ANNUAL REPORT 2017

Caribbean Agricultural Research and Development Institute
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Acronyms

APP Agricultural Policy Programme (EU)  CR CARDI Representative
ARVTU Agronomy Research and Variety Testing (EU)  EDF European Development Fund
BADMC Barbados Agricultural Development and Marketing Corporation  EU European Union
BAMC Barbados Agricultural and Management Corporation  FAO Food and Agriculture Organisation
BAMSI Bahamas Agriculture and Marine Science Institute  GYD Guyanan Dollar
BADMC Barbados Agricultural Development and Marketing Corporation  GDTC Goldsborough Demonstration and Training Centre
BADMC Barbados Agricultural Development and Marketing Corporation  GEF Global Environment Fund
BARVTU Agronomy Research and Variety Testing (Barbados)  GLRS Greenland Livestock Research Station
BADMC Barbados Agricultural Development and Marketing Corporation  GVC Global Value Chain
BADMC Barbados Agricultural Development and Marketing Corporation  ICT Information and Communications Technology
BADMC Barbados Agricultural Development and Marketing Corporation  IDM Integrated Disease Management
BADMC Barbados Agricultural Development and Marketing Corporation  IICA Inter-American Institute for Cooperation on Agriculture
BADMC Barbados Agricultural Development and Marketing Corporation  INIBAP International Network for the Improvement of Banana and Plantain
BADMC Barbados Agricultural Development and Marketing Corporation  ITC International Trade Centre
BADMC Barbados Agricultural Development and Marketing Corporation  MAFRT Ministry of Agriculture, Forestry, Fisheries and Rural Transformation
BADMC Barbados Agricultural Development and Marketing Corporation  MAFFW Ministry of Agriculture, Food, Fisheries and Water Resources Management
BADMC Barbados Agricultural Development and Marketing Corporation  MALF Ministry of Agriculture, Land and Fisheries
Introduction

On December 5th, 2017, the Caribbean Agricultural Research and Development Institute (CARDI) celebrated 43 years of service to the region. The Institute moved from 12 countries in 1974 to 14 countries in 2017 with the Bahamas and Cayman Islands being the latest additions in July 2016 and January 2015 respectively. The Institute functions as the agricultural arm of CARICOM which provides agricultural services to the region.

We dedicate this Annual Report to Dr Francis Asiedu.

Dr Francis Asiedu retired from CARDI on 31 March 2017, after 28 years of unstinting service.

Dr Asiedu, a national of Ghana moved to the Region in 1982, to take up a position of lecturer at the University of Guyana. After seven years at the University, Dr Asiedu joined CARDI Jamaica as a Senior Scientist in Animal Nutrition and Production. Since that time to present he has made an outstanding contribution and left an indelible mark on CARDI’s research and development programme as both a researcher and manager. As a researcher, Dr Asiedu is widely recognised for his pioneering research for development of small and large ruminants, swine and poultry enterprises in the Caribbean. Some of his notable achievements included the development of feed inputs and feeding systems technologies for ruminant livestock and swine from local agro and...
industrial by-products and forages; the adaptation of molasses and urea blocks and silage technology for small farmers and the development of tech packs on feeding and production systems for sheep and goats. He was also instrumental in the development and management of the Goat Breeders Society of Jamaica and the Caribbean Small Ruminant Network (CASRUNET). His work primarily in the small ruminant industry in Jamaica resulted in a 72% increase in meat production and a 66% increase in herd productivity between 1992 and 2000.

During his tenure as scientist and later as the CARDI Representative in Jamaica, Dr Asiedu represented the Institute with distinction at various high level meetings and undertook several consultancy missions to Africa, the Pacific, Latin America and Europe. He also served on several national and regional Boards and Committees. Under his stewardship and professional work ethic, Jamaica continued to be one of the most consistently successful CARDI Country Offices.

In 2008, Dr Asiedu moved to CARDI Headquarters, Trinidad and Tobago to take up the position as Technical Services Manager where his primary responsibility was to lead the management and implementation of CARDI’s very diverse research portfolio. During his tenure as Technical Services Manager he directly supervised the Institute’s scientists and research assistants, deployed the use of various Information and Communication tools (ICTs) and simplified the Institute’s administrative and financial systems for project implementation. Collectively these assisted in simplifying the project management process at CARDI which today, positions the Institute as a partner of choice in the implementation of agricultural research and development projects in the Region. Dr Asiedu has been recognised at the national, regional and international levels for his contribution to research and development. He has received awards from the Goat Breeders Society of Jamaica and the Ghanaian Association in Jamaica for outstanding service and contribution to the development of agricultural science research in Ghana, Jamaica and the Caribbean. He has also been acknowledged for his dedicated service to CARDI.

Dr Asiedu leaves an enduring legacy, and as he moves onto the next phase, we at CARDI are grateful for his exceptional and dedicated service to the Institute and the Region, his adopted home.
The Caribbean Agricultural Research and Development Institute aligns its objectives with climate change and climate change resilience in mind. The uses of climate smart agricultural practices are researched and advised by CARDI scientists to farmers and other stakeholders. Many experiments across the region are developed to make recommendations for farmers to mitigate against climate variations. The section on commodity development has some details of work geared towards climatic conditions.

Special Olympics is a global sporting organisation that supports persons with intellectual disabilities by developing athletic abilities and teaching life skills. The Special Olympics group in St Kitts was awarded a grant from the Global Environment Fund (GEF) Small Grants Programme to develop an innovative protected agriculture model to produce goods used at the group’s home and to sell at the local markets. CARDI was approached to provide technical assistance to develop this model.

