
 FY – Fiscal year
 GFC – Geospatial and Farming Systems Research Consortium
 GIS – Geographic Information System

GMCC – Green Manure Cover Crops
 HYV – High Yielding Varieties
 IARC – International Agricultural Research Center
 ICRISAT – International Crops Research Institute for the Semi-Arid Tropics
 ICT – Institute of Technology of Cambodia
 IDRC – International Development Research Centre
 IDSS – Integrated Decision Support System
 IFDC – International Fertilizer Development Center
 IFPRI – International Food Policy Research Institute
 IIASA – International Institute for Applied Systems Analysis
 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
 INGENAES – Integrating Gender and Nutrition within Agricultural Extension Services
 INRAN – Institut National de la Recherche Agronomique du Niger
 IPM – Integrated Pest Management
 iREACH – Innovation Research, Extension, and Advisory Coordination Hub
 IRD – Institut de Recherche Pour le Développement
 IRRI – International Rice Research Institute
 ISRA – Institut Sénégalais de Recherches Agricoles
 ITA – Institut de Technologie Alimentaire
 IUCN – International Union for Conservation of Nature
 IWMI – International Water Management Institute
 LIVES – Livestock and Irrigation Value Chains for Ethiopian Smallholders
 LNERV – Laboratoire National d’Élevage et de Recherches Vétérinaire
 LNRPV – Laboratoire National de Recherche sur les Production Végétales (LNRPV)
 MAFF – Ministry of Agriculture Forestry and Fisheries
 ME – Management Entity
 MoEY – Ministry of Education and Youth
 MOU – Memorandum of Understanding
 MSU – Michigan State University
 NARS – National Agricultural Research Systems
 NGO – Nongovernmental organization
 NM-AIST - Nelson Mandela African Institution of Science and Technology
 NUS – Neglected and underutilized species
 PDAFF – Provincial Department of Agriculture, Forestry and Fisheries
 PRC – Policy Research Consortium
 PI – Principal investigator
 PTOS – Power Tiller Operated System
 R4D – Research for Development
 RESOPP – Réseau des Organisations Paysannes et Pastorales du Senegal
 RHoMIS – Rural Household Multiple Indicator Survey
 RUA – Royal University of Agriculture
 SAR – Synthetic Aperture Radar
 SBIR – Small Business Innovation Research
 SEARCA - Southeast Asian Regional Center for Graduate Study and Research in Agriculture
 SI – Sustainable intensification
 SIIL – Sustainable Intensification Innovation Lab
 SIPS – Sustainably intensified production systems

STEM – Science, Technology, Engineering and Mathematics
SSA – Sub-Saharan Africa
SUA – Sokoine University of Agriculture
TAMASA – Taking Maize Agronomy to Scale in Africa
TP – Technology Park
TRA – Technology Readiness Assessment
UAV – Unmanned Aerial Vehicle
UBB – University of Battambang
UPB – Polytechnic University of Bobo-Dioulasso
USAID – United States Agency for International Development
USG – United States Government
UTIA – University of Tennessee Institute of Agriculture
WAgN – Women in Agriculture Network

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I. Executive Summary

The Feed the Future Innovation Lab for Collaborative Research on Sustainable Intensification (SIIL) successfully completed its seventh year since inception. All awards are years of active research and data collection in SIIL's focus countries. This report covers current activities in Bangladesh, Cambodia, Guatemala, Honduras, Niger, and Senegal. SIIL continues to support the goal of developing an integrated research portfolio of sustainable intensification practices that offer the greatest potential to reduce hunger while improving the resilience and nutrition status of smallholder farmers in the target regions. This fiscal year SIIL has positioned itself to build on the achievements of past years while ensuring the continued relevance of the research with a renewed focus on leveraging regional efforts, scaling innovations, and strengthening local institutional and human capacity with the goal of working towards the *journey to self-reliance*.

During this past year, research projects and consortia began working on final redesign and scaling (identifying appropriate partners) technologies and innovations developed during the first phase of the Innovation Lab, and this report highlights the accomplishments and lessons learned during that time. Project teams had already identified promising innovations from their research by using a holistic approach to innovation and scaling and by actively collaborating with strategic partners to leverage investments from both the public and private sectors. They were then able to communicate their successes through multiple knowledge management platforms, which have been key to successful implementation that will ensure greater impact, reach and return on investments. The SIIL continues to grow by collaborating with more than 100 national and international organizations (including 8 CGIAR and 18 US universities) and supporting more than 160 students and young scientists to work towards increasing sustainable agriculture productivity, enhancing the resilience of cropping systems, and supporting nutritional outcomes.

This summary serves to highlight a few of the activities from our portfolio: the Appropriate Scale Mechanization Consortium (ASMC) launched a new website to increase visibility and reach of the Consortium. The website showcases their technologies and achievements and also houses reports, manuals, and e-learning materials. The ASMC Cambodia Hub signed a partnership agreement with SmartAgro to promote the use of cover crops and supported SmartAgro in developing promotional materials. It also developed the GoNative App in collaboration with a U.S.-based private company and the University of Battambang, designed to bridge the communication gap between smallholder farmers and consumers. The digital and geospatial tools and farming systems consortium was fully established and started interaction with various partners in multiple countries to provide guidance and advanced data analysis covering different domains of sustainable intensification. The Bangladesh Polder project published their newsletter *Polder Tidings* Vol 3, No. 2 April 2021 and a nutrition brochure (healthy eating: what to put on your plate). The S3 Cambodia project is currently developing a STEM + agricultural curriculum to pilot at their secondary school green lab, producing a module on tomato grafting. The Senegal team continued to work with women's groups around the country and were able to obtain 6 permits for selling enriched dual-purpose millet flour in supermarkets and health districts around Senegal. Finally, the Bean Study, led by Michigan State University and CIAT, conducted meetings with 7 breeders and seed producers (registered and certified seed only) in Guatemala and Honduras to learn more about the types of beans being produced in the region, which bean varieties farmers are most likely to grow and should be included in the nurseries, they also prepared a protocol to collect seed from farmers and local markets to include in the nursery.

Other highlights include a) celebration of the Center for Sustainable Agricultural Intensification and Nutrition (CE SAIN) at Royal University of Agriculture in Cambodia five-year anniversary; b) expansion of Agricultural Technology Parks in the Mondulkiri and Preah Vihear provinces of Cambodia focused on sustainable agricultural practices; c) official opening of the iREACH Agricultural Technology Park located at ISRA's research station in Bambey, Senegal, d) engagement with the USAID Missions, Innovation Labs, and CORAF on the implementation of the activity tracker to support collaboration and coordination activities in West Africa; and e) development and launch of the SI Assessment Framework mobile app to increase usability.

SIIL is committed to human and institutional capacity building as evidenced by the number of short-term trainings offered to 7,066 individuals (2160 women, 31%), despite the limitations from COVID-19 constraints worldwide. During FY 2021, SIIL supported 37 individuals through long-term degree granting training, 41% of whom were

females. These represented 21 Ph.D. students (24% F), 13 M.Sc. students (62% F), and 3 B.Sc. students (67% F). SIIL country coordinators continued to provide support to partners on the implementation and coordination of research, capacity building activities, communication, and support of ongoing research. Collectively, SIIL's researchers produced over 70 peer-reviewed publications and delivered over 60 virtual presentations in FY 2021.

II. Focus Country Key Accomplishments Bangladesh

The Appropriate Scale Mechanization Consortium (ASMC 2), continued to concentrate on scaling up improved mechanization innovations and techniques. Additionally, the project, “Pathways of scaling agricultural innovations for sustainable intensification in the polders of coastal Bangladesh” moved forward with its work in polder communities dealing with improved rice planting techniques and improved production and cultivation practices. Below are highlights from the projects that worked in Bangladesh during FY 2021:

A. ASMC 2:

1. Four research articles were published in national and international journals and one manuscript was submitted, and one ASABE 2021 conference paper was published and presented virtually at the 2021 SILL Annual Meeting. Additionally, three presentations were given at the Bangladesh Agricultural University Research Annual Workshop 2021, and the SILL and ASMC annual meetings in 2021.
2. The Smart Agro-Technology Innovation Youth Network (SAIYN) was successfully launched on August 26, 2021, to engage teenagers and youth with agro-technology innovation through the Zoom online video conference platform. 195 (Males: 146, Females: 49) participants joined in the ceremony from home and abroad and the SAIYN leadership were introduced to the participants during the launching ceremony. SAIYN already has an official Facebook page and an email for further communication. SAIYN has two slogans, one in English (Think Great, Do Great | Innovate for Green Planet) and another in Bengali. SAIYN has set the mission and vision considering 4-H Illinois approach to convey the youth engagement activities to the national and international audiences. A flyer of SAIYN has been prepared for dissemination. Now, SAIYN has launched first idea competition on the theme “Smart Agriculture for Green Planet”. The grand finale of the idea competition will be held on November 5, 2021.
3. A draft leaflet (Bangla version) on the combine harvester was prepared and used during the Field Day program of Boro Harvesting 2021 (April-May 2021). Final design and printing are in process and a project flyer was also published for ASMC annual meeting 2021. A SAIYN flyer was prepared and disseminated to the participants of launching ceremony.
4. One research associate and two MS fellows were selected and recruited to assist with Phase I I research.

B. Pathways of scaling agricultural innovations for sustainable intensification in the polders of coastal Bangladesh

1. The project team established 13 learning hubs in *rabi* and 10 in *aman* season spreading across four polders involving 227 farmers for demonstration of improved cropping patterns and eight field days involving more than 300 farmers and community leaders despite the prevailing COVID-19 pandemic.
2. Implemented the Cluster Farmer Field School (CFFS) model in two polders attended by 92 farmers within a small hydrological boundary.
3. Published 1 Polder Tidings Vol 3, No. 2 April 2021, 2 Newsletters in April and July 2021, and Nutrition Brochure (Healthy Eating: What to put on your plate?).
4. NARES provided 560 kg of high quality seeds of HYV (high yield variety) rice for establishing demonstration farms and mentoring the farmers through CFFS in the polder zone.

Burkina Faso

The ASMC 2 was also active in Burkina Faso during FY 2021. As a part of the funding extension, ASMC 2 continued to concentrate on scaling up the improved mechanization innovations and techniques created during ASMC’s first phase, including improved oxen yokes and soil tillers. Below are the highlighted activities completed in Burkina Faso during FY 2021, including the no-cost extension:

C. ASMC 2:

1. Eight (08) local blacksmiths were trained at ASMC demonstration site in Koumbia (Tuy Province, Hauts-Bassins Region) for making planters and chopper. Those blacksmiths came from different western areas of Burkina Faso (Banfora, Diébougou, Fouzan, Dédougou, Tougan).
2. ASMC team attended a symposium in Ouagadougou from June 17-21, 2021, with the abstract "Test of the animal-drawn planter designed and developed for appropriate agricultural mechanization to optimize the maize planting system in Burkina Faso".
3. The TRA (Technology Readiness Assessment) and GAP analysis were conducted for the planter. Data is currently being analyzed and a report will be available before end of the year.

Cambodia

The S3 Cambodia: Scaling Suitable Sustainable Technologies worked to augment the research conducted by the WAgN project to improve the diffusion and adoption of the innovations created through the first project. ASMC 2 will also continue their activities in Cambodia, in conjunction with various partners, including UBB, RUA and CE SAIN. Below are the highlighted activities completed in Cambodia during FY 2021:

D. ASMC 2:

1. Prepared conservation agriculture (CA) training slide decks to train PDAFF (Provincial Department of Agriculture, Forestry and Fisheries) to carry out MetKasekor model, an open market model, to introduce the 4 technologies (no-till planter, land leveler, cover crop and seed broadcaster).
2. Signed partnership agreement with SmartAgro to promote the use of cover crops and supported SmartAgro in developing promotional materials.
3. Conducted field showcase to farmers and service providers. About 450 ha and 179 households changed the farming technology from CT to CA, using 3 technologies: no-till planter, land leveler, and cover crops.

E. S3 Cambodia – Scaling Suitable Sustainable Technologies:

1. A desk study of regional efforts to promote the transfer of agricultural information from classrooms to households through 4-H, school gardens, and other forms of agricultural education. This review was presented at the International Society of Environmental and Rural Development Conference and the 2021 SILL annual conference.
2. Compiling a written and physical inventory of wild food garden (WFG) species used for food, fiber, medicinal, and agricultural input purposes in Cambodia.
3. Developing STEM + agricultural curriculum to pilot at secondary school green lab, producing a module on tomato grafting.

Guatemala/Honduras

F. Economic impact of improved bean varieties in Central America and the USA:

The “Economic impact of improved bean varieties in Central America and the USA”, a study lead by Michigan State University (MSU) and the International Center for Tropical Agriculture (CIAT), is a USAID buy-in that is being funded by the SILL to evaluate and estimate the economic impact of investments made by the former Legume Innovation Lab program, CIAT, and other organizations and universities on bean breeding. The evaluation will focus on the USA (i.e., Michigan), Guatemala, Honduras, Nicaragua, and Haiti, with fields trial being conducted in Guatemala and Honduras. The project began on January 1, 2021 and will run for two years. Below are the highlights completed during FY 2021:

1. Signed complete contract with Kansas State University in March 2021.

2. Conducted several Zoom conversations with bean breeders from MSU and North Dakota State University, and the coordinator for the bean yield trials representing the Michigan Bean industry to introduce them to the study's objectives, seek their input, and share data needs.
3. Compiled and curated data from the Michigan Dry Bean Performance trials for the period 1997–2020 provided by Dr. Scott Bales (MSU). The information will be used to determine, in combination with information from bean elevators, the attributable improvement in dry bean productivity from MSU.
4. In Guatemala and Honduras, conducted informal conversations with 7 breeders and seed producers (registered and certified seed only) in March 2021 to learn which regions producing most beans in each of the two countries, which varieties farmers have grown the most (per these informants' experience) and should be included in the nurseries, and prepared a protocol to collect seed from farmers and local markets, to include in the nursery.

Senegal/Niger

The Senegal project is focused on “Improving food and nutrition security of smallholder agro-pastoral farming systems by integrating crop-livestock-human nutrition in Senegal and Niger” and will build upon the previous research completed with the first project. This project will also expand its focus to encompass a more regional approach in West Africa. Below are the highlighted activities completed in Senegal during FY 2021:

G. Improving food and nutrition security of smallholder agro-pastoral farming systems by integrating crop-livestock-human nutrition in Senegal and Niger:

- Obtained 6 permits for selling enriched millet flour in supermarkets and health districts around Senegal.
- Established variety - fertilizer - sowing density demonstrative trials at 4 ISRA research stations (Bambey, Niore, Sinthiou Malem, and Boulel) with 6 farmers around each station for a total of 24 farmers.
- Exchange with Niger project PI on the protocol for the installation of agronomic trials and seed multiplication, as well as dual-purpose millet seed varieties.
- Completed training of farmer's and women's cooperative managers on monitoring and evaluation of procedures and reporting methods.

III. Research Program Overview and Structure

Digital and Geospatial Tools Consortium – Building a new era of Predictive Agricultural Innovation to Improve the Livelihoods of Smallholder Farmers

The Geospatial Farming Systems Consortium will focus on providing high-resolution soil, climate, crop, livestock, nutrition, and socioeconomic data. These datasets can help in quantifying past conditions and inform future changes in the adoption of different management practices to improve the overall resiliency and sustainability of agricultural systems in the targeted regions (e.g., West Africa and Asia) and in the Feed the Future Zones of Influence. The consortium plans to focus on creating and promoting the following based on their proposed objectives:

- *Modeling tools*: to examine mixed crop-livestock farming systems' suitability and land capability for agriculture productions in targeted regions.
- *Remote-sensing products*: to assess current conditions, trends, and potential future conditions in targeted countries.
- *Connection*: to link agricultural productive capacity and child malnutrition using livestock ownership, field size, use of improved seeds and fertilizer, and climate variability.
- *Resilience*: to examine the potential implications of agricultural innovations on social and biophysical risk and resilience at local test sites in targeted regions.
- *Innovation integration*: develop geospatial products that integrate across project outputs to map biophysical and social risk analysis for the targeted regions and the potential of specific agricultural innovations to increase resilience in the face of climate change.

