IMPROVING LIVES THROUGH AGRICULTURAL RESEARCH

CARDI’S Achievements
2007 to 2011
The CARDI Mission
“Contributing to the enhancement of the well being of Caribbean people through the reduction of poverty and hunger and protection of the natural environment”

The CARDI Vision
The Centre of Excellence in the Caribbean for the provision and application of research for development in agriculture that contributes to the creation of wealth and the competitiveness of the sector in the Region.
CARDI’s Achievements
2007 to 2011

Improving Lives Through Agricultural Research
This booklet was first published in July 2012 with the purpose of informing the Region’s highest policy makers assembled at the 2012 CARICOM Heads of Governments Meeting in St Lucia, of the major achievements of CARDI in the execution of its mandate during the period 2007-2011.
Table of Contents

Overview of CARDI’s Role in Regional Agriculture 8
Summary of Main Achievements 2007 - 2011 10
CARDI’s Achievements in CARICOM Member States for the period 2007 - 2011 15
  Antigua and Barbuda 16
  Barbados 18
  Belize 20
  Dominica 22
  Grenada 24
  Jamaica 26
  Montserrat 30
  St Kitts and Nevis 32
  St Lucia 34
  St Vincent and the Grenadines 37
  Trinidad and Tobago 40
Overview of CARDI’s Role in Regional Agriculture

The agriculture sector remains a major contributor to employment and to GDP in several CARICOM Member States. It thus continues to be a key driver to the Region’s sustainable development. In recognition of the sector’s importance, the Region has developed and adopted several regional policy decisions. These include the Regional Transformation Programme for Agriculture (RTP), the Jagdeo Initiative and the Lilliendal Declaration on Agriculture; the latter two are geared to support the RTP. As a consequence of the above there has been the adoption of a New Agriculture driven primarily by technology, information and knowledge. Successful implementation of these policy decisions and the shaping of productive and resilient agricultural sectors require dedicated, timely and task driven Agricultural Research for Development (AR4D).

CARDI’s overall mandate specifically aims to support these policy decisions. The Institute incorporates the principles of the New Agriculture in its overall programme of work.

The Institute’s activities:

- recognise agriculture as a business
- contribute to the Region achieving the target of 25% Food and Nutrition Security by 2015
- contribute to the enhancement of quality of life of people in the agricultural and rural sectors
- consider new and emerging issues, including Climate Change, Protected Agriculture, and Agro-energy.

The approach adopted by CARDI in pursuit of its mission is based on three pillars:

i. a bottom up and client led approach to ensure that CARDI’s programmes are primarily influenced by the needs of its stakeholders and clients

ii. transparency and accountability relative to CARDI’s activities with its Member Countries, Clients, Strategic Partners and Donors

iii. working together in collaboration with key Strategic Partners and Stakeholders to share human, technical and financial resources in order to contribute to the achievement of the goals of the Region and the Institute

In particular, the Institute’s Work Programme reflects the key priorities of Member States and aims to:

- add value and/or complement national activities
- facilitate intra-regional transfer of technology and resources
- support CARDI in becoming a major broker of agricultural technology, personnel and finances from extra-regional sources, improve the quality and quantity of plant and animal genetic material to satisfy the increased crop and livestock production needed by the Region to meet its Food and Nutrition Security target
- identify policies and legislation that need to be developed, modified and/or harmonised for the New Agriculture
- build the trained human capacity for the development of the sector
- identify and initiate technology innovations, including emerging issues, that impact on the development of agriculture in the Region.
**Intensification of AR4D in CARDI Programmes**

Since 2007, there has been a concerted effort to align the approach of the Institute to meeting national and regional mandates with the validated approaches recommended by world renowned agricultural research agencies and forums. The international institutions within the Consultative Group on International Agricultural Research (CGIAR) have adopted the proposal put forward at the 2010 Global Conference on Agricultural Research for Development (GCARD) for the transformation of agricultural research for development systems (AR4D) for global impact. This proposal, known as the GCARD road map, adopts a six-point plan for transforming AR4D around the world, as follows:

i. the need for collective focus on key priorities, as determined and shaped by science and society

ii. the need for true and effective partnership between research and those it serves

iii. increased investments to meet the huge challenges ahead and ensure the required development returns from AR4D

iv. greater capacities to generate, share and make use of agricultural knowledge for development among all actors

v. effective linkages that embed research in the wider development context and actions enabling developmental change

vi. better demonstration and awareness of the development impact and returns from agricultural innovation.

As a consequence, a new approach to agricultural research endorsed by CGIAR and adopted by CARDI is that of AR4D. The AR4D approach is based on the application of the concepts, principles, methodologies and research results related to food production, food availability and food affordability for the achievement of development goals. CARDI’s work programme is fostered by national consultations and regional collaboration and can thus easily adopt the AR4D approach to ensure visible and measurable impact.

Using an AR4D approach the Institute’s MTPs strategically addresses the following critical national and regional issues:

- Food and nutrition security
- Reduction in poverty and hunger
- Enhancement of the quality of life in the agricultural and rural sectors.

To implement this approach, CARDI has three Strategic Axes that provide the framework for the development and operationalisation of the Institute’s Medium Term Plans (MTP 2008-2010 and MTP 2011-2013), and are consistent with the guidelines for AR4D systems. The Strategic Axes are:

I. Development of Sustainable Industries

This involves the deployment of science, technology and innovation to facilitate the development of sustainable commercialised production and marketing systems of targeted commodities in order to contribute to the Region’s food and nutrition security within the context of the optimal utilisation and conservation of our natural resources.

II. Development of Strategic Linkages

In recognition that CARDI (as many other institutions) does not have all the resources (human, physical and financial) to deliver effective AR4D support to the Region’s agriculture, the Institute has to work closely with allied agencies/institutions in pursuing its mandate.
Strategic Axis 2 also offers the platform for the promotion of CARDI as the preferred agricultural research and development institution in CARICOM and its contribution to food and nutrition security and economic well being of the peoples of the Region.

III. Institutional Strengthening

This Axis is the conduit for attaining the resources to enable delivering on Strategic Axis 1 through programmes that aim to build the level of resources (quantum and quality) that is essential if the Institute is to successfully fulfil its mandate. The programmes contained therein build the capacity of CARDI staff, as well as that of partners and stakeholders, and, mobilises and manages human and physical resources.

Principal Commodities and Thematic Areas

The Principle Commodities and Thematic Areas of the MTPs relative to 2007-2011 are:

- Roots and tubers
- Cereals and grain legumes
- Hot pepper
- Fruits and Vegetables
- Small ruminants
- Germplasm
- Protected Agriculture
- Climate Change
- Information and communication
- Capacity building
- Resource Mobilisation

Summary of Main Achievements in the Principal Commodities and Thematic Areas 2007 - 2011

During the period CARDI intensified AR4D activities in the following areas:

Roots and tubers

Cassava, sweet potato and yam are the commodities of focus of this sub-programme in which CARDI has maintained a strong research and development component. The main objective of this sub-programme is to contribute to the development of roots and tubers industries through the generation of production packages that facilitate increased production and the preparation of investment profiles.

The results of project activities benefit all its Units and the Institute facilitates the flow of information, expertise and experiences among Member Countries. During 2007-2011, the main interventions were: increased propagation facilities; expansion of the tissue culture facility in St Vincent and the Grenadines; construction of weaning and hardening facilities; retrofitting of the quality control laboratory in Barbados; optimisation of nursery propagation protocols for cassava; introduction of high yielding varieties for fresh and processed use; increased production of disease free planting material; provision of processing equipment to improve the efficiency of adding value to tropical root and tuber crops; the provision of training in Integrated Crop Management (ICM), post harvest technology, value added methodologies and marketing.