It was designed and constructed in St Kitts during 2017. The model design involves the transformation of a freight shipping container to a growing chamber that supports the growth of a wide array of leafy vegetables. It includes artificial lighting, temperature control and a nutrient rich growing medium. The primary rationale for the design is to provide a model for growing plants that withstand hurricane and drought conditions. Resilience includes providing the shipping container with a good foundation to prevent tilting and also water storage tanks to harvest rainwater for future production use. The facility will provide a basis in the near future for research in protected agriculture technology by CARDI. The shipping container is located at the compound of the St Kitts Ministry of Education’s School Meals Programme.
Four of the 14 CARDI member states were severely affected by the hurricane season of 2017. Hurricane Irma, Category 5 at its peak, hit Antigua and Barbuda, Bahamas and St Kitts and Nevis. Two weeks later Hurricane Maria was also a Category 5 hurricane and in Dominica caused several deaths, casualties and catastrophic damage to land and property.

Post-hurricanes, CARDI engaged in disaster relief. CARDI Country Representatives for Antigua and Barbuda, Dominica and St Kitts and Nevis assisted in mobilisation of resources across islands. Initial relief efforts were focused on providing food, shelter and health care to the affected populations.

CARDI partnered with the Inter-American Institute for Cooperation on Agriculture (IICA) to conduct post hurricane rehabilitation initiatives. These were designed to supplement other initiatives planned and ongoing in the affected countries being led by the respective government authorities and the OECS Commission. The activities complemented actions executed by the Ministries of Agriculture as well as actions approved by IICA under the Rapid Response Action (RRA) instrument of technical cooperation. Among CARDI actions were the ongoing efforts by CARDI to provide seed and rebuild nursery infrastructure. The actions were designed to be executed in the immediate to short term given that the General Technical Cooperation Agreement between IICA and CARDI was initially scheduled to end in December 2017 but has since been extended to June 2018.

CARDI’s short term response included working with stakeholders on the ground to kick-start the production of commercially important commodities while our long-term response will be focused on building a resilient agriculture sector through the promotion and adoption of climate smart practices and technologies. CARDI supplied seeds to farmers from seed banks in Belize and in Antigua and Barbuda for a variety of commercially important food crops such as beans, corn, squash and peas.
Being the premier agricultural organisation in the region, it is important that CARDI maintain its solid bonds with CARICOM, ministries, universities, farmers and other organisations and stakeholders. These actors play a major role in the sustenance of the agricultural industry and it is important that CARDI continues to work together with them. This section describes some of the work done with these strategic linkages.

CARDI Trinidad and Tobago unit collaborated with the following during 2017 in the execution of its work programme: The Tobago House of Assembly (THA) Division of Agriculture, The Ministry of Agriculture, Lands and Fisheries (MALF) Research Department, Mr. Ramdeo Boodoo (private farmer Edinburgh, Chaguanas), Sugarcane Feeds Centre (SFC), Trinidad and Tobago Goat and Sheep Society (TTGSS), the Government of New Zealand, Caribbean Industrial Research Institute (CARIRI), Food and Agriculture Organisation of the United Nations (FAO), Inter-American Institute for Co-operation on Agriculture (IICA), International Trade Centre (ITC), University of the West Indies (UWI) and the Common Fund for Commodities (CFC).

CARDI Trinidad and Tobago participated in the following exhibitions, i) UWI TechAgri Expo, 18-19 April, ii) Couva Health and Wellness Fair, 20-21 May in partnership with Caribbean Agricultural Commercial Services Hub (CACSH) and iii) Lakshmi Girls’ Hindu College Science Fair, 25 October. Several publications related to CARDI’s activities were developed including: CARDI Livestock/Meat Fabrication, Information and Communications Technology (ICT) in Agriculture and Research Results of Agricultural Policy Programme (APP).

Over the past 10 years, CARDI has hosted students from universities throughout the world to support the career development of individuals interested in agricultural research and development. In 2017, we hosted two B.Sc. university students under the Institute’s internship programme.

Yasmin John, second year B.Sc. student at the St Augustine Campus of the University of the West Indies was exposed to upgraded livestock management practices during September 2017. Tiana Rakotoson, a second year B.Sc. student at the Agrocampus Ouest, Rennes, France worked on the methodology for the establishment and maintenance of an innovation platform related to sweet potato value chains during a 20-week internship (September 2017 – January 2018).

CARDI Guyana was involved with the University of Guyana (UG) in introducing aquaponics to the campus. The project was executed by a final year student from November 2016 to August 2017. Aquaponics is a system that combines conventional aquaculture with hydroponics (cultivating plants in water) in a symbiotic environment. The objective of this study was to determine optimal tilapia number (25, 50, 75 or 100), in a 250-gallon (950 L) fish tank, to grow lettuce in an aquaponics system. The results showed that 50 tilapia allowed highest growth rate of lettuce. The project can be described as a success; it should however be mentioned that there were challenges in executing this activity. These included frequent blackouts, flooding and availability of fish feed. It is suggested that a reliable uninterrupted energy supply be sourced (perhaps solar), that raised working beds (above the flood zone) be constructed and automated internet data collection be installed.

Work is ongoing with the UG Faculty of Agriculture towards development of a local fish feed. The potential of using popular locally available fish species, tambaqui and hassar should also be explored as prices of freshwater species on the local market are higher than ocean caught fish. These enhancements will allow for the advancement of aquaponics technology in Guyana.
In St Lucia, institutional strengthening through partnerships was achieved. CARDI St Lucia worked with the Ministry of Agriculture through seminars and workshops in areas of banana production training and in Black Sigatoka Disease training and awareness. IICA and CARDI collaborated to support and promote the training of extension officers and local farmers. These collaborations will continue in subsequent years to ensure the partnerships and relationships between CARDI, IICA and the ministry are strengthened.