The Appropriate Scale Mechanization Consortium (ASMC 2)

The ASMC aims to introduce multifunctional and modular mechanized technologies that are technically, environmentally, economically, and socially appropriate for use by smallholder farmers (including women) with the flexibility to accommodate different power sources. They are currently active in four countries. The specific intervention and entry point will vary by country as determined by the host country partners and needs of the producers. These technologies contribute to enhanced labor productivity and increased land productivity, thus sustainably reducing poverty among smallholders.

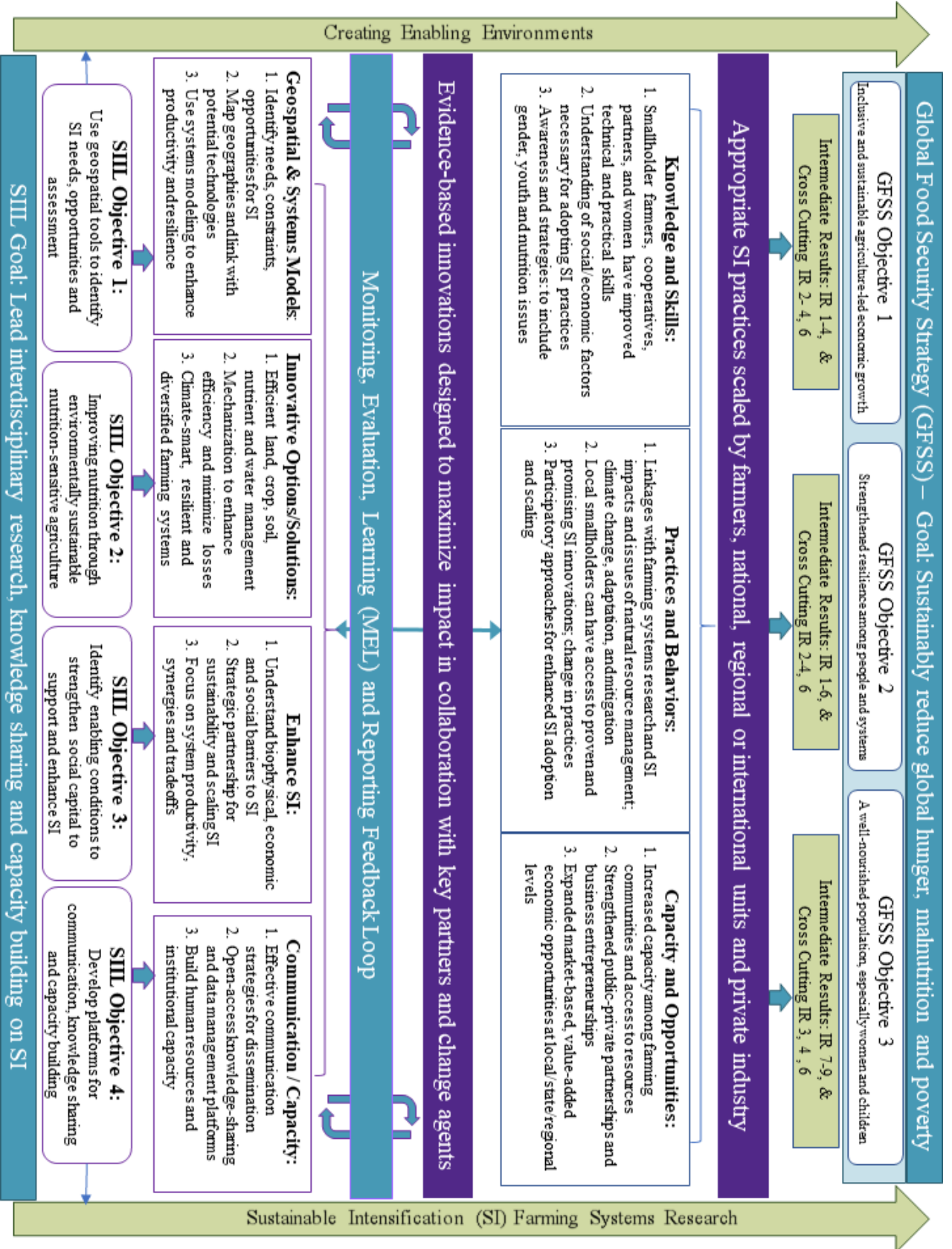
ASMC 2 worked on scaling its innovations in 3 countries – Bangladesh, Burkina Faso, and Cambodia. The objectives for the consortium focus on the following goals:

- *Scaling*: will work to scale SI innovations and associated technologies to stakeholders (farmers, manufacturers/ blacksmiths, extension, service providers, mechanics, private and public sectors).
- *Capacity Building*: will work to build technical and entrepreneurship capacity of service providers, fabricators and manufacturers, and mechanization experts in the focus countries.
- *Policy*: will work to create and contribute to an enabling policy environment for mechanization among smallholder farmers.

Focus Country Research Subawards

The SIIL supported three country subawards (Bangladesh, Cambodia, and Senegal/Niger) in FY 2021. Together, the research project subawards will investigate a diverse range of sustainable intensification practices and innovations across the SIIL focus countries. The broad focus areas being crop-livestock interaction; better management of crops and livestock to enhance resource use efficiency; diversification (integration of legumes; home gardens; and new crops); and precision and sustainable agricultural practices. The SIIL research subawards are implemented and led by collaborations between U.S. universities, NARS centers, NGOs, and CGIAR partners.

IV. Theory of Change



V. Research Project Reports

Theme I: Geospatial and Digital Tools

A. Digital and Geospatial Tools Consortium (FY2020 – FY 2023)

1. **Name:** Digital and Geospatial Tools Consortium (DGTC, Principal Investigator (PI): Ignacio Ciampitti, Kansas State University)
2. **Locations: Global** – Due to the nature of the consortium’s research and the incorporation of remote sensing, the projects are often not location-dependent. The locations listed for each subaward report may refer to field work locations, targeted areas for remote sensing work, or a combination of the two. However, the processes and methods can be scaled globally.
3. **Collaborators:** *United States* – aWhere, Corteva Agri-Science, Descartes Labs, Microsoft, Michigan State University, University of Colorado, University of Maryland, University of Minnesota; *Bangladesh* – International Rice Research Institute (IRRI); *Senegal* - Initiative Prospective Agricole et Rurale (IPAR), Centre of Excellence on Dry Cereals & Assoc. Crops, National Centre for Livestock Research, Kolda (CRZ), Senegalese Agricultural Research Institute (ISRA).
4. **Description and Achievements:** The DGTC will focus its efforts, through a portfolio of research subawards and independent research, on five primary objectives. The achievements listed under each objective refer specifically to the efforts of the DGTC leadership team at Kansas State University.
 - **Modeling tools:** to examine mixed crop-livestock farming systems' suitability and land capability for agriculture productions in targeted regions.
 - **Remote-sensing products:** to assess current conditions, trends, and potential future conditions in targeted countries.
 - **Connection:** to link agricultural productive capacity and child malnutrition using livestock ownership, field size, use of improved seeds and fertilizer, and climate variability.
 - **Resilience:** to examine the potential implications of agricultural innovations on social and biophysical risk and resilience at local test sites in targeted regions.
 - **Innovation integration:** develop geospatial products that integrate across project outputs to map biophysical and social risk analysis for the targeted regions and the potential of specific agricultural innovations to increase resilience in the face of climate change.
5. **Capacity Building:**
 - Provided a webinar entitled "Approaches to regional mapping of land capability for land planning and localization of information through the LandPKS mobile application" on December 15, 2020.
 - On January 7, 2021, Drs. Brown and Grace recorded a video and uploaded it to the SIIL site. This presentation, entitled 'Drought and Food Security' described how to use remote sensing to identify drought, and then the analytical framework used to connect food availability and access to food security. Examples from Mali were used, and the group discussed how drought could be studied as a food security driver.
 - Provided a webinar on the three types of map products being developed: degraded lands, high-resolution crop distribution, and crop climate-risk / suitability. The webinar shared the basic methods that are used, previous research, and examples of how products have been used. A follow-up Q&A session with partners focused on specific needs in each of the countries as well as what types of additional training they would like.
 - Started new collaborations with partners in Senegal with the goal of setting up a crop model to simulate dual-purpose millet and estimate the spatiotemporal variabilities in crop productivity across different environments in Senegal.

6. **Lessons Learned:**

- The Consortium leaders have learned a great deal about the nature of ongoing research in each partner country as well as the needs and data availability for each country. This has been a necessary first step toward the development of eventual test sites in their focus countries. Over the coming months, they will use this information to further develop their research plans.
- Continued to learn about the challenges related to the lack of a good quantity/quality ground-truthing data (field observations). Thus, the Consortium will be discussing and organizing more scientific calls to plan for future projects and discuss possibilities of investing time and resources (if available) in data collection. Improving this step will be critical for moving the Consortium forward and providing useful digital products to partners and smallholder farmers.
- Now that staffing is in place, the Consortium initiated a new semi-regular video call among graduate students and postdocs to increase project-level communication. This new approach to communication will be critical to their success as COVID-related issues continue to create challenges for group engagement and interactions.

7. **Peer Reviewed Publications:**

- 1) Brown, M. & Grace, K. (January 2021). Drought and Food Security (video). <https://www.youtube.com/watch?v=-4vgngiWpTY&t=100s>
- 2) Ciampitti, I. A. (January 2021). Digital Farming Systems Consortium Objectives Infographic
- 3) Ciampitti, I. A. (September 2021). Soil and climate characterization to define environments for summer crops in Senegal (dataset). doi: <https://doi.org/10.7910/DVN/ZSZXDK>
- 4) Ippolito, T. (September 2021). Senegal Land Capability Classification (dataset). doi: <https://doi.org/10.7910/DVN/IRVTAK>
- 5) Neff, J. (December 2020). Approaches to regional mapping of land capability for land planning and localization of information through the LandPKS mobile application (video). <https://www.youtube.com/watch?v=L5VsTi6YxdE.x>
- 6) Nejadhashemi, A. (August 2021). Current and Future Opportunities for Livestock Farming in West Africa (video). <https://www.youtube.com/watch?v=TIUnxNabR2A&t=2s>
- 7) West, P., Gerber, J. S., & Jin, Z. (February 2021). Suitability and climate-risk data team: preliminary plans and needs (video). <https://www.youtube.com/watch?v=QUJFZZBSmNg>

Theme II: Appropriate Scale Mechanization for Smallholder Farmers

B. Summary of ASMC 2 Activities

1. **Name:** Appropriate Scale Mechanization Consortium (PI: Prasanta Kalita, University of Illinois at Urbana-Champaign)
2. **Locations:** Bangladesh, Burkina Faso, Cambodia, and Senegal
3. **Description:** The ASMC facilitates the introduction of multifunctional and modular mechanized technologies that are technically, environmentally, economically, and socially appropriate for use by smallholder farmers. The overall objective of the project is to sustainably intensify smallholder farmers' cropping systems and on-farm operations through mechanization. The ASMC utilizes a user-centric systems approach through an Innovation Hub model in each of their four focus countries. The Hubs identify specific mechanization needs, leverage ASMC resources accordingly, and implement innovative solutions.
4. **Collaborators:** *United States* - Kansas State University, Michigan State University, and North Carolina A&T State University, ADM Institute for the Prevention of Postharvest Loss (Illinois). Additional international collaborators are listed under each ASMC country report.
5. **Achievements (See FY 2021 AWP Objective 3):**
 - Launched a new website that will increase the reach of the Appropriate Scale Mechanization Consortium. It will showcase the achievements and goals of the consortium. The website will also house reports, manuals, and E-learning materials. Several videos that showcase ASMC technologies have been added to the website.
 - Efforts to develop a database of global agricultural mechanization research have begun. This database will house documents created through ASMC work as well as outside entities. This database will allow ASMC to become the leading entity for resources on agricultural mechanization.
 - Held the Appropriate Scale Mechanization Consortium Phase II Virtual Inception Meeting. This meeting brought together more than 50 participants, including project members, Science Advisory Committee members, Sustainable Intensification Innovation Lab Management, and other collaborators. At this meeting, ASMC Managing Entity and ASMC Science Advisory Committee Members were able to provide feedback on the project.
 - A survey to assess the current status of agricultural mechanization in Africa was launched. The results will be assessed in Fall 2021. A survey to assess the current status of agricultural mechanization in Asia has been developed and will be launched in Fall 2021.
6. **Capacity Building:**
 - A 12-Module Agricultural Mechanization Open Course was developed by Dr. Srivastava and Dr. Harrigan. The Modules can be found in the Supporting Documents section.
 - Worked to develop a book that discusses agricultural mechanization, natural resources management, and postharvest loss reduction for smallholder farmers has begun in partnership with Dr. Md Mojurul Alam and Dr. Chayan Saha.
7. **Lessons Learned:**
 - Although virtual meetings continue to increase the frequency of communication, it does not replace the benefits of having in-person meetings, workshops, and field days in ASMC focus countries.
8. **Presentations and Publications:**
 - See individual ASMIH reports for publications and presentations created during FY 2021.

ASMC 2 - Bangladesh

1. **Name:** Appropriate Scale Mechanization Innovation Hub (ASMIH) - Bangladesh
2. **Locations:** Innovation Hub location: Bangladesh Agricultural University, Mymensingh (Bangladesh)
Field locations: Dumuria and Wazirpur (Bangladesh)
3. **Description:** The goal of the ASMIH - Bangladesh project is promoting appropriate-scale agricultural mechanization for sustainable intensification focusing on smallholder farming systems in Southern Delta region of Bangladesh. The target equipment interventions include Rice transplanters; rice reapers, mini-combine rice harvesters, strip-tillage planters, no-tillage planters, bed planters, and axial flow pumps
4. **Collaborators:** Bangladesh - Bangladesh Agricultural University (BAU), Bangladesh Rice Research Institute, Bangladesh Agricultural Research Institute, and ACI Motors Ltd.
5. **Achievements (See FY 2021 AWP Objective 3):**
 - Laboratory-based testing and training set up of the electric motor operated reaper has been manufactured and installed for agricultural engineering students and trainees. This will be used for training and academic purposes at the Department of Farm Power and Machinery, BAU.
 - ASMIH-Bangladesh signed a letter of agreement (LoA) with BARI (research institute) and ACI Motors Ltd. (private sector agricultural machinery marketing company) to conduct collaborative project activities.
 - The rice transplanter was used in Khulna, Barishal, and Patuakhali districts during *aman* seedling transplanting (July-August 2021). With the close monitoring of the ASMIH-Bangladesh project, 0.33 ha, 0.41 ha and 0.94 ha land were transplanted in Khulna, Barishal, and Patuakhali districts, respectively. In Patuakhali, Martin Boiragi, as a single shade service provider of ASMIH-Bangladesh, transplanted 4.0 ha land.
 - ACI Motors Ltd., an active collaborator of ASMIH-Bangladesh, has sold 663 Yanmar combine harvesters among the farmers/entrepreneurs across the country during March-May 2021 through Government subsidy program. Among them 4, 3 and 9 combine harvesters were sold in Khulna, Barishal and Patuakhali districts, respectively. According to the information provided by smart assist remote (SAR) system of ACI Motors, 471.35 ha Boro paddy (April-May) was harvested using Yanmar combine harvester across the country. The entrepreneurs of Khulna, Barishal and Patuakhali districts harvested 181.05 ha, 279.21 ha and 437.63 ha paddy fields, respectively during the period. ACI motors is using technical and financial data and training & business modules developed by ASMIH-Bangladesh for publicity and capacity building of the entrepreneurs who purchased machines from ACI Motors Ltd.
6. **Capacity Building:**
 - In May 2021, ASMIH-Bangladesh team member Md. Rostom Ali conducted a training on the reaper, mini-combine harvester, and combine harvester to village mechanics under the program entitled “Grammen Mechanics Training Program” at the Horticulture Centre, Mymensingh. The training program was organized by Department of Agricultural Extension (DAE), Ministry of Agriculture. In the training program leaflet and research findings on the reaper, mini-combine harvester, and combine harvester were presented among 30 participants.
 - Capacity of field mechanics under ASMIH-Bangladesh is improving continuously through providing machinery-based services among farmers and entrepreneurs at the fields.
 - Several hand tools and machinery fabrication related machines have been added in the Machine Shop of the Department of Farm Power and Machinery, Bangladesh Agricultural University.
 - The ASMIH-Bangladesh team and faculty members of the Department of Farm Power and Machinery, Bangladesh Agricultural University participated in online guest lectures on “Agriculture Machinery Manufacturing”, by Professor Jonathan Colton of Georgia Tech University, USA. The capacity of the participants was enhanced, and the materials shared will be helpful as educational and training materials.