Cereals and grain legumes

The primary objective of this sub-programme centres on the development and selection of suitable varieties, the production and supply of seeds, and the development of production and post production technology packages for selected productive varieties. Interventions were
carried out in the areas of: increased availability of corn seeds (Antigua, Belize) and soybean seeds (Belize); utilisation of improved varieties of rice, corn and beans (Belize), corn (Grenada) and evaluation of a new urea fertiliser formulation that is deep-placed to improve rice productivity (Guyana).

**Hot pepper**

The primary objective of this sub-programme is to contribute to the development of the regional hot pepper industry by developing and stabilising suitable germplasm and developing appropriate production and post harvest technology packages to facilitate commercial production and supply to appropriate markets.

During the period, the major activities were in the areas of: the genetic improvement of three of the four major commercial varieties; the selection and homogenisation of indigenous “types” in Dominica and Trinidad and Tobago; the production of quality-declared, disease free seed for commercial hot pepper production; and the establishment of an agreement with a regional commercial entity to market CARDI breed/produced seed with an increase in annual demand from 60 lb to 600 lb, representing a projected increase of about 8,000 acres (3,200 hectares) in hot pepper production. CARDI is the major producer of quality declared hot pepper seed in the Region. The Institute is also the dominant regional facilitator towards the development of a sustainable hot pepper industry.

**Fruits and vegetables**

The Institute’s work in this sub-programme aims to increase the productivity and production of fruits and vegetables. In fruits, activities during the period were executed in: pineapple (production, crop scheduling and post harvest handling); citrus (research into best rootstock/scion combinations related to the management of Citrus Tristeza Virus (CTV) and the management of Citrus Greening disease); golden apple (dwarfing techniques and orchard maintenance regimens and fruit fly management protocols); coconut (research into the management of red palm mite and the production and sale of coconut seedlings of resistant dwarf types) and breadfruit (post harvest handling for export). There were two major areas of interventions in vegetables: i) development and training in Integrated Pest Management (IPM) strategies and ii) vegetable production using Protected Agriculture (described in more detail below) where activities focused on strengthening the technical and administrative capacities of stakeholders along the entire value chain and creating useful internal and external linkages to support industry sustainability.

**Small ruminants**

The major activities undertaken were: the introduction of pedigree animals; the stabilisation of upgraded local breeds; the introduction and utilisation of improved forages; the use of locally produced feeds and the production of by-products, such as milk, cheese and soaps. Regional experts agree that the most limiting factor prohibiting the further expansion and development of the small ruminants’ industry is the unavailability of quality breeding stock, particularly females, which are needed to support stock multiplication and improvement programmes. It is for this reason that emphasis was placed on providing the local farming community in Jamaica with high quality pedigree stock (primarily Boer goats), access to a superior stud service and upgraded local stock from CARDI’s selective breeding programme. The other limiting factor of critical regional importance is feed, which has become increasingly important because of rising prices of grains and other feed ingredients. In response, CARDI has focused on the development of forage based feeding systems by introducing and evaluating improved fodder crops for ruminant livestock feed. Principal among these accessions is the *Brachiaria* hybrid, Mulato which was developed by CIAT in Columbia and which now supports ruminant livestock production in Barbados, Jamaica, Trinidad and Tobago and St Kitts and Nevis. CARDI has also devoted attention to value-added components of the industry by providing technical support for the development of dairy and cosmetic products from goats’ milk in Jamaica.
**Germplasm**

The availability of quality germplasm (seeds, planting materials and improved breeding stock) is critical to the development of sustainable agro-based industries. Activities in this area included: increased infrastructural capacity for the propagation and distribution of planting material in Antigua, Barbados, Belize, Dominica, Jamaica and St Vincent and the Grenadines; the introduction of improved high-yielding root and tuber crop varieties in several countries including Grenada, Jamaica, Montserrat, St Vincent and the Grenadines and Trinidad and Tobago; the identification of cassava and sweet potato varieties suitable for processing; the maintenance of the regional hot pepper germplasm bank in Barbados; the maintenance of sweet potato, cassava and yam varieties at the Mona Demonstration and Training Centre, Mona, Jamaica; a germplasm bank of rootstock resistant to Citrus Tristeza Virus (CTV) in St Lucia; the introduction of new high-yielding corn varieties to Belize and Grenada; the introduction of improved goat breeding stock (animals and semen) in Jamaica and the introduction of improved forages in Barbados, Jamaica, St Kitts and Nevis and Trinidad and Tobago.

**Climate Change**

In recognition of the serious and often negative impact of the vagaries of weather and climate on agricultural production, the Institute seeks to facilitate sustainable means of maintaining and increasing agricultural outputs. The following interventions were executed: collaboration with the Caribbean Community Climate Change Centre (5Cs), and the Caribbean Institute for Meteorology and Hydrology (CIMH) in the implementation of the Caribbean Agrometeorological Initiative (CAMI) funded by the EU/ CTA; establishing recognition of critical relationships between the factors of climate change and those of plant productivity through a series of national consultations and workshops; establishing immediate needs related to the management of climate sensitive pests and diseases; research to increase the usefulness of protected agriculture and water management systems as options in climate change adaptation strategies; increasing the Region’s capacity for climate change modeling; developing appropriate soil and water management methodologies; the introduction of agrometeorological equipment and climate resilient crop varieties; establishment of conservatories to protect regional biodiversity and the establishment of germplasm banks to enable a rapid restart of food production after a natural disaster.

**Protected Agriculture (PA)**

Based on the importance placed on this form of agriculture in the Region, the Institute’s activities in this Thematic Area sought to facilitate the development of sustainable protected agriculture systems. There was a focus on: identifying measures and/or practices to alleviate unsuitable high temperatures within structures; developing effective crop protection strategies; reducing reliance on soil based systems; development and strengthening of Protected Agriculture (PA) producer groups; the creation of linkages between producers and local high end and export markets and training in structures, requirements, greenhouse technologies and production and marketing systems.

**Information and Communication**

CARDI has begun exploring use of ICT4D tools to disseminate technologies for production, value addition and marketing with a particular purpose of engaging the youth. The CARDI website has been upgraded and emphasis was made in increasing web-based information transfer.

The following information resource guides and/or tools were produced:

- ‘R&D in Agriculture: a bulletin on information resources’. This publication is a bulletin on information resources which aims to guide
CARDI staff and other agricultural stakeholders in the Caribbean Community (CARICOM) and abroad to articles, journals, books, audio-visual materials, institutions and events related to the priority commodities and thematic areas in current CARDI Medium Term Plan (MTP).

- ‘Agriculture in the News: issues affecting Caribbean agriculture’, a monthly newsletter which provides a compilation of selected news articles on issues affecting agriculture in the Caribbean Region. Articles from newspapers, online news service agencies, newsletters and press releases were featured.

CARDI staff were provided with SDI Alerts (Selected Dissemination of Information) which generates email updates on the latest news items, journal articles, research reports and/or publications and event notices pertaining to CARDI’s priority commodities and thematic areas.

A CARDI D group was set up in 2011 for the dissemination of information to CARDI staff and stakeholder clients. Circulated via Dgroups were mission reports, publications and technical reports and SDI alerts.

The collections (including bibliographical databases) related to CARDI publications and non-CARDI publications concerning commodity and thematic areas were managed.