CARDI St Vincent and the Grenadines is partnering with VincyFresh to provide assistance with technology packages (techpacks) for crops purchased by the company. CARDI has developed a series of techpacks for several commodities including roots and tubers, and vegetables; however, a more concise one-pager format is being requested. In the new format, chives and hot pepper have been completed and partially completed, respectively. There will also be on-farm demonstrations to validate the technology packages.

CARDI Bahamas engaged in the following partnerships and collaborative initiatives in 2017:

- A study tour and training in Jamaica was conducted in April. This was in collaboration between CARDI Jamaica and the Ministry of Agriculture, Jamaica, and afforded six persons from Bahamas Agriculture and Marine Science Institute (BAMSI) the opportunity to observe and train at several livestock facilities in key areas. These included visits to fully automated and small-scale poultry and pig facilities, agriculture training schools, small ruminant and cattle breeding farms. The team also received training in making molasses urea blocks and silage, semen collection, evaluation, extension and storage, estrous synchronization and artificial insemination practical activities in goats.

- CARDI responded to a request for technical assistance from The University of The Bahamas (UB) for a consultation concerning refurbishment of a UB poultry house.

CARDI maintains a strong working relationship with several agencies and institutions in Barbados. These include the Ministry of Agriculture Food Fisheries and Water Resource Management (MAFFW), Barbados Agricultural Development and Marketing Cooperation (BADMC), Barbados Agricultural and Management Corporation (BAMC), Barbados Agricultural Society (BAS), the United Nations Food and Agriculture Organisation (FAO), the Inter-American Institute with Cooperation in Agriculture (IICA), Agronomy Research and Variety Testing Unit (ARVTU), University of the West Indies (UWI), farmers groups, farmers, farming enthusiasts and other educational institutions.

CARDI scientists visited The International Potato Center (CIP), through IICA’s support.
Commodity Development

In 2017, CARDI continued to lead development in many different crop and livestock commodities. This section outlines the main commodity development activities across the Institute for the period.

Hot peppers

CARDI Barbados conducted a project entitled ‘Production of hot pepper breeder seeds and germplasm conservation’ which aimed to produce breeder seeds of stabilised varieties and to preserve germplasm for accessions collected across the region. A total of 10.4 kgs of good quality, pure, clean breeder seeds (12 varieties) was produced in 2017. Of this amount, 1.1 kg (varieties West Indies Red, Scotch Bonnet and Moruga Red) was sent to CARDI Antigua and Barbuda for commercial multiplication and production of seed for regional growers.

Examination of Moruga Yellow plant structure and fruit set in a varietal improvement production plot established in June 2017 at Sisters’ Road, Hardbargain, Trinidad.

During 2017, CARDI Trinidad and Tobago focussed on increasing the commercial supply of high-quality seed of two indigenous landraces of Capsicum chinense Jacq. These were the yellow-fleshed Moruga Yellow hot pepper and a highly pungent but mildly hot cultivar known locally as ‘Pimento’ or ‘Trinidad Seasoning Pepper’. Both landraces were the subject of a varietal improvement programme for the identification, stabilisation and conservation of stabilised highly productive germplasm.

CARDI Trinidad and Tobago also aimed to produce elite lines of ‘Trinidad Seasoning Peppers’ for commencement of stabilisation of the landrace. A 0.2 ha plot was established at Goldsborough Demonstration and Training Centre (GDTC), Tobago with seedlings of six selections of a cultivar of Capsicum chinense. Four of the selections were taken from major growing areas of pimento peppers - Paramin, Tabaquite, Tobago and
On-field Pimento isolation at GDTC, Tobago at week 20.

Recording measurements of a Pimento landrace berry from Paramin, Trinidad for market quality.

Valencia. The other two selections were taken from municipal markets. A total of 1,095 plants were established in rows 1.2 m apart and 1.0 m between plants. The plot was managed using an integrated crop management approach including the provision of drip irrigation. Throughout the growing period, crop growth conditions were hampered by heavy weed infestation, that proved difficult to manage with post establishment herbicide use due to a high-water table and waterlogged conditions in several areas. The project is ongoing and therefore impacts and outcomes will be reported upon completion.

In Cayman Islands, purification and stabilisation of lines of the local seasoning and hot peppers was done; 0.42 kg of pure, clean, viral free seeds of local seasoning peppers were extracted from harvested berries. The berries were selected from the most robust plants with none or the least disease and pest symptoms and they were treated according to well established protocols. The resulting seeds have been provided to the Department of Agriculture to produce seedlings which will be made available to farmers for purchase. This seed will provide more than 151,000 high quality seedlings.

In St Kitts and Nevis, Scotch Bonnet hot peppers were planted at the CARDI field station to evaluate performance under guinea grass mulch. Following a focus group discussion with farmers, the scientific experiment was adjusted with further plantings on five farmers’ fields. From initial observations, the mulch plots experienced a lower density of weeds than the un-mulched plots. An important outcome of this work is that field staff acquired knowledge in preparing and applying guinea grass mulch; a process that proved to be more technical than previously thought. A future study that investigates the economics of hot pepper (among other crops) under climate smart agriculture production is planned for the near future.

In Antigua, Scotch Bonnet was planted on a 1 ha seed production plot at CARDI’s Betty’s Hope station. Though Antigua did not get a direct hit from the passage of Hurricane Irma on 5-6 September, there was significant wind damage to the Scotch Bonnet plot. Wind damage to the peppers included damaged branches, broken and uprooted plants and plants blown to almost 180 degrees.

About 25% of the plants had to be removed and the remaining 75% will require significant resources to bring them back to acceptable seed production levels. An on-farm experiment titled ‘Evaluating the effectiveness of guinea grass mulch under tomato production’ was commenced in September in St Kitts and Nevis.