- Three farmers each from ten different sites around Bangladesh participated in field days and were trained in operating, maintaining, and troubleshooting CA and irrigation machinery.
- Research findings were presented in various international and national conferences and workshops.

7. **Lessons Learned:**

- Farmers are eager to receive the services of ASMIH-Bangladesh through the rice transplanter, harvester, and seeder on their lands. These services have inspired farmers and encouraged them to use the appropriate machines in crop cultivation.
- Youth and teenagers, especially at university level, are becoming more accustomed to using modern and innovative agro-technologies that will boost them towards thinking of pursuing an entrepreneurial career path.
- Agreements among different public and private organizations with ASMIH-Bangladesh have provided new ways to contribute to mechanization activities in Bangladesh.
- Gender sensitization training has offered fundamental ideas on gender, basic differences between sex and gender, and aspects of gender (e.g., gender-awareness, blind, relation, sensitivity, equality, and equity). Both women and men have enriched their knowledge on gender, especially on women's empowerment and youth engagement in agricultural machinery through this training. This training also makes clearer the role of gender in agriculture, specifically in using agricultural machineries.

8. **Presentations and Publications:**

- 1) Alam, M., Saha, C. K., Ali, M., & Hossain, M. Appropriate Scale Mechanization Innovation Hub (ASMIH) – Bangladesh, BAURES Annual Workshop 2021, Bangladesh Agricultural University - *presentation*
- 2) Alam, M. & Saha, C. K. (December 2020). ASMIH-Bangladesh. SIIL-Polder Inception Workshop - *presentation*
- 3) Alam, M. (May 2021). Appropriate Scale Mechanization Innovation Hub (ASMIH)-Bangladesh: A Sustainable Approach. BAU Annual Research Progress Workshop 2021 - *presentation*
- 4) Alam, M. (June 2021). Appropriate Scale Mechanization Innovation Hub (ASMIH)-Bangladesh. ASMC Virtual Inception Meeting - *presentation*
- 5) Alam, M., Saha, C. K., Ali, M., & Hossain, M. (May 2021). Appropriate Scale Mechanization Innovation Hub-Bangladesh (project abstract)
- 6) Alam, M., Saha, C. K., Sarkar, S., & Kalita, P. (July 2021). Present Status of Appropriate Scale Mechanization in the Selected Villages in the Southern Delta of Bangladesh. ASABE 2021 Annual International Meeting, USA. doi: <https://doi.org/10.13031/aim.202100776>
- 7) Alam, M. & Saha, C. K. (August 2021). Smart Agro-Technology Innovation Youth Network (SAIYN).
- 8) Basir, M. S., M., Sarkar, S., Saha, C. K., Hossain, M., & Alam, M. (November 2020). Mechanical Transplanting of Hybrid Rice for Sustainable Food Security(pp.887–893). Journal of Bangladesh Agricultural University, 18(S1), Bangladesh. doi: <https://doi.org/10.5455/JBAU.12571>
- 9) Hasan, M., Ali, M., Saha, C. K., Rahman, M., & Alam, M. (November 2020). Custom Hiring Service of Reaper for Harvesting Paddy (pp.872–879). Journal of Bangladesh Agricultural University, 18 (S1), Bangladesh. doi: <https://doi.org/10.5455/JBAU.12575>
- 10) Hasan, M., Ali, M., Saha, C. K., Alam, M., & Rahman, M. (November 2020). Provision of Custom Hiring Service of Mini-Combine Harvester for Paddy Harvesting: an experimental evidence from Bangladesh (pp.338-353). International Journal of Agriculture Innovation, Technology and Globalization, 1(2020, 4), Switzerland. doi:10.1504/IJAITG.2020.111894

- 11) Hasan, M., Tanaka, T. S., Ali, M., Saha, C. K., & Alam, M. (June 2021). Harvester Evaluation Using Real-Time Kinematic GNSS and Hiring Service Model (pp.363-382). *AgriEngineering*, 3(2), Switzerland. doi: <https://doi.org/10.3390/agriengineering3020024>
- 12) Hasan, M., Ali, M., Saha, C. K., Alam, M., & Hossain, M. (August 2021). Technical Performance and Benefit of Mini-combine Harvester in Southern Delta of Bangladesh. *Journal of Agricultural Mechanization in Asia, Africa & Latin America*. 00845841
- 13) Hossain, M. (January 2021). Agricultural Mechanization in Bangladesh: Present Status and Future Strategy, Engineers Institution of Bangladesh (IEB) about Agricultural Mechanization in Bangladesh: Present Status and Future Strategy - *presentation*
- 14) Hossain, M., Hoque, M., Alam, M., Alam, M., & Saha, C. K. (July 2021). Investigation of long-term conservation agriculture at BARI and adaptive trials of conservation machinery and water management systems in the southern delta of Bangladesh. Internal Research Report 2020-2021.
- 15) Hossain, M., Ali, M., Saha, C. K., & Alam, M. (September 2021) BAU Reaper: Efficient Cereal Harvester for Marginal Farmers- *presentation*
- 16) Kalita, P. (December 2020). Sustainable Intensification Innovation Laboratory: Appropriate Scale Mechanization Consortium (ASMC), SIIL-Polder Inception Workshop - *presentation*
- 17) Mottalib, M. A., Hossain, M., Amin, M., & Hoque, M. (September 2021). Selection of appropriate conservation tillage-cum-planting machinery for planting of soyabean in the southern region of Bangladesh. *Agricultural Engineering International: CIGR Journal*
- 18) Pathan, M., Ali, M., Hasan, M., Saha, C. K., & Alam, M. (July 2020). Evaluation of Harvesting Speed and Idle Time of Mini-combine Harvester using GIS Mapping (pp.751–759). *Journal of Bangladesh Agricultural University*, 18(3), Bangladesh. doi: doi.org/10.5455/JBAU.101583
- 19) Saha, C. K. & Alam, M. (April 2021). Popularizing farm machinery in the polder zones of Bangladesh. <http://books.irri.org/serials/polder-tidings/202104v03n02-Polder-Tidings.pdf>
- 20) Sarkar, S., Alam, M., Khan, I., M., Hossain, M., & Saha, C. K. (November 2020). Seedling Raising Nursery Business for Sustainable Mechanical Rice Transplanting in the Southern Delta of Bangladesh (pp.880–886). *Journal of Bangladesh Agricultural University*, 18(S1), Bangladesh. doi: <https://doi.org/10.5455/JBAU.12558>

ASMC 2 – Burkina Faso

1. **Name:** Appropriate Scale Mechanization Innovation Hub (ASMIH) – Burkina Faso
2. **Locations:** Innovation Hub location: Polytechnic University of Bobo-Dioulasso, Bobo-Dioulasso (Burkina Faso); Field locations: Koumbia, Burkina Faso
3. **Description:** The main objective of the project in Burkina Faso was to increase maize productivity through appropriate scale mechanization using animal draft for smallholder farmers. The targeted equipment interventions included: a refined ox yoke, single row ox-driven planter, conservation ripper (chisel plow), and an animal-drawn crop cultivator. Other tools include forage/fodder chopper and solar powered irrigation systems.
4. **Collaborators:** Burkina Faso - Polytechnic University of Bobo-Dioulasso; United States - Tillers International
5. **Achievements (See FY 2021 AWP Objective 3):**
 - Participation and presentation at the ASMC-SIIL inception meeting held on June 15, 2021.
 - A farmer “field day” was organized on August 19, 2021, by farmers who have already used the ASMC planter. Also invited were project members and other farmers. Around twenty farmers (men, women, and youth) participated in the activities.
 - Eight blacksmiths were identified in the center of Burkina Faso and will be trained in November 2021 for making planters and choppers.
 - ASMC team attended a symposium in Ouagadougou from June 17-21, 2021 and presented the abstract “Test of the animal-drawn planter designed and developed for appropriate agricultural mechanization to optimize the maize planting system in Burkina Faso”.
 - An on-line agricultural mechanization course has been developed and is being reviewed by ASMC scientists before offering the course. There are 12 modules in the course including topics such as tillage/seedbed preparation, planting, weed control, harvesting, power for mechanization, and machinery management
 - The TRA (Technology Readiness Assessment) and GAP analysis were conducted for the planter. Data is currently being analyzed and a report will be available before end of the year.
 - Researchers from INERA ordered three choppers for smallholder farmers in the north of Burkina Faso. In total, 11 choppers are being used by the communities and villages in that area.
6. **Capacity Building:**
 - Fifteen students were trained on the process of GAP analysis and have greatly improved the administration process.
 - A master’s student will defend his thesis on gender at the end of FY 2021.
7. **Lessons Learned:**
 - The main lesson is that: the scaling process requires a good organization and communication process before introducing the use of any technology into field trials. However, those same trials at the same time help to gather information and adjust the scaling strategies.
 - The results from the GAP analysis and TRA questionnaire are very important before starting the scaling process.
 - The Hub realized how important and relevant planting technology is for smallholder farmers in Burkina Faso.
8. **Presentations and Publications:**
 - 1) Millogo, V. (August 2021). A chopper as appropriate tool for livestock production and effects on silage nutritive characteristics based-maize-sorghum and millet in Burkina Faso (pp.273-283). International Journal of Applied Science and Research, 4(4), Rishi Nagar, Near Hawa Bangla, Indore (India). 2581-7876.

ASMC 2 - Cambodia

1. **Name:** Appropriate Scale Mechanization Innovation Hub (ASMIH) – Cambodia
2. **Locations:** Innovation Hub location: Royal University of Agriculture, Phnom Penh (Cambodia)
Field locations: Banan district (Battambang province), Puok district (Siem Reap province), and Stung Chinit (Kampong Thom province)
3. **Description:** The main objectives of the ASMIH-Cambodia include:
 - To design and assess conventional and direct seeding mulch-based cropping systems.
 - To assess the performance of appropriate scale machinery while preserving soil capital.
 - To adapt and train smallholder farmers, service operators, field technicians, and students on the use of ASM and conservation agriculture (CA)-based cropping systems.
 - To support multi-stakeholder initiatives.
 - To initiate a negotiation process between farmers for the individual or collective management of fodder sources or crop diversification after wet season rice.
4. **Collaborators:** *Cambodia* - Institute of Technology of Cambodia (ITC), Royal University of Agriculture (RUA), Conservation Agriculture Service Center (CASC), Ministry of Agriculture Forestry and Fisheries (MAFF), University of Battambang (UBB), Department of Agricultural Land Resources Management (DALRM); *France* – CIRAD; *Philippines* - Southeast Asian Regional Center on Graduates Studies and Research in Agriculture (SEARCA); *United States* - United States Department of Agriculture, Agricultural Research Service National Soil Dynamics Lab (USDA-NSDL)
5. **Achievements (See FY 2021 AWP Objective 3):**
 - Conducted coordination meeting on planning, methodology and roles of each project partner to achieve the project goal of 2500 ha CA land among RUA, Swisscontact and CASC/DALRM/CIRAD.
 - Recruited a trainer by CASC/DALRM and 3 trainees for CASI by FAE and CASC/DALRM.
 - Prepared Partnership Agreement to identify the roles and contribution by project partners.
 - Conducted field showcase to farmers and service providers. About 450 ha and 179 households changed the farming technology from CT to CA, using 3 technologies: the no-till planter, the land leveler, and cover crops.
 - Supported the Noeurn workshop to develop and print out sign boards, stickers, and banners to increase visibility and the sale of the seed broadcaster. 80 units of seed broadcasters were sold to farmers (who occupy around 20 ha/farmer) from April to September 2021. This is equal to 1,600 ha of land using the seed broadcaster technology
 - Prepared training materials and provided orientation and short-training on ASMC II project, Soft-skills, Business Management and MetKasekor model to trainer and trainees and CA machinery to trainees.
6. **Capacity Building:**
 - Built the capacity of three interns on: CASI technology, agricultural mechanization, maintenance and service, door-to-door consultations with individual farmers about the CASI and mechanization service, data collection through field survey and experiments, planting operations, and assessment and evaluation of farmland for CASI application.
7. **Lessons Learned:**
 - Well-controlled cover crops after sowing are needed because it is a kind of weed or rolling down after sowing it causes problem on crops such as moisture, sunlight, nutrients, and pests. But to rolling out before cropping, it provides nutrient recycling.

- All classes and workshops were cancelled due to COVID-19, causing a delay of all study and research. Practical study in workshops was initially impossible to handle but were later able to proceed with a limited number of students per session. COVID-19 not only delayed the academic semester, but also the research being conducted for thesis of the students.
- All meetings in large groups, on-farm demonstrations, and survey activities cannot be done, either.
- Internships can continue, but instruction and trainings have been changed from traditional in-person to distance teaching methods, as a result of COVID-19.

8. **Presentations and Publications:**

- 1) Vernet, P. A., Faysse, N., Suos, V., Oung, N., Son, S. (December 2020). Investing in a no-till planter in Cambodia: A promising opportunity for certain categories of service providers(pp.1-13). Asian Journal of Agricultural and Environmental Safety, 1, Battambang Cambodia. 2575423

Theme III: Rice Fallows and Horticulture – South Asia

C. Bangladesh

1. **Name:** Pathways of scaling agricultural innovations for sustainable intensification in the polders (PI: Krishna Jagadish, Kansas State University; and Sudhir Yadav, IRRI)
2. **Locations:** Polder 30 in the Khulna district of Bangladesh
3. **Description:** The primary objective of the project is to increase farm income and nutrition security by intensifying polder farming systems through implementation of sustainable and economically viable practices. Specifically, the project aims to advocate for high yielding and stress tolerant rice varieties, improve productivity of rice and fish cultivation, and introduce high value rabi crops to increase farm income and improve household nutrition.
4. **Collaborators:** Bangladesh - BRAC, Bangladesh Agricultural University, IRRI, IWM, Khulna University, Patuakhali Science and Technology University, Sher-e-Bangla Agricultural University, Shushilan; United States - Kansas State University, Arkansas State University
5. **Achievements (See FY 2021 AWP Activity 4.4):**
 - Two women and two young men joined the pool of “service providers in mechanical harvesting of rice” developed in phase I of the SIIL-Polder project.
 - The project team established 13 learning hubs in rabi and 10 in the *aman* season, spreading across four polders and involving 227 farmers for the demonstration of improved cropping patterns.
 - Eight field days involving more than 300 farmers and community leaders were held despite the prevailing COVID-19 pandemic.
 - Implemented the Cluster Farmer Field School model (CFFS) in two polders which were attended by 92 farmers within a small hydrological boundary.
 - NARES provided 560 kg good quality seeds of HYV rice for establishing demonstration farms and mentoring the farmers through CFFS in the polder zone.
 - The project team shared the concept of year-round cropping through improved in-polder water management for food and nutrition security of the polder community to about 4,000 farmers of four polders.
6. **Capacity Building:**
 - The project implemented a large-scale capacity building program for the polder communities of southern Bangladesh. A total of 5412 individuals were trained on different aspects of agriculture, water management, nutrition, youth, and women’s engagement in agricultural mechanization to improve livelihoods in the region.
 - The project collaborated with ASMC and USAID initiative CSISA-MEA (Cereals Systems Initiative for South Asia Mechanization Extension Activity) to leverage knowledge on agricultural mechanization and private sector involvement to expedite agricultural mechanization in the coastal zone.
 - The project also made an informal partnership with SIIL Digital Farming System Consortium to simulate extrapolation domain of the agricultural and water management innovations across the polder zone.
7. **Lessons Learned:**
 - Many farmers want to take the risk of cultivating rice and watermelon in the dry season instead of other crops. The main reason is that rice is the main staple, and marketing of watermelon is easy for farmers as the buyers buy it directly from the field.
 - Purposely involving women provides insights on gender dynamics in the polder. For example, women farmers in the new polders feel shy about being identified as “farmer”; instead, they want to put their husband’s name.

