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

Cooperative Agreement: AID-OAA-A-15-00039

SECOND QUARTER REPORT | FISCAL YEAR 2018
JAN. 1 – MARCH 31, 2018

Prepared by the University of Florida for the U.S. Agency for International Development.
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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
BAC	Communal Agricultural Office
BIFAD	Board for International Food and Agricultural Development
CHIBAS	A research laboratory associated to 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'Entrepreunariat Agricole
DI	Direction of Innovation
DOR	Director of Research
EMA	Ecoles Moyennes d'Agriculture
FAMV	Faculté d'Agronomie et de Médecine Vétérinaire
IRB	Institutional Review Board
LSU	Louisiana State University
MS	Master of Science
MARNDR	Ministère de l'Agriculture, des Ressources Naturelles et du Développement
NAIP	National Agriculture Investment Plan
M&E	Monitoring and Evaluation
NGO	Nongovernmental Organization
ORE	Organization pour la rehabilitation de l'environnement
SARD	Support to Agricultural Research and Development
SOHADERK	Solidarite Haitienne pour le Developpement Rural de Kenscoff
UF	University of Florida
UI	University of Illinois
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.

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

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 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 accomplished a number of milestones and continued to make progress on key research projects in the second quarter of fiscal 2018.

Highlights of this quarter's activities are below.

- Two additional graduate students started master's programs at the University of Florida (UF), joining the original 17 graduate students enrolled at UF and LSU.
- The Climate Smart Solutions, the Legume Breeding and the Support to Higher Education programs accounted for four research publications.
- Three training events were held with a total of 163 participants, and 93 percent of them reported an increase in knowledge.
- Faculty at two partner universities implemented curriculum changes following their participation in AREA's higher education program.
- Undergraduate students in UF's Department of Electrical Engineering began developing a prototype for a second-generation weather station that will be less expensive and provide more functionality than the first stations AREA installed in 2017.
- Fourth-year FAMV students participated in the compulsory Diagnostic Internship program that was revamped as part of the partnership between AREA and FAMV.
- AREA selected six applicants to receive mini grants to purchase lab equipment and other nonexpendable items needed for research projects and teaching.
- Evaluations were conducted on four potential cover crops to decrease nematodes in the soil.
- Women represented 27 percent of participants benefitting from project's activities conducted this quarter.
- Hosted a group officials from the Ministry of Agriculture's Directorate of Innovation, employees of agricultural research centers (Haiti's CRDDs), and USAID Agreement Officer Reginald Toussaint on a tour of agricultural research, extension, water quality and agribusiness facilities in Florida.

A. Climate Smart Solutions to Production Challenges

1. Wireless Weather Stations across Haiti and Climate Modeling Support

The goal of the Climate Smart Solutions program is to support Haitian institutions and its agricultural sector in managing the risks associated with climate variability. AREA is working to provide climate information and develop tools that farmers can use to improve planning and decision-making to reduce climate-related risks.

Below are key accomplishments of AREA Climate Smart Solutions program in the second quarter of Year 3.

Output 1: Create a portal for our partners to learn basic electronics, build and maintain weather stations and access weather data.

In January, Dr. Bill Eisenstadt continued to work with Joe Gasper, an IT expert at UF/IFAS, to develop a process to automatically upload weather data from AREA weather stations to display on AREA's website. The work consists of identifying optimal software to transmit the data over the web. These strategies have to be scalable for hundreds of weather stations and will require substantial software design, which may be a focus of a fourth-year project. Gasper is also developing a script to transmit weather information automatically from the Weather Underground website to AREA's website. Dr. Eisenstadt also met with Dr. Kati Migliaccio and her Haitian student Floyid Nicolas to facilitate his access to the data from the AREA weather station in Montrouis. As part of his MS degree course work, Nicolas is researching how and how much rice yields fluctuate in response to climate variability in Haiti. In February, Dr. Eisenstadt worked with AREA communications coordinator Charles Boisseau to improve content on AREA's website and update links to weather station data.

Outcome 2: Workshop for Weather Data in Support of Day-to-Day Operations on the Farm in Haiti

No activities this quarter.

Output 3: Upgrade weather stations with new sensors and ways to collect and transfer data in areas where Wi-Fi service is limited or not available.

In January, Dr. Eisenstadt assisted undergraduate students from the University of Florida's Department of Electrical Engineering in developing a prototype for a second-generation weather station. The new stations will be less expensive and provide more functionality and expandability than the first-generation weather stations AREA installed in 2017. Dr. Eisenstadt also purchased the parts for the prototype. The students have completed the process to establish communication between the new prototype and the Weather Underground website, where the data will eventually be

stored. In February, the students also developed software to record the data on secure digital (SD) memory cards. This upgrade is one that AREA's Haitian collaborators have requested because Wi-Fi connectivity problems have frequently resulted in missing data. The students also configured the soil moisture sensor, so it now works with the new weather station program. A prototype has been successfully tested indoors. In February, Dr. Eisenstadt presented the AREA weather station work to the University of Florida's 2018 Water Institute Symposium.

2. AREA Agroclimate Program

Output 1: Needs Assessment, planning and preparation for the Agroclimate Training program.

- Agroclimate Focus Group Questionnaire Completed

One goal of the AREA Climate Smart Solutions program is to better equip Haitian farmers with a variety of crop management options that best suit their individual circumstances and location. On Feb. 6, 2018, AREA held focus groups with eight agricultural sector experts (seven men and one woman) working in the corridors of Kenscoff, Duvier, Cul-de-Sac Plain and Matheux. The team included Dr. Caroline Staub, AREA's technical coordinator and Climate Smart Solutions program leader, Anne Catherine Gilot, AREA's monitoring and evaluation expert in Haiti, and agronomist interns Molene Pierre and Roseline Roche. Together, the groups discussed regional climate impacts on major commodities, strategies for managing climate-related risks, and the accessibility of context-specific weather and climate information for use in decision-making. Dr. Staub also presented a synopsis of the upcoming AREA-led climate risk management capacity building program and recorded feedback from the participants. The information will inform the research and capacity-building programs proposed in AREA's Year 3 work plan. The team identified potential existing institutional structures for the integration of climate risk management training within the agricultural sector in Haiti. As suggested by focus group participants, AREA will conduct additional focus groups to obtain feedback and comments from a wider sample of the agricultural community in Haiti.

Figure 1. AREA's Anne Gilot and Dr. Caroline Staub conducted focus groups in Haiti with extension agents and agricultural sector experts.

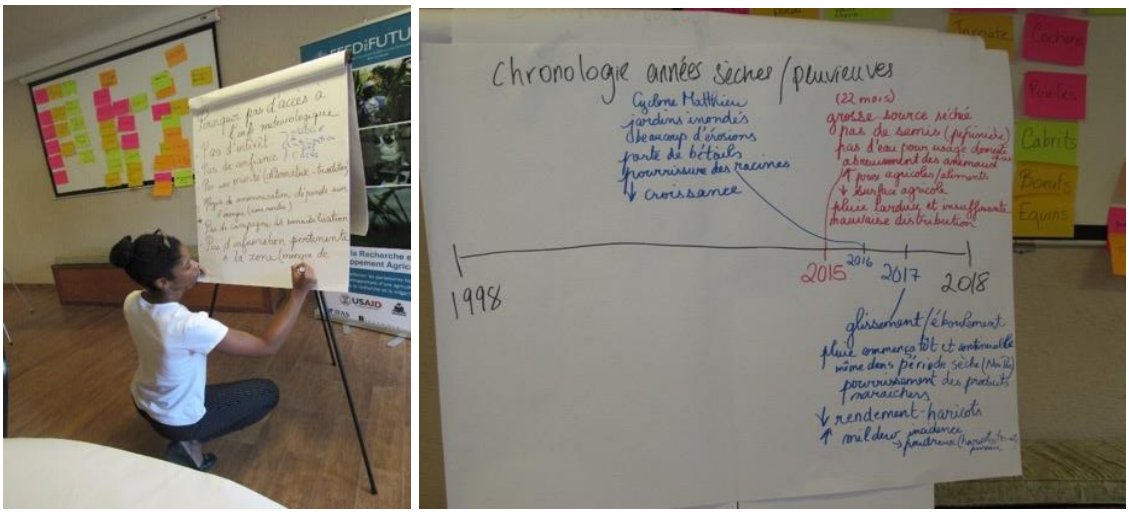

Figure 2. AREA's Anne Gilot recorded participants' responses during a discussion of the differences in access to and usefulness of weather and climate information (left) and a timeline of recent climate-related losses in Kenscoff (right).

- Partnership with the University of Reading

In January and February, Dr. Staub worked with Jan Machnik, the IFAS Global research administrator, to finalize a partnership between AREA and the Participatory Integrated Climate Services for Agriculture (PICSA) team, three experts from the University of Reading who will provide guidance with the delivery and evaluation of AREA's PICSA Agroclimate training activities for consecutive parts and targets two audiences: 1) For data analysts at the Centre National de Meteorologie, how to analyze and present meteorological information for use in agriculture? 2) For agronomists working with farmers in Haiti, how to engage farmers in a discussion about climate risk and risk management? The team is planning the part 1.

- IRB protocol addendum development

In March 2018, Dr. Staub started preparing the documentation for the training and evaluation components of the PICSA Agroclimate training that will be submitted to UF's Internal Review Board (IRB) prior to the trainings.

- Participant selection strategy

In March 2018, Dr. Staub developed a strategy for identifying the recipients of the training, ensuring that participants invited by AREA have the background and mandate necessary to excel in their work with farmers on climate risk management.

- PICSA instructor's manual translation from English to Haitian Creole

Haitian Creole linguist Josue Dimanche completed the preliminary translation of the PICSA Agroclimate Training instructor's manual. The manual will be refined prior to the beginning of the training.

- Feedback received from AREA AOR and the Haiti Ministry of Agriculture's Direction of Innovation

On March 8, 2018 Dr. Staub presented the Agroclimate Training activity plan and timeline to the members of the Haitian Ministry of Agriculture and USAID Agreement Officer Reginald Toussaint. Their feedback and suggestions will inform the training logistics.

Figure 3. Dr. Staub presented AREA's Climate Smart Solutions program's upcoming capacity building initiative to officials with Haiti's Ministry of Agriculture and USAID's Reginald Toussaint.

Output 2. Agroclimate Training Part 1 - Gainesville, FL *

No activities conducted in this quarter.

Output 3. Agroclimate Training Part 2 – Haiti *

No activities conducted in this quarter.

Output 4. Agroclimate Training Evaluation Round 1 *

No activities conducted in this quarter. * Pending agreement with partners at the University of Reading

Output 5: Producing Agroclimate Educational Resources for Haitian Educators

- Prototype of Online Climatology Tool for Haiti evaluated by faculty in Haiti

AREA is developing an Online Climatology Tool for Haiti (OCTH) in Year 3 to inform tertiary-level climatology and agronomy curricula at partner institutions. It is designed to allow Haitian faculty and students to explore monthly rainfall and temperature patterns across Haiti under the

influence of El Niño Southern Oscillation (ENSO), an important predictor of inter-annual climate variability in the region. The ability to use seasonal ENSO forecasts and understand the impacts on rainfall and temperature across the island can inform agricultural planning and operational decisions. In January 2018, Dr. Staub met with Dr. Clyde Fraisse, associate professor of Agricultural Engineering at the University of Florida and head of the Agroclimate team, to discuss the observations by climatology and agronomy faculty in Haiti of the prototype of the online historical climatology tool. The Agroclimate team is now improving the tool by introducing context-specific functionality including dual language (French and English) as well as a metric scale. In March 2018, Dr. Staub provided a translation of the tool's technical terminology.