Fruits and vegetables

The objective of this study was to assess how effective traditional conservation agricultural practices can be on soil characteristics and water availability. This was done in an effort to increase the productivity of farms and sustain agriculture production over wet and dry seasons. Six different farms participated in the first wet season (September-December) evaluations. By the end of the year it was noted that mulched plots outperformed un-mulched plots in terms of soil moisture content, root zone temperature, plant growth and flowering onset.
Trinidad and Tobago has a long-standing national interest in roots and tubers. A project ‘Improving the root and tuber Industry of Trinidad and Tobago through increasing the availability of good quality, viral free, planting material’ is being conducted. The project focusses on: i) climate resilience trials for cassava and sweet potato in Trinidad and ii) the maintenance of varietal conservation plots of cassava and sweet potato at the Goldsborough Demonstration and Training Centre (GDTC), Tobago.

One of the expected climate change impacts for the Caribbean are more frequent extreme weather events, including periods of drought and flooding. CARDI Trinidad and Tobago is collaborating with the Ministry of Agriculture, Land and Fisheries (MALF) to execute a sweet potato research trial on a private farm in Edinburgh, Central Trinidad titled ‘Determination of the yield potential of four varieties of sweet potato under different water regimens’. The experiment will be completed in 2018.

CARDI Barbados has continued to maintain its sweet potato germplasm conservation plots comprising 31 varieties/cultivars, the largest sweet potato collection on the island. Slips are treated with a fungicide and insecticide and allowed to air-dry before planting in rows along raised banks at spacing of 0.3 m within row and 1.2 m between rows. Drip irrigation is used when necessary. Material is also stored in tissue culture.
During 2017, sufficient planting material to establish 2 ha was distributed to farmers. Black Rock was the variety most requested.

In addition to sweet potato, a cassava germplasm bank comprising 18 cultivars was established in Barbados in 2017 and is being maintained.

In an effort to strengthen capacity in germplasm management, CARDI facilitated the participation of a representative of the Ministry of Agriculture, Food, Fisheries and Water Resources Management (MAFFW) in a 1-week training course at the headquarters of the International Potato Centre (CIP) in Lima, Peru. Topics covered included germplasm characterisation, data collection, multiplication and maintenance and other CIP protocols developed for its climate resilient and pest and disease resistant germplasm programme.

CARDI Cayman Islands completed morphological characterisations of local sweet potato germplasm and local cassava and maintained germplasm conservation plots of both crops.

In Grenada, CARDI continued to partner with the Village Bakery and farmers in collaboration with the Ministry of Agriculture to develop the cassava value chain with emphasis on the cassava composite bread. Through collaboration with extension officers, CARDI sourced cassava from targeted farmers and ground it into mash which was then sold to the Village Bakery. In 2017, the Village Bakery was able to expand its weekly consumption of cassava mash by 20% (from 115 to 135 kg weekly). As a result, the bakery was able to get into new supermarkets in Grenada and also into Carriacou. Prior to 2015 there was an oversupply of fresh cassava. In 2017 the reverse has occurred so that there is now an undersupply of fresh cassava.
During the reporting period a regional project, funded by the government of New Zealand, titled ‘New Zealand Regional Small Ruminant Project’ was conducted. Details of activities in this project are given under the heading ‘Projects’ following this section.

CARDI Bahamas conducted the following activities in 2017:

• Introduction of four new varieties of legumes for feeding sheep and goats
• Provided seeds and technical support for the establishment of 4 ha of high protein silvo-pastures at BAMSI, Andros
• Distributed seeds for 0.4 ha of pasture to each of 17 farmers in Long Island
• Provided technical support to improve husbandry and management practices at the small ruminant unit at BAMSI, Andros
• Assisted in the reduction in perinatal mortality at BAMSI from 87% to less than 1% from improved feeding and nutrition and management
• Provided recommendations to acquire a fresh chop machine to improve feeding management
• Conducting a CARDI National Livestock survey in all the Bahamian islands – this is ongoing
• Developed protocols for daily, weekly, monthly, quarterly and annual management of sheep and goats
• Submitted an inventory of the small ruminant unit at BAMSI, which details the breeds
• Guided a breeding program for the breeds at the BAMSI unit
• Trained staff at the BAMSI unit on weaning and feeding neonates
• Provided technical assistance in acquiring and establishing forages at BAMSI - leucanea, moringa and gliricidia seeds
• Trichantera and gliricidia cuttings were made available to BAMSI through Bodles, Jamaica
• Introduced a scientific approach to feeding different physiological stages of sheep and goats for improved nutritional status
• Recommended equipment for harvesting and chopping fresh grass, reducing the labour required for this task

CARDI Barbados carried out a project geared at increased production of ruminant products in Barbados through development and utilisation of forage based feeding systems. The objective was to introduce alternative feeding systems that can deliver the required nutrition at lower costs. This was done in collaboration with MAFFW.

Between August and December 2017, efforts were focussed on stockpiling local ingredients to be used to formulate rations. A mulberry (Morus spp.) forage bank was established on 0.1 ha. Mulberry leaves and stems were harvested at 8 weeks old and cassava and sweet potato peels were collected from processors. Ingredients were dried and ground using a hammer mill and a 1 mm sieve. They were then stored in plastic drums. Other ingredients to be included in the formulation are cracked corn, soybean meal, common salt and a vitamin mineral mix. During 2017, 500 mulberry plants were distributed to six farmers for use in their small ruminant feeding systems with positive results.

