



Appui à la Recherche et au Développement Agricole (AREA) Project

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Acronyms

AOR	Agreement Officer's Representative
AKOSAA	Amelyorasyon Kapasite pou Ogmante Sekirite Alimantè an Ayiti
ANATRAF	Association Nationale des Transformateurs de Fruits
AREA	Appui à la Recherche et au Développement Agricole, also known as Support to Agricultural Research and Development
AUS	American University of the Caribbean
BAC	Communal Agricultural Office
BIFAD	Board for International Food and Agricultural Development
CHIBAS	A research laboratory associated with Quisqueya University's College of Agriculture
CIAT	International Center for Tropical Agriculture
CIIFAD	Cornell International Institute for Food, Agriculture and Development
CIMMYT	International Maize and Wheat Improvement Center
COP	Chief of Party
CRDA	Centre de Recherche et de Documentation Agricole
CRDD	Rural Center for Sustainable Development
DFPEA	Direction de Formation et de Promotion de l'Entreprenariat Agricole
DI	Directorate of Innovation
DOR	Director of Research
EMA	Ecoles Moyennes d'Agriculture
FAMV	Faculté d'Agronomie et de Médecine Vétérinaire, also known as the State University of Haiti's College of Agriculture
IRB	Institutional Review Board
LSU	Louisiana State University
MS	Master of Science
MARNDR	Ministère de l'Agriculture, des Ressources Naturelles et du Développement, also referred to as Haiti's Ministry of Agriculture
NAIP	National Agriculture Investment Plan
M&E	Monitoring and Evaluation
NGO	Nongovernmental Organization
ORE	Organisation pour la réhabilitation de l'environnement, or Organization for Rehabilitation of the Environment
SARD	Support to Agricultural Research and Development
SOHADERK	Solidarite Haitienne pour le Developpement Rural de Kenscoff
UF	University of Florida
UHM	Haiti's Unité Hydrométéorologique, or Haiti's Hydrometeorological Unit
UI	University of Illinois
UNEPH	L'Université Episcopale d'Haïti, or the Episcopal University of Haiti
USAID	United States Agency for International Development
USDA-PASA	United States Department of Agriculture Service Agreement Participating Agency
WINNER	Watershed Initiative for National Natural Environmental Resources

Disclaimer

The authors' views expressed in this publication do not necessarily reflect the views of the U.S. Agency for International Development or the U.S. Government.

Project Background

In May 2015, the University of Florida's Institute of Food and Agricultural Sciences (IFAS) and two other U.S. land grant institutions (the project consortium*) entered a five-year cooperative agreement with the U.S. Agency for International Development to support its Feed the Future initiative in Haiti.



The Appui à la Recherche et au Développement Agricole (AREA) project team's approach to address the long-standing challenges of food insecurity and under-nutrition in Haiti is to support public and private institutions that are working to improve agricultural productivity. These institutions include the Ministère de l'Agriculture, des Ressources Naturelles et du Développement Rural (MARNDR), Faculté d'Agronomie et de Médecine Vétérinaire (FAMV), and other higher education institutions. The project builds on the Haiti's National Agriculture Investment Plan (NAIP), which outlines dozens of projects designed to revive and modernize its agricultural sector following a devastating earthquake in January 2010.

The project consortium is working to increase the availability of improved production technologies to farmers and the private sector through effective extension and development of an agricultural innovation system. The rapid scaling up of proven technologies is designed to increase adoption rates in the short term and propel the development of new technologies over the longer term. Developing functional and sustainable agricultural systems requires building on successful models and forging linkages to the national and international efforts already in place in Haiti.

Key Principles: The AREA project is guided by five key principles designed to build a sustainable agricultural innovation system in Haiti. These are:

1. Provide opportunities for Haitians of all classes to improve their lives. Support training, innovation, well-implemented programs, and inclusive communication that will create ways to serve the needs of Haitian farmers. A special emphasis is to reach the country's often-overlooked community of female farmers.
2. Mentor agents of change in governmental and nongovernmental institutions and organizations. Mentors provide guidance, training and knowledge that can help individuals

Consortium Members



* The AREA project consortium's members are: The University of Florida, Louisiana State University and the University of Illinois at Urbana-Champaign. The University of Florida's Institute of Food and Agricultural Science leads the team.

AREA and SARD: The AREA project is also known as Support to Agricultural Research and Development (SARD). For clarity, the authors use AREA in this document.

increase their confidence and build stronger leadership and problem-solving skills. The goal is to expand the number and effectiveness of change agents in the agricultural sector.

3. Build and support stronger, more equitable farmer organizations and agribusinesses. Countries that meet their food needs have strong farmer organizations and agribusinesses that play a key role in supporting farmer education and agricultural research. Establishing and improving the management of farmer cooperatives and organizations may help overcome the limited access farmers, particularly women, have to credit and training.
4. Foster a culture of evaluation, self-assessment and accountability. Professionals serving the agriculture sector are more effective when they develop skills that enable them to address problems, test solutions, accept responsibility and meet expectations. Research and effective information and technology delivery require credible information and equitable delivery methods.
5. Inspire educated and trained Haitians to fuel the growth of the agriculture sector through innovative research and extension. Enabling educated and trained individuals to contribute to and help rebuild Haitian agriculture will catalyze agricultural productivity. Fostering entrepreneurial opportunities through business model incubators that support talented researchers and innovators can increase their long-term commitment and contributions to Haiti.

Executive Summary

AREA researchers continued to make progress on key research projects in the first quarter ended Dec. 31, 2018.

However, many training, research and travel activities were cancelled or hampered because of protests and civil unrest in Haiti. The U.S. State Department issued an advisory recommending U.S. citizens not to travel to Haiti because of frequent and unpredictable protests, tire burning, road blockages and violent crime. The AREA office was closed for a portion of November and most travel from the United States to Haiti was cancelled in December because of safety concerns.

Milestones and key research and educational activities during the most recent quarter are summarized below.

- AREA researchers completed tests and a disease note to alert the scientific community and Haiti's agricultural sector of an agent causing a "new" toppling disease that has been devastating banana and plantain crops in the Matheux corridor (from Cabaret to Montrouis), a first step in developing management recommendations to help control the disease.
- The first AREA-supported student graduated from the University of Florida on Dec. 15, 2018 and returned to Haiti to seek employment in the agricultural sector; 19 other graduate students remain in good academic standing in their respective master's programs at the University of Florida and Louisiana State University.

- AREA expanded graduate-level training; five additional students from Haiti were selected to enroll in the English Language Institute and obtain conditional admission to academic programs.
- AREA completed and published or presented three additional scientific publications highlighting research conducted by AREA graduate students and the Higher Education Research and Development programs.
- Forty-five people attended short-term AREA events, including 18 at a five-day workshop on how extension agents and farmers can use new approaches to reduce the risk of financial losses during an era of increased climate variability; 100 percent of surveyed respondents reported an increase in knowledge and skills.
- The Soil Science Research program launched two research experiments on soil fertility management practices on plots at the Bas Boën CRDD.
- AREA awarded 11 grants of up to \$4,000 to purchase research supplies and equipment needed for research and educational purposes.
- AREA conducted due diligence on pilot projects designed to address research priorities of Haiti's agriculture sector; nine projects were given preliminary approval for grants of up to \$20,000 each.
- UF/IFAS hosted the dean and vice dean of research of the State University of Haiti's College of Agriculture (or FAMV) on a trip to the University of Florida to tour numerous laboratories and consult with experts on how best to set up labs and classrooms under construction at FAMV.
- Forty-eight percent of all participants in AREA long- and short-term trainings were women, the highest rate of females represented in project activities thus far.

A. Climate Smart Solutions

Background

The goal of AREA's Climate Smart Solutions program is to support Haitian institutions and its agricultural sector manage risks associated with climate variability by reducing losses during unfavorable years and maximizing harvests in favorable ones. AREA is researching how climate variability affects the livelihood of Haitian farmers and their ability to respond to these challenges. AREA also facilitates access to climate information, develops tools that farmers can use to improve seasonal planning and day-to-day decision-making, and builds capacity for outreach on climate risk management in agriculture.

Below are key accomplishments of AREA Climate Smart Solutions program in the first quarter of Year 4.

Output 1: Analysis of farmers' decision-making process with respect to climate risk and the use of weather and climate information

In October and November, AREA held six focus group meetings with farmers and the leaders of farmers' groups at rural centers for sustainable development (CRDDs) at Montrouis, Duvier, Wynne Farm and Robin. This brings the number of focus groups we have had in Years 3 and 4 to 16.

The aim of the focus groups is to understand the impact of weather-related dilemmas on the livelihood of hillside farmers. The groups provide insights and information, such as: 1) the relative weight that hillside farmers give to weather-related dilemmas as opposed to other limiting factors (e.g. capital shortage, seed quality, shifts in market demand); 2) how farmers have traditionally responded to adverse impacts of drought, hurricanes, and other weather-related events in recent years; 3) the type and usefulness of meteorological and climatological information shared with them (if any).

While a final report is not yet available, on Oct. 23, 2018, one of the co-leaders of the Climate Smart Solutions program presented the results of surveys from the first eight focus groups to 33 representatives from Haiti's agricultural sector. Preliminary results show that extreme weather events, particularly those associated with the timing and quantity of rainfall, represent a major risk each year for more than 50% of participants. Depending on the rainfall, crops may not germinate, flower or reach maturity, while livestock may suffer from drought, or drown during hurricane-related floods. Farming practices, such as the planting date, rate and crop selection, need to change in response to rainfall variations. For example, farmers increasingly select crops that have a short cycle and are more likely to survive heat and drought. The majority of participants also engage in rapid, more lucrative activities including commerce, construction and transportation services. Some farmers receive the short-term (seven-day) weather forecasts, which they mostly use when a hurricane is coming. Forecast timing and accuracy were highlighted as major limiting factors.



Figure 1. On Oct. 24, AREA's M&E specialist (left) and an AREA research assistant (right) lead a focus group in Duvier with farmers.

Output 2: Study of the current state of weather information in Haiti

The Climate Smart Solutions team is leading an ongoing effort to recover historical information on Haiti's climate data collection, compilation and dissemination. This work is in partnership with the Ministry of Agriculture's Unité Hydrométéorologique (UHM). In October and November, the program's data and climate specialist compiled and cleaned up rainfall and temperature data for Damien and the airport in Port-au-Prince.

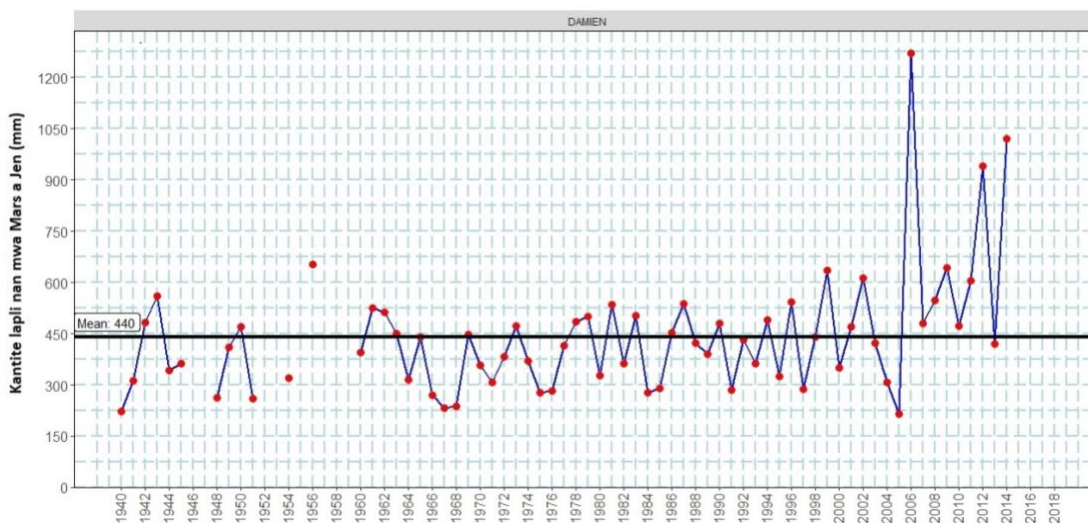


Figure 2. Total rainfall (mm) for the period of March to June from 1940-2018 as measured by the weather station at Damien shows higher and more varied rainfall in recent years. Source: UHM

Members of the Climate Smart Solutions team also produced a third draft of an article on the state of climate information production and dissemination in Haiti. Once completed, they will share this inventory of climate data with AREA partners and communicate about AREA's efforts to access data for climate risk assessment and management in Haiti. AREA hopes that circulating an inventory of Haiti's climate data and associated infrastructure will increase the number and pertinence of interventions in risk management across climate-sensitive sectors in Haiti.

The article will include an inventory of climatological networks and stations in Haiti, including the stations' operational status, and provide access to data to the public. Through this work, AREA seeks to raise the awareness of agricultural stakeholders and those in other climate-sensitive sectors about availability of climate information to encourage its use in research and business.

Output 3: Climate risk assessment and management outreach workshops

In October 2018, AREA gathered 33 representatives of farmers' groups and other AREA partners in Haiti's agroclimatological sector to discuss the upcoming climate outreach program. The attendees provided valuable feedback on the feasibility of the outreach program in Haiti. Fifteen farmer group leaders volunteered to participate in a pilot phase of the program.



Figure 3. A co-leader of the Climate Smart Solutions program and an AREA data and climate specialist lead a presentation on the AREA climate outreach program.