**Strengthening human capacity**

One of the major areas of CARDI activities is to strengthen the human capacity of its clients and stakeholders along with its own staff. Emphasis is placed on building a cadre of knowledgeable and skilled stakeholders along the targeted commodity value chains through capacity building programmes in production, post harvest, value addition, group dynamics and communication. During the period 2007-2011, training related to following commodities/thematic areas included:

- Roots and tubers: integrated crop management; post harvest technology; food safety management; marketing; plant propagation techniques - 1,086 stakeholders in Dominica, Jamaica, St Vincent and the Grenadines and Trinidad and Tobago; appropriate produce specific post harvest practices; post harvest handling of white potato (*Solanum tuberosum*) and onion - 60 farmers in Belize.

- Cereals and grain legumes: improved production, harvest and post harvest technologies for white corn and black beans - 40 farmers; Belize.

- Hot pepper: production and post harvest methodologies - 121 stakeholders in Belize, Dominica, St Lucia and St Kitts and Nevis.

- Fruit and vegetables: fertigation techniques - 60 farmers and extension officers in Dominica; IPM for pest control; Good Agricultural Practices (GAP) and cost effective production techniques - 461 persons in St Kitts and Nevis and Belize; post harvest technologies for fruits, vegetables and root crops - 55 students and extension officers in St Lucia; post harvest handling and quality assurance in breadfruit and dasheen - 78 farmers, exporters, pack house operators, processors and extension officers in St Lucia; pineapple production, crop scheduling and post harvest handling - 55 farmers and extension officers in Dominica; production and post harvest practices in melons - 24 farmers and agricultural officers in St Lucia; determination and use of pineapple maturity indices for various market outlets, - over 40 farmers and technicians in St Lucia; vegetable grafting - 30 farmers and propagators in Dominica.

- Small ruminants: general husbandry, production methods, feeding systems - 986 persons from Jamaica and Grenada; certification level training in artificial insemination - 39 technicians and livestock personnel; 14 persons certified to international standard HEART/NTA system from Jamaica.
• Protected Agriculture: greenhouse methodologies and structure requirements - 451 persons from Dominica, Haiti, Jamaica and Trinidad and Tobago.

• Climate Change - methodologies for climate change impact studies - 40 stakeholders from the Region; risk management in smallholder agricultural production systems (a train the trainer programme) – 24 persons; water use efficiency in the agricultural sector – 19 persons.

• Information and communication - Web 2.0 technologies (25 persons in Trinidad and Tobago); IT systems maintenance and update; Wordpress (nine persons from Haiti, Jamaica, Haiti, Dominica, St Vincent and the Grenadines and Trinidad and Tobago); communication tools and methods for practitioners in food and nutrition security - 15 persons in St Kitts and Nevis).

• ASTI systems: concepts and applications (27 persons from 12 countries, 20 persons from Belize).

**Resource Mobilisation**

The Institute has embarked on a very robust and aggressive Resource Mobilisation programme that is aimed to supplement the resources provided by Member States. Consequently, for the period 2008 to 2011, the positive cash contribution by CARDI to Member States was EC$ 23,000,000; this amount represents the difference between actual government contributions (EC$27,000,000) and total expenditure by CARDI (EC$50,000,000).
CARDI Countries
Antigua and Barbuda, Barbados, Belize, Dominica, Grenada, Guyana, Jamaica, Montserrat, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Trinidad and Tobago
CARDI’s work in Antigua and Barbuda continues to support the national programme in Food and Nutrition Security. The commodities of focus are sweet potato, hot pepper, corn, squash and pumpkin.

**Roots and tubers (sweet potato)**

CARDI, in collaboration with the Ministry of Agriculture, the Agricultural Development Cooperation and the Central Marketing Cooperation, evaluated the effects of variety, time of planting and zones on sweet potato marketable yields. This was in response to farmers’ and Ministry technical experts’ observations that low yields were obtained when sweet potatoes were planted at certain times of the year.

After three years of experimenting, the results showed that:

- time of planting and accession consistently affected productivity and that the best times for planting were between October to February.
- the cultivars ‘Hurricane’ and ‘Catch Me’ gave the highest yields irrespective of the planting times and locations.
- varietal and time of planting trends showed similarities for the 2008-2009 and 2010-2011 plantings.
- zone effects were significant in the 2008-2009 plantings.

The research results allow planning and projections to be more precise when using sweet potato for food security, marketing and commercial export ventures.
The expected productivity is guided by varietal/accession performance, time of planting and to a lesser extent location of planting.

**Seed production (primarily hot pepper, corn, Pumpkin, squash)**

CARDI Antigua is the Institute’s main commercial seed producer and, with the additional responsibility of having to supply CARICOM with seed, the Antigua seed storage facility also serves as a reservoir for indigenous seed. All seed produced by the Unit is tested according to the rules of the International Association for Seed Testing (IAST). The Unit has upgraded its seed processing and storage facility.

The varieties known as ‘Local’ pumpkin, (*Cucurbita argyrosperma*), ‘Local’ table squash, (*Cucurbita pepo*), ‘Local’ cucumber (*Cucumis sativus*) and ICTA-FM Corn (*Zea mays*), all highly productive under Antigua conditions, were grown and quality seed produced and stored for ready availability to the farming community in recovery efforts after natural disasters such as hurricanes.

Over the period 2008-2011, the following quantities of hot pepper, corn, pumpkin and squash seeds were supplied to farmers in the Region:

- Hot pepper - 240 lb (109 kg)
- Corn - 840 lb (395 kg)
- Pumpkin - 26 lb (12 kg)
- Squash - 7 lb (3 kg)
CARDI’s work programme in Barbados seeks to support the initiatives of the Ministry of Agriculture, Food, Fisheries and Water Resource Management (MAFFW) towards national food and nutrition security. The commodities targeted are hot pepper, roots and tubers, biotechnology and small ruminants.

**Hot pepper**

The Barbados Unit maintains the regional hot pepper germplasm bank of 73 accessions from CARICOM Member States. Breeder seed of selected purified and stabilised hot pepper cultivars are rejuvenated every two years and breeder seed of the commercially released varieties (West Indies Red, Scotch Bonnet and CARDI Green) is supplied to the CARDI certified seed production units in Antigua and Belize for commercial seed production to supply the Region’s farmers.

CARDI Barbados supports the achievement of optimum yields by encouraging the use of improved methodologies such as using quality pure seeds, stale bed technique (for weed control), high planting density (10,000 plants per acre), fertigation and Integrated Pest Management. Following the recommended technical package has resulted in weekly harvesting over a six month period with yields moving from the national average of 15,000 to 20,000 lb per acre to 45,000 lb thereby improving the income of hot pepper farmers.

**Roots and tubers (cassava and sweet potato)**

CARDI is working with MAFFW on seven varieties (three imported and four collected nationally by MAFFW) for the production of planting material to supply farmers with clean, disease free supplies of high yielding varieties of cassava at the beginning of their planting season.
These varieties have been rapidly multiplied in a retrofitted Common Fund for Commodities - European Union (CFC-EU) Project weaning/hardening nursery at Graeme Hall to supply the MAFFW and three farmers. CARDI has conducted research to reduce the impact of scarabee weevil which reduces tuber quality. Traditionally, this pest is managed by cultural practices and/or the use of insecticides. To determine a viable Integrated Pest Management regimen using acceptable inputs, the unit conducted trials using a biopesticide containing spores of the fungus *Beauvaria* sp. Work on this non-chemical intervention is ongoing. This work is very critical to Barbados as there is interest from marketing firms in the United Kingdom and Canada (TESCO and Cavendish respectively) to import sweet potato from Barbados. Successful management of Scarabee weevil with this biopesticide would eliminate present concerns about pesticide residues.