Another project in Barbados was the building of capacity in establishment of small ruminant breeding programmes. This is consistent with our mandate to contribute to the development of the regional small ruminant industry. CARDI built capacity among scientists, technicians and farmers in selection and breeding strategies. This is required as, beside quantity, a lack of quality breeding stock has been identified as one of the constraints to increasing regional production levels.
The Greenland Livestock Research Station (GLRS), Barbados, is widely recognised as one of the best such facilities in the Caribbean region yielding top quality breeding stock year after year. In October, CARDI partnered with the GLRS to deliver a small ruminant breeding and selection workshop. A total of 17 participants were drawn from Barbados, Jamaica, Montserrat, St Lucia, and Trinidad and Tobago. Feedback received from participants was positive.

In August, CARDI Antigua and Barbuda, following discussions with livestock farmers and the MALFBA, identified areas of strengthening small ruminant production in that territory. These included developing a forage feeding system using locally sourced high-quality forages. Additionally, CARDI took the initiative to support the efforts of small ruminant, poultry and beekeepers in Barbuda.
CARDI undertook many projects in 2017. Three of the high budget, larger projects involving multiple countries are detailed in this section.

**Caribbean Regional Small Ruminants Capacity Building Activity**

The Caribbean Regional Small Ruminants Capacity Building Activity was funded mainly by the New Zealand Ministry of Foreign Affairs and Trade (MFAT) under the New Zealand Aid Programme's Latin America and Caribbean Programme. Partners in the project included FAO and IICA. CARDI, the implementing agency, provided leadership, considerable scientific staff resources and administrative management. The New Zealand consulting firm Prime Consulting International Ltd proved be an invaluable resource, providing much needed guidance, technical backstopping and leadership in the crucial area of instructional design, remote learning and course development. The University of the West Indies provided strong support in ICT infrastructure and mobile applications development. The Ministry of Agriculture in Jamaica was a very useful partner in the implementation through its provision of infrastructure, personnel and policy support. The partnerships developed during the project have remained robust and continue to serve the interest of Caribbean agriculture, beyond the boundaries of this activity.

The arrangement, signed in June 2015 by MFAT and CARDI, agreed upon the components of the activity, which was designed to support the sustainable development of the small ruminants sector across the Caribbean region over 2 years by working with the Ministries of Agriculture and local stakeholders in the target countries (Belize, Dominica, Grenada, Guyana, Jamaica, St Lucia and St Vincent and the Grenadines). The principal activities were to develop capacity in animal husbandry, support augmented breeding programmes and enable information sharing and coordination towards improved marketing, system functioning and innovation.

In December 2015, The University of the West Indies (UWI) was engaged to develop a training platform using open-source Moodle software with support from the Prime instructional design consultant. In 2017 three smartphone apps were created under an extended contract with UWI in 2017.

One app, SR-Learn, is an educational tool which mimics the Moodle site with the desktop version compressed into a mobile version. A user must first be registered on a course via the desktop version in order to access course content on a mobile platform. The second app, SR-Market, was created to connect prospective buyers and sellers in a virtual marketplace. A user can upload information relative to their demand or supply. The SR-Market app serves as a way of marketing by connecting a buyer and seller and not as an online auctioneer. The third app estimates live weight of small ruminants from girth and body length measurements.

Several training sessions were held in the target countries where a variety of techniques were learnt by farmers including the production and use of molasses-urea blocks, cultivation of forage banks, intensive slatted-floor housing, synchronised breeding and artificial insemination.

To measure the impact of training sessions coupled with the support from the online learning resources (inclusive of the mobile apps), a survey was developed and sent to participants by e-mail with a follow up phone call. As is usual in surveys of this type response rate was somewhat below 50%, but those who did respond suggested that the training was a resounding success. Most persons indicated that they would be interested in following up on further activities, although some expressed that some improvements were necessary for better course delivery.

During a completion mission by Prime International Consulting Ltd accompanied by CARDI representatives, 10 farmers were interviewed in Antigua, Jamaica and St Lucia. All farmers indicated satisfaction with the activity and were implementing a variety of techniques learned. Increased production was reported by eight farmers. The other two farmers were not able to see production increases due to problems of labour (St Lucia) and praedial larceny combined with land tenure issues (Antigua).
Black Sigatoka Disease (BSD) Project

In banana and plantain cultivation, Black Sigatoka Disease (BSD)—caused by the fungal pathogen, *Mycosphaerella fijiensis*—is devastating. Approximately 97% of all banana and plantain varieties grown in the Caribbean are susceptible to BSD. The disease is aggressive and challenging to control, resulting in significant yield loss and increased cost of production. An Integrated Disease Management (IDM) approach is required for effective disease management. The success of the IDM programme depends on keeping the disease at a very low level in the field and keeping the plants healthy.

In November 2013, the Caribbean Development Bank (CDB) conducted an analysis of the BSD country programmes of Dominica, St Lucia and St Vincent and the Grenadines, which revealed that the countries were not using an IDM approach but had a propensity towards the use of fungicides in their BSD management. The use of fungicides has a negative impact on the environment and can be hazardous to humans when used on farms. Also, if a fungicide programme is not well monitored, the result may be the evolution of the fungus becoming more aggressive and tolerant to the fungicide over time, thus reducing the fungicide's efficacy.