A five-day training of trainers was held Dec. 3-7 in Haiti; the workshop was rescheduled from November because of civil unrest in Haiti. Its aim was to:

1. Introduce the core components and principles of Participatory Integrated Climate Services for Agriculture, or PICSA, which is a participatory agricultural extension approach to help farmers make informed decisions related to climate change
2. Present and discuss results from prior implementation of PICSA in Malawi, Ghana and Tanzania
3. Build the capacity of *paysans vulgarisateurs* (extension agents and officers who represent farmers' associations) to train farmers in the PICSA approach
4. Produce clear plans for the implementation of PICSA following the workshop

The workshop, held at Palm Events Center in Port-au-Prince, was attended by 18 *paysans vulgarisateurs* representing 15 farmers' organizations in the Kenscoff area. Among those facilitating and leading the training were AREA staff members, including three AREA agronomists from Haiti, one of the co-leaders of the Climate Smart Solutions program, two staff members from UHM, and a senior research fellow at the University of Reading in London who has conducted such trainings in 21 countries. The senior research fellow and two other researchers at Reading developed PICSA to help smallholder farmers around the world to deal with climate variability and change.

During the first three days of the training in Haiti, participants were introduced to the PICSA approach. UHM representatives gave a presentation on key concepts, including climate, climate change and climate variability. The participants split into groups according to their geographical location to learn about PICSA steps and tools, including the resource allocation map (or RAM) and the seasonal calendar. For the RAM exercise, participants were asked to draw on a flip chart the operations of a typical Haitian farmer, including the flow of all the resources connected with his or her farm. Participants then created a seasonal calendar to represent the timing of activities for various crops and business enterprises and to link these to weather conditions that influence these

activities. Participants also benefitted from a discussion with an experienced agronomist who talked about the traits of different varieties of potatoes available on the market in Haiti.



Figure 4. A seasonal calendar shows the evolution of the growing season for pea and tomato production, as well as the importance of weather conditions at each step.

In a plenary session, an AREA agronomist presented historical climate data collected in Damien and the participants discussed whether the graphs showed evidence of climate variability and climate change. They also discussed their own perceptions of rainfall changes on their farms. They learned how to teach others how to calculate probabilities and risks for the start and length of the agricultural season as well as the amount of rainfall in the season, and to interpret and use seven-day and three-month rainfall and temperature forecasts. Participants also learned how to use and teach others to use crop, livestock and livelihood options matrices and participatory budgets to evaluate and compare livelihood options and select those with the highest chance of profit or the lowest risk of losses in above normal and below normal rainfall years.



Figure 5. *Paysans vulgarisateurs* work in groups develop a livelihood options matrix, a tool farmers can use to identify the different livelihood options that are available to them and which may be most suitable to different types of households.

Following the plenary, participants revisited the resource allocation maps that they had drawn on the first day and decided whether to add options. UHM then gave a presentation on the seasonal weather forecasts and how the forecasts are produced. Participants completed an exercise on how they would discuss a weather forecast with farmers. In the afternoon, the groups of participants prepared for the upcoming field day with farmers by assigning roles, such as activity leaders and timekeepers. They also organized training materials, such as flipcharts, historical climate graphs and markers.

During a field day on Dec. 7, 2018, the 18 trainers worked in groups to teach other farmers to use PICSA. Fifty-six farmers attended the training at Wynne Farm in Kenscoff. In groups, farmers produced resource allocation maps, analyzed historical climate information, calculated probabilities and risks, discussed an options matrix, and completed a participatory budget.



Figure 6. Trained *paysans vulgarisateurs* watch as a farmer trainee fills out a participatory budget according to the PICSA approach.

On the final day of the training, the participants reflected on their experiences and discussed questions that came up during the trips to the field and visits with farmers. The three groups reported that farmers were highly engaged and interested in the tools and information presented, with, such as actions they can take to adapt to climate variability and participatory budgeting.

Finally, the groups were provided blank work plan sheets to complete with their individual plans for meeting with farmers in their associations and the information they would cover. An AREA agronomist provided a suggested plan that farmers were encouraged to consider and adapt for their use. Support provided during the rollouts of PICSA training to the farmers was discussed, and it was decided that AREA team members will provide materials (flip charts, paper and packs of climate

graphs, crop information and monitoring forms) and practical support while agronomists will provide training assistance.

The workshop concluded with participants completing a feedback survey. Surveyed participants reported their skills — related to practices such as using and explaining seasonal weather forecasts and calendars to farmers, creating participatory budgets and explaining resource allocation maps — increased 93% (Figure 7). Knowledge of agricultural planning and climate-related subjects increased 82%.

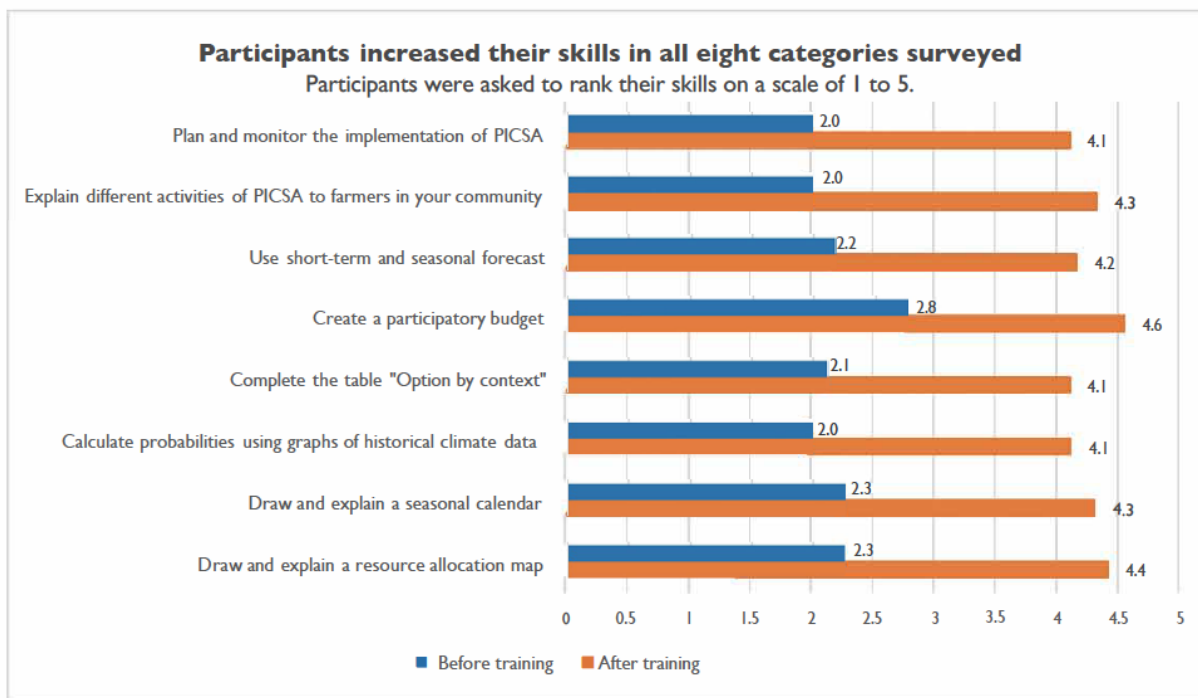


Figure 7. Surveyed participants in the PICSA training reported a 93% increase in skills in eight categories.

In a follow-up report on the training, the senior research fellow from the University of Reading wrote that the overall five-day workshop was “successful” with the 18 farmer extension agents “ready to roll” out the PICSA training to farmers in their respective farmer associations. He provided a critique and suggestions for improving subsequent trainings, including clarifying information and encouraging agronomists to brainstorm with farmers and stretch them to think of more ways they can adapt climate variability, such as considering changing breeds of livestock, crop varieties and the way they manage their soil.

“Overall, I was very impressed and encouraged by the workshop,” the senior research fellow reported. “It was well organized and the team worked very conscientiously to make sure it was a success. Participants could see the value of the approach and were keen to implement what they had learned with their farmer groups.”



Figure 8. A UHM coordinator (left) talks about the AREA-UHM partnership. A representative from the Ministry of Environment's Climate Change Division (right) asks about joining in PICSA training and outreach efforts.

Output 4: Workshop on analysis of climate data 2.0

AREA is helping UHM fulfill its mandate with Haiti's Ministry of Agriculture in the face of major budget and human capacity constraints. Since August 2018, AREA-led capacity building focused on the processing and analysis of climate data for outreach programs in agriculture. Training sessions were co-led via Skype by a University of Reading in England researcher and the co-leader of the Climate Smart Solutions program in Gainesville. On Oct. 22, 2018, UHM officials presented the results of the August and September sessions to colleagues and interns at UHM headquarters.



Figure 9. Haiti's Hydrometeorology Unit interns follow closely as a climatology technician presents her work on quality control of climate information at UHM headquarters on Oct. 22, 2018.

On Nov. 29, 2018, AREA and UHM co-led a workshop with seven representatives of AREA partners from the Ministry of Environment and nongovernmental organizations. A group of data analyst interns from UHM also participated. The participants manipulated climate data using R-Instat, performed routine data quality checks, and produced simple graphics to help those in climate-sensitive sectors to better understand long-term changes in rainfall and temperature. The group also discussed the interpretation and communication of statistics with lay audiences.



Figure 10. Left: Haiti's Hydrometeorology Unit climatology forecaster teaches participants to process climate information as part of a Nov. 29 workshop. Right: A participant receives a certificate of completion.

Output 5: Creation and support of a Haitian weather station network to technically support a wireless weather network among key institutional partners

No activities this past quarter.

Output 6: Support and upgrades on second-generation weather stations in Haiti

During the first quarter, a professor of electrical engineering at the University of Florida and AREA's weather station specialist worked to troubleshoot Wi-Fi issues that have limited the reporting capability of the solar-powered weather stations that AREA installed in Haiti.

The electrical engineering professor set up two weather stations on UF's campus in Gainesville to test improvements to the stations. The improvements include:

- Installing solar arrays with larger capacity
- Rewriting software and installing new backup batteries to improve data storage accuracy and program operation
- Adding a timer to automatically reset weather stations that stop working

To save battery power during low light conditions, including during shorter days in winter, the electrical engineering professor plans to install larger 10-watt solar arrays on two weather stations that he is testing in Gainesville. The existing Haiti weather stations are equipped with six-watt solar arrays.



Figure 11. AREA set up weather stations on the University of Florida’s campus to test upgrades to make more reliable the stations installed in Haiti.

To better work with little or no sunlight, software was rewritten so that following each data measurement cycle the test stations will turn off after data is broadcast to the Weather Underground website. A long-lasting backup coin cell battery was added to the electronics to save data if the power is lost and a program was rewritten to retain the real-time clock values and data and program variables when the weather station resets. These upgrades will increase the accuracy of weather data time reporting on both micro SD cards and in data transmitted to Weather Underground.

In November, a periodic problem was addressed that occurs when the station has a low voltage battery brownout due to insufficient solar power. This is reportedly a common problem in remote internet-of-things devices and applications. When this occurs the weather station scrambles its program memory and fails to properly operate. The station solar power and battery needs to be disconnected and reconnected or the station needs to be reset. This became evident when testing the station in Gainesville. The primary fix is to introduce an electronic and physical “watchdog timer” that resets the weather station if the programming does not report proper operation through a periodic output signal every minute or so. A watchdog timer module was subsequently added to a test station, and it now starts up again when power is restored.

The next steps are to complete testing of the upgrades in Gainesville and then to build and install improvements to the stations in Haiti. In spring 2019, AREA anticipates installing new station electronics in the five weather stations that AREA has installed in Haiti.

B. Collaborative Capacity Building in Maize Seed Systems

Background

The majority of farmers in Haiti use adapted (i.e., “low-risk”) but low-yielding maize cultivars that meet their needs and are acceptable to Haitian consumers. The AREA project partnered with International Maize and Wheat Improvement Center (CIMMYT) to identify higher-performing maize cultivars suitable for Haiti. After extensive testing on various CIMMYT varieties, one variety, Mayi Plus 1, or MP1 (S10TLYNGSHGAB01), was selected for seed multiplication and as a candidate to replace the Hugo (HP1) variety that was introduced more than 10 years ago.

Working with CIMMYT, AREA is training farmers to produce seeds of these improved maize varieties. Additionally, AREA is training agricultural professionals to design and implement variety trials that integrate participatory breeding evaluations by farmers. These trials are designed to compare the performance of MP1 with HP1, and they will help AREA and its partners to inform farmers about the advantages of using the new variety of maize. Farmers need accurate information presented in an understandable manner to judge the risks and potential benefits of changing their traditional cultivar lineup and agronomic practices that lead to an increase in maize production.

In fiscal year 2019, AREA’s Maize Seed Systems program consists of four primary activities:

1. Train researchers and agricultural professionals in the implementation of standard operation procedures (SOPs) for conducting maize experiments
2. Introduce phenotyping technology at the CRDDs, universities, and in on-farm demonstrations
3. Evaluate the implementation of SOPs by the Haitian trainers
4. In coordination with CIMMYT, AREA conduct on-farm demonstration plots in farmers’ fields

Output I: Train researchers and agricultural professionals to implement standard operation procedures for conducting maize experiments

AREA held two workshops in Haiti to help researchers and agricultural professionals to develop the skills needed to organize research trials, implement standard operating procedures in a breeding program and integrate farmers into the plant breeding process. These workshops followed a training held at the University of Illinois at Urbana-Champaign (UIUC) Sept. 8-17, 2018.