- Ongoing Publications

In an effort to reinforce Haiti's capacity to build, maintain and use low-cost automated weather stations, Dr. Staub is leading the Climate-Smart Solutions team to develop an extension publication that will provide AREA partner institutions with specifics on the acquisition of station parts, building, siting and maintenance. In January and February, Drs. Staub and Eisenstadt worked on the manuscript and they anticipate submitting it to the board of the University of Florida's Electronic Data Information Source (EDIS) before the end of Year 3. The English version was completed in March 2018 and circulated to co-authors for review. It also has been translated into Haitian Creole and will be submitted in April to the EDIS editorial board. In March, Dr. Staub began writing a second extension publication that will provide AREA academic partner institutions with information on the OCTH, including user instructions and potential applications in higher education in Haiti. In March, she also made progress on the literature review section of a manuscript that focuses on the integration of local knowledge to inform climate risk management in Haitian agriculture.

<u>Output 6. Climate module for FAMV Internship: Diagnosis of Agrarian System</u>
No activities conducted in this quarter.

B. Collaborative Capacity Building in Maize Seed Systems

The development, production, dissemination and adoption by farmers of well-suited cultivars are key components of a viable maize production system.

The majority of farmers in Haiti use adapted but low-yielding maize cultivars that are acceptable to Haitian consumers. For farmers to change their traditional cultivar lineup and adopt new agriculture practices to increase production, they need accurate information presented in an understandable manner, so they can judge the risks and potential benefits.

AREA is working with the International Maize and Wheat Improvement Center (CIMMYT) to train farmers in the production of seeds of improved maize varieties. With its germplasm collection and breeding programs, CIMMYT is the leader in identifying maize cultivars suitable for production in Haiti. In addition, AREA will train agricultural professionals to design and implement variety trials that integrate participatory breeding evaluations by farmers.

Output 1: Conduct train-the-trainer sessions using the corn seed production modules developed in Year 2

Thirty participants (22 male and 9 female) attended a maize seed system training in Les Cayes, Haiti on March 13 and 14. This was a joint activity between AREA and Mayi Plus project administered by CIMMYT. The AREA project developed three training modules translated to Haitian Creole. The modules covered the basic biology of the seed, the critical stages of corn development based on the Iowa system, seed quality, seed storage and best agronomic practices. Participants took pre- and post-tests of knowledge.

Output 2: Evaluate the implementation of seed production modules by the Haitian trainers

The AREA project's M&E coordinator is analyzing and will report the results next quarter. These results, as well as observations by the trainers, will inform changes to the modules. AREA will schedule additional trainings with CIMMYT using the modified materials. Ludger Simon led the training and worked with AREA to assist in the translation of the materials. The project also will hire him to work on the maize seed system activities.

Output 3: Implement modules of standard operation procedures (SOPs) for conducting maize experiments

AREA's curriculum specialist and Dr. Martin Bohn, a corn breeder from the University of Illinois, began work to develop the modules. Simon will identify Haitian participants to attend the training, which will be held in Illinois in July.

Output 4: Evaluate the implementation of SOP modules by the Haitian trainers.

Nothing to report this quarter.

Output 5: Introduce phenotyping equipment at the CRDDs (Bas Boën and Montrouis) and participating farmer organizations.

Nothing to report this quarter.

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C. Legume Research Program

The objective of AREA's Legume Breeding program (LBP) is to develop and release high-yielding, disease- and pest-resistant legume cultivars that have better tolerance for abiotic stresses compared with cultivars currently used by farmers in Haiti. The LBP focuses on genetic improvements of legume crops — common beans, peanuts and pigeon peas. The peanut breeding work began as a joint effort between AREA and a USAID project funded by the Feed the Future Peanut and Mycotoxin Innovation Lab. AREA has taken over the peanut breeding work. Dr. Raphael Colbert, the AREA's legume breeder, and Dr. Barry Tillman, professor and peanut breeder in the Agronomy Department at the University of Florida, are collaborating on this effort.

The legume germplasm evaluation, breeding and selection activities are being conducted at various experimental stations in the target region that represent different agroecological zones and climatic conditions. This increases the ability to develop new varieties that are adapted to a wide range of environmental conditions. Trials conducted at the CHIBAS experimental station in Cabaret and the CRDD in Bas Boën aim to select germplasm that is adapted to lowland conditions and trials conducted at the CRDDs in the Kenscoff region (including Robin and Duvier) that is adapted to highland conditions. At these locations, the LBP evaluates the performance of different lines and varieties under low fertility input conditions (with or without phosphorus). This includes evaluating their ability to produce nodules and fix nitrogen under low N conditions. In addition to these traits, the LBP selects improved lines for their resistance to common diseases, nematodes and insect pests and for desirable phenotypic characteristics such as plant stature, earliness and overall yield performance.

Output 1: Select and evaluate lines of common beans that are adapted to several agroecological zones in Haiti and possess desirable phenotypic and genotypic traits.

- Evaluation and Selection of the LBP Improved Bean Lines

As reported last quarter, Dr. Colbert is increasing seeds from the four most-promising advanced black bean lines (PR1423-99, PR1423-110, PR1423-117 and PR1423-153) in Cabaret. He planted the bean lines on Dec. 21 to increase the number of seeds so larger-scale evaluation trials can be implemented in April. In previous trials in both highland and lowland conditions, the LBP evaluated the performance of these four advanced lines, local varieties and the introduced improved bean line DPC-40. The high-yield performance of the four advanced lines is comparable to DPC-40, but the LBP lines mature earlier. Earliness is desirable because it allows farmers more flexibility in their planting schedule and reduces risks posed by weather, pests and diseases by shortening the time that the beans are in the field. Dr. Colbert will work with the International Farmer's Organization for Sustainable Development (http://www.ifosud.org/), based in Leogane, Haiti to increase the seeds from these four advanced lines. They plan to plant the seed increase plots in April. The seeds will be harvested, packaged and then planted in grower evaluation trials during Year 4. The LBP will use grower trials to evaluate these lines to determine if they are candidates for release as new, improved varieties for Haiti. The LBP will develop a plan to produce high-quality, foundation seeds for any potential new variety.

- F_2 and F_4 plant selection at CHIBAS research station in Cabaret

In spring 2017, Dr. Colbert made 22 new crosses between local varieties and improved lines from the Puerto Rico breeding material that he has been evaluating in Haiti. He made the crosses at a greenhouse at the CRDD in Robin, which is located east of Kenscoff in the Port-au-Prince district. He harvested the F_1 seeds, produced from the crosses in June 2017. He planted these seeds in a greenhouse at the CRDD in Duvier in August to obtain F_2 seeds for further evaluation. In mid-December, he planted these F_2 seeds at the CHIBAS experimental station in Cabaret. During this quarter, he has been collecting data on plant growth, important plant characteristics such as date of flowering and overall yield performance. Based on the data that he collected and his visual assessment of individual plants, he made selections of individual plants and during the first week of March, collected seeds from these plants to advance the F_3 population.

In December, fifty-eight F_4 bean population were planted at the Cabaret research center to generate an F_5 population. The best performing plants were selected and harvested during the week of March 5, 2018.

Output 2: Select and evaluate lines of pigeon pea that are adapted to several agroecological zones in Haiti and possess desirable phenotypic and genotypic.

Nothing to report this quarter.

Output 3: Select and evaluate lines of peanut that are adapted to several agroecological zones in Haiti and possess desirable phenotypic and genotypic traits.

- Peanut Breeding Program

Drs. Colbert and Tillman are developing improved peanut varieties for Haiti. These varieties have higher yields and better disease resistance than local varieties.

- Seed stock increase CHIBAS Research Station in Cabaret

As reported last quarter, five of the late-maturing lines (15B31_1107-1, 15B31_1185-1, 15B32_1118-1 15B32_1123-1, 15B32_1156-1) were selected for further testing based on their yield performance, disease and insect resistance. Dr. Colbert is increasing seeds of these in all of these lines at the CHIBAS research station in Cabaret. The seeds take 120 days to reach maturity. He anticipates harvesting these seeds next quarter. After harvest, the AREA project will develop a contract with an organization to increase seeds for larger-scale evaluations.

Output 4: Form strategic partnerships with Haitian and non-Haitian researchers that will promote the success and sustainability of the legume breeding program.

Leading legume breeders from of Puerto Rico (James Beaver and Tim Porch) and Honduras (Juan Carlos Rosas) and a representative of the Ministry of Agriculture (Gasner Demosthene) visited the legume breeding plots in Cabaret to assist in data collection and make visual observations of the performance of Dr. Colbert's breeding materials. This yearly visit is part of the regional breeding plan for a project funded under the USAID's Legume Innovation Lab that includes components in Honduras and Puerto Rico. The AREA project's legume program is evaluating some of the materials developed by these two breeding programs. For example, Dr. Colbert had some of these breeding materials as part of his trial at Damien. The data collected on breeding material in the Damien trial will be compared with their performance in Puerto Rico and Honduras.

Dr. Colbert met with Jon Draxton from the International Farmer's Organization for Sustainable Development. This organization promotes sustainable farming, owns a tractor, and conducts farmer training and education. The organization will increase promising new bean seed varieties developed by the LBP. The effort to increase seeds will begin next quarter through a contract for services agreement between the AREA and the organization.

The Peanut and Mycotoxin Innovation Lab (PMIL) project, managed by the University of Georgia, released a call for proposals in March which includes potential funding for projects conducted in

Haiti. Haiti is listed as a second priority country and a maximum of $500,000 per project is available for up to four years of funding. Dr. Colbert is working with Dr. Tillman on the proposal, which will build onto the breeding work that was initiated between Colbert's AREA project and Tillman's former PMIL funded project. They hope to obtain funding to enhance the AREA project's peanut component by focusing on undergraduate, graduate (MS) training and human and institution capacity development in Haiti. A concept note describing the work plan and proposed budget of the peanut breeding component is being finalized for submission.

Output 5: Capacity building in plant breeding and improvement

Two ARA interns (Ramy Bertin from Quisqueya University and Danianie Avril from University Notre Dame) are working on their memoire under the supervision of Dr. Colbert. One agronomist (Joany Moline) was hired to support Dr. Colbert's research program.

The interns conducted literature reviews to develop research topics that will focus on common beans or peanuts.

Dr. Colbert will serve on the graduate committee's Rocheteau Dareus and Riphine Mainviel. Dareus will be working on cowpea breeding and improvement. Mainviel will be working on phenotyping common beans. Drs. Esteban Rios and Geoffrey Meru have invited Raphael to serve on their graduate committees. Dr. Colbert will be responsible for supporting their research efforts when they conduct a portion of their MS research in Haiti.

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D. Plant Pathology

The focus of the AREA Plant Pathology program is to improve the capacity of the Bas Boën CRDD to operate and maintain a functional plant disease diagnosis laboratory. This has been accomplished through training of staff, improving the plant pathology lab area, creating an isolation room and supporting a lab technician. Also, AREA is working to help identify the causal agent of a "new toppling" disease that has affected banana plants in Haiti and to determine its distribution. AREA expects this research will lead to recommendations on methods to control the disease.

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

AREA's plant pathology technician analyzed 27 samples during the quarter ended March 30, 2018. The samples were collected at various locations in the region (Table 1) and analyzed at Bas Boën CRDD. This analysis involved a number of steps. By viewing samples under a stereoscope, the technician can detect the symptoms and signs (characteristic spores, fruiting bodies) of a disease's causal agent. After placing samples in a moist chamber for 24 to 48 hours, she used a microscope to analyze fungal growth stained with lactophenol. She accessed AREA-purchased reference books on common plant pathogens of major crops to confirm diagnoses.