**Small ruminants**

A major constraint to the economic production of sheep in Barbados is the cost of imported feed. In order to reduce production costs and dependency on imported supplies, CARDI, is encouraging the use of Mulato II grass (*Brachiaria* hybrid), Mulberry (*Morus indica*) and molasses urea blocks by Barbados Blackbelly sheep farmers.

The weaning/hardening nursery at Graeme Hall was refurbished and is currently being used to rapidly multiply Mulberry planting material to supply 20 selected sheep farmers for the establishment of forage banks. This will result in increased capacity to supply improved forages on their farms.

CARDI continues to lead a coordinated effort with the Barbados Agricultural Society (BAS), MAFFW and University of the West Indies (UWI) to register purebred Barbados Blackbelly sheep in a database of the recently established Barbados Blackbelly Sheep Breed Society.

**Biotechnology**

CARDI has refurbished its labouratory facilities at Cave Hill, UWI Campus. The Unit can now facilitate the movement of tissue culture planting material of cassava and sweet potato sourced from St. Vincent and the Grenadines to neighbouring islands by certifying them as disease free. Furthermore, this laboratory has the capacity to conduct virology research in hot pepper and sweet potato to address viral pathogen challenges in these crop commodities.
The aim of CARDI’s work in Belize has been to support national initiatives to enhance food production for both the domestic market and for export to Caribbean and Central American countries. The Unit’s work programme focused on cereals (corn and rice), grain legumes (red kidney beans and small red and black beans) and hot peppers which are targeted commodities in the Agricultural Policy of the Government of Belize.

The Unit also provides technical assistance to various organisations including the Inter-American Institute for Cooperation on Agriculture, the United Nations Development Program, the Belize Agricultural Health Authority, the Belize Citrus Growers Association, the Citrus Research and Education Institute and the Pesticide Control Board.

**Cereal and grain legumes**

Demands for regionally-grown cereals and grain legumes have increased in the Central American markets since the food crisis of 2008, which resulted in sharp increases in the cost of these commodities from international suppliers. In response, the Unit increased its acreages under commercial production of corn and soybeans by 10%. Additionally, CARDI Belize expanded evaluation trials of varieties of corn and beans of acceptable grain quality for targeted Central American markets. To date, one high yielding variety of white corn and one variety of yellow corn have been selected as suitable for local production for these export markets. Similar work on bean varieties is in progress.

CARDI in collaboration with the Inter-American Institute for Cooperation on Agriculture, (IICA), under the Project for the Innovation of Agriculture (REDSICTA) demonstrated improved production, harvest and post harvest technologies for white corn and black beans to 40 farmers of Jalcate and San Vincente villages of the Toledo District. This was primarily done through the
establishment of on-farm demonstration plots at each farm holding. Additionally, motorised corn shellers and portable corn/bean dryers and grain/seed cleaner were introduced to improve the efficiency of post harvesting systems and to improve the quality of grains.

Based on the successful outputs of this project, CARDI has been requested by United Nations Food and Agriculture Organization (FAO) and the Ministry of Agriculture to carry out further developmental work for basic grain seed production by small producers.

**Hot pepper**

In 2011, under a FAO/CARICOM/ CARIFORUM Food Security Project, the ‘Caribbean Hot Pepper Production and Post harvest Manual’ was developed. A total of 500 copies of this manual were published by FAO in the first instance, for distribution free of charge in Belize and other Caribbean countries. Additionally, under the same Project, the methodologies recommended in this manual were introduced and demonstrated through a series of training workshops for hot pepper value chain stakeholders in Belize. Thirty-six stakeholders, including farmers, extension officers and technicians of the Ministry of Agriculture were participants of this training.

**Seeds for Haiti**

CARDI produced and shipped 69,300 lb of open pollinated yellow corn seed, 13,200 lb of red kidney bean seed and 8,800 lb of black bean seed to Haiti, following the destructive earthquake of January 2010. This was a component of the CARICOM initiative titled ‘Support for Re-vegetation Component of the Resuscitation of Agriculture in Haiti’.

**Integrated Farming Systems (IFS)**

IFS concepts were introduced to farmers of five districts. This was done as a component of the Agriculture Enterprise Development for Rural Belize (AED) funded by European Union (EU) and managed by local United Nations Development Programme Office in collaboration with the Ministry of Agriculture and Fisheries in Belize. Five biodigesters were installed and were operating using pig waste. One chicken tractor (movable chicken coop) was constructed and provided to one women’s group. During training sessions with farmers groups, silage presses, fodder choppers and soybean roasters were manufactured and are now in use by the trainees.

**Climate change**

Following training, CARDI Belize now has proficiencies in the development of pest and disease forecasting systems as part of the Caribbean Agrometeorological Initiative (CAMI) funded by the European Union (EU)/ The Technical Centre for Agriculture and Rural Cooperation (CTA). The Caribbean Agricultural Research and Development Institute (CARDI) Unit acquired an automated weather station and the output is currently being used to assist in developing regional weather related forecasting models for Black Sigatoka Disease in banana and Asian Citrus Psyllid in citrus. A model for Asian Soybean Rust is also being developed.
CARDI’s work in Dominica has been to support and strengthen the development programme of its primary stakeholder, the Ministry of Agriculture, and collaborate with the Dominica Export Import Agency (DEXIA), farmer groups and private companies within the value chains of the targeted commodities.

Roots and tubers (yam, dasheen, cassava and sweet potato)

During 2010 - 2011, CARDI trained over 120 farmers, extension officers and exporters on improved management techniques of roots and tubers through on-farm demonstration plots and on-farm workshops.

Anthracnose is the most debilitating production disease of yam, due mainly to the hot and humid conditions prevalent in Dominica. A yam anthracnose management strategy was developed by CARDI Dominica.

Cassava production in Dominica is primarily for processing into farine and cassava bread. Three processing facilities were upgraded and the owners were introduced to good manufacturing practices and packaging procedures. The upgraded facilities received motorised graters, squeezer presses, stainless steel sinks food grade containers and utensils for improved efficiencies in the making of farine and cassava bread. The resultant improvement is now driving increased production of cassava. The Unit assisted in the upgrade of the propagation facility of the Ministry of Agriculture to facilitate increased multiplication.
and bulking up of the new cassava and sweet potato germplasm that are expected to be imported into Dominica.

A DVD titled ‘Yam Production, the Dominica Experience’ along with several information packages were developed and distributed.

Fruits

Citrus tristeza virus (CTV) has severely reduced domestic production of citrus and in response CARDI evaluated CTV tolerant rootstock to determine the optimum scion/rootstock combination for increased productivity in the presence of this virus. CARDI also supported various Government initiatives in the management of Huanglongbing (citrus greening disease).

Hot pepper

CARDI assisted Dominica the local hot pepper industry through the Institute’s quality hot pepper seed programme. The CARDI developed varieties, CARDI Green and West Indies Red are the varieties of choice for both fresh berries and processing. CARDI introduced the variety, Moruga Red to Dominica and production of this variety is presently increasing in acreage with recent initiatives for the revitalisation of the industry. Training in hot pepper crop production and post harvest management was provided. Research has been conducted into effective pest and disease management. The Unit collected germplasm of Bonda Ma Jacque (an indigenous landrace previously grown in Dominica for the processing market) for productivity trials in support of the expansion of commercialisation activities as this landrace is well known and appreciated for its pungency and taste.

Vegetables (Protected Agriculture)

CARDI leads the way in Protected Agriculture (PA) research in Dominica. Three plastic films used to cover greenhouses are being evaluated to determine the most appropriate for Dominica conditions.