- Water management in the selected polders remains largely traditional, and communities often lack knowledge on how to improve in this area.
- Lack of agricultural machinery, mechanics, and local service providers in the polder zone are the documented challenges in attracting more farmers to use farming machines.
- Geography plays a big role in scaling the use of machinery. It is difficult to transport machines from one polder to another due to large river systems without ferry around the study polders

8. **Presentations and Publications:**

- 1) Assefa, Y. (February 2021). Crop diversification in the polders of Bangladesh: Yield stability, profitability, and associated risk(pp.102986). *Agricultural Systems*, 187, 102986. doi: <https://doi.org/10.1016/j.agsy.2020.102986>
- 2) Mondal, M. (April 2021). Healthy Eating: What to put on your plate? (Nutrition Awareness Brochure)
- 3) Mondal, M. Evaluation of gravity-led and energy-fed drainage for sustaining food security in the polders of the coastal zone of Bangladesh. *J. Irrigation and Drainage – accepted*
- 4) Multiple authors. (May 2021). Polder tidings Vol. 3 No. 2
- 5) Multiple authors. (April 2021). SIIL-Polder Newsletter April 2021 Issue 1
- 6) Multiple authors. (August 2021). SIIL-Polder Newsletter July 2021 Issue 2

D. Cambodia

1. **Name:** S3-Cambodia: Scaling Suitable Sustainable Technologies (PI: David Ader, University of Tennessee, UT)
2. **Locations:** Siem Reap, Kampong Thom, Battambang, Kampong Cham and Phnom Penh, Cambodia
3. **Description:** The Scaling Suitable Sustainable Technologies (S3-Cambodia) project will support agents to scale suitable and sustainable technologies in Cambodia. By employing the gender and ecologically sensitive impact pathways mapped during the 2015-2020 WAgN-Cambodia project, S3-Cambodia will advance the capacity and roles of scaling agents in technology diffusion through applied research, technical assistance, curricula development and organizational strengthening. This process will demonstrate the potential for and provide critical information on scaling technology through local, national, and regional networks and for uptake of sustainable intensification (SI) technologies by rice-based farmers and others, serving as a regional model for self-reliance.
4. **Collaborators:** *Cambodia:* Royal University of Agriculture / Center of Excellence on Sustainable Agricultural Intensification, University of Battambang; *Switzerland/Cambodia:* Swiss Foundation for Technical Cooperation (Swisscontact); *France/Cambodia:* Centre de coopération internationale en recherche agronomique pour le développement (CIRAD); *Thailand:* ECHO Asia; *Philippines:* Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA); *USA:* University of Pennsylvania, Tennessee State University
5. **Key Achievements (See FY 2020 AWP Activity 4.7):**
 - Lay the groundwork for three green labs in Bannong district, Battambang: Konteur II secondary school, Phnom Sompov secondary school and WeFarm agricultural training center.
 - Collected additional information (and materials) for the target SI technologies to supplement baseline understanding and support scaling strategy, including compiling a written and physical inventory of wild food garden (WFG) species used for food, fiber, medicinal, and agricultural input purposes in Cambodia.
 - Conducted a desk study of regional efforts to promote the transfer of agricultural information from classrooms to households through 4-H, school gardens, and other forms of agricultural education. This review was presented at the International Society of Environmental and Rural Development Conference and the 2021 SIIL annual conference.

- A SWOT analysis of previous and ongoing initiatives to promote agricultural technologies through the private sector in Cambodia. This analysis of four case studies will be presented as a white paper.
6. **Capacity Building:**
- S3-Cambodia student Gracie Pekarck completed the first year of her master's degree at UT this spring. She is enrolled in the Agricultural Leadership, Education and Communication program, and studying transfer dynamics from school gardens to households in Cambodia. Over the summer, Gracie interned with the Southeast Asia Prayer Center in Oakmont, PA.
 - The project supported three nurseries to expand their production of grafted tomatoes and selection of WFG plants and established three model gardens as part of a planned green lab facilities at secondary schools and a youth training center.
 - S3-Cambodia organized eight short-term trainings and demonstrations during this period, reaching 345 participants in total.
7. **Lessons Learned:**
- The project is learning the limits to integrating all three SI technologies (vegetable grafting, cover crops, WFG plants) into the same production system. Some technologies may be better suited to certain scales and certain types of farmers, and there may be synergies between certain types of cover crop and WFG species and grafted tomatoes. They are working to identify these synergies and limits so that they can better guide scaling strategies.
 - Working to address food insecurity and the sustainable intensification of food systems has provided the team with important lessons. During the COVID-19 pandemic, when travel is restricted, it has been important to have regular meetings with in-country partners. As Cambodia is 11 hours ahead of Eastern Standard Time, it makes sense to vary the times of meetings, so that US and Cambodian collaborators can rotate morning and evening meeting times.
 - The importance of having access to strong internet, especially with Zoom meetings, has been highlighted over the past year. They also organized separate, quarterly meetings between Cambodia-based partners (UBB, RUA, CIRAD, and Swisscontact) that take place in Khmer during more convenient times to discuss collaboration across the two scaling pathways.
8. **Presentations and Publications:**
- 1) Ader, D. R., Shapiro, H., Willcox, A., & Willcox, E. (March 2021). Attitudes Towards and Relationships with Cave-Roosting Bats in Northwest Cambodia(pp.87-104). *Journal of Ethnobiology.*, 41(1), Online, USA. doi: <https://doi.org/10.2993/0278-0771-41.1.87>
 - 2) Ader, D. R. & Pekarck, G. C. (August 2021) Evaluation of school gardens as a method of scaling up sustainable agriculture technologies. *International Journal of Environmental and Rural Development – accepted*
 - 3) Ader, D. R. & Enriquez, J. P. (August 2021). Intensificación sostenible como estrategia para afrontar problemas de seguridad alimentaria y nutricional (Sustainable intensification as a strategy to face food security and nutrition problems) (pp.112-114). *INNOVARE Revista de Ciencia y Tecnología*, 10(2), Online, Honduras. doi: <https://doi.org/10.5377/innovare.v10i2.12272>
 - 4) Ader, D. R., Eissler, S., Bates, R. M., Huot, S., Gill, T., & Brown, S. (February 2021). Wild Gardening as a Sustainable Intensification Strategy in Northwest Cambodian Smallholder Systems(pp.107-126). *Journal of Agriculture, Food Security, and Community Development*, 10(3), Online, USA. doi: <https://doi.org/10.5304/jafscd.2021.103.006>

Theme IV: Crop-Livestock Interactions - West Africa

E. Senegal and Niger

1. **Name:** Improving food and nutrition security of smallholder agro-pastoral farming systems by integrating crop-livestock-human nutrition in Senegal and Niger (PI: Doohong Min, Kansas State University; and Aliou Faye, ISRA)
2. **Locations:** Louga, Diourbel, Kaffrine, Kédougou, Kolda and Sedhiou regions in Senegal; Niamey and surrounding areas in Niger
3. **Description:** This project will focus on large-scale dissemination of three innovations (dual-purpose millet line stover for livestock feeding, best agronomic management practices for sustainable intensification of millet cropping systems, and fortifying millet-based products especially for pregnant women and children as well as promoting millet grain byproducts as chicken feed) to create more awareness and enhance human and animal food and nutrition while generating further income and nutritional outcomes for smallholder farmers in the targeted regions of Senegal and Niger. We believe that if we implement a farming systems approach then this will guide the dissemination of these technologies along the dissemination pathway and improve overall crop-livestock integration.
4. **Collaborators:** *Senegal* - Institut Sénégalais de Recherches Agricoles (ISRA) – Centre National de Recherches Agronomiques de Bambey (CNRA/Bambey), University of Thiès - ENSA, Institut de Technologie Alimentaire (ITA), Agence Nationale de Conseil Agricole et Rural (ANCAR), Le Réseau des Organisations Paysannes et Pastorales du Sénégal (RESOPP), Bureau d'Analyse Macro Economiques (BAME), Peace Corps Senegal; *Niger* - Institut National de la Recherche Agronomique du Niger (INRAN/ CERRA-Maradi)
5. **Key Achievements:**
 - Met with Niger project PI on how to implement the protocols for the installation of agronomic trials and seed multiplication and shared the dual-purpose millet variety seeds with them.
 - The registration of Senegalese millet varieties SL 28, SL 169, and SL 423 in the national variety catalog in May 2021.
 - Training of 25 agricultural technicians (20 men and 5 women) on how to map the demonstration sites around Senegal production sites.
 - One student continued their PhD thesis work on improving the nutrition of children and pregnant women with enriched, extruded millet flour.
 - Installation of eight demonstration plots for the SL 423 and SL 28 varieties of dual-purpose millet and training on how to run the demonstrations.
6. **Capacity Building:**
 - Several women's groups we trained on seed production and chicken feed production.
 - 3 M.Sc. and 2 B.Sc. student successfully defended their work at their respective universities.
 - A Ph.D. student from the University of Thies-ENSA was hired to support the project.
7. **Lessons Learned:**
The coordination of a multi-partner project proved to be very challenging, especially as COVID-19 had a negative impact on the ability to meet and conduct activities.
8. **Presentations and Publications:**
 - 1) Mbaye, L. P. (August 2021). Assessment of the N, P and K mineral fertilization needs of new varieties of millet [*Pennisetum glaucum* (L.) R. Br.] "Chakti" and "Taw", compared to the variety former "Souna3" on an experimental station at the CERAAS agricultural farm in Thies. – Thesis
 - 2) Faye, A., Sonko, A., Ndour, Y., Ndienor, M., & Bakhoum, N. (April 2021). Evaluation of nutrients (N, P, K) limiting maize (*Zea mays* L.) yield in two agro-ecological zones of the southern-central of Senegal(pp.396-406). JCBPS; Section B, Vol. 11, (No. 2), Available online atwww.jcbps.org. doi: ISSN: 2249 –1929
 - 3) Gueye, Yacine. (August 2021). Contribution to the adoption of dual-use millet in the production systems of the North Groundnut Basin: development of rations based on millet stalks for growing cattle. – Thesis

VI. Associate Award Research Project Reports

A. Feed the Future Policy Impact Study (Policy Research Consortium) – Award # SI9050/A00-1012-S001- Kansas State University

1. **Name:** Feed the Future Policy Impact Study (Policy Research Consortium) (Subaward PI: Cary Pray, Rutgers University)
2. **Locations:** Mainly global location due to the nature of the policy work, including country level programs and collaborators in Rwanda, Senegal, Nigeria, and Malawi.
3. **Program Description:** The Feed the Future Policy Impact Research Study is a multi-institutional Consortium led by Rutgers University (RU) and operates as an associate award of the USAID funded SILL. This Consortium supports the achievements of the U.S. Government Global Food Security Strategy objectives through contributing to the improvement of policy approaches and outcomes. It also supports the learning agenda on policy, systems analysis, and implementation and assists the initiative to report on the success of its efforts. The aims of the Consortium are to develop a clearer understanding of contemporary agricultural and structural transformation, to develop and utilize specific set of indicators to quantify the impact or progress of key global food security goals and understand how agricultural and food policies help to enable and contribute to agricultural transformation.
4. **Collaborators:** Collaborators for the Policy Research Consortium include the Ahmadu Bello University, International Fertilizer Development Center (IFDC), Michigan State University, Montana State University, Northwestern University, Tufts University, University of Florida, African Economic Research Center, University of Ibadan, University of Rwanda and Université de Gaston-Berger, University of Western England.

Subprojects:

- *Agricultural transformation and nutrition policy* (PI: William Masters, Tufts University)
 - *Effect of Supply Chains on Agricultural Profitability and Household Well-Being in Rwanda and Senegal* (PI: Charles Moss, University of Florida)
 - *Global Security Act: Policy Analysis and Measurement* (PI: Lori Post, Northwestern University)
 - *How does household water insecurity relate to household water quality, food security, and COVID-infections: health, agriculture, and policy implications* (PI: Sera Young, Northwestern University)
 - *Indicators of Agricultural Transformation* (PI: Eric Raile, Montana State University)
 - *Nigeria Data Collection Analysis* (PI: Thomas Reardon, Michigan State University)
 - *Proposal to Support CMAAE Thesis and Faculty Research* (PI: Njuguna Ndung'u, African Economic Research Consortium)
 - *Research on the Impacts of Food, Agricultural and Nutrition Policies in Rwanda* (PI: Niyitanga Fidele, University of Rwanda)
5. **Key Achievements:**
 - Earlier versions of research on the conceptualization and measurement of self-reliance were presented at the 25th Annual Conference of the International Consortium on Applied Bioeconomy Research in July 2021 and at the 2021 AAEA & WAEA Joint Annual Meeting in August 2021. The associated time-series self-reliance dataset is nearly ready for public release, as well.
 - Research on the conceptualization of resilience and its use in food systems is likely to be published in the Annual Review of Resource Economics, which would be a high-quality and high-profile venue that would contribute to significant subsequent use of the research.
 - Northwestern University (*Global Security Act: Policy Analysis and Measurement*; PI: Lori Post).
 - a. Provided biweekly briefings for USAID and other partners, along with a 25-page briefing report to USAID leaders on the state of the pandemic globally and specific to the Feed the Future target countries, as well as low- and middle-income countries and regions.
 - b. The GASSP impact for September 2021: 1642 unique views and 320 unique users downloading data or using this project's data for research or tracking.

- c. Daily published updates on COVID-19 surveillance, forecasting, vaccinations, and variants.
- Northwestern University (*How does household water insecurity relate to household water quality, food security, and COVID-infections: health, agriculture, and policy implications*; PI: Sera Young).
 - a. Invited to conduct briefings on the Household Water Insecurity Experiences Scale (HWISE) and the Individual Water Insecurity Experiences Scale (IWISE) to the UN's Food and Agriculture Organization (FAO), USAID, Oxfam, REACH, the International Food Policy Research Institute (IFPRI), on Capitol Hill, the World Bank, International Water Management Institute, the Reckett Group, Danaher, Unilever, UNICEF, UNESCO, WaterAid, GAIN, 2030 Water Resources Group, Xylem, Millennium Water Alliance, and Water Keepers.
 - b. Beginning to publish on estimates of nationally representative water insecurity: <https://news.gallup.com/opinion/gallup/320825/monitoring-world-water-access.aspx>.
- Tufts University (*Agricultural transformation and nutrition policy*, PI: William Masters).
 - a. Research on food systems, retail prices & diet costs in Food Policy (Feb 2021), Science Advances (Dec 2020), and book chapter on agriculture-nutrition linkages, plus article on global inequality in agriculture in Nature Food (April 2021) UN Food Systems Summit Scientific Group report on cost of meal preparation (May 2021) and paper on global food price reporting in Food Policy (Sept 2021).
 - b. Policy engagement on food prices & diet costs for USAID Global Learning & Evidence Exchange (GLEE) on February 8, 2021, and December 14, 2020, for FAO event on agriculture, food systems & nutrition, plus UN Food System Summit Science Days side events on July 6-7, 2021.
 - c. Public outreach on diet cost and affordability, through Nature Outlook article and Tufts profile, plus post at Our World in Data (July 2021).
 - d. Montana State University (*Indicators of Agricultural Transformation*, PI: Eric Raile) Dr. Eric Raile presented research on climate-smart agriculture in Senegal and Uganda to USAID personnel and related stakeholders in March 2021. Feedback for that presentation was very positive.

6. **Capacity Building:**

- The publication on climate-smart agriculture in Uganda involved a close collaboration with Dr. Jackline Bonabana-Wabbi and Julian Kirinya at Makerere University.
- Dr. Megan Roosevelt has been crucial to the work over the last year on the conceptualization and measurement of resilience and self-reliance. Dr. Roosevelt was a new addition to the project and is now in a tenure-track position at the Virginia Military Institute. She began with the project as a post-doctoral research scientist.
- From PRC work on HWISE Scale:
 - a. Began data collection on water security in refugee camps at Cox's Bazaar, in a new collaboration with the University of Western England.
 - b. Action Against Hunger will be expanding their assessments in Latin America to include the WISE Scales, as has a large consortium in Colombia. PRC Dr. Sera Young is working on developing such an initiative in Brazil as well.
 - c. Preparing to launch a study of home testing of geogenic fluoride in Kenya, with a test that is almost as simple as an at-home pregnancy test.