Table 1. Plant disease samples collected and analyzed from January - March, 2018 at the at Bas Boën CRDD

Plant	Location	Disease/ symptoms	Causal/ associated agent	No. of samples
Corn	CRDD Bas Boën	Common smut	*Ustilago maydis*	1
Corn	CRDD Bas Boën	Gray leaf spot	*Cercospora* sp.	2
Corn	CRDD Bas Boën	Corn rust	*Pucccinia polysora*	3
Sorghum	CRDD Bas Boën	Yellow Aphids		1
Plantain	CRDD Montrouis	Black sigatoka	*Mycospharaerella finjiensis*	2
Coconut	Merger	Mealy bugs		2
Bean	CRDD Bas Boën	Fusarium wilt	*Fusarium* sp.	3
Swiss chard	CRDD Bas Boën	No pathogen found		2
Bean	Galet Chanbon	Rust		5
Mango	Ganthier	whitefly		2
Orange	Ganthier	Scale insects		2
Bean (root)	CRDD Bas Boën	*Pythium*		2
Bean	CRDD Bas Boën	Angular leaf spot	*P. griseola*	3

The plant pathology team sampled plantain that displayed symptoms of Panama disease. Samples were shipped to UF and James Fulton, UF plant pathology doctoral student, isolated *Fusarium oxysporum* f.sp. *cubense* from four different plant samples. He established single spore isolates of each. He prepared the materials needed to perform vegetative compatibility group testing with the isolates, which will allow grouping to know types of *Fusarium* isolates that cause the disease. This is a step toward a disease report for the disease in Haiti. This is important because although the disease has been present in Haiti, there is no literature on the types of isolates in Haiti relative to those pathogenic isolates from around the world that cause this disease.

Extension documents (addressing two bean diseases)
Two extension documents, "Alternaria Leaf and Pod Spot of Snap Bean in Florida" (PP-61) and "Management of Powdery Mildew in Beans" (PP-311), were translated and adapted into Haitian Creole. In addition, previous translations, including Tropical Vegetable Disease I (PP 40), were reviewed and the adaptation points or comments were highlighted to facilitate the review process.

Expert elicitation
The consent form of "Analysis of the Haitian banana and plantain industry: an expert elicitation Instrument: Expert elicitation workshop" was translated into French. This form will be used to conduct an expert elicitation for disease risk in banana.

Disease notes: progress toward publication

- Fusarium wilt of banana: mating type identification (completed)
    - Next steps: collection of additional samples; Pathogenicity tests; Basic molecular characterization
- Phytophthora blight of beans: The pathogen has been isolated.
    - Pathogenicity tests are being carried out at the Bas-Boën CRDD.
    - Missing steps: Complete the Koch's postulates & molecular characterization
- Powdery mildew of beans
    - Morphological description of the pathogen (completed)
    - Manuscript (written)
    - Missing step: Molecular characterization. This disease has been found on the hillsides of Pétionville. Samples will be collected during the planting season (late April and

May). After the samples are collected, molecular characterization can be carried out within few days.

- Other candidates for diseases notes include the following: Rhizoctonia root rot of beans, downy mildew of corn, at least a viral disease of corn, at least a viral disease of beans. Description of the diseases and/or morphological characterization of the pathogens were conducted.
    - Missing step: the molecular characterization for publication purposes. The samples will be collected in April-May.

Output 2: Technical training support for CRDD and Ministry of Agriculture personnel

Joubert Fayette, post-doctoral researcher in plant pathology, will train the staff at the Haiti Ministry of Agriculture and interested in staff at the CRDDs next quarter. He has developed training materials tailored to the needs of Ministry of Agriculture Plant Protection Department. The training will be on the following:

- Microscope care and use
- Isolation and identification of phytopathogenic bacteria
- Isolation and identification of phytopathogenic fungi
- Best practices in laboratory management

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

In February, Dr. Joubert Fayette, Dr. Randy Ploetz (professor and banana expert, Plant Pathology Department, UF) and James Fulton, traveled to Haiti to obtain disease tissue samples in fields where plantains were exhibiting symptoms of the toppling disease. Below is a summary of their findings.

Symptomology
The team traveled to the plantain and banana growing region around Montrouis to sample plants showing symptoms of the toppling disease. Agronomists from the Montrouis CRDD selected farms to visit where they knew the field managers and heard that their fields had diseased plants. On these farms, the team observed field incidence rates of the disease between 1 percent to 30 percent. Incidence and not severity seem to be the most important metric for classifying the significance of this disease as it appears that all plants that develop this condition eventually collapse under their own weight. The field managers can recognize infected plants before lodging occurs. They were able to describe the symptoms of the disease and the disease progression. In one case, a farmer tried to manage the toppling of his plants by tying the plant pseudostem to stakes buried into the ground to support the plants from falling prior to fruit maturation. While this disease problem has existed for several years, it appears it has become more severe in the last two years (2016 and 2017).
Common symptoms of the disease observed in the field:

- Softened plant tissue that appears as a type of soft rot. Softened plant tissue was noticed in plant tissue early in their maturation as sword suckers
- Chocolatey brown necrotic discoloration appears externally and internally. This discoloration appears to begin externally and proceed inwards towards the true stem (Figures 4-5).

- Necrotic discoloration extends several feet in length and width while penetrating tissue to a depth of several inches (Figure 6).
- Necrosis appears at approximately the same location on each layer of pseudostem (Figure 7).
- Excessive "sweating" or water seepage as bulbous edemas on the surface of plant tissue. This is apparent on cut tissue as copious fluid drains from the wound. This fluid accumulation is visible as discoloration in the general location.
- An unusual but distinct smell
- Base leaves appear to split or shred when plant tissue is opened (Figure 8)
- Finally, toppling (Figure 9)
- Differences of incidence between cultivars exist as Cavendish and FIHA 21 seemed affected less often compared to plantains.

Symptoms **not** observed in the field:

- Pathogen signs
- Consistent presence of any insects such as *Cosmopolites sordidus*. On only one occasion was a sugarcane weevil observed. Insects do not appear to be a vector.
- During the laboratory work, no fungal organisms were observed other than a positive control (*Fusarium oxysporum*)

Based on personal communication with field managers and agronomists in Haiti, the symptoms appear to coincide with seasonal changes in precipitation. The incidence decreases during the dry periods of the year (mid-November to beginning of March) and increases during the wet (beginning of March to mid-November) (Figure 10). This would appear to eliminate drought as the cause of this problem and suggests the possibility of certain types of pathogens that are associated with wet environmental conditions.

Figure 4. Necrotic tissue appears as a chocolatey-brown discoloration both externally and internally. Photo credit: R. Ploetz.

Figure 5. This discoloration appears to start from outside of the pseudostem and progress inwardly.

Figure 6. Necrotic discoloration extend several feet in length and width while penetrating tissue to a depth of several inches.

Figure 7. Necrotic discoloration extend several feet in length and width while penetrating tissue to a depth of several inches.

Figure 8. Upon opening, base leaves appear to be split or shredded.

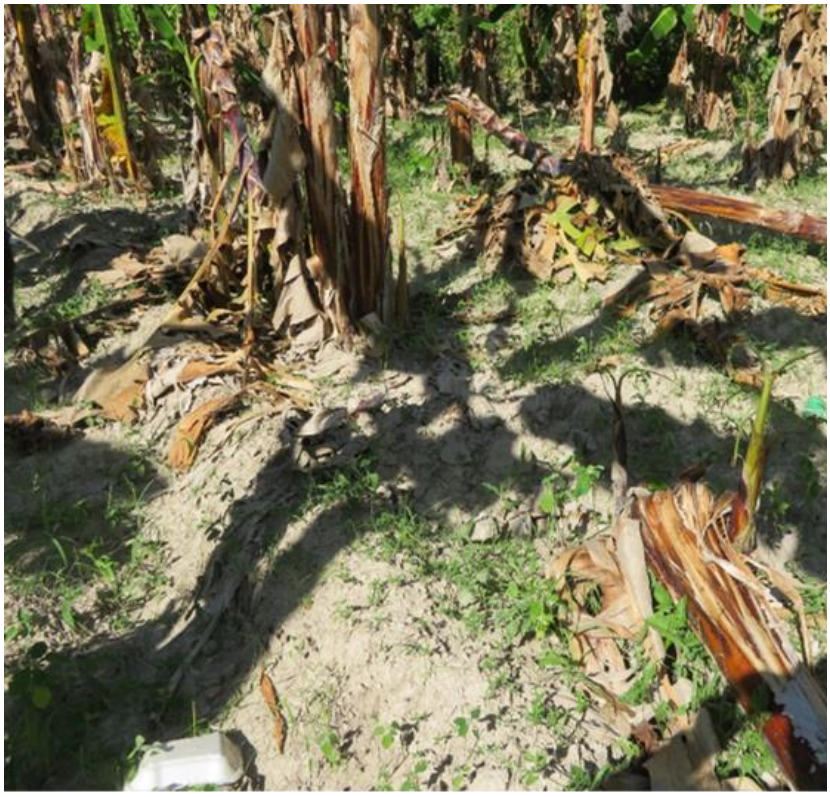

Figure 9. Plants were consistently observed to collapse or topple at inflorescence when plantain bunches would form.

Incidence of Toppling Disease by Month

January	February	March	April	May	June	July	August	September	October	November	December
Dry period: Less incidence		Wet period: Increased incidence								Dry period: Less incidence	

Figure 10. Incidence rates are apparently highest during the wet time of the year.

Production information

Farmers' fields were comprised largely of the cultivar Musquée ("French" plantain), while the cultivars FIHA (Honduran Foundation for Agricultural Research) 21 and Cavendish are produced to a lesser extent. This supports the data published by Thierry Lescot (2004). In addition, the cultivar Bluggoe is produced in the region (personal communication, AREA employee). FIHA 21, Cavendish, Bluggoe, and Musquée apparently are intentionally grown together. Farmers' use this mixed cultivar production technique to suppress disease and provide insurance against losses. Bluggoe (ABB) and Cavendish (AAA) are alternatively planted around the perimeter of a field with mixed varieties of plantain (ABB) distributed inside of this perimeter. Disease incidence in plantains is higher compared with bananas. This production scheme could explain lower incidence rates on plantains in some locations. This maybe the result of creating buffers between more tolerant cultivars and susceptible varieties (Figure 11).

When planting new fields, farmers primarily use suckers from their own plants or get suckers from neighboring farmers. But there are "clean" sources of planting material in the country (personal communication, Jonathan Greenham, chief of party for Feed the Future North's AVANSE program). The buying and selling of sword suckers as planting material are significant economic decisions for farmers because selling individual suckers can provide an additional income. To recommend disease control practices, AREA needs to understand how farmers obtain and exchange planting materials. It is highly probable that planting materials are a source of new disease incidence.

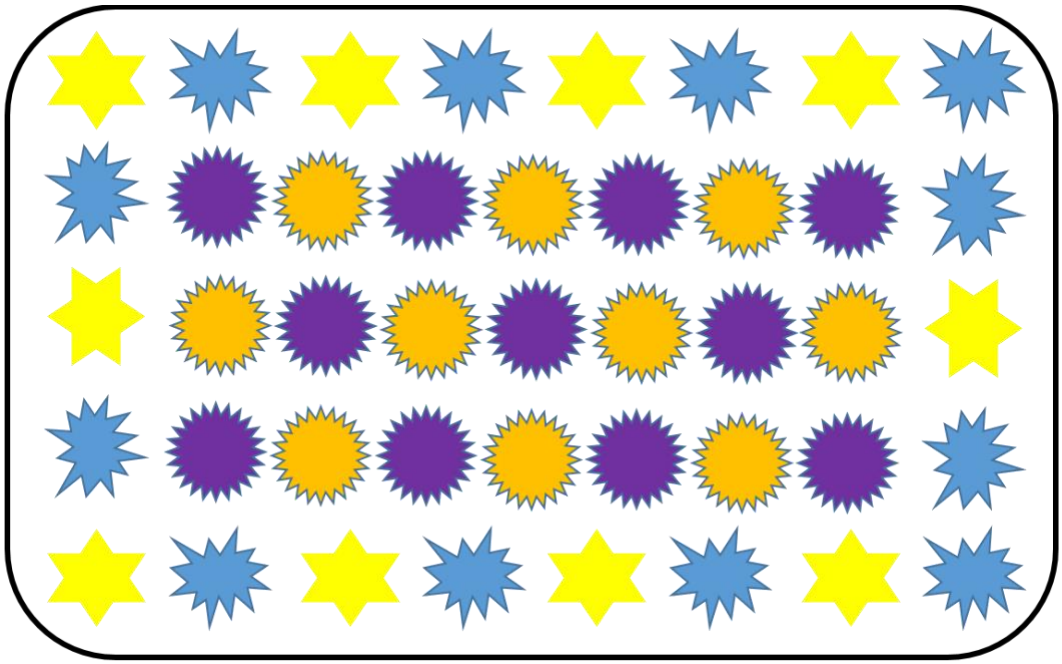

Figure 11. A typical Haitian smallholder production system. Legend: Yellow stars = Bluggoe (AAB). Blue stars = Cavendish. Purple and yellow decagons = mixed verities of plantain.