To facilitate improved production and productivity in domestic vegetable PA production, a comprehensive training programme in fertigation (the delivery of plant nutrients through irrigation) targeting farmers, extension officers, nurseries and input providers was held; 60 persons were trained.

The Unit conducted research and training in the use of non-soil media and grafting onto resistant rootstock for the management of tomato bacterial wilt (*Ralstonia solanacearum*), a serious problem when tomatoes are grown in soil based media in greenhouses. Training in grafting techniques was provided to 30 farmers and propagators.
Over the past four years, CARDI’s work in Grenada has supported national agricultural development in the following strategic commodities: fruits, vegetables, hot pepper, corn, roots and tubers, and small ruminants.

**Fruits (Golden apple)**

CARDI has been collaborating with the Ministry of Agriculture (MOA) to develop a hot water treatment protocol to treat golden apple fruits for fruit fly (*Anastrepha obliqua* L.) infestation. This has been facilitated by support from the Florida Association for Volunteer Action in the Caribbean and Americas (FAVACA). If the treatment is successful, Grenada will be able to resume shipments of golden apple to the USA market. In addition, the Unit provided 213,000 plants of the dwarf golden apple to the Trinidad and Tobago Agri-business Association (TTABA) in Trinidad. Technical information was also supplied for both nursery and on-farm production.

**Hot pepper**

CARDI is Grenada’s major supplier of hot pepper planting material, both certified seed and seedlings, to farmers. This has been the backbone of the national hot pepper industry thus enabling the production of berries for export and for processing by leading agro-processors, including Baron Foods, De La Grenade Industries and many small agroprocessors. Baron Foods alone provides an annual market for 260,000 lbs of berries. This contributes about EC$390,000 annual income for farmers.

**Roots and tubers**

Support to the root crop industry has primarily been to supply planting material of sweet potato and cassava. Six new varieties were introduced for testing; those suitably adapted to local conditions will be distributed to farmers.
Small ruminants

CARDI, in collaboration with the MOA and Inter-American Institute for Cooperation on Agriculture (IICA), has made interventions to help improve the production and marketing of small ruminants.

Two improved goat housing demonstration units were constructed, one in Carriacou and Grenada. The unit in Carriacou was stocked with eight Boer goats for meat production while the unit in Grenada was stocked with eight animals of milk breeds (Saanan, Toggenburg and Alpine). The latter was designed for milk production to supply milk to consumers in the close environs, and also to the cheese processing plant at Belmont Estate. These units have also been used to train farmers in improved goat production systems using the Farmer Field School Approach.

Vegetables (Seedling production)

The major contribution of CARDI to the vegetable subsector is the supply of high quality planting material to commercial farmers, homeowners and backyard gardeners. Approximately 350,000 vegetable seedlings are distributed annually from the CARDI nursery to farmers nationwide. Technical advice was also supplied to vegetable farmers upon request via telephone, farm visits and literature. Training in production of high quality vegetable seedlings was carried out for various farmer groups.

Corn

Open pollinated corn varieties were introduced from CARDI Belize primarily to help replace expensive hybrids which have proved vulnerable to local stress factors such as, high disease incidence and producing poor yields. The variety, YC001, one of the open pollinated varieties introduced by CARDI, has successfully adapted to local conditions. It has been well received by farmers and currently an estimated 25% of national production comes from this variety.
The CARDI Jamaica Unit activities are geared towards contributing to the national goals for sustainable agricultural development as described in Jamaica’s Vision 2030. The work programme of the Unit is developed in consultation with the Ministry of Agriculture and Fisheries and other stakeholders in order to identify national priorities, current initiatives and gaps.

**Livestock (Small ruminants)**

The development of the small ruminant industry is the focus of the CARDI Jamaica Livestock programme. Research and development activities and training were conducted in nutrition and feed delivery systems, good husbandry practices, improved breeds and breeding systems and best management practices. These have contributed to increased production and productivity over the last three years.

The efforts of the breeding programme resulted in the delivery of over 150 improved goat breeding stock to small ruminant farmers throughout Jamaica but mainly in the Manchester Plateau. Over 2,000 breeding does were exposed to improved breeding bucks from the Boer, Nubian and Alpine breeds produced at the CARDI Sam Motta Demonstration and Training Centre. Breeding and production studies conducted showed opportunities to shorten kidding intervals by more than 30 days, which will result in farmers getting increased production per year from their breeding females.

Under the validation and demonstration effort in small ruminant production and management, over 550 persons, including farmers, students and input suppliers, benefitted from organised on-station and on-farm exercises.

Ongoing collaboration with the Food and Agriculture Organization of the United Nations (FAO), the Jamaica Goat Farmers Association (JGFA) and the Jamaica 4H...
Clubs, assisted the execution of the small ruminant component of the European Union Food Facility (EUFF) project.

Feed, especially commercial concentrates, is responsible for over 50% of production cost of small ruminant production. To address this constraint to industry viability, three feeding trials investigated the use of agro and industrial by-products. These proved to be a cheaper and competitive alternative.

With the unavailability of land another limiting factor, forage adaptation, production and grazing trials were conducted on mined-out bauxite lands where selected forage varieties were tested to determine their feeding value for goats. Some recommendations are now available to farmers regarding the production capabilities of the reviewed forages.

The Sam Motta Demonstration and Training Centre (SMDTC) continued to demonstrate an integrated livestock/crop production system that utilises animal manure to improve productivity on mined out bauxite lands. See following section.

**Soil management and water management (restoring crop productivity in mined-out bauxite soils)**

CARDI is assisting in the recovery of lands which have been mined for bauxite and is helping to restore the soil to full economic productivity. Over the years, production practices, including the use of both traditional and vermi-composts (using the earthworm *Eisenia fetida* to degrade goat manure, feed wastes and crop residues) mulches and the use of drip irrigation conducted within small plots have shown that economic yields of traditional crops of callaloo (*Amaranthus* spp.), tomato (*Solanum lycopersicum*), sweet and hot pepper (*Capsicum* spp.) can be achieved. Funding will be sought to upscale the results.

**Roots and tuber crops (sweet potato, cassava and yam)**

Working with pilot producer groups in selected areas, one acre demonstration plots have been set up in six communities. These demonstrate best practices to famers for improving production and productivity of root and tuber crops.

Over 200 farmers have been trained in areas of Integrated Crop Management and marketing strategies for roots and tuber crops.

Planting material of poor quality has been a major contributor to poor yields of root crops. In collaboration with Christiana Potato Growers Cooperative Association (CPCGA), through funding from Inter-American Institute for Cooperation on Agriculture (IICA) and more recently
Jamaica continued

the major project funded by the Common Fund for Commodities (CFC) and EU, civil works has been undertaken at the CPGCA Tissue Culture Laboratory to double the floor space from 580 sqft to 1160 sqft. Output of tissue cultured plantlets of select varieties of sweet potato, cassava and yams is projected to be 40,000 plantlets every 6 weeks. To serve as a weaning, hardening, and bulking up facility, 24,200 sqft of greenhouse space is under construction. A Tissue Culture Specialist has been recruited under the CFC project to establish protocols for culturing sweet potato, cassava and yam and conduct training for the sustainability of the facilities.

As part of a germplasm conservation programme the CPGCA tissue culture laboratory currently maintains 56 sweet potato, 18 cassava and two yam varieties (four others already sourced are soon to be added) in vitro. At the in vivo germplasm bank at the CARDI Mona Demonstration and Training Centre, 26 sweet potato, ten cassava and two yam varieties are being maintained.