On Nov. 8, 2018, 12 researchers and agricultural professionals attended a workshop on maize seed systems. Participants mapped out the maize research activities planned by the partner institutions. They also reviewed the Creole version of the Standard Operation Procedures guide discussed the methods for collecting the phenotyping data.

At the end of the workshop, the participants proposed these next steps: (1) Organizing a second workshop in December 2018 on the standard operation procedures for conducting field trials and to involve additional stakeholders; (2) Having a CIMMYT representative and the leader of our maize program follow up with partners (CRDDs; universities; the Ministry of Agriculture, Natural Resources and Rural Development, or MARNDR; and others) on trial protocols; (3) Planning for a University of Illinois associate professor to travel in Haiti by the third quarter of fiscal year 2019 to introduce phenotyping technology to the research partners and collaborators.

On Dec. 14, AREA held a second maize seed systems workshop focused on planning to conduct the participatory field trials. Ten researchers and agricultural professionals from MARNDR, FAMV, Bas Boën and Montrouis CRDDs; CHIBAS, a research laboratory associated to Quisqueya University's College of Agriculture; the Episcopal University of Haiti (UNEPH); and the American University of the Caribbean (AUC) attended. Workshop facilitators were the leader of our maize program, a CIMMYT representative, and AREA specialists in human and institutional capacity development and monitoring and evaluation.

Participants discussed the purpose of the trials and developed a plan to conduct seven trials on research plots and on 14 farms in the West, Southeast and South departments. They also discussed the University of Illinois associate professor's visit in 2019 and the next steps for the establishment of the trials in the spring 2019 planting season.

By March 2019, the research and agricultural professionals who attended the training in Illinois will implement what they learned after they establish field trials in target maize production zones.

The Haitian trainers will prepare their variety trials in Year 4 as they evaluate improved maize cultivars shown to be better performing than the traditional types grown in Haiti.

Output 2: Evaluate the implementation of SOP modules by the Haitian trainers

AREA staff members are working with the University of Illinois associate professor to review the evaluation instrument used for the SOP modules. AREA will use the instrument during additional trainings scheduled during this fiscal year.

Output 3: Introduce phenotyping technology at the CRDDs, research institutions and via on-farm demonstrations

The University of Illinois associate professor is preparing to travel in Haiti by the third quarter of 2019 to introduce the phenotyping technology to the research partners and collaborators. Phenotyping is a key method to describe a crop's morphological and physiological traits, which can increase yield and improve quality. The phenotyping training will teach participants how to use the MultispecQ Version 2.0 instrument, which measures key crop physiological processes that play a major role in crop performance and yield. In August, AREA ordered five of these instruments but have not received them from the manufacturer because it is working to resolve a calibration issue prior to shipping them. AREA will schedule the training once we receive the instruments.

Output 4: On-farm validation trials for the best-performing maize genotypes

AREA's team leader consulted with CIMMYT about the maize genotypes to include in on-farm validation trials and received a proposal to use several open-pollinated varieties, including MP1 and Hugo. At the Dec. 14 workshop, research partners proposed to use a third variety, HP2012, a hybrid developed by the Organization for Rehabilitation of the Environment (ORE). These three will be compared with local varieties once research partners and collaborating farmers establish their field trials starting in March 2019.

C. Legume Research Program

Background

Legume crops such as common beans and peanuts are important for providing protein and nutrients necessary for adequate human nutrition. If managed optimally, legume species also can contribute significant levels of soil nitrogen through their symbiotic relationship with nitrogen-fixing bacteria.

AREA's Legume Breeding Research program focuses on the genetic improvement of common beans and peanuts. The peanut breeding work started as a joint effort between the AREA project and the USAID-funded project under the Peanut Innovation Lab.

Since the launch of the AREA project, AREA developed a bean improvement pipeline by planting and evaluating the seeds of the best-performing plants several times over and in different agroecological zones. AREA's legume breeder chose four lines of black beans for larger-scale evaluations based on the lines that showed the best agronomic traits, such as erect plant stature, large number of pods per plant, earliness and tolerance to disease. The research activities were conducted at experimental stations located in different agroecological zones to ensure the lines were adapted to a wide range of climatic and environmental conditions.

In July 2018, AREA's Legume Breeding program leader left the project for a position as a legume breeder in Honduras. AREA will continue to support legume program research initiatives in Year 4, with a focus on increasing seeds of the four most-promising bean lines and testing them in growers' fields and at research centers. We will fund the increase of the improved germplasm and subsequent on-farm evaluations.

Output 1: Increase bean seeds of the four most-promising bean lines

AREA entered a contract for services agreement with the Bas Boën CRDD to increase the seeds from the four improved bean lines. On Dec. 24, contractors seeded plots at a field in Ti Mache (in the Croix-des-Bouquets area) with these improved varieties. Separately, CHIBAS, a research laboratory associated with Quisqueya University's College of Agriculture, is increasing seeds of these

four improved varieties on research plots in Cabaret for use in grower trials that the research lab will lead.

If the seed increase in Ti Mache is successful, in the late spring AREA will use the remaining seeds that were produced in the summer of 2018 and stored at the Bas Boën CRDD for grower trials in the Duvier/Kenscoff region. The seeds produced on plots in Ti Mache will be used to establish grower field evaluations in November 2019. AREA will collect agronomic and yield data on the performance of the four improved lines and share the data with CHIBAS, which has hired a full-time legume program technician to manage the legume program initiated by AREA. AREA will continue to work with CHIBAS to share data and collaborate on the grower evaluations of the improved lines of beans.

Output 2: Field testing of the four bean lines developed by the AREA project

Nothing to report in the first quarter.

Output 3: Seed increase of advanced peanut lines developed by AREA and Dr. Barry Tillman at UF

Five lines of peanuts (15B31_1107_-1, 15B31_1185_-1, 15B32_1118_-1, 15B32_1123_-1, and 15B32_1156_-1) are being increased at a field in Cabaret established by CHIBAS in the first quarter of fiscal year 2019. CHIBAS is funding the work to increase the seeds, while AREA is facilitating collaboration with a UF professor of agronomy and peanut breeder. This UF professor worked had with the leader of the Legume Research program to select the highest-performing the lines of peanuts that he bred at UF. These five lines were selected for their high performance in trials at several locations in Haiti. CHIBAS hired a full-time legume program technician to establish grower trials for the upcoming peanut planting season. AREA will support CHIBAS and the ongoing collaboration with the UF professor.

Output 4: Field testing of the advanced peanut lines

Nothing to report in the first quarter.

D. Plant Pathology

Background

The AREA Plant Pathology program seeks to improve the capacity of the Bas Boën CRDD to operate and maintain a functional plant disease diagnosis laboratory. This has been accomplished through staff training, improvements to the plant pathology lab area, the creation of an isolation room and the support of a lab technician. Also, AREA is surveying crops for plant diseases and identifying disease-causing organisms. As part of this effort, AREA is working to help identify the causal agent of a new toppling disease that has affected banana plants in Haiti and determine its

distribution. AREA expects this research will lead to recommendations on methods to control the disease. Additionally, AREA is providing general training in plant diagnostics, plant disease management and risk assessment for Haitian agricultural professionals at Haiti's Ministry of Agriculture and universities.

Output 1: Provide pest and disease identification to farmers and develop management guidelines for dissemination to farmers and agricultural service (extension) providers

During the quarter, AREA's Haiti-based plant pathology technician and a plant pathologist continued to survey and diagnose plant diseases on the major food crops at the Bas Boën CRDD and the surrounding region. However, plant diagnosis services were reduced starting in October because of limited electricity at the Bas Boën CRDD. Since electricity was reduced to one to two days per week, AREA informed the CRDD's management that for reasons of safety and productivity AREA staff would not work at the center when electricity was unavailable. Instead, AREA arranged to perform diagnostic work at the Ministry of Agriculture's Division of Plant Protection lab. Table 1 lists the samples collected and diagnosed at Bas Boën's Plant Pathology Laboratory. The sampled crops included common bean, spinach, plantain and tomatoes. The table includes information about the diagnostic samples.

Table 1. Plant samples analyzed during the first quarter.

Sample Code	Plant	Location	Diseases/Pathogen	Insect(s)
18-74	Swiss chard	Bas Boën CRDD	Galls/ <i>Meloidogyne</i> sp.	Mite
18-90	Pepper	Bas Boën CRDD	<i>Alternaria</i> fruit rot/ <i>Alternaria</i> sp.	
18-77	Common bean	Bas Boën CRDD		Mite, green scale
18-83 b	Common bean	Bas Boën CRDD		White flies, aphids
18-87	Sorghum	Bas Boën CRDD	Grey leaf spot of sorghum/ <i>Cercospora</i> sp.	
18-88	Sorghum	Bas Boën CRDD	<i>Alternaria</i> leaf spot/ <i>Alternaria</i> sp.	
18-81	Spinach	Bas Boën CRDD	<i>Cercospora</i> leaf spot/ <i>Cercospora</i> sp.	
18-80	Common bean	Duvier	Mosaic and leaves rugosity/ Unknown virus, no detection	
18-78	Common bean	Duvier	Manganese deficiency	
18-84	Common bean	Duvier		Aphids, acariens

18-91	Sorghum	Duvier	Sooty mold/ <i>Capnodium</i> sp.	Aphids, white flies
18-92	Pepper	Duvier	Galls/Meloidogyne sp.	
18-93	Plantain	Duvier		Cochineal
18-94	Lima bean	Duvier	Sooty mold/ <i>Capnodium</i> sp.	white flies, acarien
18-96	Cassava	Duvier	Virus - like mosaic	
18-97	Cassava	Duvier	Sooty mold/ <i>Capnodium</i> sp., <i>Alternaria</i> sp.	
18-98	Pea	Duvier	Sooty mold/ <i>Capnodium</i> sp.	
18-99	Common bean	Duvier	Powdery mildew/ <i>Erysiphe</i> sp.	
19-01	Tomato	Duvier	Powdery mildew/ <i>Erysiphe</i> sp.	
19-03	Spinach	Duvier	<i>Alternaria</i> leaf spot/ <i>Alternaria</i> sp.	
19-04	Pepper	Duvier	Powdery mildew/ <i>Erysiphe</i> sp.	
19-06	Cabbage	Duvier	<i>Alternaria</i> black spot/ <i>Alternaria</i> sp.	
18-117	Corn	Bas Boën CRDD	Phosphorus deficiency	
18-118	Corn	Bas Boën CRDD		Mites
18-119	Swiss chard	Bas Boën CRDD	<i>Cercospora</i> leaf spot / <i>Cercospora</i> sp.	
18-120	Beet	Bas Boën CRDD	<i>Cercospora</i> leaf spot/ <i>Cercospora</i> sp.	
18-121	Beet	Bas Boën CRDD		Insect feeding
18-122	Mango	Bas Boën CRDD		Cochineal
18-123	Plantain	Damien	<i>Mycosphaerella</i> sp. Sigatoka negra	
18-124	Cassava	Damien	Symptom like virus	
18-125	Cassava	Damien	<i>Cercospora</i> brown spot, <i>Cercospora</i> sp.	
18-117	Corn	Bas Boën CRDD	Phosphorus deficiency	

In order to monitor bean crops at the Bas Boën CRDD and in the Cul-de-Sac plain during the bean season, AREA's lab technician began regular visits to bean fields. The trips, which included regular sampling and diagnosing pathogens, were designed to monitor plant diseases and recommend appropriate control practices.

Disease Note: "new" disease in Haiti eggplant

AREA finalized a disease note on a newly identified pathogen, *Lasioidiplodia hormozganensis*, affecting eggplants in Haiti. To our knowledge, this is the first report of *L. hormozganensis* causing fruit rot in Haiti. To characterize this pathogen, AREA pathologists shipped two isolates from Haiti to UF's

Plant Diagnostic center to compare the pathogen found on eggplant to other plant pathogens and to conduct additional pathogenicity testing on other hosts. The genus *Lasiodiplodia* contains several important phytopathogenic species that cause diseases in a wide range of hosts (Alves et al., 2008), including *L. theobromae* fruit spot on eggplant (Viera et al., 2018; Woodward et al., 2005).

AREA plans to submit the article to the academic journal Plant Disease. Publishing a disease note requires descriptions of the disease occurrence and severity in the field and identification of the disease agent to the species level based on morphological and molecular (gene sequencing) characteristics. Koch's postulates must be completed to verify that the causal agent isolated from a symptomatic plant is the causal agent of the disease. AREA will work with the Ministry of Agriculture to create a fact sheet on the pathogen to share with farmers.

Work to diagnose diseases in common bean

Previously, AREA researchers collected diseased bean samples from the FTF-west corridor and isolated putative pathogenic strains of fungi including *Sclerotinia* sp., *Pythium* sp. and *Phytophthora* sp. In November, plant pathology team members seeded beans into 60 pots at the Bas Boën CRDD and planned to use the inoculum they prepared for the fungi on the bean plants. CRDD staff were unable to water and maintain the plants because of political unrest and lack of safety, and the bean plants died. In the second quarter, the beans will be reseeded and pathogenicity tests will be conducted. We will conduct additional tests once the pathogenicity tests are complete, including molecular characterization, in order to publish disease notes.



Figure 12. Research was hampered to inoculate beans planted in 60 pots at Bas Boën CRDD because of an inability to water during a period of civil unrest.