Laboratory Analysis

The plant pathology team brought selective isolation media to Haiti so that the initial disease samples could be analyzed at the Bas Boën CRDD. Disease samples were collected on Feb. 15 and placed on different selective media plates two days later. Since the team suspected *Erwinia (Dickeya)* spp. to be the causal agent of "Pseudostem Wet Rot" or "Toppling Disease," minimal salt medium (MSM) media was used to identify bacterial isolates that demonstrated pectolytic activity. Based on the results of this initial plating on selective media, two bacteria isolates were found to have positive reactions for MSM (Figures 12-13). The MSM showed a positive response, growth and color indicator change. On Feb. 20, the bacteria isolates were transferred from the MSM plate to nutrient agar (NA) media. Three distinct bacterial organisms were isolated from the samples. No fungal growth was observed other than the positive control, a *Fusarium oxysporum* f. sp. *cubense* sample collected and processed in the laboratory.

The team sampled in the same fields on Feb. 23 and shipped the samples to the plant disease diagnostic lab in Gainesville, Florida, which has better equipment and allowed James Fulton to perform more selective testing and molecular work, as needed. Fulton repeated isolations and

plating studies on these samples. Additionally, also will re-infect tissue culture plants with the isolates to confirm which, if any, isolates cause the disease in plants inoculated with the putative pathogen. The results from the laboratory work in Gainesville and inoculation tests will be reported next quarter.

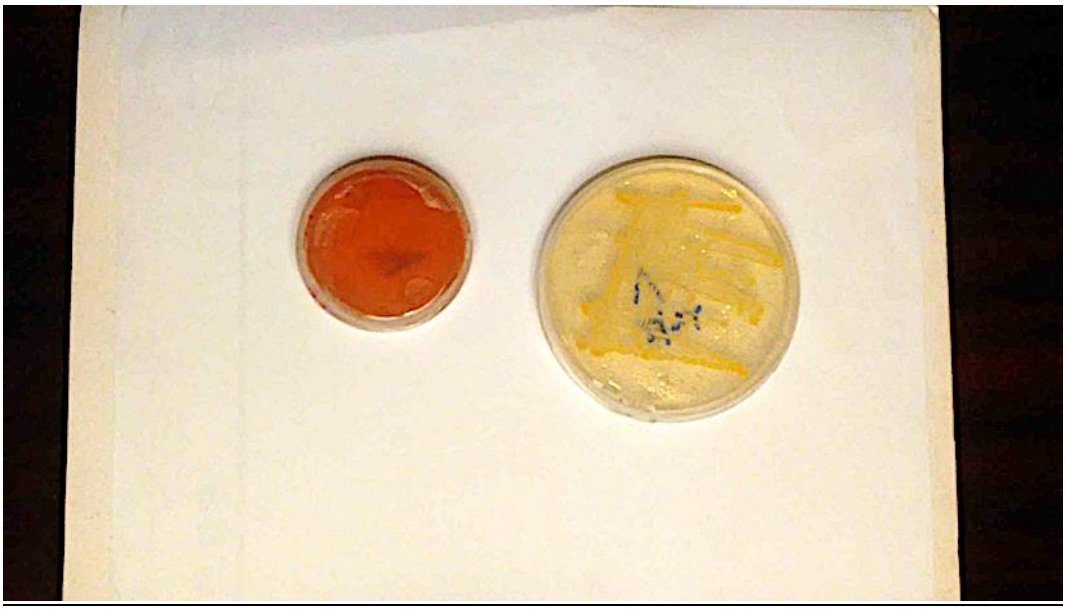

Figure 12. Two bacterial organisms were isolated and cultured. When transferred to MSM media a positive response was observed within 24 hours.

Figure 13. Two bacterial organisms were isolated and cultured.

In addition to isolating potential plant pathogens from diseased tissue, basic testing was performed on soil collected around diseased plants. The soil tests included soil pH, electrical conductivity, nitrogen, potassium, and phosphorus levels (Table 2). The results indicate that the soils where

disease samples were collected are very alkaline, somewhat poor in nitrogen, and abundant in potassium and phosphorus. This baseline data may be important to understand the environmental conditions associated with disease symptoms.

Figure 14. Since symptoms were first reported in 1990, this problem has been reported throughout the country. Areas of major production represented by black dots. Map produced by Thierry Lescot (2004)

Table 2. Soil analyses of samples taken on Feb. 15, 2018

Sample	pH (field kit)	Nitrogen	Phosphorus	Potassium	EC	pH (probe)
7	>7.5	Deficit	Surplus	Adequate	479	8.28
8	>7.5	Deficit	Surplus	Adequate	229	8.54

<u>Output 4: Map the current distribution of banana toppling disease and other banana/plantain diseases in Haiti</u>

Fulton conducted a literature review of banana diseases in Haiti and elsewhere to obtain information about the types of diseases reported in Haiti. In addition, he contacted banana experts to learn about their banana disease research in Haiti. He met with Jonathan Greenham, chief of party (COP) of the USAID-funded AVANSE program. They discussed joint activities related to plant pathology training in North Haiti and collecting samples of diseased bananas on farms in the region.

Fulton worked with Nana Adu, MS student in UF/IFAS's Department of Family, Youth and Community Sciences, and Dr. Mickie Swisher, professor in Family, Youth and Community Sciences, to develop instruments to evaluate the perceptions of toppling and other banana diseases in the

region. They will complete these instruments next quarter and submit them to UF's and Haiti's internal review boards (IRBs) for approval.

Based on a search of the literature, the first report of toppling disease was in Marigot in 1990. Since then, it has been reported in many of the country's major plantain production areas (Marigot, Leogane, Arcahaie, and Cap-Haitian) (Figure 14). Fulton will use this information to identify a sampling frame and design research to develop a reliable map of the current distribution of the disease in Haiti.

Output 5: Conduct strategic planning for Ministry of Agriculture for addressing new plant pathogens in Haiti

While the delegation from Haiti's Department of Innovation visited Gainesville in March, Dr. Karen Garrett, professor in UF's Plant Pathology Department, and her lab members discussed the possibility of evaluating the ministry's capacity to identify and respond to new disease pathogens in Haiti. Drs. Garrett and Fayette plan to conduct a planning session with the ministry in Haiti next quarter.

Output 6: Training of Haitian collaborators in plant disease management and strategic planning, including training in the R programming (statistical computing) environment and scenario analysis

Drs. Garrett and Fayette began developing workshop materials in French for the R computer programming workshop. A training module entitled "Introduction to R" is based on an existing module (published in the online teaching journal Plant Health Instructor). The team updated and translated the module to French. AREA's plant pathology team will hold a workshop in Haiti next quarter using these materials and publish the French translation online.

- Dr. Fayette earned a certificate in R training by taking the course online via the platform DataCamp (https://www.datacamp.com/home) so that he can teach the Introduction to R module. Presently, he is working on the Intermediate R course.

Other related activities:

- Drs. Garrett, Staub, and Fayette, with James Fulton and other students, completed an initial draft of a book chapter on adaptation strategies for plant disease management under climate change. The chapter focuses on plant disease management using Haiti as a case study. They plan to submit the chapter to APS PRESS, the publishing imprint of The American Phytopathological Society.
- Using other funds, Garrett, Fayette and Fulton presented at the annual workshop for the Consultative Group for International Agricultural Research (CGIAR) Roots, Tubers and Bananas (RTB) program for seed systems in Nairobi, Kenya, March 27-30. This workshop provided cross-fertilization of ideas for seed system improvement between AREA and CGIAR RTB.
- Garrett, Fulton, and other colleagues finalized an invited paper describing methods and concepts that the AREA project is implementing in Haiti, for the Annual Review of Phytopathology: "Network analysis: a systems framework to address grand challenges in plant pathology."

- The plant pathology team submitted an abstract for this summer's International Congress of Plant Pathology (ICPP) 2018: Plant Health in a Global Economy. The presentation, "The past, present, and future of plant diagnostic networks in Haiti" will examine how diagnostic networks are vital components of plant protection services, providing surveillance for emerging diseases and decision-support for farmers. The presentation will describe how these networks can be best adapted to the Haitian context and identify how they should be sustained after a period of initial support from external donors. The team was invited to give a plenary presentation at the ICPP 2018 meeting on AREA's work in Haiti as a case study.

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E. Soil Science Research Program

Haiti's soils are predominantly from calcareous parent materials and they are generally young. 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. This is the case of soils found in the semi-arid part of the Feed the Future West corridor from Ganthier to Saint-Marc. The soils have a smectic mineralogy and a strong tendency to salinity mainly because of high evapotranspiration and low rainfall. This causes a low aggregate stability associated with other physical problems. For about 20 years, land located in this region was the subject to intense agricultural use due to the presence of hydro-agricultural infrastructure and population pressure. Also, intensive and indiscriminate use of the soils caused its degradation and decrease of their 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

Output 1: Spatial variability study of soil attributes and properties

In February, Dr. Wesly Jeune processed and analyzed soil samples at the FAMV soil testing lab. He and his team continued to analyze sub-samples and focused on measuring organic matter according to a LOI (loss on ignition) method.

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

AREA recently received approval from USAID to purchase the necessary fertilizers. AREA now is in the process of purchasing the products.

Output 3: Management of soil salinity to create better conditions for crop growth and yield increase.
No activities this quarter.

Output 4: Cover crops for soil improvement and nematode management.

This study evaluates the susceptibility of various cover crops to root-knot nematode (Meloidogyne spp.). Cover crops can protect and improve soil fertility by reducing soil erosion, building soil organic matter and, in the case of leguminous cover crops, providing a nitrogen source for subsequent cash crops. They can also improve the productivity of soils by suppressing plant-parasitic nematodes that adversely affect cash crop root systems and thus reduce uptake of water and nutrients. This study forms part of Robyn Adair's thesis, a master's student at UF. In January, Adair and Dr. Jeune set up experiments and collected data at two agroecological sites, Bas Boën and Duvier CRDD. At each site, we collected a compound soil sample at every plot unit; totaling 32 soil samples. The physical and chemical properties of these samples will be analyzed in the laboratory during Year 3. From the samples collected at both sites, they then extracted plant-parasitic nematodes and preserved them in formalin. They measured photosynthetically-active radiation (PAR) as well as Leaf Area Index (LAI) from the crop canopy at two-week intervals after planting. They also collected weed density and biomass data 30 days and 60 days after planting. Preliminary results demonstrate that LAI values associated with for Lablab and sorghum were higher in Bas Boën than in Duvier. The primary analyses also show a higher nematode population in Duvier than in Bas Boën.

Output 5: Capacity building related to soil management.

The main objective of this training is to promote a soil management method that is designed to result in optimal crop yields. In January 2018, Dr. Jeune prepared the training material as well as the evaluation tests. He also met with FAMV faculty to plan the soil fertility management component of the February 2018 FAMV Diagnostic Course. For more details, please see section L.

Dr. Jeune conducted a soil fertility management training workshop with agronomy students and professionals on March 15-16 (Figure x). The training session focused on diverse topics including soil as a life support system, soil erosion, soil alkalinity, soil nutrients availability, diagnosis of soil fertility and soil nutrients management in Haiti. The two-day workshop was held at the Bas Boën

CRDD. Twenty-five participants (including eight females) attended. They included members of farmer associations, undergraduate students and members of FONHDAD. Forty-four percent of the participants were agricultural producers, extension agents, and master farmers. The private sector (32 percent) and NGOs (24 percent) accounted for the remainder.

Figure 15. Soil fertility management workshop held on March 15-16, 2018.

Participants were asked to complete a survey before and after the workshop to measure how much they learned. Twenty-two participants completed both the pre- and post-tests, an 88 percent response rate. A paired t-test showed that there is a strong evidence that the soil fertility management training led to knowledge gain among participants on average (figure Y).