7. **Lessons Learned:**

- The lack of field research during this period, due in part to the pandemic, reduced opportunities for learning lessons. The biggest lesson learned is the continued lack of clarity around concepts of resilience and self-reliance will make progress difficult.
- From PRC work on the COVID Dashboard:
 - a. COVID-19 will most likely never go away and should now be considered endemic.
 - b. The waning immunity of those people having taken the vaccine drops to 8% after 6 months.
 - c. Delta is the dominant variant even though Theta, Eta, and Mu appear to be more contagious

with worse outcomes.

- d. There will continue to be more contagious variants with worse health outcomes until vaccinations + deaths + infections reach a threshold of 90-95%. There is no indication that this will ever occur.
- e. It has become evident that the need to be very clear about how a new indicator can be or is useful—another metric is useless unless it can truly add value. Fortunately, this has been possible to do with the COVID Dashboard.

8. **Presentations and Publications:**

Journal Publications

- 1) Bai, Yan; Masters, W.; Costlow, L.; Ebel, A.; Laves, S.; Ueda, Y.; Volin, N.; Zamek, M.; Herforth, A. (July 2021). Review: Retail consumer price data reveal gaps and opportunities to monitor food systems for nutrition (pp.102-148). *Food Policy*, 104 (2021), online. doi: <https://www.sciencedirect.com/science/article/pii/S0306919221001275?via%3Dihub>
- 2) Brewis, A., Workman, C., Wutich, A., Jepson, W., Young, S., Household Water Insecurity Experiences—Research Coordination Network (HWISE-RCN), Adams, E., Ahmed, J.F., Alexander, M., Balogun, M. and Boivin, M., (2020). Household water insecurity is strongly associated with food insecurity: Evidence from 27 sites in low-and middle-income countries. *American Journal of Human Biology*, 32(1), p.e23309. <https://doi.org/10.1002/ajhb.23309>
- 3) Masters, W., Bai, Y., Ebel, A., L., S. Food prices in a pandemic: Global data show higher costs for nutritious food groups. *Nature Food* (Under Review)
- 4) Masters, W., Bell, W., & Lividini, K. (March 2021). Global dietary convergence from 1970 to 2010 altered inequality in agriculture, nutrition, and health. (pp.156-165). *Nature Food*, 2, online. doi: <https://www.nature.com/articles/s43016-021-00241-9>
- 5) M., Y., W., P., S., A., & T. (July 2021). Water Security and Nutrition: Current Knowledge and Research Opportunities (pp. nmab075). *Advanced Nutrition*, (2021), online. doi: <https://academic.oup.com/advances/advance-article/doi/10.1093/advances/nmab075/6322255>
- 6) M., R., S., W., O. (July 2021). The Interplay Between Policy and COVID-19 Outbreaks in South Asia: Longitudinal Trend Analysis of Surveillance Data(pp.24251). *JMIR public health and surveillance*, 7(2021), online. doi: <https://publichealth.jmir.org/2021/6/e24251/>
- 7) Raile, E., Raile, A., & P. (June 2021). Analysis and Action: The Political Will and Public Will Approach (pp.237-254). *Action Research*, 19(2), online. doi: <https://doi.org/10.1177/1476750318772662>
- 8) R., Y., K., B., & R. (May 2021). Building Public Will for Climate-Smart Agriculture in Uganda: Prescriptions for Industry and Policy (pp.237-254). *Journal of Agricultural Food Industrial Organization*, 19(1), online. doi: <https://doi.org/10.1515/jafio-2021-0012>
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- 1) Masters, W., Herforth, A., Martinez, E., Greb, F., & Hendriks, A. (July 2021). Cost and affordability of preparing a basic meal around the world. https://bonndoc.ulb.uni-bonn.de/xmlui/bitstream/handle/20.500.11811/9201/FSS_Brief_Cost_of_Basic_Meals.pdf?sequence=1

Presentations

- 1) Nsabimana, A. F. Niyitanga, D. Weatherspoon, and A. Naseem (2020) “Land Policy and Food Prices: Evidence from a Land Consolidation Program in Rwanda” To be presented at the annual meeting of ICABR (was scheduled for June 2020, but to be held virtually in October 2020)
- 2) Naseem, A., Oehmke, J., Raile, E., & Roosevelt, M. (August 2021: Journey to Self-Reliance and Agricultural Transformation. Presentation at AAEA 2021, Austin TX
- 3) Masters, W., Schneider, K., Christiansen, L., & Webb, P. (August 2021). Availability, Seasonality, and Affordability of Nutritious Diets for All – Evidence from Malawi. Presentation at ICAE 2021, online
- 4) Anderson, Jock. (July 2021). Climate Change and African Agricultural Adaptation Imperatives during Agricultural Transformation. Presentation at ICABR 2021, Online
- 5) Masters, W. (August 2021). COVID resilience in food prices and diet costs. Presentation at AAEA 2021, Austin, TX
- 6) Pray, C. (July 2021). Developing Resilient Agricultural Innovation Systems in Sub-Saharan Africa and South Asia. Presentation at ICABR 2021, Online
- 7) Post, L. & Oehmke, J. (July 2021). Dynamic Panel Estimates of The Transmission and Persistence Of COVID-19: Measuring the Dynamics of the Pandemic Informs Policy in FtF Target Countries in Sub-Saharan Africa and Asia. Presentation at ICABR, Online
- 8) Moss, C. & Mbaye, S. (July 2021). Impact of Policies on Agricultural Transformation in Senegal. Presentation at ICABR 2021, Online
- 9) Masters, W. (June 2021). Is a Healthy and Sustainable Diet Affordable? Presentation at 22nd Annual Harvard Nutrition Obesity Symposium: Global Food Systems and Sustainable Nutrition in the 21st Century, Boston
- 10) Naseem, A., Oehmke, J., R., & Roosevelt, M. (July 2021). National Self-Reliance: Measurement and Determinants. Presentation at 25th Annual Conference of the International Consortium on Applied Bioeconomy Research, online
- 11) Reardon, T. & Liverpool-Tasie, S. (August 2021). Policies for keeping supply chains open and Small and Medium Enterprises (SMEs) healthy. Presentation at AAEA 2021, Austin, TX
- 12) Naseem, A., Oehmke, J., Raile, E., & Roosevelt, M. (August 2021). Policies for National Self-Reliance: Conceptualization & Measurement. Presentation at AAEA, online
- 13) Reardon, T. & Liverpool-Tasie, S. (July 2021). Policies for Resilient Food Systems. Presentation at ICABR 2021, Online
- 14) Raile, Eric. Political Will and Public Will for Climate-Smart Agriculture in Sub-Saharan Africa
- 15) Pray, C., Naseem, A., & Nagarajan, L. (August 2021). Private agricultural R&D investment and diversification of input markets. Presentation at ICAE 2021, Online
- 16) Pray, C., Nagarajan, L., & Anderson, J. (August 2021). Technology policy for post-COVID research and innovation. AAEA 2021, Austin, TX
- 17) Post, L. & Oehmke, J. (August 2021). The Global SARS-CoV-2 Surveillance Project: Policy, Persistence and Transmission. Presentation at AAEA 2021, Austin TX
- 18) Naseem, A. & Raile, E. (July 2021). Using Measures of the Journey to Self-Reliance (J2SR) to Assess USAID Food the Future Policies. Presentation at ICABR 2021, Online
- 19) Masters, W. & Venkat, A. (July 2021). Using Retail Prices and Diet Costs to Measure Food System Performance in SSA and South Asia. Presentation at ICABR 2021, Online

VII. Human and Institutional Capacity Development

Short-term Training

Country of Training	Brief Purpose of Training	Who was Trained	Number Trained		
			M	F	Total
Bangladesh	TRA and Gap Analysis - Training of Trainers (via Zoom)	Civil Society	11	5	16
Bangladesh	Field day on harvesting at Pakhimara Bazar, Kalapara, Patuakhali	Producers, Government, Private Sector, Civil Society	39	0	39
Bangladesh	Training on Harvesting at Hazipur, Sadarpur, Kalapara, Patuakhali	Producers, Government, Civil Society	28	0	28
Bangladesh	Field day on harvesting, at Purba Dhamsar, Wazirpur, Barishal	Producers, Government, Civil Society	34	3	37
Bangladesh	Training on harvesting, at Purba Dhamsar, Wazirpur, Barishal	Producers, Government, Civil Society	23	3	26
Bangladesh	Field day on harvesting at Baratia, Dumuria, Khulna	Producers, Government, Private Sector, Civil Society	32	6	38
Bangladesh	Training on harvesting at Dumuria, Khulna	Producers, Government, Civil Society	19	8	27
Bangladesh	Training of village mechanics at Khulna, organized by DAE	Producers, Government, Private Sector, Civil Society	34	0	34
Bangladesh	Training on Harvesting at BAU, Mymensingh to village mechanics, organized by DAE	Producers, Civil Society	31	0	31
Bangladesh	Advance training on conservation agriculture and irrigation machineries and their maintenance (June 15)	Producers, Civil Society	13	2	15
Bangladesh	Advance training on conservation agriculture and irrigation machineries and their maintenance (June 16)	Producers, Civil Society	14	1	15
Bangladesh	Advance training on conservation agriculture and irrigation machineries and their maintenance (June 17)	Producers, Civil Society	13	2	15
Bangladesh	Advance training on conservation agriculture and irrigation machineries and their maintenance (June 18)	Producers, Civil Society	14	1	15
Bangladesh	Advance training on conservation agriculture and irrigation machineries and their maintenance (August 17)	Producers, Civil Society	11	3	14
Bangladesh	Advance training on conservation agriculture and irrigation machineries and their maintenance (August 18)	Producers, Civil Society	11	3	14
Bangladesh	Field day on rice transplanting at Wazirpur, Barishal	Producers, Government, Civil Society	23	12	35
Bangladesh	Training on entrepreneurship development at Wazirpur, Barishal	Producers, Government, Civil Society	18	5	23
Bangladesh	Training on rice transplanting and seeding raising at Wazirpur Barishal	Producers, Government, Civil Society	18	5	23
Bangladesh	Field day on rice transplanting at Kalapara, Patuakhali	Producers, Government, Civil Society	27	7	34

Country of Training	Brief Purpose of Training	Who was Trained	Number Trained		
			M	F	Total
Bangladesh	Training on entrepreneurship development at Kalapara, Patuakhali	Producers, Government, Civil Society,	18	5	23
Bangladesh	Training on rice transplanting and seedling raising at Kalapara, Patuakhali	Producers, Government, civil Society	18	5	23
Bangladesh	Launching ceremony for the Smart Agro-Technology Innovation Youth Network (SAIYN)	Private Sector, Civil Society	146	49	195
Bangladesh	Field day on rice transplanting at Dumuria, Khulna	Producers, Government, Civil Society	21	14	35
Bangladesh	Training on entrepreneurship development at Dumuria, Khulna	Producers, Government, Civil Society	16	7	23
Bangladesh	Training on Rice transplanting and seedling raising at Dumuria, Khulna	Producers, Government, Civil Society	16	7	23
Bangladesh	Field day on Rice transplanting at Lobonchora, Khulna	Producers, Government, Civil Society	29	6	35
Bangladesh	Training on entrepreneurship development at Lobonchora, Khulna	Producers, Government, Civil Society	22	3	25
Bangladesh	Training on Rice transplanting and seedling raising at Lobonchora, Khulna	Producers, Government, Civil Society	22	3	25
Bangladesh	Orientation training on the productivity of rice-maize and rice-sunflower cropping patterns in the polder zone	Producers	1182	562	1744
Bangladesh	On-the-field training and knowledge sharing seminar on the productivity of maize and sunflower under semi-mechanized cultivation	Producers, Government, Private Sector, Civil Society	221	88	309
Bangladesh	Orientation on semi-mechanized and climate-resilient cultivation practices of maize and sunflower	Producers	1445	615	2060
Bangladesh	Nutritional awareness training for mothers and schoolteachers	Producers	0	85	85
Bangladesh	Production procedure and nutrition from climate resilient and nutritious rice	Producers, Government, Private Sector, Civil Society	97	24	121
Bangladesh	Mechanical harvesting of rice by reaper	Producers, Civil Society	133	57	190
Bangladesh	Polder water management and sluice gate operation for adoption of improved cropping system in the polder zone	Producers, Government, Private Sector, Civil Society	258	84	342
Bangladesh	Safe pesticides application in rabi crops	Producers	19	8	27
Bangladesh	Mechanized cultivation (PTOS + mini-tiller) of maize and sunflower	Producers, Government, Private Sector, Civil Society	93	22	115
Bangladesh	Maize and sunflower production by dibbling and traditional method and nutritional awareness	Producers, Civil Society	311	108	419
Burkina Faso	Training session of Smallholder Farmers on how to better use the ASMC planter at Koumbia	Producers, Government, Private Sector	11	2	13

Country of Training	Brief Purpose of Training	Who was Trained	Number Trained		
			M	F	Total
Burkina Faso	ASMC Farmers' Field Day	Producers, Government, Private Sector	22	9	31
Burkina Faso	TRA and Scaling Gap Analysis: Training of Facilitators & Data Collector Teams	Government	11	5	16
Burkina Faso	Blacksmith Training in Koumbia	Producers, Government	11	1	12
Cambodia	Scaling up CA through 4S model	Private Sector	22	4	26
Cambodia	Cover crops for soil improvement	Producers, Government, Private Sector	21	3	24
Cambodia	Training with service provider for putting the affordable price of service provision for land levelling with land plane	Private Sector	4	1	5
Cambodia	Demonstration land levelling (February 5)	Producers, Government, Private Sector	26	15	41
Cambodia	Demonstration land levelling (March 2)	Producers, Government, Private Sector	30	4	34
Cambodia	Discussion with service provider the price of services for land levelling using a small plane leveler	Producers, Government	15	7	22
Cambodia	Demonstration land levelling (March 10)	Producers, Government	15	11	26
Cambodia	Demonstration of green sowing on rice and move forward CA transition under Agro-ecology practices	Producers, Government ⁵	5	4	9
Cambodia	Demonstration of green sowing on corn and move forward CA transition under Agro-ecology practices	Producers, Government	8	2	10
Cambodia	Demonstration of green sowing on corn under difference species of cover crops (sorghum, sun hemp) and forage crops	Producers, Government	25	10	35
Cambodia	S3/F2F - Joint Training on Tomato Grafting - NUBB - Bannan	Producers	7	9	16
Cambodia	S3/F2F - Joint Training on Tomato Grafting - NUBB - Sangke	Producers, Civil Society	12	6	18
Cambodia	S3 - Long-cycle cover crops after wet season rice - CIRAD	Producers, Private sector	22	2	24
Cambodia	S3 - Cover Crop + Machinery Demand Creation - CIRAD	Producers, Government, Private Sector	30	4	34
Cambodia	S3 - Green Lab Training and Demo - NUBB	Civil Society	6	2	8
Cambodia	S3 - Wild Food Plant Propagation Training - NUBB	Civil Society	7	3	10
Cambodia	S3 - Tomato Grafting Training - NUBB	Civil Society	6	5	11
Cambodia	S3/HEIP Conservation Ag Vegetable Production for Battambang School Administrators - NUBB	Civil Society	80	37	117
Senegal	Enriching flour training and marketing	Producers	17	193	210
Senegal	Youth training on quality seed production	Producers	13	3	16
Total	62 total trainings were held during FY 2021		4906 (69%)	2160 (31%)	7066

Long-term Training

The following table reports all U.S. citizens/permanent residents and third country nationals that are currently receiving SILL funds through consortia, research subaward projects, associate award, or buy-in awards. The total number of degree-seeking students is 37 with 41% females. There are 21 Ph.D. students (24% F), 13 MSc students (62% F), and 3 BSc students (67% F).