Meeting with FAMV and the Sanitary Protection Unity of the Ministry of Agriculture

In November, AREA team members met with FAMV's vice dean of research and the director of the Sanitary Protection Unit of the Ministry of Agriculture and her staff to discuss how to communicate two new disease findings *Lasiodiplodia bormosganensis* and the bacterial pathogen isolated from diseased banana samples from Haiti associated with toppling disease. The discussions included communicating to different audiences: the scientific community in the U.S. and abroad, the public and private agricultural sector, and farmers in Haiti. The SPU director requested a second meeting in December with the AREA plant pathology team to share the research results with the Ministry of Agriculture, finalize the communication plan and organize additional collaborative capacity-building efforts for ministry staff regarding research and extension to farmers. The meeting was cancelled because of civil unrest and rescheduled for Jan. 17, 2019.

Output 2: Technical training support for personnel at CRDDs, Ministry of Agriculture and universities

Preparation for IPM and safety training

Training materials were compiled related to pesticide safety and outlined a series of modules that will be delivered to farmers in the Kenscoff region around April 2019. Next quarter, AREA will hire someone to translate the materials. AREA is procuring 100 backpack sprayers and personal protective equipment (PPE) which will be distributed to participating farmers during the training. AREA has made initial contact with personnel within the Sanitary Protection Unit of the Ministry of Agriculture to explore a partnership with the Ministry on this training. AREA staff will not use pesticides during the training.

R-Training Part II

Because of civil unrest, AREA cancelled a second workshop on the programming language R, which was scheduled Dec. 10-11, 2019. The workshop was a follow-up to an R workshop AREA held for academics and agricultural researchers on June 11-12, 2018. The Part II workshop, rescheduled for Jan. 14-16, 2019, will focus on statistical analyses, and participants will analyze their own data set using R.

All the teaching materials, including Power Point presentations, exercises, R packages, and data files, were prepared in the first quarter, including translations into French. AREA will provide the materials to attendees via USB thumb drives. To make the workshop more applicable to agricultural professionals in Haiti, the training materials use data collected by Haiti's Ministry of Agriculture in 2014.

Nematode training

AREA's plant pathology lab technician collaborated with a AREA master's degree student to train farmers in Montrouis and students and faculty at the American University of the Caribbean in Les Cayes. They prepared the training modules and materials for the hands-on exercises. They also collected pepper roots infected by *Meloidogyne* sp. at the Bas Boën CRDD and the material will be

maintained on live plant hosts in the CRDD's greenhouse. The training was scheduled for December but it was cancelled due to civil unrest. It will be rescheduled for the second quarter.

Training at the Division of Plant Protection

In November, AREA coordinated with the laboratory manager at the Ministry of Agriculture's Division of Plant Protection to plan basic plant diagnostic training for their technical staff. A list of materials were prepared for review by the lab manager to prepare for training sessions on isolation, inoculation and how to conduct Koch's postulates. In December, AREA's lab technician trained other technicians on using an autoclave, identifying symptoms of fungal diseases, sampling, preparing mediums for parasitic fungi culture, and isolating plant parasitic fungi.

Output 3: Understanding the etiology and epidemiology of banana toppling disease

Since early 2018, two AREA plant pathology researchers have studied a possible new disease affecting plantain and bananas in Arcahaie, a commune in the West department of Haiti. Local growers report incidence rates reaching 30%, which poses a significant threat to the nation's plantain/banana industry and possibly worldwide. In Year 3, AREA made progress in understanding its etiology, epidemiology and diagnostic characteristics.

In the most recent quarter, AREA completed all of the tests required to confirm the causal agent of the toppling disease as the bacteria *Klebsiella variicola*. Our efforts focused on using sequencing the data of specific genes to confirm the identity of the bacteria isolated from samples collected from diseased tissue from Haiti. AREA amplified and sequenced 16s (16s ribosomal RNA), the rpoB (Beta-subunit of RNA polymerase B), phoE (outer membrane pore protein E), and infB (translation initiation factor IF-2) using the primers and protocols previously described (Rosenblueth et al, 2004). Sequences were deposited in NCBI GenBank (accession: [MK217521-MK217522](#); [MK235993-MK235998](#)). According to BLAST searches, fragments of sequences 16s, rpoB, phoE, infB from isolates G18-1365 and G18-1376 showed 99% identity with sequences of *Klebsiella variicola* strains. Sequences of these four genes were concatenated, aligned with MUSCLE (Multiple Sequence Comparison by Log-Expectation), and constructed phylogenetic trees inferred following the maximum-likelihood method using Mega-X software (Kumar et al., 2018). The body of literature documents this bacterium causing similar rot in bananas and carrots (Chandrashekar et al., 2018; Fan et al., 2016). The G18-1376 and G18-1365 isolates have been deposited at the Belgian Co-ordinated Collections of Micro-Organisms (BCCM) at Ghent University with the following accession numbers, LMG 31122 and LMG 31123, respectively. AREA also submitted the gene sequences to the National Center for Biotechnology Information, which is part of the National Institutes of Health.

The AREA plant pathology team prepared a manuscript to submit to the journal Plant Disease. We intend to submit the manuscript to the journal after a communication plan is developed with the director of the Sanitary Protection Unit of the Ministry of Agriculture. A meeting has been scheduled for January to develop the plan.

In November, one of the researchers traveled to Haiti where he planned to test a card technology developed by Whatman Flinders Technology Associates to extract the DNA of the putative pathogens to better understand the diagnostics, incidence and geographic distribution of the disease. Unfortunately, AREA cancelled his trip to the banana production areas for safety reasons. This trip was rescheduled for Jan. 18.

Output 4: Strategic planning for Ministry of Agriculture to address new plant pathogens in Haiti

In the first quarter, AREA plant pathology researchers created training materials for the Haiti Ministry of Agriculture personnel on conducting risk assessments for pests in Haiti or those that have a potential to enter Haiti. According to the International Plant Protection Convention in 2012, pest risk analysis is “the process of evaluating biological or other scientific and economic evidence to determine whether an organism is a pest, whether it should be regulated, and the strength of any phytosanitary measures to be taken against it.”

The training, scheduled to start in January 2019, is in response to a request from the Ministry of Agriculture’s Sanitary Protection Unit. It will include a process for assessing a pest to characterize its risk and determine appropriate regulatory and disease control measures.

E. Soil Science Research

Background

Haiti’s soils are predominantly from calcareous parent materials. They are generally young, except in some oxidic mineralogy soils found on moist mountains and where the geomorphic surface remains relatively stable. Due to the high content of carbonate, these soils, including component floodplains, have pH levels ranging from moderately to strongly alkaline (7.9 – 9.0). These conditions have led to the low bioavailability of micronutrients and phosphorus. Also, these soils are deficient in nitrogen. Soils in the semi-arid part of the Feed the Future-West corridor from Ganthier to Saint-Marc fit these characteristics. The soils have a smectic mineralogy and a strong tendency to salinity mainly because of high evapotranspiration coupled with low rainfall. This causes a low aggregate stability associated with other physical problems. For about 20 years, land located in this region was intensely farmed because of the presence of hydro-agricultural infrastructure and population pressure. Also, intensive and indiscriminate use of the soil caused their degradation and decrease of its natural fertility, affecting agricultural productivity and the provision of other ecosystem goods and services.

The objectives of the soil fertility management program are to:

- Map the spatial distribution of key soil attributes to inform soil fertility management research and extension
- Establish and evaluate multiple approaches for soil restoration and its sustainable conservation

- Make recommendations to farmers and other land managers

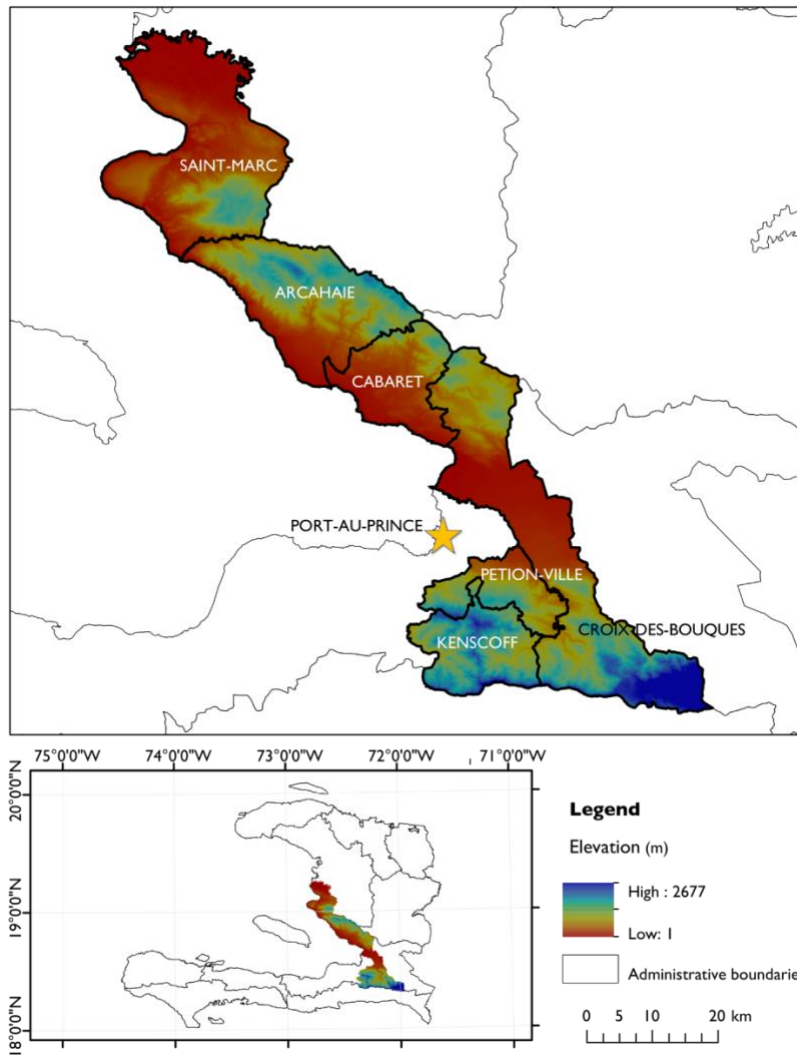


Figure 13. Map shows the wide-range of elevations in the Feed the Future West corridor where AREA is working.

Output 1: Spatial variability study of soil attributes and properties

In November, the leader of AREA’s soil fertility program and his team began compiling the results of the first three years of the project, including soil maps. This information will be included in a booklet on the pedosystem, or soil characteristics, of the Feed the Future (F²TF) West corridor. The content of this booklet will include the geomorphology, pedogenesis, and physical and chemical characteristics of the soils in the F²TF corridor.

Output 2: Develop best management practices for fertilizer application of specific crops grown on soil types common in the FTF-west region of Haiti

This experiment is an evaluation of how a maize crop (variety MP1) responds to varying fertilizer application rates and formulas. In October, the leader of the soil fertility program changed the trial design and fertilizer amounts to adjust for a new plot size being used for the study.

Ten soil samples, collected at five georeferenced points, were analyzed at the soil testing lab of the Bas Boën CRDD for pH, Ec, organic matter, N-NO₃⁻, N-NH₄⁺, P, K⁺, Mg²⁺, SO₄²⁻, Mn²⁺, Fe²⁺, and Cl⁻ levels. The Bas Boën soil testing lab used the Melich-1 extractor and LaMotte soil test kit to determine the pH and Ec in a soil solution 1:2 (water/soil). Organic matter was analyzed by colorimetric method. The soil fertility management team shipped the 10 soil samples to UF's soil testing lab for chemical analysis. The results will be compared with those at the Bas Boën CRDD to assess the accuracy of the Bas Boën soil lab results.

The results (Table 2) showed a small variation of pH, ranging from 7.8 to 8.4 with a mean of 8.2. The low variation was verified (cv=2%). Electrical conductivity (Ec) ranged from 0.2 to 0.9 dS/m. Most of the Ec values can be characterized as high (0.65 dS/m) or very high (>0.85 dS/m). Excessive values (>=7000 parts per million, or ppm) of calcium (Ca) were found, which was expected as soils in the Cul-de-Sac plain, mainly in Bas Boën, are highly influenced by limestone. Excessive calcium content is detrimental for nutrient balance and micronutrients availability. Phosphorus and potassium showed generally low to moderate values, while low contents were verified for NO₃⁻.

Table 2. Statistical parameters of the soil chemical analyses from the Bas Boën CRDD

Statistical parameter	pH	Ec dS/m	N-NO ₃ ⁻ ppm	P ₂ O ₅ ppm	K ₂ O ppm	Ca ppm
Minimum	7.8	0.2	5.0	57.5	108.0	7000.0
Maximum	8.4	0.9	50.0	115.0	180.0	14000.0
Median	8.3	0.3	15.0	86.3	144.0	14000.0
Mean	8.2	0.5	19.5	82.7	144.0	12600.0
Std.dev	0.2	13.8	24.3	37.9	295	1.5
Coef.var	0.02	0.5	0.7	0.3	0.3	0.2
Skewness	-0.6	0.7	0.9	0.1	0.0	-1.3
Kurtosis	-1.6	-1.2	-0.4	-1.8	-2.2	-0.4
Normtest.W	0.8	0.8	0.9	0.8	0.7	0.5
Normtest.p	0.0	0.1	0.1	0.0	0.0	0.0

PPM = parts per million; dS/m = deciSiemens per meter

The fertilizer application experiment started in November after AREA finalized a services agreement with the Bas Boën CRDD. The CRDD provided the maize seeds used in the experiment.