The average baseline score was 3.32 points (ranging from 0 to 10.5) out of 20 possible points. The average post-score was 13.84 points (ranging from 2 to 20).

All those surveyed reported an increase in knowledge. However, more than 30 percent of respondents did not score more than 10 points, which is half of the maximum possible score. The results suggest that some of the content, such in-depth theoretical concepts, required prior knowledge and a certain level of critical-thinking skills that these participants may not have possessed. AREA will take these results into consideration for future theory-based workshops. The next workshop is planned for the end of May and will focus on more practical knowledge. It will address soil sampling scheme, use of GPS in soil sampling, methods of soil collection and analysis,

interpretation of soil data, and precision agriculture.

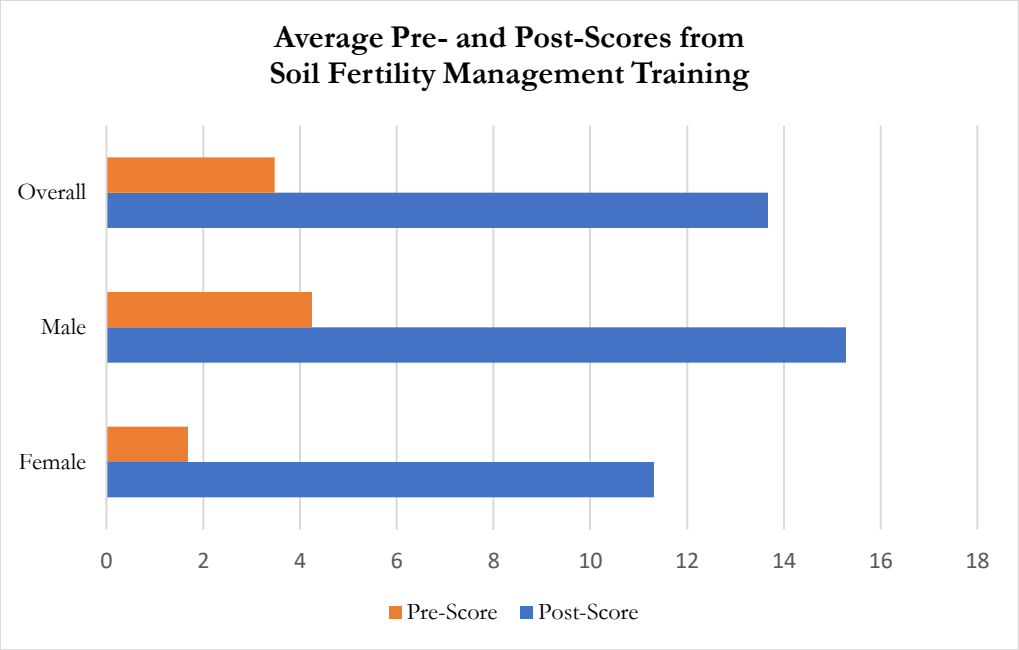

Figure 16. The average pre- and post-scores of respondents at the May 15-16 training workshop, broken down by gender.

F. Launching Research Programs

Output 1: Launching programs in Sweet Potato and Rice with LSU experts

The LSU AgCenter drafted a scope of work to supplement the afore-mentioned support of graduate studies with in-country technical assistance. Dr. Koenig as AREA project director responded to this draft with a teleconference with interested faculty members of the LSU AgCenter, particularly the following:

- Dr. Elizabeth Gollub of the LSU AgCenter's School of Nutrition and Food Science, who has assessed the nutritional situation in Haiti, proposes to provide nutritional education. This program will focus on Asian Spinach (brassica family) as an easy to prepare, palatable vegetable that could be added to meals to provide key (health-promoting) nutrients.
- Dr. Arthur Villordon, a soil fertility specialist of the LSU AgCenter's Sweet Potato Research Center, is working with Dr. Wesly Jeune, AREA's in-country Soil Fertility Management Program Leader, to develop an appropriate extension program.
- Dr. Jeff Davis of the LSU AgCenter's Entomology Department will refine his original proposal to use pheromone traps in reducing weevil infestations.

Dr. Gollub has provided a detailed list of activities that she proposes to conduct for the rest of the project's duration. When Drs. Davis and Villordon refine their proposed activity proposals, a finalized SOW will be submitted to the University of Florida.

G. Mini-Grant Program

The AREA project launched a Mini-Grant program to support the development of agricultural research professionals, encourage collaboration among researchers and research institutions, and address agricultural research priorities. The projects also will address gender disparities within the agricultural sector and promote gender equity.

Output 1: Request for Application finalized and released

AREA received 10 applications for the first of a series of three mini grants. These first grants provide up to $4,000 to qualified applicants for the acquisition of supplies and other nonexpendable items. To be eligible for AREA grants, applicants are required to be affiliated with a Haitian higher education institution, a technical branch of the Ministry of Agriculture, Natural Resources and Rural Development (MARNDR) or the Rural Centers for Sustainable Development (CRDDs). Preparations were also were made to release requests for application for the next in the series of grants to be released in April: Mini Grant No. 2 (for individual research projects) and No. 3 (for collaborative research).

Output 2: Review and selection of successful applications for mini-grants

An AREA committee reviewed the applications for the first series of grants and eliminated two as unqualified. Two others also were eliminated for various reasons. One rejected applicant, who requested the purchase used equipment, will be encouraged to apply for a Grant No. 2 or 3. AREA is preparing a letter to send the applicants informing them of the grant decisions.
AREA's Gainesville team is in the process of purchasing and shipping the products for the winners of the first series of grants.

Output 3. Workshop on financial management

Nothing to report this quarter.

H. MS and Grad Certificate Program

Nineteen AREA-funded master's of science students are enrolled in graduate school at UF (17) and LSU (2). Seventeen students have developed research projects. Many of these students will travel to Haiti this summer to begin experiments in the field and collect data. Some students will relocate to Homestead, Florida, where they will live as they conduct research at the UF/IFAS Tropical

Research and Education Center, the only university research center in the continental U.S. focusing on a large number of tropical and subtropical crops.

In January, two students were enrolled at UF and started classes after completing English Language Institute (ELI) program. A third student re-enrolled in the ELI program to improve her English, completed her standardized tests and obtained admission from UF for summer 2018 semester. Four individuals completed their graduate certificate program applications to UF**.** One student accepted into the program plans to enroll in courses this summer semester. The other three candidates have not yet informed AREA on the status of their applications. One additional candidate is in the process of completing an application.

Table 3. List of research projects MS graduate students are working on:

Student	**Project**	**Summary**
Franky Celestin	Efficiency of different Phosphorus rate on the Growth and Yield of Black Bean (*Phaseolus, vulgaris*).	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.
Marie Christelle Calixte	Current practices in implementing practicums in Haitian agricultural technical and vocational education and training: Review of six (possibly five) technical schools.	The purpose of the study is to have a better understanding of agricultural technical and vocational education and training (TVET) in Haiti. Specifically, it seeks to get a picture of how TVET fits into the Haitian agricultural and extension system through the curriculum and the integration graduates into the workforce. The objectives are to uncover the role of agricultural TVET in Haiti, to appreciate the theory and practical balance of agricultural TVET curricula, and to discover the sectors with highest demand for agricultural TVET graduates.
Rocheteau Dareus	Screening Cowpea (*Vigna unguiculata* L.Walp) Germplasm for Root Knot Nematodes Resistance (*Meloidogyne 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.
Lynhe Demesyeux	Plantain and banana nematode resistance in Haiti and Florida	Assessment of nematode population in Arcahaie and in Homestead, Florida and evaluation of fruit quality and nematode resistance of 15 new cultivars in Homestead.
Stephanie C. Docteur	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.
Marie Darline Dorval	Genomic Prediction of Sweet Sorghum Agronomic Performance under Drought and Irrigated Environments in Haiti	The goal is to use different models of genomic prediction 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.
Cassandre Feuillé	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.
Jhonson Leonard	Biological control activity of rice rhizosphere bacteria and their interactive effects with silica treatment against sheath blight of rice	This study aims to develop new biocontrol agents and cultural practices with silica fertilizer for disease management of sheath blight in rice. Sheath blight is caused by the soil-borne fungus *Rhizoctonia solani* 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 *R. solani* on Potato Dextrose Agar plates. This bacteria will be identified though 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. Research will be conducted in the Antimonite region. The cultural practices that promote or impair the development of major rice diseases will be studied.
Marie Rachele Lexidort	Use of Molecular Markers for Identification of Major Sweet Potato Weevil species present in Haiti	Study of the characteristics of the major sweet potato weevil species in Haiti and spatial distribution.
Jean-Maude Louizias	Cover crops for weed and nematode suppression and improving soil fertility in the lowlands of Haiti	The aim of this study are to: 1) Observe which cover crop is more effective in suppressing sedentary plant-parasitic root-knot nematodes in eggplant cropping systems. 2) Evaluate the yield of eggplants following the incorporation of residue of different cover crops. 3) Compare the ability of velvet beans (*Mucuna pruriens* L.), and cowpea (*Vigna unguiculata*) cover crops to suppress root-knot nematodes with sunn hemp (*Crotalaria juncea).* 4) Evaluate the efficacy of cover crops in suppressing weeds.
Riphine Mainviel	Agronomic performance and genetic diversity among select common bean varieties in Haiti	The goal of the project is to evaluate the agronomic performance of 15 elite dry bean-breeding lines under development by the AREA and the Legume Innovation Lab programs and determine the genetic diversity of these and 10 other bean cultivars in the market in Haiti.
Redjino Mompremier	Soil erosion and sediment transport modeling on a watershed in Arcahaie, Haiti, and evaluation of the reservoir sedimentation on the water	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

	availability for agricultural production in the Courjolle irrigated perimeter.	management practices (BMPs) applicable for sustainable agriculture in the area.
Floyid Nicolas	Assessing the impacts of climate change on rice (*Oryza sativa*) yields with DSSAT CERES-rice model in the Artibonite Valley of Haiti.	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. 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, CO_2 and solar radiation. 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.
Liliane Poincon	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.
Josue St. Fort	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 weather conditions. This will help decision-makers to develop strategies to account for climate variability in growing this crop.
Carina Theodore	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.
Calvin Wilfrid	Assessment of intercropping and biological insecticide applications on *Melanaphis sacchari* 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. The impact of certain biological insecticide applications on sugarcane aphid outbreaks will also be evaluated.

I. Ministry of Agriculture

Output 1. Working with the training branch of the Direction of Innovation to develop an action plan and publish the extension bulletin: Les Bulletins Agricoles du MARNDR

No new activities to report this past quarter.

Output 2. A delegation of the Direction of Innovation of the Ministry of Agriculture visits research and innovation centers in Florida

March 4-10, AREA hosted a group of six officials from the Haiti Ministry of Agriculture's Directorate of Innovation, two employees of CRDDs, and USAID Agreement Officer Reginald Toussaint on a tour of agricultural research, extension, water quality and agribusiness facilities in Florida. This was part of AREA's effort to assist the ministry in improving Haiti's agricultural research and extension services. Specifically, Garry Augustin, director of the DI, requested AREA's assistance to visit the Florida facilities to inform ministry officials as they establish an innovation center in Haiti.

AREA created an itinerary, coordinated tours, and arranged transportation and lodging. After arriving in Fort Lauderdale, the group traveled in a 15-passenger van accompanied by AREA staff to numerous locations across Florida to learn about major agricultural research, extension and business operations. Stops included the UF/IFAS Tropical Research and Education Center in Homestead, Lipman Produce in Immokalee, ECHO Farm in North Fort Myers, the USDA's Natural Resource Conservation Service in Brooksville, a Suwannee River Water Management Authority facility in White Springs, UF's North Florida Research and Education Center in Live Oak, Southern Cross Sea Farms in Cedar Key, and the Florida Department of Agriculture and Consumer Services' Division of Plant Industry in Gainesville. The visits were designed to provide Haiti officials with insights about major agricultural activities, including the operations and the management of cropping systems, a state plant pathology lab, seed production, crop storage and quality control, clam farming, privately funded agricultural research, large-scale tomato production and more.