Coded Name	Sex	University	Degree	Major	Program End Date (month/year)	Degree Granted (Y/N)	Home Country
1	F	Bangladesh Agriculture University	Ph.D.	Agricultural Economics	2021, December	N	Bangladesh
2	M	Bangladesh Agricultural University	M.S.	Agricultural Engineering	2021, December	N	Bangladesh
17	M	Bangladesh Agricultural University	Ph.D.	Agricultural Engineering	2021, December	Y	Bangladesh
22	M	Bangladesh Agricultural University	M.S.	Agricultural Engineering	2022, June	Y	Bangladesh
55	M	Bangladesh Agricultural University	M.S.	Agricultural Engineering	2022, June	N	Bangladesh
78	F	Bangladesh Agricultural University	M.S.	Rural Sociology	2022, April	Y	Bangladesh
79	M	Bangladesh Agricultural University	Ph.D.	Farm Power and Machinery	2022, June	N	Bangladesh
80	F	Bangladesh Agricultural University	M.S.	Rural Sociology	2022, April	Y	Bangladesh
32	M	Bangladesh Agricultural University	Ph.D.	Agricultural Engineering	2022, June	N	Bangladesh
36	M	Bangladesh Agriculture University	Ph.D.	Water Governance	2021, December	Y	Bangladesh
53	M	Bangladesh Agricultural University	Ph.D.	Agricultural Engineering	2022, June	Y	Bangladesh
159	M	University Joseph KI-ZERBO	Ph.D.	Agronomy	2023, January	N	Burkina Faso
160	F	University Saint Thomas d'Aquin (USTA)	B.S.	Agronomy	2022, February	Y	Burkina Faso
161	M	University Joseph KI-ZERBO	Ph.D.	Agronomy	2023, October	N	Burkina Faso
162	F	University Joseph KI-ZERBO	Ph.D.	Agronomy	2022, April	Y	Burkina Faso

Coded Name	Sex	University	Degree	Major	Program End Date (month/year)	Degree Granted (Y/N)	Home Country
19	M	Royal University of Agriculture	Ph.D.	Agricultural Engineering	2021, June	Y	Cambodia
41	F	Royal University of Agriculture	Ph.D.	Agro-Industry	2021, June	Y	Cambodia
42	M	Royal University of Agriculture	Ph.D.	Agricultural Engineering	2021, June	Y	Cambodia
43	F	Royal University of Agriculture	M.S.	Agronomy	2021, December	N	Cambodia
44	M	Royal University of Agriculture	Ph.D.	Agribusiness Development	2021, June	Y	Cambodia
45	M	Royal University of Agriculture	Ph.D.	Animal Science	2021, June	Y	Cambodia
59	M	Royal University of Agriculture	Ph.D.	Land Management	2021, June	N	Cambodia
65	M	Royal University of Agriculture	Ph.D.	Food Science	2021, June	N	Cambodia
81	M	Royal University of Agriculture	Ph.D.	Agricultural and Food Science	2021, February	N	Cambodia
82	F	Royal University of Agriculture	M.S.	Public Administration	2022, January	N	Cambodia
157	M	Royal University of Agriculture	M.S.	Crop Science	2023, June	N	Cambodia
91	F	Michigan State University	Ph.D.	Agricultural Economics	2023, June	Y	Colombia
158	M	National Agriculture Research Systems (NARS)	Ph.D.	Agricultural, Food, and Resource Economics	2025, August	N	Colombia
30	F	University of Gaston Berger	M.S.	Agricultural Engineering	2020, December	Y	Senegal
83	F	University of Bambey	M.S.	Animal Science	2021, May	Y	Senegal
84	F	University of Thies	M.S.	Animal Science	2021, July	Y	Senegal
85	M	University of Thies	Ph.D.	Animal Science	2023, September	N	Senegal
86	F	University of Bambey	B.S.	Agronomy	2021, April	Y	Senegal
87	M	University of Thies	M.S.	Animal Science	2021, April	Y	Senegal
88	M	University of Bambey - ISFAR	B.S.	Agricultural Engineering	2021, July	N	Senegal
89	F	University of Tennessee	M.S.	Agricultural Leadership and Education	2022, May	N	USA
90	F	Tufts University	Ph.D.	Agriculture, Food, and the Environment	2022, January	Y	USA

Institutional Development

CE SAIN Institutional Development: The CE SAIN, which celebrated their five-year anniversary in FY 2021, continues to build human and institutional capacity at the Royal University of Agriculture in Cambodia. The CE SAIN implements its scholarship and research grant program to increase faculty teaching, research, and extension capacity through long-term training and degree enhancement. The Center, through its five Technology Parks, has also played a key role in linking RUA faculty and students and the private sector, NGOs, Innovation Labs, and other networks. These partnerships support the promotion of information dissemination and serve as a catalyst for new innovations.

Partnerships: Cambodia - Conservation Agriculture Service Center (CASC); Ministry of Agriculture Forestry and Fisheries (MAFF); Ministry of Education, Youth, and Sport (MoEY); Department of Agricultural Engineering (DAEng); Royal University of Agriculture – Phnom Penh; University of Battambang; and multiple Feed the Future Innovation Labs (e.g., Horticulture; Livestock Systems; Integrated Pest Management); and Swisscontact. Additional collaborators due to the ASA CAST (Commercialization of Aquaculture for Sustainable Trade) project include American Soybean Association, World Vision, and Auburn University.

Institutional Sustainability: The regional coordinators funded in Senegal and Burkina Faso have also helped with continuing some of the critical research initiated by the NARS (ISRA and INERA) and supported institutional capacity building to sustain long-term research. They will continue to collaborate with national and regional organizations, especially as the iREACH initiative begins their implementation phase.

Partnerships: Senegal - Mathematica (project on Sustainable Agricultural Decision Tools, AICCRA with International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) on climate resilient technology dissemination; *Cambodia* - Texas A&M University, University of Virginia, Royal University of Phnom Penh, WorldFish Malaysia, Cleber (private company, manufactures Oggun tractors), USDA ARS National Soil Dynamics Lab, Danfoss Hydraulics, SEARCA, Institute of Technology – Cambodia, Swiss Federal Institute of Aquatic Science and Technology (EAWAG).

VIII. Innovation Transfer and Scaling Partnerships

Plan of Action

The SIIL supported the creation, testing and scaling of 30 technologies during FY 2021, 11 of which were made available for uptake and 8 that have already shown adoption by the public and private sectors, many of which were carried over from SIIL's first funding phase. During this reporting period, SIIL's project partners have worked with numerous organizations, institutions, farming groups and local artisans to create, scale up, and extend their various innovations despite the constraints of COVID-19 this past year.

Steps Taken:

- ASMC continues to collaborate with the private sector motor companies, the Department of Agricultural Extension, the BARI, and the BAU to create, fund, and extend their rice harvesters and transplanters. They also work with CIRAD, Smart-Agro, and Swisscontact to support scale-up.
- CE SAIN continues to work to develop various improved conservation agriculture practices in conjunction with the University of Tennessee and several Feed the Future Innovation Labs. Additionally, they demonstrated these practices to the government, the public and private sectors, as well as high school and college students at the Royal University of Agriculture supported tech parks in Cambodia.
- The Polder project continues to work with local universities, the IARC and NARES to create an innovate cropping pattern for more sustainable rice production in the polder region. Using virtual field days, trainings and workshops, the project was able to refine the planting techniques for wider uptake.

Partnerships:

- **ASMC:** Bangladesh Agricultural University (BAU), ACI Motors Ltd., Metal Pvt Ltd., Bangladesh Agricultural Research Institute (BARI), Bangladesh Rice Research Institute (BRRI), Department of Farm Power and Machinery, Department of Agriculture Extension (DAE) subsidy program, CASC/DALRM, CIRAD, Smart-Agro, Swisscontact, RUA, International Agricultural Research Center (IARC)
- **CE SAIN:** Livestock Systems IL (University of Florida), Project Everest, University of Tennessee
- **Unlocking the production potential of polder communities in Bangladesh:** BARC, International Rice Research Institute (IRRI), local public universities
- **Improving Food and Nutrition in Senegal and Niger:** ANCAR, Local Food Processing Institute, ISRA – CERAAS, Peace Corps, ENSA, Agropastoralists of the Senegal peanut basin

Technology Ready to Scale (Phase 3):

- **ASMC – Burkina Faso:** ASMC Forage Chopper
- **ASMC - Cambodia:** Cover Cropping; Land Leveler; No-Till Planter; Seed Broadcaster
- **CE SAIN - Cambodia:** Living Fence, Permaculture, Vermicompost
- **Unlocking the production potential of polder communities in Bangladesh:** Rice-Maize cropping system in polders; Rice-Sunflower cropping system

Technologies Transferred (Phase 4):

- **ASMC - Bangladesh:** Combine Rice Harvester; Rice Reaper; Rice Transplanter; Two-Wheel Tractor Based Seed Planter
- **ASMC – Burkina Faso:** Mechanized Maize Planting System with ASMC Planter
- **Improving Food and Nutrition Security in Senegal and Niger:** Enriching millet flour for pregnant women and undernourished children and pearl millet see sub-residues for chicken feed-making; Dual-purpose pearl millet grain and fodder biomass production; improved dual-purpose pearl millet stover for livestock feed

IX. Environmental Management and Mitigation Plan (EMMP)

An annual environmental mitigation activity review was conducted by the SIIL management entity across all subawards. The review entailed an evaluation of all activities outlined in the EMMP. Given the previous year's focus providing subawardees' with greater knowledge and tools to improve EMMP compliance and reporting, there were no issues to highlight during this reporting period. Mitigation and monitoring activities took place in accordance with the EMMP. In cases of fertilizer and pesticide purchase and use, project partners provided appropriate personal protective equipment and training for the safe use of the materials. The SIIL ME conducted a site visit to Ethiopia and verified that safety guidelines, training, and signage were addressed in accordance with the concerns raised in the previous year.

In addition, the Piestar DPx system, which the SIIL utilizes for reporting and project monitoring, underwent significant revisions of the EMMP module to support SIIL's compliance enforcement. The Piestar DPx updates included a new fertilizer, pesticide, and microbial inoculant purchase request/approval system. The annual environmental mitigation activity review also is incorporated into the DPx system to ensure that project monitoring is streamlined and to optimize knowledge sharing within the SIIL management entity. The current EMMP module is shown below. Categories not shown in the screen shot include: a) conducting applied research not exceeding 4 ha in a single location and NOT involving support for procurement or use of chemicals pesticides or fertilizers; b) conducting research not exceeding 4 ha in a single location that does involve the procurement and use of use of chemicals pesticides or fertilizers; c) conducting applied research exceeding 4 ha in a single location; d) conducting applied research with microbial inoculants. Responses from investigators are reviewed semi-annually by the SIIL management entity to ensure compliance with the SIIL EMMP. All sub-award activities are currently in compliance with the SIIL EMMP.

X. Open Data Management Plan

The SIIIL management entity established the SIIIL Dataverse to store and curate all SIIIL subaward datasets and serve as a data repository and access hub for the SI community in general. During this reporting period, SIIIL subawards and consortia reported that 57 separate complete datasets have been uploaded representing 506 files. The complete datasets can be found in the SIIIL's Dataverse (<https://dataverse.harvard.edu/dataverse/SIIIL>), hosted by Harvard Dataverse.

Each complete dataset is required to, at a minimum, include: codebooks; metadata; data dictionaries; forms, templates, and data gathering tools; explanations of redactions, when applicable (e.g., anonymization, removal/redaction/masking of personally identifiable information); notes on data quality, data limitations, or data context; and data gathering methodologies, dates, points of contact, geolocation(s).

The SIIIL is in continual discussions with USAID's Data Development Library (DDL) staff to resolve issues related to the Geospatial and Farming Systems Research Consortium and the Precision Agricultural project on how to submit datasets given the excessive size of these geospatial datasets.

The SIIIL also has continued to utilize CGSpace as a repository for sharing informal publications and outputs from SIIIL funded work. SIIIL established this repository with CGSpace in 2017 to share SIIIL funded outputs that otherwise did not have formal publishing platforms for public sharing. To date, 44 communications materials such as presentations, videos and other media, management documents, reports, training materials, newsletters and stories, and other communications materials have been shared on the SIIIL CGSpace repository for open access.

Finally, all previous SIIIL annual reports (2015-2020) have been uploaded into the USAID Development Experience Clearinghouse (DEC) and are available to the public.

XI. Governance and Management Entity Information

Regional and Country Coordinator Activity

The SILL coordinators in Senegal, Burkina Faso, and Cambodia monitor in-country activities, represent various capacities, and organize SILL-funded events. The coordinators in West Africa also conduct research to address gaps or expand the scope of in existing in-country SILL subawards. Descriptions of the research and accomplishments are below:

- (1) **Burkina Faso:** Dr. Hamidou Traoré, the SILL Burkina Faso Coordinator and Director General of INERA, works with graduate students, research scientists, and government delegates to move the food and agricultural security agenda forward. Here are some highlights from his work in FY 2021:
 - Three field trials and one screen-house experiment were performed in 2020.
 - a. Two rain-fed field trials dealt with integrated water and soil fertility management through cropping systems, including four tillage methods, two different cropping systems, and four soil amendments. The first one was conducted at the Saria Research Station (Center-West region) while the second was established at the Kouaré Research Station (East Region). The treatments were the same on both stations except that the zai as tillage method was only tested on Saria station against the tide-ridges on Kouaré station.
 - b. The third field experiment assessed the resistance of cowpea mutants to *Striga gesnerioides* in a naturally infested field in the Central Plateau region. Another mutant cowpea field was established at Kamboinsé Research Station to advance M2 and M3 populations in rain-fed conditions.
 - c. The herbicidal effects of bat (*Desmodus rotundus*) droppings, poultry droppings, compost, *Jatropha curcas* cake, organic fertilizer, and dung from cattle and small ruminants to control *Striga hermonthica* were compared in pots established in screen-house conditions.
 - Two farmer surveys were conducted to investigate the impacts of the COVID-19 pandemic on horticulture practices and herbicide use, respectively. The first survey was open to the entire territory of Burkina Faso and the second was implemented in the Central Plateau and Centre-East regions.
 - Analytical services laboratories were requested as provision of Lab services from ICRISAT-Niamey Lab to assess nutrient contents in weed samples collected in Long-term trial and a national private Lab to evaluate nutrient contents and physical properties of soil and manure samples.
 - Evaluation of organic fertilizers to control *Striga hermonthica* in Sorghum growth in screen-house conditions (on-going activity on Kamboinsé research station of INERA).
 - Assessment of cowpea mutant lines for their tolerance to *Striga gesnerioides* in natural infested field (on-going research) (on-going activity in farmer's field located in Zorgho department)
 - Assessment of agro-morphological traits of cowpea mutant lines in rain-fed conditions (on-going research) (on-going activity on Kamboinsé research station of INERA).
 - Potential role of cereal-legume intercropping systems, soil amendment and Tied-ridges in integrated soil fertility and water management in smallholder farming systems (on-going activity on Kouaré research station of INERA).
 - Potential role of integrated cereal-legume cropping systems, tillage methods and soil amendments on soil fertility and water management in smallholder farming systems (on-going activity on Saria research station of INERA).
- (2) **Cambodia:** Dr. Manny Reyes continues his work as the SILL Country Coordinator for SILL, working primarily with CE SAIN and the ASMC-Cambodia teams, but also continuing SILL's regional work in South Asia by cultivation partnerships in the Philippines, Bangladesh, and other countries in the area. Here are a few of the highlighted accomplishments from FY 2021:

- Facilitated the hiring of three field technicians from RUA that were assigned with the Conservation Agriculture Service Center team from the ministry of Agriculture, Forestry, and Fisheries and CIRAD and Swisscontact.
- Connected CE SAIN, the Food Safety Innovation Lab, and ASMC to collaborate on hiring a Gender and Youth Coordinator for CE SAIN. While ultimately unsuccessful, it was decided by the team to write a proposal for a Gender Certificate that would be offered as a capacity building initiative through the Royal University of Agriculture. Purdue University and the Food Safety Lab led the proposal writing.