Technological support to Twickenham Industries, a key cassava processor was provided with the fabrication of two roll away trolleys with ten shelves each) to be used in a 210 cuft oven. The trolleys allow conveyor stacking for efficient loading. The Jamaica Unit also assisted with the installation (assembly and electrical works) of a mill which was donated to Twickenham Industries from a previous EU intervention. Since this intervention, the factory output has increased three-fold and the number of products on offer has also increased, leading to the employment of three additional staff.

The improved facilities are now also rented to other cottage industry groups that do not have the capacity to dry and mill their products. The technical support and infrastructural development activities are valued at US$ 270,000.

Protected Agriculture

Protected Agriculture (PA) is seen by Jamaica as a critical vehicle for boosting production of vegetables and herbs thus contributing to food and nutrition security and import substitution especially with respect to vegetables for the tourism sector. CARDI’s efforts are geared towards

- improvement of product marketing and trading linkages
- establishment of improved PA systems for selected vegetables and herbs
- promotion and strengthening of producer and cluster groups working in PA
- training of stakeholders
- improving access and information on PA to all stakeholders
In the area of agro-energy, CARDI, in collaboration with the Petroleum Corporation of Jamaica (PCJ), is assessing the relative productivity of five castor bean and two Jatropha varieties on reclaimed bauxite lands. This study began in April 2011 and the first harvest of oil seeds began in the first quarter of 2012.

In herbs, CARDI has developed technological protocols for the successful cultivation of cerassee (*Momordica charantia* L), red sorrel (*Hibiscus sabdariffa*), spearmint (*Menthaspicata, syn M. viridis*), peppermint (*Mentha x piperita*) and lemongrass (*Cymbopogon spp.*). This information is being incorporated into a technical manual of agronomic practices for the growing of specific herbs, spices and medicinal plants in Jamaica.

In contributing to ongoing efforts to safeguard the Caribbean Basin from the introduction and ravages of invasive species, CARDI continues in its technical advisory role on the national Plant Health Coordination Committee.

CARDI also sits on the Steering Committee of the GEF / UNEP/CABI Mitigating the Threats of Invasive Species in the Insular Caribbean (MTIASIC).

As a member of the national Alien Invasive Species Working Group (AISWG), CARDI is participating in the current review of the database of invasive species of interest to Jamaica.
CARDI has provided support to the Ministry of Agriculture (MOA) to assist in implementation of its development programme. Emphasis has been on improving production and productivity of roots and tubers (cassava and sweet potato), and bananas; also facilitating production of crops under ash and acid rain.

**Hoop house construction**

Agricultural production in Montserrat has been particularly challenging because of the heightened volcanic activity on the island.

Hoop houses were introduced to be used for crop production in times of heightened volcanic activity when acid rain and ash can prevent growth. This innovation was adopted by backyard gardeners and led to them supplementing their incomes.

**Roots and Tubers**

CARDI developed a business plan for the improvement of the value added cassava industry for the Ministry of Agriculture. Activities implemented resulted in labeled
packages of cassava bread being available commercially. Germplasm of improved sweet cassava varieties were introduced and made available to farmers.

To improve the productivity of local sweet potato production, farmers were provided with planting material of high yielding, consumer acceptable sweet potato. In addition, there was training in the management of the sweet potato weevil, *Cylas formicarius*.

**Banana production**

The CARDI Unit assisted the MOA in obtaining tissue culture planting material of bananas for hardening and distribution to farmers. This led to Montserrat now being self-sufficient in bananas.
Agriculture has always been important to the economy of the Federation of St Kitts and Nevis. It is identified as one of the pillars for transformation. The CARDI Unit in St Kitts and Nevis lends support to the development programmes of the Departments of Agriculture on both islands. The main areas of focus have been sweet potato, hot pepper, pest management in cabbage, fruit fly control and protected agriculture and most recently, forages for livestock production. CARDI has also contributed to the capacity building of extension officers and producers on both islands.

**Sweet potato**

CARDI has led research on management of the sweet potato weevil (*Cylas formicarius*), the main sweet potato pest in the Federation. The introduction of Integrated Pest Management (IPM) techniques, including trapping, has led to a reduction in the incidence of sweet potato weevil infestations.

To identify cost effective trapping techniques, six different weevil trap/ pheromone combinations were evaluated: (Taiwanese, commercial and Clorox bottle traps each with Taiwanese and Great Lakes lures). The best combination was found to be the locally constructed trap using Clorox bottle and the Taiwanese lure. This is a cheaper alternative for the farmer to the commercial trap which was previously used.
Recommendations were made to processors on suitable varieties for value added product development. Sweet potato crisps utilising the suggested varieties are now been successfully produced and marketed.

**Hot pepper**

![Bright red berries of “Ball of Fire” hot pepper](image)

CARDI has supported the St Kitts Department of Agriculture in its attempt to introduce hot pepper as a crop for diversification. Investigations into mulching systems showed that high quality berries can be produced in times of low water availability with the use of plastic and grass mulch. Marketing information was also provided to facilitate export of the crop.

**Protected Agriculture**

Crop production under a Protected Agricultural (PA) system is new to farmers in St Kitts. CARDI is using its PA structure on the station as a demonstration unit. It is also collaborating with the University of the West Indies and McGill University, Canada, to determine the best locally available growing medium and to determine suitable sweet pepper and tomato varieties for PA production.

**Fruit fly control**

Three commercially available traps for the control of the West Indian fruit fly were evaluated. The best one was the McPhail commercial trap which farmers in the Federation are now using in fruit fly control.

**Pest management in cabbage**

Research was conducted into the efficacy of Radiant and Entrust classified as “Reduced Risk Pesticides” for the control of Diamond Back moth in cabbage under local conditions. The results showed that these two new pesticides can be used for the effective management of this pest.

![Training in crop protection of cabbage.](image)

**Capacity building**

Capacity building of farmers and extension officers was facilitated by conducting workshops in agribusiness, training, Good Agricultural Practices (GAPS), management of sweet potato weevil and greenhouse management. The Unit facilitated a regional workshop on information and communication strategies for nutrition practitioners.
CARDI’s primary research for development work in St. Lucia has been in keeping with national agricultural policy objectives and the priority crops of the Institute’s work programme, roots and tubers, hot pepper, vegetables and fruits in the Institute’s Work Programme are all found in the country’s new Agricultural Action Plan.

**Roots and tubers (cassava, sweet potato and yam)**

A major constraint affecting the agricultural sector over the last decade is the unavailability of planting material. This has resulted in shortages and increased retail prices. CARDI has been multiplying root crop planting material for dissemination to farmers. Germplasm of these crops is also being conserved in order to mitigate the scarcities which follow disasters, such as tropical storms and hurricanes.

**Hot pepper**

Hot pepper production in St. Lucia is insufficient to support the agro-processing industry. Large quantities of pepper mash are imported to supplement local production as processors seek to take advantage of both local and export market opportunities. CARDI has taken the initiative to train hot pepper farmers and private seedling producers in increasing their production and thus take advantage of the high demand for hot peppers by local processors.

**Fruits**

CARDI provided technical assistance in the form of research, development and training for improving the quality of pineapples sold by farmers to consumers, supermarkets and hotels on the island. This was part of national efforts to help banana farmers to diversify. Assistance was provided under an Food and Agriculture Organisation of the United Nations (FAO) funded project.
to watermelon farmers in the form of (i) training in production and (ii) post harvest skills and the production of a Caribbean melon production and post harvest manual for melon stakeholders. Passion fruit has the capacity for replacing some of the fruit juices imported into St. Lucia. CARDI has developed an improved low cost passion fruit production system which has been validated and demonstrated to farmers. To sustain production, CARDI continues to provide passion fruit seedlings to farmers at a highly subsidised price.