The study uses a randomized complete block design with four replications of 14 treatments, totaling 56 plot units. On Nov. 30, 2018, AREA team members sowed the maize seeds and applied fertilizer, which consisted of phosphorus and a basic dressing of potassium and nitrogen. We observed a germination rate close to 100%. We monitored the experiment regularly to anticipate potential issues. AREA is working on the next steps: maintaining fertilization, weed control and irrigation.



Figure 14. The plot used for the fertilizer application experiment showing the planting of maize seeds (top) and two weeks after planting (bottom).

Output 3: Management of soil salinity to create better conditions for crop growth and yield increase

In October 2018, AREA revised the plan for an experiment to develop best management practices to reduce soil salinity and improve crop growth on a plot in the Cul-de-Sac plain, where salt-affected

soil is a prominent issue. Instead of maize and bean, the plan is to use higher value cash crops — tomato or eggplant — to offset the high cost of plastic mulch that will be used. In November, AREA’s team leader spent time looking for the ideal soil environment to conduct the experiment.

Output 4: Capacity building related to soil management

Also in October, the soil fertility team leader and a master’s student from the University of Florida prepared a field day for farmers on the best practices for applying fertilizer to bean crops. This activity, which is part of the student’s bean crop experiment, involved assessing the effectiveness of applying varying rates of phosphorus and potassium and a consistent amount of nitrogen to bean crops. This workshop, scheduled Nov. 22, 2018, was postponed due to civil unrest in Haiti starting on Nov. 18. It has been rescheduled for the second quarter.

F. Nutrition Interventions

Background

Improving household nutrition is important to increasing food security in Haiti. The [World Food Programme reported in 2018](#) that Haiti has one of the highest levels of chronic food insecurity in the world, with more than half of its population chronically food insecure and 22% of its children chronically malnourished.

In 2012, Haiti published its updated national nutrition policy aimed at children from birth to five years, pregnant and breastfeeding women, older persons and persons infected with HIV/AIDS and tuberculosis (SUN, 2014). Among the priorities advanced in the policy are “increased use of locally produced food, reduction of micronutrient deficiencies through supplementation, and food fortification....” AREA nutrition interventions focus on research on new varieties of leafy green vegetables that are adapted to different ecological zones in Haiti and can improve household nutrition. An assistant professor in LSU’s School of Nutritional and Food Sciences leads training efforts focused on the nutritional aspects and preparation methods for these new plant introductions.

Output 1: Develop and implement training focusing on household nutrition

AREA completed the training modules and materials and they are now in review and will soon be translated. In the second quarter, AREA will begin conducting trials in Montrouis on “Asian spinach,” an easy to prepare, palatable vegetable that could be added to meals to provide key, health-promoting nutrients. AREA scheduled the nutritional training using Asian spinach for April 2019.

AREA agronomists contacted farmer organizations in the regions surrounding the CRDDs of Kenscoff, Montrouis and Bas Boën to identify farmer participants for this upcoming training. They met with some of the organizations to emphasize the importance of identifying female farmer training participants. The modules and training materials are complete and in review. The materials

will be translated next quarter. The Asian spinach will be seeded in February and we expect to establish trials in two or three locations in early March. The training is scheduled for May 2019.

G. Pilot Projects

Background

In Year 3, AREA launched a Pilot Projects program, previously called Mini Grants, to support the development and increase the capacity of agricultural research professionals, encourage collaboration among researchers and research institutions, and address agricultural research priorities.

AREA is providing three types of awards:

- Category 1: Acquisitions of supplies and other nonexpendable items for up to \$4,000 each
- Category 2: Individual research projects for up to \$8,000 each
- Category 3: Collaborative research projects for up to \$20,000 each

In fiscal year 2018, AREA issued two calls for proposals for Haitian researchers to apply for grants. In early 2018, we selected awardees for the first call — for research and educational supplies and other nonexpendable items. These supplies were later acquired, shipped and distributed to the recipients in Haiti.

On May 31, 2018, the deadline closed for the second call for proposals, which consisted of three types of awards: (1) additional supplies and nonexpendable items for research and education, and support for (2) individual Haitian researchers and (3) collaborative projects.

Pilot Projects: category 1

AREA selected 11 applications for the second round of awards for up to \$4,000 for supplies and other nonexpendable items. The items will assist researchers, educators and extension professionals in Haiti to equip their labs, field sites and educational classrooms with supplies and materials to conduct research or improve course content related to agricultural research and education in Haiti. We subsequently purchased the items (Table 3) and they will be shipped to Haiti in the second quarter.

Table 3. Recipients of supplies and other nonexpendable items.

Recipient/institution	Item(s)
Université Publique du Centre	Basic lab instruments and supplies
Université Notre Dame d’Haïti	Lab cart on wheels, laptop, projector, and supplies and materials for educational science classroom

American University of the Caribbean, MARNDR	Basic lab instruments and supplies, soil test kits and probes
Université Notre Dame d'Haïti	Aflatoxin test kits, projector
Université Publique du Centre	Meters, GPS, electronic scales, lab supplies
Université Publique du Centre	Projector, microscope, electronic scales, laptop
De L'Université Episcopale D'Haïti	Clinometer, measuring tools and meters, auger
CRDD Montrouis	Basic lab supplies and materials, and digital scale
FAMV	GPS, binoculars, camera, clinometer
De L'Université Episcopale D'Haïti	Basic lab instruments and materials (e.g., Bunsen burner, reagents), and measuring tools and devices for soil, water, temperature, etc.
FAMV	Color charts, balance, meters

Pilot Projects: categories 2 and 3

In mid-October, AREA selected nine pilot projects for preliminary approval to receive funds in the individual and collaborative pilot project research categories. These projects were selected after an evaluation process that included the recommendations of panels of qualified external reviewers. AREA's pilot projects' coordinator and IFAS and UF administrators are reviewing the proposals to address any compliance issues before approving projects. AREA anticipates completing the compliance review of the pilot projects in February.

On Nov. 13 and 14, 2018, AREA trained Haitian researchers who submitted the selected pilot projects at its Petionville, Haiti office to explain the due diligence and screening processes. The researchers revised their proposals and addressed budgetary issues that were identified. AREA's pilot projects' coordinator is working with UF to finalize the compliance review and identify the pilot projects to receive funding.

Additionally, AREA developed a manual to guide grant recipients in managing their projects. The manual details USAID and University of Florida requirements related to the conduct of researchers, cost principles, auditing and other award provisions. The manual will be finalized in January 2019 and translated into French.

In the second quarter, AREA will conduct a one-day training for researchers to distribute the manual and provide information on managing the pilot projects according to federal, local and University of Florida regulations. Before receiving funds, recipients' organizations will sign service agreements to start projects. The list of projects under consideration is in Table 4.

Table 4. Pilot projects tentatively approved for funding, pending final due diligence.

Project	Category	Institution(s)
Bean preservation trial by combining two physical preservation techniques: drying and heat	Collaborative	FAMV, Université Episcopale d'Haïti

Dynamics of yellow aphid (<i>Melanaphis sacchari</i>) infestation on sorghum and selection of potential biological control agent against <i>M. sacchari</i>	Collaborative	FAMV, Université Episcopale d'Haïti
Development of a technical-economic referential for greenhouse horticulture in Haiti: A case study of cultivation of <i>Var Yolo Wonder</i> pepper and <i>Anana F1</i> tomato with indeterminate growth	Collaborative	CRDD Duvier, Agro-INOVA, FAMV
Diagnosis of fertilization practices of vegetables in the Kenscoff area	Collaborative	FAMV, Ministry of Agriculture
Enhancing the involvement of women in agroforestry practices in Haiti: The case of house gardens in the valley of Jacmel and Salagnac	Individual	FAMV
Project of maintenance, stabilization of rice variety "TCSI0," and control and evaluation of <i>Black Chaff</i> (Straw) disease in Verettes (Artibonite Valley)	Individual	Organization of the Development of the Artibonite Valley
Multi-local trials of beans rich in iron and tolerant to drought in the South and West departments of Haiti	Collaborative	AUC, Bas Boën CRDD
Impact of new production techniques on corn seed quality (<i>hugo plus</i>) in the Matheux corridor	Individual	Montrouis CRDD
Comparative effect of agronomic and nodular adaptability of seven black bean varieties in rainfed mountain agriculture, case of municipalities of Petionville and Kenscoff	Individual	Duvier CRDD

Output 1: Issue new call for proposals for grants aimed at a broader applicant pool

Later this fiscal year, depending on how many pilot projects are funded, AREA may issue another call for proposals to award additional grants for researchers needing supplies and nonexpendable items for teaching and research projects.

H. MS and Graduate Certificates

Background

Among AREA's primary goals is to support and inspire Haitian agricultural professionals by offering programs to build their research, education and extension skills. One key way AREA is doing this is by providing long-term capacity training to Haitian scholars through MS degree programs at UF and LSU. In addition, AREA supports Haitian students in non-degree graduate certificate programs offered via distance learning.

Output 1: Continued support of AREA-funded master's of science students enrolled in graduate school at UF and LSU

At the end of the first quarter, 19 Haitian students were enrolled in graduate school at the University of Florida (17) or Louisiana State University (2), and all are in good academic standing. During the first quarter, one student graduated from UF with a MS degree in Agriculture Education and Communication; she represents the first of the AREA-sponsored students to graduate.

Table 5. A summary of the research projects of AREA-funded MS graduate students.

Project (or title of completed thesis)	Summary	Graduation date (or expected)
Efficiency of Different Phosphorus Rates on the Growth and Yield of Black Beans (<i>Phaseolus, vulgaris</i>)	The lack of knowledge on adequate agricultural techniques and practices leads Haitian farmers to make ineffective decisions regarding fertilization and soil management. The purpose of this study is to find a proper phosphorus fertilizer rate that can provide an optimum yield to the Haitian farmers (especially in the Feed the Future Corridor) who produce black bean.	Aug. 10, 2019
<i>Understanding Haitian Agricultural Technical and Vocational Education and Training: Review of Four Schools</i>	The purpose of the study is to provide a better understanding of agricultural technical and vocational education and training (TVET) in Haiti. It provides a picture of how TVET fits into the Haitian agricultural and extension system through the curriculum and the integration graduates into the workforce, including a review of the sectors with the highest demand for agricultural TVET graduates.	Dec. 15, 2018
Epidemiological characterization of toppling disease in plantain/banana seed systems	Characterize the systems of plantain/banana suckers Define ways plantain/banana seeds reach farmers and how the toppling disease can be disseminated throughout the different fields via seeds Evaluate potential management strategies to control the disease from spreading.	May 2020
Screening Cowpea (<i>Vigna unguiculata</i> L.Walp) Germplasm for Root Knot Nematodes Resistance (<i>Meloidogyne</i> spp.) and Morphological, Physiological, and Agronomic Traits	Identification of resistant dual-purpose cowpea lines to root knot nematodes (RKN) that can be used in developing countries such as Haiti in subsistence farming, livestock feeding, and as a cover crop to improve soil fertility in intercropping systems.	Aug. 10, 2019

Plantain and banana nematode resistance in Haiti and Florida	Assessment of nematode population in Archaie and in Homestead, Florida, and evaluation of fruit quality and nematode resistance of 15 new cultivars in Homestead.	Aug. 10, 2019
Factors Affecting Haitian Farmers' Perception and Willingness to Adopt the Black Sigatoka Disease Prevention Methods in Plantain and Banana Plantations	Analysis of Haitian banana and plantain farmers' knowledge of the disease and attitude toward prevention methods on their plantations.	May 10, 2019
Genomic Prediction of Sweet Sorghum Agronomic Performance under Drought and Irrigated Environments in Haiti	The goal is to use different genomic models to predict the yield and stem sugar content of 272 lines of sweet sorghum under different environments. The best-performing lines (high yield, high stem sugar content and drought tolerant) will be released to farmers and could potentially be used as parents for further sorghum breeding programs.	Aug. 10, 2019
Biotechnology for breeding improved vanilla in South Florida and Haiti	Biotechnological methods in tissue culture and genetic transformation are needed to advance vanilla cultivars with improved yield and novel quality characteristics. This study has three general aims: 1) Develop tissue culture propagation methods and stable genetic transformation of <i>Vanilla planifolia</i> (and closely related species); 2) Define basic horticultural practices, such as training of vines, fertilization, irrigation to grow vanilla commercially in South Florida; 3) Survey conditions and assess grower interest to cultivate vanilla in Haiti, where it could be a high-value alternative crop.	Dec. 14, 2019
Large Scale In Vitro Clonal Propagation of Banana Using Bioreactors	Develop a protocol for the micropropagation of banana using bioreactor technology to overcome unreliable conditions of energy production.	Aug. 10, 2019
Family Social Support and Personal Goal-Setting of Youth from Rural Communities in Agricultural Vocational Schools in Haiti	The overall purpose of this research is to explore the personal aspirations of youths in agricultural vocational schools in terms of material possessions, education, living environment, and careers choices. This research will also analyze the extent youths' family environment is a vital source of influence for setting their goals.	Dec. 14, 2019
Biological control activity of rice rhizosphere bacteria and their interactive effects	This study aims to develop new biocontrol agents and cultural practices with silica fertilizer for disease management of sheath	Aug. 2, 2019