On the group's last afternoon in Florida, the officials met most of the Haitian graduate students enrolled at UF through the AREA project, students who will return to Haiti to help transform the country's agricultural sector.

After returning home, Augustin wrote a report on the lessons learned, which he shared with AREA PI Rose Koenig and others.

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J. Gender Assessments and Interventions

The AREA project is working to identify gender constraints in the agricultural sector. This includes making recommendations and developing interventions that are gender-responsive to the programming of agricultural projects, particularly through extension and advisory services.

Output 1: Country report on gender integration

Taisha Venort, the project's coordinator of the gender assessments and intervention, continues work on several activities related to generating the upcoming report on integrating gender dimensions in Haiti's agricultural extension services. She has completed a relevant literature review and has developed assessment instruments that will be used for interviews with extension stakeholders. To properly conduct these key informant interviews, she is preparing documents for approval by the Institutional Review Board (IRB) at the University of Illinois and in Haiti. She is analyzing and collecting qualitative data for the report.

Output 2. Workshop/training on how to conduct agricultural technology assessment using gender lens

An agreement has been reached with Cultural Practice LLC, an international development consulting firm, to conduct this workshop in July 2018 in Haiti. The goal is to train extension service providers and other stakeholders on ways to integrate gender responsiveness in agricultural technology transfer processes to efficiently reach participants, particularly women.

Venort has been in touch with a representative of Cultural Practice to provide a concept note to the University of Illinois to guide this activity. This concept note will help to: (1) determine time period for the workshop (2) finalize IRB documents for submission beforehand (3) select extension stakeholders to be involved (4) collaborate with a nutrition expert at the Louisiana State University to integrate nutrition components specific to the technologies.

Output 3. Agricultural technology assessment using gender lens

Venort has identified two potential technologies to be discussed with the project's PI and stakeholders. She is preparing a background document on these technologies to help prepare for the assessment activity. This will be finalized following the technology introduction workshop and a training of the extension stakeholders.

K. Extension Experiment

The goals of the AREA Extension Experiment project are to:

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

After creating evaluation instruments, establishing relationships with implementing partners, and hiring and training staff, AREA officially launched the project in September 2017.

Output 1: Extension Models Implementation Workshops

This activity was completed in Q1 of Year 3.

Output 2: Questionnaire to assess previous use of/familiarity with new technologies

This activity was completed in Q1 of Year 3.

Output 3: Group Dynamics

The group dynamics instrument assesses individuals' experiences with the farmer association in which they are a member as well as the perception of their role in the association. These data will be used in both quantitative and qualitative analyses to understand how group traits affect adoption. In combination with the observational data, we will explore whether we can identify traits or characteristics of farmer associations that contribute to a higher adoption rate. The data will also be combined with those collected in 2016-17 regarding the structure of the farmer associations in order to enhance our typology of types of farmer associations. As of March 2018, Dr. Anglade and his team has conducted 863 interviews (97 percent complete). This is an on-going activity through March 2018. The data collected will be cleaned, processed, and analyzed in Year 3.

Figure 17. An intern interviewing a farmer.

Output 4: Observation at Farmer Association Meetings

Using the observation instrument, Dr. Anglade and his team are making direct observations of group meetings. This is an on-going activity. As of March 2018, the agronomists have participated in 15 meetings. After each meeting, the surveyor writes a brief case summary of observations. The instrument includes a list of questions to guide development of a case summary. AREA will conduct qualitative analyses of the case summaries to identify common themes within and across the different associations. This information will also be used in combination with the data from group

dynamics to identify characteristics of farmer groups that contribute to a higher rate of adoption.

Figure 18. Participating in a farmers' group meeting.

Output 5: Verifications of adoption

This output includes two components: observation of assisted testing and measurement of independent testing. The observation of assisted testing was completed in March. Using the "observation of assisted testing" sheets prepared by the Haiti-based extension experiment team, the observation activity involved working with the 90 participating farmers and a representative of each farmers' organization. For each extension model, the agronomist reported the percentage of liaison farmers who chose to test the technologies after receiving a sample in FY3 Q1. In addition, each agronomist asked the association representative to estimate the number of their farmers who will choose to employ each innovation in the following growing season.

In January the AREA team also prepared for the measurement of independent testing, by working on making the technologies available to farmers in the region for purchase through four retail outlets that sell agricultural supplies. The team hired a distribution logistics manager to help AREA establish a market for the new technologies in the study region and ensure the distribution and control of the merchandise (the technologies) in the stores. In February, the distribution logistics manager met with the owners of the four stores to discuss partnering with the project to ensure the technologies are available in the stores. The technologies are: push-pull hoes, jiffy pellets, PICS bags and kale and komatsuna seeds. AREA's team in Haiti received the products on March 2, 2018. The employee repackaged and branded the technologies and distributed them to the stores (see Appendix for pictures). The technologies were available for purchase in the stores on March 12, 2018 (Figures 19 and 20).

In June 2018, AREA plans to launch the instrument to measure the response of farmers to the products. The social science team prepared this "exit interview" questionnaire in FY2, and it will be reviewed and field tested prior to implementation. Among other things, the survey will measure the percentage of farmers who chose to purchase any of the five technologies for use on their farms.

The farmers are not receiving any direct assistance or encouragement from AREA to purchase the products. This activity is expected to last two months.

Figure 19. Packaging and branding the technologies.

Figure 20. Packaging and branding the technologies.

L. Higher Education Research Interviews

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 curriculum, 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.

The following are key accomplishments of the program in the second quarter of Year 3.

Output 1: Presentation of Higher Education Research Results to Higher Education Institutional Dean Partners in Haiti

AREA held a six-hour meeting with university partners on March 2, 2018 at the Best Western Hotel. Among those who attended were the following deans and representatives: FAMV (Jocelyn Louissaint), Campus Limonade of the State University of Haiti (Guesly Jean Pierre and Emerson Louis), American University of the Caribbean (Arsene Similien and Bury Renaud), Université Notre Dame D´Haiti (Marie Alexandra Alexandre) and Université Episcopale d´Haiti (Carl Dukens Gilet). Fourteen people including AREA staff participated. Drs. Grady Roberts and Absalon Pierre presented the results of this research conducted by the project.

One of the key findings of the research is that faculty members requested more opportunities to develop students' practical skills, via practicums, internships and labs. Additional recommendations from the research were to integrate extension and "soft" skills in courses and linking universities with Haiti's agriculture sector.

As a follow up, AREA will provide curriculum consultation sessions with institutions that request help to improve their programs. The officials were also invited to the Innovation in Agricultural Education conference May 3-May 4, 2018 at Karibe Hotel in Pétionville, where local professors and other experts will share their experiences and best practices for teaching at the higher education level.

Output 2: Evaluation of the FAMV Internship - Diagnosis of Agrarian System course

FAMV asked AREA to evaluate the curriculum and pedagogical practices of its Diagnosis of Agrarian System course, a field practicum that fourth-year students are required to complete. To examine the course and make recommendations for improvements, AREA's higher education team and colleagues participated in the September 2017 program, which was held over 12 days in Ennery and Savane Carrée in the Artibonite region. They interviewed students and faculty, examined course content, and later analyzed the data and developed recommendations.

Output 3: Lead Researchers Contribute to the FAMV Internship through workshops and trainings

On Jan. 16, Drs. Absalon Pierre, Wesly Jeune and Lemâne Delva, and other AREA staff members presented FAMV faculty the results of the surveys and recommendations to improve the next course.

From Jan. 26-28, AREA followed up by organizing and financially supporting a retreat for FAMV faculty at Kaliko Beach Hotel. FAMV professors, including Vice Dean of Research Ophny Nicolas Carvil, participated. Dr. Pierre developed a worksheet to guide discussions and to help participants clarify the main objectives of the course and determine ways to modernize its content. They developed an agenda, decided that all professors and students would use PowerPoint when making presentations, and recommended that students use new technologies such as GPS during the internship. Professors were required to send presentations to the committee for approval prior to the start of the course. This helped the committee to know the content of each presentation and the time necessary for each professor.

These changes were incorporated in the most recent field practicum, which was held Feb. 14 to Feb. 25, 2018, in Marigot and Cayes-Jacmel. Ninety-one students participated. The students were divided into two big groups to analyze the two farming regions, where they interviewed farmers to learn how they grow, manage, process and sell agricultural products. They collected and analyzed data, and collaborated to develop a case study of these important agricultural regions.

AREA researchers and staff provided expertise and assistance during the program. Dr. Wesly Jeune, the lead researcher on the AREA's soil fertility program, taught the students about soil science and demonstrated how to use GPS devices and digital tools to conduct a landscape analysis of these regions. Dr. Pierre, the AREA project's human and institutional development specialist, taught a session on research ethics. Taisha Venort, AREA's gender specialist, provided lessons on data collection and management techniques.

Some changes noted by AREA staff were improvements in efficiency and time management of the course. An agenda was well prepared and distributed beforehand, which improved scheduling. The PowerPoint presentations approved by the committee saved time and improved organization, which reduced pressure on professors and students by limiting last minute changes. In some cases, instruments to collect data (crops systems, livestock) were prepared so students avoided having to collect missing data, as was often the case at previous courses. Students also had more time to analyze data they collected in the field.

On the final day of the program, the students gathered in Jacmel to make presentations about their research findings. Faculty, local farmers and guests, including deans of FAMV and AREA management (Drs. Rose Koenig and Lemâne Delva, and Chief of Party Maurice Wiener), attended the event. AREA researchers will follow up to continue to help FAMV improve the course.

Additional Activities

- Publications

Pierre, A., Calixte, M. C., Moore, K., Bunch, J. C., Koenig, R., Delva, L. & Roberts, T. G. (in press). Haitian agricultural faculty preparation for their academic roles. Journal of International Agricultural and Extension Education

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M. Faculty Development Academy

Faculty Development Academy is an AREA program to train a cohort of professors to improve college-level courses and curricula and to implement innovative teaching methods. AREA's higher education team has completed its core Faculty Development Academy activities since last December, including developing and delivering training materials, and training selected faculty members at its seven partner institutions using a train-the-trainers model. The lead educators trained by AREA project experts, in turn, have been teaching what they learned to other faculty. A detailed description of the academy was in previous reports.

When needed, AREA's project team is available to assist the partner institutions to provide the three training modules that compose this program. AREA also is collecting syllabi from them to document changes made in courses, and encourages the institutions to continue training their faculty using the modules.

Output 1: Curriculum Consulting Sessions

Starting in the third quarter of this fiscal year, AREA's higher education team will be available to work with faculty members of its higher education partners who request consulting sessions to improve their course curriculum.

Output 2: Convention on Innovation in Agricultural Education: Enhancing Higher Education in Agriculture

AREA continued preparing for its conference on Innovation in Agricultural Education, which is thought to be the first such conference devoted to agricultural higher education in Haiti. The conference, to be held May 3-4, is expected bring together about 100 U.S. and Haitian agricultural professors and researchers. AREA finalized an agreement with Karibe Convention Center Hotel to serve as the venue for the conference. Haiti and U.S. scholars submitted 21 submitted abstracts, which they will be present at the event. AREA requested its seven higher education partners to each select up to 10 professors to attend, particularly those who participated in the Faculty Development Academy. Other officials, including deans from the partner schools, have also been invited to participate and give presentations about their institutions and to welcome participants. Drs. Gael Pressoir from Quisqueya University and Audalbert Bien-Aimé from the Limonade Campus of the State University of Haiti will be among the keynote speakers. They will talk about innovations in agriculture and the importance of good teaching methods, including improved curricula.

N. Postharvest and Food Safety Program

The goals of the Postharvest Loss Management and Food Safety program are to:

1. Develop training programs designed to decrease postharvest loss, improve food safety and inform potential exporters about U.S. regulations related to food exports.
2. Contribute to food safety research in Haiti with a focus on aflatoxin contamination.

Below are the key accomplishments of the program in the second quarter of fiscal 2018.