In Guyana, eight accessions were introduced: Grande Naine (dessert banana), FHIA–02 (dessert banana), FHIA–03 (cooking banana) FHIA–21, PITA–17, PITA–21, PITA–23 and PITA–27 (all plantain accessions). Field trials in Guyana revealed that PITA–17 (plantain) and FHIA–03 (cooking banana) were tolerant to BSD. However, it is to be noted that the local Creole plantain is similarly tolerant. PITA–17 has a light green skin, beige color flesh, not too sweet taste, is shorter than Guyana's Creole plantain (22 cm length versus 28 cm) but tends to be uniform and yields 16 to 19 kg/bunch versus 14 kg/bunch for the Creole. FHIA–03 is short (18 to 20 cm) and uniform in length, peels easily, slices easily and has a whitish flesh. It is high yielding 20 to 24 kg per bunch, comparable to the popular local Apple and Cayenne bananas. These field evaluations are ongoing with many accessions in the ratoon phase to be harvested during 2018. Nevertheless, given PITA–17's shorter and more uniform length, plantain fries processors may have a preference as it should give a greater yield of fries (less wastage due to fruit curve). The cooking banana FHIA–03 can be examined for flour production.

In St Vincent, one plantain (FHIA–21) and five banana (FHIA–01, FHIA–03, FHIA–17, FHIA–18 and FHIA–23) accessions bred by the Honduran Agricultural Research Foundation (FHIA) were introduced. The MAFFRT also requested that four CIRAD accessions (916, 918, 920 and 924) be included in the evaluation. As controls, the Cavendish varieties Grande Naine and Jaffa were used. The received accessions were multiplied in sufficient quantities at the Orange Hill Plant Tissue Culture Laboratory and some were shipped to the other participating countries as tissue culture material where they were weaned and hardened.

Using randomised block designs, three plots were established in St Vincent at Montreal Gardens (October 2014), Rabacca (March 2015) and Mount Williams (November 2015 – February 2016). The trials were managed according to the local agronomic practices stipulated by the Windward Islands Banana Growers Association (WINBAN) Banana Manual. All management practices were applied uniformly across sites, and no fungicide treatments were applied. Data was collected on the mother plant and first sucker. Using the International Network for the Improvement of Banana and Plantain (INIBAP) technical guidelines the following parameters were recorded: disease development time, youngest leaf spotted, leaf emission rate, disease severity, infection index, agronomic data, and environmental data. Agricultural data recorded at bunch emergence and harvest were time from planting to shooting, plant crop cycle, height of pseudostem, and so on.
girth of pseudostem, height of following sucker, weight of bunch, number of hands in bunch, number of fruits and number of functional leaves at harvest. Two organoleptic tests were conducted the first done on fresh ripe fruits and the second on green cooked fruits.

Analysis indicated a significant variation among accessions. The FHIA BSD tolerant accessions performed better than the CIRAD and Cavendish varieties. The FHIA tolerant accessions had more than 11 leaves at flowering with FHIA–17 presenting as many as 13. Both CIRAD and Jaffa varieties had on average 10 leaves whereas Grande Naine had eight. At harvest, the FHIA accessions had more than seven leaves whereas the French Agricultural Research Centre for International Development (CIRAD) varieties range between five and six and Cavendish (Grande Naine and Jaffa) four to five. Generally, all the FHIA accessions performed well and exhibited high tolerance to BSD. The mean bunch weight was calculated and reported for each accession of which FHIA–17 had the largest bunch weight for both mother and sucker of 30 and 37 kg., respectively. FHIA–17 also reported the highest number of hands per bunch with 11 and 12 for mother and sucker respectively. FHIA–01 which has a significantly longer crop cycle has a smaller harvest of 18 kgs. CIRAD–916 and Grande had the lowest bunch weights.

In St Lucia, a FHIA banana variety plot tolerant to Black Sigatoka Disease was maintained and extended to increase the number of suckers to be given to farmers for planting. The plot was set to serve as both demonstrating plot and exhibition field.

Workshops were conducted in the participating countries of Dominica, Guyana, St Lucia and St Vincent and the Grenadines to strengthen the capacity of Black Sigatoka Disease management. Besides delegates from the participating countries, the workshops were attended by representatives from Fairtrade International and the Canadian Hunger Foundation. There were combinations of classroom, laboratory and field sessions and the facilitator was Dr Robert Power of Suriname. Participants were taught the phyto-pathological cycle and epidemiology of BSD, IDM, climatic forecasting of disease intensity and laboratory methods of measuring fungicide efficacy and crop productivity. A total of 92 technicians were trained with 27 from Dominica, 25 each from Guyana and St Vincent and the Grenadines and 15 from St Lucia.

Coconut Industry Development

This coconut project seeks to improve the industry in Belize, Dominica, Dominican Republic, Guyana, Jamaica, St Lucia, St Vincent and the Grenadines, Suriname and Trinidad and Tobago. The project is funded by the European Union (EU) with lead implementation by the International Trade Centre (ITC). CARDI is responsible for the implementation of two of the four expected outcomes (Table 1). The project seeks to improve the competitiveness of the coconut industry in the Caribbean with the objectives of improving market linkages, increased production performance and quality, and better regional coordination. Beneficiaries include small coconut farmers, plantation operators, owners and workers, coconut producing and processing communities, young people and women in coconut and coconut product processing and marketing, small and medium enterprises (SME) involved in coconut product manufacturing and their providers of equipment and services in their communities.