Breadfruit, a major export crop, mainly to the United Kingdom, United States and Canada, received special attention in the areas of improved pack house operations and the training of pack house operators in the best post harvest handling practices.

**Coconut rehabilitation**

The green nuts of the coconut (*Cocos nucifera* L.) are in great demand now for coconut water, which is consumed as a beverage. Nuts are harvested mostly from tall varieties that were established many decades ago on copra production estates. These trees are no longer productive as they are very old, tall and infested with the red palm mite. To support efforts to revitalise the coconut water industry CARDI, in collaboration with Inter-American Institute for Cooperation on Agriculture (IICA) and the Ministry of Agriculture, produced thousands of dwarf coconut seedlings at its Field Station. These were made available to farmers for establishment on their holdings, to satisfy the demand for fresh water nut and to sustain a number of fledgling bottled coconut water entrepreneurs.

**Protected Agriculture**

Vegetable production in St. Lucia is traditionally seasonal. Most of the production is carried out in the dry season (January to June) because wet season production (July to December) is plagued by a proliferation of...
weeds, pests, and diseases which seriously affect crop performance and increase labour costs. CARDI has been conducting research to alleviate problems with pests and diseases. The Ministry of Agriculture has introduced Protected Agriculture (PA) production systems and methodologies which facilitate year round production and therefore can address the high year-round demand for vegetables (such as sweet pepper, tomato, cucumber and lettuce). To complement this initiative, CARDI has initiated a research and training project funded by the Caribbean Development Bank (CDB) on problems that limit the production/productivity of vegetables under protected structures and there are ongoing investigations comparing productivity factors of protected agriculture and open field vegetable production systems.

**Invasive species management**

Citrus Tristeza Virus (CTV) is an invasive species that attacks citrus trees. It is usually transmitted by budding or grafting on susceptible sour orange rootstock and also by sucking pest insects, primarily the brown citrus aphid. The presence of CTV has been observed on a few locations on the island by the Ministry of Agriculture. Control of the disease on existing plantings is difficult. In new citrus plantings, control can be best achieved by grafting onto CTV tolerant citrus rootstock. CARDI continues to maintain, in its germplasm bank, three CTV-tolerant lemon rootstock varieties from which seeds are extracted from fruits and supplied to the Propagation Unit of the Ministry of Agriculture to generate seedlings for use as rootstock.

*Tomatoes: comparing productivity of PA and open field systems*
A close working relationship between the CARDI unit and the Ministry of Agriculture has been developed. This relationship has been a major boost to the transfer of CARDI technologies. The commodities of focus for the work programme in St Vincent and the Grenadines are cassava, sweet potato, vegetables from protected agriculture and small ruminants.

**Root crops (sweet potato and cassava)**

Since 2007, there was an emphasis on activities to strengthen the root crop value chains to facilitate the Ministry’s aim of increased commercial production for both domestic and export markets. Importance was given to:

i. increasing the productivity of fresh and value added systems through the use of appropriate technologies in the value chains; and

ii. increasing the access, affordability and quality of planting material. The root crop activities were implemented in collaboration with the Ministry of Agriculture Research & Development and Extension Units, IICA, Arrowroot Industry Association, CaFAN / ECTAD and farmers.

**Sweet potato production**

Research into the productivity of nine sweet potato varieties in Chateaubelair, Rabacca and Akers showed that Rabacca and Akers were the most productive zones and that the most commonly grown and exported variety (Black Vine), consistently gave the lowest yield. The highest yielder was the newly introduced variety, Viola (from the International Potato Center). However, discussions with farmers during the training sessions indicated that Black Vine has several preferred
characteristics, including good taste and texture (consumers like it), a comparatively long shelf life, does not bruise easily and ships well making it highly suitable for both local consumption and export.

A total of 55 farmers, 15 extension officers, 12 agricultural students and three CARDI field assistants received training (theory and hands-on) in all aspects of sweet potato production under the CARICOM/Japan sweet potato project executed out of St Vincent. Use of CARDI technologies and the newly introduced varieties have improved yields by over 100% and also increased percentage of marketable tubers.

**Cassava production**

Activities continued on the cassava varieties previously selected for agroprocessing. These varieties produce yields over twice the local varieties commonly used.

**Value added systems**

Upgrading of farine processing facilities was done with the aid of the Ministry of Agriculture, Zee and Sons Construction Company and the Bureau of Standards. Five small agro-processing facilities were upgraded to facilitate improved sanitation protocols and training was provided to processors on the importance of sanitation and Good Manufacturing Practices. Focus was also placed on training processors in all aspects of food safety. The visible upgrading of facilities has resulted in increased public demand for the output of these processors. This has led to increased production and hiring of more employees.

**Planting material**

Demonstrations and training in innovative propagation, using cassava ministem and tip-shoot cuttings, were conducted to show how to produce planting material throughout the year and not only at the time of harvest of the tubers. Year round availability of planting material facilitates year round tuber production and supports a constant supply of cassava to the fresh and value added markets. These practices have been adopted by government propagation stations. A new tissue culture laboratory with an annual capacity of 600,000 plantlets was constructed at Orange Hill. At Perseverance two Protected Agriculture (greenhouse) structures, with an annual capacity of 360,000 plants were constructed to serve as new weaning and hardening facilities.
Weaning and hardening facilities at Perseverance

**Small ruminants**

CARDI supported the national livestock programme by providing technical information on feeds and feeding systems for small ruminants through visits by the Institute’s livestock scientists.

**Protected Agriculture**

The unit evaluated eight growth media (Dumbarton mix, Taiwan mix, coconut coir, compost and coir, compost and Promix, Promix and coir, compost and soil, soil and coir) for tomato seedling production. Results showed that the locally produced coconut coir proved to be the most economical while supporting good seedling growth.

Training programmes in protected agriculture continued; 15 extension officers, two officers from the Communications Unit and 20 farmers were trained.
The commodities targeted in the Institute’s work programme (hot peppers, roots and tubers, vegetables, small ruminants and fruits) are all included in the country’s National Food Production Action Plan 2012-2015. Work in Trinidad and Tobago has sought to make strategic research for development interventions along the value chain of these commodities. This was done by facilitating industry development through the provision of technical assistance and promoting the creation of useful and synergistic linkages among stakeholders along the value chain.

**Roots and tubers (cassava and sweet potato)**

Towards achieving the sectoral goal of increasing the production of staples to meet national demands, several research and development interventions were undertaken along the sweet potato and cassava value chains.

For the period under review the Unit collaborated with its partners, the Trinidad and Tobago Agri business Association (TTABA) and the Agricultural Society of Trinidad and Tobago (ASTT) and farmers groups representing cassava and sweet potato farmers to modernise the root crop industry through the:

(a) Identified six improved cassava varieties and 18 sweet potato varieties for use in fresh and processed channels

(b) Refurbishing of two weaning and hardening facilities, valued at TT$0.7M, to rapidly multiply and disseminate disease free planting material to farmers.

(c) Establishment of three one-acre plots to demonstrate and train farmers in Good Agricultural Practices; to date, over 250 farmers have been exposed/trained.
(d) Strengthening the processing capacity of medium sized enterprises through the installation of two cassava washer/peeler machines, valued at TT$0.3M. These machines have doubled production capacity. This collaboration is ongoing.

(e) Training in food safety management systems to 160 persons.

Trinidad and Tobago possesses a range of unique hot pepper landraces (commonly referred to as varieties), which includes the ‘Scorpion’, reputedly the hottest pepper in the world. In recognition of the potential commercial value of many of these landraces, CARDI collected specimens from across the country and characterised and catalogued them in an effort to conserve the gene pool for future generations.