Output 1: Create reference and other outreach materials that communicate to service providers and farmers about ways to prevent postharvest losses and improve food safety.

The postharvest technology and food safety team produced reference and other materials to educate members of Haitian food industry about ways to develop and implement a Hazard Analysis Critical Control (HACCP) plan to prevent foodborne pathogens in food processing facilities.

The training package covered four sections: 1) an introduction to the HACCP system, including how and why it evolved to seven principles; 2) the prerequisite and preliminary programs that are critical to the implementation of a food safety system, including the formation of a HACCP team with duties of each member defined, and prerequisite programs such as good hygiene and good manufacturing practices; 3) The three types of hazards (biological, physical and chemical) and how they can be controlled during food handling and storage; 4) The seven HACCP principles as described by the National Advisory Committee on Microbiological Criteria for Foods (hazard analysis, determination of the critical control points, establishment of the critical limits, establishment of monitoring procedures, correctives actions, surveillance and recordkeeping) and how these principles fit into an HACCP plan.

Output 2: Design, develop and conduct a one-week training on postharvest loss management.

On Feb. 22 and 23, the AREA team trained participants of the food industry in Haiti on the HACCP principles and the steps to develop and implement an HACCP plan in a food processing facility. The United States and the members of the European Union, among other countries, require food processors to have a well-implemented HACCP plan to ensure consumers' food is safe. One of the key goals of the training was to increase export opportunities for Haitian food processors. (Because of the difficulty of having participants attend a five-day workshop, AREA developed the training to provide the material over two days.)

The 57 people who attended the training were divided into five groups of 10 or more participants, and each group simulated a HACCP team at a food production company, makers of peanut butter (group 1), west Indian cherry juice (group 2), summer sausage (group 3), ice cream (group 4), and Dous Makoss, a Haitian fudge (group 5). During the first day of the training, the participants learned the theoretical background on the HACCP system and the process for putting in place the plan. On the second day, each group had the task to produce a HACCP plan based on the following process:

1. Organize the HACCP team by assigning specific tasks to the team members, such as HACCP team coordinator, quality assurance manager, sanitation manager, technical counselor and maintenance coordinator.
2. Describe the food product and draw a process flow diagram for the product.
3. Develop the standard operating procedures for food manufacturing and ensuring proper hygiene in the food facility
4. Apply the seven HACCP principles in the flow diagram to develop the plan.

Evaluation of the training

The participants were invited based on the relevance of their main activities to food safety and food handling practices. Among the 57 attendees, 46 reflected were counted in the project's Monitoring and Evaluation after adjusting for those who had attended a prior AREA training. Among the 46, 18 (39 percent) were women, and 85 percent were from the private sector.

To measure how much knowledge participants gained, they were surveyed using a test with content on the HACCP process before and after the training. Forty-two participants completed both pre- and post-tests, corresponding to an overall response rate of 91 percent. Ninety-one percent of the participants completed the survey. Eighty-one percent had an increase in knowledge.

The test consisted of 15 multiple-choice questions on the HACCP process from its preliminary steps to its seven principles. Each question had four possible answers, except for the first question on prerequisite programs that included a "None of the above" option. The average baseline score was 3.81 points (ranging from 0 to 7 points) out of 10 possible points. The average post-score was 5.36 points (ranging from 2 to 9 points), resulting in an average increase in score of 1.55 points (ranging from -1 to 6 points). A paired t-test showed that there is a strong evidence that the training led to knowledge gain among participants (see Figure 1).

Eighty-one percent of the respondents had a higher score after completing the training. Though not statistically significant, the change in the average score of female respondents was higher than that of male respondents: 84 percent of women respondents and the 78 percent of the men respondents reported an increase in knowledge.

Post-test scores suggest participants may need additional training and prior to implementing an HACCP system at their workplace. While the factors associated with the low average post-score achieved remain unknown, but it indicates the lack of initial background of participants. Whatever the reason, it is important to take these results into consideration for the next workshops dealing with in-depth subjects and concepts that may require prior knowledge in the area.

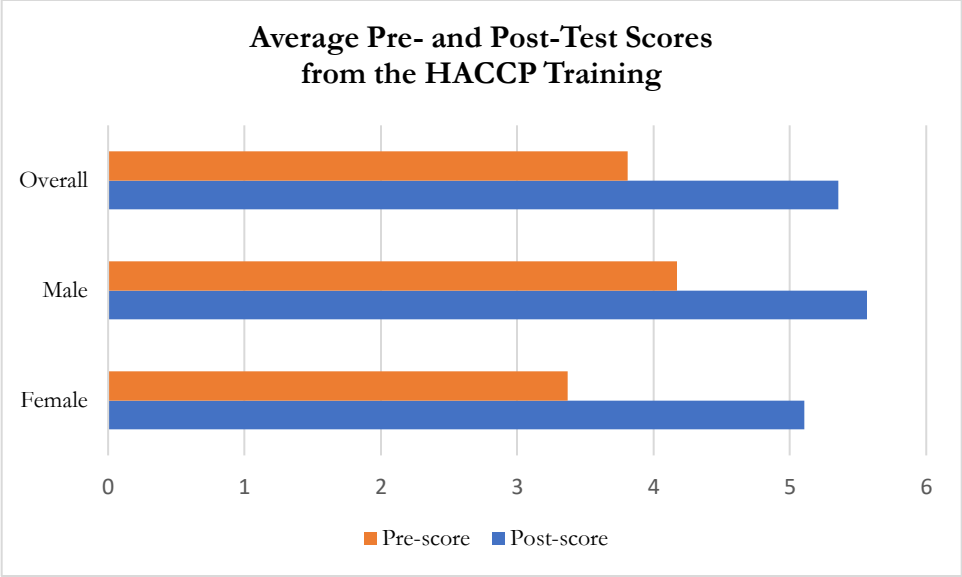

Figure 21. The average pre- and post-scores of respondents, broken down by gender.

Output 3: A one-week training on Food Safety, Good Agricultural Practices Certification and the requirements of the Food Safety and Modernization Act (FSMA)

As previously reported, in October 2017, Dr. Lemâne Delva, AREA's director of research, and Antonio Antoine, postharvest technology and food safety specialist, participated in a grower training organized by Produce Safety Alliance (PSA) in North Carolina. The training was based on a curriculum designed to provide a foundation of Good Agriculture Practices (GAP) knowledge that included co-management of food safety and environmental management goals, and the requirements of the Food Safety Modernization Act (FSMA) Produce Safety Rules. After the training Delva and Antoine both received a train-the-trainer certificate that qualifies them to conduct the PSA grower training under the supervisor of a qualified lead trainer. The AREA project and PSA have a verbal agreement to replicate the training for the Haitian farmers. AREA hired a professional to translate the PSA training materials to Haitian Creole. The translation is expected to be completed in May, and the training will take place in Haiti in the early summer.

Output 4: Identify key private sector companies interested in developing a Hazard Analysis and Critical Control Points (HACCP) plan

The postharvest technology and food safety team developed criteria to select the private sector companies that are ready implement a HACCP plan. In the upcoming months, the team will visit the companies.

Output 5: A large-scale study aimed to improve storage conditions of grains, beans and peanuts in major public markets in the FTF-West Corridor

The program includes conducting a large-scale study to investigate storage conditions and to reduce aflatoxin contamination in grain crops and peanuts. AREA plans to store cereal grains (corn, rice and sorghum) and peanuts under traditional and improved conditions in four public communal markets: Arcahaie, Croix-des-Bouquets, Kenscoff and Vialet. Aflatoxin is a toxic substance

produced by fungi (Aspergillus flavus or Aspergillus parasiticus). In preliminary work, AREA performed a short-term baseline study to determine the aflatoxin content and perform microbial analysis and to characterize the commodities in these markets. A student from the Department of Food Science of FAMV, as part of his undergraduate memoir, measured the aflatoxin content, which was reported last quarter. In the most recent quarter, AREA conducted the microbial analysis. The enumeration of total germs, yeasts and molds and fecal coliforms realized with the respective use of the following growth media: Plate Count Agar (PCA), Brain Heart Infusion Agar (BHIA) and Violet Red Bile Agar (VRBA).

Quantification of total germs

Total plate count was accomplished by counting aerobic colonies at 30°C according to the 2015, MFHPB-18 norms. The PCA culture medium was prepared by dissolution of 17.5 g in one liter of distilled water. This preparation was heated by stirring frequently, then allowed to boil for one minute. The sterilization, intended to destroy all the germs initially present in the medium, was carried out in an autoclave at 121ºC for 15 minutes and 10^{-1} to 10^{-3} dilutions were performed using four test tubes each containing 9 ml of peptone water. After the dilution, deep seeding of the PCA medium in three petri dishes was done. Then, the petri dishes containing the different dilutions were incubated in an oven at 35°C for two days. After two days, the germs were counted.

Quantification of yeasts and molds

Yeasts and molds were counted by colony at 25°C under aerobic conditions according to standard NF V08-059: 2008 (Appendix 2). The BHIA culture medium was used. It was prepared from the dissolution of 52 g in one liter of distilled water and then heated by stirring frequently and boiling for a minute. The mixture was then sterilized by autoclaving at 121° C for 15 minutes and . then dilutions of 10-1 to 10-3 were made using four test tubes each containing 9 ml of peptone water, using a sterile 1 ml pipette. The mixture of the mother solution was collected and placed in a petri dish, with this same pipette, and 1 ml of the mother solution was placed in a test tube, and so on, until the dilution was made for each test tube. After dilution, a deep seeding of the medium for yeasts and molds was completed. After the incubation at 35ºC for three days, the colonies were counted.

Quantification of fecal coliforms

The colony of fecal coliforms were counted at 30° C under aerobic conditions using the 2016 standard NF V08-050. Violet Red Bile Agar/Glucose and Lactose culture medium. It was prepared from the dissolution of 50.62 g in one liter of distilled water and then heated by stirring frequently and boiling for a minute. Sterilization was performed at 121° C for 15 minutes in an autoclave and 10^{-1} to 10^{-3} dilutions were made using four test tubes each containing 9 ml of peptone water. After dilution, a deep seeding of the medium for fecal coliforms was done. Incubation of the petri dishes was performed at 37º for 24 hours and the colonies counted.

Colony identification was performed using morphological criteria developed by Pitt et al. (1997). After 72 hours of incubation, the petri dishes for yeasts and molds began to develop, but their visual aspects did not allow AREA to reach a conclusion. It was necessary to wait up to five days of incubation under the same conditions mentioned above, thus, the colonies were characterized macroscopically. An attempt at microscopic identification was made using an optical microscope and iodine and methylene blue dye solutions to facilitate observation.

Results

The raw results of the microbial analysis are shown in Appendix 2. A complete analysis of the data will be presented in the next quarterly report.

Output 6. Poster/and or paper presentation at Institute for Food Technologists International (IFT) Conference in the United States

- AREA submitted an abstract to the Institute of Food Technologists (IFT).

On Dec. 18, the postharvest technology team submitted an abstract to the Institute of Food Technologists' poster evaluation committee. The abstract was not accepted by IFT.

Monitoring and Evaluation (M&E)

This section summarizes achievements and challenges of AREA research activities covering the second quarter of the FY2018.

This quarter's performance is highlighted by the following:

- Two additional graduate students joined the pool of 17 graduate students and started master's programs at the University of Florida (UF);
- The Climate Smart Solutions, the Legume Breeding and the Support to Higher Education programs accounted for four research publications;
- Three training events were held, and 93 percent of the 163 participants reported an increase in knowledge;
- The Support to Higher Education program report two partner universities implemented curriculum changes;
- GPS units were introduced to FAMV Diagnostic Internship program in Jacmel;
- Six project partners were selected to receive mini grants;
- Four potential cover crops to decrease the population of nematodes in the soil were evaluated over a three-month period;
- Women represented 27 percent of participants benefitting from project's activities conducted this quarter.