<table>
<thead>
<tr>
<th>Outcome 1</th>
<th>ITC</th>
<th>Market opportunities identified and value chain development plans agreed.</th>
<th>Synergies and continuity developed with existing regional and national programmes to enhance regional integration of markets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outcome 2</td>
<td>CARDI</td>
<td>Competitiveness and sustainability is enhanced by dissemination of production intensification methods and by improving synergies between different actors involved in value chain</td>
<td></td>
</tr>
</tbody>
</table>
Outcome 3 ITDCARDI Annual Report 2017
Access to information and advisory services on finance, trade, agriculture, management and markets facilitated for small producers

Outcome 4 CARDI Annual Report 2017
Small producers have greater access to risk management instruments, particularly on climate and market risks

• Support of lead and second ring farmers
  A farmer characterisation exercise covered around 200 farmers in the Dominican Republic, 140 farmers in Jamaica and 125 in Guyana. Following this more than 70 farmers were interviewed for the selection of lead farmers. A team representing National Support Programme (NSP) members, local supporting institutions, CARDI and ITC selected 10 lead farmers in each country. These farmers are providing and receiving support in improving coconut related agricultural and marketing practices on their farms and on other farmers farms through participatory approaches. Lead farmers committed themselves to host trainings and demonstration plots on their own farms and to involve neighbouring farmers (second ring farmers) with the objective to develop a cluster in which the lead farmer is the focal point for second ring farmers who follow up the progress in their ring. The surveys conducted during farmers characterisations obtained valuable first-hand information of land tenure, incomes, characteristics of coconut plantations, production and selling issues, source of funding, willingness to take risk, and support institutions. The findings in each country were shared with the other countries and with NSPs as a benchmark and for baseline information.

• Investment prospectus and cost-benefit analysis
  One of the objectives was to identify potential investment solutions to mobilise finance for Jamaican coconut value chains, particularly those involving smallholders and SMEs. The outcome built on the farmer characterisation, the Global Value Chain (GVC) analysis, market trends and the local ecosystem and started by covering the supply and demand landscape for agribusiness in Jamaica. It then focused on three specific product-market business options for coconuts which involve smallholders and specific value chain operators and support service providers. The three target areas were previously defined with close consultations between the alliance partners in Jamaica; these were:
  a. Development of a coconut seedling business
  b. Processing of coconut water for local consumption
  c. Development of a business that processes and exports coconut water.

  In addition to assessing economic and market conditions in Jamaica, the study suggested potential finance and investment mobilisation structures for the three priority areas identified by industry stakeholders.

  In combination with the study, a detailed cost benefit analysis was undertaken. The financial experts modelled the projected economic and financial impacts of investing in Jamaica’s coconut sector.

  Both the investment prospectus and the cost-benefit analysis will be used to help stakeholders decide and better define the finance, support, partnership and business models in the context of their work in coconuts and beyond. The findings of the investment prospectus and the models proposed will be validated with the relevant national stakeholders.

• Trainings/nurseries
  Supply of seedlings will come from nurseries located in a shade house in Jamaica.
that the project is supporting with public and private collaboration. Selection of sites for technical advisory services for the establishment and strengthening of national nurseries continued. Each country was visited and nurseries toured to provide technical advice on good management. Generally, there were areas of non-compliance with good management practices. Training and demonstrations sessions were held in Barbados and Dominican Republic.

In Jamaica, two major interventions were made at a nursery. The shaded area was expanded by the construction of an additional 24.3 m x 30.4 m (80 ft x 100 ft) shade house. In consultation with the National Irrigation Commission a system to supply 1486.5 m$^2$ (16,000 square feet) of nursery with irrigation was designed.

**Acquisition of quality planting material: germplasm and seed nuts**

The project biotechnologist coordinated with Centro de Investigación Científica de Yucatán (CICY) in Mexico to conduct the transfer of germplasm to the project countries. Initiatives are in force to establish national germplasm banks in order to facilitate the process. The transfer of germplasm will be accompanied with appropriate training from CICY to the country technicians.

In addition, ITC and CARDI are exploring using validated contacts provided by CICY and NSPs members to source green dwarf varieties. Contacts have been established with certified nurseries in Brazil, Belize and El Salvador.

In Trinidad and Tobago, programmes were implemented to support commercially driven growth in the coconut subsector. These included integrated management and intensification of coconut production systems.

In St. Vincent and the Grenadines, some of the priority areas of productivity and sustainability, identified by the NSP, that constrained the development of the coconut sector are:

- Lack of economic incentives for farmers to engage in the coconut sector
- Lack of availability and access to planting materials

To address these concerns two coconut nurseries were established, the first at the Rivulet Agricultural Research Station and the other at the Perseverance Agricultural Research Station.

In St Lucia, germplasm collection and evaluation of local nuts began for the establishment of an IPM nursery. There was no gene test and no formal information on agronomic performance, but the selection was done strictly based on the considerable experience and technical know-how of the representatives who pioneered the selection. About 1,000 nuts were established at the nursery at CARDI St Lucia. These nuts were sold to farmers and stakeholders at Eastern Caribbean Dollar (XCD) $5 per plant.

In Dominica, one nursery unit was established under the coconut project at the La Plaine Agricultural Station for the purpose of supplying farmers with healthy seedlings.
The Caribbean Agricultural Commercial Services Hub (CACSH) is the commercial subsidiary of CARDI. Much of the activity during the year was in Guyana where CACSH secured contracts to be sole agents for Seminis seeds (a very popular brand in Guyana) and Monsanto Roundup.

A significant activity of CACSH in Guyana is the sale of vegetable seeds. Seeds sold in Guyana by CACSH are Green Challenger, Salvation and Tropicana (cabbage); Hymark (cantaloupe); Moruga Red, Scorpion and Scotch Bonnet (hot pepper); Iceburg (lettuce); Aristotle, Early Sensation and Jade (sweet pepper); Heatmaster and Tyranus (tomato) and Mickylee (watermelon). Total seed sales up to August 2017 amounted to GYD $10,660,100.

Sales of the herbicide Roundup which began in August, are progressing satisfactorily, amounting to G$979,200 to date.