(3) Senegal: Dr. Aliou Faye continues his work as the West Africa Regional Coordinator. Here are a few highlights:

- Participation and contribution to SIIL- iREACH meeting.
- Participation in the SIIL training on data management and reporting in December 2020.
- Contribution to the development of strategic iREACH documents including the communication plan, M&E activities, and iREACH tracker.
- Identification of suitable technologies to be showcased in the Agricultural Technologies Park (ATP), housed in Bambey, and discussion with scientists who generated those technologies on the fact sheets or related publications.
- Preparation of the ATP protocols and map and finalization of the technologies to be implemented in the ATP).
- Presentation of the ATP innovations at the iREACH Committee meeting for validation for approval.
- Implementation of the ATP at the CERAAS farm at ISRA - CNRA in Bambey.
- First and second sequence video of the implementation of the ATP and preparation for the Open House Day for the Tech Park, planned for October 2021.

SIIL Personnel Changes

- a. SIIL hired two new post-doc researchers funded by K-State and US Department of Agriculture, Dr. Prakash Jha and Dr. Hardeep Singh, to support efforts regarding digital modeling, for use in crop production, water safety, access, and usage, and other food security issues among our target regions around the world.
- b. Ms. Gauresh Rajawat, a computer science graduate student, was hired to develop a Sustainable Intensification Assessment Framework mobile app and has since graduated.
- c. Ms. Sanders Barbee was hired as the new Student Communications Assistant.
- d. Dr. Zachary Stewart moved to USAID as a Production Systems Specialist in the Center for Agriculture-Led Growth in the Bureau for Resilience and Food Security. A replacement at a postdoctoral fellow was identified and she will be starting in November 2021.

XII. Other Topics

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

1. **Name:** The Center of Excellence on Sustainable Agricultural Intensification and Nutrition (CE SAIN)
2. **Locations:** Phnom Penh, Cambodia
3. **Description:** CE SAIN – housed in Cambodia’s Royal University of Agriculture (RUA) – helps improve food and nutritional security in Cambodia by supporting agricultural research and education while fostering innovation. CE SAIN’s goal is to 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. CE SAIN’s three core objectives are: a) coordinate and leverage Innovation Labs and other USAID-funded SAIN activities, b) build human and institutional capacity of the RUA, and c) establish Technology Parks to showcase high-potential technologies and strategies to sustainably intensify smallholder farming systems.
4. **Collaborators:** *Cambodia* - Cambodian Agricultural Research and Development Institute (CARDI), Conservation Agriculture Service Center (CASC); Ministry of Agriculture Forestry and Fisheries (MAFF); Ministry of Education, Youth, and Sport (MoEY); Department of Agricultural Engineering (DAEng); Provincial Department of Agriculture, Forestry and Fisheries (PDAFF), Royal University of Agriculture - Phnom Penh; University of Battambang; and multiple Feed the Future Innovation Labs (e.g. Horticulture; Livestock Systems; Integrated Pest Management); and Swisscontact. Additional collaborators due to the ASA CAST (Commercialization of Aquaculture for Sustainable Trade) project include American Soybean Association, World Vision, and Auburn University.
5. **Key Achievements:**
 - Defined two more potential ATP locations in Monduliri and Preah Vihear Province by partnership with Cambodian Agricultural Research and Development Institute (CARDI) and Provincial Department of Agriculture, Forestry and Fisheries (PDAFF).
 - CE SAIN hired more staff to support the newly funded project called Bighead Catfish Culture (BCC), funded by the Feed the Future Fish Innovation Lab.
 - Four staff were recruited for two more operations in Preah Vihear and Monduliri Province. Five Agricultural Extension Officers (AEOs) hired for the five ATPs. One Agricultural Technical Advisor (ATA) and one Agricultural Technical Officer (ATO) hired to support the technical aspect to all CE SAIN’s ATPs. Two female staff members were promoted to Senior Communication Officer and Communication Officer. One Communication Assistant was hired to support communication team. Sixteen interns (6 females) were recruited to join the Internship Program at the CE SAIN office and at various ATPs to learn hands-on practices and receive mentoring support from Provincial Agricultural Coordinator (formerly called Farm Managers) and the CE SAIN team on both soft and hard skills. Overall, CE SAIN currently has 32 staff members (15 females).
6. **Capacity Building:**
 - 25 CE SAIN staff members (10 females) joined the trainings/workshops with NGO partners, stakeholders and in-house training to strengthen and improve their capacity for their career development and encourage the learning and knowledge-sharing platform within staff and partners.
 - 234 (63 females) received USG supported short-term agricultural sector productivity or food security training.
 - A 16-lecture series was conducted with 468 (225 females) and because of the COVID-19 pandemic the lecture series was conducted virtually.

7. **Lessons Learned:**

- Due to COVID-19, activities conducted by CE SAIN remain limited. CE SAIN continues to learn ways to work around the constraints and allow as many people as possible to participate in their programs. This year, while only 72 individuals (8 females, 11%) visited all CE SAIN's Tech Parks, the groups represented a wide variety of people, including farmers, academics, NGOs, youth groups, USG partners, business owners, and researchers.

8. **Presentations and Publications:**

- 1) Chea, L., Ngoun, S., Ro, S., & Roeurn, S. (January 2021). Genotypic variation in agronomic characteristics of tomato genotypes (*Solanum Lycopersicum* L.) under high temperature condition in Cambodia. Presentation at SIIIL Annual Meeting 2021, Online - *poster*
- 2) Chea, L., Ngoun, S., Ro, S., Roeurn, S., Theam, P..... Genetic variation in agronomic traits and yield performances of tomato (*Solanum lycopersicum*) genotypes in response to heat stress. *Asian Journal of Agricultural and Environmental Safety (AJAES)* – *accepted*
- 3) Hok, L., Muth, E., Neumann, R. B., & Pheap, S. (January 2021). Effect of Seasonal Flooding on Nutrients and Organic Carbon in Paddy Soils. Presentation at SIIIL Annual Meeting 2021, Online. - *poster*
- 4) Hong, C., SOCHEATH, O., Yem, S., Lam, B., & Song, S. Detection and Management of Tomato Leaf Curl Virus (TLCV) by Using Plant Extract Species to Control Disease Severity and Disease Incidence. *Environmental Science and Engineering*. - *accepted*
- 5) Hong, C., SOCHEATH, O., Lam, B., & Song, S. (January 2021). Detection and Management of tomato leaf curl virus disease and its whitefly vector through plant extract management approaches for inducing severity and leaf curl. Presentation at SIIIL Annual Meeting 2021, Online. - *poster*
- 6) Hong, C., SOCHEATH, O., Yem, S., Lam, B., Var, S., & Eam, S. (August 2021). Management of tomato leaf curl virus disease transmission by whiteflies vector (pp.28-34). *Asian Journal of Agricultural and Environmental Safety (AJAES)*, 1(2575423), Cambodia. *Scientific Journal*
- 7) Norng, C., Erlinda, D., Francisco, E. B., Thavrak, H., Ang, V. (January 2021). Physicochemical Properties, Proximate Composition and Microbial Hazard in Fermented Muskmelon (*Cucumis Melon* Linn) from Local Commercial Processors in Cambodia (pp.025). *Journal of Nutrition & Food Sciences*, 4(1), Cambodia. 2565-5779
- 8) Norng, C., Erlinda, D., Francisco, E. B., Thavrak, H., Ang, V. (January 2021). Identification of Lactic Acid Bacteria from Fermented Young Muskmelon (*Cucumis melon* Linn) (pp.120-125). *ACTA SCIENTIFIC NUTRITIONAL HEALTH*, 5(2), India. doi:10.31080/ASNH.2020.05.0817
- 9) Norng, C., Erlinda, D., Francisco, E. B., Thavrak, H., & Chay, C. (January 2021). Effect of Using Different Substrates on the Quality of Fermented Young Muskmelon. Presentation at SIIIL Annual Meeting 2021, Online - *poster*
- 10) Norng, C., Erlinda, D., Francisco, E. B., Thavrak, H., & Chay, C. (January 2021). Identify the Lactic Acid Bacteria in Fermented Young *Cucumis melon* Linn. Presentation at SIIIL Annual Meeting 2021, Online - *poster*
- 11) Nut, N. (January 2021). Modeling Crop Yields under Conservation Agriculture and Conservation Tillage Using APEX Model. Presentation at SIIIL Annual Meeting 2021, Online - *poster*
- 12) Ro, S., Chea, L., Ngoun, S., Stewart, Z. P., Roeurn, S., Theam, P., Lim, S., Sor, R., Kosal, M., Roen, M., Dy, K.S., Prasad, P.V.V. (February 2021). Response of Tomato Genotypes under Different High Temperatures in Field and Greenhouse Conditions (pp.449). *Plants*, 10, Switzerland. doi:10.3390/plants10030449
- 13) Pinn, T., Buntong, B., & Acedo JR, A. (January 2021). Vegetable Farming Practices in Cambodia: Case study of Small-scale Vegetable Farmers in Kandal, Kampong Chhang and Battambang Provinces. Presentation at SIIIL Annual Meeting 2021, Online - *poster*

- 14) Nut, N., Mihara, M., Jeong, J., Ngo, B., Sigua, G., Prasad, P.V.V. & Reyes, M. R. (August 2021). Land Use and Land Cover Changes and Its Impact on Soil Erosion in Stung Sangkae Catchment of Cambodia. *Sustainability* 13, 9276.
- 15) Reyes, M. R., Hok, L., Lor, L., Hin, L., Buntong, B., Clemmons, H., & Kornecki, T. S. (January 2021). Effects Testing and Modifying the OggunTractor, Morrison No-Till Drill, and United States Department of Agriculture Crimper for Conservation Agriculture Production System in Cambodia. Presentation at SILL Annual Meeting 2021, Online. - *poster*
- 16) Stewart, Z. P., Hok, L., Chea, L., Chork, R., Han, S., & Chea, K. (January 2021). Effect of Living Mulches and Nitrogen Management on Soil Nitrogen in Chili pepper Production. Presentation at SILL Annual Meeting 2021, Online. - *poster*
- 17) Theng, D., Nut, N., Taingun, S., Pok, S., & Chou, P. (February 2021). Evaluation of Land Use and Land Cover Change and its Drivers in Battambang Province, Cambodia from 1998 to 2018. International Alumni Seminar 20 years of Land Management and Land Tenure, alumni webinar on Land special issue on “Sustainable Land Management and Tenure”, TUM, Munich, Germany
- 18) Vipham, J., Nai, R., Buntong, B., Tong, S., M. Young, G., & LeGrand, K. (April 2021). Development of Cold-Chain for Postharvest Loss Reduction of Chinese Cabbage (*Brassica campestris* L. ssp. *pekinensis*) (pp.9-22). *Food Science and Engineering*, 11(1), David Publishing Company. Doi :<http://www.davidpublisher.com/index.php/Home/Article/index?id=45271.html>.

Innovation Research, Extension and Advisory Coordination Hub (iREACH)

1. **Name:** Innovation Research, Extension and Advisory Coordination Hub (iREACH)
2. **Locations:** Burkina Faso, Ghana, Mali, Niger, and Senegal
3. **Description:** iREACH – which sits in the West and Central African Council for Agricultural Research and Development/Conseil Ouest et Centre Africaine pour la Recherche et le Développement Agricoles (CORAF) – seeks to intervene in key CORAF intervention domains – agriculture, food, and nutritional security; policy, institution, markets and trade; and gender, youth, and social equity, as well as the associated pillars – community of practice on scaling technologies and innovations for sustainable impact; integrated regional capacity strengthening in agri-food research and innovation; and knowledge management and foresight. iREACH’s three core objectives are: a) improve coordination, alignment, and integration of relevant activities, b) create and strengthen technology parks and facilitate effective flow of information and innovations, and c) build human and institutional capacity.
4. **Collaborators:** West and Central African Council for Agricultural Research and Development (CORAF); National Institute for the Environment and Agricultural Research (INERA); The Fruit and Legumes Regional Center hosted by the Center for National Research on Science and Technologies (IRSAT) – Bobo Dioulasso, Burkina Faso; Council for Scientific and Industrial Research (CSIR); The Roots and Tubers Center hosted by the Crops Research Institute (CRI) – Accra, Ghana; Rural Economy Institute (IER); Rice Regional Center of Specialization hosted by the Regional Center for Agricultural Research (CARRA) - Niono, Mali; Agricultural Research Council of Niger (INRAN); The Livestock Regional Center – Niamey, Niger; and the Senegalese Institute of Agricultural Research (ISRA); The Dry Cereals Regional Institute of Excellence hosted by the Center for the Improvement of the Adaptation to Drought (CERAAS) – Thies, Senegal; multiple Feed the Future Innovation Labs (e.g. Fish, Food Processing, Legume, Peanut, Poultry); and International Fertilizer Development Center (IFDC) and AfricaRising.
5. **Key Achievements:**
 - The Advisory Committee (AC) oversaw the review, guidance, and approval (April 7 and May 11, 2021) of the work plan for the life of the initiative, including the AC’s Terms of Reference, the Agricultural Technology Park (ATP), and communication protocols.

- A platform for tracking activities of the various partners, was developed and exposed to 15 Innovation Labs and the USAID Mission in Senegal. During the set-up phase of the tracker, iREACH hosted over 25 informational and training sessions conducted with the iREACH working group, the SIIL management entity team, USAID Innovation Labs, Missions, and Agreement Officer's Representatives over the past year. Over 150 personnel from 15 Innovation Labs, USAID Washington plus five Missions were in attendance. During the reporting period, the activity tracker was built and projects for 123 activities within 16 Innovation Labs under the participating Missions were created and populated. This provided a foundation for the October 2021 launch of the iREACH Activity Tracker, and this information will be accessible to the Innovation Labs and any relevant through a quarterly subscription.
 - Two hectares of land with irrigation facilities were allocated by to iREACH by CERAAS, the headquarters of the CORAF Center of Excellence on Dry Cereals and Associated Crops, to house the first ATP. An initial list of technologies to be showcased in the ATP was developed and demonstration plots of improved crop varieties, prototypes of processing/post-harvest machinery, and fertility management were established. Two visits to the demonstration plots were organized for ISRA's Director General staff, as well as the staff of one of Senegal's media outlets (Agence de Presse Sénégalaise-APS).
 - iREACH, in partnership with ISRA/CERAAS, planned the launch of the ATP at Bambey, Senegal, with the attendance of representatives from the Minister of Agriculture, the mayor of Bambey (Sereer), ISRA, and CORAF DG's. This included one Farmer Field Day to be conducted at Bambey in October 2021, with over 100 anticipated participants, including farmers, private sector organizations, government agencies, researchers, non-governmental organizations, development workers, and others.
 - iREACH continued facilitating the activities related to opening ATPs in Burkina Faso, Ghana, Mali, and Niger. Ghana, Mali, and Niger were fully funded in FY 2021 and are due to open in 2022.
6. **Capacity Building:**
- 14 scientists and 7 iREACH working group members (4 females) from the CORAF regional centers of excellence: maize (Benin), fruit and vegetable (Burkina Faso), roots and tubers (Ghana), rice (Mali), dry cereals (Senegal), and the CORAF executive secretariat joined a training on the use of KSU/SIIL's Sustainable Intensification Assessment Framework (SIAF).
 - Approximately 100 individuals were anticipated to visit the new Bambey ATP. The group represented farmers, academics, USG partners, Innovation Lab teams, civil sector, researchers, and high-ranking government officials (Ministry of Agriculture).
 - 7 iREACH working group members (3 females) attended an overview given by the Appropriate Scale Mechanization Consortium (ASMC) on its Technology Readiness Assessment tool.
7. **Lessons Learned:**
- The ATP in Senegal was designed for implementation at CERAAS in Thies, Senegal due to its accessibility, proximity to a highly traveled roadways and government officials. However, additionally communication was warranted between local stakeholders for the opening at that location--the 2021 ATP opened in Bambey with the potential to move back to CERAAS in Thies in 2022.
8. **Presentations and Publications:**
None to report for FY 2021.

Gender Integration Highlights:

During the FY 2021 reporting period, SIIL requested the Consortia and subawards provide additional information on how their projects were integrating gender into their research. All of them are actively integrated gender into their programs. While many projects reported implementation issues due to COVID-19, below are the highlights from few selected projects:

Trainings conducted by the S3-Cambodia project during this period reached a total of 345 participants, including 102 female participants (30%). This fell short of the annual target of 35% female participation, but they hope to increase women's participation as schools re-open and they are able to engage more students in training activities.