Indicator 1 – Number of individuals who have received U.S. government-supported long-term agricultural sector productivity or food security training (RAA) – EG.3.2-2 (FTF 4.5.2.6)

Two new graduate students entered their rmaster's programs at the University of Florida after successfully completing an intensive English course and taking the standardized tests (GRE and TOEFL). There are now 17 graduate students enrolled at the College of Agriculture and Life Sciences (CALS) at UF and two at the College of Agriculture at Louisiana State University (LSU). This indicator is on target one remaining student will entering her long-term training the following quarter.

Table 4. Number of Haitian students in the departments of the agricultural colleges at UF and LSU

Department of Interest	No. of Students	No. of Female Students
Entomology	2	1
Agronomy Department	1	0
Horticultural Sciences	6	4
Environmental Horticulture	1	1
Plant Pathology	1	0
Agricultural and Biological Engineering	3	0
Soil and Water science	1	0
Food and Resource Economics	1	1
Agricultural Education and Communication	1	1
Family, Youth and Community Sciences	2	1
Total	19	9

Indicator 2 – Number of research and extension publications as a result of project assistance – custom

Four publications were reported in Q2. This indicator continues to be on target. The Climate Smart Solutions program accounted for two conference presentations. The Legume Breeding program reported one thesis conducted on common bean lines was successfully defended at the Université Quisqueya. The Support to Higher Education program reported one additional research article submitted to the Journal for International Agricultural and Extension Education (JIAEE); meanwhile, one research publication accounted in the Q1 report has been accepted at JIAEE, switching status from submission to acceptance. See Table 1 for more details on the publications.

Table 5. Research publications

AREA Program	Title of Article/Presentation	Status	Location
Climate Smart Solutions Program	From Models to Decisions: Managing Natural Resources in a Changing and Uncertain Climate	Presented	International Conference of the Mauritian Academic Diaspora 2018
	Wireless Weather Stations and Maintenance Training for Haitian Agriculture	Presented	6th University of Florida Water Institute Symposium
Legume Breeding Program	Study of the Growth Parameters and Yield of 17 Common Bean Lines in Alkaline and Saline Soil at the Bas-Boën CRDD	Undergraduate Thesis Defended	Library at Université Quisqueya
Support to Higher Education	Haitian Agricultural Faculty Preparation for their Academic Roles	Accepted	Journal for International Agricultural and Extension Education (JIAEE)

	Haitian Faculty Perceptions of Students' Competence at Graduation: an Opportunity for Curricula Modification	Submitted	Journal for International Agricultural and Extension Education (JIAEE)

Indicator #3 – Number of individuals who 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)

This indicator has already surpassed the FY2018 goal of 159 by more than 100 percent. In the second quarter, 163 people participated in short-term trainings (workshops and internships) supported by the AREA project. This includes the second FAMV diagnostic internship program in the project's activity, in which 89 students participated. An increase is expected for this indicator as more short-term trainings are planned for the third quarter. Table 6 provides the breakdown of the number of participants by the training events.

Indicator #4 – Number of training events delivered

Four training events were held in the second quarter, including the student internship program at FAMV.

Table 6. Breakdown of training events held during Quarter 2

Workshop	Location	Participants	Proportion of Female Participants	Proportion of Participants with increase in knowledge
All Q2 Workshops	Haiti	163	25.2%	93%
FAMV Diagnostic Internship Program	Jacmel, Marigot and Cayes-Jacmel	89	14.6%	98%
Internship Program – Extension Experiment Interns	AREA Office	4	50.0%	100%
HACCP Training	Hotel Montana	46	39.1%	81%
Soil Fertility Management Training	Bas Boën CRDD	24	33.3%	100%

Indicator #5 - Percentage of participants with an increase in knowledge related to research and extension – custom

In the second quarter, 93 percent of participants who completed pre- and post-knowledge tests reported an increase in knowledge, exceeding the target of 85. In the HACCP training, though improvements in post-scores were observed on average with 81 percent of individuals who showed an increase in knowledge, post-scores suggest that participants may need additional training and mentoring before being able to implement a HACCP system at their workplace.

Indicator #6 – Number of curriculum changes at partner educational institutions – custom
Two new curriculum changes were tracked at partner educational institutions: one on the entomology course at the Faculté d'Agronomie et de Medecine Veterinaire (FAMV) and the other in an AutoCAD course in the college of civil engineering of the American University of the Caribbean (AUC) in Les Cayes.

Indicator #7 – Number of new technologies or management practices introduced as a result of U.S. government assistance – custom

One new technology or management practice was introduced in the quarter. Students were provided GPS units during the FAMV Diagnostic Internship program to locate their area to improve the quality of the data collected in the field. The soil maps being created as part of the Soil Science Research program will be reported in the third quarter.

Indicator 8 – Number of grant-funded projects in Haiti as a result of project assistance – custom
The request for applications was launched the past quarter. Ten applications were received and six were accepted. Partner institutions in higher education and CRDD composed the awardees. Details will be provided in FY2018 Q3.

Indicator 9 – Number of technologies or management practices under research, under field testing, or made available for transfer as a result of USG assistance E.G.3.2-7

The Plant Pathology Program identified fungi called *Pythium* and is currently researching its impact on beans. There was also a study conducted on four cover crops (sunn hemp, lablab, cowpea, sorghum Sudan grass). The purpose of this research was to evaluate the potential of the four cover crops to decrease the population of nematodes and to increase the nitrogen level and organic matter in the soil. Thus, 103 technologies and management practices are under research and 36 lines are under field testing. Similar to FY2018 Q1, the Climate Smart Solutions Program currently has two technologies and management practices under research: a next generation weather station and a climatology tool. The Legume Breeding Program has 100 lines of bean under research, and it selected 36 lines (28 bean lines and 8 advanced peanut lines) to further evaluate under field testing.

Indicator #10 – Proportion of female participants in U.S. government–assisted programs designed to increase access to productive economic resources (assets, credit, income or employment) – GNDR-2

An increase in the proportion of female participants was observed in project's activities during the second quarter. Table 3 shows the disaggregation by program type for this gender indicator. Special efforts were made to increase women's participation in short-term trainings, but the result of 25 percent was weighted down by the low number of female undergraduate students at FAMV during the second diagnostic internship. 47 percent of female participants for degree-granting trainings was recorded, but it is expected to reach 50 percent in the third quarter. The project team continually put forth efforts to target women and increase their proportion in its activities.

Table 7. Proportion of Female Participants in project's activities, disaggregated by program type

Program Type	Q1	Q2
Overall	23%	27%
Short-term Trainings	20%	25%
Degree-granting Trainings	53%	47%
Internship program	-	50%

Table 8. Results from Quarter 1 of FY2018

Indicators	Q2 FY18	Annual Target	Q2 % of Accomplishment of FY2018
Number of individuals who have received U.S. government-supported long-term agricultural sector productivity or food security training (RAA)– EG.3.2-2 (FTF 4.5.2.6) Please note: N is for New and C is for Continuing	19 17 C 2 N	20 17 C 3 N	95%
Number of research and extension publications as a result of project assistance – custom	4	10	40%
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)	163	159	103%
Number of training events delivered – custom	3	12	25%
Percentage of participants with an increase in knowledge related to research and extension – custom	93%	85%	-
Number of curriculum changes at partner educational institutions – custom	2	8	25%
Number of new technologies or management practices introduced as a result of U.S. government assistance – custom	1	15	7%
Number of grant-funded projects in Haiti as a result of project assistance – custom	6	10	60%
Number of technologies or management practices under research, under field testing, or made available for transfer as a result of USG assistance E.G.3.2-7	107 Under Research 36 Under Field Testing	75 Under Research 51 Under Field Testing	-
Proportion of female participants in U.S. government–assisted programs designed to increase access to productive economic resources (assets, credit, income or employment) – GNDR-2	27%	50%	-

Appendix

Appendix 1: M&E Indicator Performance Tracking Table – FY2018

Support to Agricultural Research and Development Program (FY18)									
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 (Note: The indicators in this section apply to both Sub-Result 1.1 and Sub-Result 1.2)									
Number of individuals who have received U.S. government-supported long-term agricultural sector productivity or food security training (RAA)– EG.3.2-2 (FTF 4.5.2.6)	- Sex - Program type	4	20 17 C 3 N	17 C	19 17 C 2 N	-	-	95% 19 / 20	Y
Number of research and extension publications as a result of project assistance – custom	- Publication type - Language - Sex of primary author	7	10	5	4			90% 9 / 10	Y
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	159	154	163	-	-	199% 317 / 159	Y
Number of training events delivered – custom	- Corridor, commune - Nationality of primary presenter	5	12	7	3	-	-	83% 10 / 12	Y
Percentage of participants with an increase in knowledge related to research and extension – custom		84%	85%	94%	93%			-	Y
Proportion of female participants in U.S. government–assisted programs	- Program type	32%	50%	23%	27%			-	N

Support to Agricultural Research and Development Program (FY18)									
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
designed to increase access to productive economic resources (assets, credit, income or employment) – GNDR-2									
Number of new technologies or management practices introduced as a result of U.S. government assistance – custom	- Corridor, commune - Crop type - Technology type	0	15	4	1			33% 5 / 15	N
Number of grant-funded projects in Haiti as a result of project assistance – custom	- Sex - Source	6	10	0	6			60% 6 / 10	Y
Number of curriculum changes at partner educational institutions – custom	- Institution	0	8	2	2	-	-	50% 4 / 8	Y
Number of technologies or management practices under research, under field testing, or made available for transfer as a result of USG assistance E.G.3.2-7	- Phase of development - Corridor - Institution	0	75 under research 51 under field testing	102 under research 36 under field testing	107 under research 36 under field testing			-	Y
*Indicators that were dropped during FY2017 are omitted									

Appendix 2. Microbial Analysis of Samples

		Arcahaie			Croix-des-Bouquets			Kenscoff			Vialet		
Product		Total place count	Fecal Colifoms	Yeast and mold	Total place count	Fecal coliform	Yeast and mold	Total plate count	Fecal coliform	Yeast and mold	Total plate count	Fecal coliform	Yeast and mold
	Methodes	ISO-MFHPB-18	ISO-16649-2	NFV08-059-2015	ISO-MFHPB-18	ISO-16649-2	NFV08-059-2015	ISO-MFHPB-18	ISO-16649-2	NFV08-059-2015	ISO-MFHPB-18	ISO-16649-2	NFV08-059-2015
	Normes	$<1.0x10^5$ UFC/g	Absence	1×10^2 UFC/g	$<1.0x10^5$ UFC/g	Absence	1×10^2 UFC/g	$<1.0x10^5$ UFC/g	Absence	1×10^2 UFC/g	$<1.0x10^5$ UFC/g	Absence	1×10^2 UFC/g
Local rice (Shella)													
					2.09×10^3 UFC/g	0.1×10^2 UFC/g	1.7×10^2 UFC/g						
		5.45×10^4 UFC/g	1.36×10^3 UFC/g	1.81×10^3 UFC/g				1.09×10^3 UFC/g	6.81×10^2 UFC/g	1.36×10^6 UFC/g	4.54×10^3 UFC/g	0	2.36×10^3 UFC/g
Corn													
		2.7×10^4 UFC/g	0	9.09×10^3 UFC/g	$2,3 \times 10^5$ UFC/g	1.09×10^5 UFC/g	1.81×10^5 UFC/g				6.0×10^3 UFC/g	7.6×10^2 UFC/g	6.7×10^3 UFC/g
								0.09×10^2 UFC/g	0	1.03×10^3 UFC/g			
Peanut													
		4.45×10^3 UFC/g	0	3.18×10^5 UFC/g	0.90×10^4 UFC/g	0	2.18×10^5 UFC/g	2.72×10^4	0	1.36×10^6			
											2.72×10^5	0	1.72×10^3 UFC/g
Sorghum		0.9×10^4 UFC/g	6.36×10^4 UFC/g	8.18×10^4 UFC/g	3.36×10^4 UFC/g	0	5.45×10^4 UFC/g				1.36×10^6 UFC/g	0.30×10^4 UFC/g	4.54×10^7 UFC/g
								1.36×10^6 UFC/g	1.36×10^4 UFC/g	1.09×10^5 UFC/g			