CACSH has designated distributors across the coastal belt of Guyana to facilitate sales of these products. CARDI supports these distribution efforts via farm visits in various districts providing technical assistance with respect to products sold (seeds and Roundup). Selected farmers and National Agricultural Research and Extension Institute (NAREI) are given samples of seeds to plant, demonstrating the productivity of the Seminis brand in Guyana. Seminis’s Sales Representative for Panama and the Caribbean visited in May, conducting field days and visiting farmers in West Berbice. It can be stated that CACSH has successfully established in Guyana.

CACSH is also very active in Antigua and Barbuda promoting seeds of onion and other commodities to farmers.
Staff and Organisation

ANTIGUA AND BARBUDA

Professional staff
Lucas, Paul, Water Resource Management Specialist/CR (from July)

Technical staff
Bowman, Donnet, Administrative Assistant
Browne, Bradbury, Technical Assistant
Crogman, Calvin, General Farm Worker (from September)
Henry, Wilstan, General Farm Worker (from September)
Josiah, Carrol, Laboratory Assistant

BARBADOS

Professional staff
Lucas, Paul, Water Resource Management Specialist/CR (from July)

Technical staff
Pratt-Russell, Florina, Administrative Assistant (from September)
McQueen, Ryiesha, Technician (from September)

BAHAMAS

Professional staff
Singh, Michele, Animal Productionist/CR

Technical staff
Pratt-Russell, Florina, Administrative Assistant (from September)
McQueen, Ryiesha, Technician (from September)

BELIZE

Professional staff
Omaira, Rostant, Crop Scientist/CR

Technical staff
Can, Roberto, Technician (from September)
Emmanuel, George, Research Assistant (from May)
Garcia, Angel, General Farm Worker
Lindo, Martin, Technician
Reyes, Hector, Graduate Assistant
Reynolds, Tenesha, Administrative Assistant
Tzib, Cornelio, Technician (until June)
Vanegas, Ambrocio, General Farm Worker

DOMINICA

Technical staff
Tavernier, Michelle, Administrative Assistant (from June)
Etienne, Dorian, Technician - responsible for administration

GRENADA

Professional staff
Andall, Reginald, Agronomist/CR

Technical staff
Bruno, Janelle, Administrative Assistant
Raymond, Reuben, Field Assistant

GUYANA

Professional staff
Roberts, Cyril Dr, Biotechnologist Breeder/CR

Technical staff
Alleyne, Dawn, Administrative Assistant
Itwaru, Basdeo, Driver

CAYMAN ISLANDS

Professional staff
Minot, Annika Dr, Plant Health Specialist/CR (from June)

Technical staff
Rico, Ricardo, Technician

Professional staff
Singh, Michele, Animal Productionist/CR

Technical staff
Pratt-Russell, Florina, Administrative Assistant (from September)
McQueen, Ryiesha, Technician (from September)
JAMAICA

Professional staff
Gregory, Robin Dr, Agronomist/ CR
Clarke-Harris, Dionne, Entomologist
Fearon, Albert, Animal Productionist

Technical staff
Asiedu, Elizabeth, Accounting Assistant (until March)
Barnes,Ralston,Technical Assistant
Davis, Wimsome, Accounts Clerk (Mandeville)
De Coteau, Siona, Accounting Assistant (from March)
Gordon-Sangster, Andrea, Secretary
Hanson-Hall, Rasheeda, Graduate Assistant
Hanson, Norman, Farm Supervisor
Jones, Desmond, Technical Assistant
Morris, Caroline, Office Assistant
Matherson-Powell, Sandra, Receptionist
Mitchell, Renick, Technical Assistant
Smith, Rohan, Technician

MONTSERRAT

Professional staff
Flemming, Kistian, Climate Change and Development Specialist/ CR

Technical staff
Gyamfi, Kwame Adu, Research Assistant/Officer-in-Charge (from May)
O’Brien Sharon, Administrative Assistant
Thomas, Jacob, Field Assistant

ST VINCENT & THE GRENADINES

Professional staff
Linton, Gregory, Crop Protection Specialist/CR (from July)

Technical staff
Joseph, Rose Marie, Technician

TRINIDAD AND TOBAGO

Professional staff
Jack, Heidi, Livestock Scientist/Officer-in-Charge, Tobago Unit

Technical staff
Ali, Nazir, Field Assistant

HEADQUARTERS

Professional staff
Alvarez, Tristan, Project Management Specialist
Asiedu, Francis, Dr, Manager Technical Services (until June)
Besai, Denise, Outreach and Communication Officer
Clarke, Barton, Executive Director
Gibson, Norman, Manager, Science, Technology and Innovation (from April)
Jagroo, Videsh, Biometrician
James, Lisa, Agricultural Economist (from June)
Muhajar, Debra, Executive Assistant
Malcolm, Margo, Head - Institutional Capacity Building Unit
Mohammed, Aziz, Value Chain and Marketing Specialist
Morris, Opal, Librarian
Nero, Curtis, Head - Finance Unit
Ramkissoon, Suresh, Accountant
Shah, Fayaz, Head - Commercial Unit

Technical staff
Hudson, Rachel, Secretary
List of Publications


Flemming, K., 2017. Developing appropriate climate smart agriculture practices. Presented at First CCCCC International Conference on Climate Change for the Caribbean: Integrating Climate Variability and Change Information into Adaptation and Mitigation Actions in the Caribbean Region. Hilton Hotel Trinidad and Tobago, October 9-12, 2017.

Flemming, K., 2017. Promoting cooperation on climate change. Presentation at the 7th Forum on Korea-Caribbean Partnership on Climate change and Food Security. The Westin Chosul Hotel, Seoul, South Korea, November 6-10, 2017.


Winchester, N. 2017. ICT led innovation – shaping the future of the small ruminants’ industry. Poster presentation at the 30th Caribbean Veterinary Medical Association Conference (CbVMA), 6-9 November 2017 Kingston, Jamaica.
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