One of the more popular landraces, the Moruga Red, was placed under a crop improvement programme to stabilise the genetic profile and produce uniform accessions. Consequently, commercial quantities of quality declared, true-to-type, disease free seed of Moruga Red was produced. Over 33 lb of Moruga Red seed (enough to establish 490 acres of the crop) has been distributed to farmers and there has been a significant improvement of berry quality and uniformity to meet market requirements. Moruga Red is now fast becoming the pepper of choice by farmers and processors.

Hot pepper

CARDI has been a major supporter in the development of a sustainable hot pepper industry. Activities were undertaken to improve the competitiveness of the hot pepper industry through the preservation of traditional landraces and validating improved production technologies.

A major problem in hot pepper production is the ever increasing shortage of labour and escalating labour costs. Investigations were undertaken to reduce labour dependency by using appropriate labour saving technologies, including the use of fabric mulches and irrigation systems.
The economic and agronomic potential of high density cropping systems were evaluated. The results of investigations using Moruga Red indicate that closer within-row spacing (as low as 12 in.) has a positive effect on yields while having no impact on size and berry quality. This information can be used to improve field productivity and meet market demands.

A booklet titled ‘Hot Pepper Production Manual for Trinidad and Tobago’ was published to guide farmers through the process of successfully growing hot pepper commercially in Trinidad and Tobago. A catalogue of the local commercial hot pepper landraces has also been produced in collaboration with the Trinidad and Tobago Agribusiness Association (TTABA).

**Vegetables (Protected Agriculture)**

In an attempt to address the problems being faced by vegetable producers, namely low productivity, high cost of production, and inadequate supply of planting material, evaluations are being undertaken to develop best practices for the production and marketing of a range of vegetables. In 2011, “best practices” have been demonstrated for over ten crops; two new varieties have been evaluated and identified as potential options for farmers to increase the diversity of production systems. Protected Agriculture (PA) systems have the capability to reliably produce large quantities of high quality vegetables, many of which are currently imported. PA is being promoted through demonstrations and training and the provision of technical assistance.

CARDI has partnered with the Trinidad and Tobago Tropical Greenhouse Operators Association, REPSOL (an integrated Spanish oil and gas company with operations in 28 countries) and University of the West Indies (UWI) to determine the best measures and practices to optimise the potential of PA systems.

**Interventions along the value chain** included:

The execution of a series of capacity building exercises for stakeholders along the PA value chain. More than 180 persons have been trained in the principles and practices of Protected Agriculture. Included in this programme were efforts to increase the access to pertinent information on PA technology through e-technology. The Trinidad and Tobago Unit partnered with REPSOL and hosted an advanced training workshop in PA.

The establishment of four protected agricultural structures as demonstration units which stakeholders visit to learn about the technology; more than USD100,000 has been invested into the establishment of these units.

Market survey executed by the Unit to determine the demand and supply requirements for vegetables produced under protected systems. The information is being packaged for distribution to farmers and is currently being used by the Ministry.

*Harvested “Hood” hot pepper berries*
Group strengthening and agribusiness cluster development. Through a series of sessions, which sensitised producers to the principles of group dynamics, the Unit assisted in the formation of a formal PA farmers group in Mayaro, called the “Mayaro Greenhouse Growers Association”. Activities were also initiated for the development of a sweet pepper agri-business cluster within the Mayaro area.

Small ruminants

Small ruminants are viewed as having the distinct potential to contribute significantly to rural development, poverty alleviation, food security and reducing foreign exchange outflows associated with the importation of meat and its by-products. However, for this potential to be realised, the constraints that impact production, productivity and marketing need to be addressed.

To support the development of the national small ruminant industry, CARDI conducted two major assessments of the current state of the industry as part of a larger regional study. The first assessment sought to determine the current profile of small ruminant operations and the second utilised the Agricultural Science and Technology Innovation Systems (ASTI) methodology to analyse the local industry.

The above studies revealed that, among other issues, feed accounts for 60-80% of the recurrent cost of production which contributes to the retail cost of locally produced mutton and goat meat being comparatively higher than the imported product.

However, a market study conducted by CARDI showed consumer preference for locally produced meat even at the higher prices. Consequently, the Unit’s programme was designed to support the overall development of the local small ruminants industry primarily by contributing to reducing the cost of production through the development of efficient feed and feeding systems.

A major intervention was made with the introduction of improved production in the PA demonstration unit.
forage-based feeding systems to reduce the cost of feed and dependency on imported feeds especially in the light of the negative effects that the continued rise in world grain prices is having on the small ruminants industry in the country.

CARDI assisted the Government of Trinidad and Tobago in its dialogue with the Government of India and the Commonwealth Secretariat on complementary initiatives for the management of the Red Palm Mite which is devastating coconuts and other palms in the country and elsewhere in the Region. As a result, a Coconut Crop Protection Specialist from India has been engaged with the Ministry of Food Production. This Specialist arrived in February 2012 and is assisting in the control of Red Palm Mite. The Institute is also providing technical assistance in the development of the action plan for this pest.

**Improved forage, Mulato**

Achievements include:

- Introduction of a new grass species, Mulato I and Mulato II (*Brachiaria* hybrids) that increases the stocking rate by 20-25% when compared to traditional Pangola and Tanner grasses.

In collaboration with Nestlé Trinidad Limited, 11 ha of Mulato grass were established on two model farms and subsequently approximately 100 ha were established on 30 farms in Wallerfield and Carlsen Field. Farmers attest to an improved carrying capacity of 20 head (including calves and heifers) per hectare, a 23% increase in milk production and high persistence of Mulato grass during the dry season.

**Fruits**

Large quantities of planting material of the dwarf golden apple from CARDI’s field station in Grenada were provided to the Trinidad and Tobago Agri business Association to ‘kick start’ a juice industry in Trinidad.
Partnership and collaborative initiatives:

The unit continued to strengthen partnership arrangements with key collaborators including:

- Ministry of Food Production, Land and Marine Affairs (MFPLMA)
- Tobago House of Assembly (THA)
- Sugarcane Feeds Centre (SFC)
- University of the West Indies (UWI)
- Inter-American Institute for Co-operation on Agriculture (IICA)
- Agricultural Society of Trinidad and Tobago (ASTT)
- Nestle Trinidad and Tobago Limited
- Trinidad and Tobago Agribusiness Association (TTABA)
- Trinidad and Tobago Goat and Sheep Society (TTGSS)
- Trinidad and Tobago Tropical Greenhouse Operators Association (TTTGOA)
- Rio Claro Farmers Association
- National Agricultural Marketing and Development Corporation (NAMDEVCO)
- REPSOL
- Chinese Academy of Agricultural Sciences (CAAS)
- Caribbean Development Bank (CDB).

Capacity Building

- On The Job Trainee (OJT) programme:

Several young persons have been mentored in areas of special needs of the Institute as part of the state’s On the Job Trainee (OJT) programme. For the period 2007-2011, 12 persons were attached to CARDI in various positions. These trainees participated in seminars, workshops, presentations and staff meetings. Two of the OJTs were sent to climate change workshops in Grenada, St Lucia and Dominica.

- Capacity building of technical professionals:

Capacity building exercises (field demonstrations, training workshops, courses and seminars etc.) have been utilised to expose more than 50 professionals to new technologies and information that will enable greater contribution to the sector.

The preparation and dissemination of information products through traditional and non-traditional methods have allowed greater access by producers and stakeholders to relevant information in a timely manner.
CARDI hosted a Protected Agriculture Lecture, in collaboration with the Chinese Academy of Agricultural Sciences (CAAS) and the Caribbean Development Bank (CDB)