The Senegal/Niger project engaged 15 more women's organizations on making and commercializing dual-purpose millet flour and trained 23 female farmers on dual-purpose quality seed cropping.

The ASMC Hub in Burkina Faso are working to develop training materials for women on conservation agriculture, mechanization, and appropriate use of the ASMC planter. Trainings will be conducted prior to planting seasons (November 2021-May 2022), with the goal of reaching 500-1000 farming households.

Nutrition Integration Highlights:

During the FY 2021 reporting period, SIIL also requested the Consortia and subawards provide additional information on how their projects were addressing nutrition as a cross-cutting theme into their research activities. While many projects reported implementation issues due to COVID-19, below are the highlights from few selected projects:

The S3-Cambodia project collected and propagated over 30 species of wild food plants, many of which are nutritious. They are also promoting the production of tomatoes during the rainy season as an additional source of income and nutrition. The curriculum developed for the "Green Labs" incorporate nutritional messaging about balanced and diverse diets.

The Policy Research Consortium supported HWIES project worked to draw connections between water and nutrition for the target communities, such as at the plenary session at the American Society for Nutrition and the resultant paper. American Society for Nutrition, 2020. "Household Water Insecurity and its Importance for Ensuring Food, Nutrition and Well-being." <https://ondemand.nutrition.org/s/2020an/annual/ASN20-27>.

The Bangladesh polder project organized a nutritional awareness training involving the mothers of the school children and female schoolteachers. The farming community was also included in the nutritional awareness program while empowering them on the production of zinc-enriched rice, maize, and sunflower. The project developed a colorful leaflet on nutritional awareness and provided training to 85 mothers of school children and female schoolteachers, focusing on the consumption of zinc enriched HYV rice, pulses, and enriching household nutrition directly by consuming maize flour, or indirectly via feeding the poultry and livestock (egg, milk, and meat). The project team also provided training to 1744 men and women farmers on improved rice-based production system focusing on improving household nutrition cultivating and consuming zinc-enriched HYV rice, maize, and sunflower.

XIII. Issues

COVID-19

As the COVID-19 pandemic continued through FY 2021, SIIL faced several related challenges, including the inability to travel and meet with partners face to face, and a decrease in activities which led to funding pipeline back-ups and implementation delays across the SIIL portfolio. Despite these challenges the major activities continued and key objectives during the reporting period were met. The SIIL Management Entity will continue to work with USAID and its various partners in their target countries and regions to ensure that programmatic functions continue as best as possible during this time.

XIV. Future Directions and Activities

Haiti Agricultural University Partnership Cooperative Agreement

The Haiti Agricultural University Partnerships Activity aims to build the institutional capacity of local universities, research centers, and other Haitian institutions so that they can identify and seek the solutions to challenges affecting their local agriculture sector. To do this, it is imperative to also build the human capacity of individuals engaged in the sector, including farmers, students, and the private sector. With support from Kansas State University, the activity will support a network of Haitian institutions to increase national capacities to develop an agricultural research and extension agenda that is aligned with national development, food security, and resilience priorities. The cooperative agreement was completed on September 30, 2021, and will continue through September 29, 2026, with work on the initial activities to begin by the end of calendar year 2021. This will be done through establishment of Center of Excellence on Mitigation, Adaptation and Resilience to Climate-Change in Haiti (CE MARCH).

iREACH Coordination Hubs Cooperative Agreement

The goal of this initiative is to create regional innovation, research, extension, and advisory coordination hubs (iREACH) in the Feed the Future target and resilience focus region, and countries that will foster private sector innovation, agricultural research, education, extension and training, and public-sector capacity building through improved collaboration, communication and knowledge sharing on aspects related to CSA and food and nutritional security in the various regions (Asia, West Africa, East Africa, and Latin America and the Caribbean).

Objectives:

- Coordinate and leverage USAID and USG and other international and national donor activities to strengthen partners' proficiency to navigate complexity, collaborate, adapt, and leverage agricultural innovations developed through stakeholder engagement.
- Build human and institutional capacity to facilitate collective ability to accelerate agricultural innovations and strengthen social capital to address climate change.
- Establish agricultural technology parks (ATPs) to showcase proven CSA technologies that will address food and nutritional security and build resilience of systems and people.

SIIL is using this opportunity to help the Digital and Geospatial Tools Consortium partner with the greater iREACH initiative and promote the use of digital modeling tools to better inform smallholder farmers, producers, private organizations, and government entities working in the agricultural sector. This cooperative agreement was completed on September 24, 2021 and will run through September 23, 2026.

Policy Research Impact Study Consortium Closeout

The Policy Research Impact Study Consortium, supported through an associate award with Rutgers University, will continue their closeout procedures. This will include a final virtual conference to share their findings, titled "Policy Systems for Transforming Agriculture: Research, Implementation and Impact", which will be held on November 2-3, 2021. The Rutgers University subaward for the Consortium will officially end in December 2021.

Expanding the Sustainable Intensification Assessment Framework

SIIL will work with its partners to continue to expand the effectiveness of the Sustainable Intensification Assessment Framework (SIAF) by updating current indicators and adding new ones, especially those related to the nutrition and social domains.

CE SAIN Institutionalization at the Royal University of Agriculture

The Center for Sustainable Agricultural Intensification and Nutrition (CE SAIN) celebrated their five-year anniversary in September 2021. They are currently funded by SILL and house at the Royal University of Agriculture in Cambodia and have five Technology Parks located around the country. During FY 2022, SILL will continue to support CE SAIN's efforts to be institutionalized at RUA, with will take over complete management of the initiative. Additionally, CE SAIN is currently working to add two more Agricultural Technology Parks in the Mondulkiri and Preah Vihear provinces of Cambodia to expand their ability to train farmers, students, and other community members on sustainable agricultural practices.

Appropriate Scale Mechanization Consortium Survey and Database

A survey to assess the current status of agricultural mechanization in Africa was launched by the Appropriate Scale Mechanization Consortium (ASMC) and the results will be assessed in late 2021. A separate survey to assess the current status of agricultural mechanization in Asia has been developed and will be launched in late 2021 as well.

Additionally, the ASMC will continue its efforts to develop a database on global agricultural mechanization research. This database will house documents created through work and research that ASMC has conducted, as well as work produced by partner entities. This database will allow ASMC to become the leading entity for resources on agricultural mechanization in their regions of focus. The SILL will continue to support both of these efforts through the life of the Consortium.

XV. Appendices

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

Funding for Phase II: 2020 – 2024

Consortiums:

Title: Appropriate Scale Mechanization Consortium – Phase 2

Awarded institution: University of Illinois at Urbana-Champaign

Dates: July 1, 2020 - June 30, 2023

Current year funding: \$749,994

Total funding: \$3,000,000

Title: Digital and Geospatial Tools Consortium

Awarded institution: Kansas State University

Dates: July 1, 2020 - June 30, 2023

Current year funding: \$500,000

Total funding: \$3,000,000

Focus Country Projects (Bangladesh, Cambodia, Senegal & Niger):

Title: Pathways of scaling agricultural innovations for sustainable intensification in the polders of coastal Bangladesh

Awarded institution: Kansas State University

Dates: July 1, 2020 - June 30, 2023

Current year funding: \$259,472

Total funding: \$749,999

Title: Cambodia: Scaling Suitable Sustainable Technologies

Awarded institution: University of Tennessee

Dates: July 1, 2020 - June 30, 2023

Current year funding: \$267,642

Total funding: \$750,000

Title: Scaling Dual-Purpose Pearl Millet-Based Technologies for the Resilience of Small-Holder Farmers in Senegal and Niger

Awarded institution: Kansas State University

Dates: July 1, 2020 - June 30, 2023

Current year funding: \$135,327

Total funding: \$749,999

Initiatives and Associate Awards:

Title: Center of Excellence on Sustainable Agricultural Intensification and Nutrition (CE SAIN) in Cambodia

Awarded institution: Royal University of Agriculture

Dates: July 1, 2016 – September 30, 2022

Current year funding: \$487,500

Total funding: \$3,500,000

Title: Innovation Research, Extension and Advisory Coordination Hub (iREACH)

Awarded institution: West and Central Africa Council of Agricultural Research and Development (CORAF)

Dates: April 1, 2020 – March 31, 2022

Current year funding: \$122,661

Total funding: \$249,000

Title: Economic Impact of Improved Bean Varieties in Central America and USA

Awarded institution: Michigan State University and International Center for Tropical Agriculture (CIAT)

Dates: January 1, 2021 – December 31, 2022

Current year funding: \$125,505

Total funding: \$165,174

Appendix B – Success Stories

SUCCESS STORIES

Success Story #1: GoNative App Developed by Native and the ASMC through SIIL Works to Bridge Gap between Farmers and Consumers in Cambodia

In Cambodia, smallholder farmers often lack access to profitable markets to sell the vegetables they worked hard to produce. In an effort to achieve a more food secure future and promote resilience among Cambodians, new digital technology needed to be introduced.



Figure 1: A daughter helping her mother, a woman farmer, use the GoNative App to sell their vegetables in Cambodia.

The Feed the Future Innovation Lab for Collaborative Research on Sustainable Intensification (SIIL) collaborator, the Appropriate Scale Mechanization Consortium (ASMC), currently works and conducts research in Cambodia. The ASMC, together with the University of Battambang (UBB), has tested and introduced several vegetable production hand tools on conservation agriculture for sustainable intensification purposes.

After receiving feedback from farmers in the region, they realized that, after mechanical tool development, what was most needed was an effective marketing tool. The ASMC was able to partner with a private company, Native, located in the United States, to produce such a tool. This innovation was the *GoNative for Battambang*, which was created and tested for farmers in Cambodia. The tool was designed to help bridge the gap between farmers who need to sell their produce and consumers who are looking to purchase it.

Manny Reyes, regional coordinator for Asia, research professor with SIIL, and collaborator on the ASMC project in Cambodia said, “These farmers requested a marketing tool that would help link them to consumers in their communities and provide a secure pathway of selling their vegetable crops.”

“Smallholder farmers sometimes lack access to profitable markets where they can sell their products,” Swetank Shekhar, founder of GoNative International said. “This app can give them the means to achieve sustainability through their hard work while also benefiting the community.”



Figure 2: The GoNative App was produced to help smallholder farmers connect with potential consumers.

GoNative will be promoted widely throughout the country and will be available to all farmers and consumers who would like to participate and experience the benefits of having access to this tool.

Horace Clemmons, founder of GoNative, said “We hope that this app establishes a much-needed communication line between farmers and consumers, and benefits the smallholder farmers in Cambodia, especially women. A large part of their livelihoods depends on the ability for them to profit off of their crops, and GoNative is intended to nurture that ability.”

Vara Prasad, university distinguished professor and director of the SIIL said that “it is not enough to increase the yields, we need to ensure that they are able to sell their produce at a good price and see this activity as business for income generation. Providing innovative digital tools along with access to broad band internet is a key step toward empowering smallholder women farmers to shift from subsistence farming to become entrepreneurs.”

Success Story #2: Smallholder Farmer Using Conservation Agriculture Taught by the ASMIH-Bangladesh Project

Md. Islam Biswas, 54-years old, is an enthusiast, smallholder farmer of the Baratia village of Dumuria Upazila in Khulna district. Biswas owns one acre of land and leases an additional one and a half acres of land that he cultivates. He normally cultivates crops in rice-rice-jute cropping pattern. Biswas has been following traditional cultivation practices of tilling 3-4 times with a power tiller, followed by laddering operations. Over the past 30 years, Biswas transplanted rice and sowed jute seed manually. Not only is this traditional method time-consuming, but it is also labor intensive and costly. Biswas began facing challenges to maintain and provide for his wife, son, and daughter.

The ASMIH-Bangladesh team provided training on conservation agriculture (CA) system. Biswas was a part of receiving that training and was able to learn about this technique. The CA system is a mechanized system that can drastically reduce cost, time, labor, and drudgery that is usually associated with rice-rice-jute based cropping system.



Figure 1: Smallholder farmer (Mrs. Boswas) picking up tender vegetable leaves.

Biswas, along with his wife, used the skills they learned from the training arranged by ASMIH-Bangladesh to operate CA machinery and began to practice in their own field. The BARI seeder is a power tiller operated CA machine that can be used as a reduced tillage tool, sowing seed in line, and covering the seeds in a single pass. Initially, Biswas used rice transplanter during rice cultivation and BARI seeder during jute cultivation on his one acre of land. After cultivation of the CA based mechanized practice on his land, there were numerous neighboring farmers who were interested to use the CA systems in their fields as well.

Biswas is now leading a group of 10 farmers at Baratia village who were interested in using CA practices in their fields. The farmers observed that a CA based seeder can ensure better seed germination in line sowing of jute. The number of jute plants per unit area were more and growth was better than the traditional broadcasted field. Line sown jute can also reduce labor for intercultural operations and harvesting.



Figure 3: CA seeder being operated by Md. Shimul Biswas, Islam Biswas' nephew

Biswas' motivation and dedication to CA systems were transmitted to neighbor farmers which in turn leads to increase the land under CA jute. Last year, 10 acres of land were under CA mechanized just cultivation in the Baratia village. In addition to Biswas, his nephew also received training from the ASMIH-Bangladesh project and is now a skilled operator of a BARI seeder and rice transplanter.

Success Story #3: Connecting Small Scale Producers and Research: On-Farm Demonstration of New Cowpea and Millet Varieties in Senegal

Ousmane Willane, a farmer who has seen nearly 70 rainy seasons, lives in the village of Touba Taba located 7 kilometers (4.35 miles) south of Kaffrine in Senegal. In 2021, Ousmane, one of the inaugural Master Farmers of the Peace Corps Senegal program, was chosen along with three other colleagues to demonstrate new dual-purpose millet and cowpea varieties. Although both are more productive and nutritious than local farmer varieties and maintain the greenness necessary at maturity for livestock feeding, they struggle with the distinction necessary for adoption by local farmers.

This is where both partnerships and scaling play a role in leveraging networks to reach the wider farming communities. Since 2017, the Senegalese Institute for Agricultural Research (ISRA) developed and worked to scale technologies by partnering with the United States Agency for International Development (USAID) Feed the Future Sustainable Intensification Innovation Lab (SIIL), Sorghum and Millet Innovation Lab (SMIL), and Legume Systems Research Innovation Lab (ILLSR) in collaboration with US Peace Corps in Senegal. At the start of the 2021 rainy season, the Regional Center of Excellence on Dry Cereals and Associated Crops (CERAAS) provided Ousmane and his colleagues 500 g of the new millet varieties, SL28 (Souna Saloum), SL169 (Souna Sine) and SL423 (Souna Baol), and 500 g of the new cowpea varieties (Leona and Kelle) plus one tradition cowpea variety (Yacine).

"I had really hesitated to take the seeds when asked to test these crops, because I didn't recognize the varieties and we had already sown for the current rainy season," said Ousmane. "I'll admit that it would have been a big mistake on my part."

There was a Memorandum of Understanding signed in 2017 between SIIL, PC, and ISRA.

Ousmane became a de facto, community ambassador for these new varieties. He was impressed early on by the rapid growth of the cowpea. Within 20 days, the new millet varieties matched the local varieties in height and had a visibly impressive biomass. Local farmers visited the field, asked the varietal names, commented on the length of the millet pods, the green coloring and big ear markings.

"All my fellow farmers who passed by my fields could not hide their surprise when saying to me, 'Hey Ousmane! You got us once again! Where did you get these varieties of millet and cowpea so different from ours?'," Ousmane said. "I respond all the time with pride and a broad smile that it is from my staff from USAID, Peace Corps and ISRA who brought them to me for testing and I confess, I am equally impressed!"

Less than 55 days after sowing, the new cowpea varieties were fully ripe, leaving Ousmane both happy and perplexed about how he would keep up with the intensity of production. He has already begun thinking about machinery to support increased production and reduce post-harvest losses. This shows how local farmers can play a role in scaling technologies as well as introducing technologies capable of alleviating chronic food and nutritional insecurity.