<p>with silica treatment against sheath blight of rice</p>	<p>blight in rice. Sheath blight is caused by the soil-borne fungus <i>Rhizoctonia solani</i> and is one of the most devastating rice diseases worldwide. Bacteria isolated from diverse parts of the rice plant have the ability to inhibit the development of sheath blight. Silica has been found to augment the defense enzyme activity in rice, thus leading to the reduction of the progression of sheath blight lesions. Bacteria will be isolated from rice rhizosphere and pure-cultured on Luria Broth Agar amended with 40 µg/ml of cycloheximide, and screened for their antifungal activity against <i>R. solani</i> on Potato Dextrose Agar plates. This bacteria will be identified through 16s rDNA sequencing, and further tested for its in vivo activities in greenhouse and field assays. The synergistic activity of selected bacteria in combination with different amounts of silicate slag, a silica fertilizer obtained as a by-product of the steel and iron industry, will be studied.</p> <p>Research will be conducted in the Antimonite region. The cultural practices that promote or impair the development of major rice diseases will be studied.</p>	
<p>Use of Molecular Markers for Identification of Major Sweet Potato Weevil species present in Haiti</p>	<p>Study of the characteristics of the major sweet potato weevil species in Haiti and spatial distribution.</p>	<p>Aug. 2, 2019</p>
<p>Cover crops for weed and nematode suppression and improving soil fertility in the lowlands of Haiti</p>	<p>The aims of this study are to: Observe which cover crop is more effective in suppressing sedentary plant-parasitic root-knot nematodes in eggplant cropping systems. Evaluate the yield of eggplants following the incorporation of residue of different cover crops. Compare the ability of velvet beans (<i>Mucuna pruriens</i> L.), and cowpea (<i>Vigna unguiculata</i>) cover crops to suppress root-knot nematodes with sunn hemp (<i>Crotalaria juncea</i>). Evaluate the efficacy of cover crops in suppressing weeds.</p>	<p>Aug. 10, 2019</p>
<p>Agronomic performance and genetic diversity among</p>	<p>The goal of the project is to evaluate the agronomic performance of 15 elite dry bean-breeding lines under development by the</p>	<p>Aug. 10, 2019</p>

select common bean varieties in Haiti	AREA and the Legume Innovation Lab programs and determine the genetic diversity of these and 10 other bean cultivars in the market in Haiti.	
Soil erosion and sediment transport modeling on a watershed in Arcahaie, Haiti, and evaluation of the reservoir sedimentation on the water availability for agricultural production in the Courjolle irrigated perimeter	This research aims to quantify the spatial distribution of the soil erosion, investigate the impacts of the movement of the sediment in the reservoir of the irrigated perimeter of Courjolle, Arcahaie, Haiti; identify and simulate different scenarios of best management practices (BMPs) applicable for sustainable agriculture in the area.	Aug. 10, 2019
Assessing the impacts of climate change on rice (<i>Oryza sativa</i>) yields with DSSAT CERES-rice model in the Artibonite Valley of Haiti	<p>The goal of this study is to assess the impact of the climate change on rice yields in the Artibonite Valley by estimating the differences between potential and real yields and provide scenario for developing tools for increasing yields.</p> <p>Historical weather data for the Artibonite Valley will be collected to project the shifting weather using a MakSIM weather generator. This will allow an estimate the likely future variation of the climate factors including temperatures, precipitation, CO₂ and solar radiation.</p> <p>Secondly, the climate and rice data collected will be run on the DSSAT model to simulate current and the potential future impacts of climate change on rice yields. From this simulation, rice yields will be compared to provide strategic scenarios necessary for increasing yields.</p>	Aug. 10, 2019
Rural Nongovernmental Organizations in Haiti: Gender Dynamics, Power and Perceived Benefits of Membership	Exploration of the roles that women play in farmers' organizations in Haiti, the degree to which they play leadership roles, and their perceptions of the benefits they accrue from membership.	Aug. 10, 2019
Evaluation of dry bean yield response to El Niño southern oscillation (ENSO) in Haiti.	This study will focus on investigating the impact of ENSO on one of the dry bean varieties (black bean Salagnac) that is being tested at Duvier. We will use a crop model to simulate biomass production for each ENSO phase and use this information to forecast the yield of dry beans under extreme	Aug. 10, 2019

	weather conditions. This will help decision-makers to develop strategies to account for climate variability when growing this crop.	
Increasing fresh-market broccoli production: effect of cooling methods on new breeding lines in Florida and on local varieties grown in Haiti.	The project is based on the evaluation of postharvest handling of broccoli using appropriate postharvest methods to reduce losses during storage. Farmers will be trained using new postharvest technologies.	Aug. 10, 2019
Assessment of intercropping and biological insecticide applications on <i>Melanaphis sacchari</i> infestations in sorghum, and identification of potential natural enemies and alternate hosts.	Compare different agricultural practices to determine the most suitable one for sugarcane aphid management in sorghum and identify natural enemies that prey on sugarcane aphid, and alternate hosts such as other grasses that can host sugarcane aphid during sorghum's off-season.	Aug. 10, 2019

Expansion of graduate school program

The AREA project review committee selected five additional graduate students from Haiti to begin the English Language Institute in January 2019 and complete their standardized tests to gain full admission to UF. These students were among a pool of students nominated by deans from Quisqueya University, FAMV, American University of the Caribbean in Les Cayes and the University of Notre Dame-Haiti. AREA completed the visa process for the candidates, identified major professors and assisted them with their graduate school applications. Three of the five students have received conditional admission to the Agronomy, Entomology and Soil and Water Sciences departments, where they will complete their MS degree with a concentration in agroecology. Two students are pending notification of conditional admission from Food and Resource Economics and Food Science and Human Nutrition departments. Their applications are in committee review. AREA assisted all the students with travel and housing arrangements. As with the other cohort of students, all the students have agreed to return to Haiti after they graduate with the goal of improving Haiti's agricultural sector in the years ahead.

Output 2: Continued support for Haitian students working to earn graduate certificates through UF's online education program

In the fall academic semester, two students from Haiti were enrolled in graduate distance learning certificate programs offered through the University of Florida's College of Agricultural and Life Sciences. They continue to make progress towards completing the requirements of the one-year program.

Output 3: Early career collaboration and "seed" funding

The principal investigator of the AREA project met with major professors and AREA graduate students to initiate plans for continuing to support the students' research and extension activities when they return to Haiti after they graduate. During the next two academic quarters, the faculty and students will develop proposals to collaborate with AREA. The team will determine which proposals are feasible to implement in Year 5.

I. Ministry of Agriculture and CRDDs

Background

In Year 3, representatives from Haiti's Directorate of Innovation participated in a weeklong field trip to visit public and private research and extension institutions in Florida. The activities proposed with the Ministry of Agriculture in the Year 4 are an outcome of the discussions and observations made during the trip, and reflect what the ministry determined were important priorities to improve their capacity to conduct research and extension.

The CRDDs are one of the key partners of the AREA project, a partnership that has yielded a wide-range of trainings and research activities. Moreover, AREA partnered with the Bas Boën CRDD to improve its plant pathology laboratory. In Year 4, AREA will work with the CRDDs to help develop a strategy for their sustainable operations and provide training to farmer organizations.

Output 1: Capacity-building trainings in extension

AREA recruited a UF extension agent in Sumter County, Florida who has a specialty in international extension to develop training modules for extension agents in Haiti. In the second quarter, AREA is facilitating the translation of these training materials into Haitian Creole. The extension agent will provide the training in Haiti during the third quarter of this fiscal year to an audience of agricultural professionals and extension agents with the Ministry of Agriculture and CRDDs.

Output 2: Linking laboratory services at the consortium universities to the Ministry of Agriculture and CRDDs

In October, UF's Institute of Food and Agricultural Services hosted FAMV's dean and vice dean of research on a trip to Gainesville, Florida to tour University of Florida facilities, including the IFAS Analytical Service Laboratories and the Plant Diagnostic Center. The vice dean chairs the board of the Fondation Haitienne de Developpment Agricole Durable (or FONDAD), which supports the Bas Boën CRDD, one of AREA's key partners. The FAMV administrators toured labs and met with managers to gain a better understanding of the services offered by the labs, both of which import samples from other countries and perform fee-based diagnostic tests. They learned about the equipment and staff needed to run a service laboratory and explored options improving the soil and plant pathology labs at FAMV and the Bas Boën CRDD. As a follow up, the director of

UF/IFAS' [Analytical Services Laboratories](#) was scheduled to visit Haiti in late November. This trip was cancelled due to unrest in the country.

In November 2018, AREA team members met with FAMV's vice dean of research and the director of Ministry of Agriculture's Sanitary Protection Unit and her staff to discuss a potential link with services at UF's Plant Diagnostic Center to meet plant diagnostic needs of the ministry. The group also discussed collaboration regarding AREA's plant pathology program, which is summarized in the plant pathology section of this report. AREA planned to meet in November 2018 with UF's plant pathology researchers and the Ministry of Agriculture. The meeting was cancelled because of unrest in the country, but it was rescheduled for Jan. 17, 2019.

Output 3: In collaboration with the Ministry of Agriculture, CRDDs and the private sector, conduct variety trials targeting vegetable producers in the Kenscoff region

AREA contacted the U.S.-based vegetable seed company Emerald Seeds to identify suitable vegetable varieties to implement trials in multiple locations in the FTF West region. Emerald Seeds exports seeds throughout the Caribbean, including Haiti. The Caribbean representative is working with AREA to identify seeds that could be adapted to Haiti. AREA staff contacted farmers in the Kenscoff area to gather information about the plant characteristics (e.g. size, type of fruit, disease resistance) that they prefer in the vegetable crops grown in different seasons. This information was shared with the representative from Emerald Seeds so that he can select varieties that can be used in the trials. AREA plans to implement these trials by the third quarter.

Output 4: Offer training on leadership and entrepreneurship to the Ministry of Agriculture, CRDDs and the private sector farmer associations

AREA began developing teaching materials on various leadership and entrepreneurship topics for trainings that we will offer administrators and staff at the Ministry of Agriculture, CRDDs and farmers' associations. Two faculty members will create training modules on organizational structure and leadership: an assistant professor in UF's Family, Youth and Community Sciences Department, and an assistant professor in Agriculture Extension at Tennessee State University who grew up in Haiti and Miami, and earned a Ph.D. at UF in Agricultural Education and Communication, with a specialty in Leadership. A U.S.-based staff member and a UF/IFAS fiscal manager are preparing training modules on fiscal management. AREA's director of research is updating modules on grant writing that AREA previously produced. Trainings on these topics will be delivered to multiple audiences beginning in the second quarter.

Output 5: Research seminar series

AREA rescheduled and/or delayed seminars presented by the project's researchers primarily because of civil unrest and a general state of insecurity in Haiti. A presentation by AREA's soil science program leader, which was scheduled for Nov. 27 at the Ministry of Agriculture, was rescheduled for a Ministry of Agriculture research conference at the Best Western Hotel in Pétionville on Jan. 24, 2019. In upcoming seminars, AREA interns from FAMV will present on their

experience with the extension experiment research program in AREA's conference room. AREA is working with our partners to schedule additional seminar activities in the next quarter.

Output 6: Planning collaborative research conference

AREA formed a committee in Haiti to plan an international research conference for November 2019.

J. Gender Assessments and Interventions

Background

The AREA project is working to identify gender constraints in Haiti's agricultural sector, make recommendations and develop gender-responsive interventions to agricultural projects' programming, particularly through extension and advisory services.

In October 2018, AREA's Haiti-based gender and extension specialist left the project. The team at the University of Illinois at Urbana-Champaign began the process to recruit a qualified replacement. The lack of a gender specialist slowed some activities in the first quarter.

Output 1. Workshop on integrating gender in agricultural development programs

Twenty-five Haitian researchers, Ministry of Agriculture officials and other agricultural professionals attended the Oct. 1-3 training to learn ways to address gender disparities when designing programs and outreach efforts to introduce agricultural technologies.

AREA partnered with Cultural Practice, an international development consulting firm based in Washington, D.C., to help develop the workshop, which was similar to trainings it conducted in countries such as Bangladesh, Nepal and Sierra Leone. The workshop was based on a technology assessment toolkit Cultural Practice previously developed under the USAID-funded Integrating Gender and Nutrition with Agricultural Extension Services, or INGENAES, a project led by the University of Illinois in partnership with the University of Florida and the University of California-Davis.

At the workshop in Port-au-Prince, participants learned about the principles of how to integrate gender considerations when introducing innovations designed to improve the country's value chain. They learned the best practices for conducting a gender analysis of technologies and providing recommendations to better reach women — as well as men. In small groups, they discussed how social norms and institutions shape opportunities for women and men. Through the use of a case study, they discovered ways to identify gender-related challenges and opportunities. By the end of the workshop, each participant developed a plan of action their institutions can take to improve the attention they give to gender considerations.

A gender specialist with Cultural Practice said the participants' high level of engagement indicated the training sparked critical thinking about how gender issues affect research and development projects. "They can better identify options that benefit women and men while also leading to better project outcomes, and ultimately improve the wellbeing of farmers," she said.



Figure 15. A gender specialist with the consulting firm Cultural Practice co-led the training on ways agricultural professionals in Haiti can address gender disparities when designing programs and outreach efforts.

Planning underway for weeklong training program

AREA has begun planning a training for gender specialists and managers of private and public sector organizations on how to integrate, implement and analyze gender impacts and outcomes in an agricultural project. This weeklong program is slated for the third quarter of Year 4. We have begun compiling teaching materials and designing the training modules. Workshop attendees will learn:

- The significance of integrating gender into a development project
- The project life cycle and where and how gender can be integrated
- The different tools and approaches for collecting gender data
- Ways of monitoring gender outcomes

Additional activities

AREA's gender specialist completed a draft of a research report on gender integration in agricultural extension services in Haiti. AREA's gender specialist will finalize the report when this position is filled by the University of Illinois at Urbana-Champaign.

Output 2. Gender assessments of promoted agricultural technologies in the AREA project

Nothing new to report in the first quarter.

Output 3: Women empowerment training series — empowering women farmers' groups in Feed the Future intervention zones

No activities to report in the first quarter.

K. Extension Experiment

Background

AREA's extension research team is conducting a large-scale research study to compare the effectiveness of the three models of extension already in use in Haiti. The three extension models being investigated are: 1) Master farmer, which centers on an expert who teaches farmers in a lecture-style setting, 2) Farmer field school, which primarily relies on the community of farmers to teach each other, and 3) Simple distribution, in which farmers come to a central location to receive the technologies and basic information on their use.

In September 2017, AREA's extension research team formally launched the experiment after previously creating the evaluation instruments, establishing relationships with implementing partners, and hiring and training staff. The experiment involves four primary objectives:

1. Work with Haitian farmer associations to evaluate the three commonly used extension models and test the technology innovations
2. Assess the interactions between extension models and farmer associations as predictors of farmers' willingness to test innovations on their own farms
3. Assess the degree to which innovation attributes influence the interactions between the extension model and rate of farmer adoption
4. Determine whether the gender of the farmer affects the efficacy of an extension model

Output 1: Complete data collection for outcome of experiment and farmers' perceptions of technologies introduced

During the most recent quarter, AREA continued to administer the exit interviews to a random sample of farmers who are members of a farmers' association.

On Aug. 6, 2018, the team launched the instrument to measure independent testing, referred to as an "exit interview" questionnaire. Using the random sample of respondents selected for the group dynamics interviews, these exit interviews will allow AREA to measure, among other things, the percentage of farmers who chose to try, without direct project assistance or encouragement, any of the seven innovations on their farms.

Additionally, AREA continued to make direct observations of group meetings. AREA is using an observation instrument to direct observations of group meetings, after which an AREA surveyor writes a brief case summary of his or her observations. The instrument includes a list of questions to guide the development of a case summary.

By Dec. 31, 2018, AREA's Extension Experiment team completed all work to collect exit interviews, a total of 815, and to observe farmers' meetings, a total of 54.



Figure 16. A graduate student in the University of Florida's Department of Family, Youth and Community Sciences reviews notes she took during an interview with a farmer in Kenscoff, Haiti.

Output 2: Data entry and preliminary analysis

By early January 2019, AREA team members were on track to finish entering all the data they collected into a database. The data will be cleaned, coded, and analyzed using the statistical software STATA. AREA will use the data to determine if they support statistically significant differences among the extension models tested. If any of the models demonstrate greater awareness of the technologies introduced in the experiment, AREA will recommend that this model be used in Haiti as the preferred extension method.

Output 3. Presentation of results to participating farmer associations

No activities in the first quarter.

Output 4: Final analysis of comprehensive extension experiment data

No activities in the first quarter.

Output 5: General dissemination of findings

No activities in the first quarter.

L. Higher Education Research and Development

Background

The objective of the Higher Education program is to strengthen the educational capacity of Haiti's agricultural institutions of higher education and to help improve curriculum so graduates can better fulfill the needs of the country's agricultural sector. As part of its effort to spur improvements to curricula, AREA is working to understand the strengths and weaknesses of key higher education programs and the training needs of the agricultural sector. This work included surveying faculty, administrators and students of six of the project's university partners and organizations that have historically employed graduates of these universities. In addition, AREA created a Faculty Development Academy to support improvements to academics and teaching at higher education institutions.

Output 1: Assess the teaching practices of Haitian faculty who went through the Faculty Development Academy

A primary focus of AREA's higher education team in fiscal year 2017 and fiscal year 2018 was to train faculty members at its partner institutions of higher education ways to improve their pedagogical practices, including their teaching methods and course content.

More specifically, AREA created a Faculty Development Academy to form a cohort of innovative, leading educators who can serve as change agents within their institutions. This train-the-trainers model encompassed topics such as how to improve college-level courses and curricula, and implement innovative classroom teaching methods. More than 100 faculty members participated in the academy, which was divided into three training sessions or blocks: designing agricultural programs, delivering programs and enhancing the scholarship of teaching and learning. AREA trained lead educators who in turn taught what they learned to other faculty members.

Now that the faculty members have had several academic semesters to implement what they learned, AREA is planning to document the extent of any changes and improvements they have made to their courses and teaching methods.

During the first quarter, two UF professors who serve as co-PIs on the AREA project developed a protocol for observers to use to monitor the teaching in classrooms. In the second quarter, they will provide online training to AREA staff and/or interns who will observe the teaching. The higher

education team plans to observe two classes each of 30 Haitian professors, resulting in 60 class observations.

Output 2: Provide consulting sessions on designing and implementing education research

No activities to report this quarter. The activity is planned for April.

Output 3: Develop trainings on how to teach leadership and extension in a technical class

AREA's higher education research results showed a gap in graduates' capabilities related to leadership and extension skills. To address this, AREA began planning a way to use a train-the-trainer approach to train teachers how to integrate leadership and extension skills into existing classes. Experts in leadership and extension from UF are working with AREA's higher education team to develop these trainings, which are slated to begin in April 2019. Haitian professors and teachers that we train will replicate these trainings at their institutions.

Output 4: Initiate training at the agricultural technical schools based on the results of AREA-funded graduate student research

As part of her research on her thesis, one UF master's graduate examined the teaching and curriculum at four agriculture technical schools in Haiti. Her work included recommendations to improve technical training. Based on these recommendations, AREA has begun to work with the deans and faculty at these schools to develop professional development training with the goal to improve curricula. AREA will invite teachers at these schools to attend the training in April.

Output 5: Continued development to improve FAMV's diagnostic course for fourth-year agronomy students

AREA is continuing to work with FAMV to evaluate and improve its annual internship diagnostic course that fourth-year students are required to complete. This year's course will be held in Les Cayes beginning on Feb. 11. AREA has begun working with FAMV to encourage them to invite faculty from AUC to participate in the course.

Additionally, the co-leader of the Climate Smart Solutions team and an AREA-funded graduate student in UF's Agricultural and Biological Engineering department are developing a new teaching module on climate for use at the diagnostic course. The module will focus on the use of weather data in disease management and feature the AREA agroclimatology educational climate tool developed in Year 3, among other applications.

AREA's human and institutional capacity development specialist has begun to work with the dean and faculty at FAMV to further improve the course, based on data collected from the course in Year 3. He will assist the faculty to improve the pedagogical approach and content of the course. AREA lead researchers will provide support in the teaching of soils, climate and research ethics.

Output 6: Support FAMV and AUC to improve laboratory facilities and procedures

In Year 3, the deans of FAMV and AUC requested help from AREA in the design and operations of laboratories for their teaching and research programs.

In October, AREA hosted FAMV's dean and vice dean of research to meet with engineering and facilities professionals at the University of Florida and to review the plans for laboratory space under construction at FAMV. They consulted with the director of IFAS Facilities Planning Operations and the owner of Moses Engineering who has served as a building contractor on a number of projects to build and renovate labs at UF. The FAMV leaders shared building plans for its new classrooms and laboratories funded by the International Development Bank (IDB). The director of IFAS Facilities Planning Operations and the owner of Moses Engineering made several recommendations, including reducing the number of windows and doors to allow for more usable space for cabinets and storage, relocating the soils lab closer to the common room containing a chemical flow hood, ensuring the installation of adequate cooling and ventilation systems, and designing the benches to ensure enough space for safe movement within the laboratory.

The FAMV dean and vice dean toured laboratories on campus to see different layouts and how common rooms equipped with expensive equipment were located so they can be used by multiple labs. In addition, they visited teaching greenhouses and other classroom spaces. The director of IFAS Facilities Planning Operations and owner of Moses Engineering agreed to visit FAMV's construction site in December to speak with the architect and construction manager to determine what design changes could be made. The trip was cancelled because of civil unrest. Instead, the group will meet virtually in January. AREA will provide recommendations for equipment and safety features for FAMV laboratories and classrooms under construction.

AREA agreed to AUC's request to assist the university in strengthening its capacity in the disciplines of soil fertility and plant pathology, including training teachers and students in laboratory procedures. AREA requested that AUC provide a list of laboratory equipment and supplies to improve their capacity in soil diagnostics and plant pathology. AREA will begin the procurement process for these items in January, and we will schedule plant pathology trainings in the ensuing months.

Output 7: Advancing the success of women in careers in agriculture and food security — professional development summer program

No progress to report on this activity in the first quarter.

Additional activities

Publications:

- Absalon Pierre, Ph.D., AREA's human and institutional capacity development specialist; Marie Christelle Calixte, AREA-funded Haitian graduate student; Kelly Moore, PhD., a researcher and lecturer in UF's Department of Family, Youth and Community Sciences; Grady Roberts, Ph.D., and J.C. Bunch, Ph.D., co-PIs of the AREA project; co-wrote a peer-

reviewed article titled Haitian Faculty Perceptions of Students' Competence at Graduation: An Opportunity for Curricula Modification. It was published in the *Journal of International Agricultural and Extension Education* in December.

- Also, the first AREA-funded Haitian graduate student completed her degree. Her thesis was titled Understanding Haitian Agricultural Technical and Vocational Education and Training: Review of Four Schools.

M. Postharvest Loss Management and Food Safety

Background

Postharvest losses of fruit and vegetable crops in Haiti approach 50 percent depending on the commodity and storage situation. Additionally, food-borne illnesses are prevalent in Haiti because of inadequate agriculture practices and poor personal hygiene. AREA developed a Postharvest Loss Management and Food Safety program to reduce postharvest losses and improve food safety and increase food security in the Feed the Future-West corridor.

Output 1: Complete storage study and four undergraduate students' complete memoirs

AREA launched a study to investigate ways to reduce aflatoxin contamination in the storage of grain crops — corn, rice and sorghum — and peanuts. Aflatoxin is a toxic substance produced by fungi (*Aspergillus flavus* or *Aspergillus parasiticus*).

AREA was unable to complete the storage study in December as planned in part because civil unrest disrupted travel and other activities in Haiti. Also, measurements were delayed because of a temporary technical problem with the Neogen Corp. AccuScan Gold reader we use to measure aflatoxin. Below is a summary of the storage study and the progress so far.

Design of the study

In the fourth quarter of fiscal year 2018, AREA launched the full-scale study in four locations: public markets in Vialet, Kenscoff and Arcahaie, and in a pilot plant, or food storage facility, at FAMV. All the storage locations except Vialet are in the target geographic area of the AREA project. AREA decided to replace a market in Croix-des-Bouquets with a location on the campus of FAMV because of a failure to reach an agreement with the management of the market.

The study involves storing the four crops in three types of storage containers: Purdue Improved Crop Storage (PICS) bags, traditional bags and plastic barrels. During the experiment, AREA has monitored aflatoxin and moisture levels in each of the three storage containers every other week.

Table 6. Summary of the independent variables in the food storage experiment.

Independent variables			
Period (week)	Location	Crop	Storage containers
0	Archaie	Corn	Plastic barrel
2	Kenscoff	Peanut	PICS bag
4	Violet	Rice	Traditional bag
6	FAMV pilot plant	Sorghum	

Note: The experiment started on different days at each location: Sept. 21 at Kenscoff, Sept. 25 at Violet, Oct. 19 at Archaie, and Dec. 20 at FAMV.

Our hypotheses:

- Aflatoxin content will increase over time
- Commodities stored in PICS bags will exhibit lower aflatoxin levels
- Samples stored in the Archaie market will have lower aflatoxin content because of its overall better sanitary conditions

AREA is conducting the experiment using a Neogen immuno-chromatographic assay to analyze aflatoxin levels and a hygrometer to measure moisture content.

To collect data, AREA hired four student interns from FAMV's Food Science Department who will use the study as the basis of their memoirs (or theses). Every two weeks the interns travel to their assigned storage site to collect samples, which they analyze at FAMV's mycotoxin research unit under the close supervision of AREA's lab technician. The interns submit monthly reports to AREA.

Preliminary results

Preliminary results of the data collected at one location, the Archaie market, are presented in Table 7 below. Despite some inconsistencies in the results, the aflatoxin levels tend to increase over time, which is not surprising. The overall trends show that the food commodities in the PICS bags display lower aflatoxin content after being stored for two weeks. However, after four weeks, commodities stored in bags that vendors traditionally use show a lower overall aflatoxin content. It is too early to draw definitive conclusions.

Table 7. Aflatoxin content (in parts per billion) in products in stored at the Archaie market.

Week	Container	Corn	Rice	Sorghum	Peanut
0		0	0	0	0
2	Traditional bag	0.71	1.89	0.53	1.31
	PICS	0.09	0.53	1.67	0.85
	Barrel	0.35	0.83	1.87	0.73
4	Traditional bag	0.71	0.18	1.53	1.07
	PICS	0.09	0.53	1.67	0.85

4	PICS	1.36	0.58	2.53	0.75
	Barrel	1.50	1.67	0.85	0.28

Output 2: Deliver a training on produce safety

Through a partnership with the Produce Safety Alliance (PSA), AREA’s director of research, who also leads the postharvest loss management program, continued to prepare to deliver a PSA grower produce safety training in Haiti in early 2019. On Nov. 27, he traveled to Homestead, Florida to co-train with the Florida-based PSA team. He taught the sixth of seven modules in PSA’s training package on postharvest handling and sanitation. In addition to leading the workshop session, he gained additional experience in watching other trainers deliver other modules, particularly ones related produce safety rules under the U.S. Food Safety and Modernization Act (FSMA). The Postharvest Technology and Food Safety team is awaiting approval from PSA on the AREA’s previously translated Creole version of the curriculum before training growers in Haiti.

Output 3: Develop and deliver a training micro-scale food processing targeting women

In Year 4, AREA will deliver a training aimed to help small-scale food processors to strengthen food-handling methods to improve food safety, hygiene, quality and packaging. This training, which will target women working in food-processing operations in Haiti, is tentatively scheduled for the last week of February. In the first quarter of fiscal year 2019, we produced the description of the training, including the training objectives, and developed strategies to recruit women who own small-scale food processing businesses. We obtained a preliminary list of food-processing enterprises from the Haitian Bureau of Norms and Standards (BHN), which is part of the Ministry of Commerce and Industry (MCI). We also have contacted the National Association of Fruit Processors (ANATRAF) for a list of processors affiliated with the association. In January, AREA team members will tour supermarkets in metropolitan Port-au-Prince to collect a list of Haitian-made food products that carry the name of women, who often own micro-scale food businesses. In the meantime, the team is producing the documents for the training event.

Output 4 Curriculum development in postharvest technology laboratory at FAMV

The Nov. 18-19, 2019, protests in Haiti created a general state of insecurity, which caused the team to reschedule some of the activities planned for December. A UF professor and extension postharvest specialist and his AREA-funded graduate student postponed their trip to Haiti, where they were scheduled to deliver a postharvest technology training. The trip, which included a meeting with instructors at FAMV and the postharvest technology team to discuss strategies to the improve postharvest technology curriculum at FAMV, was cancelled and rescheduled to spring 2019.

Output 5. Production of technical document to support the efforts of Haitian National Bureau of Norms and Standard to produce norms to protect consumers from aflatoxin contamination

No updates to report in the first quarter

Monitoring and Evaluation (M&E)

Summary of FY2019 Q1 Performance

This section summarizes indicator performances and challenges of AREA research activities covering the first quarter of the FY2019.

Political instability in late 2018 hindered many of AREA activities in the FTF West corridor in the fiscal year 2019 first quarter ended Dec. 31. Nonetheless, AREA made progress on a number of performance indicators. Highlights:

- One Haitian student graduated with a master's degree from the University of Florida and the remaining 19 remain in good academic standing in their respective programs at UF and Louisiana State University;
- Three publications were recorded in the MS and the Higher Education Research and Development programs;
- AREA held three short-term training events with a total of 45 participants; 100 percent of test respondents reported an increase in knowledge;
- The Soil Science Research program launched two research experiments on soil fertility management practices at the CRDD Bas Boën;
- Eleven Pilot Projects in the category of research supplies and equipment were awarded and nine beneficiaries were identified for individual and collaborative research projects;
- The highest rate of women represented in project's activities conducted this quarter was recorded: 48% of participants in degree-granting and short-term trainings were female.

Note: The number of participants in the M&E section may differ from the numbers elsewhere in this document. This reflects USAID's requirement to exclude in the final indicator totals those who have participated in prior AREA training activities in the same fiscal year.

Overview of Indicator Performance

- Indicator No. 1 – Number of individuals who have received U.S. government-supported long-term agricultural sector productivity or food security training – *USAID indicator: (RAA) – EG.3.2-2 (FTF 4.5.2.6)*

The life of project (LOP) target of 20 was reached in FY2018 Q3. In the first quarter of this fiscal year, AREA continued to support 18 graduate students at the College of Agriculture and Life Sciences (CALS) at the University of Florida (UF) and two at the College of Agriculture at Louisiana State University (LSU). One graduate student finished her master's program and graduated in December.

- Indicator No. 2 – Number of research and extension publications as a result of project assistance – *custom USAID indicator for AREA project*

AREA reported three publications during the most recent quarter (Table 8). The four publications in the table include one article by the Higher Education Research and Development program that was included in our indicators when it was submitted in the second quarter of last fiscal year; it is listed here because it was officially published in December 2018.

Table 8. Listing of the conference presentations and the research publication reported in Q4.

No.	Program	Title of presentation/article	Status	Publication/event
1	Extension Experiment	Rural Haitian Nonprofit Organizations: Civic Engagement.	Presented	UF 2nd Graduate Diversity Research Symposium
2	MS and Graduate Certificates	Rural nonprofit organizations in Haiti: Gender, power and perceived benefits of membership.	Presented	UF 2nd Graduate Diversity Research Symposium
3	Higher Education	Understanding Haitian Agricultural Technical and Vocational Education and Training: Review of four schools	Defended	UF Department of Agricultural Education and Communication
-	Research and Development	Haitian Faculty Perceptions of Students' Competence at Graduation: An Opportunity for Curricula Modification	Published	Journal of International Agricultural and Extension Education

- Indicator No. 3 – Number of individuals who have received U.S. government-supported short-term agricultural sector productivity or food security training – *(RAA) (WOG)– EG.3.2-1 (FTF 4.5.2.7)*

AREA trained 55 people during this three-month period. These individuals came primarily from public universities and institutions (49%) and farmer groups (31%), with the remaining from the private sector (15%), and nongovernmental agencies and others (5%).

- Indicator No. 4 – Number of trainings events delivered – *custom USAID indicator for AREA project*

Three training events were held between in the first quarter (Table 9). Additionally, AREA's 10 Haitian university student interns participated in AREA's internship program. The interns conducted research under the supervision of the leaders of the Extension Experiment, Gender Interventions and Assessments, and Postharvest Technology and Food Safety programs.

Table 9. List of training events held during Q1.

Workshop/program	Location	Participants	% of Female Participants	% of participants with increase in knowledge
Internship	AREA office	10	50%	-
Addressing Gender Issues in Technology Design, Use and Dissemination	Hotel Montana	21	52%	100%
Agroclimate Data Analysis	AREA office	7	14%	100%
PICSA Training	Palm Events Center	17	50%	100%
Total Q1 Workshops	Haiti	55	43%	100%

Note: the internship program is not counted as a training until the program is finalized in the fourth quarter of fiscal year 2019.

- Indicator No. 5 – Percentage of participants with an increase in knowledge related to research and extension – *custom*

All participants who completed pre- and post-training tests reported an increase in knowledge, exceeding the target of 85% (Table 9).

- Indicator No. 6 – Number of curriculum changes at partner educational institutions – *custom*

No new changes in the curriculum of institutions of higher education were reported this quarter but the target for this indicator is expected to be reached after AREA holds a follow-up meeting with the participants of the Faculty Development Academy later this fiscal year.

- Indicator No. 7 – Number of new technologies or management practices introduced as a result of U.S. government assistance – *custom*

One new management practice was introduced in the first quarter: A technology assessment toolkit developed by Cultural Practice under the USAID-funded INGENAES project was presented at a gender workshop. Participants learned the best practices for conducting a gender analysis of technologies. In the second quarter, AREA expects to introduce new tools in trainings events in the Climate Smart Solutions, the Postharvest Technology and Food Safety, and the Soil Science Research programs.

- Indicator No. 8 – Number of grant-funded projects in Haiti as a result of project assistance – *custom*

AREA awarded 11 projects up to \$4,000 for supplies and other nonexpendable items, reaching its FY2019 target.

- Indicator No. 9 – Number of technologies, practices and approaches under various phases of research, development, and uptake as a result of USG assistance – *E.G.3.2-7*

Seven technologies and management practices are under research (Phase I) and seven are under field testing (Phase II). See Table 10 for more details. The performance of this indicator is expected to continue increase as more field experiments are set up in the next quarter. The Climate Smart Solutions program has two technologies under field testing and research: an educational agroclimatology tool and an upgraded, or second-generation, weather station.

The Climate Smart Solutions program is planning to evaluate the climatology tool in one of FAMV's courses in quarter 2. The second generation of weather stations are being improved with larger solar arrays, longer-lasting batteries and other upgrades. An AREA graduate students is researching three intercropping practices in the South (Les Cayes). The Soil Science Research program launched two experimental trials in which different dosages of three fertilizers are applied to maize and black bean fields.

Three cover crops (sunn hemp, velvet, and cowpea) were under field testing to evaluate their potential in decreasing the population of nematodes found in the soil. The Postharvest Technology and Food Safety program continued its comparative study on aflatoxin content in four agricultural commodities using three different storage methods and in different market conditions.

Table 10. Number of technologies or improved practices under testing.

Program	No.	Technology or improved practice	Phase	Objective
Climate Smart Solutions Program	1	Climatology tool	Phase I – Under Research	Online education tool to study El Niño Southern Oscillation in influencing rainfall in Haiti
Climate Smart Solutions Program	1	2 nd generation weather station	Phase I – Under research	To improve access to data and allow data to be stored over a Wi-Fi network and on a micro-SD memory card.
Soil Science Research	3	Fertilizer (Nitrogen, Triple Superphosphate Muriate of potash)	Phase I - Under Research	Identify the best soil fertility management practices for maize and black beans
Master	3	Cover crops (Sunn Hemp, Cowpea, Velvet Bean)	Phase I – Under field testing	Evaluate the potential of cover crops in suppressing weeds and the population of nematodes in lowlands of Haiti

Master	3	Intercropping practices (Sorghum in monoculture, Sorghum intercropped with pigeon pea Sorghum intercropped with corn)	Phase I – Under Research	Effect of intercropping on sugarcane aphid infestations in sorghum
Postharvest Technology and Food Safety	3	Storage methods (Plastic barrels, PICS bags and polypropylene bags)	Phase II – Under field testing	Study on the aflatoxin content in sorghum, maize, rice and peanuts using three storage methods under different market conditions

- Indicator No. 10 – Percentage of female participants in U.S. government–assisted programs designed to increase access to productive economic resources – *GNDR-2*

An increase in the proportion of female participants was observed in project’s activities at the start of FY2019, reaching 48%. Table 11 shows the breakdown by program type. Special efforts were made to increase women’s participation in short-term trainings; the project team achieved the 50% mark in degree-granting trainings as well as in the internship program. This quarter, the project recorded the highest proportion of female participants in its programs, and continuous efforts will be made to maintain this progress in FY2019.

Table 11. Proportion of female participants in project’s activities by program type.

Program Type	QI
Short-term trainings	47%
Degree-granting trainings	50%
Internship program	50%
Overall	48%

Appendix

M&E Indicator Performance Tracking Table – FY2019

Support to Agricultural Research and Development Program (FY19)									
Indicator type (Unit of measure)	Disaggregation	Baseline (FY 16)	Annual target (FY18)	Q1 (FY18)	Q2 (FY18)	Q3 (FY18)	Q4 (FY18)	Annual performance achieved to the end of reporting period (%)	On target Y/N
Sub-Intermediate Result 1: Agricultural productivity increased (the indicators in this section apply to both Sub-Result 1.1 and Sub-Result 1.2)									
Number of individuals who have received USG-supported degree-granting non-nutrition-related food security training (RAA)– EG.3.2-2 (FTF 4.5.2.6)	- Sex - Program type	4	20 20 C 0 N	20 20 C	-	-	-	100% 20 / 20	Y
Number of research and extension publications as a result of project assistance – custom	- Publication type - Language - Sex of primary author	7	15	3	-	-	-	20% 3 / 15	N
Sub-Result 1.1: Enhanced human and institutional capacity development for increased sustainable agriculture sector productivity									
Number of individuals who have received U.S. government-supported short-term agricultural sector productivity or food security training (RAA) (WOG)– EG.3.2-1 (FTF 4.5.2.7)	- Sex - Corridor, commune	75	500	55	-	-	-	11% 55 / 500	N
Number of training events delivered – custom	- Corridor, commune - Nationality of primary presenter	5	15	3	-	-	-	20% 3 / 15	N

Percentage of participants with an increase in knowledge related to research and extension – custom		84%	85%	100%	-	-	-	-	Y
Sub-Result 1.2: Enhanced technology development, dissemination, management and innovation									
Number of new technologies or management practices introduced as a result of U.S. government assistance – custom	- Corridor, commune - Crop type - Technology type	0	10	1	-	-	-	10% 1 / 10	N
Number of grant-funded projects in Haiti as a result of project assistance – custom	- Sex - Source	7	11	11	-	-	-	100% 11 / 11	Y
Number of curriculum changes at partner educational institutions – custom	- Institution	0	8	0	-	-	-	0% 0 / 8	N
Number of technologies, practices, and approaches under various phases of research, development, and uptake as a result of USG assistance E.G.3.2-7	- Phase of development - Corridor - Institution	0	65 under research 10 under field testing	7 under research 7 under field testing	-	-	-	-	N
Sub-result 1.3: Reduce gender disparities in access to, control over and benefit from resources, wealth, opportunities, and services - economic, social, political and cultural									
Percentage of female participants in U.S. government–assisted programs designed to increase access to productive economic resources – GNDR-2	- Program type	32%	50%	48%	-	-	-	-	Y

*Indicators that were dropped in FY2017 are omitted.